

https://dspace.org/

A model of care which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

Neophytou, Natalia

2024
University of the Witwatersrand, Johannesburg
https://hdl.handle.net/10539/47344

Neophytou, Natalia. (2024). A model of care which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder [PhD thesis, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/47344

Downloaded from a DSpace repository. https://dspace.org/

A model of care which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

Natalia Neophytou

299547

Dissertation submitted to the Faculty of Health Science, University of the Witwatersrand, Johannesburg, in fulfilment of the requirements for the degree of Doctor of Philosophy.

Supervisors: Prof J Potterton, Prof G Torres



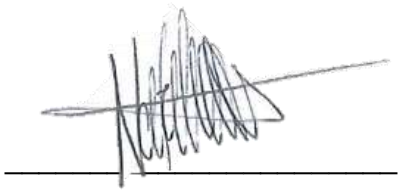
Centre for Exercise Science and Sports Medicine,

School of the Therapeutic Sciences,

Johannesburg, 2024

DECLARATION

I Natalia Neophytou declare that this thesis is my own work. This dissertation is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.



Natalia Neophytou

28th day of October 2024

Date

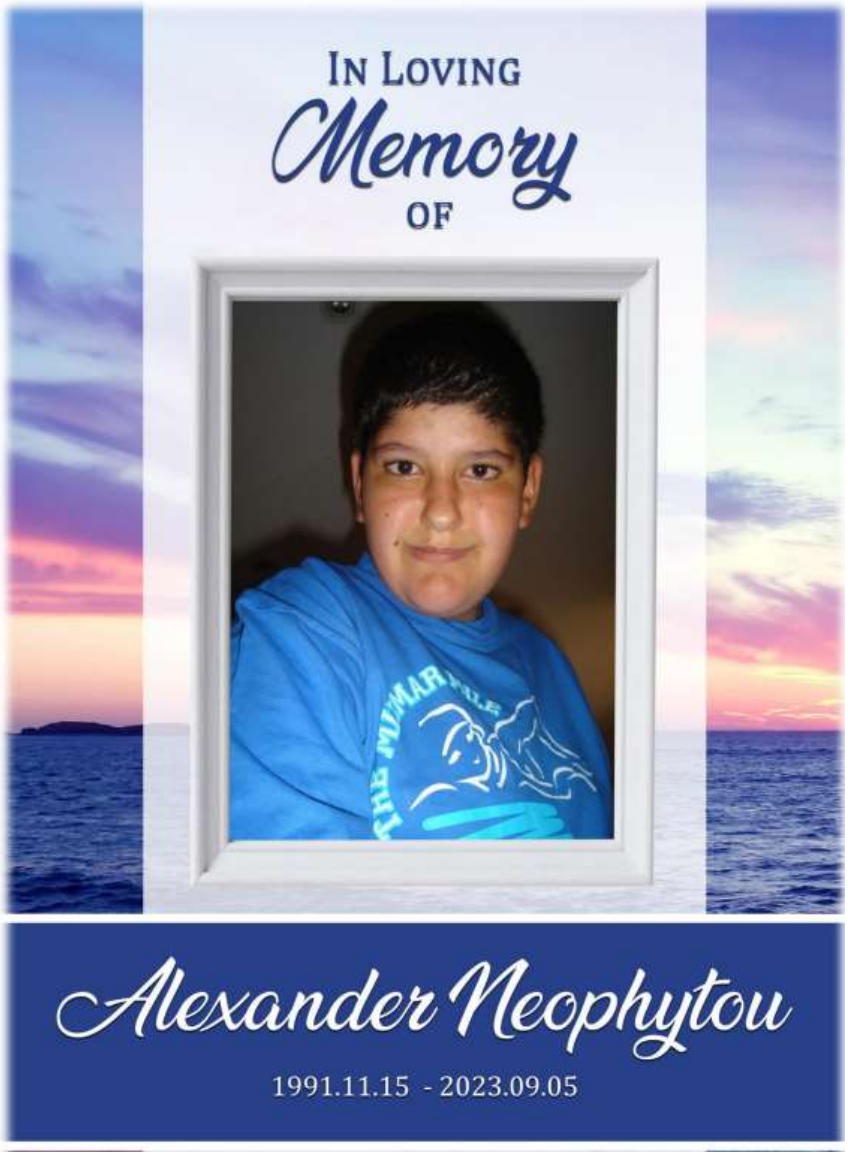
DEDICATION

This dissertation is dedicated to my brother Alexander who passed away in 2023.
Thank you for all the amazing memories we made, the crazy songs we sang, and the special bond we shared.

You were one of a kind ♥

I hope research such as this will make an impact in the future, and help individuals just like you to lead a better, happy, healthier life.

Love, your big sister x



PUBLICATIONS ARISING FROM THIS STUDY

1. Neophytou N. 17 - The importance of motor assessment, and current motor assessment tools available for individuals with autism spectrum disorder. In: Papaneophytou NL, Das UN, editors. Emerging Programmes for Autism Spectrum Disorder: Academic Press; 2021. p. 273-84.[1]

ABSTRACT

BACKROUND: Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder, characterised by core deficits in communication, reciprocal social interaction and restricted or repetitive interest and/or behaviours. It often also results in an array of motor impairments and reduced physical activity. In general, assessment and management strategies for ASD target the core deficits and neglect comorbidities and other complications. There is no comprehensive model of care (MoC) for the management of motor impairments or reduced physical activity in children with ASD. Developing such a model could address these gaps.

AIM: To develop a comprehensive MoC for children with ASD that includes motor proficiency and physical activity by exploring the perceptions and insight of clinical experts, parents, and teachers on the core deficits, current motor proficiency, and physical activity levels of children with ASD.

METHODS: A qualitative sequential study comprising three phases was conducted to develop a model of care for children with ASD. **Phase one:** Semi-structured individual interviews, lasting 25-60 minutes, were conducted with expert clinicians (n=11), parents (n=8) and teachers (n=6) involved with children with ASD. Interviews aimed to explore the perceptions, knowledge and insights on what a model of care should include for managing motor proficiency and physical activity levels. The researcher made use of purposeful as well as snowball sampling techniques. **Phase two:** A model of care was developed based on phase one data, and using MoC development guidelines and current literature. **Phase three:** A nominal group discussion, lasting 82 minutes was conducted with nine participants (three expert clinicians, three teachers and three parents) to review the MoC. A discussion was had in terms of whether each groups expectations were met, and their suggested changes were made to optimise the model. For phase one and three data, the interviews and nominal group discussion data were audio-recorded transcribed, and manually coded using a deductive approach. Following the generation of the codes, statements aligning to the codes were extracted and explored using an inductive approach after which categories and themes were generated using thematic analysis. To quantify the content, latent analysis was conducted and data was used to develop the MoC. Demographic categorical data were analysed using frequencies and percentages, while continuous normally distributed demographic data were analysed using means, modes and standard deviations and non-normally distributed continuous demographic data were analysed using median and interquartile ranges.

RESULTS: Twenty-five participants with a mean age of 43.4 (±12.9) years participated in this study. The group of teachers had a mean age of 39.5 (±8.7) years and a mean of 12.9 (±9.2) years teaching experience; the group of clinicians had a mean age of 39.5 (±11.8), with a mean of 13.3(±11.1) years of clinical experience; and the parents had a mean age of 51.6 (±14.3), with their children having a mean age of 16 (±8.1) years. All of the clinicians came from the private sector, all of the teachers were presently based in the private sector (with 3 having taught previously in the public or tertiary sectors) and the parents represented middle to high socioeconomic groups. Overall, teachers, clinicians, and parents believed that improving motor proficiency and physical activity levels in children with ASD is often neglected and should be included in their assessment and management. Following interviews and the thematic analysis of transcripts, five themes emerged from the teachers, while six themes emerged for both the clinicians and parents. Participants believed that motor proficiency levels were generally poor, albeit varied in individuals with ASD. They reported a need for management strategies to target these deficits since they could reduce independence and effect daily functioning. They believed education and awareness regarding deficient motor profiles, and the importance of meeting physical activity guidelines and developmental milestones was needed. They cited financial constraints and resource availability as the main barriers for access to therapies and that individual considerations would need to be taken into account when developing any exercise based intervention. The MoC developed from participant insights focuses on motor proficiency and physical activity levels, and includes five main domains: education, determining the motor profile, assessment and feedback, implementation of interventions and monitoring of interventions. The model places the individual with ASD at the center, surrounded by key stakeholders and support structures to provide tailored support.

CONCLUSION: It was believed that motor proficiency and physical activity levels in children with ASD have been neglected in the past, and that a general mind shift is needed in key stakeholders so that support for these deficits is integrated into managing the disorder more holistically. The developed MoC provides a framework for addressing physical inactivity and reduced motor proficiency in children with ASD. It identifies key stakeholders who should be involved in the process and highlights the need for multidisciplinary, and individualised management for children on the spectrum.

ACKNOWLEDGEMENTS

Firstly, I would like to express thanks to the University of the Witwatersrand for providing the infrastructure in which to do the study.

I would also like to express my gratitude to the following people who helped and supported me in the completion of this study:

- Prof Joanne Potterton and Prof Georgia Torres, my primary supervisors, for all the motivation, guidance, advice and help throughout my study and for helping me think “out of the box” to make this study the best that it could be. Your help and constant valuable input was greatly appreciated.
- Prof Georgia , thank you for helping me stay motivated through one of the most traumatic years (2023) of my life, losing my brother was extremely difficult. Thank you for coming to his funeral and being more than a supervisor - but a friend.
- To Dr Kerith Aginsky for all your assistance with proofreading and keeping me motivated.
- To the participants of the study, thank you for the commitment you showed throughout the study from the interviews through to the focus groups. Thank you for the valuable input you provided- without you, this project would not have been possible. Thank you for the valuable feedback when reviewing the proposed model of care, and for providing the changes and adaptions to make the model the best that it can be.
- To my loving family for all the support throughout the course of this study, for always being there for me and spurring me on along the way. Even though our family is a little smaller now, the love we have for each other is unwavering and infinite. Mimi and Daddy I love you very much.
- Thank you to my amazing fiancé – John Vinjevold, thank you for being the greatest support and loving human a woman could ever ask for. Thank you for motivating me throughout this journey, being patient with me and providing yummy snacks along the way. You have been my rock, my peace and my solace- I love you.

With sincere appreciation
Natalia Neophytou

TABLE OF CONTENTS

DECLARATION ii
DEDICATION iii
PUBLICATIONS ARISING FROM THIS STUDY iv
ABSTRACT v
ACKNOWLEDGEMENTS vii
TABLE OF CONTENTS viii
LIST OF DEFINITIONS xii
LIST OF ABBREVIATIONS xiv
LIST OF FIGURES xv
LIST OF TABLES xvii
CHAPTER 1: PROBLEM IDENTIFICATION 19
1.1 Introduction and problem 19
1.2 Rationale for the study 21
1.3 Research question 22
1.4 Aims and objectives 22
1.5 Structure of dissertation 23
CHAPTER 2: LITERATURE REVIEW 25
2.1 Introduction 25
2.1.1 Search strategy 26
2.2 Autism Spectrum Disorder 27
2.2.1 What it is Autism Spectrum Disorder 27
2.2.2 Diagnosis 28
2.2.3 Early identification 30
2.2.4 Diagnostic challenges 31
2.2.5 Epidemiology of autism 32
2.2.6 Core deficits 33
2.2.7 Other integral deficits 37
2.2.8 Current treatment procedures and interventions 49
2.2.9 Current treatment procedures and interventions in South Africa 58
2.3 Models of care 61

2.3.1 What it is a model of care 61
2.3.2 Frameworks and models of care in special populations 61
2.3.3 Model of care Development 67
2.4 Conclusion 69
CHAPTER 3: METHODOLOGY 71
3.1 Introduction 71
3.2 Study design for the three phases 72
3.3 Site of study 72
3.4 Study population 73
3.4.1 Sampling techniques 73
3.4.2 Inclusion and exclusion criteria 74
Phase one: 74
Inclusion criteria for teachers, experts and parents 74
Phase two: 75
Inclusion/exclusion criteria 75
Phase three: 75
Inclusion criteria for teachers, experts and parents 75
3.5 Testing procedures & equipment 75
Phase one: 75
Phase two: 80
Phase three: 82
3.6 Data Analysis 88
3.87 Ethical Considerations 88
CHAPTER 4: RESULTS 89
4.1 Introduction 89
4.2 Demographic data 89
4.3 Phase one data 93
4.3.1 Objective 1 94
4.3.2 Objective 2 123
4.3.3 Objective 3 140
4.3.4 Objective 4 162
4.4 Phase 2 initial model of care design 171

4.4.1 Objective 1 171
4.4.2 The model of care development results 171
STEP ONE: Project Initiation 171
STEP TWO: Diagnostic 175
STEP THREE: Solution Design 180
4.5 Phase 3 data-finalizing the MOC 196
4.5.1 Objective 1 196
4.5.2 Nominal group discussion themes 196
4.5.3 Completion of model of care via theoretical implementation, optimisation and sustainability 197
STEP FOUR: Implementation 197
STEP FIVE a: Optimization and sustainability 200
STEP FIVE b: Distribution plan 207
4.6 Final model and handout 208
CHAPTER 5: DISCUSSION 209
5.1 Introduction 209
5.2 Section A- discussion of phase one data 209
5.2.1 Discussion of demographic information 209
5.2.2 Discussion of teacher, clinician and parent perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD under identified themes 211
5.2.3 Discussion of teacher, clinician and parent expectations for the model of care developed in this study 228
5.3 Section B- Model development 230
5.3.1 Model development and definitions of the major domains of the model of care 230
5.4 Section C- discussion of phase three data 234
5.4.1 Changes to the model following nominal group discussions 234
CHAPTER 6: CONCLUSIONS, STRENGTHS AND LIMITATIONS, AND RECCOMENDATIONS 236
6.1 Conclusions 236
6.2 Limitations of study 237
6.3 Strengths of study 238

6.4 Recommendations 239
6.5 Take home messages 242
REFERENCES ..... **Error! Bookmark not defined.**
LIST OF APPENDICES 258
Appendix A – Autism Spectrum Disorder Diagnostic Criteria 259
Appendix B – Data from 42 studies using the consensus on Exercise Reporting Template (CERT) (modified to summarise all studies on one form) 261
Appendix C– A summary of the characteristics and findings of the studies included in the CERT review 262
Appendix D– Guiding principles of a model of care [26] 267
Appendix E – COREQ (Consolidated criteria for reporting qualitative research) 32 item checklist 268
Appendix F – Individual and overall word clouds (teachers, clinicians, and parents) 270
Appendix G – Field notes (sample pages) 275
Appendix H– Reflective/reflexive journal (sample pages- full journal can be provided on request) 288
Appendix I – Permission letter from schools to conduct research 290
Appendix J – Information sheet/ Letter to invite parents, teachers and 291
clinical experts to be interviewed 291
Appendix K – Informed Consent form for interviews 294
Appendix L– Questions for phase one interviews 295
Appendix M – COVID protocol for interviews and nominal groups 297
Appendix N – Audio recording consent form 298
Appendix O – Distress protocol 299
Appendix P – Nominal group guiding questions 301
Appendix Q – Guideline of interaction for nominal group interview 302
Appendix R – Ethics clearance certificate 303
Appendix S- Reflective Statement of the researcher 304
Appendix T-Complete sample of verbatim quotes per theme and category per group 307
Appendix T– Model User Guide 363
Appendix U– Turn it in report 374

LIST OF DEFINITIONS

Autism Spectrum Disorder: a neurodevelopmental disorder, which is characterised by impaired social communication skills, repetitive behaviours, or a restricted range of interests. Together these impairments may result in reduced social and occupational functioning.[2]

Asperger's syndrome: a neurodevelopmental disorder, which is classified as one of the autism spectrum disorders. Asperger's is characterised by impairments in social interaction, communication, repetitive behaviours as well as a narrow set of interests. It does not however encompass impairments in cognitive and linguistic abilities.[3]

Clumsiness: movement which is awkward, performed without skill refinement, and is not a result of a known neurological disease.[4]

Down syndrome: a congenital disorder resulting from a chromosome defect (chromosome 21), which causes mild to severe mental disability as well as low muscle tone. Individuals with this disorder typically present with a flatter facial profile and a shorter stature.[5]

Dynamic Balance: an individual's ability to react to, as well as anticipate, changes in balance as their body moves through space.[6]

High functioning autism: individuals who have difficulties with communication, have restricted and repetitive interests, yet have an absence of detectable brain damage, biological markers and neurological impairments, and have an IQ above seventy.[7, 8]

Low function Autism: individuals who have a predisposition for autism due to assimilated or genetically determined biological factors and have an IQ of below seventy.[9]

Model of care: A model of care (MoC) serves as a standardised conceptual framework, which guides best practice care and service delivery for individuals or specific population groups as they progress though the stages of a condition/disease, injury or event. [10]

Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS): a disorder individuals are diagnosed as having when individuals do not meet the criteria for other pervasive developmental disorder diagnoses, or have a less severe presentation of this disorder clinically.[2]

Rett syndrome: a rare genetic disorder that affects the way the brain develops. Typically individuals present with coordination and movement difficulties as well impairments in hand movement and communication.[11]

LIST OF ABBREVIATIONS

ACI: Agency of Clinical Innovation

ADD: Attention Deficit disorder

ADHD: Attention Hyper Deficit disorder

ADLs: Activities of Daily Living

AMI-TEA: Comprehensive Medical Programme for Autism Spectrum Disorders

AS: Asperger's Syndrome

ASD: Autism Spectrum Disorder

BOT: Bruininks-Oseretsky Test of Motor Proficiency

BMI: Body Mass Index

CDC: Centers of Disease Control and Prevention

CNS: Central Nervous System

COREQ: Consolidated criteria for reporting qualitative research

DOMS: Delayed Onset Muscle Soreness

EASY-OT: Educational Assessment of School Youth for Occupational Therapists

ESCAP: European Society of Child and Adolescent Psychiatry

DSM-5: Diagnostic and Statistical Manual of Mental Disorders, fifth edition

GNS: Global Neuromotor Impairment Score

HD: Hyper Deficit Disorder

ID: Intellectual Disability

IQ: Intelligence Quotient

MABC: Movement Assessment Battery for Children

MoC: Model of care

OCD: Obsessive Compulsive Disorder

OT: Occupational Therapy

PDD: Pervasive Developmental Disorder

PDD-NOS: Pervasive Developmental Disorder Not Otherwise Specified

RS: Rett Syndrome

SES: Socioeconomic status

SIT: Sensory Integration Testing

STOTT: A general test of motor impairment for children by DH Stott

SYNAPSE: Systematic Network of Autism Primary Care Services

TD: Typically developing

ZNA: Zurich Neuromotor Assessment

LIST OF FIGURES

Chapter 1

Figure 1.1: The International Classification of Functioning, Disability and Health……..... 21
Figure 1.2: Structure of the dissertation ……..24

Chapter 2

Figure 2.1: Pediatric developmental screening protocol (Adapted from Centre of Disease Control) …….....….30
Figure 2.2: Sample of exercise interventions used for CERT analysis between 2000-2024 (n=42) ……....55
Figure 2.3: Frequency of reported exercise intervention parameter/variables for individuals with ASD, using CERT guidelines (n=42) ……...56
Figure 2.4:MoC pathway potential relationship within the International Classification of Functioning, Disability and Health framework(1) ……..…63
Figure 2.5:Organisation of the Systematic Network of Autism Primary Care Services (SYNAPSE) model …….……....65
Figure 2.6: Organisation of the AMI-TEA programme ……..……..…66
Figure 2.7 :The five key processes and tasks in model of care development (Adapted from ACI (2) (2013)) ……...……69

Chapter 3

Figure 3.1:Three-phase qualitative sequential exploratory study design model ……71
Figure 3.2 The six-step process used by the researcher for thematic analysis ……78
Figure 3.3:The MoC development process,(2) and which phase of this study they occurred…...80
Figure 3.4: A critical change in phase thee methodology due to the reflexivity processes ……84
Figure 3.5: Modified nominal group technique process used in this study ……..85
Figure 3.6: The four step process used by the researcher for the nominal group data analysis ……87

Chapter 4

Figure 4.1A: The MoC development process - Step one ……..……171
Figure 4.2: Teacher thematic map (category and theme) ……..172
Figure 4.3: Clinician thematic map (category and theme) ……..173
Figure 4.4: Parent thematic map (category and theme) ……..174
Figure 4.1B: The MoC development process - Step two ……..175

Figure 4.5: Teacher, clinician and parent thematic maps consolidated to show differences and similarities (n=26) ……176
Figure 4.6: Teacher, clinician and parent consolidated thematic map showing main ideas …..177
Figure 4.7: Symbols used to depict autism ……179
Figure 4.1C: The MoC development process-Step three ……....180
Figure 4.8: Sequence of prevention as per van Mechelen at al. ……182
Figure 4.9A: Adapted sequence of prevention for motor deficit and physical inactivity in children with ASD ……183
Figure 4.9 B: Modified adapted sequence of prevention for motor deficit and physical inactivity in children with ASD including education and awareness as a starting point in the cycle. …..184
Figure 4.10A&B: MoC design variations over time following feedback from supervisors …..185
Figure 4.10 C: MoC design variations over time following feedback from supervisors …..186
Figure 4.10 D: MoC design variations over time following feedback from supervisors …..187
Figure 4.10 E: MoC design variations over time following feedback from supervisors …..188
Figure 4.10 F&G: MoC design variations over time following feedback from supervisors …..189
Figure 4.11: Ecological system as postulated by Urie Bronfenbrenner [201] ……190
Figure 4.12: Final design presented to supervisors ……..……..192
Figure 4.13: Infographic/handout presented to supervisors ……..194
Figure 4.1 D: The MoC development process - Step four ……..197
Figure 4.1 E: The MoC development process - Step five ……..200
Figure 4.14 Model of care for children with ASD including motor proficiency levels and physical activity levels ……208

LIST OF TABLES

Chapter 2

Table 2.1 Severity levels for autism spectrum disorder as stipulated by DSM-5(5) ……29
Table 2.2 Ten principles recommended to guide the management of individuals with ASD as per ESCAP 2019. ……...51
Table 2.3 Inclusion criteria and search rules for studies used in the CERT analysis below……54
Table 2.4: ICF general subcategory health related domains as presented in the ICF manual. ……62

Chapter 4

Table 4.1: Domain 1 items of the COREQ checklist- primary researcher characteristics ……89
Table 4.2: Domain 1 items of the COREQ checklist- supervisor 1 and 2 characteristics ……91
Table 4.3: Demographics of total interview sample including teachers, clinical experts and teachers involved with children with ASD (n=26) ……92
Table 4.4: Demographics of sample population (n=26) ……93
Table 4.5: A summary codes and categories per theme found for teachers and teaching assistants relating to perceptions, knowledge and insight of motor skills and physical activity levels in children with ASD ……..95
Table 4.6 A summary codes and categories per theme found for teachers and teaching assistants relating to perceptions, knowledge and insight of how to improve the motor skills and physical activity levels in children with ASD ……119
Table 4.7:A summary the most common categories per theme found for clinicians in the data relating to perceptions, knowledge and insight of motor skills and physical activity levels. ……123
Table 4.8:A summary of the most common categories per theme found for clinicians in the data relating to perceptions, knowledge and insight of how to improve the motor skills and physical activity levels in children with ASD ……133
Table 4.9: A summary of the most common categories per theme found for parents in the data relating to perceptions, knowledge and insight of motor skills and physical activity levels ……141
Table 4.10: A summary of the most common categories per theme found for parents regarding how they believe motor proficiency and physical activity levels can be improved in children with ASD. ……151

Table 4.11: Table showing how the consolidated final themes inform the MoC domain names ……..181
Table 4.12: Table showing showing suggested changes to the model in order of rank …..205

CHAPTER 1: PROBLEM IDENTIFICATION

The subtopics that will be covered in this chapter include:

1.1 Introduction and problem
1.2 Rationale for the study
1.3 Research question
1.4 Aims and objectives
1.5 Structure of the dissertation
1.6 Conclusion

"*It's never the differences between people that surprise us. It's the things that, against all odds, we have in common."*[12]

1.1 Introduction and problem

In South Africa, Autism or Autism Spectrum Disorder (ASD) affects one in 68 children under the age of six years.[13] According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) (Appendix A)[2] for an individual to be diagnosed with ASD, they must experience "persistent deficits in social communication and social interaction across multiple contexts"; "have restrictive, repetitive patterns of behaviour, interests, or activities"; "their symptoms must be present in the early developmental period" and "should cause clinically significant impairment in social, occupational, or other important areas of functioning."

At present, the diagnostic criteria make no mention of motor impairments, which are commonly found in ASD.[14] These common motor impairments are consistent across both low and high functioning individuals[15] and include: problems with fine and gross motor skill development; gait and coordination difficulties; abnormalities in posture, as well as impairments in motor control, imitation and planning. Over time there has been a slight shift towards addressing these motor impairments through various interventions,[16-19] since it has been shown that a reduction in motor impairments has resulted in a better quality of life for these individuals.[20]There remains an obvious need for further research to determine the extent to which various motor variables are compromised within the population, as well as to what extent these motor proficiency deficits may impair other areas of the individual's life. In the meantime however, any new models of care should aim to reduce motor impairments in the population.

In addition, individuals with ASD have significantly reduced physical activity levels and are less likely to engage in consistent vigorous physical activity compared to their neurotypical

counterparts.[21, 22] It has also been reported that individuals with ASD would rather engage in more self-contained physical activities such as swimming and cycling as opposed to team sports.[23] Overall, it seems their reduced physical activity levels may be as a result of their impaired motor, sensory, social and behavioural domains, with environmental factors also playing a role.[24]

The combination of all the above mentioned deficits at varying severity levels compromise the functioning of these individuals on a day to day basis, and although various therapies and interventions are available there are no formal protocols in place to ensure motor deficit and physical activity level interventions are included as part of their standard care in an effective manner. A large gap therefore exists in terms of guided standardised holistic management for these individuals. One way this issue could be solved, would be to develop a comprehensive guide or management strategy to formally target motor deficits and physical activity levels in an efficient manner, which could then be integrated into the overall management plan of the individual.

A model of care (MoC) generally outlines the way health services are delivered though the stages of a condition or injury and is based on best practice care and services for a specific population group. Models of care aim to ensure that patients receive optimal and efficient care by the most appropriate clinicians throughout the different stages of the disease process.[10] The aim of designing a novel MoC, is to generate improvements in service delivery by effecting change.[10] Although some overlap and general issues across all diseases/ conditions exists, models of care need to be evidenced-based and strategically and specifically developed for optimal outcomes.

Models of care may be implemented within established frameworks to improve specific domains of the condition outlined by the framework. For example, in 2001 the World Health Organization published a detailed framework on what should be considered in terms of function and health for various health conditions named “International Classification of Functioning, Disability and Health” as illustrated in Figure 1.1 on the next page.[25]

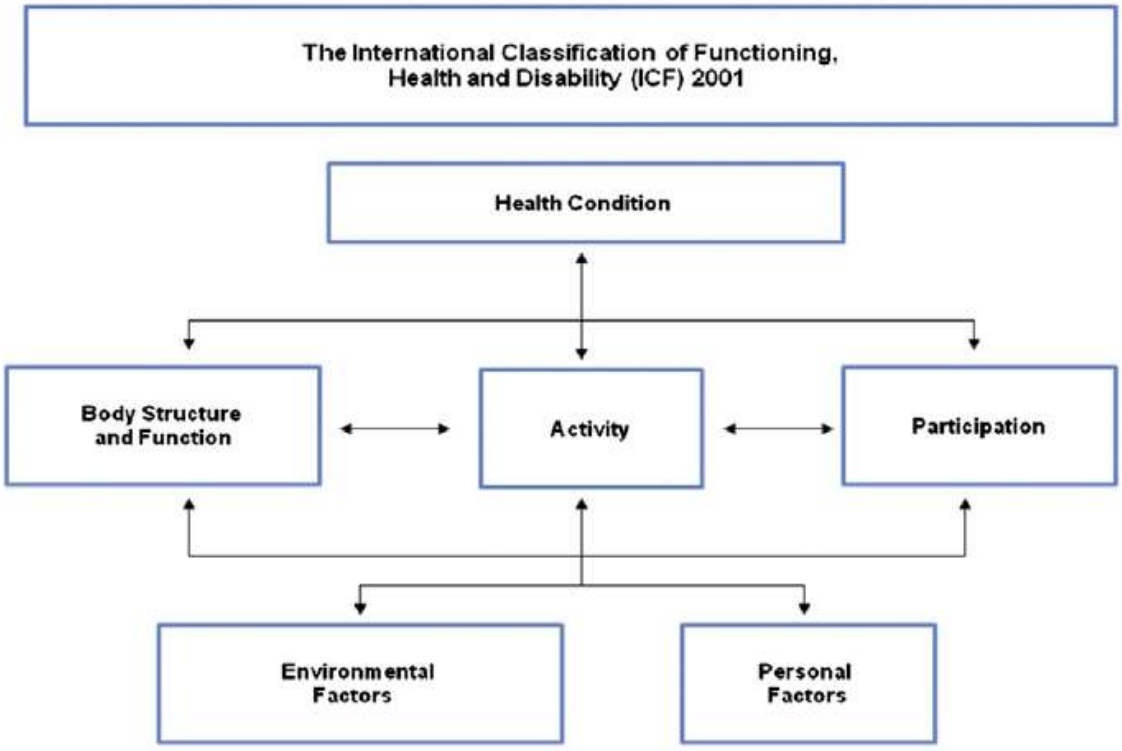


Figure 1.1: The International Classification of Functioning, Disability and Health

Although the six areas presented in this framework apply to ASD and may be used as a foundation to build upon, a MoC can be developed to specifically manage core deficits and comorbidities of the condition. For individuals with ASD, comprehensive multidisciplinary, continuous and coordinated care is essential in providing optimal care for the individuals and early diagnosis and intervention is paramount in achieving optimal outcomes.[26]

The purpose of this study is to therefore, develop an appropriate MoC focusing on improving motor skill proficiencies (and not isolated skills), as well as improving physical activity levels in individuals with Autism Spectrum Disorder in addition to managing their core deficits. The proposed model of care may be beneficial in promoting better management of children with ASD, as well as the overall improvement of the quality of life and participation of the children.

1.2 Rationale for the study

No formal comprehensive MoC for the management of children with ASD currently exists. Furthermore, although core deficits have been clearly defined in the ASD population, and subsequent treatments developed to target the core deficits, children with ASD often have several comorbid motor difficulties that may not be targeted. Due to a lack of regular motor assessments being carried out within the population, as well as the lack of knowledge regarding the benefit of

targeting these difficulties to assist with general functioning, motor proficiency training is often not prioritised in the population. Motor impairments often lead to reduced performance in activities of daily living which can further lead to disruptions in social, physical and mental well-being.[27] Furthermore, the decreased level of physical activity in this population may further exacerbate motor deficiencies and thus compound the problem. Furthermore, due to the lack of standardised approaches, or lack of understanding regarding what motor profiles generally encompass, it would be imperative to identify what motor related aspects need to be considered and included in approaches for to develop interventions to manage these deficits.

A novel model of care that provides a framework on how to optimally manage children with ASD including, motor proficiency and physical activity levels would benefit the population tremendously. The model of care may guide the improvement of motor related deficits and be integrated into their general management plans, to make their management more holistic. For example, if their motor deficiencies and reduced physical activity levels are identified earlier in their lives, and a comprehensive model of care is available to guide targeting these issues, improvements may occur in the general quality of life of the individual, as well as their related social and behavioural realms.

1.3 Research question

What should be included in an appropriate, multidisciplinary, and comprehensive model of care for children with ASD that includes motor proficiency and physical activity?

1.4 Aims and objectives

The aim of this study is to develop a model of care for individuals with ASD which includes motor proficiency and physical activity levels.

In order to answer the research question, this study was conducted over three phases with separate objectives to meet the overall aim.

Phase 1:

1. To explore the perceptions and insight of teachers on the current motor proficiency and physical activity levels in children with ASD and how these could be improved though a model of care.
2. To explore the perceptions and insight of clinical experts on the current motor proficiency and physical activity levels in children with ASD and how these could be improved though a model of care.

3. To explore the perceptions and insight of parents on the current motor proficiency and physical activity levels in individuals with ASD and how these could be improved though a model of care.
4. To establish what the expectation of a model of care for children with ASD focusing on motor proficiency and physical activity levels is from teachers, clinical experts and parents.

Phase 2:

1. To develop a model of care for individuals with ASD focusing on motor proficiency and physical activity based on literature, teachers, clinical experts and parents.

Phase 3:

a) To establish whether a newly developed model of care for children with ASD focusing on motor proficiency and physical activity levels meets the expectations of teachers, clinical experts and parents.

1.5 Structure of dissertation

This dissertation is structured around six chapters (Figure 1.2). The contents of each chapter are detailed in the figure on the next page.

1.6 Conclusion

This chapter introduced the background literature and problem, which informed the study aims, and objectives. The chapter provided a rationale for the study highlighting the need for this study due to the gaps in the literature. An overview of the thesis was presented in diagrammatic format. The literature reviewed to inform this thesis will be presented in the following chapte

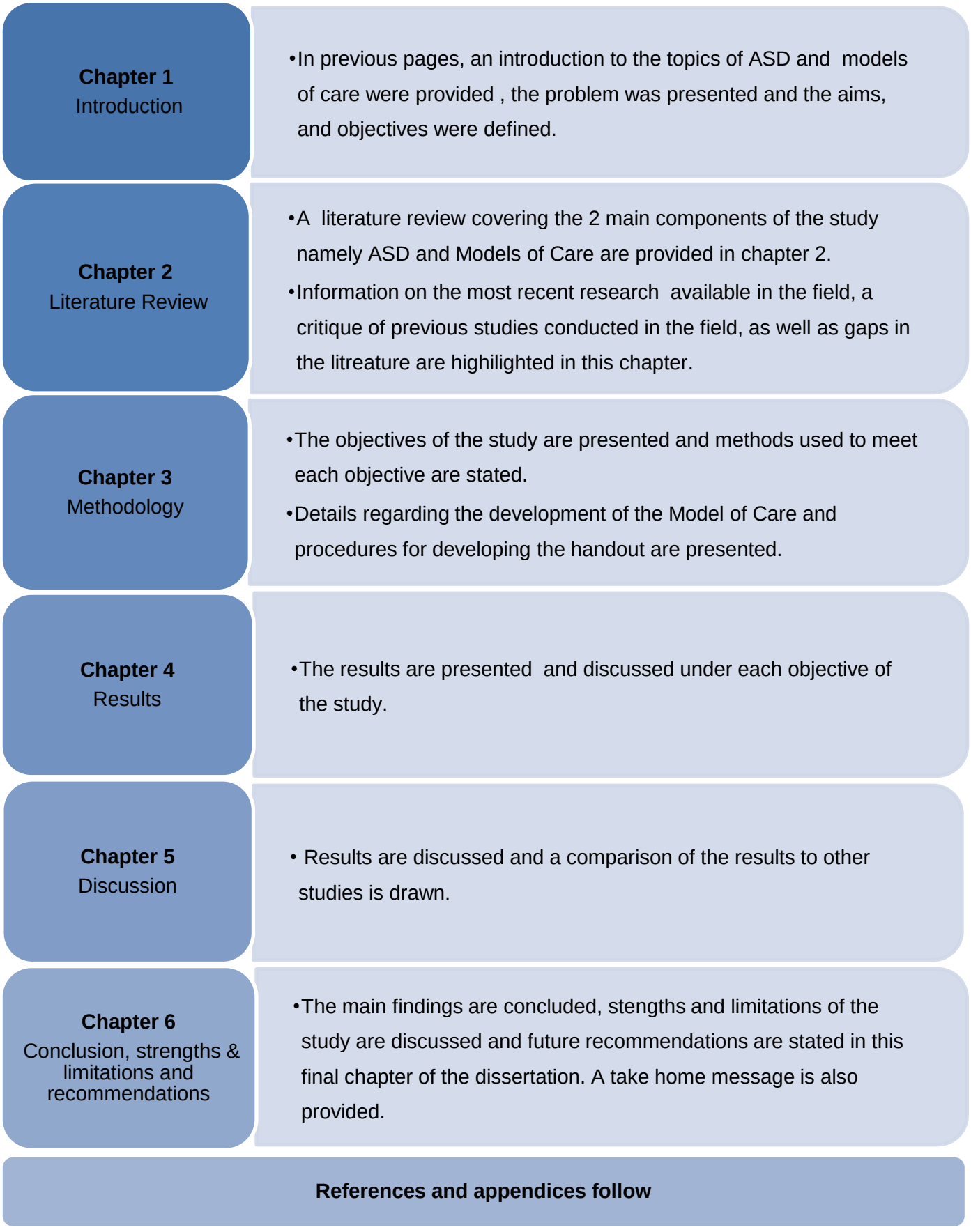


Figure 1.2: Structure of the dissertation

CHAPTER 2: LITERATURE REVIEW

The subtopics that will be covered in this chapter include:

2.1 Introduction

2.1.1 Search strategy

2.2 Autism Spectrum Disorder

2.2.1 What is Autism Spectrum Disorder?

2.2.2 Diagnosis

2.2.3 Early identification

2.2.4 Diagnostic challenges

2.2.5 Epidemiology

2.2.6 Core deficits

2.2.7 Other integral deficits

2.2.8 Current treatment procedures and perceptions

2.3 Models of care

2.3.1 Models of care for special populations

2.3.2 Model of care development

2.4 Conclusion

"The jury is supposed to be twelve peers, but technically that would mean every single person on the jury should have Asperger's syndrome, because then they'd really understand me."[12]

2.1 Introduction

At present, there is a disconnect between ASD diagnosis and management, partly due to some deficits not being assessed, or deemed not important to assess early on, and partly in not having a standard management strategy or model of care to inform management. Furthermore, there may be barriers in management that often arise due to the stigma of the condition. It is common for caregivers to avoid getting the necessary diagnostic tests done for fear of having their child being given the label "Autistic". Unfortunately, this thinking often delays treatment or completely prevents it. Education regarding the condition, what systems and management strategies are available, and what they entail is therefore paramount.[28] It has become clear that optimal management requires a clear strategy and early diagnosis for an optimal outcome in terms of the

improvement of core and other profound deficits, and the improvement in the children's quality of life.[28]

In this chapter, the three core components of this study are discussed, namely: autism spectrum disorder, motor proficiency and models of care. Firstly, autism spectrum disorder is briefly reviewed in order to provide an understanding of the condition. The epidemiology of the condition is reviewed to get a clear understanding of the incidence, distribution and other factors relating to the condition. Individuals with ASD struggle with communication, social interaction, as well as have restrictive interests, which are well documented in the literature. Secondly, these individuals however also often suffer from a variety of motor impairments, as well as reduced physical activity. This chapter also therefore highlights the other integral deficits that are not identified in the core criteria, but which should be included in a holistic management plan for children with ASD. Information regarding current therapies used in the population is also provided and important gaps in the literature are highlighted.

Thirdly, models of care (MoC's) are discussed. Models of care that have been developed for other special populations are discussed to provide insight into what should be or may need to be considered when working with neurodivergent population groups. Lastly, MoC development is discussed in this chapter, in order to provide information regarding the process involved as well information regarding what makes a good model of care.

A narrative approach was used for this literature review. This approach was selected to review the varied, multidisciplinary research available on the above-mentioned components. This method allowed for a broad synthesis of studies, which assisted the researcher in reviewing gaps and trends in the literature.

2.1.1 Search strategy

In order to compile the below literature review and inform interview questions, the following search strategy was used. Databases including Medline, PubMed, Scopus, SagePub, Web of Science and Google scholar, were frequently checked throughout the study to make sure the most recent information was being included in this dissertation. Terminology used i.e. key words and search terms were compiled from the headings of chapters and subheadings of chapters in this document -which were generated by the researcher to inform the study.

A sample list of terms that was used in one of the databases is provided below as an example:

i. Example of search terms used in PubMed:
    a. Autism Spectrum Disorder or ASD coupled with the following terms relating to the condition: diagnosis, screening, early identification, early intervention, diagnostic challenges, epidemiology, prevalence, core deficits, restricted interests, behaviour, maladaptive behaviour, communication, social communication, social skills, social interaction, intellectual disability, other deficits, integral deficits, physical activity levels, motor skills, motor skill deficits, motor deficits, motor praxis, coordination, motor co-ordination, motor planning, clumsiness, kinesia paradoxa, fine motor skills, manual dexterity, catching skills, gross motor skills, ambulation, gait, agility, posture, balance, static balance, dynamic balance, posture, postural control, muscle strength, flexibility, environmental factors, obesity, comorbid psychopathologies, depression, anxiety and mental health.
ii. Autism Spectrum Disorder or ASD coupled with the following terms relating to models of care or interventions: current treatment procedures, current treatment perceptions, gaps in management, treatment approaches, management guidelines, management procedures, exercise guidelines, South Africa, Frameworks, ICF domains, treatment models, domains, factors to consider, exercise interventions, and exercise management strategies.

The most relevant articles, with pertinent information for this study were read, consolidated, and included into the literature review. There were no language, study design, nor year of study restrictions. There was however a preference to include articles published from more recent years (2015 or later) in order to provide a more up to date review of literature. Furthermore, in cases where articles were written in other languages, the researcher used online translate functions (often part of journals) available to understand the relevant text. References of initially identified articles were inspected to find additional studies which may have been appropriate to include in the literature review.

2.2 Autism Spectrum Disorder

2.2.1 What it is Autism Spectrum Disorder

Autism spectrum disorder (ASD) is a life-long, highly variable neurodevelopmental disorder, which may affect all areas of an individual's life.[29, 30] Individuals with ASD may have severe impairments in some areas of their lives, while be relatively normal or even excel in other areas,[31] and

therefore vary in level of function between low, moderate or high. In order for an individual to be regarded as high functioning, they should have a diagnosis of autism, yet have an intelligent quotient (IQ) above seventy, as well as have no detectable brain damage, biological markers and neurological impairments.[7, 8] In contrast, in order for individuals to be regarded as low functioning, they need to have an autism diagnosis, an IQ of less than seventy, as well as a genetic biological predisposition for autism.[9]

Generally, symptoms of the disorder remain relatively constant throughout the lifespan; however, variances can occur depending on when diagnosis was made, whether the individuals received early intervention as well as the severity of the disorder.[32, 33] Since ASD is a lifelong disorder, and not considered curable, individuals require management throughout their lives. Individuals generally struggle with being able to live independently, having optimal employment opportunities as well as having good mental health, and relationships.[34]

2.2.2 Diagnosis

"It is imperative that a diagnosis of autism is made as early as possible.[28] The benefit of timeous early diagnosis is twofold: 1) the sooner the individual is diagnosed the sooner appropriate intervention can ensue to improve disease specific outcomes, and more likely the less their stereotyped behaviours would be, and 2) it allows time for counseling, and help with future family planning from the parents' perspective.[35]

In 2013, the American Psychiatric Association released the fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) which is considered the gold standard reference that healthcare providers use to diagnose autism.[2] The DSM-5 demonstrates good sensitivity and specificity for various instruments for the criteria.[36-38]"[1]

According to DSM-5,[2] in order for a diagnosis of autism to be made an individual needs to have: "persistent deficits in social communication and social interaction across multiple contexts (criterion A), as well as have restricted, repetitive patterns of behaviour, interests or activities (criterion B). Furthermore, the individuals' symptoms need to have been present from early childhood and should limit or impair everyday functioning (criterion C) and the aforementioned disturbances should not be better explained by intellectual disability (intellectual developmental disorder) (criterion D)."(See appendix A)

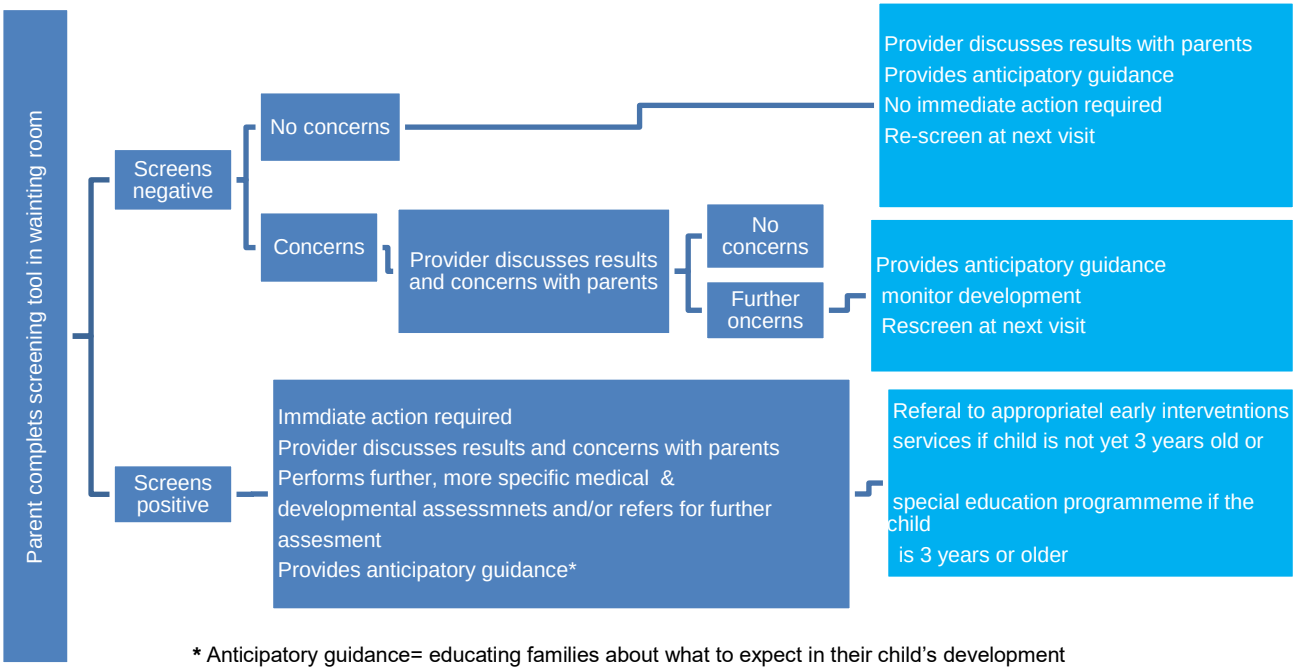
Furthermore, severity of the condition specifically for social communication impairments and restricted repetitive patterns of behaviour need to be determined. They are defined as either being level 1 (requiring support), level 2 (requiring substantial support) or level 3 (requiring very substantial support).[2] These are stipulated in detail as follows by the DSM-5[2] and are shown on the next page in Table 2.1:

Table 2.1 Severity levels for autism spectrum disorder as stipulated by DSM-5[2]

Severity level	Social communication	Restricted, repetitive behaviours
Level 3 "Requiring very substantial support"	Severe deficits in verbal and nonverbal social communication skills cause severe impairments in functioning, very limited initiation of social interactions, and minimal response to social overtures from others. For example, a person with few words of intelligible speech who rarely initiates interaction and, when he or she does, makes unusual approaches to meet needs only and responds to only very direct social approaches.	Inflexibility of behaviour, extreme difficulty coping with change, or other restricted/repetitive behaviours markedly interfere with functioning in all spheres. Great distress/difficulty changing focus or action.
Level 2 "Requiring substantial support"	Marked deficits in verbal and nonverbal social communication skills; social impairments apparent even with supports in place; limited initiation of social interactions; and reduced or abnormal responses to social overtures from others. For example, a person who speaks simple sentences, whose interaction is limited to narrow special interests, and how has markedly odd nonverbal communication.	Inflexibility of behaviour, difficulty coping with change or other restricted/repetitive behaviours appear frequently enough to be obvious to the casual observer and interfere with functioning in a variety of contexts. Distress and/or difficulty changing focus or action.
Level 1 "Requiring support"	Without supports in place, deficits in social communication cause noticeable impairments. Difficulty initiating social interactions, and clear examples of atypical or unsuccessful response to social overtures of others. May appear to have decreased interest in social interactions. For example, a person who is able to speak in full sentences and engages in communication but whose to- and-fro conversation with others fails, and whose attempts to make friends are odd and typically unsuccessful.	Inflexibility of behaviour causes significant interference with functioning in one or more contexts. Difficulty switching between activities. Problems of organization and planning hamper independence.

2.2.3 Early identification

Although an autism diagnosis can be made when a child is as young as 18 months of age, in general a valid, reliable and stable diagnosis of ASD can be given to an individual from 20 to 24 months.[39]At present however, most individuals are diagnosed with ASD after the age of four.[40] This delay in diagnosis may hinder early implementation of necessary treatment and therapy interventions, thus this is a critical area for future improvement in ASD diagnosis. Furthermore, it has been described by Christensen et al.[40] that not all ASD subtypes are diagnosed at similar rates. In fact he reports that autistic disorder is generally reported sooner at a mean age of 3 years, 10 months; while Pervasive developmental disorder-not otherwise specified (PDD-NOS) slightly later at a mean of four years, one month and lastly Asperger's disorder is reported far later at a mean age of six years, two months.[40] Interestingly, Christensen et al.[40] reports that hearing and vision problems are generally some of the first problems to be reported within the first few months of a child's life while fine motor skills, communication and social difficulties are generally reported from six months of the individuals life.[40] Since there are no discrete neuroanatomical abnormalities or definite biomechanical markers that define ASD, diagnosis is purely based on clinical and behavioural assessment.[41] According to the Centers of Disease Control and Prevention (CDC) children are recommended to undergo broad developmental screenings at nine, eighteen, and twenty four months, which assess if the individuals have any developmental delays.[42] More specific ASD screenings are recommended by the CDC at age eighteen, should the child have a higher risk of ASD based on family history or abnormal behaviours noted from general screenings. The process should follow the pediatric developmental screening protocol recommended by the CDC as illustrated in Figure 2.1 below.



***** Anticipatory guidance= educating families about what to expect in their child's development

Figure 2.1: Pediatric developmental screening protocol (Adapted from Centre of Disease Control)[42]

As the figure on the previous page illustrates, the starting point for diagnosis would be parents completing a relevant screening questionnaire for their child. Follow-up comprehensive diagnostic evaluations would be conducted if any impairments are observed in the screening observations. Research indicates that parents are reliable sources of information about their children's development.[42] Furthermore, certain screening tools such as the Ages and Stages Questionnaire, the Child Development Inventories and Parents' Evaluation of Developmental Status, are conducive to building a relationship between the clinician and parent in which the parent can communicate and highlight their concerns and what they have observed in terms of their child's development.[42] In most instances, allowing the parent to complete the screening questionnaires is also deemed time and cost effective.[42, 43]

Following the screening process, if ASD is suspected, an ASD specific diagnostic tool should be used to confirm diagnosis. It has been suggested that although there are many ASD diagnostic tools no single tool should be used as the basis for diagnosis but rather a combination of a few to confirm the diagnosis.[42] In general ASD diagnostic tools depend on two main sources of information: parents' or caregivers' reports of their child's development, as well a clinical professional's assessment of the child's behaviour.[42] Following diagnosis there may be referral to specialists for further investigation and management.

2.2.4 Diagnostic challenges

Current ASD diagnostic processes are currently by no means perfect. In fact, although there has been an expansion of the current diagnostic criteria (DSM-5), some argue that some clinically important characteristics are still missing from the criteria.[44] Poor postural control, general motor deficits, an inability to process sensory stimuli, impaired imitation skills, as well as a low levels of attention and arousal are some of the common characteristics noted in children with ASD, yet are not included in the criteria.[44] It is thought that one of the reasons motor impairments are not included in the criteria is that in most cases the motor impairments found are not pervasive.[45] However, recent research suggests that these impairments are much more common than previously thought.

According to Teitelbaum et al.[46] motor impairments, for example movement asymmetries, are present at birth, and could therefore contribute to the early identification of ASD. Similarly, Baraneck et al.[48] and Pan et al.[49] also reported that the assessment of motor activity may play a part in the early identification of ASD.

In general, there have also been questions raised regarding the sensitivity of gold standard autism diagnostic tools for females[47] which may skew the prevalence rates seen amongst boys and girls diagnosed with ASD. This issue needs to be investigated and addressed.

2.2.5 Epidemiology of autism

Epidemiologic data for ASDs are scant, especially in low and middle income countries such as those found in Africa, Latin America, Central and Eastern Europe and Asia.[48] It has been suggested that the reason epidemiological data is limited in the general ASD population is because there is difficulty in establishing the age of onset- particularly in very young nonverbal children where their behaviour is similar to typically developing children. Furthermore, some challenges may exist in differentiating these individuals from individuals diagnosed with intellectual disabilities at a young age.[48] In addition, epidemiological data obtained is often based on ad hoc reported school data and community case finding surveys which may not be entirely reliable.[48]

Recent epidemiological data (2022) suggests that the global prevalence of ASD is estimated to affect one in 100 individuals.[49] In South Africa specifically, ASD affects approximately one in 68 individuals.[13] In addition, it has been found that approximately one in 42 boys are diagnosed with ASD -with boys being generally four times more likely to acquire the disorder compared to girls. Simon Baron-Cohen, however suggests that once female ASD is diagnosed effectively the numbers may change to 2:1.[13, 50]

It has also been suggested that there is an annual prevalence growth rate of between 10-17% globally.[13] In some countries however, this rate has been reported to be higher, for example in the USA, where in the past (between 2012 and 2014) prevalence rates increased by 30% (from one in 88, to one in 68 individuals).[51] Albeit the majority of new cases have been milder cases of ASD, and there have been less changes in more severe cases – particularly in those who have comorbid intellectual disability, there has been an overall increase nonetheless.[33, 51, 52]

Many different reasons have been put forward to try and explain this increase in prevalence, some of which include:

i. An improved understanding of the autism phenotype which has led to the expansion of the current diagnostic criteria (DSM-5) which encompasses a broader definition of autistic disorder. In this case many children, who were previously diagnosed with intellectual

disabilities, have been reclassified as having an autistic disorder. Hence a greater number of individuals are being diagnosed with ASDs compared to in the past.[33, 53, 54]

ii. An improved application of the diagnostic criteria over time. An increase in experienced clinicians, as well as improved assessment methods have allowed for earlier and more accurate diagnosis, which could certainly increase prevalence rates over time.[33, 53, 54]

iii. An increase in ASD awareness. Increased funding into ASD research,[55] and ASD awareness campaigns coupled with transformative public attitudes regarding ASD may all have contributed to increased prevalence rates observed over time[55] however, further research needs to confirm this.

Worryingly, although the above mentioned diagnostic criteria, tools, clinicians and awareness is improving there are still many children in the population going undiagnosed, or not being diagnosed timeously.[48]

The increasing prevalence means that individuals working in clinical, teaching, and early intervention settings may experience a higher demand in their respective field to assist individuals with ASD,[56] therefore there is a need have improved strategies and formal MoCs to manage this. Furthermore, it may be important to determine whether any differences exist in terms of the ability to diagnose as well as access diagnostic tools between the private and public healthcare sectors in South Africa as this could better inform implementation of MoCs.

2.2.6 Core deficits

In order to develop a model of care for individuals on the spectrum it is important to firstly understand what the core deficits of a person on the spectrum are and how these would affect their function and interaction with others and their environment. An understanding the core deficits t may help guide development of an appropriate MoC, for the population. The core deficits of ASD are described in detail below as per the DSM-5 diagnostic criteria (Appendix A) and expanded on with examples to provide this insight.

i. Persistent deficits in social communication and social interaction across multiple contexts

According to the DSM-5, social communication and social interaction difficulties are more clearly described under three main categories.[2] In all instances individuals should exhibit these deficits at present or should have had a history of these difficulties at some point in their lives. Under the first category, deficits are described as being related to social emotional reciprocity failures. In

this instance, individuals are described to be unable to engage with others due to abnormal social approaches, unable to have conventional reciprocal conversation, or have a reduced ability to share interests, share emotions, as well as are unable to initiate or respond to social interactions.[2] Overall they have been reported to have to have decreased social awareness.[57]

Under the second category, social interaction deficits are described as being related to non-verbal communication failures. In this instance, individuals are described to be unable to engage with others due to having poorly integrated verbal and non-verbal communication skills, having possible abnormalities in eye contact and body language or having deficits in comprehending and making use of gestures. For example, individuals on the spectrum, may stare inappropriately at people they are engaging with, may fail to use appropriate gestures to portray agreement i.e. not nodding of the head or using other gestures of acknowledgment, and may not be able to use body language to share perspective i.e. pointing to objects in the distance to indicate interest.[57] They may also be described as having a total absence of non-verbal communication or facial expressions.[2]

In terms of physical language delays, individuals with ASD, may experience delays early on in their lives or be completely nonverbal. It needs to be noted that, although generally children may differ in terms of the rate in which they acquire and are able to use speech and language effectively,[58] the majority of children, who experience delays in language early on, generally reach proficiency levels similar to their age-matched peers, and this is the same for those on the spectrum. Importantly, it has been reported by the World Health Organisation that these language delays that occur early on in individuals are not predictive of ASD unless the individuals also demonstrate atypical social interaction skills and decreased motivation to take part in social communication.[58]

In addition, they may also have practical language hurdles, which frequently result in misinterpretations of verbal cues due to literal interpretations.[57] This may be accompanied by speech patterns lacking typical pitch and emotional depth observed in neurotypical individuals.[57] The speech used by individuals on the spectrum may come across as monotonous or conversely have exaggerated expressiveness. In most instances, individuals with ASD may be ignorant to the unusual nature of their language, for example they may try and communicate with meticulous precision using overly formal, and specialised vocabulary to try and get their point across.[57]

Under the third and last category, social interaction deficits are described as being related to being able to comprehend, preserve and cultivate relationships.[2] In this instance, individuals struggle to engage with others due to having problems in being able to adapt their behaviours to varied social settings and having difficulties in making friends.[2] They also find it difficult to engage in imaginative play or have a total lack of interest in their peers. They struggle with being able to spontaneously understand verbal and nonverbal cues, as well as seem to be less interested in engaging in social interaction.[2]

It has been reported that their lack of interest may be as a result of social interaction fatigue whereby individuals on the spectrum become fatigued from trying to mimic the styles of social interaction of typically developing individuals.[59, 60] This has been termed "camouflaging".[59] Difficulties in being able to have conventional relationships with others may lead to social isolation which in turn may lead to other issues such as impaired mental health.[57]

Individuals on the spectrum find it difficult to understand neurotypical individuals and that neurotypical individuals find it difficult to empathise with those on the spectrum.[57, 61] Although individuals on the spectrum themselves are reported to have no or reduced empathy, recent evidence does not support this.[57] In fact, clinical observations of autistic adults indicate that their empathic response may actually be heightened, showing a tendency toward intense emotional responses.[57] The reason for these heightened responses are often attributed to feeling anxious or confused rather than to a lack of awareness or interest in the person they are engaging with.[57] Some research does indicate that individuals have a different capacity to share the feelings of others (affective empathy),[62] yet that the capacity to recognize and understand other people's mental states (cognitive capacity) is generally present.[63]

ii. Restricted, repetitive patterns of behaviour, interests or activities

According to the DSM-5, restricted, repetitive patterns of behaviour, interests or activities are more clearly described under four main categories.[2] In all instances individuals should exhibit these deficits at present or should have had a history of these difficulties at some point in their lives.

Under the first category, deficits are described as being related to repetitive motor movements, repetitive use of objects or speech, and stereotyped movements that are atypical and excessive for the individuals' age.[2] The stereotyped behaviours may be different from child to child according to their developmental stage, and the behaviours generally continue throughout the

individuals life.[58] Stereotyped behaviours may include whole body movements such as body rocking or more specific body areas such as the head or hands in head spinning or hand flapping or unusual finger movements.[2] They may also include atypical gait and other strange behaviours such as flipping or spinning of objects and lining up of objects. In terms of repetitive speech and speech behaviours, individuals may have echolalia, use idiosyncratic phrases and perform mouthing. In general stereotyped behaviours tend to increase when the individual is hyper aroused or excited or is in distress.[57, 58]

Under the second category, deficits are described as being related to inflexible adherence to routines, rigid thinking patterns, ritualized patterns of verbal or nonverbal behaviour and insistence on sameness.[2] Furthermore, individuals on the spectrum are generally less able to or are slower at adapting to circumstance's, experiences or scenarios.[58] In fact, they may have strong adverse reactions to change, which may result in distress of the individual. In turn, they tend to adopt even more stringent routines to combat this. In addition it has been reported that they typically have a strong adherence towards rules due to their like of predictability and consistency and that they typically engage in persistent ritualised patterns of behaviour.[58] It has been reported that ritualised patterns of behaviour, acts of organizing objects, creating systems for objects or tasks and other repetitive behaviours assist the individuals in self-regulating.[59]

Under the third category, deficits are described as being related to having obsessive interests that are exceptionally intense or narrowly focused.[2] Individuals on the spectrum have a varied range of restrictive special interests and these can change throughout their life.[59] Importantly, it should be noted that the extent and intensity of the special interest generally disrupts their capability to fit into social settings, and may disrupt engagement in every tasks as their interest may take priority. Furthermore, these repetitive and resticted intersts may disrupt family dynamics and relationships and may cause distress on the individual themselves.[59]

Under the fourth category, deficits are described as being related to having hypo-reactivity or hyper-reactivity to sensory input for example seeming indifference to temperature or pain.[2] Individuals may potentially also have strange interests in environmental sensory aspects for example excessive smelling or touching of objects, having abnormal responses to sounds or textures or be captivated with different movements or lights.[2]

iii. Symptoms need to have been present from early childhood, should limit or impair every day, social and occupational functioning, and are not better explained by intellectual disability

According to the DSM-5, deficits in social communication and social interaction, as well as restricted, repetitive patterns of behaviour, interests or activities described in detail above, need to limit or impair the everyday functioning of individuals with ASD.[2] The deficits should also impair social and occupational function whereby for example individuals may not be able to live independent lives, hold down a job or run a household. Lastly, deficits should not be better explained by intellectual disability and need to have been present from early childhood.[2]

It is important to identify these deficits on an individualised level as early as possible and determine the extent the core deficits have on their function. In doing, so appropriate strategies or interventions may be implemented to assist these individuals improve function and overall quality of life.[64]

2.2.7 Other integral deficits

Although ASD is diagnosed based on core deficits being present, there is an extensive list of other integral deficits within the ASD population.[65]

i. Motor deficits

Individuals with ASD have been found to develop at slower rates compared to neurotypical individuals in terms of developmental skills,[66] and have an increased prevalence of motor impairments compared to the general population.[67] In a study by Green et al (2009), it was reported that in their sample of 101 children with ASD tested using the Movement Assessment Battery for Children, 79% of the children presented with motor impairments.[68] In general, it has been found that in individuals with ASD motor impairments generally present early on in life and typically persist over the individuals' lifetime,[67] unless intervention occurs.[14] Since motor impairments in individuals with ASD are currently classified as "associated symptoms" and not diagnostic characteristics, they are often not deemed to be a priority to screen for, nor to restore. If motor impairments persist, they generally result in reduced quality of life for the individual, as well as a reduction in physical activity, social engagement and behavioural deficits.[28] Thus assessing and targeting these impairments early on may contribute to better success of the overall management of the condition and should be an essential element in the overall treatment plan.[67] In fact, Fournier et al.[69] argue that motor deficits should be categorised as potential core

features of ASD, and that treatment interventions should include motor performance and motor coordination mediation .

Although the exact pathophysiologic mechanisms of ASD are not entirely understood, studies report that the motor disruptions observed in ASD may be attributed to abnormal neurotransmission, abnormal neurobiological changes and changes in functional brain anatomy.[69, 70] In terms of neurotransmission, commonly, impairments in the dopaminergic, serotonergic, and GABAergic systems have been described.[71-73]

There have been consistent findings of increased total brain volume- specifically in areas such as the caudate nucleus, cerebellum and cerebral hemispheres [74, 75] while findings show decreased size of corpus callosum.[74] In addition, it has been suggested that abnormalities noted in the basal ganglia, thalamus and supplementary motor areas of the brain may be likely sources of motor impairments in ASD.[75] Interestingly, there have been differences, and sometimes conflicting findings noted in the neuroanatomy across the autism spectrum.[69] For example, in one study it was found that there was significantly less grey matter volume in children with high-functioning ASD in three regions of the brain, namely the subcortical region, posterior cingulate region, and precuneus region compared to individuals with Asperger's.[76] While, in another study children with high-functioning autism had greater white matter volumes around the basal ganglia compared to those with Asperger's.[76] Overall, it would seem that there is disrupted neuronal organisation, neuroanatomical changes, as well as cortical connectivity issues in children with ASD resulting in motor dysfunction.[69] Although these changes may be different across the subtypes of individuals with ASD all present with significant motor deficits compared to their neurotypical counterparts.[69]

Common motor deficits described in the literature include impairments in: motor milestone development,[46] motor praxis,[46] coordination and planning,[69, 70] fine motor skill/ manual dexterity performance,[77] and gross motor skill performance.[78]In addition, deficits in specific areas reported to be important for the optimal performance of motor tasks, include: postural control,[79, 80] muscle strength,[81] coordination[82] and flexibility.[83]These will be discussed below, and should be considered for inclusion into the model of care.

a) Motor praxis, coordination and planning

It has been confirmed in many studies that individuals with ASD require more time to plan and execute movements.[27, 84, 85] Motor planning (praxis) includes marked impairments in motor coordination, which often interferes with their ADLs. In addition, poor body awareness in children with ASD may further exacerbate their problems with motor planning in terms of carrying out and planning imitative movement.[86] Additionally, they demonstrate slow reaction times for movement preparation which is often interpreted as clumsiness. In fact these individuals are generally described as being uncoordinated and clumsy, as they struggle with simple everyday tasks such as catching a ball or walking however, they show unexpectedly good dexterity in skilled and complex coordinated movement patterns[87] such as drawing, playing computer games or model building -often termed "kinesia paradoxa".[45] Kinesia paradoxa or the ability to perform more complex tasks better than non-complex tasks has been attributed to the individual having increased focus on that particular task or becoming obsessed with the particular task, or that the more difficult task may have imbedded cues (e.g. verbal instructions or visual cues).[85] Due to the above-mentioned deficits children with ASD require increased repetition to learn a particular motor plan,[32] as well increased verbal, physical and visual cuing to improve the performance of tasks at hand.[88]

b) Fine motor skills, manual dexterity performance, and gross motor skill performance

Although limited research exists on fine motor skill development in individuals with ASD, it has been reported that children with ASD have fine motor delays and decreased fine motor skill performance[89] compared to their age-matched neurotypical counterparts.[90] Furthermore, it has been reported that individuals with ASD demonstrate poorer writing skills overall compared to typically developing individuals.[91] It has therefore been suggested that it may be useful to assess fine motor skills in the first 18 months, particularly in children who are at risk for developmental delays.[89]

In a study by Mahone et al.[92] it was found that individuals aged 7-13 years with high-functioning ASD (n=24) had increased deficits in motor persistence compared to neurotypical controls (n=60), which is the ability to maintain voluntary actions over a period of time without assistance.[92] In their study, two measures of motor persistence (lateral gaze fixation where individuals had to sustain a lateral gaze for 20 seconds, and developmental neuropsychological assessment statue task where individuals had to maintain a fixed body position with eyes closed during a 75-second period) were measured.[92]

In terms of gross motor skills it is often reported that gait, agility and balance proficiency may be decreased in ASD populations.[93-96] Gait patterns are characterised by differences in limb-movement patterns, kinetic and potential energy cycles, overall velocity, and ground contact forces. Optimal gait is required to ambulate effectively as well as efficiently perform activities of daily living. Gait deficits may lead to compensatory walking patterns resulting in joint and muscle pain and strain, overall poor circulation, and reduced mobility thus interfering with quality of life and ADLs.[97]

Centers in the brain and spinal cord that regulate gait and specifically regulate locomotion include mesopontine tegmentum locomotor region, spinal cord locomotor region, and cerebellar locomotor region. Regulatory gait centers coordinate with posture control systems within the cerebral hemisphere and the cerebellum.[98] For optimal gait initiation and performance, there needs to be prime integration of multiple sensory and motor pathways, leading to coordinated postural and intentional movement constituents.[99] Since individuals with ASD may have impaired postural control systems (discussed further below), weight-bearing asymmetries[79] and sensory and motor pathway deficits it would stand to reason that they may, in addition, experience gait discrepancies. Furthermore, individuals with ASD across age groups, have difficulties of various severity, in coordinating their upper and lower body movements of differing severity[89, 100] which may further lead to gait impairments.

It has been suggested that individuals with ASD have a distinct gait pattern similar to individuals with Parkinson's disease,[101, 102] while others suggest the pattern is more similar to those who have been diagnosed with cerebella ataxia.[69, 103] Overall, gait deficits documented within the ASD population are said to include increased knee flexion and increased hip flexion at toe-off during the gait cycle, toe-walking,[70] slower walking pace, longer stance times during the stance phase, and decreased stride length. It should, however, be noted that there is a lack of thorough and reliable interpretation of gait information within the ASD population, and findings are often conflicted.[97] For instance a study by Venazza-Martin et al.[101] reported a decreased stride length (a mean of 0.67 ± 0.14cm) in nine children with autism (between ages of four and six years – no mean age provided) as compared to an age-matched control group(n=6). While Rinehart et al.[104] found that there was no reduced stride length, but rather a variability in increased stride length in ten high functioning individuals with ASD. Both these studies had very small sample sizes and care should be taken not to generalise the results. The conflicting findings between studies has been reported to possibly be due to differences in ASD severity in the participants studied.

Other gait deficits reported within the population include reported altered center of pressure shifts during gait initiation. This means that individuals struggle to transition from a large to small base of support due being unable/have deficits in stabilizing their center of gravity.[99] There have also been findings of increased upper body oscillations,[101] altered foot contact patterns[105] and difficulties with foot movements.[106] Additionally, Ming et al.[70] reported that toe-walking occurred in 19% (n=30) of the children (n=154) children (age range 2-18 years) with autism in their study.

Since movement quality may be impaired in individuals with ASD, it is very likely that individuals may struggle with agility type tasks. To the researcher's knowledge however, no studies currently exist specifically documenting agility in the population compared to typically developing individuals. However, some studies regarding improvements in agility scores following interventions in ASD-only populations do exist.[33] It has been reported by Dowell et al.[107] that children with ASD have slower timed movements, which may hinder their performance in fast-paced agility tasks. However, this was based on a study that included 37 children with autism spectrum disorder (ASD) and 50 typically developing (TD) children between the ages of eight and thirteen years. Further studies with bigger sample sizes would need to confirm this.

The lack of research of agility in individuals with ASD is of great concern since efficient ambulation requires proficient agility.[108] Future research should, therefore, aim to determine whether there are marked agility deficiencies' and to what extent in individuals with ASD compared to neurotypically developing individuals.

Balance is the ability to maintain a controlled body position during task performance, and is dependent on the vestibular, somatosensory and visual systems.[109] It is comprised of static (ability to hold a stationary position with control) and dynamic balance (ability to remain balanced while engaged in movement).[109] Individuals with ASD have been documented to have both static and dynamic balance deficits.[44] A study by Ament et al.[110] in which two hundred children participated (56 diagnosed with ASD (mean age 10.27±1.28 years), 63 diagnosed with ADHD (mean age 9.98±1.34 years) and 81 who were typically developing (mean age 10.31±1.18 years)), it was suggested that static balance deficits measured using the M-ABC-2 may be specific to ASD diagnosis and may be useful in differentiating ASD from other developmental disorders in which motor impairment may be evident.

Furthermore, in a study by Freitag et al.[111] 16 individuals with high-functioning ASD (n=14) and Asperger's (n=2) (mean age 16.4 ± 2.4years) were compared to 16 IQ matched neurotypical

controls (mean age 17.9 ±1.6years). One of their main findings was that there was significantly impaired motor performance of the high functioning ASD and Asperger's group compared to controls with regard to static and dynamic balance skills (jumping side to side (p= .0001) and jumping forward (p< 0.0001) as well as significant diadochokinesis (p =0 .0003) when tested using the Zurich Neuromotor Assessment (ZNA).[111] Similar findings were found in Noterdaeme et al. [78] study who reported significantly (p < 0.003) higher mean balance impairment scores (7.2±1.7) in 11 children with ASD (mean age 118±28 months) compared to 11 neurotypical controls (mean age 97±7 months) who had mean scores of 5.4±1.4 respectively. Balance in this instance was a combined measure of four items (standing quietly on one leg, hopping on one leg, toe gait, heel gait) which were combined and then assigned a global neuromotor impairment score (GNS).[78]

Static and dynamic balance deficits may be due to abnormalities often described in the cerebellum (decreased development), which is responsible for balance, fine motor control, as well as muscle coordination[44] and or impaired postural control systems.[112] Postural control systems are important for the execution of standing, walking and activities of daily life.[113] In a meta-analysis by Lim et al.[114] in which 19 studies were reviewed (n=985, of which n=434 had ASD, and n=551 were neurotypical), it was found that there was a significant effect size differences (p<0.001) in postural control between ASD and neurotypical individual groups (of differing ages (three-fifty two years)) for sensory conditions including eyes open and eyes closed.[114]

Although balance deficits have been recorded, further research needs to confirm whether consistent balance deficit patterns are present within the population.

c) Postural control, muscle strength, coordination and flexibility.

Postural control systems are important for the execution of standing, walking and activities of daily life.[113] In a study by Memari et al.[115] it was found that individuals with ASD demonstrate poor postural stability compared to their typically developing counterparts. In their study it was found that there was significantly higher (p < 0.001) amounts of postural sway in the anteroposterior range, as well as the medio lateral range (p = 0.002) using the Bertec force plate between children with ASD (n= 21; ASD (IQ > 80; aged 9–14 years) compared to neurotypical children (n=30; aged 8-15 years).[115] These findings are similar to other studies reporting increased postural sway in individuals with ASD.[79, 99]

It is assumed that these postural control deficits are as a consequence of poor motor modulation for motor and sensory outputs.[116] Deceased postural control may result in motor tasks or activities being performed in more static positions,[80, 117] which may be frustrating for the individuals' as these static, more controlled postures may be difficult for the individual to maintain.[44] More specifically, individuals with ASD have difficulties maintaining single limb stance, tandem stance (heel-to-toe), standing with their feet together and performing prone extension or supine flexion for long periods of time.[44] It has been found that when one or more sensory inputs are removed - for example closing one's eyes, postural stability is decreased even further in individuals with ASD compared to neurotypical counterparts in the same settings.[80] In addition, it has been found that postural instabilities may become exaggerated in stressful situations, and that they may interfere with social interaction.[118] Further research needs to be conducted to determine the extent to which postural control performance deficits are pronounced in a wider range of functional tasks, for example in performing running and jumping type activities.[99]

Static postures in the ASD population have often been disregarded in research; hence limited posture profiles exist for this population. Postural impairments have been linked to a lack of motor experiences, sensory-motor integration, attention problems, social disabilities and have been associated with learning impairments.[115]

In a study by Neophytou[33], it was reported that children with ASD demonstrated poor posture scores in the lower back, abdominal and ankle regions.[33] Lower back and abdominal postures have been directly linked to difficulties in maintaining attention in class, as well as in hindering learning in students.[119] The study sample in Neophytous' study was small (n=27) and, this relationship should be investigated further.[33]

In order to perform activities of daily living effectively, an individual needs to have optimal muscle activation and strength.[120, 121] It has been reported that individuals with ASD have decreased muscle tone[122] as well as general muscle weakness.[123] It was also reported by Bhat et al 2011, that one of the early motor impairments commonly observed in individuals with ASD include weakness in pronation and supination of the hands.[122] Furthermore, it has been found that reduced handgrip strength in individuals with ASD is related to the severity of condition.[124]

To the researcher's knowledge there are no studies comparing the flexibility profiles of individuals with ASD to neurotypical individuals. Some studies report single flexibility test results

for example sit and reach test measures[33] yet this information is extremely limited. It has been documented that individuals with ASD generally lead sedentary lifestyles.[27, 125] In particular, reduced physical activity may lead to increased muscle tightness and reduced flexibility. Although full flexibility profiles have not been determined, there have been attempts to improve flexibility in the population through exercise interventions.[33] Successful interventions include aquatic exercise programmes[126] and general exercise programmes all of which improved flexibility in certain body areas in individuals with ASD.[33]

d) Motor deficit management, effectiveness and gaps in the management

Motor deficits have been targeted though specific interventions.[33, 127, 128] There are however, issues with motor skill assessment within the ASD population and gaps in the management of individuals on the spectrum using targeted therapies.[129] Current research indicates that several modified assessment tools are being used to determine the motor proficiency of individuals with ASD.[130] Although these modified tools may seem to be appropriate initially, there have been studies to comment on the inappropriateness of certain test items after a tool has been used.[33, 131] The lack of appropriate tools for motor assessment is however, not the only problem facing individuals with ASD. Assessments have often, in the past looked at particular motor deficits in isolation. For example, in a study by Rinehart et al.[85] gait disturbances were assessed in newly diagnosed individuals with ASD, yet coordination necessary for optimal gait was not measured. A standardised tool measuring a variety of motor variables would therefore help combat this problem. Targeted interventions have been developed to improve singular motor skills,[132] and although this may improve specific motor impairments, other co-existing motor impairments may be neglected.

Recently a meta-analysis, examining the effect of physical activity interventions on youth diagnosed with autism spectrum disorder was conducted in 2018.[133] The synthesized analysis included a total of 29 studies with 30 independent samples ($n = 1009$) and found that there were moderate to large positive effects ($g \geq 0.5$) in individuals with ASD who participated in interventions targeting the development of locomotor skills, manipulative skills, skill-related fitness, social functioning, and muscular strength and endurance.[133] In addition, this meta-analysis provided insight into the fact that exercise-based interventions may not only improve the physical and motor aspects of an individual's life but may also cross over into the social, and behavioural realms. Overall, the researchers concluded that using exercise, as a means of intervention is a good evidence-based strategy to improve the overall lives of individuals on the

spectrum. There is also evidence to suggest that exercise interventions may decrease stereotypical behaviours, improve academic performance and improve cognitive function and physical fitness.[134]

ii. Reduced physical activity

It has been found that individuals with ASD have significantly lower physical activity levels when compared to neurotypical individuals.[21, 22] It has been reported that individuals with ASD do not meet Center for Disease Control's Physical Activity Guidelines[135, 136] and that physical activity levels are low in children who are older, as well as in adolescents with ASD, indicating a trend of decreased physical activity as they age similar to neurotypical children. [22, 137 ,125] There are a few reasons as to why this population may have reduced physical activity levels, which will now be discussed.

a) Motor skills

One of the possible reasons cited for reduced participation in physical activity is motor impairments/ difficulties. [68, 138] Having limited or impaired movement skills may result in children being unable to participate or excel in certain activities. This may lead to individuals forming a preference for sedentary activities such as playing computer games.[21, 139] A reduction in motor proficiency has also been documented to make individuals feel inferior to others in terms of motor skill execution and may have a psychological impact on the individual.[140] A study by Healy et al.[24] 2018, in an analysis of 29 experimental studies it was concluded that engaging in physical activity contributes to improvements in the motor, manipulative, and fitness skills of young people with ASD.[141]

b) Sensory impairments

Sensory impairments have been said to contribute to reduced physical activity participation in individuals with ASD.[139] It has been reported that sensory processing issues occur in between 42% and 100% of individuals with ASD.[142-144] These deficits may reduce proficiency in motor activities and may lead to individuals avoiding activities rich in sensory stimulation.[139] This could potentially increase the preference for certain activities and again reduce overall physical activity levels.

c) Social communication

Physical activity participation may further be reduced by deficits in social communication. Social communication impairments may lead to a reduction in participation in group physical activities[21, 139] or where communication is paramount in achieving a sporting outcome. Impaired

communication skills impede the development of optimal peer interaction, as well as enjoying the social aspects of participating in group physical activities.[145] Communication between individuals with ASD and neurotypical counterparts may be further compromised due to a lack of understanding of their behavioural problems whereby behavioural issues may cause anxiety, irritation, or discomfort for those interacting with them[146] - which may in turn isolate them from group activities.[22] It has been suggested that continued group participation in exercise, despite the barriers mentioned above may have a positive effect on social communication within individuals with ASD,[147] which in turn may allow for improved participation in physical activity.

d) Environmental and other factors

Environmental factors may also reduce physical activity participation in children with ASD. Similar to the general population, environmental barriers in the form of not having access to various physical recreation facilities and resources may affect the participation in physical activities in children with ASD.[148, 149] In addition, poor environment in terms of poor family and peer support may also reduce physical activity performance of individuals with ASD as well as cause negative behaviour towards sport and sport performance.[148, 149]

e) Reduced physical activity management, effectiveness and gaps in the management

There have been few studies conducted to solely improve the physical activity levels of individuals with ASD. However, there has been a steady increase in exercise-based interventions for individuals on the spectrum targeting numerous variables.[133] Yet, one of the largest gaps in the literature at present is identifying what the main barriers of engaging in physical activity may be, as well as what should be considered in order to reduce barriers towards engaging in physical activity. Reduced physical activity could also potentially lead to obesity (see next section).[24]

iii. Obesity

a) Obesity levels

It has been suggested that reduced physical activity levels and disordered eating patterns in children with ASD may be closely associated with obesity development.[150] The eating behaviours of these individuals include having a preference for soft, sweet and energy dense foods (which may contribute to their risk of obesity)[151] and being unusually and highly selective.[150]

In study by Hill et al.[152] it was found that in a sample of 5053 children (aged 2 to 17 years) with a confirmed diagnosis of ASD, 33.6% were overweight and 18% were obese.[152] The study found that, in particular, the children aged 2 -5 years (of non-Hispanic white origin) had a significantly unhealthy weight compared to their neurotypical counterparts of the same age. The study also found that for this sample in particular, predicting factors of the obesity levels were due to having Latino ethnicity, lower parent education levels, and poor sleep patterns.[152]

In a recent study (2019) by Healy et al. [133] it was found that in a sample of 875,963 youth with autism spectrum disorder and 31,913,657 typically developing youth aged 10-17 years, 19.4% of the children with ASD were overweight compared to the 14.9% in neurotypical individuals who were overweight ($p=0.04$).[133] In addition, it was found that 23.05% of the children with ASD were obese compared to the 15.91% in neurotypical children ($p=0.02$). The study also found that individuals who had severe autism were more likely to be obese compared to those with mild ASD (odds ratio = 3.35, $p < 0.01$). [133]

In general, the difficulties experienced within this population in terms of the physical, behavioural, and psychosocial realms may make them susceptible to developing obesity.[150]

b) Obesity management, effectiveness and gaps in the management

A recent systematic review conducted by Healy et al.[133] reviewed the effect of weight management interventions (including exercise, diet, and medication) for youth with ASD. Twelve papers were included in their study, and it was found that there was minimal research exploring the effectiveness of weight treatment interventions in individuals with ASD highlighting a large gap in the literature.[133] Only half of the papers included in their review indicated positive results in weight reduction after participants had engaged in weight management interventions.[133] The researchers concluded that personalized, holistic, and multidisciplinary team-based interventions [133] may be effective in reducing weight among young individuals with ASD. They also concluded that it would be necessary to ascertain which aspects of the interventions directly contributed to their success, and which contributed to their weaknesses so that future interventions could be better designed and measured. [133]

iv. Comorbid psychopathologies

a) Common psychopathologies

Comorbid psychopathology is defined as the occurrence of two or more forms of psychopathology in the same person, and includes anxiety, mood, conduct and oppositional defiant disorders, as well as psychological disorders like schizophrenia and phobias and attention deficit/hyperactivity disorder (AD/HD).[153] It has been reported that intellectual disability (ID) may further exacerbate psychopathologies in individuals with ASD, specifically with regards to symptom presentation.[153] For example , it seems that the presentation of depression in the population may be dependent on their cognitive function, whereby lower functioning individuals seem to present with increased behavioural issues while those who are higher functioning present with more typical depressive symptoms.[154]

Depression has been reported to be the most common comorbid psychopathology in individuals with ASD.[155] Due to the lack of measures to effectively assess comorbidities in this population these psychopathology rates , in particular the rate of depression could be much higher than reported.[155] Furthermore, it has been reported that the incidence and development of depression in high functioning individuals with ASD generally increases through adolescence with their increased awareness of them being different to others their age.[156]

Other types of psychopathologies often associated with ASD include OCD, anxiety, phobias, and psychosis. In a study by Amr et al.[157] it was found that sixty three percent of children diagnosed with ASD, had an additional comorbid disease diagnoses, which included anxiety disorders (of which obsessive compulsive disorder was most prevalent (55%)), ADD/HD, conduct disorders as well as major depressive disorder.

In a different study, it was reported that approximately a lower percentage (30%) of children with ASDs have concurrent OCD.[158] There is some concern however about whether an ASD and OCD diagnosis can be separated, as individuals with OCD participate in repetitive acts in order to reduce anxiety which is similar to symptomatic individuals with ASD.[153] This is similar to anxiety and depression in ASD, where there is significant overlap and concerns that ASD may not be able to be separated from these psychopathologies.[153] Anxiety prevalence within children with ASD is reported to range between 11-84%, with the large range being attributed to differences in study methodology.[159] It has been reported that anxiety may occur due to ASD-specific

difficulties, cognitive and social impairments, increasing age, as well as feeling and better understanding that they may be different to others.[159]

b) Comorbid psychopathology management, effectiveness and gaps in the management

Although it is well known that individuals with ASD, have high rates of comorbid psychopathies, minimal systematic assessment[153] and standardised treatment approaches exist to assist the population. Matson and Nebel-Schwalm[153] have suggested that for best practice to ensue, there needs to be a clear primary separation of comorbid ASD symptoms from core symptomology.[153] Following this, specific scales can be developed and employed to further enhance the comorbidity diagnosis while creating tailored targets for symptom and behavioural intervention.[153]

Psychopathies are currently treated in part with psychoactive medications, which include anti-psychotics, anti-anxiety medications, anti-depressants and stimulants. In the general population, as well as within the ASD population these prescription medications may contribute to weight gain and obesity.[160] Considering this population may already have a predisposition to being overweight or obese,[161] close monitoring of their general health and a preference for alternative therapies may need to be considered in their holistic management.

In summary

The core deficits of ASD are clearly defined, and in general, individuals with ASD are managed in such a way as to improve these core deficits. Considering that there are clear neuroanatomical differences in individuals with ASD compared to neurotypical individuals, which directly influence motor function, motor function should be considered a core deficit of the condition. Furthermore, other pronounced deficits including reduced physical activity levels, increased obesity levels and comorbid psychopathologies should be considered when developing l models of care for individuals with ASD so that individuals are holistically managed to optimise outcomes.

2.2.8 Current treatment procedures and interventions

Over time, the treatment and management of ASD has improved.[162] Advances have been made, in diagnosis, as well as management of the condition and a lot of research now exists on effective interventions for core deficits as well as other frequent comorbid deficits.[162] Although these

advancements have been made there are still areas needing further research, as well as areas where improved strategies in terms of management are still needed.[162]

The management of ASD typically includes early and intensive behavioural therapy, which is used to improve cognitive, communication, and social functioning difficulties, as well as assist in reducing inappropriate behaviours.[162] Nutritional interventions, educational interventions as well as psychopharmacological treatments are used to address issues experienced by the child in these realms.[162] Often, the management of ASD may also include sensory integration therapy to target sensory processing issues, speech therapy to address communication difficulties as well as other alternative medicine approaches dependent on the child's needs.[162]

Therapies and interventions are generally carried out by trained healthcare professionals including developmental pediatricians, child psychiatrists and psychologists, occupational and behavioural therapists, speech therapists, and remedial teachers.[162]

a) Autism management guidelines

In 2018 the European Society of Child and Adolescent Psychiatry (ESCAP) identified the need for a practice guidance document that could be used to improve the knowledge and practice for professionals working in Europe with people on the autism spectrum.[163] Although the document was developed for a European context, the principles identified within the document could be applied to other contexts as a starting point for management. Additional requirements could then be added or adapted to make management more context specific where needed.

The document developed by the working party and endorsed by the ESCAP Board, synthesized the current information on ASD including research, expert opinions, and other existing international guidelines.[163] The overall goal of the document was to compile a practical guide for supporting individuals with autism and their families.[163] The document outlines ten general principles for the treatment and management of ASD. These are presented in Table 2.3 on the next page.

Table 2.2 Ten principles recommended to guide the management of individuals with ASD as per ESCAP 2019.

Principle	Recommendation
1.Pre-treatment assessment	Early support for families with children with special needs is crucial to improve parental confidence and minimize later problems. Objective assessments provide a baseline for planning interventions and monitoring progress.
2. Each individual, each family is unique	Diagnosis and assessment should consider the individual's profile of strengths, difficulties, and needs, as well as family and social context. Interventions must be adaptable to changes in individuals, families, and circumstances over time.
3.Focus on individual strengths, not just limitations	Identify and foster individual strengths to provide a positive environment for autistic individuals and their families. Utilise areas of strength to compensate for areas of weakness and enhance overall well-being.
4.Intervention should be based on a “functional analysis” of behaviour	Consider all factors limiting an individual's ability or quality of life to develop effective interventions. Identify potential causes of difficulties and develop skills to improve quality of life.
5.Focus on making the environment more “autism friendly”	Identify environmental factors that may limit progress or quality of life and reduce environmental stress. Minor environmental changes can significantly impact behaviour and well-being.
6.Effective treatment is not determined by a fixed number of hours or sessions of intervention	Therapy should maximize opportunities throughout the day to facilitate progress and minimize difficulties. Focus on core difficulties in social relating, communicating, and imagination to address significant challenges.
7.Reassess the professionals’ role	Professionals serve as coaches for key individuals involved in the individual’s life. Case-coordinating professionals integrate recommendations for intervention and support planning for the future.
8.Provide access to full and effective participation and inclusion in society	Deliver psychosocial interventions in school and community settings to promote inclusion. Support provided in various contexts should make physical and social environments more accessible and supportive.

9.Respect individual rights	Empower individuals with autism and their families to defend their rights and participate fully in society. Support policies and programmes that promote equality, inclusion, and empowerment.
10.Establish referral mechanisms and coordinate key agencies	Coordinate services across government departments and community agencies involved in the life course of people with autism. Advocate for comprehensive national autism strategies to address diverse needs and challenges.

The guideline highlighted the need for assisting and providing support for individuals throughout their lives. It is important to reduce as many barriers individuals on the spectrum may face, as well as provide as many opportunities possible for them to be included and be able to engage in education, work and societal settings.[164] The guide also provides information on specific therapeutic interventions that can be used to assist individuals' on the spectrum. The therapeutic interventions are presented under categories in the guide and include: developmentally based interventions, social communication therapies, interventions based on applied behaviour analysis, parent-focused behavioural management programmes, interventions for behaviours that challenge, treatments for co-occurring conditions, pharmacological treatments, and other therapies.[163]

Under the "other therapies" category, specific therapies like speech and language therapy as well as occupational therapies are described where information regarding some motor deficits are described. The guide also mentions treatments that should not be used.[163]

When implementing exercise based interventions to target motor skills and physical activity levels, the above guidelines would therefore need to be considered, and the key principles need to be adhered to in exercise based programme development and design.

b) Exercise based intervention guidelines

Numerous exercise based interventions, have been implemented within the ASD population, to target various facets of the condition and although many exercise based interventions have been deemed successful, often due to methodological failures they cannot be reproduced effectively.

In a study entitled, “Consensus on Exercise Reporting Template (CERT): An internationally-endorsed reporting guideline for exercise interventions”,[165] a model on how to effectively communicate and report on findings on exercise interventions was proposed. [165] For this study, the researcher briefly reviewed exercise interventions conducted between the years 2000 and 2024 for individuals on the autism spectrum and consolidated the findings below using the CERT guidelines. The researcher did this to highlight gaps in the reporting of exercise interventions for the population, as well as highlight methodological uncertainties due to the non-reporting of specific aspects of the intervention.

The researcher reviewed studies included in Healy et al’s.[133] meta analysis (n=29) which included articles published between the years 1970 and 2018, Ruggeri et al’s,[96] systematic review which included articles published between the years 2000 and 2019 (n=41), as well as reviewed studies between the years 2020-2024. The reason for choosing studies from the meta analysis and systematic review was for quality assurance purposes – all studies that were found in both studies were included in the final analysis for example (n=13) as well as others as described below. Although more recent meta-analyses have been conducted, Healy et al. [133] included the most studies in their analysis which is why the researcher selected their study to incorporate in the overview. The researcher used similar inclusion criteria and search rules reported by Healy et al[133] and Ruggeri et al’s.[96] (for continuity purposes) for the studies published between 2020-2024 to be included in the analysis below. Inclusion criteria and search rules for the studies described above are shown in Table 2.3 on the next page.

Table 2.3 Inclusion criteria and search rules for studies used in the CERT analysis below

Inclusion criteria and search rules	Healy et al.2018 [133]	Ruggeri et al.2020[173]	Studies 2020-2024 And CERT analysis
Language written in	English	English	English
Year published	1970-2018	2000-2020	2020-2024
Data bases searched	SPORTDiscus, ERIC, PsychINFO, PubMed/ Medline, Child Development and Adolescent Studies, and PsychARTICLES.	CINAHL, Clinical Trials, Cochrane, PEDro, PubMed, Web of Knowledge	SPORTDiscus, ERIC, PsychINFO, PubMed/ Medline, Child Development and Adolescent Studies, and PsychARTICLES, CINAHL, Clinical Trials, Cochrane, PEDro,Web of Knowledge
Key words used in search	Autism spectrum disorder, autism, ASD, physical education, physical activity, adapted physical education, adapted physical activity, exercise, and evidence-based practices.	Autism spectrum disorder, physical therapy, motor intervention, and exercise.	Autism spectrum disorder, autism, ASD, physical education, physical activity, adapted physical education, adapted physical activity, exercise, and evidence-based practices, physical therapy, motor intervention.
Participant criteria: diagnosis, age range	Formal diagnosis of ASD; 2-22 years.	Formal diagnosis of ASD (if other diagnoses were included, the results of participants with ASD were statistically analysed separately"; 2-21 years.	Formal diagnosis of ASD; 2-22 years.
Outcome measures rules	Must have quantifiable outcome measures.	Must have an objective outcome measure that was statistically analysed	Must have quantifiable outcome measures.
Setting and design	Must have taken place in a physical education, physical activity, or sport setting; Needs to implement a method or intervention.	Group study designs including cohort and clinical trial studies; be any type of motor or physical intervention; needs to investigate effects of a motor intervention on a motor outcome , or effects of a motor learning variable on motor skill acquisition, transfer, and/or retention.	Must have taken place in a physical education, physical activity, or sport setting; needs to implement a method or intervention.

The final sample included: 26 studies from Healy et al.[133] (three were excluded due to being published prior to 2000); and 13 of which overlapped with Ruggeri et al. study'. The remaining eight (n=8) in Ruggeri et al. [96] published in 2018 or after were also included. The researcher then included a further eight studies published between 2020 and 2024 (reviewed using criteria

in table 2.3, with two studies being randomly selected by the researcher for each year between 2020-2024). The final sample selected included 42 exercise interventions between the years 2000 and 2024 as illustrated in Figure 2.2.

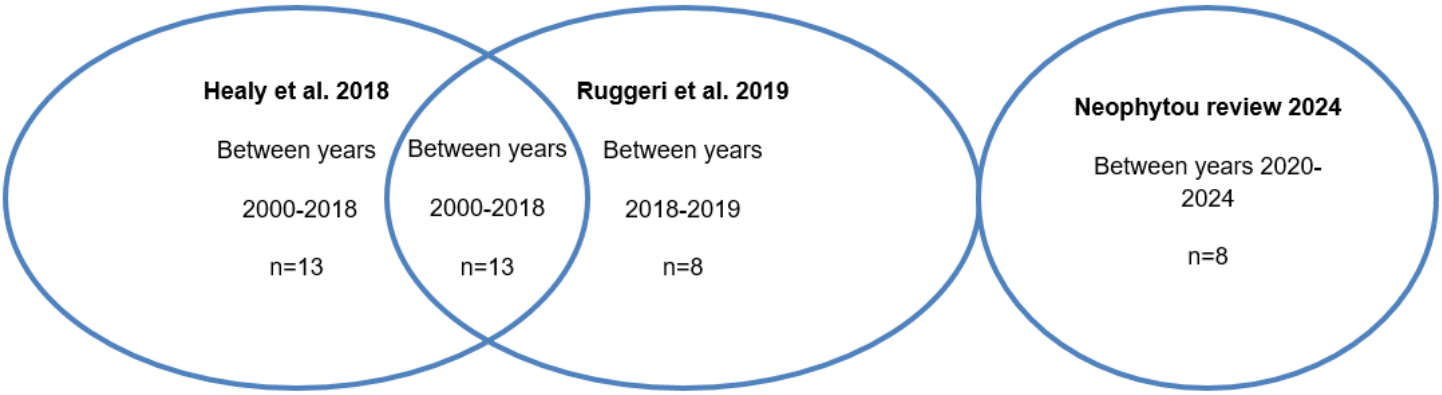


Figure 2.2: Sample of exercise interventions used for CERT analysis between 2000-2024 (n=42)

The CERT template was used to document whether all the necessary items were effectively reported in each study. Using the CERT guidelines the researcher read each paper and determined if information was provided (yes=1) or wasn't provided (no=0) for 19 questions outlined by the CERT criteria. Each paper was scored out of 19 and documented in an excel document. The researcher created a modified template to allow many studies to be reported in one table. The complete table may be found in Appendix B for all 42 studies. Figure 2.3 on the next page illustrates the strengths and weaknesses of the interventions in terms of which variables were or were not reported.

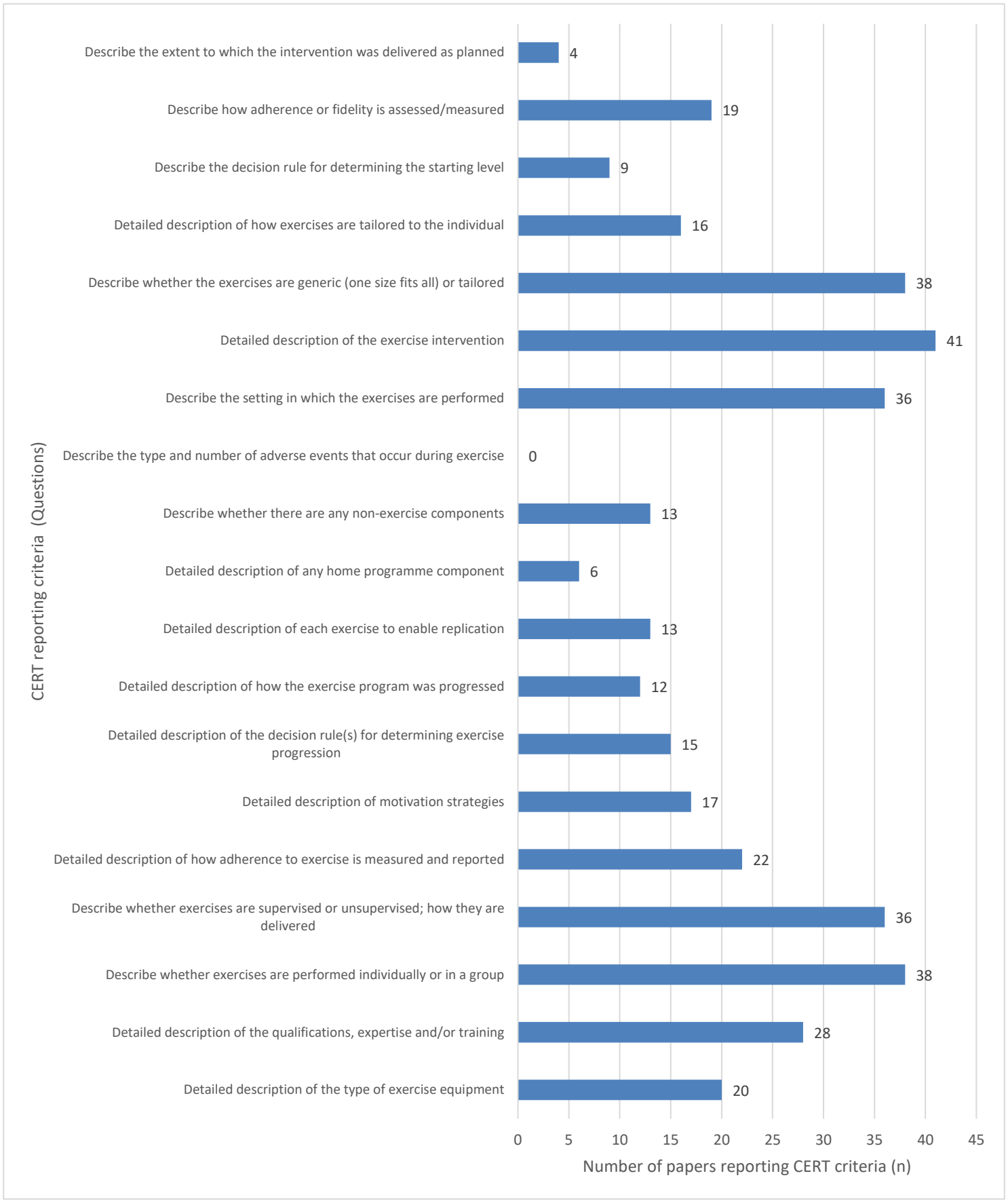


Figure 2.3: Frequency of reported exercise intervention parameter/variables for individuals with ASD, using CERT guidelines (n=42)

In Figure 2.3, it may be seen that from the 42 studies analysed using the CERT reporting criteria, the most frequently reported variable across exercise interventions was a detailed description of the overall exercise intervention (n=41), however, it was found that of the 42 studies reviewed that only 13 provided detailed description of each exercise- therefore making it difficult to replicate the intervention exactly.

Other frequently reported variables included if the exercises were standard across the groups (n=38), the setting in which the exercises were carried out (n=36), whether sessions were carried out for individuals or as a group (n=38), whether sessions were supervised (n=36), and what the qualifications, expertise and/or training of the individuals carrying out the interventions out were (n=28).

Less than half of the studies included in the final analysis provided detailed description of the equipment used (n=20). For example yoga interventions did not describe if yoga belts or blocks were used, the majority of aquatic interventions did not mention if any pool equipment was used (e.g. noodles, pool weights) and equine interventions did not mention the types of additional equipment used in conjunction with the horses. This makes it difficult to replicate interventions exactly.

In addition, less than half of the studies reported how adherence to exercise was measured and reported (n=20), how participants were motivated during the intervention (n=17), and whether exercises were tailored to the individual (n=16).

Variables least reported were how interventions were progressed (n=12), how the starting point of exercise was determined (n=9), and if the extent to which the intervention was delivered as planned (n=4). In most instances the intervention was described in detail yet there was no statement as to whether it was followed exactly or needed to change in some way to accommodate individuals.

Lastly, this brief review highlighted that none of the interventions made mention of the type or number of adverse reactions to the intervention or exercise used. This may indicate that there were no adverse reactions or that adverse reactions were not documented. This is an important discrepancy that needs to be addressed in future research for a better understanding of the reaction to exercise of ASD individuals.

The CERT analysis above highlights the strengths and weakness of how authors report exercise-based interventions. Future research should endeavor to use the CERT guidelines to improve reporting and help clarify important methodological processes. In doing so, interventions may be better compared and further clarity may be obtained in terms of which strategies assist individuals with ASD most profoundly.

The reviewed interventions included in the CERT for children with ASD found improvements in a range of outcomes using various physical activities. For example, in a two week cycling intervention sleep metrics including: sleep efficiency, sleep onset latency, and sleep duration were improved.[166] While, in an eight week traditional Greek dance intervention[167] and a twenty week trampoline-based training programme,[168] improvements in body coordination, balance, and motor skills were observed.

The majority of exercise-based interventions, including those included in the above CERT analysis have also been effective in reducing core symptomology in individuals with ASD,[134, 141, 169] in improving motor proficiency levels for varied variables,[14, 170] and other general struggles.[171-173] Therefore, using these types of interventions, reported following CERT criteria should be pursued in the management of individuals with ASD.

A detailed summary of the characteristics and findings of the studies included in the CERT review, highlighting how exercise-based interventions may be effective improving various variables within individuals with ASD can be found in Appendix C in Table 7.1.

2.2.9 Current treatment procedures and interventions in South Africa

In South Africa the management of individuals on the spectrum involves a mix of intervention strategies including therapeutic modalities as well as some educational strategies. There are however many challenges in South Africa with regard to providing comprehensive, holistic and multidisciplinary care. Although early intervention is recommended in the management of ASD, reduced access to early diagnosis for various communities as well as, limited care providers specialising in the field of ASD may be barriers to effective management in South African communities.[174] It has been reported that treatments focusing on speech therapy, occupational therapy, and behavioral therapies like Applied Behavioral Analysis (ABA) are some of the

therapies offered in South Africa, however no formal protocols for management exist that the researcher is aware of. Furthermore, although some families (specifically those accessing the private healthcare sector) do get assistance and access to interventions improving communications skills, social skills and the performance of activities of daily living, public healthcare services are often limited or are inconsistent in delivering adequate care to those on the spectrum.[175] Therapy sessions in public facilities tend to be less frequent and brief compared to services offered in the private sectors, for example, sometimes services are limited to just 30 minutes per month, and waiting periods can stretch from several months to over a year.[174, 175]

In terms of education, autism awareness is limited but has improved over time through advocacy group such as Autism South Africa. Education for children on the spectrum is limited by a lack of resources.[176] At present, there are only six government-funded autism-specific schools across the South Africa, and these are primarily located in urban areas like the Western Cape and Gauteng, which can accommodate around 800 children.[176] Although these specialised schools offer structured environments and relevant care, they are unable to meet the demands of the number children requiring assistance.[176]In provinces such as Limpopo and Mpumalanga, there are no autism-specific schools,[174, 176] and children often end up in mainstream schools that are not equipped to handle their needs. Of greater concern is that teachers in these settings frequently lack the training necessary to support children with ASD effectively.[176] Another concern is that that children who can't access ASD specific schools are also unable to access mainstream schools which generally leads to reduced function and progress of the individual.

One of the largest barriers towards optimal management for those on the spectrum in SA lies in the area of early diagnosis.[174] Public healthcare professionals, especially those in rural areas, often do not receive adequate training in identifying ASD.[174] This often leads to delayed diagnoses, and a reduction in obtaining the benefits associated with early intervention such as early progress in reducing core deficit areas and other associated difficulties. Another barrier to optimal management of individual on the spectrum in South Africa include socioeconomic factors.[175] Socioeconomic factors play a large role in access to care.[175].Cultural misconceptions, particularly in rural communities where autism may be misunderstood as a form of witchcraft, also contribute and often hinder early diagnosis and intervention.[174, 175]

Another barrier in terms of management for individuals on the spectrum in South Africa include language diversity and cultural beliefs. In South Africa, there are twelve official languages,[177] thus many children with ASD may struggle in therapy sessions that are conducted in English,

especially if they are exposed to multiple languages at home. In terms of cultural beliefs, some caregivers and parents distrust public healthcare services, they also may fear being judged by community nurses, which often discourages them from seeking necessary medical interventions.[175, 178]

Although progress has been made regarding better management of individuals on the spectrum in a South African setting, including initiatives by the Department of Education to train more teachers and establish more autism-friendly schools. There is a need to improve management as well as address the above mentioned barriers.[175] The development of the MoC in this study may assist in bridging some of these gaps.

2.3 Models of care

2.3.1 What it is a model of care

A model of care (MoC) serves as a standardised conceptual framework, which guides best practice care and service delivery for individuals as they progress though the stages of a condition, injury or event.[10] Tailored MoCs' help to ensure individuals receive the best and optimal care, by the most appropriate clinicians at the optimal time in the disease or condition's process.[10]

2.3.2 Frameworks and models of care in special populations

i. Frameworks

In 2001 the World Health Organization issued a thorough outline on what should be considered in terms of function and health for various health conditions named "The International Classification of Functioning, Disability and Health" (ICF) as illustrated in Figure 1.1 in chapter 1.[25] Importantly, the ICF framework focuses on function, rather than disability, and focuses on the abilities of the individual at a patient rather than only the systems level.[25]

The six main areas outlined in the framework include body functions and structures, activities, participation, environmental factors and personal factors. "Core sets" of information per disability are then added in under the main headings in the framework in order to guide special considerations in terms of function and health management for that condition. For example, for multiple sclerosis under the heading body function, core sets of information include : "energy and drive functions, emotional functions, higher-level cognitive functions, seeing functions, sensation of pain, urination functions, muscle power functions and gait pattern functions". In contrast, for cerebral palsy (for adults) under the heading body function, core sets of information include: energy and drive functions, intellectual functions, sleep functions, higher-level cognitive functions, sensation of pain, mobility of joint functions, muscle power functions, muscle tone functions, control of voluntary movement functions.

Each "core set" heading has been developed as a practical tool to guiding systematic and comprehensive description of functioning in clinical practice which serves to guide optimal management and care for the specific condition.[25] At present, core sets are available for numerous chronic conditions as well as orthopedic conditions, yet none are available for individuals with ASD. Table 2.4. Below illustrates generic core sets that may be used as a reference or starting point for health-related functions to consider when working with individuals. Although the six areas presented in this framework apply to ASD and may be used as a foundation

to build upon, a more specific MoC can be developed to specifically guide management of core deficits and comorbidities of the condition. Thus future research needs to establish specific categories for individuals on the spectrum.

Table 2.4: ICF general subcategory health related domains as presented in the ICF manual.

Body	
Function	**Structure**
Mental functions, sensory functions and pain, voice and speech functions, functions of the cardiovascular, haematological, immunological and respiratory systems functions of the digestive, metabolic, endocrine systems genitourinary and reproductive functions, neuromusculoskeletal and movement-related functions, functions of the skin and related structures	Structure of the nervous system the eye, ear and related structures, structures involved in voice and speech, structures of the cardiovascular, immunological and respiratory systems, structures related to the digestive, metabolic and endocrine systems, structures related to genitourinary and reproductive systems, structures related to movement, skin and related structures
Activities and participation	
Learning and applying knowledge, general tasks and demands, communication, mobility self-care, domestic life, interpersonal interactions and relationships, major life areas, community, social and civic life	
Environmental factors	
Products and technology natural environment and human-made changes to environment support and relationships attitudes services, systems and policies	

At present the establishment of a model of care for individuals on the spectrum specifically targeting motor impairments and physical activity may contribute to the improvement in the overall function of individuals on the spectrum. Figure 2.4 below indicates which domains a MoC pathway may influence and where it may fit in in the framework. It is proposed that implementing an MoC to specifically target motor proficiency and physical activity may improve specific body structures and functions (illustrated by red arrows). Specifically, motor-based interventions may improve mental function, functions of the cardiovascular and respiratory systems, functions of the digestive, metabolic and endocrine systems as well as neuromusculoskeletal and movement-related functions.

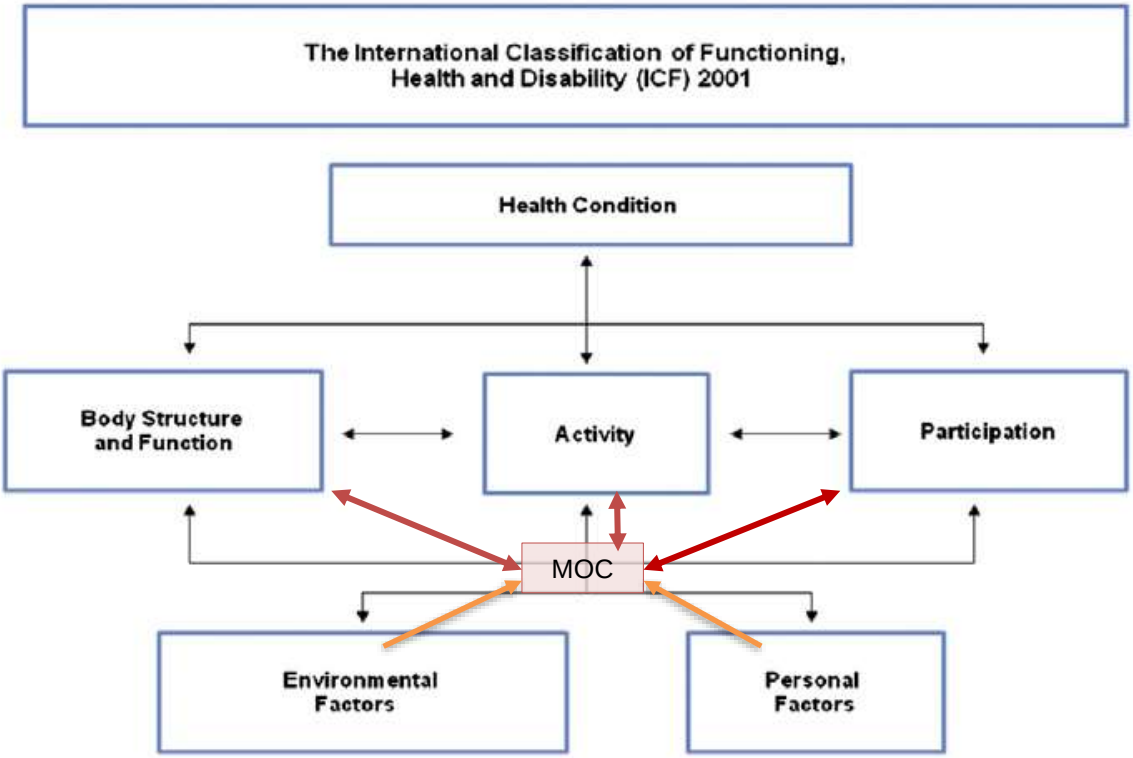


Figure 2.4: MoC pathway potential relationship within the International Classification of Functioning, Disability and Health and disability framework[25]

Furthermore, the proposed MoC may improve activity of the individual in terms of improved general task performance as well as improved mobility and self-care (illustrated by red arrows). These effects will need to be confirmed with future research following MoC development and implementation. Environmental factors and personal factors (illustrated by orange arrows) may in turn influence the proposed MoC and again this would need to be determined. For example things like an individual's age, level of functioning, presence or absence of co-morbid conditions, family level of educational, access to resources, family structure, the type of schooling in which an individual is enrolled may influence the MoC. Therefore these may be factors that would need to be considered when specific categories for individuals on the spectrum are developed.

ii. Treatment models and models of care

There have been various treatment models for individuals with ASD. However, there have not been any developed to specifically address motor proficiencies or physical activity levels within this population. In a study by Odom et al.[56] a meta evaluation of comprehensive treatment models developed for learners with ASD and their families was conducted. The evaluation included 30 treatment models after following six stringent inclusion and exclusion criteria behavioural.[56] The purpose of their study was to determine the quality of several aspects or

domains of comprehensive treatment models that have been developed for learners with ASD and their families. Odom et al.[56] concluded that the comprehensive treatment models that were reviewed were mostly based on the applied behaviour analysis framework, while some were based on relationship or developmental-based frameworks.

They found that the domain that was strongest was the operationalisation component of the models, while measuring implementation of the models was the weakest domain as evidence was lacking. They indicated that the review could aid researchers, families and service providers in making informed decisions on selecting which treatment models may be best for the individuals they were working with.[56] Additionally, they recommended that future research should focus on documenting the appropriate implementation of treatment model procedures, determining the efficacy of the models described as well as using that information to scale the models up to allow learners with ASD as well as their families to use them more effectively.

iii. Examples of domains included in treatment models/frameworks

The below studies provide examples and insight into the components and domains used in care treatment models and frameworks for individuals with ASD. In reviewing these domains insight is provided as to what could be considered and included in more specific exercise or motor-based models of care. The ideas presented in this review may be considered for the model development for this study and are not an extensive list of all models available at present.

In a study by Kong et al.[179] a model named the Systematic Network of Autism Primary Care Services (SYNAPSE) was described. They developed the model using and applying frameworks of chronic disease management as well as co-production principles and intend their model to be used as a framework of practice, to improve health outcomes for individuals with ASD.[179] Their model is shown in Figure 2.5.

The model Illustrates that funding and policy support, patients and families as well as providers would flow into the SYNAPSE model, afterwich accessible workforce training and outreach to relevant primary healthcare provides would need to occur.[179] The model indicates that primary healthcare providers would be responsible for comprehensive evaluation, managing psychiatric and medical comorbidities and provide comprehensive functional evaluation and care. This would link up with the models' primary domains included under the protocol implementation component. These domains include: ASD screening; comprehensive medical evaluation (including nutrition

evaluation, home evaluation); a medical specialist referral network and psychiatry referral network; as well as parenting support. This model provides an alternative concept to the ICF framework described previously and includes more specific ASD domains.[179]

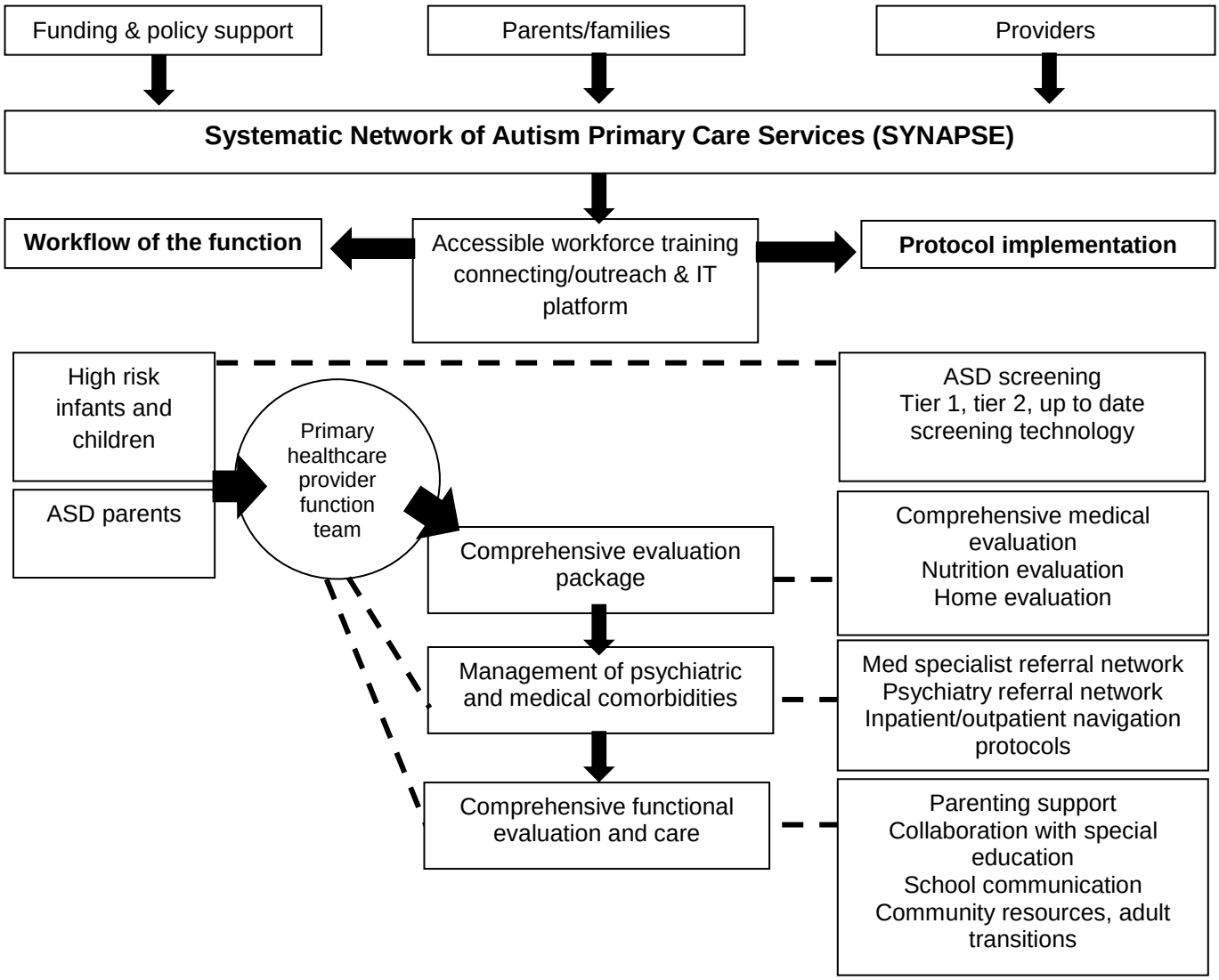


Figure 2.5:Organisation of the Systematic Network of Autism Primary Care Services (SYNAPSE) model

Green et al.[180] described a care pathway for individuals with ASD up to the age of eleven years. The care pathway comprised four components with relevant domains described under each component. Component A, Pre-diagnosis, included the domains step-wise monitoring and pre-diagnosis care; component B, Around diagnosis, included the domain family support; component C, Post diagnosis included the domain primary intervention; the last component D, Long term

support included the domains family care management, case management and step up and step down care.[180] This care pathway was developed to provide early and proactive care for children with ASD which included guided care for improving social communication, restricted interests and sensory difficulties.

There have also been programmes and models developed to guide referral and general management processes for individuals with ASD. For example, Parellada et al.[181] developed a programme named the Comprehensive Medical Programme for Autism Spectrum Disorders (AMITEA). This programme aimed to meet the needs of individuals on the spectrum in a clinical setting whereby they wanted to facilitate and coordinate provisional and differential diagnosis of the condition, integrate all necessary medical procedures, track and assist with psychiatric conditions, assist with issues experienced with activities of daily living, sleep and nutrition as well as follow-up on all therapeutic specialty needs. The organisation of their programme is presented in Figure 2.6 below. Their model included a guided pathway regarding referral from doctors in the public sector into their programme. The individual would have an evaluation, have a consequent medical and or psychiatric visit, then be referred to specific specialties asper their needs, or be referred for additional specialty tests. They would then be followed up with in the participating clinics and hospitals within their programme as part of their management.

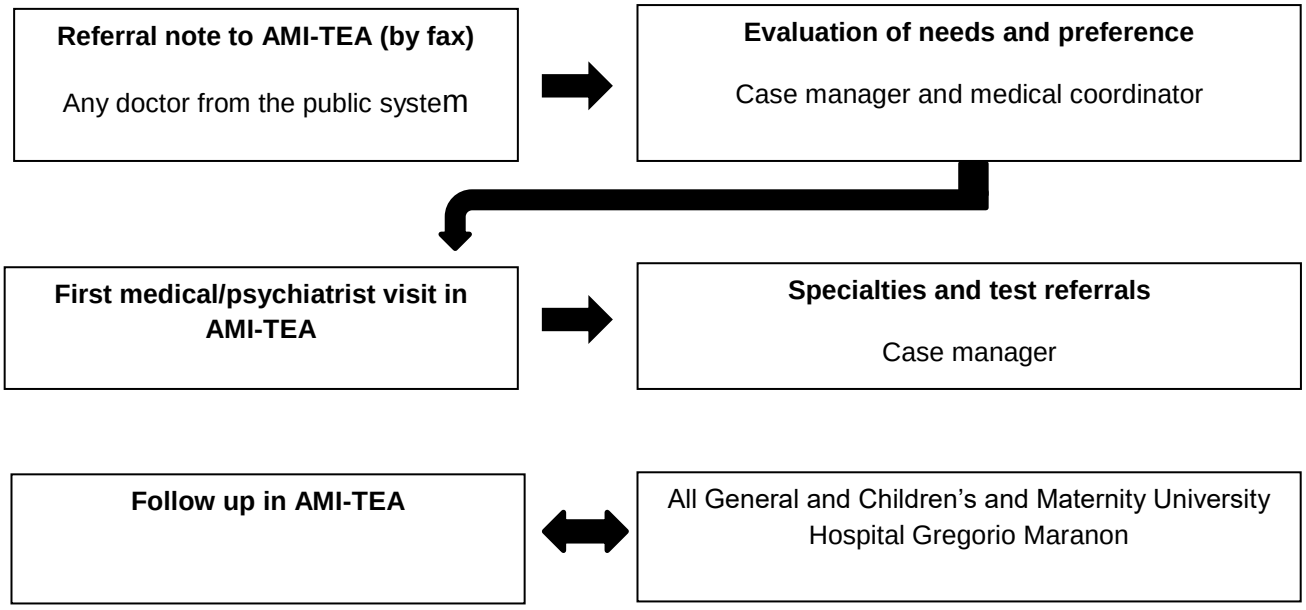


Figure 2.6:Organisation of the AMI-TEA programme

Another model developed to guide interprofessional referral and assessment and diagnosis of ASDs was developed by Koushik et al.[182] Their model was developed within a large, public

academic health care system for children aged 24 – 48 months who had low socioeconomic resources. Their overall goals were to increase diagnostic efficiency and care coordination in socioeconomically disadvantaged communities. Their model illustrated the optimal flow pathway for referal.[182] Their pathway began with a concerned medical doctor or other referral party who referred individuals with ASD to the MetroHealth Autism Assessment Clinic in Cleveland in Ohio. From there it was determined which doctor the patient would be assigned to including whether it was neurologist, or developmental pediatrician based on complex family history, behaviour issues with suspected autism or language regression. From there a work up was done including a medical evaluation, a review of intake information and a review of other assessments available. Following on it would be then be determined if a diagnosis could be given which resulted in either education or recommendations for the family with referrals for services; or the individual being referred for other evaluations. The model also included a follow up re-assessment aspect after 6 and 12 months. Their model significantly reduced time to diagnosis of ASD for young children.[182] This model is important to consider for the South African context, since socio-economically disadvantaged individuals in South Africa, may face discrimination in accessing healthcare services.[183]

The last two models described above effectively illustrate how individuals could be guided in terms of management, from diagnosis through to treatment and are examples of how the processes may need to be different in various settings. They provide valuable insight regarding how models can be effective in directing optimal referral and diagnosis and should also be considered in the development of more specific motor skill and physical activity based models.

2.3.3 Model of care Development

The development of an innovative model of care requires careful planning, generation, implementation,and evaluation and assessment of the sustainability of the new model.[184] In addition the overall goal of refining service delivery through affecting change should be the primary consideration when developing a MoC.[10] In addition, the development of a MoC should follow set guiding principles to ensure optimal efficacy of the model, and a clear methodology for design purposes.[10]

Important guiding principles as proposed by the Agency of Clinical Innovation (ACI)[10] include: 1) the new model of care be centered around the patient and their needs and that the care provided should be safe and of a good quality; 2) that the model has localised flexibility and considers

equity of access; 3) that the model supports integrated care and proficient resource utilization; 4) that the model has clearly defined outcome measures and evaluation processes; 5) that the model is innovative in service delivery and organization as well as sets the standard for future service delivery. (Appendix D)

i. Factors to consider when developing a model of care

One of the first things that need to be considered when developing a model of care for special population group is that the model needs to be based on the most current and best evidence available for that person or population.[10] In addition, any new models of care that are developed should link to current strategic plans and initiatives for that population group whether it be local, national, state or private.

Health care systems often find themselves in a balancing act between trying to provide quality care and having stringent budgets.[184] Therefore, it is imperative to factor in budgets available, do costings and determine whether any funding opportunities exist, when designing a MoC within a healthcare system.

Development of a model of care should be based on input from a multitude of resources as well as developed in association with expert multidisciplinary clinicians, managers and healthcare partners, the patients themselves, their carers or organisations that represent them as well as their community.[10] This ensures fair and equal representation and allows for maximal input form valued stakeholders.

Lastly, a model of care should be developed in such a way as to manage or consider the journey of care through different phases of the disease process or condition through a multidisciplinary setting.[10]

ii. Development process

According to the Agency of Clinical Innovation (ACI)[10] there are five key processes in MoC development with designated key tasks per stage. These are illustrated in Figure 2.7 on the next page.

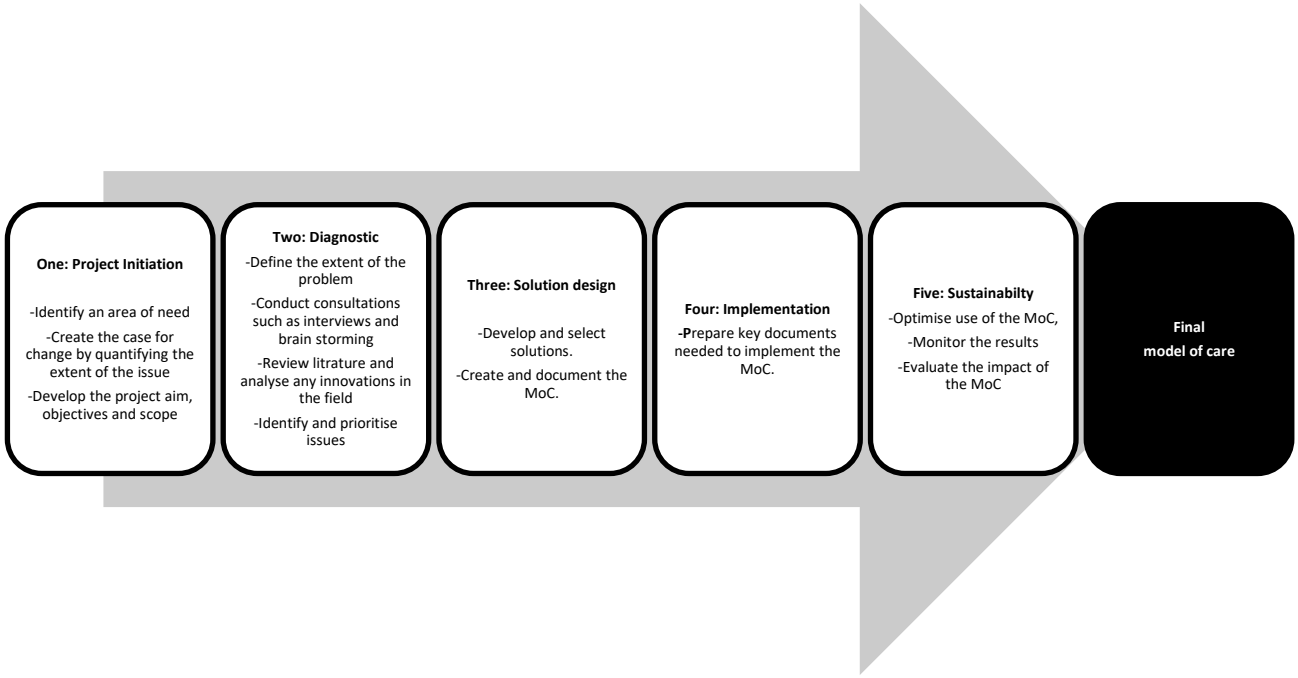


Figure 2.7 :The five key processes and tasks in model of care development (Adapted from ACI [(2)] (2013))

In summary

Models of care are important in providing frameworks for best practice and service delivery. Although treatment models for individuals on the spectrum do exist as reviewed above, at present there is no MoC focusing on motor skills and physical activity for children with ASD. This study aims to bridge this gap. In order for optimal care to ensue for individuals with ASD a novel MoC that encompasses a holistic management plan needs to be developed which includes these physical components. The development of this model should follow specific guidelines, consider various factors and follow a standard process as described above.

2.4 Conclusion

In conclusion, the above literature review provided context for this study. Firstly, autism spectrum disorder was reviewed, including epidemiology, core and other main deficits as well as current therapies used for the population. Reviewing how often motor issues are overlooked in ASD care, and how various barriers may affect early diagnosis, we see a clear need for a supportive model of care. In particular, review of motor deficits often seen within the population, general motor skill and physical activity improvement barriers as well as autism specific considerations reported in the population directly linked to the main research question which questioned what should be included in the model of care. Furthermore, the following gaps and problem areas in the literature were highlighted:

- There seems to be no standardisation of diagnostic and screening protocols for the population as well as a lack of assessment of motor skills and proficiency levels.

- The need for individualised, holistic management and intervention, was highlighted. Motor aspects such as motor skill proficiency and physical activity levels should be one of the facets of holistic management as they are integral to the functioning of the individual.

- Exercise based interventions that have been developed and conducted within the population are often lacking in comprehensiveness, may have flawed methodologies or fail to report critical information as summarised in the modified CERT assessment report.

- There is a gap in the literature in terms guiding the management and improvement of motor proficiency and physical activity levels. Future models should demonstrate clear model development and consider including implementation efficacy measures.

This study aims to bridge some of these gaps.

CHAPTER 3: METHODOLOGY

The subtopics that will be included in this chapter include:
3.1 Introduction
3.2 Study design
3.3 Site of study
3.4 Study population
3.5 Testing procedures and equipment
3.6 Ethical considerations
3.7 Statistical analysis

"Jacob's concept: The concept of Asperger's is like a flavouring added to a person and although my concentration is higher than those of others, if tested everyone would have traces of this condition too." [12]

3.1 Introduction

The research approach and design for this study are set out in this chapter. This study comprised of three phases outlined in Figure 3.1 below. The methodology per phase is discussed below:

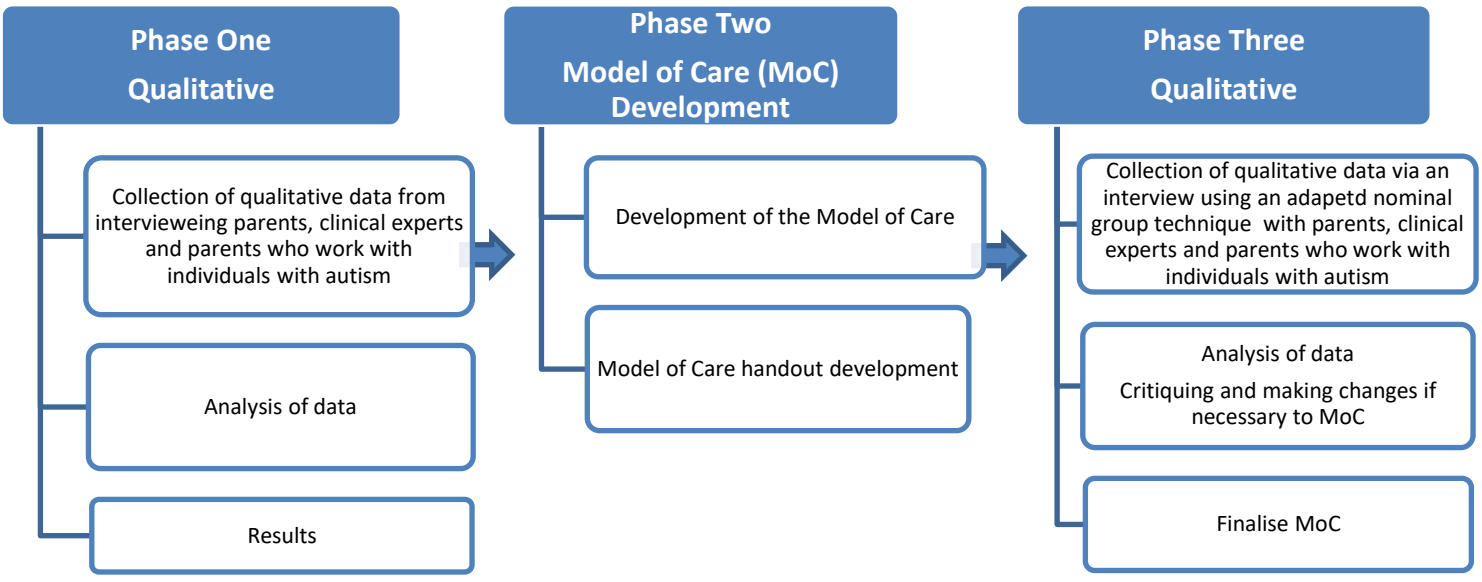


Figure 3.1:Three-phase qualitative sequential exploratory study design model

3.2 Study design for the three phases

This study is a qualitative, sequential, exploratory study.

A pragmatic research philosophy was used in the undertaking of this study, where the research question was the most important determinant of the research philosophy. Ontology (nature of enquiry) of this study was dependent on external and multiple views chosen to enable the answering of the research question.

An explorative approach was used during phase one in which teachers, parents and clinical experts were interviewed to determine what should be incorporated into a motor proficiency and physical activity targeted model of care, and if it would be of value. Since autism is a highly complex condition that affects each individual differently, a qualitative study design was chosen for phase one of this study. Qualitative interviews allowed for a deeper understanding of the distinct challenges and potential barriers these professionals face in working with children on the spectrum. This approach allowed for rich, and detailed insights that would be difficult to capture with a broader cross-sectional survey. While a survey may have allowed for data to be gathered from more participants, it would have likely missed the depth of information needed to develop a comprehensive and effective model of care tailored to the intricacies and unique aspects of ASD.

An inductive approach was used during phase two in order to develop an appropriate model of care based on information gathered in phase one. An explorative approach was used during phase three in which teachers, parents and clinical experts were invited to participate in one modified nominal group discussion to determine whether the model of care developed in phase two met expectations. Overall, therefore the study was sequential in design. This study followed the COREQ (Consolidated Criteria for Reporting Qualitative Research) checklist.[185] The COREQ checklist was developed to encourage clear and comprehensive reporting of interviews.[185] This 32 item checklist helped the researcher ensure that necessary information was collected during data collection as well as comprehensive reporting of the data was conducted . In Appendix E the completed checklist is attached, with references to where the information can be found within this thesis.

3.3 Site of study

Phase one of the study occurred at various pre-arranged interview sites, as well as virtually via Microsoft Teams and recorded WhatsApp calls (conducted from the researcher's home). The researcher conducted the interviews at a preferred location of the individual being interviewed or

virtually if so requested. Data analysis of the interviews was conducted at the Department of Exercise Science and Sports Medicine (DESSM).

Phase two of the study was completed at DESSM, where the model of care was developed using phase one data (interview responses, generated word clouds (Appendix F), field notes (Appendix G) and the researcher's reflective journal (Appendix H) and data accumulated via the literature.

Phase three of the study was completed on Microsoft Teams as per the request of the majority of the participants.

3.4 Study population

3.4.1 Sampling techniques

Phase one- Purposeful and snowball sampling:[186]

For this phase of the study, clinical experts in the field of ASD from the following disciplines: biokinetics, physiotherapy, occupational therapy, neuropsychology, psychiatry, as well as parents of children with ASD, and teachers or teaching assistants teaching children with ASD, were recruited and interviewed on motor proficiency, physical activity levels and what should be included in a model of care for the children.

The researcher obtained permission from autism specific schools to conduct research with the teachers and parents at the schools (Appendix I). The researcher approached four schools. The principal sent out the information and invitation to participate letter (Appendix J) to parents and teachers via email, for recruitment into the study. Parents and teachers who wanted to participate contacted the researcher and signed informed consent (Appendix K) prior to participating in the study. Additional parents and teachers were purposely recruited via social media platforms including Facebook (via teacher and parent support groups with permission from group admins) and the Autism South Africa website. Snowball sampling followed whereby interviewed parents and teachers recommended other parents and teachers to be interviewed. This was done by the parent or teacher asking the potential new participant if they could share details with the researcher so as not to infringe on the Protection of Personal Information Act (POPIA act). The researcher then contacted those willing to participate and set up interviews with them. Following the procedure above. They were questioned on what they wanted to include, and expected to be included in a model of care. "The teachers that were recruited in this study all taught at different schools. Three teachers were recruited from the Gauteng Province, one teacher was recruited

from the Western Cape, one teacher was recruited from Pietermaritzburg and one teacher was from Gqeberha"

The clinical experts sample was invited to be interviewed for the study via an information letter (Appendix J) that was sent out via email to each individual, as well as through WhatsApp groups. These individuals were selected according to their expertise in the field, and were found via the online web. Some expert clinicians were identified via Autism South Africa's registry of experts in the field.

In total 6 interviews were conducted with teachers, 11 with clinical experts, and 8 with parents of children with ASD, making up a total sample of 25 participants. No individuals approached refused to participate in the study and no participants dropped out of the study.

Phase two- model of care development: No individuals were recruited in this phase of the study.

Phase three- Purposeful sampling:
For this phase of the study the same sample from phase one were invited to participate in a group discussion using an adapted nominal group technique. All the participants were contacted via their preferred contact method provided in phase one and invited to join the final interview. Eleven participants agreed to participate in the final discussion, however two individuals cancelled prior to the final interview (one cited a work related commitment clash and the other had immigrated to New Zealand and was unable to participate due to time zone differences).

The final nominal group discussion included a total of 9 participants (3 individuals from each group: clinicians (n=3), teachers (n=3) and parents of children with ASD (n=3)) to represent the total group of participants included in the first phase of the study. The researcher wanted transparency across all groups to facilitate and foster multidisciplinary decision-making. The researcher's one supervisor joined the nominal group discussion as a mediator.

3.4.2 Inclusion and exclusion criteria

Phase one:

Inclusion criteria for teachers, experts and parents

i. Be a teacher or teaching assistant who works with individuals with ASD regularly(at least once a week), with at least one year of teaching experience; or

ii. Be a registered medical doctor, biokineticist, physiotherapist, neuropsychologist, psychiatrist, or occupational therapist with the Health Professionals Council of South Africa (HPCSA); and have a minimum of one year of clinical experience with children with ASD; or
iii. Be a parent with a child or adolescent with ASD

Phase two:

Inclusion/exclusion criteria

None

Phase three:

Inclusion criteria for teachers, experts and parents

i. Individuals who participated in phase one of the study.

3.5 Testing procedures & equipment

Phase one:

This phase comprised of face-to-face and virtual interviews: an interview guide with probing questions was developed for the interview process. The procedure is discussed below.

i. Developing interview questions

Following a literature review, an interview schedule with some probing questions was compiled. The interview comprised of questions that were applicable to all the parents, teachers and clinical experts; as well as questions that were more specific to each group. The final questions used for the interviews may be found in Appendix L.

The questions covered two main themes:

a) Motor proficiency in individuals with ASD

   The questions asked under this theme in the interviews assisted in gathering information on their insight and perceptions of general and motor proficiency in individuals with ASD.

b) Physical activity levels in individuals with ASD

   The questions asked under this theme in the interviews assisted in gathering information on their insight and perceptions of physical activity levels in individuals with ASD.

The researcher conducted a pilot interview with a parent of a child with ASD to address any interview question issues and to be more competent in the interview process prior to engaging with formal participants of the study. The pilot interview was included in the final analysis as the researcher felt the parent shared pertinent information that would better inform the model of care and no changes were made to the interview schedule.

ii. Data collection method

Interviews were conducted over a period of five months (starting date: 16 November 2023- End of March 2024) and then analysed. Interviews were conducted either face-to-face or via an online platform depending on the participant's preference. All COVID protocols were followed at all times (Appendix M). Interview guidelines were followed at all times,[187] while making use of guiding questions (Appendix L).

In total, eight interviews were conducted with parents of which one was face-to-face and seven were virtual. Six interviews were conducted with teachers all of which were virtual. In total, eleven interviews were conducted with experts of which two were face to face and nine were virtual. All interviews were included in the analysis. The interviews were conducted in English and facilitated by the researcher and lasted between twenty two- to sixty-two minutes.

For this study, interviews were conducted until data saturation was met. This was determined via a reflective analysis using the reflective journaling of the researcher. Throughout the study the researcher kept a reflective journal (Appendix H). This was read several times throughout the interview process and reflections were continuously documented regarding main ideas obtained by participants and whether new information or ideas were being introduced. Once no new ideas were brought up in interviews it was determined that data saturation was met. An interpreter was available on request to assist if any participant required translation services, yet there was no need for the interpreter in this study. The distress protocol was used once (see below), yet there was no need for any interviews to be repeated.

The information gathered from the interviews was audio recorded using the Otter AI App when interviews were conducted in person, and Microsoft Teams and the PC version of the Otter Ai App were used when the interviews were conducted virtually with the permission of the participants (Appendix N).

The recordings were automatically transcribed via the Otter or Microsoft teams software on the respective platforms. The Otter AI App is deemed to have a high degree of accuracy for a automated speech recognition systems.[188]The researcher also kept field notes of pertinent information observed during the sessions (Appendix G). The researcher transferred each transcription to a Microsoft word document and, while listening to the recordings corrected any errors in the automatic transcriptions. No transcripts were returned to participants for correction, supervisors checked transcripts for errors. A word cloud for each interview was created using the Otter software (Appendix F), as well as one overall word cloud for the total group of parents, teachers and clinicians. The overall group word clouds were used to assist the researcher identify key words in the transcripts for coding purposes. The recordings and transcriptions were stored digitally, as separate documents per interview and labelled clearly in a password protected laptop, and only the researcher and supervisors had access to the data.

A distress protocol was created, and was followed for one of the parents who became emotional during their interview (Appendix O). The parent did not want to be referred to the designated psychologist on standby and chose to continue with the interview after they gathered themselves and took a few minutes break.

iii. Data credibility and trustworthiness

Trustworthiness of the qualitative data collected was maintained using the following four strategies:[189]

1. Credibility was maintained by making use of hypothetical cases or reframing of the questions to help elicit more personal responses[189] furthermore, the researcher engaged in the interviews for prolonged periods of time to ensure information was consistently given and that no answers were changed due to perceived preferred responses (body language and expressions in face-to-face interviews; or positive acknowledgment in virtual instances) of the researcher.[189]
2. Transferability was maintained by considering the data rather than the subjects, whereby the researcher "determined if the content of the interviews and behaviours and observed events were typical or atypical of the lives of the informants"[189] this was based on the researcher's experience in the field.
3. Dependability was maintained by describing the exact data gathering, analysis and interpretation procedures , to ensure that the study may be optimally repeated in future.[189] Reflexivity statements are found throughout the methodology section to clarify any changes to processes or procedures to again ensure repeatability.

4. Confirmability was maintained by making use of two external auditors in the form of the researcher's supervisors. The supervisors followed through the progression of events in this study and discussed, understood, and gave feedback on why decisions were made in terms themes and categories etc. This allowed the researcher to determine if the supervisors arrived at comparable conclusions given the same data and context therefore ensuring confirmability.[189]

iv. Analysis of qualitative data into themes

Qualitative data analysis was conducted using an iterative, six-step cyclical process, which was informed by both, the researcher and her two supervisors involved in the study and is illustrated in Figure 3.2 on the next page. The six-step process was adapted from the procedures for thematic analysis outlined by Braun and Clarke (2006),[190] in which six steps are generally followed including 1.Familiarisation of the data, 2. The generation of codes, 3.Combining codes into themes 4.Reviewing themes, 5.Determining the significance of themes, and 6. Reporting of findings. The researcher adapted this analysis so that reflexivity would be essential and central in all stages of the process.

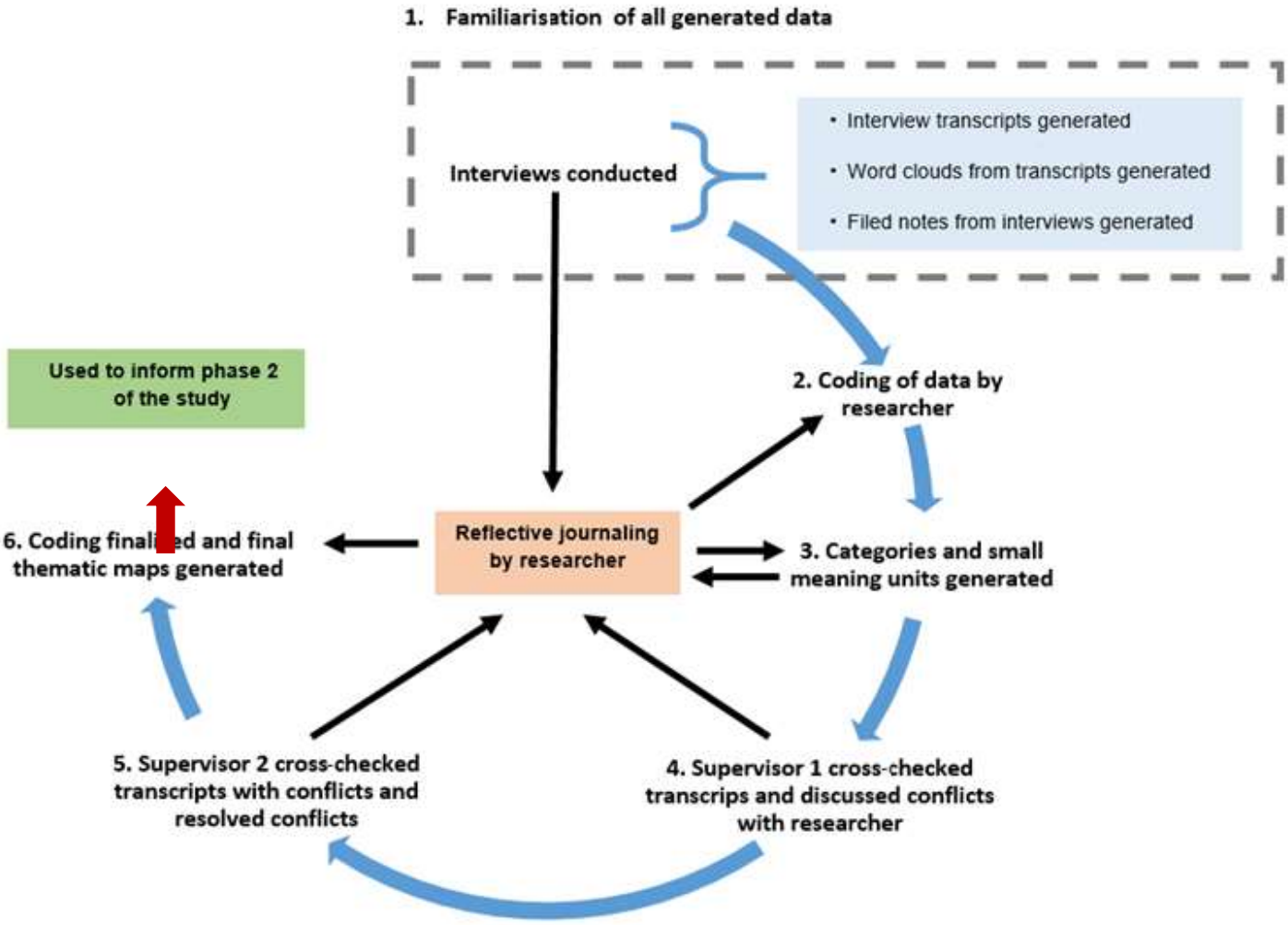


Figure 3.2 The six-step process used by the researcher for thematic analysis

In step one, following data collection via interviews, interview transcripts, word clouds generated from the transcripts, as well as field notes were read and re-read to become familiar with the data. Familiarisation was done to get an understanding of what the main perceptions and insights of the participants were regarding a motor proficiency, physical activity and what they thought should be included in a model of care. Following familiarisation the researcher reflected on the data and documented that in her reflective journal (Appendix H). Thoughts and ideas in the reflective journal were applied to step two in the process which was also used to inform data analysis.

In step two, data were loaded into Max QDA software. Each transcript was clearly labelled and kept in categories of either parent, teacher or clinician. This was done to assist in a clear organization and data interpretation per group. Data were coded and organised into main points and ideas and then reviewed by the researcher. Coding was done by assigning a label to data content. This was done for each line of the participant transcripts, and additional codes were assigned in cases where overall ideas were brought forward when sentences were combined. Following the first coding of the data, the researcher reflected on the data and documented that in her reflective journal, which was used to better inform data analysis in step three.

In step three, further data analysis was conducted in which data was further defined and divided into smaller meaning units. These meaning units were divided further and put into categories ensuring at all times that the overall ideas were not compromised. Data was then revisited and reflected upon by the researcher in her reflective journal. Following this, final changes were made to the coded transcripts.

In step four, one of researcher's supervisors checked all the transcripts to ensure correct coding of categories and meaning units. At this stage the researcher reflected upon the supervisor's input and if there where inconsistencies they were discussed with the supervisor. Again reflection was done and documented in the researcher's journal.

In step four, differences between the researcher and supervisor in terms of coding the transcripts was referred to the researcher's second supervisor to consolidate and make a final decision in terms of coding category or small meaning unit - in so doing triangulation was obtained.

In step five, the researcher took into consideration both her supervisors views regarding the coded transcripts. The researcher re-read the thematic analysis component of her reflective journal and

made all final changes to the coded data. At this point themes were identified and thematic maps were generated using Edraw mind software whereby categories were slotted under main themes and perused by the researcher and her supervisors. The themes were checked by the researcher's supervisors, and consensus was reached as to whether they truly reflected the main ideas the participants brought forth. The thematic maps generated were then used to inform step one, namely, the project initiation phase for the development of a model of care in phase two of this study.

Phase two:

This phase was comprised of the development of the model of care based on phase one data.

i. Developing a model of care

The guiding principles of developing a model of care were followed at all times to generate the MoC. (Appendix D).

Development of the MoC followed the following process illustrated in Figure 3.3, and comprised of five steps:[10] Steps one-three were completed in phase two of the study, and steps four-five were completed in phase three of the study.

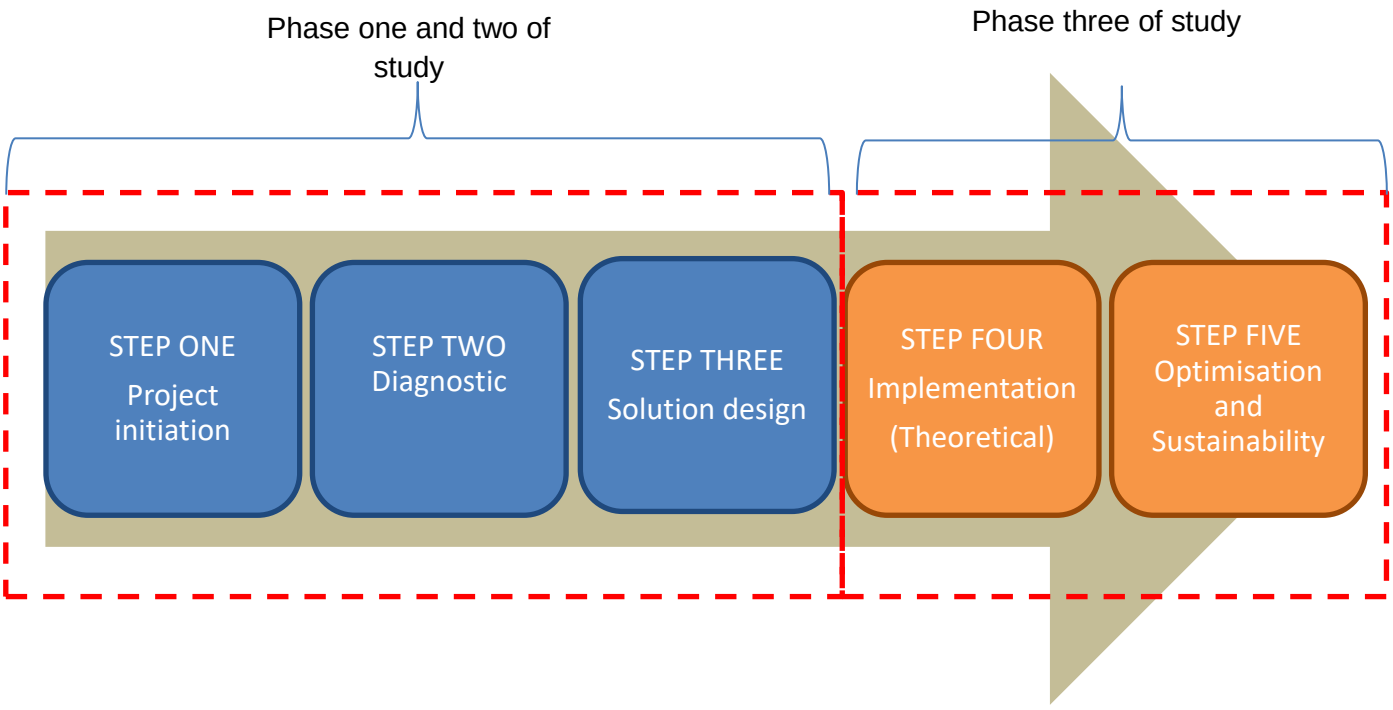


Figure 3.3: The MoC development process,[2] and which phase of this study they occurred

Step 1: Project Initiation: Following the completion of phase one, a model of care would begin to be designed. In this step of the MOC development, phase one data from the interviews that were coded using MaxQDA software were used to generate thematic maps (see below).

a) Thematic map generation

Thematic maps were generated using thematic analysis (the process is illustrated in Figure 3.2 , chapter 3). Codes and categories were documented for the teachers, clinical expert and parent groups and themes were identified for each group. Codes were grouped (in terms of similarity) and then organised in MaxQDA in ascending order of most frequently reported codes. Individual thematic maps were generated for each group with their associated codes and categories. Edraw mind software was used to visually present the thematic maps per group of participants (teachers, clinical experts and parents). The purpose of the thematic maps was to inform the next step in the process.

Step 2: Diagnostic: The extent of the problem was defined using the thematic maps created from the phase one data (interviews, field notes and reflective journaling) as well as the extensive literature review conducted for the study. The researcher then used the three thematic maps generated in step one and determined the differences and similarities across the three thematic maps. One compiled map was then generated. In addition, general models of care were researched and used to understand what a model of care should encompass. Following this process, pertinent information was added to the literature review of this study and reflections of the overall process where added to the reflective journal (Appendix H). Notes regarding the defined problem and links between the three thematic maps were documented in the reflective journal.

Step 3: Solution Design: In this step, the combined thematic map was used to identify domains to include in the MoC framework. Domains selection is documented thoroughly in the researchers reflective journal (Appendix H). The selection of an appropriate format for the model was based on information gathered during the diagnostic phase of MoC design, as well on what would be appropriate following literature review. Extensive reflection was done in this phase of the study and documented thoroughly in the researcher's reflective journal. The model was then drawn up by the researcher using diagrammatic software named Wondershare Edraw Max and discussed with her supervisors. The model was then tweaked by adding or making small amendments based on the supervisor's feedback, and finalised prior to implementation. See results section.

Step 4: Implementation (theoretical): Following the development of the model, experts were questioned (in a large group format using adapted nominal technique (phase three of study)) on whether the model had met their expectations (information obtained in phase one of the study). Specific implementation questions were asked in this phase regarding how it should be done and where the model should be distributed. This would inform the final distribution of the model once the study was complete. (See phase 3 section below).

Step 5: Optimisation and sustainability: Following the final interview, any relevant changes were made to the MoC. An appropriate handout for the model of care was designed to be distributed. The researcher, using information from the reflective journal and the final interview (specifically information regarding distribution of the model) came up with a way to optimise distribution of the MoC, and will in the future monitor the results and evaluate the impact. See results section. Following the completion of the study the MoC was sent to all participants and participating schools as a starting point of distribution.

ii. Designing an appropriate handout for the model of care to be distributed to relevant parties

A handout was designed using diagrammatic software for the newly developed model based on other models being used in the field. Information gathered from the participants regarding what they expected to be included in the MoC or accompanying material was considered and included in the handout. Following the completion of phase three. The handout was then distributed to all study participants and via Autism South Africa to inform individuals of the model once the study was complete. See results section.

Phase three:

i. Methodological reflexivity of phase three

During the data collection phase of this study a large methodological aspect of this study was discussed with the researcher's supervisors and a critical change was made. Initially phase three of the study was going to comprise of focus groups. This phase was going to be comprised of face-to-face/virtual focus groups. "Focus groups provide insights into how people think and provide a deeper understanding of the phenomena being studied".[191] Three focus groups would have been carried out – one for the parents, one for the teachers and one for the clinical experts. In the focus groups, the three samples would have provided further feedback to the researcher regarding their perceptions and knowledge of the two core themes of the study namely: motor proficiency levels and skills and physical activity levels in individuals with ASD after which the researcher would have shown the proposed model of care and led a discussion on any changes

the participants may have requested. The researcher had developed focus group guided questions yet these were adapted as the process changed.

The reason for the methodological change was due to the researcher meeting with her supervisors and bringing to their attention the concerns regarding the running of three separate focus groups. At this stage in the research process the researcher had conducted 24 interviews. Upon reflection of the already conducted interviews and by regularly reading through field notes, the researcher had noted that many of the participants had indicated that therapies/strategies to improve the management of individuals with ASD skills were often conducted in “silos” (by specific experts) with limited crosspollination of ideas between the parties involved and no holistic approach in terms of management in moving forward. At this point the researcher felt that by conducting individual focus groups for either the parents, the teacher or the clinicians this issue would further be exacerbated. The researcher’s supervisors agreed with this concern and following an in depth discussion it was advised to change strategy to address participant views.

It was agreed upon that the researcher would instead invite all the participants to one group discussion session so that parents, teachers and clinicians could all engage with each other and the researcher through a guided interview process. Furthermore, the researcher was advised to use a modified nominal group technique (in depth details of this process are found in the next section) in order to get richer data from the sample in terms of finalising the model. The reason for this was that one of the researchers supervisors suggested that conducting one large focus group in which further questioning on the two core themes of the study may prevent consolidation of the model. It was suggested that it would be more valuable to present the proposed model of care first to the large sample and then ask specific guided feedback questions to get information regarding specific changes to the model of care. The final agreed upon methodological change is illustrated in Figure 3.4 on the next page.

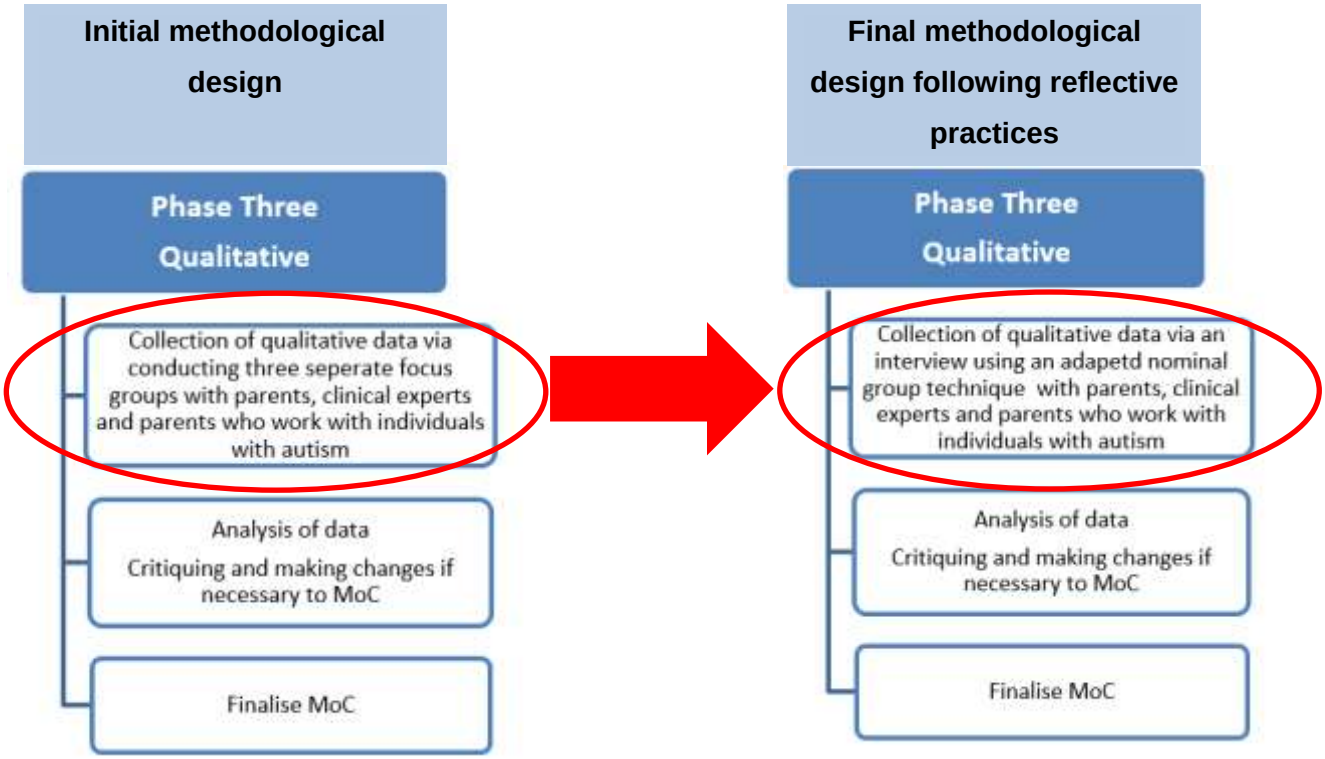


Figure 3.4: A critical change in phase three methodology due to the reflexivity processes

ii. Phase three modified nominal group technique

The nominal group discussion technique is a technique used to seek consensus amongst a group of individuals who provide ideas linking to a specific topic.[192] It has value in that every participant part of the group has an equal voice during the structured process. The nominal group technique has also been recommended as an effective and reliable data collection method, especially when undertaking research with clinical experts." [192] Traditionally the nominal group technique comprises of five steps namely: 1: Introduction, 2: Silent idea generation, 3: Idea sharing, 4: Group discussion and 5: Voting and ranking.[192]

For this study the nominal group technique was modified to follow seamlessly from previous data collected. The nominal group technique was adapted as illustrated in the Figure 3.5 (following page) along with description for each component. The main modification was that the participants were given the model of care that was generated by the researcher ahead of time so that they could reflect upon the document and provide informed feedback. In this manner silent generation would be conducted by the participants outside of the interview space and allow an extended

reflection period for them to provide in depth feedback. The modification of this nominal technique assisted in ensuring optimal flow for data generation to optimise the developed model of care. Questions were developed for the nominal group discussion and checked by the researchers supervisors prior to the group discussion. The researcher made all the suggested changes from her supervisors. The final nominal group questions can be found in Appendix P.

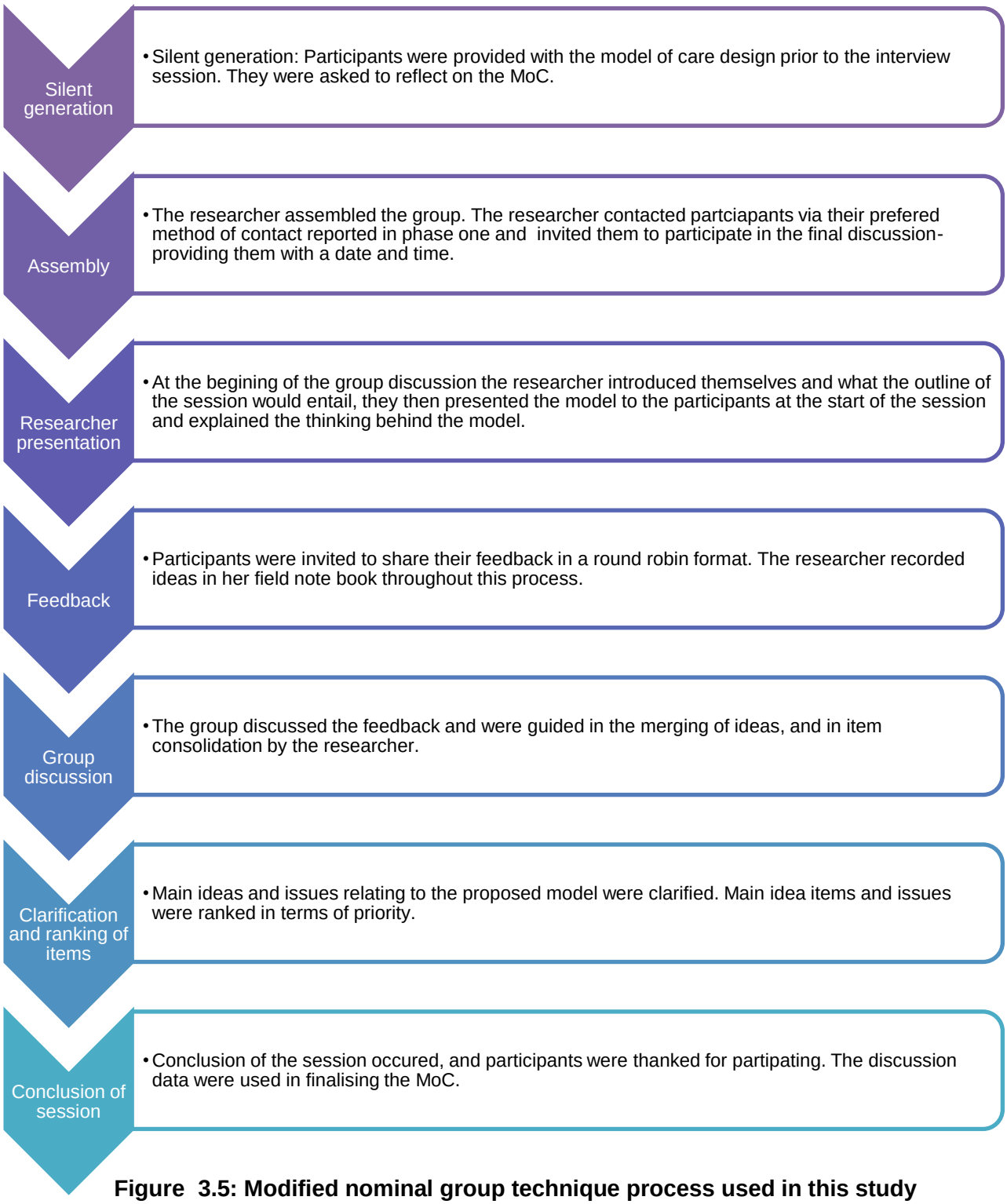


Figure 3.5: Modified nominal group technique process used in this study

i. Data collection method

For the group discussion, the researcher facilitated the group, while an assistant moderator (the researcher's supervisor (number 2)) was primarily responsible for discussion moderation and noted the order in which participants spoke. The session lasted 82 minutes. The researcher and assistant moderator followed written guidelines on how to conduct the guided interview. These included details about the role of the moderator in establishing ground rules and making the environment a safe place for group members, making the group feel at ease, and the importance of a non-judgmental stance, and the need to moderate dominant group members. In addition, to ensure consistency throughout the guided interview the researcher followed guidelines, which was developed prior to the interview. The researcher developed the guide (Appendix Q) based on a review on the literature and reflexivity activity. In the reflexivity activity, the researcher documented (in their reflective journal) essential guiding statements from other guided interviews to be included in the guide, as well as procedural statements that the researcher felt would be important in the session. The session was conducted in English, and a translator was not included in the interview as none of the participants required a translator in the previous interviews. A distress protocol was available, but did not need to be used (Appendix O).

ii. Data credibility and trustworthiness

Trustworthiness, credibility, transferability, dependability and confirmability were all maintained in the same way as described for phase one of the study and may be referred to on page 77.

iii. Analysis of qualitative interview data and final recommendation considerations

Qualitative data analysis for the nominal group was conducted using an iterative, adapted 4-step cyclical process, which was informed by the both, the researcher and her two supervisors involved in the study and is illustrated in Figure 3.6 on the next page. The four-step process was informed by the procedures for thematic analysis outlined by Braun and Clarke (2006)[190] presented previously. They formulated this four-step process so that reflexivity would be essential and central in all stages of the process.

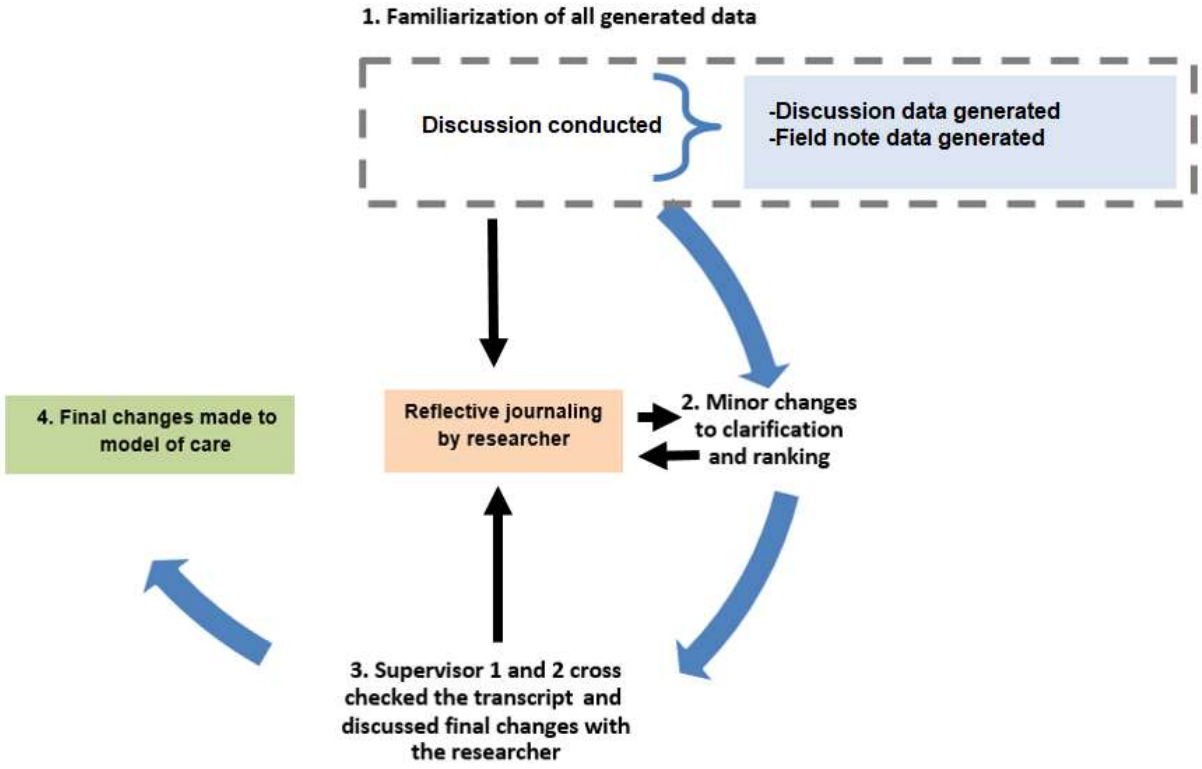


Figure 3.6: The four- step process used by the researcher for the nominal group data analysis

In step one, the transcript and field notes were read, and re-read to get an understanding of what the main perceptions and insights of the participants were regarding the model of care. Following familiarisation the researcher reflected on the data and documented that in her reflective journal (Appendix H). Thoughts and ideas in the reflective journal were applied to step two in the process which was also used to inform data analysis.

In step two , the researcher reflected upon whether the clarification and ranking of items was done appropriately in the discussion and minor changes were made in terms of the clarification of items and ranking of items from the transcript. These minor changes were all documented in researchers reflective journal.

In step three, data from the transcript was checked by both of the researchers' supervisors. The supervisors checked the items needing clarification as well as the ranked items compiled at the end of the transcript. A discussion was had regarding the final change to be made, which informed step four of the process.

In step four, final changes to the model of care were made.

3.6 Data Analysis

Demographic categorical data was analysed using frequencies and percentages, while continuous normally distributed demographic data was analysed using means, modes and standard deviations and non-normally distributed continuous demographic data was analysed using median and interquartile ranges.

For phase one and three data, the interviews and nominal group were audio recorded with the Otter AI and Microsoft Teams applications, the recordings were automatically transcribed by the software, and cross checked and corrected by the researcher. The researcher took field notes to complement the recordings. Data were then manually coded using a deductive approach by the researcher and the researchers two supervisors - this ensured standardisation – when any discrepancies occurred they were discussed, and a consensus reached. Following the generation of the codes, statements aligning to the codes were extracted and explored using an inductive approach after which categories and themes were generated via thematic analysis. In order to quantify the content, latent analysis was conducted.

3.87 Ethical Considerations

- The researcher applied for, and was granted ethical clearance from the Human Research Ethics Committee of the University of the Witwatersrand prior to commencing the study (M220241)(Appendix R).
- The researcher obtained permission from schools to interview parents and teachers (Appendix I), and the participants signed informed consent prior to participating in the study (Appendix K).
- The researcher obtained permission for audio recording of the interviews prior to recording interviews and focus groups (Appendix N).
- All the information gathered was kept safe, private and password protected, thus only the researcher and relevant supervisors had access to the findings. Data will be stored for six years if not published and for two years if published after which it will be destroyed.
- All identifying information was kept confidential by not using any identifiable information on data collection sheets, but instead using a participant coding system. The results of the interviews were only used for research purposes.
- COVID protocols were followed at all times (Appendix M).
- A distress protocol was followed (Appendix O) where participants required it.

The results of this study are presented in chapter four.

CHAPTER 4: RESULTS

The subtopics that will be included in this chapter include:

4.1 Introduction

4.2 Demographic data

4.3 Phase 1 data

4.4 Phase 2 initial model of care design

4.5 Phase 3 data

4.6 Final model design and handout

"We all know that a sky with clouds in it is much more interesting than one that doesn't have any." [12]

4.1 Introduction

Results are presented under three main sections as per the phases of the study. Each objective per phase is presented first and results follow.

4.2 Demographic data

i. Researcher and supervisor demographics

The researcher's (interviewer) personal characteristics are presented in Table 4.1 below as required by the COREQ checklist.[185] Supervisor demographics are provided in Table 4.2. A reflective statement on the positionality of the researcher is included in Appendix T.

Table 4.1: Domain 1 items of the COREQ checklist- primary researcher characteristics

No	Item	Guide questions/description	Details
Domain 1 : Research team and reflexivity			
Primary Researcher characteristics			
1	Interviewer/facilitator	Which author conducted the interview?	The researcher : Natalia Neophytou
2	Credentials	What were the researchers credentials?	MSc(Med) Biokinetics

3	Occupation	What was their occupation at the time of the study?	Lecturer and clinical Biokineticist
4	Gender	Was the researcher male or female?	Female
5	Experience and training	What experience or training did the researcher have?	The researcher had conducted interviews for previous studies prior this study. The researcher conducted pilot interviews prior to collecting formal data
Relationship with participants			
6	Relationship established	Was a relationship established prior to the study commencement?	For the majority of the participant's no relationships existed prior to the study. **Parent 1:** Family member of participant- this interview was the first interview conducted and was initially meant to be a mock interview and practice for the researcher however due to the distress protocol being used the researcher deemed it important to include in the final analysis. **Clinician 2:** Clinician had attended the same school as the researcher 17 years prior. No contact since. **Clinician 7**: Clinician in private practice who had been taught by researcher four years prior for one year. **Clinician 10:** Clinician was the psychiatrist of the researcher's one family member. Researcher had met the clinician once prior to the research. **Clinician 11:** Acquaintance of researcher, clinician worked in the building next door to the researcher
7	Participant knowledge of the interviewer	What did the participants know about the researcher?	The majority of the participants only knew information about the researcher from the information sheet that they were given.(Appendix E) Parent 1, clinician 2 and clinician 10 and 11 would have known more personal details of the researcher given the nature of the relationship as stated above.
8	Interviewer characteristics	What characteristics were reported about the interviewer/ facilitator?	None

Table 4.2: Domain 1 items of the COREQ checklist- supervisor 1 and 2 characteristics

No	Item	Guide questions/description	Details
Domain 1 : Research team and reflexivity			
Supervisor 1 Characteristics			
2	Credentials	What were the supervisors credentials?	Professor, Physiotherapist
3	Occupation	What was their occupation at the time of the study?	Personal professor
4	Gender	Was the supervisor male or female?	Female
5	Experience and training	What experience or training did the supervisor have?	Professor within the physiotherapy department, a trained physiotherapist with over 30 years' experience in rehabilitation and research across all population groups
Relationship with participants			
6	Relationship established	Was a relationship established prior to the study commencement?	No relationships existed with any of the participants prior to the study besides clinician 11. Clinician 11: A colleague that works within the multidisciplinary team at the Sports clinic next to our department.
7	Participant knowledge of the supervisor	What did the participants know about the supervisor?	The participants only knew information about the supervisor from the information sheet that they were given.(Appendix E)
8	Supervisor characteristics	What characteristics were reported about the supervisor/ facilitator?	None

Supervisor 2 Characteristics			
2	Credentials	What were the supervisors credentials?	Associate professor, Clinical exercise physiologist
3	Occupation	What was their occupation at the time of the study	Head of department of the Department of Exercise Science and Sports Medicine, Senior lecturer
4	Gender	Was the supervisor male or female?	Female
5	Experience and training	What experience or training did the supervisor have?	Associate Professor within the Department of Exercise Science and Sports Medicine, a trained clinical exercise physiologist with over 30 years' experience in physical activity intervention and management
Relationship with participants			
6	Relationship established	Was a relationship established prior to the study commencement?	No relationships existed with any of the participants prior to the study besides clinician 11. **Clinician 11:** A colleague that works within the multidisciplinary team at the Sports clinic next to our department.

7	Participant knowledge of the supervisor	What did the participants know about the supervisor	The participants only knew information about the supervisor from the information sheet that they were given (Appendix E)
8	Supervisor characteristics	What characteristics were reported about the supervisor/ facilitator?	None

ii. Participant demographics

After 25 interviews data saturation was reached. This was determined via a reflective analysis using the reflective journaling of the researcher (Appendix G). Following the completion of each interview, the interviewer would read the transcript as well as reflect on main ideas brought forth by the participant. When the researcher deemed no new information was being reported data saturation was deemed to be achieved and the interview process ceased. This was done per group of participants as information reported per group differed. Overall the mean age of the group was 43.4 ±12.9 years and the majority were female (88.0%). Total group demographics are presented in Table 4.3 below.

Table 4.3: **Demographics of total interview sample including teachers, clinical experts and teachers involved with children with ASD (n=25)**

Gender	**Frequency n (%)**
Female	22(88.0)
Male	3(12.0)
Age	**(Mean ±SD)**
Mean Age	43.4 ±12.9

Participant demographics per group, namely clinicians, parents and teachers are presented in Table 4.4 below. For the teachers, the majority of the teachers were female (88.0%), and this was the same for clinicians (91%) and parents (87.5%). The mean age of the teachers at the time of interviews was 39.5 ± 8.7 years (n=7), while the mean age of the clinicians was 39.5 ± 11.8 years(n=11), and the mean age of parents was 51.6 ± 14.3 (n=8). The teachers had mean of 8.7 ±9.2 years teaching experience, and all were from private schools (3 teachers had worked in the public sector previously, while one had previous experience in the university research setting). In the group of clinicians biokineticists made up the largest group interviewed (n=5), followed by occupational therapists (n=3). Other clinicians that were interviewed included one physiotherapist, one neuropsychologist and one psychiatrist. The mean years of clinical experience amongst the clinical expert group interviewed was 13.3 ±11.1 years. The majority of the parents included in this sample had at least one male son diagnosed with ASD, besides one parent who had two daughters with ASD and another parent who had one daughter with ASD. Overall, the total group

of parents reported having 6 male children and 3 female children amongst them. The mean age of the children with ASD (n=9) was 16 ± 9.81 years at the time of interview.

Table 4.4: Demographics of sample population (n=25)

Teachers (n=6)	
Gender	**Frequency n (%)**
Female	5(83.3)
Male	1(16.6)
Age and experience	**(Mean ±SD)**
Mean Age (years)	39.5 ±8.7
Mean Years of experience	12.9 ±9.2
Clinical experts (n=11)	
Gender	**Frequency n (%)**
Female	10(90.9)
Male	1(0.1)
Profession	**Frequency (n)**
Biokineticist	5
Occupational therapist	3
Physiotherapist	1
Neurological Psychologist	1
Psychiatrist	1
Age and experience	**(Mean ±SD)**
Mean Age (years)	39.5 ± 11.8
Mean Years of experience	13.3 ±11.1
Parents (n=8)	
Gender	**Frequency (n)**
Female	7
Male	1
Female children with autism	3
Male children with autism	6
Age	**(Mean ±SD)**
Mean age of parents (years)	51.6±14.3
Mean age of children with ASD at time of interview (years)	16±9.81

4.3 Phase one data

During phase one, interviews were conducted to determine the perceptions and insights of teachers, clinicians and parents on the current motor proficiency and physical activity levels in children with ASD and how these could be improved though a model of care. Through thematic analysis and reflexivity, themes emerged from the participants. For all three groups of participants, three main themes emerged regarding the perceptions, knowledge and insight of the participants on motor skills and physical activity levels in children with ASD. Further themes emerged when analysing the data regarding how a model of care could improve motor proficiency and physical activity levels. Different themes were found across the three groups due to differing perspectives,

however, there were overlapping themes, codes and categories amongst the three groups. Data per group are presented per objective below. A sample of verbatim quotes accompanying the themes and categories are presented under each theme. **The complete sample of verbatim quotes per theme and category per group has been included for reference purposes as well as to assist if additional clarity is needed in Appendix T.**

4.3.1 Objective 1

Objective 1: To explore the perceptions and insight of teachers on the current motor proficiency and physical activity levels in children with ASD and how these could be improved though a model of care.

Following six interviews with teachers and teaching assistants, data saturation was reached. Through thematic analysis three themes emerged regarding the perceptions, knowledge and insight of teachers and teaching assistants on motor skills and physical activity levels in children with ASD. A further two themes emerged when analysing the data regarding how a model of care could improve motor proficiency and physical activity levels, these five themes are presented below.

i. Teachers and teaching assistants perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Table 4.5 shows a summary of the codes and categories making up each theme for the teachers and teaching assistants regarding perceptions, knowledge and insight of motor skills and physical activity levels of children with ASD.

Table 4.5: A summary codes and categories per theme found for teachers and teaching assistants relating to perceptions, knowledge and insight of motor skills and physical activity levels in children with ASD.

Theme 1 : Reduced motor skills and a brain body disconnect – "their body is not their friend"	
Category	**Codes making up categories**
Specific motor skills and/or deficiency (Motor profile)	Motor profile, specific motor deficiency, variability of motor skills, motor profile,
Inadequate motor assessments	Motor assessments not appropriate, lack of assessment, motor testing not a priority
Varied but overall reduced physical activity levels	Physical activity levels, physical activity dosage, physical activity guidelines, physical activity preferences
A brain-body disconnect and motor cross-over effects	Benefits of physical activity, cross-over effects , brain-body disconnect
Theme 2 : "Barriers with physical activity "	
Category	**Codes making up categories**
Core deficits barriers	Sensory, social, connection, interaction, behaviour
General barriers	Exclusion, self-confidence, comorbidities, level of impairment, finances, resources motivation, fears, level of impairment, environment, lifestyle, culture, physical activity preferences, frequency of therapy
Theme 3 : Individual considerations: "You don't stop being Autistic"	
Category	**Codes making up categories**
Exercise based programme design for the model of care	Frequency, intensity, time, type, supervision, variability, fun, make it interesting, holistic, physical activity preferences
Other factors	Socioeconomic factors, emotional factors, interpersonal factors

Theme 1: A brain body disconnect- "Their body is not their friend"

a) Specific motor skills deficiency (Motor profile)

All of the teachers indicated that they believed children with ASD had variable levels of motor proficiency. Overall, however the teachers indicated that in general children with ASD had reduced motor proficiency levels and that they struggled with performing motor tasks. One teacher indicated that in some instances they would have to assist children in the classroom with nearly all motor related tasks and that these children required far more attention due to this. One teacher believed that individuals with ASD could also be highly proficient in sporting or physical activity tasks due to the nature of the condition being on a spectrum.

"I know it's not very good, but what can I tell you, autism kids struggle with motor skills, big and small, even with the fine, or you know, like jumping rope or something like that. I know it's difficult for them."- Teacher 1

"He does not do anything. Firstly, he struggles with his fingers. How to hold a pencil. So it means we are doing everything for him. It shouldn't, so the child needs more care. They need more attention than other kids."-Teacher 4

Teachers indicated that it's not only individuals on the spectrum that are struggling with motor proficiency deficits but rather that all children are struggling - including neurotypical children. One teacher believed that motor skill issues were not as obvious in ASD compared to other brain related disorders.

"I would have thought that, that was an apparent symptom for children who are on the spectrum but these days, even typical children are struggling in those areas."- Teacher 2

One of the teachers stated that she believed ASD was a sensory motor disability, as opposed to a cognitive behavioural disability. She also indicated that the difficulties that children experienced with their sensory motor skills could result in behavioural challenges. In contrast, one teacher believed motor deficits occurred not as a result of ASD but rather as an extension of the condition.

"For me, a lot of the behaviour is because they're struggling with their sensory and their motor cortex, not necessarily because they're behaving normally or, you know, those challenging behaviours. So that's my perception of autism"-Teacher 5

"Well as the as far as I know, autism doesn't really manifest itself in terms of mobility to the extent that you know, other, you know, brain, you know, things that affect the brain can actually cause mobility problems. It certainly can, but I think it is more by extension rather than directly that a person of autism would have movement problems."-Teacher 1

The majority of teachers indicated that they believed motor skills were important, and that they were required for optimal performance of activities of daily living (this was for both children with ASD and neurotypical children). One of the teachers strongly believed that motor skills were part of foundational skills that children needed for optimal functioning. She compared motor skills to being like a foundation of a home and that without motor skills, the house would collapse. A different teacher indicated that she believed that improving motor skills should extend to other populations too, such as children with Downs Syndrome and ADHD (Attention Hyper Deficit

Disorder) for example. Overall, teachers believed that motor skills are critical to include in the overall management of children with ASD.

"Look at like activities of daily living, how do you wash dishes, breaking that down into motor movements, that you then encourage their body in order to do it. So I think motor programmes are very, very beneficial, and important."-Teacher 5

"In autism and children in mainstream it is very important."-Teacher 6

Teachers indicated that improving mobility and motor function could improve their ability to interact with others and thus that it would be important to improve just based on the social benefit. They indicated that the more frequently children participated in motor related activities and therapies the more advanced they became compared to other children. Overall, they believed that those engaging in motor activities performed better overall in various scenarios. Teachers believed that improving motor skills would help children perform everyday tasks more competently, and that these improvements could potentially extend into their adult years.

"Improving those motor skills will help them for later on in life. You know, something as simple as tying your shoelaces doing up your buttons, brushing your teeth, brushing your hair, all of those sort of like motor planning skills can be done through physical activity strengthening."-Teacher 3

"If they are able to, you know, to be mobile to be able to participate in things that involve mobility, their overall ability to interact with the people surrounding them would be highly improved. Therefore, this is absolutely crucial to do."-Teacher 1

"If you're good at sports, sports is a way to make friends, so a way to interact. It is a way to actually be you know, incorporated into an environment, whether it be you know, your neighborhood, whether it be your school because the biggest problem with a person with autism, or the biggest struggle is interacting with people."-Teacher 1

They also indicated that engaging in physical activities was beneficial as long as they were actively engaging in them. They then reported common motor difficulties they had observed when teaching children on the spectrum. Motor difficulties reported included deficits in handgrip and manual dexterity, proprioception, motor planning, apraxia and dyspraxia, muscle tone, and gross motor skills. Overall, they indicated that children with ASD struggled to control their bodies and reported that engaging in motor activities assists in improving coordination and balance.

"I did observe that most of them came up with difficulties where they would either require to have OT for low muscle tone, or they would require to have speech therapy as well for language difficulties and the fine motor. I did also observe the fact that most of them did not have well-developed muscle tone, either the gross motor or the low muscle tone."-Teacher 2

"Yes, as I said, something as simple as holding a pencil and writing. You know, how much pressure do I put on it? Have I put enough pressure on it, how do I turn the page? How do I pick up my book? How do I sit on the chair? Do I sit on it too hard? Do I sit on it too soft? How do I get out of my chair and walk towards the door? How do I go downstairs? All of these things that you see in the school setting are part of the motor planning issues."-Teacher 3

"That child can't do anything like holding a pencil, he lacks in everything."-Teacher 4

"I think it's still hard and it's a challenge some days, and it's tricky for them to control their bodies."-Teacher 5

Teachers drew attention to the fact that in some instances individuals on the spectrum where meeting developmental milestones but that they had reduced movement quality. One of the teachers specifically mentioned that because of this, she would try to observe how children were moving and how they specifically carried out tasks, when she was working with them.

"Sure, they might be able to do it automatically, but when that instruction is given, how are they able to do? So you know, yes, they might have movement and I think a lot of the time people think all autistic children meet their developmental milestones often, but we don't look at how they're moving."-Teacher 5

The group of teachers overall believed that motor skills were not a priority in terms of treatment and management in individuals with ASD. They indicated that often cognitive, and behavioural deficits take precedence, and that academic performance is often the focus in the school setting. One of the teachers indicated that if motor proficiency was considered integral in the management of individuals with ASD that society would observe more people on the spectrum being successful in areas where having good motor skills is important. A different teacher also indicated that it may not be a priority as she believed that the understanding of motor-related deficits and motor planning difficulties is something relatively new in South Africa.

"It's something that's lacking here, you know, there is a big focus on the academics with our kids, but not really a focus on looking at motor planning, the social skills, the play skills, the executive functioning skills, the emotional regulation skills, so ya that's something that could definitely be addressed."-Teacher 3

"So again, going back to we see autism as something that you know, we are perceiving it again, as that cognitive or that behavioural difficulty. We're not looking at it from a motor perspective. So we ignore that side. We then don't focus on movements and exercise with them, and I think also because it's hard, so a lot of people kind of give up."-Teacher 5

It was believed, that in the past children who struggled with motor-related tasks (e.g. gripping a pencil), would often continue to struggle without support or help, but that they would somehow come up with mechanisms to cope and continue their leaning journey.

"You could see people holding a pencil and using that thumb wrap and it wasn't something shocking because at the end of the day, they were able to produce letters, the orientation of the letters was the same as yours who was holding it on a tripod grip. I can understand the difference between a palm grip obviously for a person who's like 15, was still holding a pencil like that and, and not using either the thumb wrap or that tripod grip but I'm just saying that we filtered through the cracks, even though we did not have the support and help."-Teacher 2

b) Inadequate motor assessments

The majority of the teachers believed motor assessments were inadequate for children on the spectrum. One teacher was of the opinion that the process of diagnosing ASD was nearly nonexistent in a South African context up to ten years ago, and that due to this, management of the condition was affected and often poor. The majority of teachers indicated that they were not aware of motor assessments being done for children with ASD, with one teacher indicating that in some instances the teachers themselves would have to have things planned to observe motor proficiency. Furthermore, one teacher indicated that he believed motor assessments were generally not being done in a normal school context and that he believed that they were not being done in South Africa overall.

"If we talk of diagnosis in South Africa, this is something that has for a long time, been virtually non-existent. So there were no official standards in terms of determining if a person is autistic or not, I think until, if not more than 10 years ago, as when they were actually ways that were, you know, put up to say

that if a child is found to be like this, then they are autistic in the South African context. So if on diagnosis, we have already been so slow, then the overall management is not going to be too good."-Teacher 1

I haven't really heard of those in your, you know, normal school context for an autism child. So I would say, yeah, in South Africa, probably not."-Teacher 1

One teacher indicated that it was generally the sensory integrated occupational therapists that she knew of that would do the motor assessments and that in general she believed it was the more the experienced occupational therapists, or those keeping up with the research that would do the assessments if they were being done. The same teacher believed that it was a relatively new area (motor assessments).

"It's more a lot of your SI trained OTs and your, your, how do I put it? Not necessarily your newer OTS, it's your more established OTS, and those with an interest in a lot of the research happening, I think they tend to do a lot more motor planning assessments, but it's still something that's quite new in South Africa."-Teacher 3

Overall, all of the teachers believed that conducting motor assessments would be important to determine the level of assistance they need when performing motor tasks as well as to identify what the individuals need in terms of rehabilitation. They also believed that assessments should be carried out to assist individuals to thrive in areas that they may be interested in as and provide information on other areas in which deficits may be present.

"In order to be able to help them, as they have needed, certainly is important. So I think an assessment, you know, gives you an idea of how much they can do without help and how much they need to do with help. So yeah, I would definitely vouch for that. You do need an assessment."-Teacher 1

"Yeah, I haven't. In fact, most of the assessment tools that I've come across are just social and mental. So they are more about whether the child is able to understand other people whether they are able to comprehend setting, you know, academic things. So yeah, I think that's something that I will also need to look into, because it's certainly an aspect that that exists, right, mobility, but yeah, I haven't really come across such assessment tools as yet."-Teacher 1

Two teachers believed that, having an assessment was related to the environment the child was in, where children who were in private schools and who had access to more qualified teachers

were potentially having regular motor assessments based on the knowledge of the importance of these skills.

"*Depends on what kind of environment you're in purely? I really think so. If you go to private schools, you would find much qualified teachers who have the knowledge of the importance of these skills and they make sure that they do frequently measure and assess them to ensure that by the time these kids are lready they build on those skills."-Teacher 2*

One teacher indicated that a screening tool would be useful, but that she didn't know which variables would need to be tested. The majority of teachers indicated that assessments they had come across were related to social and cognitive functioning and whether children were able to comprehend academic tasks. They therefore, indicated that this needed to be remedied since they believed the motor proficiency and the measurement thereof in children with ASD, would be of value.

"Yeah, I don't know, there'd obviously need to be some sort of, like screening tool. Or something. No, I couldn't, I wouldn't , there isn't a set of variables, I don't know."-Teacher 3

"Yes, it [motor assessments] would be of value."-Teacher 5

One teacher indicated that assessment equipment may be a barrier in terms of conducting assessments and that should also be considered in future. In particular, he made reference that equipment may not be available due to ASD not being prioritized by governmental agendas.

"So even that assessment equipment itself is not in abundance, because this condition, this disorder, is not one of the top agendas of government, whether its health, whether it be education."- Teacher 1

c) Varied but overall reduced physical activity levels

The majority of teachers believed that physical activity levels varied from child to child but that overall they were not meeting physical activity guidelines. They indicated that similar to neurotypical children there were children who enjoyed participating in physical activity and those who did not. They also indicated that their physical activity levels were dependent on their level of impairment on the spectrum and that participating in physical activity may be difficult for them to do.

“It depends from kid to kid, you know, the kids I've worked with over the years, we've got some incredibly physically active kids who actually enjoy sport. And then I've got some gamers, who do not like physical activity at all. But it's exactly the same as their typical peers. You know, you've got sporty active kids and you've got kids who don't like sports.”-Teacher 3

“So I think that can vary from most and I'm using this word in inverted commas, but kind of very lazy look where they start and they sit on a couch all day, right through to very, very busy where they're running and they're up and down and all over the place all day. So I think you've got a spectrum there within itself.”-Teacher 5

“Definitely not. Even the ones that are really busy or not, they're not getting, I think because it's hard for them.”-Teacher 5

One of the teachers highlighted the variability within the children where she indicated that the children she worked with seemed to be generally active, but that for some children even going to the bathroom and back would be too much for some children. The majority of the teachers indicated that physical activity should be improved in everyone, and that reduced physical activity levels were an issue across population groups, whereby they believed reduced physical activity was a societal issue not only an ASD specific issue. All the teachers, believed that physical activity doesn’t receive enough focus and that it may be perceived that it is not relevant for children on the spectrum. Furthermore, one teacher indicated that in some instances people did not provide opportunities for them to engage in physical activity due to it not being deemed relevant or important.

“I also want to start it on the general level. People are not reaching that requirement in general. Right? And I think that individuals with autism are also not reaching that, and it's not their fault. It is because the people that are responsible for taking care of them have only focused on the social aspect. So we are not giving them the opportunity, the opportunities to participate as they would want to, or as they would need to in physical activity, so they're not getting as much physical activity as they need, neither are they given the chance to do so”.-Teacher 1

“I think it can be improved in everyone. First of all, but certainly in this population, because the assumption it seems in most cases is that it is not relevant to them.”-Teacher 1

They indicated that the children had various preferences in physical activity and that there should be individual considerations when developing interventions for them. (See theme three

d) A brain body disconnect and motor cross-over effects

Three teachers indicated that children on the spectrum often had a “brain-body disconnect” where if they were given a task, often they would want to cognitively (brain) perform the task but that their body would not perform the task (disconnect).These teachers indicated that this could often contribute to them not physically being able to perform motor tasks as they often were not in control of their bodies. They also indicated that in this sense other individuals often perceived them as being naughty or disruptive or having behavioural issues as they did not do what they were being asked to do, but that often it was more a matter of them not actually being able to do the activity requested. This also extended into other areas of their lives and teachers reported numerous cross-over effects due to reduced motor skills.

“I think it just it has a lot to do with their impulse control of their body. As I said before, not being in control of their body. You know, their brain says one thing and their body does something else. A lot of Autistics, teenagers, young adults, you know they, and this is where we get a lot of our information from they're saying that, you know, my body doesn't do it, or my body's not my friend, that my body doesn't do what I want it to do.”-Teacher 5

“Most definitely, because it affects things like their sitting, and turning the pages in a book, and if you if look at the visual motor side of it- looking from a book to a screen, or a screen to a book, from the teacher to the book, there's so much; and a lot of the research in autism at the moment, especially in the states, is that mind body disconnect-so my brain says one thing and my body does something completely different. And you know, a lot of people see that as, as behaviours, but it's not, they're not always in control of their bodies.”-Teacher 3

“What a teacher might be seeing as a you know, the kid being defiant, or the kid being disturbing or the kid not being able to sit still. Maybe it's something that they just not in control of.”-Teacher 3

The majority of teachers believed that children on the spectrum often struggled with their sensory and motor context. They also indicated that often they did not intentionally behave in a strange way but rather that their body responded differently in certain environments due to them not being in control of their bodies.

“So they go out into the public and they behave differently on the outside and it's not because they're trying to be different or trying to be difficult or otherwise but it's how their body responds to the environment or whatever is going on inside them as well.”-Teacher 5

"For me, a lot of the behaviour is because they're struggling with their sensory and their motor cortex."-Teacher 5

An area in which motor proficiency was deemed to play an important role was communication. One teacher specifically delved into this, and reported that in some instances where children on the spectrum had difficulties with communication they were provided with a means to communicate, for example, teaching them sign language (Makaton). She went on to describe that in some of these instances the children were not physically able to make the signs due to their poor motor skills. Therefore, motor skills would directly compromise the children's ability to communicate with others.

"If you look at children who do not speak, they get given Makaton sign language, which is great for some children, but for a lot of our guys that motor planning and that execution of the motor skills is really hard. So they struggle then to make the signs and it's taken as a they don't understand why they can't do it. And it's not a they might not be able to do it, but it's not a case of I don't want to actually physically can't get my hand to make that sign."-Teacher 5

"A lot of guys when they get to what we call open communication and start communicating through typing have said that they have a brain body disconnect, and the way to help them is by coaching the body and getting the body to perform motor movements that aren't just automatic, but what we call purposeful movement."-Teacher 5

Three teachers reported that often academic time or learning time was reduced because teachers needed to facilitate poor perceptual or motor skills first. In some instances no academic work could be done due to needing to focus on other motor issues first. In other circumstances academic time was lost due the children needing to go for therapy due to their reduced motor skills.

"So much time is lost from a child trying to adjust because of the lack of developed perceptual skills."-Teacher 2

We didn't even look at academics. The only thing we were doing was perceptual skills, and in those perceptual skills, we had to drill all of these things that I'm talking about, making sure they go on the monkey bars, making sure they go on the jungle gym, go down the fireman's pole. Crossing the midline jump on the, on the, on the bench from right to left, right to left and right left all the way."-Teacher 2

"We spend the whole time doing that because it's needed for them to be able to sit down and start writing lines. Because if they don't have that, that strong build up core muscle, how are they going to be able to

sit on the chair, even focus? Because when you slouching on the chair, you're going to end up falling asleep and missing out."-Teacher 2

Two teachers indicated that in some instances children could not move beyond a specific grade or are held back due to reduced motor skills. One of these teachers indicated that in these instances children often got bored, and did not make any further progress – she indicated that this should be considered in future. The majority of the teachers also indicated that reduced motor skills could affect learning and concentration - for example not being able to sit due to reduced core strength could prevent focus and engagement in class. They also indicated that reduced sensory motor skills and being kept back as result of these could make the children bored and less likely to engage further in academic settings.

"And so to speak, in a lack of a better word, that in a class of 20, you could have 11 children going for OT, so even it's taking our academic time because the minute you start your lesson, the therapist is at the door."- Teacher 2

"So this child has to go out for therapy, so they losing out on the Maths hour, they losing out on the literacy hour, they losing you know what I mean?"-Teacher 2

"And then also giving more access to appropriate education and not just very basic education. A lot of our guys get, you know, stuck with grade R or grade one education and they don't get moved beyond that. So a lot of them are very, very bored, and then a better understanding of that sensory motor condition and not just autistic children are naughty."-Teacher 5

Teachers indicated that repetitive and restricted behaviour could lead to an individual not readily engaging in motor-related tasks or physical activity due to having a preference in engaging in their preferred activity.

"But when we when we look at the compulsion for certain things, because one of the things about autism is that there is, you know, this one interest that the person has, that there's this thing that they do all day, every day, and they cannot take their eyes off a certain thing for what it could be an object that they hold in their hand. For another person, it may be the colour of clothes they wear, but for whatever it may be, even movement related to the extent where they move their hand in a certain way the whole time, or their foot in in a certain way the whole time. So in cases where you need them to eat more by a certain way that can stand in the way so you can actually affect their mobility."-Teacher 1

The majority of the teachers stated that a lack of motor skills could influence independence and prevent children from doing specific vocational tasks, for example: dressing, feeding, and being able to go to the bathroom independently. They indicated due to their reduced motor proficiency levels that they required more attention and one on one assistance as well as increased facilitation in the school setting. Two teachers indicated that difficulties in performing motor tasks or being able to perform motor task may compromise the individual later on in life in terms of independence and relying on other people to do the tasks for them. Furthermore, they indicated that specific motor deficits could influence other motor skills. For example, poor balance and vestibular/sensory processing was cited as being deficits that could prevent them from riding a bicycle.

"He can't even hold the pencil, let alone teach himself, let alone open his zip, it means that, means that he is facilitated in all areas of his life?"-Teacher 4

"So firstly we will see, in what area does this child need help, whether its basic feeding himself, or in the toilets. Okay, of course we are teaching them to be independent. But these is kids they can't be independent and they depend on you, at school they depend on the teachers, at home they depend on mommy or parent or carer."-Teacher 4

"She'll find somebody who can do it, and who's that somebody who will be able to do it? It's that child that was deprived of the good education in the township, but it was exposed to these skills on an ongoing basis."- Teacher 2

Theme 2: Barriers with physical activity

a) Core deficit barriers

The majority of the teachers indicated that children struggled with ASD specific barriers such as cognitive, sensory and social barriers and other general barriers. In terms of cognitive barriers, teachers reported that although individuals on the spectrum could engage in automatic movements that cognitively if they were given specific instruction to complete movements task that they could not do them due to not understanding the instructions.

"So a lot of our guys can engage in very automatic movements such as running or jumping on a trampoline or swimming in a swimming pool. But when it comes to giving them specific instructions to complete something, or to do something, that's where the breakdown is happening."-Teacher 5

It was reported, that in a sport setting often children did not participate due to not having motor planning skills to be able to carry out specific tasks. Furthermore, teachers indicated that children struggled to perform new tasks due to lack of understanding and that this was one of the challenges they were facing. However, one teacher believed that not being able to understand tasks was a preconceived barrier based on what professionals where previously taught and that this was not necessarily the case and that it was rather a brain-body barrier as described above. In addition, one teacher also indicated that children with ASD often don't understand the emotions of others and that may be a barrier towards engaging in physical activity.

"I think again, it goes back to what professionals have previously taught, and to the understanding that we have of autism based on the dominant research in that we believe, because a child can't speak or can't move appropriately, that they don't understand when they do understand. We're learning more and more that they are understanding and they are listening and comprehending. But again, it's a body barrier, not, and not a cognitive barrier."- Teacher 5

"I think sometimes our kids in a lot of the sports, they tend not to participate in it because they're not quite sure how to do it and there goes that motor planning, like how do I kick a soccer ball? How do I hit a tennis ball? How do I hold the tennis racket?"-Teacher 3

"As soon as it's a new movement that we've got to start teaching them, that's where the difficulty is coming in."-Teacher 5

In terms of sensory barriers, the majority of the teachers believed that sensory issues may prevent individuals from engaging in physical activity and that in some instances teachers would limit engagement in certain "alerting" type activities in order to mitigate this. Importantly, one teacher highlighted that physical activity may be hurtful to the children and that it may cause them pain and so it should not be forced on the children. More specifically, one teacher stated that noise and lights could make children feel uncomfortable and may prevent them from engaging in exercise.

"It depends, you know, for a lot of my kids that I've worked with over the years, there are sensory programmes involved so some of them, you know, certain activities we tend not to try and get the child to engage in because they are too alerting." -Teacher 3

"But you know, not pushing it on certain kids because for them the physical activity might actually be hurtful." -Teacher 3

In terms of social barriers, one teacher made explained that that motor proficiency levels could dictate social standing in a school setting whereby the more proficient they were in sport the more popular they could be. Furthermore, one teacher stated that social play skills could affect participation and be a barrier in the children engaging with activity and others on the playground. While one teacher indicated that deficits in social skills could result in the individuals not being able to access community and community programmes.

"If you are good at sports, simply in a school situation, you're popular, because you're good at sports."- Teacher 1

"But again, is that because they choose not to be active or is it because they don't have the social play skills to participate on the playground?"-Teacher 3

b) General barriers

Overall, all the teachers interviewed believed that there were many barriers individuals on the spectrum experienced toward engaging in physical activity, and one teacher specifically highlighted that this was due to not understanding the condition properly, and that if it was understood as being more than just a cognitive or behavioural disability that barriers could be better understood. General barriers the teachers collectively reported were teaching settings, finances and access to resources, therapies interfering with class time, lifestyle, the condition of ASD as a whole leading to exclusion and other factors related to exclusion.

"So there's so much that that is a barrier for autistic individuals that people are not realizing, and again because we are stuck on seeing it as a cognitive or behavioural disability, and we're not looking past that."-Teacher 5

"Communication is obviously a big one, access to education, because again, people just see the behaviour and they think that that's all there is to it."- Teacher 5

Firstly, in terms of the teaching environment, teachers indicated that in a government setting where one teacher was responsible for 60 or more children that individualised attention was not often possible in terms of assisting with motor deficits or emotional support since the teachers where often overwhelmed and just trying to keep up with their own work. One teacher also indicated that it was dependent on teachers or staff whether they were actively involved in activities or not.

"Teaching in a public government school were I had 60 Something children in the class. Do I really care how you're holding your pencil? No. Do I really care if your mum and dad were fighting last night? No. Then I'm Also drowning myself. I still have to deal with marking all these 67 books and making sure that you understand the concept, and this and that, and the pressure from the department saying by this time I need to have covered 12345."-Teacher 2

In terms of the school setting itself, one teacher indicated that in some instances the type of school could limit the types of physical activities the teachers could do with the children - for instance she reported that in the smaller schools she was often able to take the children to a park or go for a walk, but that she wasn't able to do that in mainstream school settings. In another scenario she explained that she believed that children had become a product in that often activities where put together to demonstrate things for parents that were not necessarily relevant or beneficial for their development. She stated that many hours of class time were often used to put together activities to show off how well the children were doing, for example, Christmas carol concerts or "showing the best cricket match". In these instances she stated, that the activities were put together for the parents' benefit but that she felt the hours of prepping for the activity often resulted in the loss of certain skills since teachers were not able to get to them.

"So the rest of the time, we were able to sort of go for a walk. We were able to go to parks but that is something that cannot be done in a mainstream school."- Teacher 2

"The whole environment becomes a business and you're selling a product by the third term or the fourth term, you've got to make the best show for Christmas carols, you've got to do the best show because the parents are gonna look up to that and that, and they're wanting to see their child in that."-Teacher 2

"In the end, that's actually not relevant to the development whatsoever, but it's like, it's to show the parents, like you say it's like the end product with the main experience."-Teacher 2

"We are sitting with children who are losing so much skills that we ourselves also say are very valuable skills, but then we take too much time focusing on irrelevant, yeah, yeah, yeah, yeah."- Teacher 2

The majority of the teachers reported that one of the biggest barriers for children not being able to improve their motor skills or engage in physical activity, was the cost or financial aspect that these would entail. They indicated that often parents were not able to afford therapies like

occupational therapy and often families would be reliant on the Red Cross for assistance. In these cases parents where often on waiting lists or only had access to minimal resources as provided by the Red Cross or other bodies. Three teachers reported that some schools did not have therapists as part of the school and that when it was advised that children needed occupational therapy, for example, that parents were not able to afford it. They also indicated that the types of schools and their offerings could also be a barrier for the children in that township schools perhaps only offered one type of extra mural activity while private schools offered many more so the children had more exposure to motor-related opportunities.

"It depends on all sorts, other kids are getting enough help-OT speech therapists because they have money or they can afford it ,while other kids cant. Like other kids are ,they're depending on Red Cross. And to get the Red Cross, an appointment, they must go each week-we're so dependent on each families."- Teacher 4.

"I barely afford the school fees, but my child needs OT. Then what? I want my child to be here, because I know it's a bright future for my child."-Teacher 2

"So it comes down to being able to get the resources and also their finances."-Teacher 4

"I can't afford it because I've got to pay what 400- 500 Rand for 30 minutes. I don't have?- twice a week? That's 1000 Rand a week. I don't have it."-Teacher 2

"And, and the fact that if you're not in a Township School, you only may be just exposed to athletics, right? And because there's no resources and if you're in your private school, you are exposed to cricket, hockey, ballet, gymnastics, but extra still, parents have to pay extra for those things, and it becomes sort of a financial issue as well."- Teacher 2

In these instances the teachers reported that there could still be financial implications if the children wanted to participate (since some activities were outsourced) in other activities that the schools did not offer and often this prevented them from participating since parents were not able to afford this.

"Over and above that. Every afternoon. There's a company that comes in, which is outsourced. If you want your child to do more cricket, you've got to pay for that. If you want your child to do that, or, you've got to pay for that, if you want your child to do karate, you've got to pay for that. You know what I mean?"-Teacher 2

Following on, teachers also indicated that a lack of access to resources was also a barrier for the children. Teachers believed that those not getting any professional help with regards to having access to doctors, nurses or appropriate education could hinder their progress. One teacher indicated that she had seen the big gap between the children's development between those who had access and were regularly getting the therapies they needed as compared to those who were "just living and growing". One teacher also indicated that physical resources needed in the classroom or teaching were also a problem – she indicated that having access to more resources could assist the teachers with carrying out better classroom activities and assist with teaching the children in a more visual manner.

"So just with after the challenges the child is just living normal lives, not getting any professional help, and we see when they grow there is a big difference, a big gap."- Teacher 4

"The other kids, you will see other kids will never see OT in his whole life. He never see a speech therapist. It's mean is just living and growing."- Teacher 4

"I will say resources, yes like the most important things- they learn through resources, through stuff through numbers, letters, puzzles, so if needed, really, they are more about visions, particularly they're more about visions."- Teacher 4

On the other hand two teachers indicated that overly frequent amounts of therapy could also hinder the children's academic performance whereby a child needing to go for OT five times in a week in a school setting, would mean five hours of academic time was lost. They also indicated that often this was very disruptive to teaching.

"The frequency of teaching them. Yeah, I've never heard of a child going to OT 5 days a week."-Teacher 2

"It's taking our academic time because the minute you start your lesson, the therapist is at the door."- Teacher 2

Teachers believed that lifestyle was a large barrier towards children being motor proficient or participating in enough physical activity. One of the issues teachers mentioned was that often there was no reinforcement of improving motor skills when the children went home. They indicated that in the past engaging in basic tasks and playing with others allowed for motor skills to be practiced incidentally, but since children where no longer participating in these activities that motor skills now needed to be taught. Teachers believed that there was a contrast between children

who had high and low socioeconomic status. One teacher specifically believed that children with a higher socio economic status and who lived in urbanised areas often were encouraged and often enabled to be sedentary where they were made to sit in front of the television or iPad and motor-related tasks like making food, carrying plates or running a bath was all done for them. The teacher also indicated that by performing tasks for the children they were slowly losing their ability to be independent. She believed, that in contrast the children in the townships were playing on the streets and performing tasks of daily activity that assisted in improving their motor skills (e.g. washing socks) since they were practicing them more often.

"So I'm talking about when they go home, they aren't involved in any activities that will facilitate what they are learning to use those fine motor muscles to use those crossovers with gross motor muscles. They go home they sit down, the plate is put in front of them and the water is run for them and this and that, you go back into the township, the very same children very same age group. You see them on the streets, running around, playing hopscotch, playing these, climbing trees, playing with the you know that game you play with the wheel where you put one foot on the side and the other one or the side , isn't that bilateral integration?"-Teacher 2

"There's no other way, there was a sense of independence, right? We were teaching them like you say to wash their own socks. Where now everything is done for them. So there is no need to do that but in not learning that they're losing their independence."-Teacher 2

"So the only way now that they would learn them is by being taught. We learnt them because you had to come back home and wash your socks. You've got to apply soap on a sock. You've got to, you've got to rub the sock in between your hands. You know, that's a skill, that's teaching and using your muscles."-Teacher 2

Overall, teachers believed that in general lifestyle was not supporting development. Examples including not being able to play outside due to safety concerns or neighbours complaining as children were too loud , being driven to school versus walking, and not doing chores (hanging washing, polishing shoes, going to the shop) were examples provided by the teachers supporting this idea. Teachers also mentioned that culture could be a significant barrier for children with ASD. They indicated that because a large portion of people in South Africa believe in traditional medicine and witchcraft that often this would skew how parents and others perceived the children. One teacher specifically mentioned that in some cases because there was a belief in witchcraft that often parents didn't believe that their children had autism

"*People believe too much in witchcraft. So with most parents, it's like they don't actually believe in autism"-Teacher 6*

"This is the lifestyle that we are living. I personally cannot send my child to go and play the tire on the streets. I can't, safety doesn't allow the kind of environment where I live."-Teacher 2

One teacher also indicated that she no longer observed children on the playground playing traditional games that required motor skills and thus these skills were not being facilitated in those scenarios either.

"Even at play time, the games that are being played at play time, like when I was at school during play time, the games we used to play with so many different games, even those traditional games are lost."-Teacher 2

Teachers indicated that not practicing motor skills due to these lifestyle issues often meant that motor skills needed to be practiced in the school setting which resulted in other issues.

"Because I keep going back to the fact that we can't change the era, we can't change the times that we live in, we can't change the environments that we stay in, that we reside in. So now, most of the time, that has to be utilised unfortunately it is at school."-Teacher 2

One teacher indicated that another barrier for children may be the condition of ASD itself, where it was important that children should not be limited by their level of impairment, but rather should be encouraged to engage with others and activities as much as possible, and that there should not be a preconceived idea that they should be limited due to their impairments.

"Then you have these kids, they are getting teaching, they're learning, there playing with other kids, it's very important. So not to be limited the level themselves [limited by their own level]. I mean, that the spectrum they find themselves in."-Teacher 4

Teachers reported that another barrier was exclusion, whereby individuals on the spectrum are often excluded from participating in activities because if their condition, which in turn does not facilitate the improvement of motor skill proficiency. One teacher was of the opinion that that in general in South Africa, policy and practice were not inclusive of students with disabilities which includes individuals on the spectrum.

"So when we talk about the inclusion of students with disabilities, it's not common in terms of policy in South Africa, it's not common in terms of you know, practice itself."-Teacher 1

One teacher also believed that the motor proficiency of the individual could lead to them being excluded from engaging in sports and the individual not being interested in sport itself.

"And the first thing that comes to mind for me is sports. Right? Because if the proficiency of a person to move is compromised, so there are certain sports that they cannot be involved in now, if they have an interest that's going to actually limit them so I would say that yes, we definitely need to up our game in that respect."-Teacher 1

It was believed that often in instances where an individual was not interested in engaging in a specific sport, that no accommodation was made for them to have an opportunity to engage in a different activity.

Theme 3: Individual considerations - "You don't stop being autistic"

The teachers believed that there were many individual considerations that should be considered for implementing a model of care for improving motor proficiency and physical activity levels. Overall, they believed that considering implementation throughout an individual's life was imperative, since people on the spectrum "don't stop being autistic", and that implementation should be holistic and should facilitate support and the need for assistance at all times. One teacher believed that although children needed to meet certain goals there were numerous factors that teachers and other therapists were not considering.

a) Exercise based programme design for the model of care

Teachers reported that the following things should be considered in terms of exercise programmes or interventions: being variable and flexible; frequency; intensity; time and type; supervision and instruction needed to guide the programme; making it fun and interesting; and implementing it as part of the children's routine. They also believed it was important to consider the level of impairment, physical activity preferences, motivation and lifestyle of the individual. Teachers believed considering the environments, socioeconomic status of the family as well as facilitating the understanding rationale behind the intervention or programme would be important to consider.

"Yeah, you don't, you don't stop being autistic. So because you don't stop being autistic, then you have to be able to receive the assistance that you need at every time that you are autistic, which is all the time. So, yeah, it needs to be a holistic approach and certainly one that spans the whole lifespan of a person."- Teacher 1

"They need the aid almost every time of the lives."-Teacher 4

In terms of variability teachers indicated that developing individualised programmes that were tailored to the needs of the individual needed to be considered. They indicated accommodating specific dislikes and likes as well as considering levels of impairment was necessary. They indicated that the model needed to be adaptable due to the high variability between individuals on the spectrum. They indicated that things like emotional understanding, proprioceptive and interceptive ability, social skills, egocentricity, being verbal or non-verbal, as well as other impairments would need to be considered. At the same time teachers believed that although these deficits needed to be considered that those implementing the programmes should be careful not to limit the individuals based on their impairments.

"So I think again, that depends very much on each individual. You know, I think some kids are going to need more intensive physical programmes versus others who won't need as intensive stuff depending on them as an individual."- Teacher 5

"My concern would be, is how adaptable could the model be right? Because we're talking about autism which is a disorder that is very dynamic, right?"- Teacher 1

In terms of an exercise-based programme or intervention, teachers indicated types of activities needed to be considered, for example, whether exercise should be used to calm the individual or get their heart rate up. They believed considering how the programme should be taught in terms of learning style would be important as they indicated that children were not only visual learners but also auditory and kinesthetic learners. They reported that type of movement should be considered where by individuals should identify whether they are able to do automatic moments versus purposeful movements and if assistance would be needed in performing those activities. One teacher indicated that ASD should be considered in terms of sensory and motor aspects as well as implementing programmes to include the performance of daily activities, so that they can be more independent. In terms of frequency teachers believed that engagement in physical activities was not enough and that this needed to be considered in terms of implementation, since those engaging in more activity developed better. One teacher stated that effectiveness needed

to be considered since improving frequency did not necessarily automatically mean it would be effective.

"So if you think of something like swinging, swinging is quite a calming activity. So that would then go against what they say because it's, you know, it's not really a get that heartbeat up, it's more a get that heartbeat down."-Teacher 3

"I think for me, one of the biggest areas is looking at what is automatic movement versus what is intentional or purposeful movement."-Teacher 5

"I think you could look at activities of daily living because a lot of them, because a lot of them struggle with that, and even though we are giving access to communication, if you can't do those basic activities of daily living, then you're not going to be independent".-Teacher 5

Teachers stated that physical activity programmes should be integrated as part of the children's routine or part of their after mural school activities.

"Oh, yeah, no, it should be should be part of their daily programme."-Teacher 5

Teachers reported that considering individual activity preferences would be very important. They also believed that considering sensory barriers could influence their preferences and that this needed to be considered. Once again they indicated that the model should facilitate variability within the children's preferences. They also reported that resource availability to accommodate preferences needed to be considered. Overall, teachers provided some information on what they had observed children to enjoy and also what they seemed to dislike. In terms of likes they reported children enjoyed automatic activities, indoor activities , dancing, hoola hooping, jumping, trampoline, cycling, running, swimming and sliding. In terms of dislikes they reported contact body sports, activities that required a lot of mobility and activities that activated their sensory triggers as activities the children didn't want to engage in. Overall however, these likes and dislikes were child dependent.

"When the motor gets slightly harder, so for example, riding a bike, that's where I think the breakdown comes in and they don't enjoy it so much because it's harder to do. So when it's an easy action. Then it's enjoyable."- Teacher 5

"Contact, body contacts. They hate Body contact."-Teacher 4

"If it's enjoyment, kind of the very automatic stuff. So like dancing when they can start jumping and then just continue jumping. That's a big one. For some of them, it's raining or spinning. A lot of them really, really seem to enjoy swimming. And I think that's a sensory aspect to, to that one."-Teacher 5

Overall teachers believed that children on the spectrum needed a lot more attention than other children and that therefore, supervision needed to be considered. They also believed that they required more instructions since they sometimes struggled to understand instructions. They indicated that repeating instructions and allowing for more practice time would assist individuals complete tasks. Lastly, they believed that supervision should entail observing quality of the movements they are performing and not just whether they are meeting milestones. They reported environment and setting should be considered, for example, avoiding noise and bright lights.

"So a lot of our guys can engage in very automatic movements such as running or jumping on a trampoline or swimming in a swimming pool. But when it comes to giving them specific instructions to complete something, or to do something, that's where the breakdown is happening."-Teacher 5

Overall, teachers indicted that strategies, interventions and programmes should strive to make exercising and engaging in physical activity fun and interesting, and that programmes should not be long and drawn out as it may reduce interest and motivation. One teacher believed that because trying to get children to exercise is difficult that often people give up and that motivating these people would be important to consider.

"So to make it more interesting, we used to keep it short in [name of school].We used to keep it short and it tend to work for them because if it's too long, it will be bored, and lose interest easily on that. We need to make it fun but short."-Teacher 4

Teachers believed that the programme or intervention would need to consider breaking down movements and trying to get children to understand how to carry out movements instead of just being prescriptive in terms of telling them what to do.

"Looking at kind of coaching them through something, so it's not just about telling them, but about coaching them through like how to complete a task, how to complete a worksheet, especially if you're looking at things like you know, the sciences with the experiments, or the PE classes or the playground or anything like that. The kids would need help on how to motor their way through those activities."-Teacher 3

b) Other factors

In terms of socio economic, emotional and interpersonal factors, teachers believed that all areas of the child's context should be considered, as well as other general life stressors, for example, moving house, family breakups or deaths in the family since those could interfere with the ability to cope with certain daily tasks. Teachers believed that in these instances that having realistic expectations of the child's ability to cope and engage with certain activities is needed.

"I think also with the era that we've just come from and going back again to the lifestyle where there's lots of break up in families and movement happening quite frequently changed basically, I really think that we are expecting too much out of these children when they have to deal with a lot of emotional aspects as well. Things that we don't take note of, you know, when it is said that the three most traumatic things in life are death, divorce and moving. How often as parents do we move from one place to another and we just feel like our kids are just gonna cope with it."-Teacher 2

Teachers believed that an important consideration was that interventions, therapies or programmes needed to be carried out in a holistic manner, in a multidisciplinary way where regular feedback was exchanged on how the child was doing ad where they were in terms of progress. One teacher believed that there seemed to be a division of responsibilities and that often deficits were overlooked because of this.

"Another thing also on the management aspect is that they there seems to be division of responsibilities to the person with autism in South Africa, rather than a collaboration of efforts. So if the problem has to do with anxiety in a school situation, you send the child to the school psychologist, and the school psychologist will deal with the child alone, right?- Teacher 1

"Imagine the impact that can have if different professionals, the teacher, the psychologist, occupational therapist, and psychologist, I actually included in the model of care, then certainly that will benefit the person with autism"-Teacher 1

"So other professionals that are actually you know, relevant in the life of this person with autism needs to brought into the knowledge of, you know, where this person is, how they function and how they can actually help them."- Teacher 1

"Anything to do with, you know, physical activity. Of course, you're going to send the child to the PE teacher, but it seems that there isn't a proper collaboration to say, Okay, I'm an OT. You are a psychologist. You are a PE teacher. What can we do together? But it's rather than, Okay, me as a PE

teacher, I have failed to help this child. I'm going to pass them over to the next person, which is a psychologist and then after that, they can go to the OT. There isn't really any form of engagement where they all are present and all are working together."- Teacher 1

ii. Teachers knowledge, perception and insight into how motor proficiency and physical activity levels can be improved

Table 4.6 shows a summary of the codes and categories making up each theme for the teachers and teaching assistants regarding knowledge, perception and insight into how motor proficiency and physical activity levels can be improved. Teachers indicated that besides considering the barriers towards physical activity as well as individual considerations, there is a need for increased education and awareness as well as a review of the curriculum in schools and possibly at universities.

Table 4.6 A summary codes and categories per theme found for teachers and teaching assistants relating to perceptions, knowledge and insight of how to improve the motor skills and physical activity levels in children with ASD.

Theme 4 : Education and training: "We need experts"	
Category	**Codes making up categories**
Lack of education and awareness	Lack of education , lack of awareness, stakeholders, improved understanding of the condition
A need for experts	Teacher training, university training
Theme 5 : A curriculum disconnect: disconnecting child and teacher needs	
Category	**Codes making up categories**
Curriculum changes are needed	Curriculum change, child product, exclusion, curriculum not meeting needs , policy changes

Theme 4: Education and training: "We need experts"

The majority of teachers believed that there was a need for improved education regarding ASD, as well as improved education regarding the benefits of physical activity and the need for having good motor proficiency levels. Teachers believed that in general people have a limited understanding of autism and that even though understanding the condition had improved there is still a lot of education that is needed. Teachers believed that professionals often held outdated understandings based on their prior education or misconceptions.

"So I think our understanding is still very limited in autism. I think we've come a hell of a long way from even three years ago, but I do think our understanding is still very limited."- Teacher 5

"The informing processes is quite important, I would say."-Teacher 1

One teacher also indicated that previously treatments and strategies were often based on theory or people's perceptions, however recently more advocacy and information was coming from individuals on the spectrum regarding motor planning. She stated that more information needs to be gathered from people on the spectrum since they were the experts on autism and that educating individuals on the spectrum was also important.

"I tend to seek the guidance of my autistic teenagers, my autistic adults. Especially when I'm working with the younger kids, I asked them, you know, what was it like for you? And how do you think I should do this? So using, they're experts on autism, so using them, and I think before, there wasn't, and I saw, I think autism when you look at education it's still a new thing. Education for autistic individuals is still a new thing."-Teacher 3

Teachers indicated that they believed educating parents specifically on being able to involve their children in the appropriate level of physical activity was important. It was believed that the model needed to change the perspective of only having interventions as an additional strategy but rather re-educating on the idea of integrating motor skills and reinforcing them on a day to day basis instead.

"I think parental involvement is something that I think would actually be quite helpful to the model of care because what you see is that, you know, most of the time, parents are detached from the process of education, educating their child with autism, and certainly even you know, in their training in physical activity, where in most cases in the parents mind, it's just okay."-Teacher 1

Teachers indicated that a lack of understanding of the condition could limit the progress of children in that they could be excluded from activities due preconceived barriers. Teachers believed that there was a need for further research to advance the knowledge and understanding of autism so that when deficits where observed that individuals could seek out appropriate therapies or assistance to improve their lives.

"So realising that in the South African context is, you know, neurodevelopmental disabilities, is very, very much not known by your average South African, right?"- Teacher 1

" But what you can do for yourself as a researcher, and other researchers as well, is to make sure that the knowledge gets advanced. I think that's the best thing that you know, would actually set the ground for the development of a model at all that we need to make sure that as many people as possible know about autism spectrum disorder, so that they can be able to see the symptoms and then when they do they can be able to seek help."- Teacher 1

In terms of training, teachers believed that there was a need to improve training for individuals to work with children on the spectrum. One teacher indicated that in some instances implementation of programmes was based on trial and error due to lack of training or information access. Another teacher indicated that she had improved her skills due to collaborating with other professionals as well as individuals on the spectrum and that she didn't have any training on special need's individuals when she was training to be a teacher.

"So basically, that's something I've just learnt on the job and learning with my in collaboration with OTs and other professionals and also from the Autistics themselves. If I think about my teacher training way back, we didn't even do special needs in my teacher training."-Teacher 3

They believed improved training was necessary as individuals on the spectrum were not only in remedial schools, but that there were many in mainstream schools and teachers found it difficult to assist them due to a lack of training.

"Definitely, because if you look at the incidence of kids on the spectrum, you know, they're not just in our special schools, our specific learning difficulty schools or our remedial schools, they're in our mainstream schools, and those teachers find these kids are the hardest because they've got no background on ASD at all. So ya, there definitely has to be a lot more in teacher training."-Teacher 3

One teacher believed that training should include training on how to assist individuals who are struggling with specific deficits (e.g. speech, motor , auditory processing), so that they could assist them at a basic level in a classroom setting instead of being dependent on other professionals.

"Also get a training of when you come across a child who's struggling with speech, what do you do auditory processing, what do you do? Fine Motor Skills? What exactly do you do like a module? That's giving the basic meaning of what they could apply in class."-Teacher 2

"It's an inclusive system, where "special" schools are going to end up being phased out or reduced, as it is put, so it is important to make sure that teacher training itself, we raise and we raise awareness on teachers themselves."- Teacher 1

"So there are different stakeholders, but the first and I think the most effective would be the universities, why universities? Because universities train teachers, right? So whatever you know, level, that teacher is gonna go to whatever school they're gonna go to, wherever they learnt at university comes in handy, right?"- Teacher 1

Theme 5 : A curriculum disconnect: disconnecting child and teacher needs

Overall, teachers believed that the teaching curriculum does not always meet the needs of the children and in some instances does not meet the needs of the teachers. Teachers believed that there was need for curriculum review, specifically in terms of integrating more motor-related activities into the curriculum. Teachers believed that therapies and interventions should be integrated in the curriculum as opposed to than being done in isolation – in that way costs would be reduced for parents and children would have greater access to the therapies they may need. It was also stated that reviewing access to specific sports could assist in children being able to learn more incidental skills.

"Why can't these people [therapists] be integrated into the curriculum? So that's a standard sort of practice."-Teacher 2

They believed that in reviewing the curriculum to meet the needs of the children there would not be instances where children are being prevented from progressing through grades based on general curriculum rules.

"I think we need to really consider communication access which we don't. So a lot of our schools forget about the communication side, which is a human right. I think there needs to be a better holistic view of autistic education."-Teacher 5

"Maybe what is needed is for these parents, I mean, is for is for these therapists, if they do happen in a school, they need to be integrated into the classroom for everyone's benefit."-Teacher 2

"And then also giving more access to appropriate education and not just very basic education. A lot of our guys get, you know, stuck with grade R or grade one education and they don't get moved beyond that. So a lot of them are very, very bored and then a better understanding of that sensory motor condition and not just autistic children are naughty."-Teacher 5

4.3.2 Objective 2

Objective 2: To explore the perceptions and insight of clinical experts on the current motor proficiency and physical activity levels in children with ASD and how these could be improved though a model of care.

Following 11 interviews with clinical experts, data saturation was reached. Through thematic analysis three themes emerged regarding the perceptions, knowledge and insight of clinical experts on motor skills and physical activity levels in children with ASD. A further three themes emerged when analysing the data regarding how a model of care could improve motor proficiency and physical activity levels, these six themes are presented below.

i. Clinician perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Table 4.7 below shows a summary of the most common codes per theme found for clinicians in the data relating to clinician perceptions, knowledge and insight of motor skills and physical activity levels of codes identified in the data. Each theme with the most frequently reported categories is presented below.

Table 4.7:A summary of the most common categories per theme found for clinicians (n=11) in the data relating to perceptions, knowledge and insight of motor skills and physical activity levels.

Theme 1 : A spectrum of motor proficiency and physical activity	
Category	**Codes making up categories**
Specific motor skills and/or deficiency (Motor profile), reduced PA levels, benefits and reported cross over effect of motor skills	Physical activity levels, physical activity dosage, physical activity guidelines, motor profile, specific deficiency
Theme 2 : Barriers to exercise and challenges in implementing exercise	
Category	**Codes making up categories**
Core deficits and daily struggles	Sensory , social, connection, interaction
General barriers and challenges	Exclusion, self-confidence, comorbidities, level of impairment, finances, motivation, fears
Theme 3 : Assessments and appropriateness	
Category	**Codes making up categories**
Motor assessment tools not being appropriate	Motor assessment tools, observation, motor tests not appropriate,
Motor testing not standard,	Variables we need to test, equipment availability and resources
Motor testing not a priority and improved diagnosis	A need for early intervention, motor assessment tools

Theme 1: A spectrum of motor proficiency and physical activity levels

a) **Specific motor skills and/or deficiencies (Motor profile)**

All of the clinicians reported that to their knowledge children with ASD have some form of motor skill deficiency. The majority of the clinicians (n=7) felt that motor skill deficiencies seem to occur on a spectrum themselves, whereby some children do not experience extreme difficulties whereas others do. One clinician stated that children are either hyperactive or hypoactive. One clinician indicated that it's a given fact that individuals on the spectrum have reduced gross motor proficiency compared to their neurotypical counterparts. It was also stated that engaging in physical activity is a necessity for children on the spectrum.

"Every individual is different. Like I said, it's, motor proficiency is a spectrum in my eyes." -Clinician 3

"I do think that physical activity is definitely a massive, massive necessity for these kids."-Clinician 11

All of the clinicians reported specific motor difficulties that they had come across while working and treating children with ASD. Common issues reported by clinicians were poor tone, poor tone specifically in the core, poor praxis and motor planning, gait, increased tone, poor balance, poor body awareness and poor coordination and body control, and poor breath control.

"They struggle with their muscle tone, and their coordination and because of the low muscle tone, all the other motor proficiencies or, or they are not proficient as they should be in coordination- they are clumsy, poor motor skills, motor planning, bilateral integration. I basically I see it all through from the very little ones to the older ones, right through." -Clinician 8

Other motor deficits reported by the clinicians were poor gross and fine motor difficulties, bilateral integration issues, difficulty performing activities of daily living , being clumsy, having reduced mobility and flexibility, having poor posture, having increased compensatory movements and having vestibular processing, having reduced quality of movement and proprioceptive issues.

"Their activities of daily living, which include their motor skills, things like dressing, things like especially handwriting we do a lot of, I find it is either reduced or the quality of them all, the quality of the end product is usually good but they are compensating so much."-Clinician 4

A few of the clinicians reported motor problems that influenced other motor skills and spoke of a link between different skills.

"The other thing is a lot of my kids with ASD don't have very good interoception they don't actually understand what's going on in their body. They don't they're not able to process that information, and then some of them struggle with general day to day organisation." -Clinician 4

When asking the clinicians what variables they would like to see being assessed in individuals with ASD, they all included the variables reported above as well as additional variables which provided further insight into which other motor skills should be included in an assessment – these are presented under the theme of assessment.

b) Reduced physical activity levels

The majority of the clinicians reported that to their knowledge children with ASD had reduced physical activity levels . One clinician mentioned that physical activity levels decreased as the children aged. Three of the clinicians stated, that similar to motor deficits, physical activity levels were varied across the children. Two clinicians stated that some children had increased physical activity levels and where meeting physical activity guidelines - particularly the hyperactive children- yet that it was child dependent.

"It tends to be poor. Other than therapy, most of them don't get anywhere close to normal physical activity levels."-Clinician 5

"Some of them are walking less than 2000 steps a day."-Clinician 11

"It really depends on the child. Yeah. So what do you think? So obviously, you've got the kids that really enjoy the physical activity and then you have the kids that don't want to participate?"-Clinician 5

The majority of the clinicians stated that children with ASD were not meeting the ACSM general population guideline of participating in moderate exercise for 30 minutes per day for five days of the week. One clinician stated that although the children were very active or hyperactive they were not meeting the guidelines. Three clinicians reported that there was variability in physical activity levels and that this extended into their adult lives.

"So with regards to the child population, I would say they do reach the 150 minutes a week but that's also child dependent. But when you look at the adults in autistic population, yes, there are a few of them who train consistently, but there are also those who just do not want to do any sort of physical activity."-Clinician 3

Many of the clinicians mentioned that physical activity levels would be dependent on whether they were at school or home as well as the kind of school they were attending.

Clinicians mentioned that the decreased physical activity levels could be attributed to laziness, as well as poor aerobic capacity, which meant that they fatigued easily. In addition, some clinicians perceived that children with ASD would use more energy than their neurotypical counterparts when performing simple tasks. Two clinicians stated that their reduced physical activity levels may be due parents being too overprotective with their children preventing them from doing physical activities, or struggling to cope with their behaviours therefore, not allowing them to do engage in physical activities.

"I think parents are also struggling just to get them or just to cope with them and the behaviour that they don't always let them do activities or physical activities."-Clinician 2

"They struggle to sort of control their body a lot of the time, and then it uses up a lot more energy than it should, than a neurotypical child."-Clinician 9

c) Benefits and reported cross over effect of motor skills

The perception of the clinicians was that improving physical activity as well as improving motor skills would benefit children with ASD. All of the clinician's demonstrated a positive attitude towards exercise in that they all stated that there is a need to include more physical activities in the lives of children with ASD and that they thought motor skills were important and added value to the children's lives. The clinicians made particular reference to the fact that having good motor skills and physical activity levels could increase independence, improve general well-being, improve daily functioning, allow children with ASD them to be more productive and improve mood as well as providing a sense of value and purpose.

"I think that the physical activity works hand in hand with the motor skills to sort of elevate their ADL's and their general well-being."-Clinician 9

"And it gives them a sense of value, a sense of purpose, not a sense of being behind in everything." Clinician 1

The clinicians stated that other benefits included improved academic, behavioural and emotional aspects as well as improved social participation.

"So especially the kids that do the bio sessions with me at 7:30 in the morning, they generally have the best focus in class."-Clinician 9

"The kid's sleeping better, eating better, calmer in class"-Clinician1

"So with [Childs name], exercise has been really valuable when he exercises and is active, it makes a massive difference to his emotional ability and his emotional control." -Clinician 11

The clinicians also reported that physical activity is a means for a child to better regulate sensory issues, vestibular problems, proprioceptive processing as well as improve language deficits. One clinician stated that physical activity provides opportunities for them to work through sensory barriers.

"It gives them the opportunity to work through sensory barriers [swimming]."- Clinician 6

"So helping them to regulate as well as helping them on a more sensory level because a lot of my children with ASD really do struggle with the vestibular and proprioceptive processing, and we know movement will increase that."-Clinician 4

As there is such a large cross-over effect of motor skills into daily activities, clinicians stated that reduced motor skills would impact other areas of their lives negatively if they were impaired.

"We're finding a lot more progress with the kids who are involved in physical activities, but it's the ones who aren't we notice everything decline, their posture; they're on their phone the whole day; their mental and cognitive abilities."-Clinician 7

Clinicians reported that children with ASD needed physical input, and that they thought motor skills were important - that in most cases children just need to get moving and that physical activity intervention is a cost-effective means of therapy.

"They definitely need physical input."-Clinician 2

"I think they deserve the best therapy that the parents can afford, and I think it's, I think physical activity is very cost effective. It's not expensive."-Clinician 10

Theme 2: Barriers to exercise and challenges in implementing exercise

a) Core deficits and daily struggles

Core deficits of ASD were frequent discussion points with the clinicians in terms of barriers of participation in physical activity in children with ASD. The core deficits deemed to be barriers included social barriers, communication barriers, stereotypic and behavioural barriers as well as cognitive and sensory barriers.

In terms of social barriers, clinicians reported self-regulation deficits, being introverted or shy and being part of different social groups could also dictate whether a child was active or not and that exclusion was a risk of not being able to engage socially.

"And he has to learn to calm down again, and then soak yourself up and build yourself up for the next interaction."- Clinician 3

"We know that as social exclusion comes in, because suddenly they're you know, they can't play with the other boys the same way when it comes to sports and things like that."-Clinician 1

In terms of behavioural barriers, screaming, shouting, banging and tantrums were cited by four clinicians regarding the fact that they may be barriers to physical activity. Furthermore, one clinician stated that poor body awareness could exacerbate behavioural problems and influence the engagement in physical activities

"I had to take my two patients completely alone and you know, entirely kind of isolated, because they used to distract all the other people so much that no one could get done what they had to get done."- Clinician 6

In terms of cognitive barriers, the majority of clinicians stated that impaired cognition would influence the understanding of tasks – specifically in performing motor skills and in some instances performing motor skill related tests. Many of the clinicians stated that the individuals understanding, should be considered when designing the model. They stated that once children understand what is expected from them it may allow for improvements in other aspects.

"Because of the poor understanding because sometimes they do not understand instructions."-Clinician 8

In terms of sensory barriers, one clinician spoke of sensory barriers influencing motor testing. It was stated that sensory triggers or negative sensory reactions could prevent a child from performing a motor-related task. Importantly, it was stated that some children may dislike engaging in physical activity due to not liking the result of the physical activities have their bodies i.e. feeling sweaty, feeling normal muscle pain after exercise and not understanding increased heart rates.

"They're extremely sensitive to sensory input, and obviously, if you have like a little bit of a setback on sensory feedback, you are automatically going to have a setback on proprioception, which automatically translates into that balance and those types of things."-Clinician 6

"Because of the way it makes them feel. Like that's really with regards to DOMS and like muscle soreness and stuff afterwards." -Clinician 3

b) General barriers and challenges

Clinicians mentioned that a child with ASD could experience other barriers towards physical activity. These included exclusion due do having reduced motor skills, reduced self-confidence, having comorbidities, variations in levels of impairment, and financial and resource barriers. These barriers as well as special considerations were used to inform model development.

In terms of exclusion being a barrier, clinicians reported that children with ASD may not have opportunities to engage in physical activity since people may not want to work with them. In addition they stated that these children are often labelled as being "difficult" and that this could exacerbate the issue that some professionals don't want to work with them. It was also stated that the motor difficulties that children with ASD experienced may in themselves exclude them from participating, or that they maybe discouraged to perform motor tasks due to having poor motor skills.

"Being told that you don't have good power control of your muscles, so you're not allowed to pick up the hamster, or cuddle the kid or cuddle the puppy or hold your little sister. It's, we're constantly alienating the kids."-Clinician 1

"They are considered quote unquote high risk that they, they fall under the stereotype of difficult to deal with."-Clinician 3

Clinicians reported that individuals with ASD having poor self-confidence influenced participating in physical activities. In particular, it was stated that having failed at something previously may result in the child being scared to try doing same or different tasks in the future.

"They know that their bodies are not, not capable of doing a lot of the things that other kids can so they don't, don't want to try because they've you know, they've tried to do stuff in the past and not been able to they are just scared to try."-Clinician 5

In terms of comorbidities being a barrier to physical activity, clinicians reported that psychiatric conditions could prevent typical activity participation. One clinician indicated that the overlapping conditions may result in not knowing how to treat the children effectively and that knowing if they have comorbid conditions and conducting family history is important .

"There's all kinds of psychiatric conditions and forms of being ADHD, bipolar, anxiety, OCD, stuff like that. All those conditions and family history score is important. Doesn't mean because you are autistic, you don't have any of those other psychiatric conditions that you can inherit."-Clinician 10

The majority of clinicians stated that level of functioning of the participants might dictate physical participation and engagement in specific tasks and even therapy. Two clinicians indicated that due to their level of functioning they spend a lot of time in therapy and that decreases time available to participate in other things such as physical activity. One clinician indicated that knowing the level of function would allow her to better prepare for her sessions as it may influence how the child engages with her materials.

"We need to know if the child you know, is going to have difficulty sitting if we need a special chair, something like that." "From just from a professional perspective, I need to know if a kid doesn't have the fine motor skills to interact with some of my materials."- Clinician 1

The majority of clinicians stated that motivation was a large barrier in getting children to participate in motor tasks and physical activity. One clinician mentioned that motivating the parents to take their children to therapy is a barrier in itself.

"Understand what drives them and what motivates them and then try and bring their experience of the world closer to the general experience of the world."-Clinician 1

Four clinicians stated that finances and having optimal resources may be barriers to physical activity in children with ASD. One clinician indicated exercise is a cost-effective therapy.

"Finances is huge, resources are a big problem, especially in our country- we have to be aware of that."- Clinician 1

Theme 3: Assessments and appropriateness

a) Current motor assessment tools and appropriateness

The majority of the clinicians felt that motor skill tools were not appropriate for children with ASD. Clinicians stated that issues with motor assessment tools included children not being able to understand instructions therefore, making them inappropriate, no norms to compare data with, needing to adapt assessments since there are not motor assessments specific to ASD and not being able to assess critical deficits in the population using standard tools. They felt that there should be guidelines for how to assess the children and an outline of what should be tested. Clinicians stated that they made use of the Jean Ayres clinical observations scales, STOTT, BOT, MABC tests, Milers assessments, SIT test and the EASY-OT. They indicated that there are variables that are often not measured.

"No, it's not appropriate. Yes, it could be better."-Clinician 1

"There should be a sort of standard guideline or outline of things that should be tested."… "A guideline for how to assess would be amazing in terms of like, what are your common challenges."-Clinician 5

"I think that it's not even about identifying motor impairments. I think it's about identifying how you can increase body mind connection. So um,whether it is that the child likes yoga and you can get them to the yoga."-Clinician 11

b) Motor testing is not standard

Clinicians stated that to their knowledge motor assessments were not standardised across the population. The majority of clinicians felt that it should be standardised, as well as tracked across their development.

"So there's not really an evidence based policy that says for ASD, you have to do these."-Clinician 2

"If we work in a specific area, that area, specifies what tests we're going to use."- Clinician 2

Clinicians provided insight into what variables they test. Clinicians reported testing a wide variety of gross and fine motor skills and activities. One clinician indicated that she doesn't always do full assessments as she knows what motor proficiencies she would find.

"I don't always do a full assessment of their motor proficiency anymore, because it's almost as if you know what it's going to be like."-Clinician 8

"So I think hypermobility and strength assessment is vital and with these kids and I definitely would include it in a model of care that we do in an assessment."-Clinician 11

"We look at motor components pertaining to those functional things."-Clinician 2

c) Motor skills are not a priority

The majority of the clinicians stated that motor skills are not a priority in the management in children with ASD. It was stated that the focus of management generally included behavioural, cognitive, emotional and speech therapies as well as other general health issues.

"I think most of the focus with his kids is around sort of their behaviour, their stimming, their general adaptive behaviours and a lot of the times I find the motor skills were kind of put on the backburner. They're ignored."- Clinician 4

"I don't actually think that there, there is not much being done for it, if that makes sense."-Clinician 6

d) Early intervention and improved diagnosis is needed

Clinicians stated that they felt that improved diagnosis for the ASD population is needed, specifically in terms of earlier diagnosis. The clinicians indicated there is a need for improved diagnosis specific to motor testing and a need to screen for impairments. One clinician stated that the DSM-5 criteria should be revised in terms of adding other deficits as part of the criteria.

"We need to find a way to diagnose and start treating them at an early stage."… "So I believe that early like motor skill training, or not training, but screening, even during the fundamental phases would be highly beneficial."-Clinician 3

"The DSM five criteria should look at including like, like other deviations in onto the spectrum. I know a lot of people who are being diagnosed in their adulthood now."-Clinician 3

ii. Clinician knowledge, perception and insight into how motor proficiency and physical activity levels can be improved

Table 4.8 below shows a summary of the codes and categories making up each theme for the clinicians regarding how they believe motor proficiency and physical activity levels can be improved in children with ASD.

Table 4.8: A summary of the most common categories per theme found for clinicians in the data relating to perceptions, knowledge and insight of how to improve the motor skills and physical activity levels in children with ASD

Theme 4 : "It's not one size fits all"	
Category	**Codes making up categories**
General special considerations	Using physical activity incorrectly or for the wrong reasons, safety, parents feeling overwhelmed, create interest and give meaning to physical activity, verbal vs non-verbal individuals, fun and games, make motor part of a routine, supervision, exclusion and effect of exclusion, medication, engagement and compliance
Individualisation, variability and flexibility of intervention	Individualisation, flexibility, adaptability , variability , a disregard for individuality
Role and stakeholder responsibility	Clinician needs, holistic and multidisciplinary approach ,
Physical activity preferences	Physical activity likes and dislikes
Theme 5 : Education: "they need more overt explanations and understanding their body"	
Category	
Awareness and education	Physical activity guidelines, general knowledge,
Empowering/training others	Training others, equipping others
Explain rationales and understanding each other	Understanding children better, teacher, clinician, parent understanding, explaining the why,
Theme 6 : Monitoring/tracking progress: "I've never in my life received a full on report"	
Category	
Goals and progress	Patient management, goals, progress
Feedback	Follow up, supervision

Theme 4: "It's not one size fits all"

a) General

All the clinicians provided numerous general considerations in terms of what needs to be considered when needing to improve motor skills, and physical activity. In general, clinicians stated that approaches to improve physical activity and motor skills should be considered, specifically a holistic and multidisciplinary team approach was advocated for. One clinician indicated that we could consider implementing specific professions in schools (Biokinetics) to specifically target motor proficiency.

"I think my ideal would be a holistic plan, with the one chapter of it being the motor intervention, but with ways that they could be multidisciplinary meetings and check-ins with each other."- Clinician 1

"I think Biokinetics needs to be introduced to the schools, to train to carry with his bags, posture, all those kinds of things. I think a biokineticist should be part of the PT programme."- Clinician 10

Clinicians thought that tailored programme design would be important. Keeping environments familiar and making sure the environment doesn't trigger sensory sensitivities. It was stated that individuals with empathy and a good understanding of others would be good instructors.

"The morning seemed to work better for the kids, especially if they've got a day full of school and different activities and things like that, because you've also got the sensory overload and you've got all of those different factors coming in."- Clinician 9

I'd say moderate intensity exercise. Intensity tends to put them in a non-responsive state."-Clinician 7

"Avoid noisy environments with too many other visual and auditory distractions as well as bright/ flickering lights or bright sunlight. Too hot or too cold and even the temperature and the textures of objects that the persons will have to hold onto/ step onto/catch/ or walk over."- Clinician 8

"So I think that the most important thing is actually somebody who has an understanding or has an empathy."- Clinician 11

Other general special considerations the clinicians stated that should be considered regarding a motor or physical activity programme, were things like making the activities fun and meaningful to the individual. It was suggested that it would be of value to give them motor-based habits and

rituals and consider including it into their basic schedule. It was also states that it would be important to build a positive relationship between the child and physical activity.

"If they could have little habits and rituals, they love little ritual motoric rituals if you can give them a motoric ritual they do before they brush their teeth, do five jumps or whatever it might be."- Clinician 10

"Game type exercises where they don't realize what they're actually doing."- Clinician 9

"I think if we can get them interested in the activity that's a bit more meaningful."- Clinician 1

"So when we are to maybe start targeting physical activity, we need to consider sort of including it into their basic schedule. So it's something that they need to sort of tick off when they a start of the day. I think that will definitely make a difference to some of them that you understand and is motivated enough." - Clinician 8

General special considerations the clinicians stated that were related ASD specifically, included how individuals react with the clinician and others, adverse behaviours and how that would affect interaction with the clinician and others around them, cognitive abilities, social deficits, and sensory deficits. It was also stated individuals who are non-verbal versus verbal would have additional things that would need to be considered. One clinician indicated that some individuals on the spectrum don't know their own limits and this could have adverse effects for the child. They indicated that this would need to be facilitated, and education provided for the child if they struggled with this issue. This linked to the safety of the child as well and that we should consider other safety-related issues. Furthermore, clinicians indicated that some children can't be tested, that demonstration may be difficult due to poor body awareness. It was also stated that allowing parents in therapy sessions could be of value or could be distracting and that it would be child depended. They mentioned that shorter sessions may be better due to limited attention spans and that it is important provide feedback to the child, for example, if they say an activity is hurting them, the activity should cease.

"One of the commonalities that I would say is that they don't know their own limits, so they've, it's really difficult for them to judge that they don't have good body perception."- Clinician 11

"I know with some of the kids it's also a safety issue because they have insensitivity to pain."- Clinician 1

“Some kids will be testable, and some kids wouldn’t be testable. I've had a little boy that just ran around for the first two sessions while I spoke to his mother.”- Clinician 5

“The attention span is not great.”- Clinician 5

Clinicians mentioned two further considerations which included the effect of medication on the body, and the effect on other family members if children with ASD were to participate in motor interventions. One clinician indicated that children should not be forced to participate as it may lead to a fear of participation.

“Once on medication that hyperactivity is definitely far more normalized. You don't want to be sedentary but you don't want this absolute phonetic hyper activity.”-Clinician 10

“You also have to consider the rest of the family, if mom is taking little Sam to rehab every day, where does that leave his sister?”-Clinician 1

“If you force them, you're going to build up that other side of it where they developed their calculate just so quick to develop fear and anxiety that's and you're going to limit the benefit that they get out of physical activity.”-Clinician 11

b) Individualisation, variability and flexibility of the proposed model of care

All of the clinicians stated that the model would need to be adaptable to account for the variability of the children and that it should be presented in a way where it can be used on an individual level. Clinicians indicated that individualised attention would also be of value.

“Everything obviously needs to be individualised.”- Clinician 9

“It depends on the day, on the kid, on literally the weather.”- Clinician 9

“Because they are so different. It's, difficult to sort of pitch it at the right level.” -Clinician 5

“Make it adaptable, so that if they have equipment that they don't need to necessarily go and buy a new kit, but may be able to adapt so that they can do what they can with what they have.”-Clinician 2

c) Role and stakeholder responsibility

The clinicians provided insight into their perception of the role players in improving motor skills and who should be responsible in increasing motor proficiency and physical activity levels. They also provided their perceptions regarding how they thought parents and teachers felt or engaged with the children in the motor realm. This was a special consideration in terms of responsibilities going forward in building the model. One clinician had the perception that we should ask teachers to include PA into their curriculum and that they would benefit from a programme that they could use with the kids.

"The teachers can also benefit from a specific programme, even that they can use for the kids to get them physically active, because not every school or placement has OTs, physios or Biokineticists."- Clinician 2

"Ask teachers to incorporate [PA activities] as part of the curriculum."- Clinician 2

The clinicians felt that the demands on the parents need to be low, one indicated that they felt that parents expected schools to improve physical activity levels, while another parent indicated that they felt they needed to chase parents to improve physical activity levels in the children. Clinicians indicated that they felt that parents do not always follow up on recommendations made to them, with one clinician stating that she felt that parents were dismissive of improving physical activity.

"I just think the demands on the parents need to be low."- Clinician 2

"I feel that the parents are generally a big influence when it comes to a lot of these things because they deal with the child more than us."- Clinician 9

"I think getting it out to the facilitators or the carers is in the main thing and then educating them on the benefits is the main thing."- Clinician 7

One clinician felt it wasn't the parents fault that physical activity wasn't being done but rather that the children themselves didn't want to take part in certain activities, while one felt that in most instances children just went along with their schedules.

"It's not the fault of only the parent. It is very often the children that also do not want to compete and to take part in certain activities."-Clinician 8

d) Physical activity preferences

In general, clinicians stated that children with ASD had various preferences as well as strong dislikes in specific instances if sensory issues were present. One clinician noted it could vary in different age groups, and another indicated that children liked variety in terms of exercise.

"Again, it depends from child to child, so I've got one that absolutely loves being in the pool, one that reacts only when there's exercise or sort of competitive games."- Clinician 9

Some clinicians stated that individuals with ASD showed a strong preference for proprioceptive, jumping, bouncing and obstacle course activities. It was stated that they enjoy balance and play type activities.

"As I said, the trampoline is a good proprioception through the legs, anything with pushing and pulling through the arms you know, crawling through tunnels."- Clinician 2

"But I find often they quite like, like bouncing stuff. Jumping on the trampoline or bouncing on a ball."- Clinician 5

Theme 5: Education: "They need more overt explanations and understanding their body"

a) Need for education and awareness

Clinicians reported a lack of education and a need to educate parents, other clinician's teachers and school on physical activity and motor skills. Clinicians felt that there was a need to raise awareness to get children to do more activity and make people aware of the ACSM criteria, and provide them with the guidelines.

"No, 99% of my patients, even my neurotypical patients, they don't even know those exist"[PA guidelines]."- Clinician 9

"And there's so much research saying that, you know, exercise is beneficial. Yeah, we just need more research to back up exercising the ASD population."- Clinician 3

Clinicians agreed that exercise is beneficial and that role players (parents, teachers, facilitators, carers, coaches and other clinicians) should be made aware that physical activity is beneficial and educate them in what the benefits may be and what the children may need. In addition, one clinician indicated that she would like to see some guidelines or some information about how individuals should actually feel after physical activity.

"I'd like to see some guidelines or some information about how they should actually feel after physical activity." - Clinician 4

"I think for the parents, it's parent education because the parents are the first line of anything. So I think that education that is by far the most important." - Clinician 9

"The schools need to know, because what I often see is kids are told like no, don't play on the jungle gym. You've got a problem. Where does that leave the kid? Everyone else is on the jungle gym?"- Clinician 1

"All I can say is through research and time, hopefully and like not even patient education, but other healthcare provider education. We can change that attitude with anything that's needed."- Clinician 3

Lastly, the clinicians stated that it was important to educate the children, to educate them on the benefits and what they could gain from exercising, to educate them on how they should feel when performing exercise and to try and create a positive relationship with physical therapy for them, and slowly building it up.

"So, it's also just about why, because we can tell them because it's good for you. But they need more than that. They need more overt explanations, and understanding their body."- Clinician 4

"I find that they, they struggle to understand what their body is feeling like what actually feels good, what actually feels not so good, what's actually safe, what's not safe."- Clinician 4

Theme 6: Monitoring and tracking progress: "I've never in my life received a full on report"

a) Goals, progress and feedback

The majority of the clinicians felt that it would be important to have goals for the child to meet as well as a management plan. The clinicians indicated that the plan should allow for growth of the individual and should be clearly communicated in the team.

Yeah, I think goals is, yeah, something, and then we can kind of show the parents like this and this is where your child is. This is the goal we are aiming towards and this is how we are going to look at getting there."- Clinician 9

"Anything that would have a growing aspect to it and improvement aspect to it."-Clinician

"*I've actually never in my life received a full on report."-Clinician 1*

4.3.3 Objective 3

Objective 3: To explore the perceptions and insight of parents on the current motor proficiency and physical activity levels in individuals with ASD and how these could be improved though a model of care.

Following eight interviews with parents, data saturation was reached. Through thematic analysis three themes emerged regarding the perceptions, knowledge and insight of parents on motor skills and physical activity levels in children with ASD. A further three themes emerged when analysing the data regarding how a model of care could improve motor proficiency and physical activity levels, these six themes are presented below. **The complete sample of verbatim quotes per theme and category per group has been included for reference purposes as well as assist if additional clarity is needed in Appendix T.**

i. Parent perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Table 4.9 shows a summary of the codes and categories per theme found for parents in the data relating to parent perceptions, knowledge and insight of motor skills and physical activity levels (n=8) of codes identified in the data.

Table 4.9: A summary of the most common categories per theme found for parents in the data relating to perceptions, knowledge and insight of motor skills and physical activity levels

Theme 1 : "People are unfit, are overweight and are unhealthy"	
Category	**Codes making up categories**
Specific motor skills and/or deficiency (Motor profile), physical activity levels.	Motor profile, specific motor deficiency, variability of motor skills, motor profile,
Reduced physical activity levels	Physical activity levels, physical activity dosage, physical activity guidelines, physical activity preferences
Benefits and reported cross over effect of motor skills	Benefits of physical activity, cross over effects
Theme 2 : Barriers: It's not that they don't want to, it's that they cannot	
Category	**Codes making up categories**
Core deficits and daily struggles	Sensory , social, connection, interaction, behaviour
General barriers and challenges	Exclusion, self-confidence, compliance, finances, resources motivation, fears, level of impairment, PA preferences
Theme 3 : "A need for an assessment that takes into account autism"	
Category	**Codes making up categories**
Current motor assessment tools , appropriateness and missing variables	Motor assessments not appropriate, lack of assessment, need for early intervention, variables we need to test
Motor testing not a priority	Priority

*In order to provide some context: Parent 1 had a son aged 32 years; Parent 2 had a son aged six years , Parent 3 had a son aged thirteen years, Parent 4 had two daughters aged 18 and 20 years, Parent 5 had a son aged eleven years, Parent 6 had a son aged eight years, and parent 7 had a daughter aged thirty years. All children had been formerly diagnosed with ASD.

Theme 1: "People are unfit, are overweight and are unhealthy"

a) Specific motor skills and/or deficiency (Motor profile)

All of the parents interviewed for this study reported that their own children had motor deficiencies. They reported that in general, they perceived most of the children on the spectrum to have some form of motor deficits or that they struggled with motor-related tasks and that is was a common issue. In some instances, the parents indicated that they did not know why the children had motor difficulties but just that they had observed them in their own children and in others. The majority of the parents reported that they felt the motor proficiencies of children on the spectrum were varied, and that it was as if the motor impairments also lay on a spectrum.

“I don't have a clear understanding of why it is that they struggle. But I know that kids with autism does struggle with motor skills.”- Parent 2

“But from a motor perspective, I suppose depends, you know, they can either, you know, have difficulty with sort of like fine motor, gross motor or a little of both in our particular set of circumstances.” - Parent 5

The parents reported specific motor difficulties that they had seen in their children. Common issues reported by parents were low muscle tone, poor fine motor skills such as writing difficulties, poor gross motor skills, underdevelopment of body musculature, midline crossing issues, poor flexibility and strength, balance issues, coordination difficulties, and poor balls skills, poor body perception skills, poor general strength, and weight issues contributing to reduced mobility.

“*Autism kids struggle with motor skills, big and small, even with the fine or you know, like jumping rope or something like that. I know it's difficult for them. That's very difficult for them. I think it's because the body perspective doesn't really know what to do.”-Parent 7*

Other motor deficits reported by the parents were fatigue and difficulties with performing daily activities and vocational activates, i.e. climbing stairs, feeding, bathing, brushing teeth.

“He battles to do a few things like walking up and down stairs. He can swim very well. Also his strokes are not what they should be. But the biggest problem is, you know, he gets tired.”-Parent 1

“And things like, I don't know, if it’s bathing himself, you know, being able to hold his hand out, sort of like to sort of like bath himself properly. Hold his toothbrush in a way that sort of like would make sense. So we so we’ve actually got a special kind of toothbrush. So it's those sort of like simple life everyday life things really.”- Parent 5

When asking the parents what variables they would like to see being assessed in individuals with ASD, they all included the variables reported above as well as additional variables which provided further insight into which other motor skills should be included in an assessment - these are presented under the theme of assessment.

b) Reduced physical activity levels

The majority of the parents reported that children with ASD have reduced physical activity levels, and that even if their own child seemed to be active or hyperactive that overall they felt that physical activity levels were sub-optimal in the ASD. Parents reported that there was variability in physical activity levels to their knowledge. The majority of the parents stated that children with ASD were not meeting the ACSM general population guidelines of participating in moderate exercise for 30 minutes per day for five days of the week. One indicated that she felt that children in general don't meet those guidelines. One parent stated that although their children were very active or hyperactive they felt that they were the exception to the rule and that in general children with ASD were not meeting the guidelines. In instances where parents could not provide information on what they thought general physical activity levels were like for children with ASD, they spoke about their own children's physical activity levels which seemed to vary from parent to parent. One of the parents indicated that physical activity needed to be improved and that we need to find innovative ways to improve physical activity.

"No, I don't think, I don't even think that kids, neurotypical kids are meeting that right now. They're all sitting in front of their iPads and gaming (laughs a lot)" "I don't think they're getting enough. Not at all."- Parent 5

"We need to improve it, and we need to find innovative ways in which to do it."-Parent 3

"Because me and my husband are natural, active people. We get our boys very active, very quickly, like we walk and we run and we swim and we do the bike riding is now our next step with the boys. And I've noticed that it's not the typical household you know, people don't go for a walk anymore."-Parent 7

There was a distinction made between verbal and non-verbal individuals on the spectrum, where one parent felt that nonverbal individuals were not meeting guidelines due to barriers, including parent fears in encouraging the children to participate in physical activities and prioritizing other fundamental needs before advocating for physical activity participation.

"Non-verbal autistic people are not getting it because parents are so stressed out just trying for them be normal or like go to the toilet to listen, to eat and do to stuff like that, they don't have the energy to make them do physical stuff."- Parent 4

Many of the parents mentioned that physical activity levels would be dependent on the school they are attending and that it also could depend on their socioeconomic status. One parent indicated that reduced physical activities were influenced by urbanisation and changes in lifestyle. She indicated that in the urban areas parents drive their children to school, allow them to play with an iPad, and generally do not play with other outdoors for fun.

"It's a lifestyle thing, guys. I think if we were having this conversation, and we were in my village where I come from, kids over there, they don't have, there's no Wi Fi, there's no iPads, they're outside running around, walking to school, and et cetera, et cetera. But in urban areas, we're driving our kids to school, they do have iPads, they have you know, we don't, they don't, I played outside growing up like with a neighbour's kids and my son doesn't do that."- Parent 5

"I think it varies every child is different levels, so their circumstances are different."- Parent 3

c) Benefits and reported cross over effect of motor skills

The overall perception of the parents was that improving physical activity and improving motor skills would benefit children with ASD. All of the parent's demonstrated a positive attitude towards exercise in that they all stated that there are various benefits that they have observed within their own children. Many of the parents indicated that participating in physical activity helps regulate their children, it helps with stimming and that it calms their children down. In fact one of the parents who is autistic himself, stated that he feels that exercise has a calming effect on him and helps him to function better as well as allows him to achieve small things which encourages him further. One of the parents indicated that exercise should be one of the first things parents should do in the day with them as it allows for better engagement with the child, as well as the child being more calm during the day. One of the parents indicated that their child had realised that performing exercise activities helps him and that it helps maintain his function.

"My son actually enjoys doing certain physical things because he actually, he realizes that it's helping him, and if he doesn't do the exercises, he deteriorates very quickly."- Parent 1

"If its first [physical activity] you have a calm kid, you have a kid that will listen to you, you have a kid that will be engaged with you."-Parent 7

One of the benefits of physical activity reported by the parents was that it is a cost-effective therapy, that can assist their children in being more independent, which should be a key focus

when managing these children. It was stated that it would be beneficial across all aspects of their life whereby if they have improved motor skills and can do specific tasks they would be less reliant on others around them.

"Those therapies on their own are not that expensive. I mean they are far less expensive than say for instance his psychiatrist or psychologist."- Parent 6

"From an independence perspective, if we can get them as independent as possible and a big part of that independence is from a motor perspective. So it definitely should be a key focus from a therapeutic point of view."- Parent 5

The parents stated that other benefits included improved sleep, improvement in mood, improvement in concentration, memory and improvement in appetite. One parent specifically mentioned that there was also value in starting physical interventions early on in the children's lives. They indicated that the more physical activity they do the more they continue to do.

"But when he does his sport, I feel that he's in a far better mood. He's more relaxed, he sleeps better at night. And I find that the physical activity really helps him tremendously and even with sums- he loves doing maths, well arithmetic. And I find when you start doing his exercises here, he seems to concentrate a lot better." - Parent 1

"I think it is, like a mood stabilizer. It's also good for the appetite, you know, so then they can eat better. Yeah. I mean, it's good for all of us." - Parent 3

"Because I know that my both my boys started two years as soon as we realized there was something not right and I look at their friends that has started it later on, or not at all, and I can see the difference in their muscle development."- Parent 7

Theme 2: Barriers: it's not that they don't want to, it's that they cannot.

a) Core deficits:

Parents described many barriers toward physical activity and one parent mentioned that in some instances it wasn't about the children wanting to do tasks but that they actually couldn't.

"You must understand that about a lot of autistic children, it's not that they don't want to, it's that they cannot."- Parent 6

Barriers that were mentioned that were directly related to the core deficits of ASD children included social barriers, interaction and communication barriers, cognitive barriers and sensory barriers. Social barriers cited included a lack of social integration and social support and a preference not to engage in team activities. Another barrier was lack of understanding of social cues.

"So I really think one of the things that is really holding our kids back is this lack of social integration and social support like for my son, he's not interested in team sports."- Parent 3

I don't understand that social stuff."- Parent 4 (Parent with autism)

Parents mentioned that not being able to understand activities or not understanding how to participate in the activities could be barriers for them. They indicated that in some cases they have cognitive deficits or associated intellectual disability which could also affect understanding.

"In my son's case, he's got a mild intellectual disability, it's like, how do you get them to understand why it's important? So those are our challenges."-Parent 3

Parents indicated that the largest barriers were the sensory issues their children had, as that prevented them from actually engaging with certain types of physical activity, and also dictated which mode of activity they could tolerate. They indicated sensory deficits could trigger negative behavioural responses. They mentioned that some children did not like to engage in social activity as sweating was a sensory discomfort.

"A lot also has to do with sensory issues. So sort of an example, going to the park becomes a sensory meltdown because it's like too many things going on you know, like that. The sun is too strong. This is this is, this is this, this is that so every little thing becomes a challenge."- Parent 3

"He doesn't like sweating because he's autistic." "I can't enrol him in soccer. I cannot enrol him in tennis. I can't enrol him into anything else that's outside because he doesn't want to sweat."- Parent 6

b) General barriers and challenges

Parents mentioned that in general a child with ASD could experience other barriers towards physical activity. These included exclusion due do having too many comorbid deficits or individuals being too fearful to work with them, interest and motivation to engage in physical activity and financial and resource barriers.

Parents indicated that service providers may be too fearful in working with their children and thus they could be excluded from the opportunity of receiving therapies. Furthermore parents indicated that in some instances schools did not want to take their children due to having too many comorbidities resulting in them not participating in school related physical activities.

"They [service providers] are scared and they don't really know how to work with them"-Parent 4

"They didn't take X because X has got too many additional, uh disorders to just autistic, and they asked for a IQ and educational risk assessment and he ranked very low."-Parent 6

The majority of parents indicated that one of the largest issues was that their children had low motivation, poor self-confidence and may not be interested in participating in exercise or physical activity, and that this was one on the big causes for reduced physical activity levels.

"As soon as there are rules, then he loses interest in the activity."- Parent 7

"He doesn't have that interest and he doesn't have the motor skills to actually do it."- Parent 3

"The biggest problem, I think is interest, they actually get bored." –Parent 1

Parents indicated that one of the biggest barriers was finance and a lack of resources which prevented their children doing various physical-related activities. Some facilities have better resources and can facilitate exercise better i.e. having a jungle gym on the play grounds.

"So now you pay, paying for a private school and you have to pay for horse riding and you have to pay for this and you have to pay for that. So I think sometimes these things just lag behind because parents don't have the money."- Parent 6

"And the other thing is that therapies on their own are not that expensive. I mean they are far less expensive than say for instance you his psychiatrist or psychologist but if you have to pay for all these

therapists out of your pocket, it's going to add up and I think that's a great contributor to the fact that people don't do these things because they cannot afford it."- Parent 6

Theme 3: "A need for an assessment that takes into account autism"

a) Current motor assessment tools, appropriateness and missing variables

Overall, parents indicated that motor assessments were either not done or if they were done they were not done frequently enough.

"Do you understand, there's no, I don't expect them to have another assessment next year, there was no discussion about ok you're going to see how far he's progressing and maybe needs therapy."- Parent 2

Some parents indicated that they felt the assessments, if they were done, were inappropriate or missing items that they felt would be of value for their children. The majority of parents reported that their own children had not had motor assessments done.

"I never had one. We just had like a speech therapy and an occupational therapy, assessment of the voice. The first time I heard about it is when you emailed, and when you put the ad[vert] on, and I was like, this would actually be a great tool."- Parent 7

. So I think they need to have somebody there that can pick up certain traits especially when they're doing gym or playing sport."-Parent 1

Parents indicated that in most instances other assessments, for example, for speech or behaviour were done but not for motor skills. Parents indicated that if an assessment was done it was done once as a part of a school readiness assessment and that there were no follow-up assessments. One parent indicated that his children had performed motor skill assessments overseas in Switzerland but not in South Africa. One parent indicated that she only realized that her son had motor skill deficiencies when she had observed other kids performing tasks that he couldn't.

Parents believed that assessments were needed and they advocated for early intervention. They further indicated that they felt that assessments would be of value in providing information on what each child needs, based on deficits so that time is not wasted on unnecessary therapies and treatments.

"An assessment would be a great idea, at least that way we know where this particular kid is and what to focus on. And we don't spend time doing things that are unnecessarily we could just literally focus on what that particular kids need and then put our focus there."- Parent 5

Parents believed that assessments were often not a true reflection of their child's capabilities. They indicated that certain things could influence testing, for example, one parent indicated that her child was not receptive to testing, another indicated that if her child was better prepared for the test in terms of what to expect, that he may have performed better. One parent indicated that because parents spend a large amount of time with their children that often they observe deficits or problems that are not measured in assessments, or due to stringent timeframe of assessments, not all things can be measured.

"I've taken my son for assessment for school and part of the assessment was skills and what I've noticed is that it wasn't a clear analysis of what he can and cannot do, because he's not like really receptive and, you know, were as I was able to tell them, I know that he can do this. I know that he can't do that- that was a better indication to them than him physically being there and doing the assessment. That's very difficult."- Parent 2

"You're with your child the whole afternoon and the evenings and you notice specific things. So I would say get the parents involved."- Parent 6

"So I think you can do all of the general assessment, but then also have the parent answer if they are able to do that or not."- Parent 2

One of the parents indicated that assessments are not appropriate and that there should be a standard on what to assess. One parent indicated that assessments used should be specific to ASD.

"So I think, I think there is definitely a need for an assessment that takes into account autism, you know."- Parent 3

"Yes, I think it's good for autistic people, especially some of them might have like, issues with their bodies, could happen, like any human, so to have a standard how to test. Motor tests, not appropriate."- Parent 4

Parents provided insight into what variables they would like to be tested. The majority of parents indicated that functional and everyday tasks should be assessed. Tasks they specifically mentioned were tying shoelaces, carrying a schoolbag, moving and carrying dishes from one

place to another and picking up items. They indicated that assessments should include a measure to indicate to what extent an individual can perform tasks independently so that appropriate care can be provided.

"So what I will say for my kids was important to do those things like run, jump, climb, hop, balance, stretch, and when they fall on the ground, to learn movement on the ground, rolling around, so to use all that different muscles to be able to do those things, you know." - Parent 4

"I think things like to what extent is the person able to independent, independently perform certain tasks or certain daily activities."- Parent 3

"That way, if we catch things that you know, that are not right earlier, then we can start dealing with them earlier instead of having to wait like when he's a year old or two years old, and it's still not walking or when he's still not sitting upright by himself. Those kinds of things, if that makes sense."- Parent 5

a) Motor skills are not a priority

Overall, parents stated that they felt motor testing was not a priority in terms of the management of children with ASD. The parents felt that motor skills were often neglected and that often therapies would only target core deficits such as speech and behaviour. Parents believed that motor skills should be tested so that a baseline can be established for the child. In this way targeted therapies can commence.

"You know what it feels to me like these days. It feels like that. Therapy and parents and the doctors all are pushing our kids mentally, but the body went missing somewhere."- Parent 7

"The so called priorities in the autism sector-from what I can see, the one is, especially for those children who have limited speaking skills, speech, and so people are like more focused on getting them to speak or to communicate."- Parent 3

"It's definitely worth it. Because then at least you have a baseline of where he was as well." -Parent 2

ii. Parent knowledge, perception and insight into how motor proficiency and physical activity levels can be improved

Table 4.10 below, shows a summary of the codes and categories making up each theme for the parents regarding how they believe motor proficiency and physical activity levels can be improved in children with ASD.

Table 4.10: A summary of the most common categories per theme found for parents regarding how they believe motor proficiency and physical activity levels can be improved in children with ASD.

Theme 4 : You have to have a mindset change because otherwise you're gonna miss the boat	
Category	**Codes making up categories**
General individual considerations	Trusting clinicians, improved understanding, feedback, inclusion of parents, making activities interesting and fun, considering safety, overcoming ASD specific barriers, environment, programme design
Individualisation variability and flexibility of intervention	Physical activity preferences, variability
Role and stakeholder responsibility	Responsibility, programme implementation, scope of practice, advocacy, parenting style
Physical activity preferences	Physical activity preferences
Theme 5: Education and awareness: "It's really frustrating when you're being told to do something, but you don't understand why."	
Category	**Codes making up categories**
Awareness and education	Stakeholders, government policies, improved understanding of the condition, explaining rationales, guidelines
Empowering/training others	Training clinicians, empowering parents, approaches
Theme 6: A lack of monitoring/tracking progress: "You must ask what's going on"	
Category	**Codes making up categories**
Goals and progress	Recurrent assessments,
Feedback	Approaches, reports, improved understanding

Theme 4: You have to have a mindset change because otherwise you're gonna miss the boat

a) General individual considerations

All the parents provided individual considerations in terms of what needs to be considered when needing to improve motor skills and physical activity. Similar categories the parents spoke about were approaches to working with the children, the uses of physical activity, making activities interesting and fun, considering safety, overcoming ASD specific barriers, providing variety and considering medication. Parents indicated that considering implementing activities as part of their routine may be beneficial, as well as throughout their lives.

"It's part of our routine and I think routine is also very, very important for kids."- Parent 7

"Our divergent children are totally different from normal children. You have to have a mind-set change because otherwise you're gonna miss the boat."- Parent 6

One of the biggest considerations parents reported to the researcher in building a model and getting individuals to engage with exercise professionals, was considerations relating to the exercise professional themselves. Parents believed it was imperative for their children to able to trust and relate to the person who would be working with them. Parents reported that the person working with the child would need to understand what the child needs and consider involving the parents when a therapist felt they could not understand the child. Overall parents indicated that therapists should consider actively participating in sessions, be consistent in administering interventions, and provide consistent feedback to parents. One parent stated that she felt it would be of benefit to include parents in the programmes in terms of what will be done with their children and to discuss what the parents' concerns may be.

"It's also about trust. He builds a trust relationship with this specific person. If he finds them trustworthy, he will work with them better. It's this, children pick up on these things very quickly, If he doesn't trust the person, he will refuse."- Parent 6

"Be playful. Participate in their therapy. You will have to be actively participating."… "The fact that she participates with him in most of the of the activities, uh, makes a huge difference."-Parent 6

"It's always a good idea to get the parents involved. To for them to #1 understand what you have planned #2 their concerns. If it's not under what you've planned, their specific concerns and make it a collaborative

experience. It makes you feel included in decisions and, funny enough, at makes a huge difference."- Parent 6

They indicated that motor or physical activity programmes should be fun and interesting, make use of incentives and avoid having too many rules.

"He loses interest as soon as there are rules."- Parent 7

"So she would use it as an incentive because she's got a whole lot of balls in a pit, and he loves the balls and the pit. So she would say, OK, at the end of the session you can have 5 minutes of playing in the balls and the pit, you know. So it's a carrot in front of the nose."- Parent 6

Parents indicated that programme design should be considered if exercise were to be implemented. Firstly, parents mentioned that environment and safe spaces would need to be considered, whereby they felt it was important for their children to feel safe, in a stigma free environment, with optimal supervision, that was in a physical space that did not trigger any sensory issues. They shared ideas regarding how we could create safe spaces that were autism friendly.

"Where the autistic people can feel safe, and where they can feel sort of like supported and no stigma, you know, that sort of thing."- Parent 3

"For example, like you have autistic hour, you know, like in certain venues, so they dim the lighting the switch of the music, that kind of stuff. So maybe to have them not just in April when its autism awareness month, but to have it on a regular basis."- Parent 3

"So I think something like that maybe, autism gyms or play gyms."- Parent 7

In terms of the implementing of an intervention or strategy, parents indicated that frequency of exercise intervention, mode of exercise, equipment usage and availability and types of exercises would need to be considered. They believed all of the abovementioned factors should be adaptable according to individual needs.

"Say instead of like walking like 20 minutes with my boys now, we have to work like 40 to 45 minutes for them to actually feel like we had some physical activity right now. But now I don't think the average kids get that much exercise in."- Parent 7

"I think maybe if they could break it down to sort of like, maybe 10 minutes or 15 minutes. Every other day. That might be a better idea." - Parent 5

"It can be very targeted, and at the same time, they can have that social, social aspect." - Parent 3

"Even if they don't do it the way you want it to be done. And they can do it the way they want."- Parent 7

General considerations the parents stated that were specifically related to the core deficits of ASD, included interaction (specifically differences with nonverbal and verbal children), social deficits, cognitive deficits and sensory deficits. They indicated that sweating and loud noise may be a sensory trigger for some children.

"So it depends which non vocal, so you get some that listen and do stuff , and you get those nonverbal ones who don't listen at all and just do their own thing."-Parent 4

"He doesn't like sweating, so he will not participate in outdoor activities because he hates sweating. He does not like it at all."- Parent 6

"It, also each family would also have different needs depending on the children's sensory profile, because everyone is obviously different. But it would be good to check in maybe, like we have options of one indoor venue and one outdoor venue."- Parent 3

Importantly, two parents indicated that children on the spectrum don't always get along with others and that this could influence whether interventions were administered in one on one formats or group formats.

"We are not people friendly."- Parent 4 (Autistic parent)

They also indicated that they may have cognitive barriers in terms of understanding what is needed from them and that time for repetition and practice would be necessary to consider.

"I do feel that the visual charts are very helpful."-Parent 2

Parents indicated that comorbid conditions would need to be considered as well as being able to adapt and modify the programme accordingly.

"My child has anxiety. My child is hyper. My child is all over the place. My child is this. My child is that."- Parent 6

"I think practicing is really important to these kids. Yeah. Repetition. So that they learn, obviously the, you know, different kids learn different ways. Like some of the more visual learners, some of them are learning through play. You just have to understand what works, what works for your kid."- Parent 2

One parent (who was on the spectrum) felt very strongly the guidelines for physical activity should not be adapted unless they need to be. He advocated for individuals on the spectrum to be encouraged to meet neurotypical guidelines and standards wherever possible and only for adaptations to be made if the child needed them to be made. Furthermore, he indicated that if an intervention or therapy was to be included as part of an individual's routine, it would need to make very clear sense to the individual before they would adopt it.

"They will change and follow routine if it makes sense to them. But you can't force them to do it because then they just won't. You know, It's going to be difficult."- Parent 1

b) Individualization, variability and flexibility of the proposed model of care

Overall, the parents stated that the model would need to adaptable to account for the variability of the children and that it should be presented in a way where it can be used on an individual level. They advocated for having choices for the children that would allow them to choose what they preferred on an individual level.

"They differ in terms of ability."- Parent 5

"Each family would also have different needs depending on the children's sensory profile, because everyone is obviously different."- Parent 3

"So I think the ideal would be to give choices in line with the with the individuals preferences, so you know, so it would be like I said, some people like energetic exercise, some people like moderate exercise, some people like it indoor, some people like it outdoor, it will be about having different options available." -Parent 3

"….however you get autistic people that have comorbidities like apraxia , I don't know what it's called, but your brain can put together the things that your thinking and your body don't work correctly. So those ones, you have to adjust a lot because they don't always listen and they just can't focus." - Parent 4

c) Role and stakeholder responsibility- Poorly defined roles and expectations

Parents believed that it would be necessary that there is a designated person or people who take responsibility to implement or carry out physical activity based interventions. Furthermore, they believed that the model should guide implementation so that it can be carried out consistently by the individuals responsible.

"I'm not sure how practical it will be if somebody doesn't take responsibility for it."- Parent 7

"Yeah, but it's something which should be worked on and ideally in a in a like consistent manner, by everyone. So by the school setting, by the parent or caregiver and by the therapists."- Parent 3

Parents perceived that the model of care should include implementation in school settings, and that in those instances teachers should be responsible for carrying it out. One parent indicated that the responsibility for improving physical activity in children with ASD lay with other individuals such as carers.

"I think that's got to be something that has to go into the schools."- Parent 1

"Somebody else is going to have to improve physical activity. I feel like that's kind of like the caregivers."- Parent 2

"I think the teachers should actually take it upon themselves to try and see what every individual child needs."- Parent 1

Two parents indicated that they felt that their wasn't a lot of information being provided to them from doctors in terms of developmental milestones children should be meeting, as well as general guidance for their children in terms of management.

"There isn't a lot of guidance coming from doctors and so on."- Parent 2

Parents stated that often it would be up to the parent to teach or provide activities for the child to do. One parent believed that it should be the responsibility of the parent to make sure their children are meeting optimal physical activity levels and get them active.

"So at the end I still think everything comes back home. It's still the parents responsibility to take responsibility for this- for the active. So I think if we can maybe encourage activities at school, but also at home for the autism kids."- Parent 7

One parent indicated that he believed that councils and government should be more active in getting individuals active to a certain level. He also indicated that from a parenting perspective that parents should not afford their children the choice to be inactive - that they should make sure that they are meeting the minimum criteria.

So yes, parents on the whole are like, there should be a bigger movement in the councils in the government's to get people up to a certain standard of you know, and parents shouldn't give kids the I didn't give my kids you know, the choice." - Parent 4

Overall, parents indicated that they felt that there was a need for better advocacy in improving motor skills from autism bodies such as Autism South Africa, for example, as they felt that not enough was being done for the children.

"I mean, you know, even Autism South Africa they're not doing enough of these things. They're not doing enough to say that, okay, you know, we're going to set up."- Parent 3

"So maybe, based on your findings, you can then approach like, social development, department for person with disabilities or woman and disabilities or whatever, whatever long name it's got, and then say that look, this is what we've identified as a need and we need to find a way to make us more accessible to the community and things like that."- Parent 3

d) Physical activity preferences

In general, parents stated that children with ASD had various physical activity preferences as well as strong dislikes, specifically if sensory issues were present. When it came to liked physical activities, parents stated that their children enjoyed running, playing with balloons, engaging in all consuming activities, cycling, bouncing, swimming, and participating in activities that were

rhythmic. They stated their children also liked to mix activities up and engage in physical activities including animals.

"He likes obstacle courses he likes playing, kicking ball and loves animals, he loves playing with the dogs."- Parent 2

"They will try things and you can start it, I think humans even autistics, we like to be like, trying stuff and if we do it, we will do more of it."- Parent 4

The parents indicated that their children did not enjoy team sports, and that children had preferences for activities based on if they preferred indoor or outdoor activities. The majority of the parents indicted that likes and dislikes of physical activities were very much child dependent and what their sensory triggers are and that that would need to be considered in the model.

"Yeah, so different ones enjoy different things, it just depends on what they've been exposed to what their sensory triggers are."- Parent 3

"He doesn't like it and I think it's because of the motor skills that he lacks."-Parent 6

Theme 5: Education and awareness: "It's really frustrating when you're being told to do something, but you don't understand why."

Overall, parents believed that improved education and increased awareness is needed amongst key stakeholders (e.g. parents, teachers, health professionals) working with individuals on the spectrum and for those in charge of developing policies and in the government sectors. They believed that education and a better understanding on what children on the spectrum need is crucial. Parents believed that educating parents should be a priority, as well as educating nannies and other individuals that work with their children on a day-to-day basis. One parent indicated that she believed that parents often don't realise their children need therapies as they don't have enough information to make these informed decisions.

"Educating the people in charge on what sort of things on what the children need."- Parent 1

" I think education starts with the parents."- Parent 4

"I don't have a clear understanding of why it is that they struggle."-Parent 2

The parents believed that society in general doesn't value exercise and that people don't want to engage in physical activity anymore. They indicated that changes need to happen on a societal level where education on the benefits of exercise needs to be carried out, as well as trying to assist people in understanding why they need to participate in physical activity.

"Because it feels like me, to me, we're living in a society that people don't want to exercise, people don't want to go outside anymore. And just to get them to realize that okay, it is not just good for me. It is good for me and my mind and my body it's good for everything. Even when I'm not feeling good. If I just go for a walk I will feel better." - Parent 7

Parents stated that there is a need to have guidelines on what their children should be able to do, and that there should be education regarding what their children could be able to do at various ages in terms of their motor skills. They also indicated that a guideline of activities for what they could do with their children would be helpful.

"So I think, a guideline on activities what you could do with your child, because those are things that are not, like I'm saying the school where he is at now. They don't give me guidelines to say okay, you can do this activity with him, this will help."-Parent 2

Parents came up with some strategies to improve awareness – for example, hosting awareness campaigns, or using already established platforms like autism South Africa to create awareness on physical activity and motor profile deficits.

"And that can be part of like the awareness. If we do like an awareness campaign that we can put that in there so that parents can refer to it."- Parent 7

I think you can use platforms like autism, South Africa because they are a lot of parents on it. Make them aware of it." -Parent 6

Parents advocated for increased training specific to ASD for those working closely with kids with ASD. One parent indicated that she did not understand why individuals are not being trained on how to work with neurodiverse children and that she felt that was a problem.

“So it's really important that I think that they are also trained on autism, you know, all disciplines that deal with like motor skills. Typically, nowadays, you know, but just have a lot more awareness.”- Parent 3

“I'm just thinking that it's something that we the same way we train you know, early childhood development for neurotypical kids. Why are those providers also not being trained on neurodiverse kids? as a standard and not something as a specialisation if that makes sense?”- Parent 5

Parents suggested that parents could be trained or empowered on how to improve physical activity levels as well as how to improve motor skills. In this way parents could be involved in facilitating the process of improving physical activity and motor skill levels.

I mean, I think it's cool. It could be a way to try to empower like, I mean, there's a lot of single moms, you know, they're all struggling financially. You know you could train a couple of them and you could get them to run the programme. They understand autistic kids so they know which kid is having a meltdown which having a trigger you know, don't come in my space, you know, wherever they can, they can, you know, and keep getting continuous training so that they can, you know, grow the programme.”- Parent 3

“Sometimes maybe even if a programme is designed, yeah, certain parents can be trained on it. Yeah. And then and then it could be done.”- Parent 3

Importantly, parents indicated that there was a large need to educate the children themselves on why they needed to do specific therapies, to assist in helping them understand as to why doing specific therapies is important.

“It's really frustrating when you're being told to do something, but you don’t understand why.” - Parent 2

“You need to get an initial buy in for autistics, you know what you can’t force them because then they will do it.”- Parent 4

Theme 6: A lack of monitoring progress: “You must ask what’s going on”

The majority of the parents felt that that monitoring the progress of motor skills was important as well as receiving feedback on if these motor skills were being improved. They also indicated that setting goals for the patient was important.

“I don't think they will always hear you because we live in a society where people want instant results.”- Parent 6

“There was no discussion about ok you’re going to see how far he’s progressed and maybe needs therapy.” …“I wish there were more kind of feedback, but then again it also depends on where your child is attending.”- Parent 2

“Although he's had OT and he's had like, even physical, physiotherapy and so on. But from what I experienced is that maybe there wasn't like a set goal that was that was laid out to say let's work towards this.”- Parent 3

“They did the assessment as well and they actually had a one on one feedback with me, where they went through the entire thing, and they also gave me a hard copy. At the school they also had similar, but I just felt that I didn't understand the feedback as well from that assessment.”- Parent 2

They stated that in most instances it was up to them (the parents) to ask how the child is doing, if there were things they could do at home with their child and what the interventions were focusing on.

“Like you must ask what's going on? What do you think? You know, where as if he was at a special needs school. There might be more feedback from them saying, you know, this week we focused on this and there is not much improvement. Can you do this with him at home.”-Parent 2

One parent provided examples of her son working with a biokineticist in which she received updates and videos and that she felt that that was a good example of receiving feedback.

“I get regular feedback on what she's doing. I get videos from her on what she's doing and it's amazing.”- Parent 6

4.3.4 Objective 4

Objective 4: To establish what the expectation of a model of care for children with ASD focusing on motor proficiency and physical activity levels is from teachers, clinical experts and parents.

i. Teacher expectations

Overall, the teachers believed that the model of care for children with ASD needed to be able to help all kids on the spectrum with various levels of impairment in both professional settings with therapists, in the classroom as well as at home. They also indicated that the model should consider being able to guide care across the individual's life span. Overall they believed the model should help to get the children active in some way. The majority of teachers stated that activities should focus on getting children to focus on activities of daily living as well as to assist in getting them to be more independent.

"It needs to help all kids, all different types to get active, like to find a way to find help through professional or in classroom or at home to get them to be active even though they may have autism what level one, two or three? They must be active in some ways." -Teacher 4

"Yeah, my summary of it is that I would like it to be holistic so that you don't only have them be taken care of in a small kind of sector such as like school. So it should be something that is implementable throughout their lives so that when now you're no longer a high school student, but now you're a university student and you have autism. That model is still able to assist. So there are ways to assist you in childhood and adulthood because this is a lifelong condition, right?"-Teacher 1

Overall, the teachers provided specific feedback regarding what they would like to be included in a model of care for children with ASD. Teachers believed improving motor skills was important but also how the children were being educated. The teachers wanted to see the model guide parents to be more involved and being able to understand what is happening with their child , for example understanding what is happening with various therapists or what is happening in school setting.

"Obviously the motor side is important, but I also think looking at how they're educated."- Teacher 5

“I will send the child off to this expert to that expert, and they will, you know, take care of it. So, I would like to see the involvement of parents to their level that they understand exactly, you know, what's going on with their child how their child functions, but the child prefers so that they can be able to provide that which the child needs. So, yeah, I say parental involvement is the first image really comes to mind in terms of any effective model of care.” - Teacher 1

Teachers stated that they wanted a holistic, multidisciplinary approach, as well as children having access (frequently) to therapists such occupational therapists, speech therapists as well as nurses and doctors. They indicated that the model should allow for different approaches to be used to improve physical activity, and that it should be flexible and adaptable and individualised to accommodate for the varying needs of individuals on the spectrum.

“I would like to see it being implemented. In a way that one, as I've said, involves parents involves different types of professionals. So a holistic approach.”-Teacher 1

“Different ways of approaching activity.”-Teacher 4

“I think you're going to have to look at very individualised programmes.”-Teacher 5

They indicated that the model should advocate for improved teacher education, teacher training, as well as improved education for the children themselves on why physical activity may be beneficial and relevant to them. Teachers believed that having a guideline as to what children could do would be beneficial to include in the model. They believed that motor skills should be reinforced in all areas of the individuals life and that training individuals to facilitate this would be of value, as well as changing the perception that motor skills need to be worked on in isolation.

“I think it can be improved in everyone. First of all, but certainly in this population, because the assumption it seems in most cases is, that it is not relevant to them.”-Teacher 1

“A guideline. Yeah. It would help a lot.”- Teacher 4

Teachers stated that they wanted the model to be relevant for all socioeconomic levels in society and that it should be tailored to individual needs.

"It needs to be one [the model] that is adaptable to the variability of the autism spectrum, but also adaptable to the variability of South African society. So you have all these different socio economic levels in society, right. So someone in suburban South Africa, and maybe someone who is having autism in the rural or township areas, would they be able to be assisted by such a model? If that's the case, then I would say that yes, the impact would be great." - Teacher 1

"You have to accommodate each child's certain needs when it comes to activity and games." - Teacher 4

"If it is adaptable enough, then I think that definitely that will be able to help everyone or as many people as possible." - Teacher 1

Teachers stated that individual barriers and individual considerations would need to be considered in the implementation of any exercise-based intervention. These were presented in theme two and theme three for the teachers under objective 1. Overall, teachers wanted more motor-based interventions as well as interventions that considered ASD from a sensory motor perspective.

"I would really like to see more motor programmes across the board, but also, more focus on the disability from a sensory and motor perspective."- Teacher 5

ii. Clinician expectations

Overall, the clinicians provided specific feedback regarding what they would like to be included in a model of care for children with ASD, in terms of the motor variables they would like to be assessed and targeted if an intervention was to occur. Specific motor variables mentioned include: gait, praxis, breathing exercises, core strengthening, balance (static and dynamic), biomechanical patterns, proprioception, co-ordination, gross motor skills (e.g. crawling, jumping), fine motor skills (e.g. holding a pen, writing), mobility, cardiovascular fitness, reaction time, force production and feedback thereof, posture, muscle strength, quality of movements and ball skills.

"Their ability to like run, walk unassisted, how is their balance etc. and like static versus dynamic balance and I also look at their throwing and catching skills."- Clinician 3

"I would definitely have a postural aspect to it."- Clinician 4

"I suppose a mixture of all the things that we know they need, you know the motor planning and you know, those kinds of proprioceptive, coordination."- Clinician 5

The clinicians reported many different variables, of which the frequency and type often related to their area of expertise. For example, the Biokineticists interviewed, spoke a lot about gross motor deficits, balance and cardiovascular fitness, while the occupational therapists, for example, frequently mentioned fine motor deficits, vestibular and proprioceptive deficits and quality of movement. Overall, the sentiment of the group was that many motor variables were deemed important to measure and target in therapy and that it would be dependent on the children's abilities and function.

Furthermore, the clinicians reported that the MoC should aim to improve independence and improve the daily functioning of the children overall. The clinicians stated that additional variables should therefore be considered, for example, self-care, hygiene, bathing, and feeding. They stated that since these had underlying motor aspects, the MoC should incorporate ways to improve specific motor skills related to assist these areas of the individual's life.

"I think self-care, if they could just look after themselves and feed themselves and make sure they can help themselves with water and that kind of thing." - Clinician 10

"Can they dress, can they do buttons? Can they eat with a knife and fork? It's more like how are they doing it? Is it taking them very long? Are they quite clumsy with it?" - Clinician 4

"Gait, the different apraxia's, dressing, feeding bathing, activities of daily living, functional activities of daily living that gives them independence."- Clinician 10

The clinicians reported that having an educational component to the MoC would be imperative. Clinicians indicated that education on the benefits of physical activity, on how physical activity should make one feel, as well as how much physical activity is appropriate, would be important to include in the model. The clinicians also felt it was important to educate on the need to foster a good relationship between physical therapy and the individuals who need it.

"Starting to create a positive relationship with physical therapy for them, and slowly building it up."- Clinician 3

“I think parents, even kids, teachers ,they all need information of how much they should be doing. What's appropriate, what's not.”- Clinician 4

“I would like to see a purposive assessment and I'd like to see a multidisciplinary group involved where you have psychologists, parents, teachers and coaches, and so that everybody gains, gains an understanding cause we actually don't understand enough. So I think in an awareness of the fact that we don't know is probably gonna get us very far.”- Clinician 11

Many clinicians reported that having a better understanding of motor deficits that widely occur in the population would be of value in terms of being able to prioritize them (in terms of intervention) to make the most impact on the areas of children’s lives they are struggling with the most. They also indicated that understanding the effect of the motor issue itself on function, would be integral to being able to prioritize and make therapy more effective. Clinicians indicated that prioritizing specific motor skills for the therapy would be necessary as they felt that they had a poor idea of where to start with the children since they often had so many impairments.

“And also of course, get something were the parents can, and also the teachers can also prioritize, they can actually say what you know, what, are they seeing the most what are their actual concerns ,what is, otherwise I think, our difficulties then, if we have all these difficulties, and this is where our little children with ASD are falling out, where do we start supporting them? - Clinician 4

“What is affecting their engagement and interaction with the environment and then from the you can use it to kind of prioritize, prioritize what's going on , because if somebody comes in and say they have midline crossing issues, well, what is it actually affecting? How much are they working on it? Is it actually affecting their output?”- Clinician 4

In terms of the overall model, the clinicians stated that it would be nice to have a guideline to refer to in terms of motor development guidelines, and assessment of motor variables (what to assess). One clinician indicated that it would be helpful to have information of levels of impairment and what to expect for each level in terms of associated deficits as that could assist in more targeted assessment and intervention.

“There should be a sort of standard guideline or outline of things that should be tested.”- Clinician 5

“So, this and this, and this is the most important in these types of patients affected at this point of the scale, you know, so not necessarily specific exercises or something like that.”-Clinician 6

“Are the kids developing in the correct sort of linear fashion we expect but they're lagging? Are they developing atypically?”- Clinician 1

“So I think if there's something that is kind of standardised, it would actually be great. And that is not only like applicable to ASD patients, it's applicable to many other special pops.”-Clinician 6

Lastly, the clinician’s provided a lot of input into what would need to be considered for individuals on the spectrum when developing the model of care, and what barriers should be considered when trying to improve motor proficiency and physical activity levels. These are presented above under objective 2 and will be considered in the MoC development to aid in meeting the expectations of the clinicians.

iii. Parent expectations

One of the biggest issues the parents spoke about was that their children did not have formal assessments, nor regular assessments and that they often struggled to understand what motor deficits their children had. Parents indicated that they often did not know what their children were supposed to be able to do from a motor perspective and that they often only realised motor deficits where present after observing other neurotypical children. One of the parents indicated that she felt the model should include a guideline of normal motor specific developmental milestones that parents could refer to, as well as guidelines as to what the parents themselves could do with their own children to assist with motor deficits.

“When I saw my sisters child doing that, and I'm like, Oh, my boy supposed to do that. And then I went and Googled it and see. Ok Okay, it is between this ages you are meant to do that. And then I jump in and I start doing these things with my boys. But it also it always felt to me it was a little bit too late. It was something we could have done earlier. If I knew that was something my boys were supposed to do.”- Parent 7

“I think, a guideline on activities what you could do with your child, because those are things that are not, like I'm saying the school where he is at now. They don't give me guidelines to say okay, you can do this activity with him, this will help.”- Parent 2

Importantly, one of the parents (who is on the spectrum himself) stated that, he wanted the model to provide guidelines that were based on neurotypical norms as a starting point, and only adjusted for atypical individuals if they needed.

"Don't treat us different to anyone else like the normal ones, like the autistic ones that can that have no physical issues. You know, like no physical medical problems. So they should do the same like anybody else. You know, maybe they do not communicate the same but they have no physical issue. So you should do all the exercise that everyone else is doing. You know, that is normal. I would say as a start should work towards the norm like that."-Parent 4

The parents felt that important items were missing from assessments, (if their children had a motor assessment), and that they felt they could assist in providing valuable information during the assessment process. They felt that if they were involved more during the assessment process that children may perform better in the assessments themselves, as parents could help prepare them better on what to expect. In addition, they felt that parents could provide better insight on the children's function during assessments as they spent more time with the children. They believed that in this way assessments could be optimised. Following on, the parents indicated that they wanted to me more involved in decision making in terms of what therapies should target, as they felt that the overall goal should be to improve independence and better performance of functional activities. Overall, parents highlighted that the MoC should assist in improving the overall assessment process i.e. creating awareness that assessments should be done in the first place - and on a regular basis, that parents should be involved in the process, that assessments should better inform interventions, and that interventions should target the overall needs of the children.

"There are things that they might miss because, like I said, although they spend a lot of time at school, you spend the most time with them."-Parent 6

"I've taken my son for assessment for school and part of the assessment was skills, and what I've noticed is that it wasn't a clear analysis of what he can and cannot do, because he's not like really receptive. And, you know, were as I was able to tell them, I know that he can do this. I know that he can't do that, that was a better indication to them than him physically being there and doing the assessment. Yeah. So I'm not I'm not really sure whether the assessment is going to anything unless you going to do it that way. But having a kid assessed, you know, in person at a specific time. That's very difficult."-Parent 2

Furthermore, parents indicated that the MoC should guide intervention in ways as to not only improve motor skills and physical activity, but to also assist in other aspects of the individuals life through exercise, for example, to assist with dysregulation, and to use it for calming purposes to reduce anxiety and other issues children struggled with.

"So if you can do, like directed good dynamic, physical activity, I think with kids, especially autistic kids that's good for them to kind of calm down, you know, like release and focus."- Parent 4

"You don't have to just focus on the problem. Incorporate exercise into it. Like I said, with the ball. So this is a calming exercise." - Parent 6

Another aspect that parents mentioned was that they were not given clear goals or feedback, regarding motor improvement, and they often referred to financial barriers and resource barriers towards therapies. These would all be necessary to consider in order to meet expectations when developing the MoC, as these would influence strategies to improve motor skills and physical activity levels. Furthermore, the parents mentioned many child-specific variables and barriers towards physical activity which would all need to be considered to meet the expectations of the parents in the MOC design.

Overall, many of the parents indicated that the model should be prescriptive in a way in terms of highlighting how often individuals should engage in exercise, and that it should focus on motor improvement that would relate to everyday function and activates of daily living. They also indicated that parents, teachers and clinicians should all be involved.

The parents provided specific feedback regarding what they would like to be included in a model of care for children with ASD in terms of the motor variables they would like to be assessed and targeted if an intervention was to occur. Specific motor variables mentioned included: gross motor skills (e.g. sitting, crawling, and jumping), fine motor skills (writing), balancing, ball skills, activities of daily living (carrying objects, washing, bathing), and hand-eye coordination. These variables reported generally came from personal experience of what they noticed their own children struggled with. Overall, parents indicated they just wanted to get their children moving.

"Something that would improve their hand-eye coordination, like ball skills, that biking things, I think would be a good idea as well."- Parent 5

“Yeah, but it's it is something which should be worked on and ideally in a in a like consistent manner, by everyone.”- Parent 3

“Get their bodies moving.” -Parent 7

Lastly, parents indicated that education and awareness should be a component of the MoC. This information is presented in objective two under the education theme.

4.4 Phase 2 initial model of care design

4.4.1 Objective 1

Objective 1: To develop a model of care for individuals with ASD focusing on motor proficiency and physical activity based on literature, teachers, clinical experts and parents.

During phase two, phase one data was used to develop a model care for individuals with ASD focusing on motor proficiency and physical activity. The MoC development comprised of 5 steps. Step one to step three were completed using the data (teacher, clinical expert and parent interviews presented above in phase one and data from the literature review). These three steps are described in detail below. Steps four and five occurred in phase three of the study, and are presented in that section.

4.4.2 The model of care development results

STEP ONE: Project Initiation

Step one of MoC development comprised of project initiation as illustrated in Figure 4.1A below.

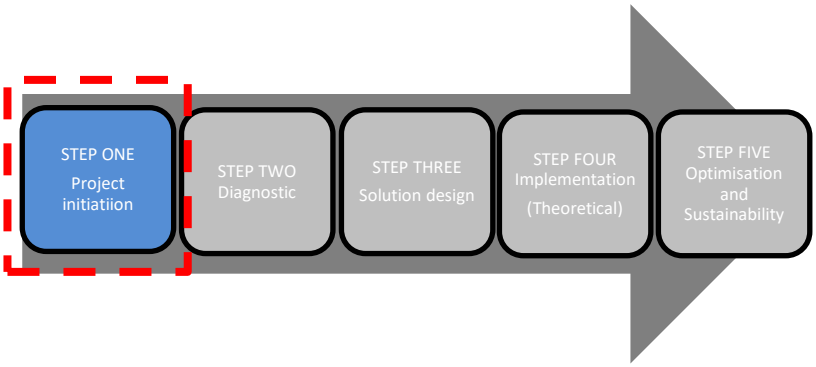


Figure 4.1A: The MoC development process - Step one

In this step of the MoC development, phase one data from the interviews that were coded using MaxQDA software were used to generate thematic maps. Thematic maps were generated through thematic analysis (the process is illustrated in Figure 3.2 in chapter 3). Although codes and categories differed between the teachers, clinical experts and parent groups, the similar themes were identified across the groups. Figures 4.2 - 4.5 below illustrate the individual thematic maps generated from each group with their associated codes and categories. Edraw Mind Software (free software) was used to visually present the thematic maps per group of participants (teachers, clinical experts and parents). Blue arrows show the connections between some of the categories, orange arrows show connections between themes.

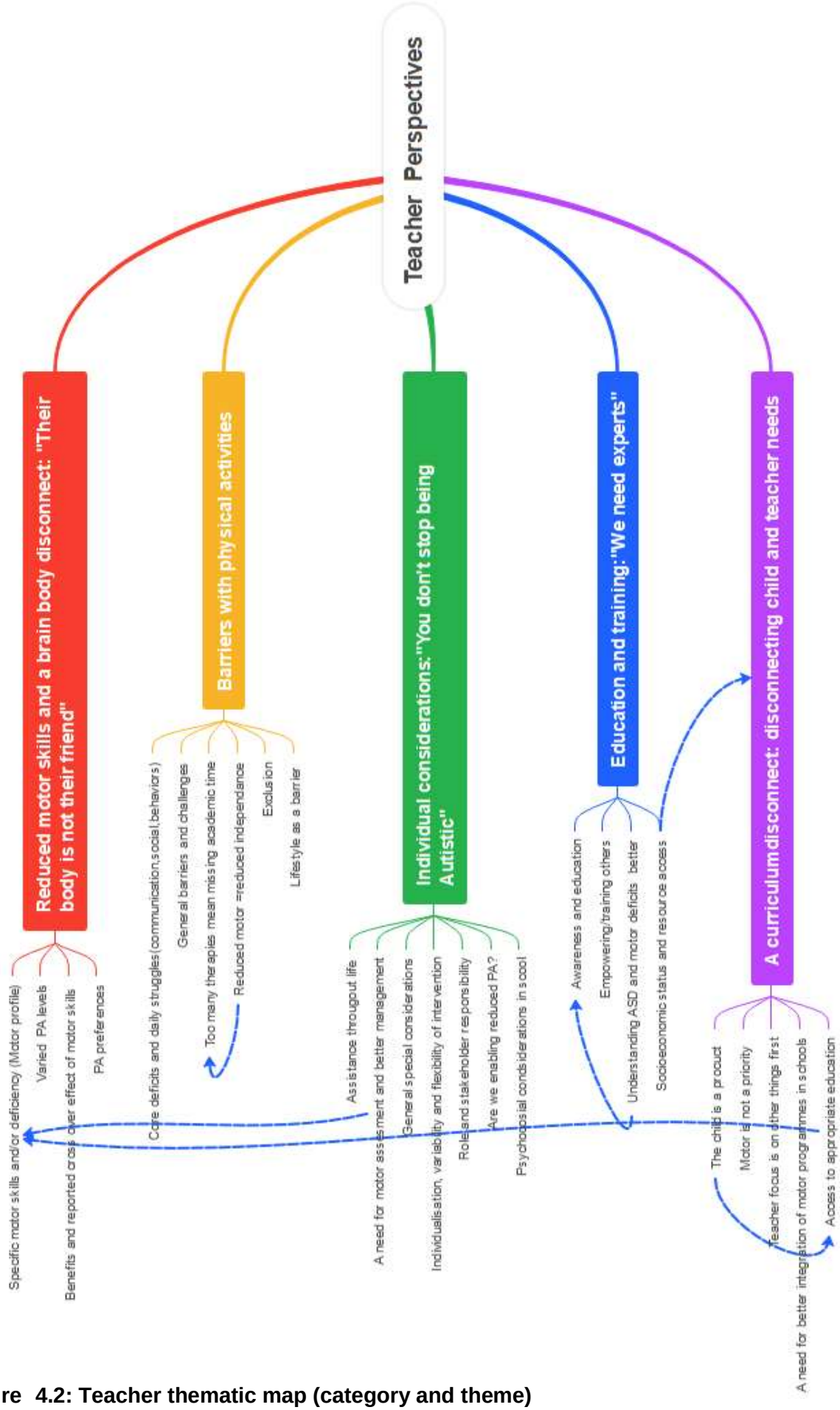


Figure 4.2: Teacher thematic map (category and theme)

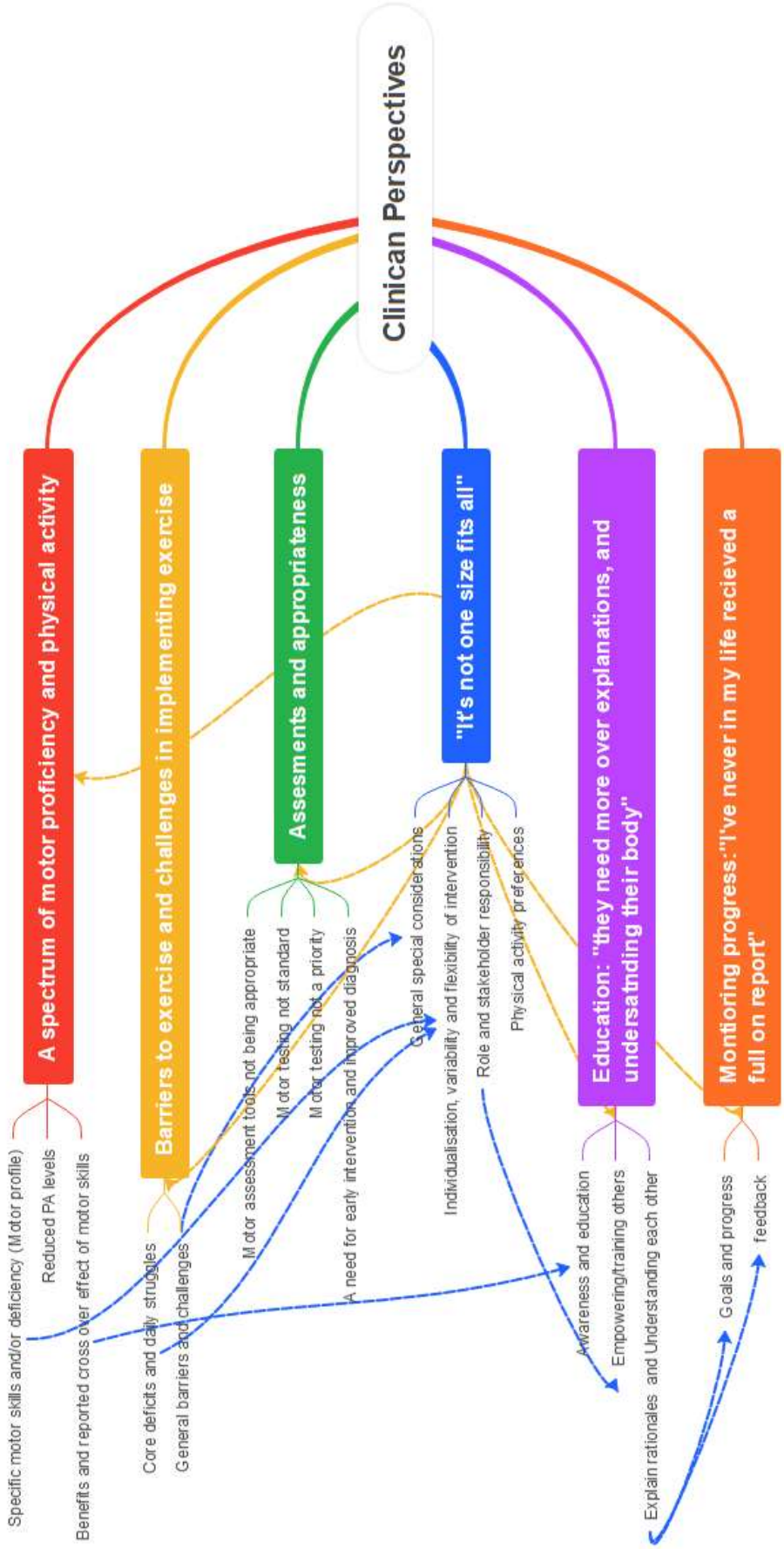


Figure 4.3: Clinician thematic map (category and theme)

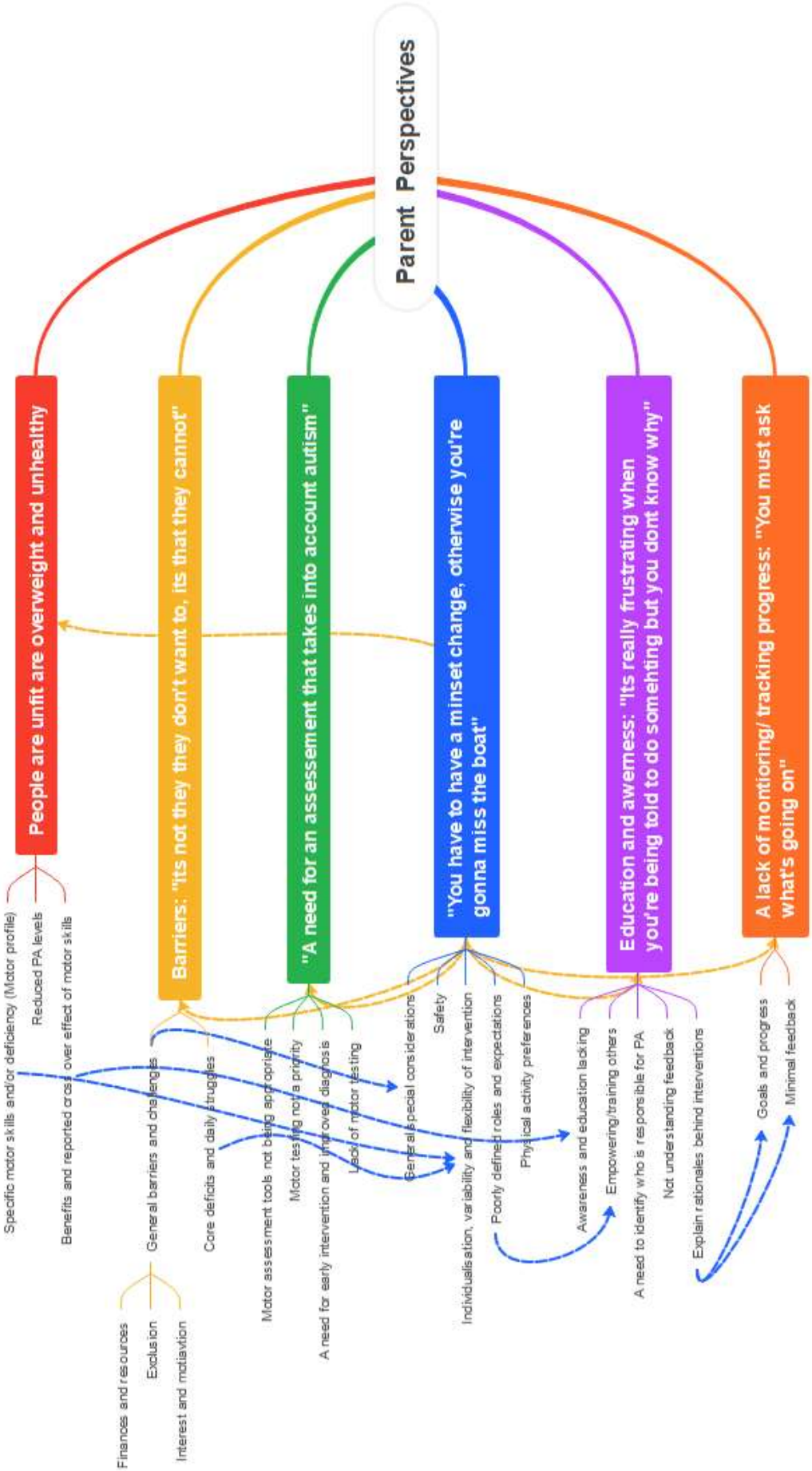


Figure 4.4: Parent thematic map (category and theme)

i. Reflexivity of thematic map generation for total sample

The researcher noted that there were overlapping themes between the three participant groups when reviewing the three thematic maps presented above. There were also connections between categories and codes. The researcher documented connections and links between the three thematic maps, which are presented in the next section. Overall, the thematic maps provided clarity for the researcher in being able to identify key areas to target in the model of care.

STEP TWO: Diagnostic

Step two of MoC development comprised of diagnosing the problem as illustrated in Figure 4.1 B below.

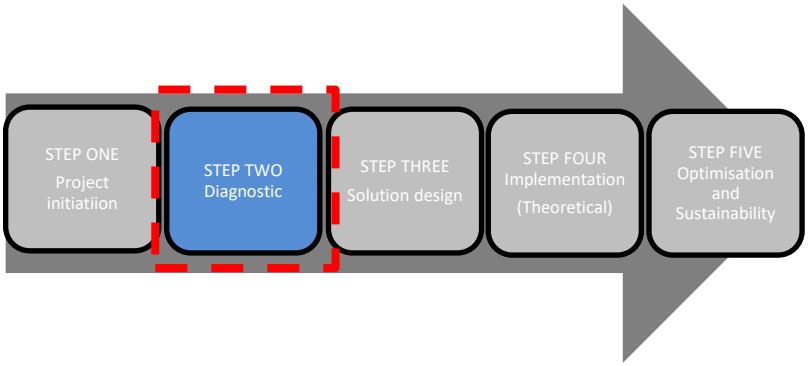


Figure 4.1 B:The MOC development process - Step two

The extent of the problem was defined using the thematic maps presented above. It became clear to the researcher that it would be necessary to merge the thematic maps to form one larger map for this step of the MoC development process. In addition, the extensive literature review conducted for the study, and a review of models of care were also used to inform and define the problem and findings thereof. These are presented below:

i. The problem defined
    a. Sample data problem identification

The information presented above in the three thematic maps were consolidated into one thematic map. First, the thematic maps were placed next to each other and the researcher highlighted the similarities (green if found in all three groups, orange if found in only two groups), differences (yellow) and relationships between codes and categories between the three groups (blue arrows). Figure 4.5 on the next page illustrates the process above. Next overlapping themes were consolidated into one final thematic map.

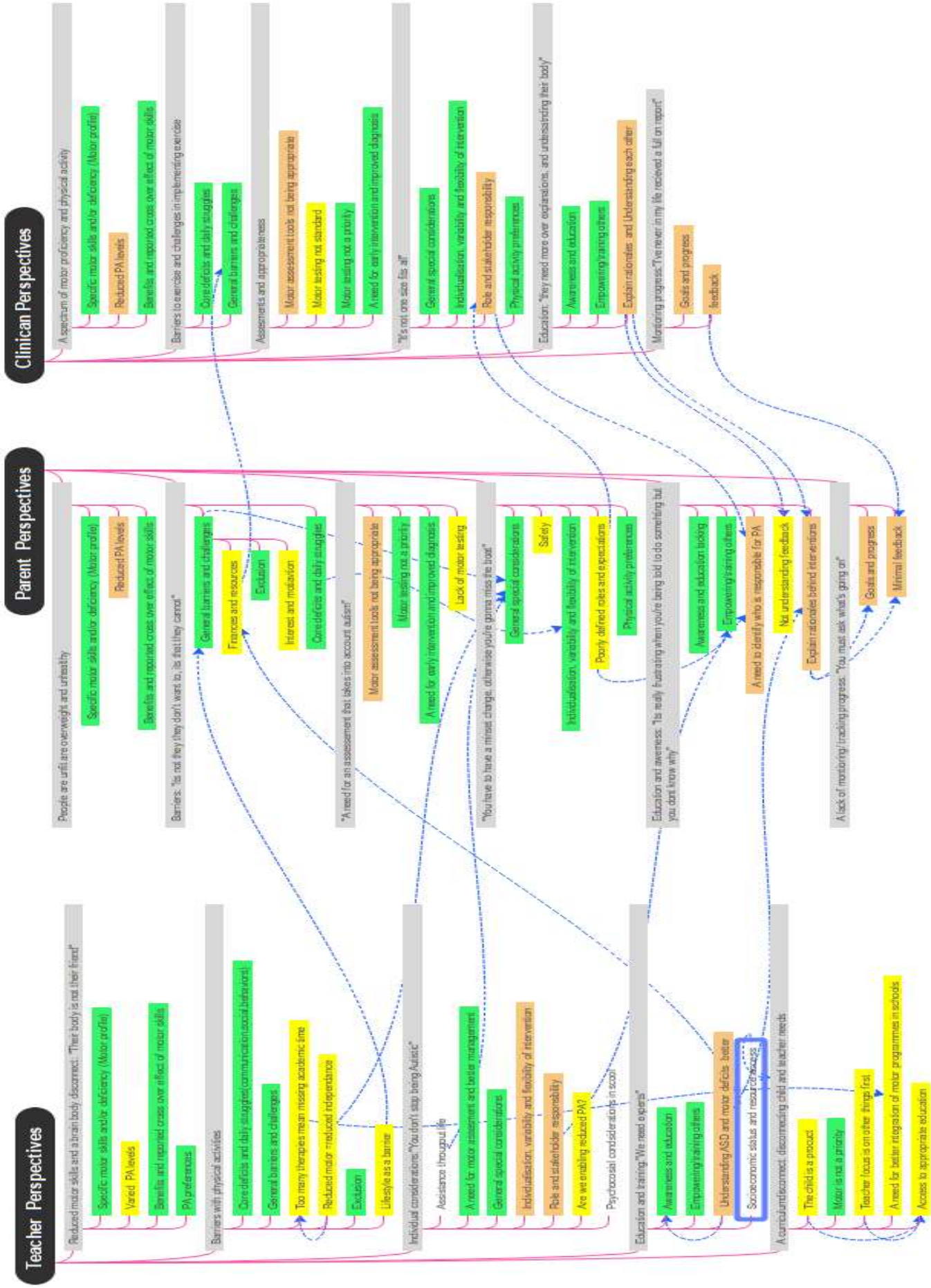


Figure 4.5:Teacher, clinician and parent thematic maps consolidated to show differences and similarities (n=26)

b. Overlapping themes leading to domain formation

Overlapping themes, categories and codes that were highlighted in Figure 4.5 were consolidated into one thematic map illustrated in Figure 4.6 below. This final overall thematic map was used to inform step three of the model of care.

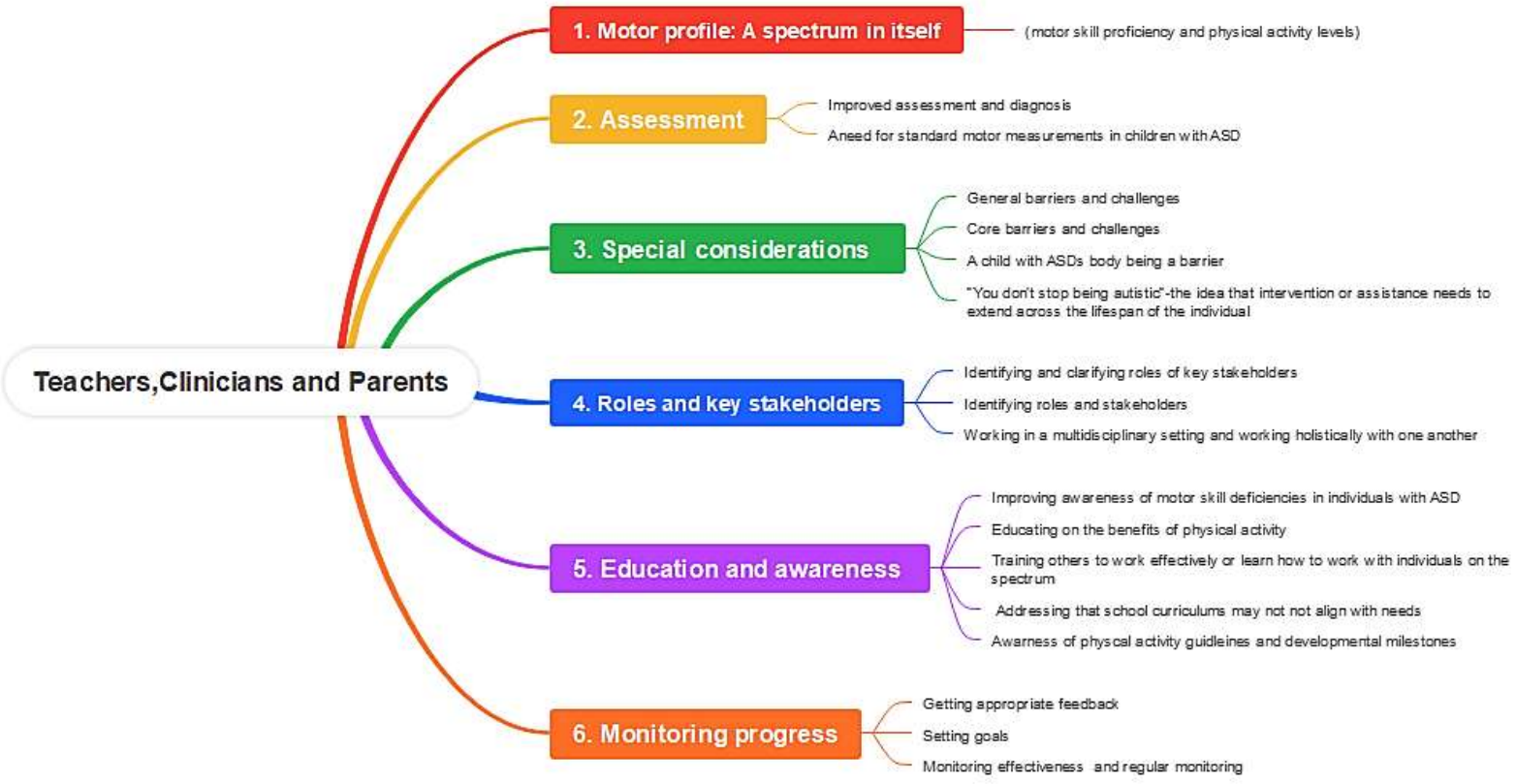


Figure 4.6: Teacher, clinician and parent consolidated thematic map showing main ideas

c. Literature review problem identification

From the literature review, the researcher identified the following concerns related to motor proficiency levels and physical activity profiles of individuals on the spectrum. Common motor deficits reported included: motor praxis, coordination and planning, fine and gross motor skills, manual dexterity, postural control, muscle strength and flexibility, gait and balance disturbances. Research indicated individuals on the spectrum engage in reduced physical activity. Additional problem areas seems to include poor or late diagnosis, inappropriate motor assessments or lack of assessment as well as non-holistic intervention and lack of intervention.

All of the above problems were indicated by some or all of the participants during the interview process. These problem areas were therefore considered and deemed necessary to include in the MoC.

Furthermore, the researcher deemed it necessary to consider and reflect on items poorly reported on exercise-based intervention studies conducted for individuals with ASD. The researcher did this by using the CERT analysis done and documented in section 2.24 of this study. The researcher considered the following poorly reported items: adherence to exercise, motivating factors during intervention, how exercises were tailored to the individual, how the starting point of exercise intervention needs to be determined, and documenting adverse reactions to exercise or understanding adverse reactions can occur. Again, some or all of the participants indicated all of the above problems during the interview process. These problem areas were therefore deemed necessary to include in the MoC. The researcher included these under the special considerations theme.

d. Symbols and colours used to depict autism – a brief review to inform model design

Various symbols and colours have been used to depict autism disorder over the years (Figure 4.7 A-G), with some symbols being deemed controversial in recent years.[193] It was therefore, important for the researcher to consider these symbols in model development from a visual perspective. The most common symbol used to depict ASD is the autism puzzle piece. The autism puzzle piece was created by a parent named Gerald Gasson who was a parent and board member on The Society for Autistic Children which is now known as the National Autistic Society. [193] The Society for Autistic Children at the time had originally adopted the puzzle piece in their logo to stand apart from other organizations, and to depict what autism was described as at the time - “a puzzling disorder” where children generally struggled to fit in. A child crying was also originally included in the logo (Figure 4.7 A) to illustrate that autistic people suffer from their condition. At present the national autistic society makes no use of this past imagery, and has redesigned and updated their logo to include colour to symbolise hope (Figure 4.7B).[193]

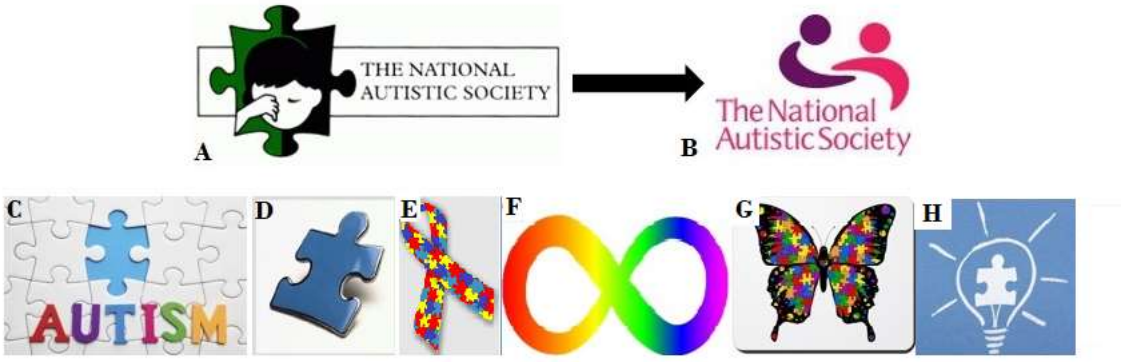


Figure 4.7: Symbols used to depict autism

A:Society for autistic children logo 1963;B:The National Society for Autism logo 2024; C&D: Examples of variations of puzzle piece logo renditions; E:Puzzle piece ribbon; F:Infinity logo with rainbow colours; G:Butterfly with puzzle pieces and rainbow colours integrated; H:Autism Speaks light it up blue campaign logo

The puzzle piece however, remains the most common symbol used to represent autism. The puzzle piece is commonly paired with the colour blue or a rainbow colour spectrum.[193] Over the years, it has attracted both positive and negative attention – where some individuals with ASD feel that it depicts the idea of individuals with ASD not being able to fit into society, or that they are not seen as fully whole people. In general it is widely accepted by the autism community. [193] The autism ribbon is another symbol used to depict autism, and generally comprises of red, blue and yellow puzzle pieces along a twisted ribbon (Figure 4.7 E). [193] Two more recent symbols now used to depict autism are the infinity symbol (Figure 4.7 F) and butterfly (Figure 4.7 G). The infinity symbol has been used to portray a message of inclusivity for individuals with ASD, while the butterfly has been used to portray a message of change, of continued development, the beauty of a different perspective and the beauty of diversity. In some instances the abovementioned symbols are used together to portray ASD.[193]

In terms of the colours mostly used to depict autism, blue is the most common.[194] The colour blue was originally chosen by general society to depict ASD as it is closely linked with feelings of calm and acceptance.[193] In fact, blue has a considerable shorter wavelength compared with bright colours, which results in reduced sensory stimulation in the brain. Thus, colours with softer tones such a greens and blues can reduce feelings of chaos and may assist in soothing sensory issues experienced by those with various conditions- including autism.[195] In addition, the organisation Autism Speaks increased the colour blues' popularity for depicting ASD through their campaign to raise awareness for people on the spectrum, which was named "light it up blue" (campaign logo depicted in Figure 4.7 H).[193] In addition to blue, a range of colours, typically in an array of rainbow colours is often used to portray that individuals with ASD fall on a spectrum - similar to

light. The colours have been used to symbolise the different abilities and challenges individuals on the spectrum may face. The rainbow colours are often paired with the above illustrated symbols such as the puzzle piece, infinity logo, and butterfly.[193]

e. Reflectivity of design elements

The researcher felt that after reviewing the symbols and colours often used to depict autism that one of the symbols should be included in the final model design. The researcher decided on including the puzzle piece into the final model design for two reasons. One, the puzzle piece would be an easy symbol to adapt, and would be a shape that writing could easily be included into. Two, the researcher felt that because the puzzle piece was the most popular symbol used to depict ASD, that it would make the model more distinguishable, in terms of it being developed for an ASD population. The researcher decided that shades of blue would be the colours best suited for the model design as this would be most ASD friendly. The puzzle piece symbol and the colour blue were therefore used as visual elements in step three to design the model.

STEP THREE: Solution Design

Step three of MoC development comprised of solution design as illustrated in Figure 4.1C below.

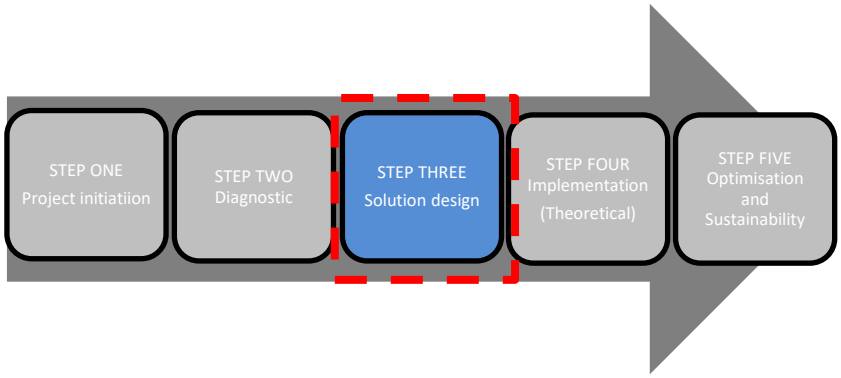


Figure 4.1 C: The MoC development process - Step three

Based on phase one data relevant domains were identified and formed part of the framework. The selection of an appropriate format for the model was based on information gathered during the diagnostic phase of MoC design - as well on what would be appropriate following the literature review.

i. The solution design

a. Consolidating data

The main themes identified from the final compiled thematic map informed the final domain names for the model, which are presented in Table 4.11. Key words are bolded to illustrate how key words were selected for the MoC.

Table 4.11: Table showing how the consolidated final themes inform the MoC domain names

Final themes identified consolidating all thematic maps	Domain name established
Varied **motor profile** and physical activity levels	Motor profile
Improved **assessmen**t/diagnosis/ and a need for standard motor measurements in children with ASD;	Assessment
Individual considerations which included : general barriers and challenges, core barriers and challenges , a child with ASDs body being a barrier, “You don’t stop being autistic” - the idea that intervention or assistance needs to extend across the lifespan of the individual	Individual considerations
Identifying and clarifying roles of **key stakeholders**, and identifying who they may be.	Key stakeholders
Working in a **multidisciplinary setting and working holistically with one another**	Implementation
Education and awareness, including : improving awareness of motor skill deficiencies in individuals with ASD, educating on the benefits of physical activity, training others to work effectively or learn how to work with individuals on the spectrum, addressing that school curriculums may not align with needs	Education and awareness
Monitoring progress, including getting appropriate feedback, setting goals to work on, monitoring effectiveness in multidisciplinary setting, working holistically with one another	Monitoring

The domains names were reflected upon and underpinning models reviewed to begin designing the model. Overall expectations for the model of the participants were considered throughout the entire design process, and helped inform the MoC infographic/handout.

b. Reflectivity of underpinning model

From the participants interviewed, there was consensus that the model needed to be extremely flexible due to the population group having various impairments along a spectrum. In addition, the model needed to allow for input from many professionals involved in the therapies and interventions of the children, and allow for feedback and regular monitoring. The researcher determined that a cyclical process within the model in which interventions could be implemented, monitored, and changed accordingly based upon the needs of the population would be of value for this population. Therefore, the "sequence of prevention" (Figure 4.8) was identified by the researcher as being a potentially effective theoretical model to be used to underpin part of the model of care. This theoretic model was developed in 1992 by van Mechelen et al.[196] In this model four clear steps are described which form part of a cyclical process.[196] In step one injury surveillance for a specific population helps inform the magnitude of the problem which is defined in terms of injury incidence and severity- making up descriptive epidemiology. In step two (making up the analytic epidemiology) there is the process of defining the mechanisms of injury and risk factors of injury leading to injury occurrence. In step three an intervention is implemented to try and reduce the risk of developing the previously defined injuries and or the severity of these injuries. In the final step an evaluation is conducted to determine if the intervention was effective and the first step is repeated to determine if the problem was reduced, the cycle continues until the intervention is deemed to be effective.

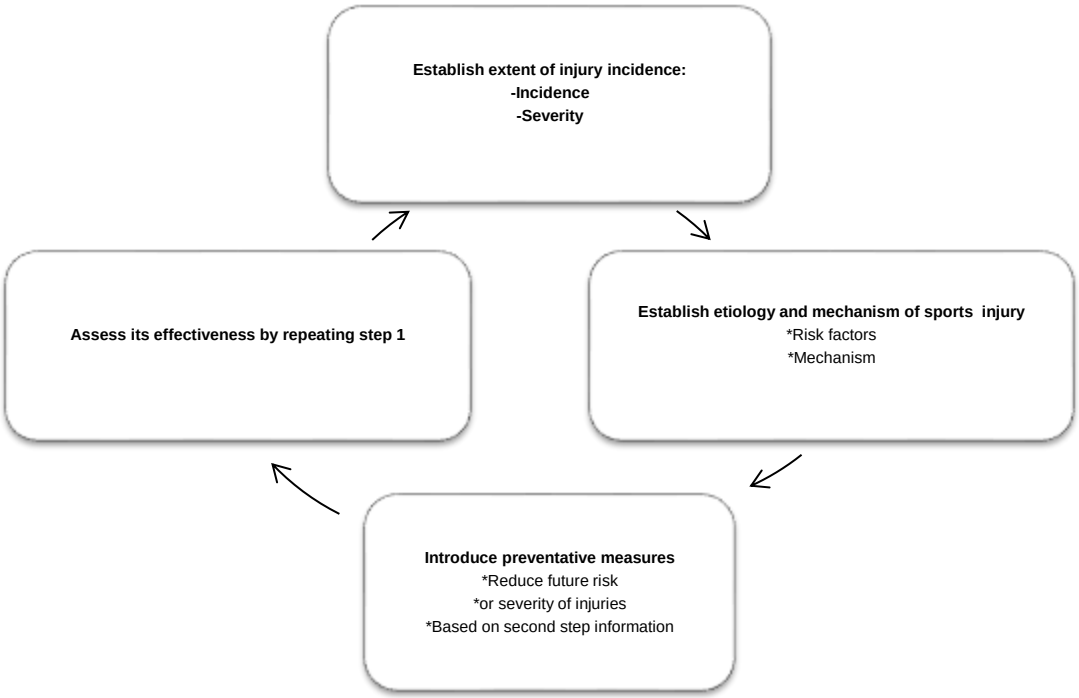


Figure 4.8: Sequence of prevention as per van Mechelen et al. [3]

The researcher felt that this cyclical model could effectively underpin part of the model of care for individuals with ASD specifically targeting motor proficiency and physical activity levels. The researcher postulated that in adapting the above theoretical model, the extent of injury incidence could be replaced by establishing the extent of autism motor proficiency deficits and physical inactivity level incidence (see Figure 4.9A). This, would inform the overall motor profile of an individual on the spectrum. In step two, establishing the etiology of the motor proficiency deficits and severity of such, would depend on appropriate and relevant motor and physical activity assessments to determine exact motor deficits and the extent of physical inactivity, as well as determine what the risk factors or barriers would be for the population. In step, three flexible and adaptable motor-focused interventions can be implemented to mitigate the issues identified in step one. In step four these interventions can be monitored and assessed to determine effectiveness.

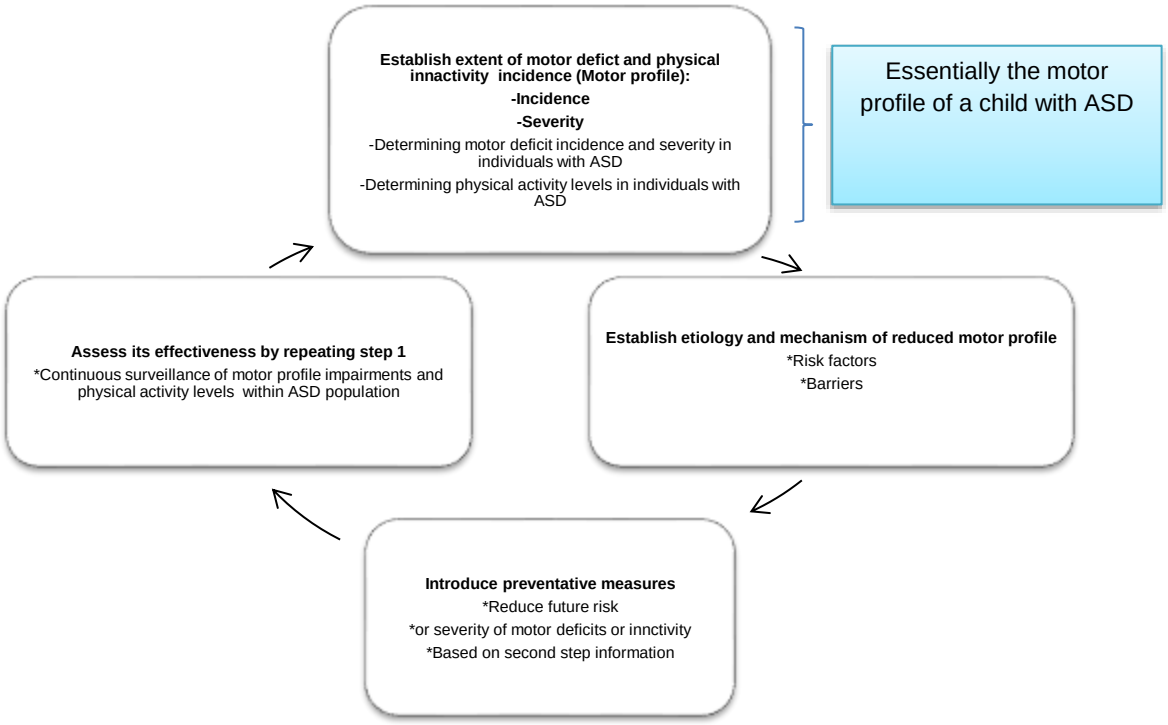


Figure 4.9A: Adapted sequence of prevention for motor deficit and physical inactivity in children with ASD.

One of the biggest themes that emerged from the interviews of the participants was education and awareness regarding impaired motor profiles and reduced physical activity levels. Although education and awareness could fit into the above model as a barrier towards understanding that

motor deficits exist within the population as well as in potentially preventing the engagement of physical activity due to motor not being seen as a priority of patient management . The researcher felt this theme should be a standalone part of the process as well as the starting point for the model of care (see Figure 4.9B below). This being a standalone process, would aid in potentially creating the buy-in needed from individuals engaging with people on the spectrum, as well those with autism themselves to engage with, and follow the rest of the cyclical sequence within the proposed model of care. The cyclical process now described would comprise of five steps instead of four. The researcher assigned single key words to each process of the cycle to be used in the model design, namely: education and awareness for step one, motor profile identification for step two, assessment for step three, intervention implementation for step four and monitoring for step five.

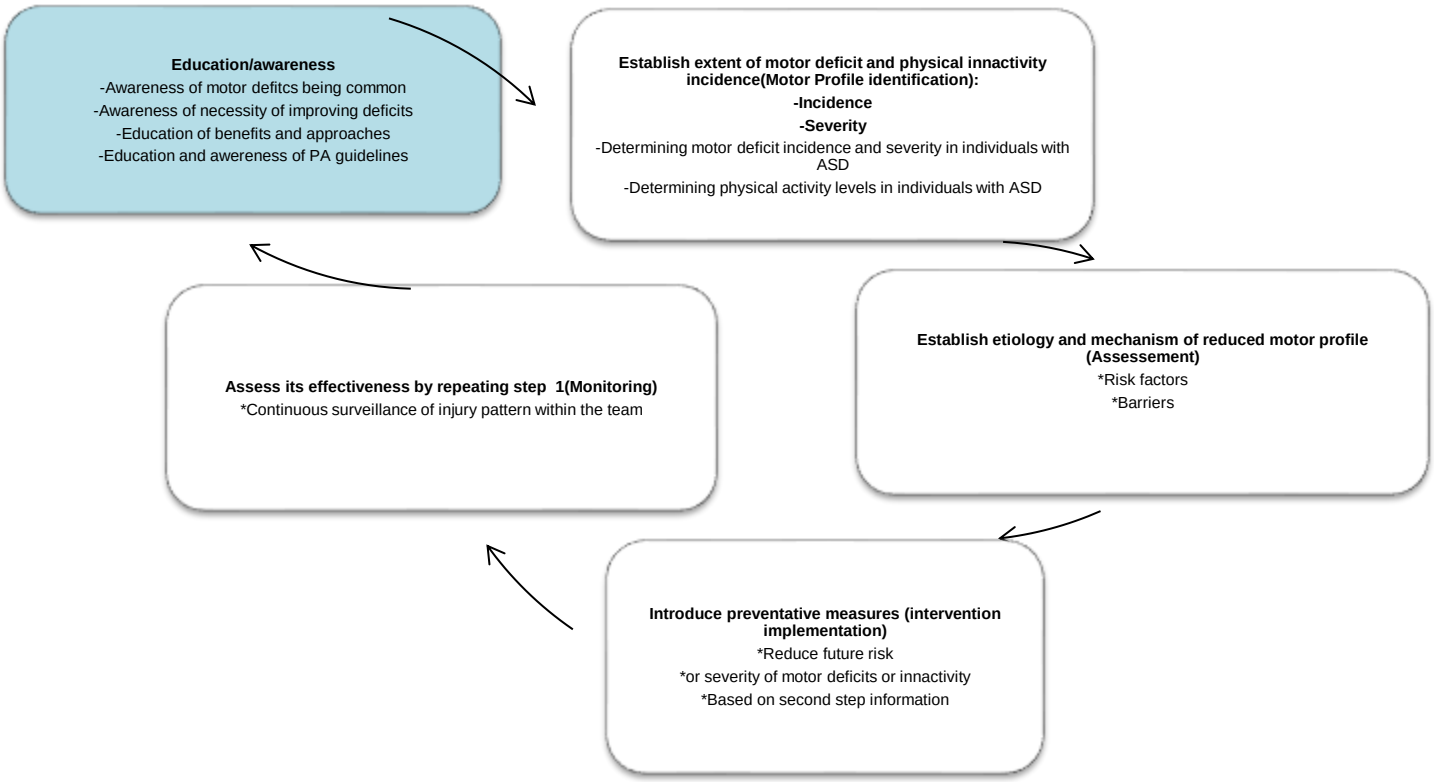


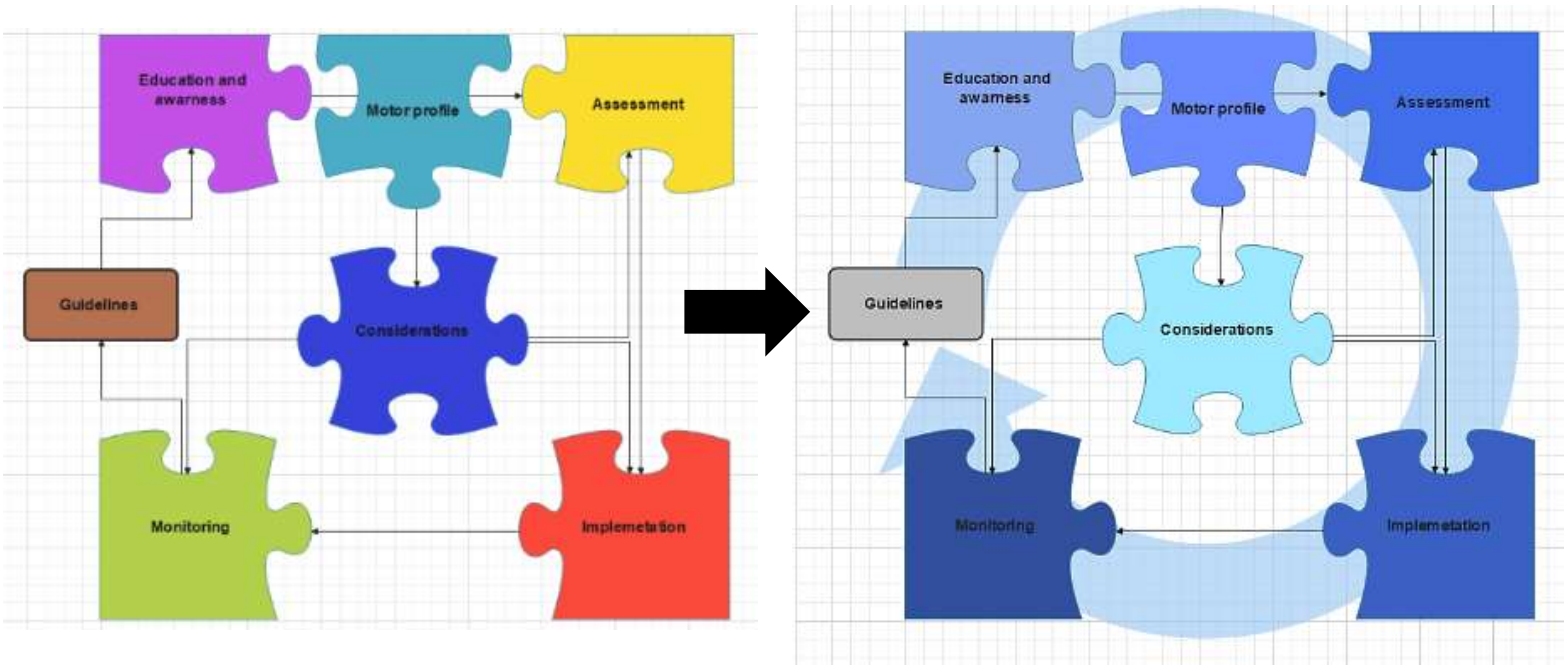
Figure 4.9 B: Modified adapted sequence of prevention for motor deficit and physical inactivity in children with ASD including education and awareness as a starting point in the cycle.

The largest theme that emerged from the participants was special considerations when working with individuals on the spectrum. Due to each individual on the spectrum being so different and having varied levels of impairment and function in terms of core deficits, motor abilities and other

general challenges, the researcher felt that this theme needed to be central to all of the steps described above - this was reflected in the initial designs that follow.

c. Initial design and progression of designs

The researcher investigated numerous overall model designs prior to designing the model. In general it appeared to the researcher that most models made use of simple block designs. This allowed for more text to be included, writing to be the focal point and space to be used most effectively. The model was drawn up using diagrammatic software (Wondershare Edraw Max) and discussed with supervisors. The model was changed and developed further following discussions with supervisors and their feedback (Figure 4.10 A-E) until a final version was compiled by the researcher and checked by her supervisors. The researcher was conscious to depict the model as a complete puzzle piece made up of freestanding pieces so as to mitigate feelings of "incompleteness" from individuals' on the spectrum, or those interpreting on behalf of them - based on review of autism symbols and colours.



A B

Figure 4.10 A-B: MoC design variations over time following feedback from supervisors

Figure 4.10 The adapted sequence of prevention was modified further and made ASD specific using puzzle pieces and a spectrum of colours. Making individuals aware of physical activity guidelines were the starting point of the process. This initial design was changed to use different

tones of blues instead of many colours, following research on symbols and colours used to depict autism (Figure 4.10 B).

Supervisors indicated that central to the figure should be the “individual”, and that special considerations could be presented along the individual depicting that each individual would need to be considered on an individual level, and that special considerations would be central to all processes in the model. The supervisors discussed where stakeholders should feed into the model and who they should be – it was suggested that follow up questions in the nominal groups should ask the participants who they think should be included in the model and where they would fit in. These changes were updated and corrected in Figure 4.10 C.

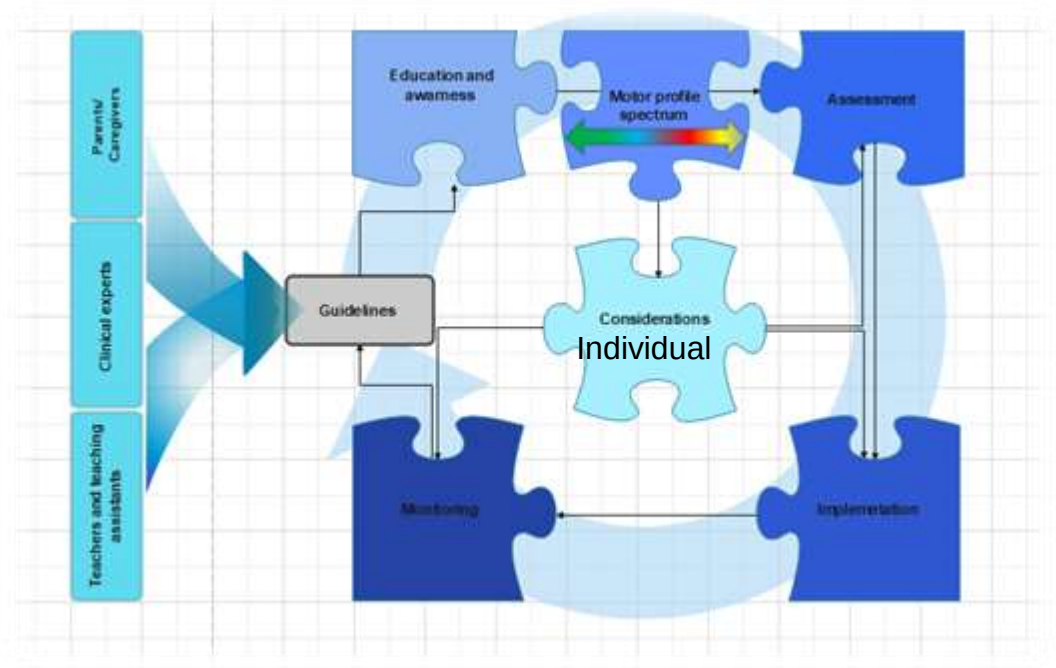


Figure 4.10 C: MoC design variations over time following feedback from supervisors

Figure 4.10 C: The design was updated to include where stakeholders could feed into the model. It was advised that the defined individuals should outline the model in some way. Furthermore, supervisors stated that the physical activity guidelines should not be the starting point of the cycle but rather form part of education and awareness as knowing or not knowing the guidelines would not be the guiding force for using the model. These changes were made and are presented in Figure 4.10D.

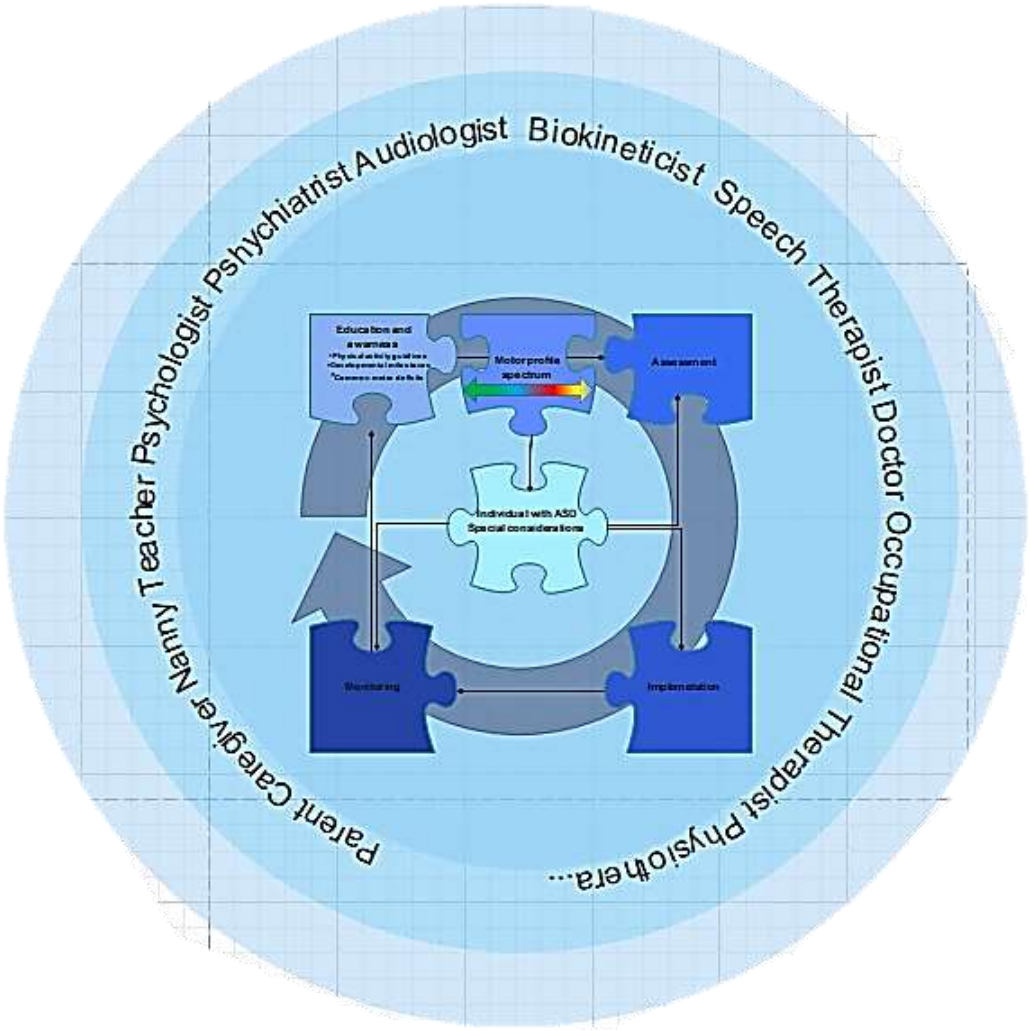


Figure 4.10 D: MoC design variations over time following feedback from supervisors

Figure 4.10 D: A more cyclical design was presented to supervisors with the individual central to the design, and special considerations surrounding the individual and linking to all aspects of the sequence of prevention process. An arrow below the words motor profile was added to graphically represent that all motor deficits making up the motor profile could be on a spectrum in terms of proficiency. At this point the researcher felt that the puzzle pieces were too far apart in the design and that the model image could be clearer with better design elements. The researcher did further research into graphical models and revised the model to be more visually appealing.

Figure 4.10 E: The design was updated with the individual central to the design (represented by an image of a person), and the wording “special considerations” was stretched and arched to surround the individual. Puzzle piece arms extend out from the center circle to indicate that the considerations and individual would be connected to the prevention process throughout the 5 processes in the model. The cyclical arrow was removed in favour of linking puzzle pieces with number denoting process order. Stakeholders were arced and stretched around the central

process, indicating that that they could influence and be included in all areas of the model. Supervisors asked that the central icon of the person be made more childlike and that we would need to consider the models' micro, meso and macro environment and how the model would fit into that. Lastly, they stated the terminology "special" considerations may have derogatory connotations and that we should consider changing it to "individual considerations".

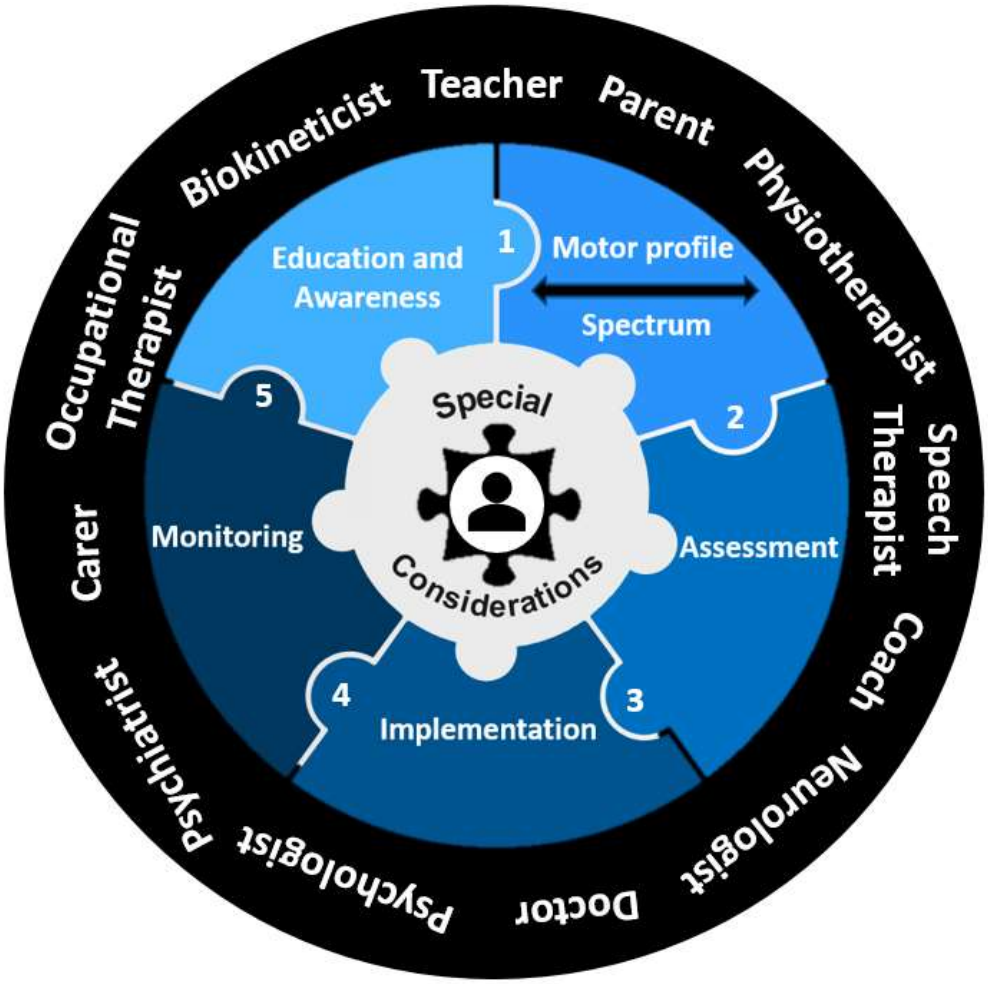
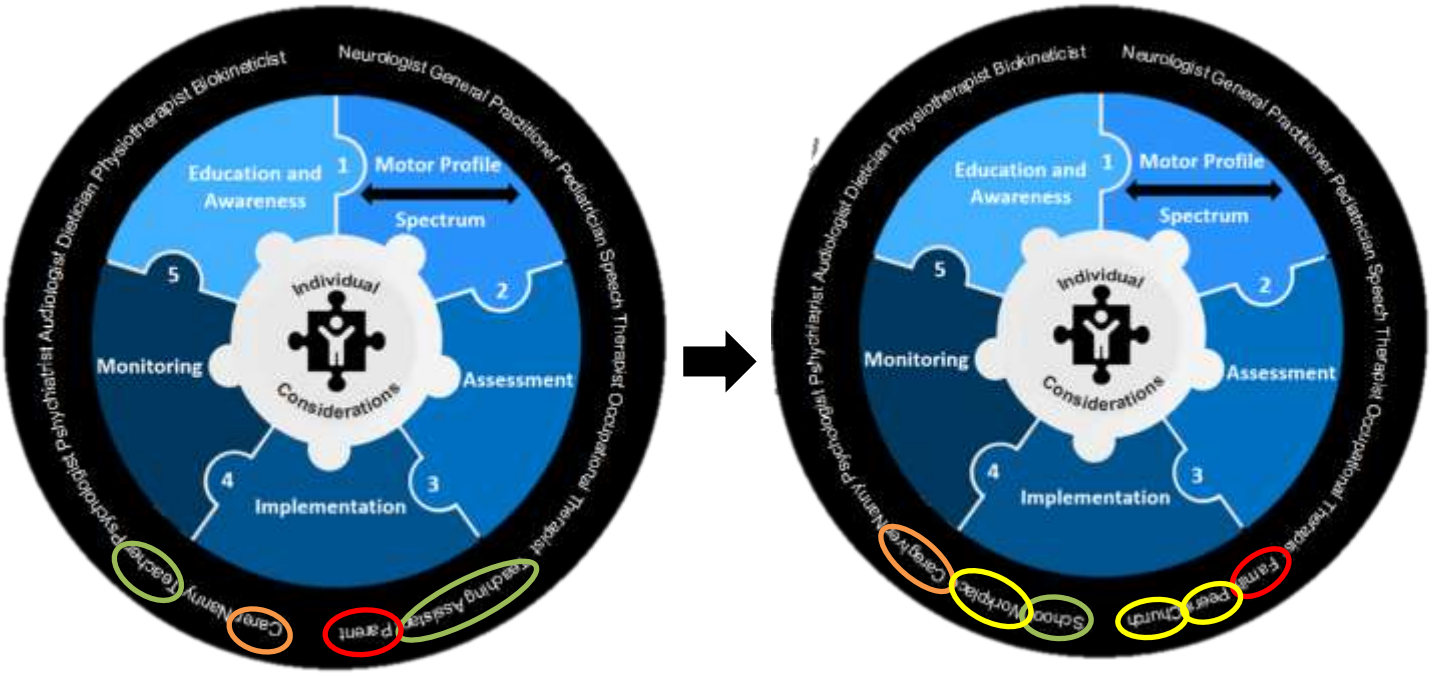


Figure 4.10 E: MoC design variations over time following feedback from supervisors

d. Final design

Figure 4.10 F: The researcher made the changes to the center of the model as well as the outer loop as per supervisors' requests. The center image was updated to reflect a child symbol; the words special considerations were modified to "Individual considerations" and key stakeholder

were stretched and looped around the outer ring for better visual appearance. Changes were made to key stakeholder names following the review of further literature detailed below.



F G

Figure 4.10 F & G: MoC design variations over time following feedback from supervisors

The researcher reviewed further literature regarding micro, meso and microsystems. The researcher reviewed the developmental systems approach, which a principle theoretical viewpoint on evolution, heredity and biological development.[197] The researcher felt that this theory did not effectively provide context for the model within a larger framework.

The researcher reviewed the family systems theory as postulated by Murray Bowen,[198] which was established to advise family therapy. It highlights that the therapist or clinician must work in conjunction with the family to improve patterns of action and thought in a systematic and consistent manner. The researcher felt that the proposed model of this study already encompassed this notion. The key stakeholders are represented in the model surrounding the individual, on the same "level" or in the same system to reflect and encourage multidisciplinary interaction and holistic or team approach. Although the theory describes optimal engagement and interaction between family, clinicians and the individuals from a clinical perspective, again the researcher felt that this theory did not effectively provide a larger context for the model in which to fit.

The researcher then reviewed the transactional model of development postulated by Arnold Sameroff.[199] This model suggests that human development occurs as a result of bi-directional interplays between the individual and their community, family, society and cultural context (where the individual can influence or be influenced by the interactions).[199] Lastly, the ecological system postulated by Urie Bronfenbrenner (Figure 4.11) was reviewed.[200]

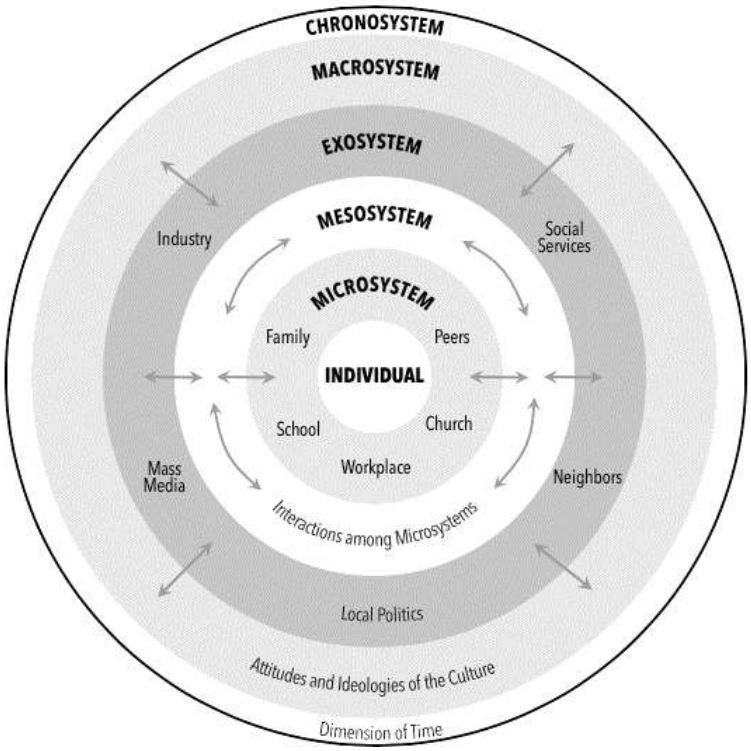


Figure 4.11:Ecological system as postulated by Urie Bronfenbrenner [201]

The ecological systems theory portrays the individual as being central to the framework whereby the individual is described as a developing physical-and-psychological who engages with five levels or systems including the microsystem, mesosystem, exosystem, macro system and chronosystem. [200] The microsystem includes the immediate social connections of the child, including family, peers and other relationships (social groups, organizations (e.g. clubs, church), and institutions e.g. school, workplace), which can influence the development of the child. [200] The mesosystem includes the greater "web of associations and possibilities" that come about from the interactions between those in the individual's microsystem.[200] The exosystem includes the backdrop or context in which an individual finds themselves, including for example government,

legal, industrial and financial systems, and the macro system includes the associations that come about from interactions within the exosystem. They can include the values of society or cultural traditions for example. [200] Lastly, the outer-most system is known as the chronosystem and can include the environmental, sociohistorical and another changing patterns across the lifespan of the individual. [200]

Following the understanding of the micro, meso, exo and macro systems the researcher decided to update the microsystem and the key stakeholders to be more thorough. and to reflect those making up the microsystem as described by Urie Bronfenbrenner.[200] The words, teacher and teaching assistants were changed to “school” (indicated in green) and the word parent was changed to “family” depicted in red. The term school would allow for not only teachers, teaching assistants to be included but other individuals who could assist at a school level where it be a principal or other individuals based within a schooling environment, it is a more encompassing term. Similarly the term family was more encompassing than the word parent. Additional categories were included including “workplace”, peers and church indicated in yellow. Lastly, the word “carer” was updated to “caregiver” (orange) as it was more formal.

Although Bronfenbrenner used the words “health services” as a whole to describe those providing healthcare services within his microsystem, the researcher decided that naming specific professions would be important to provide a guideline to those seeking therapy or management as it would allow for potential key clinicians/professions to be identified. In fact, during parent and clinician interviews it was mentioned that, 1) parents did not know which professionals they needed to seek assistance from, and 2) clinicians where unsure of the scope of other clinicians and who other key stakeholders could be in terms of administering specific therapies to children with ASD. The researcher felt that naming the clinicians might assist with the identification of who could assist individuals in terms of therapies. Education regarding scope and roles of clinicians could be integrated into the educational component of the model. The researcher added in an exosystem surrounding the model in the form of a dark gray outer circle and included the terms “mass media”, “industry”, social services” , “neighbours”, and “local politics”. Lastly, the researcher added one final circle depicted in light grey which comprised the macro system and the term “attitudes and ideologies of the culture” were housed within this system. This outer ring could encompass the social attitudes and perceptions towards ASD, potential stigmas associated with the condition and how different cultures navigate the management of individuals on the spectrum (inclusion vs exclusion).

As per the researcher's supervisors the micro, meso, exo and macro system would be discussed in the nominal group discussion with the participants of the study to determine appropriate and need of these outer rings being included in the model. The final design is illustrated in Figure 4.12 below. The researcher added one last design element to the final design which was puzzle notches between the systems (outer rings), which was in keeping with the theme, to indicate a relationship between all levels and systems. The model was then tweaked following one final meeting with supervisors and finalised prior to phase three.

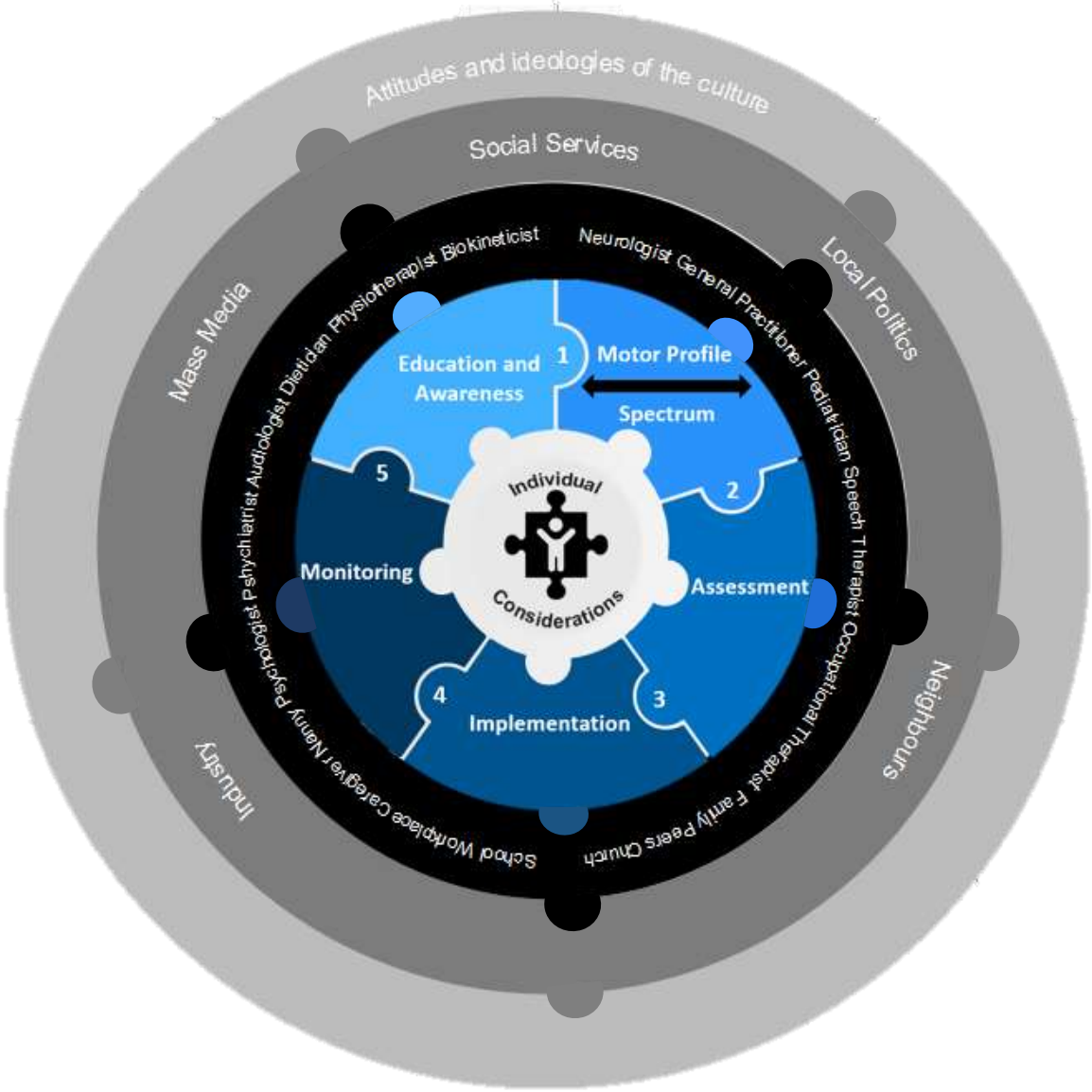


Figure 4.12: Final design presented to supervisors

e. Accompanying infographic/handout

During the interviews with the participants of this study, numerous expectations of the model were described. One of the main expectations was that information would be provided to create awareness and education surrounding physical activity guidelines and developmental motor milestones. Participants, in particular the parents and clinicians, wanted clarity on common motor variables that could be deficient in an individual on the spectrum. Specifically, clinicians wanted a guideline on what variables to consider for testing. Improved assessments and knowing how to assess was asked for, and direction on what to consider for the individuals and a better understanding of barriers the individual may face when trying to implement activity-based interventions. The researcher therefore, felt that it would be necessary to provide an accompanying handout with the model to meet participant expectations.

The researcher developed the infographic using the main domains central to the model and expanding on the information summarised in participant interviews. Information regarding, physical activity guidelines, as well as guidelines for how the individual should feel, were things the researcher deemed important to include. Other information regarding barriers towards physical activity, individual considerations and how interventions should be implemented was also included in the handout. The handout was checked by the researcher's supervisors and changes were made accordingly.

The infographic was designed keeping the same design elements and colours for continuity purposes. The final infographic/handout can be seen in Figure 4.13. The handout consisted of two pages. Page one of the handout was designed specifically for the individuals working with children ASD, whilst page two was designed specifically for children with ASD. The handout was presented at the end of the nominal group discussion to obtain feedback from the participants.

A Model of Care for ASD: motor skills and physical activity

GUIDELINES AND BENEFITS

Kids and teens (aged 6-17) should perform:

60	Minutes per day of moderate to vigorous physical activity	3	Days of the week bone strengthening activities	3	Days of the week performing muscle strengthening activities

BENEFITS OF PHYSICAL ACTIVITY & IMPROVING MOTOR SKILLS

- Improved bone and joint health
- Maintenance of a healthy body weight
- Improved flexibility and mobility
- Improved cognitive function and mood
- Improved sleep and appetite
- Reduced stereotypic behaviours
- Prevention of chronic diseases
- Improved performance of activities of daily living
- Increased independence



MOTOR PROFILE

Individuals with ASD may have motor difficulties, which fall on a spectrum in terms of level of proficiency

LOOK OUT FOR POSSIBLE IMPAIRMENTS IN:

- Gross and fine motor skills
- Flexibility and mobility
- Balance and proprioception
- Gait and posture
- Muscle tone and strength
- Coordination
- Bilateral integration
- Midline crossing
- Body control
- Quality of movement
- Poor praxis and motor planning
- Ball skills and manual dexterity
- Visual motor skills
- Performing activities of daily life
- Reduced fitness

ASSESSMENT

Motor skills and physical activity levels should be regularly assessed in children with ASD.

GOALS OF ASSESSMENT

- Tailor the assessment approach to the specific needs, abilities, and characteristics of the individual being assessed, considering factors such as age, developmental level, and cultural background.
- The assessment should be flexible and adaptable to account for the large variability within the ASD population.
- Appropriate motor assessment tools should be used and/or can be adapted to assess children based on specific needs.
- Determine baseline proficiency for as many of the motor difficulties the individual struggles with.
- Determine short term and long term goals for the individual
- Determine time points as to when reassessment should occur
- Provide feedback of all findings to all individuals involved in the child's management plan

IMPLENTATION

Individuals with ASD should regularly engage in physical activity and should be enrolled in motor skill programmes if needed

IMPLENTATION SHOULD:



- Be individualised, flexible and adaptable
- Should consider all individual considerations (core deficits and others)
- Should consider all barriers towards physical activity participation
- Should be designed using a multidisciplinary approach to create a holistic management plan
- Restore/improve overall physical health
- Improve social, behavioural and cognitive deficits through physical activity
- Improve quality of life and overall wellness
- Minimize the risk of injury or chronic illness in the future

MONOTORING

Any intervention or programme developed for individuals with ASD should be monitored regularly to determine effectiveness

MONITORING SHOULD INFORM

- Whether changes or adaptations need to be made
- Future implementation for needs not met
- What other strategies should be used in conjunction with the current one and which key stakeholders need to be involved
- Whether further awareness or education is needed regarding the current strategy implemented
- Determine if programmes/interventions need to be adapted in any way, and whether they need to be progressed or regressed and if they should continue

Overall monitoring should involve all people involved in the management and care for the individual on the spectrum

Figure 4.13: Infographic/handout presented to supervisors (Page1)

WHY IS EXERCISE SO IMPORTANT

1. Super Strong muscles: When you exercise, your muscles get stronger and stronger! Strong muscles help you run faster, jump higher, and climb higher than ever before.

2. Happy Hearts: Exercise makes your heart super happy! When you move your body, your heart gets stronger, pumping blood all around your body and keeping you healthy and strong.



3. Brain Boost: Did you know exercise makes your brain super smart? It's true. When you're moving and grooving, your brain releases special chemicals that help you focus better, remember more, and be the best superhero thinker ever!

4. Energy Explosion: Exercise gives you a burst of energy, like a rocket launching into space! When you're active, your body makes energy to keep you going all day long.

5. Happy Vibes: Moving your body makes you feel happy inside and out! So, put on your smile and get ready to feel fantastic!

6. Super Sleep: After a day full of adventure and exercise, your body is ready for a super sleep! Exercise helps you sleep like a superhero, so you wake up feeling refreshed and ready to conquer the day



A Model of Care for ASD: Educational handout for children





HOW TO BE AN EXERCSISE SUPERHERO

Find Your Fun: Everyone has their own special way to move! Whether it's dancing, playing soccer, jumping rope, or even just running around with friends, find what makes you feel like a superhero and go for it!

Power Up: Before you start moving, make sure you've got your super fuel! Drink water and eat healthy snacks like fruits and veggies to give your body the energy it needs.

Warm-Up Time: Just like superheroes warm up before a big mission, you should warm up your body too! Do some stretches or light jogging to get your muscles ready for action.

Move and Groove: Now it's time to shine! Run, jump, skip, hop, and play to your heart's content. Remember, the more you move, the stronger you become!

Cool Down: After your adventure, it's important to cool down. Take some deep breaths, do some gentle stretches, and thank your body for being so awesome.

Super Rest: Every superhero needs their rest to recharge their superpowers! Make sure you get plenty of sleep so you can wake up ready to conquer the day

HOW DO SUPERHERO BODIES FEEL WHEN EXERCISING?

Pumped up Heart



When you're exercising, your heart starts to beat a little faster, but not too fast. It's like a drum keeping the rhythm of your adventure!

Breath of Fresh Air

As you move, your breath becomes deeper and more steady, filling your lungs with fresh air like a gentle breeze on a sunny day. Breathing deeply helps you feel calm and focused, ready to take on any challenge with ease.



Mighty Muscles



As you move, your muscles start to feel strong and powerful, like they're ready to take on any challenge.

Flexibility Freedom





You become as flexible as a rubber band, bending and stretching with grace and ease. Reach for the stars and touch your toes – your body can do amazing things when you set it

Energized Engine



You might feel like you have a lot of energy bubbling inside you, ready to burst out like a superhero ready to save the day!

Sweaty Superhero

You might start to feel a little sweaty, but that's totally normal! Sweating helps your body stay cool and shows that you're working hard and having fun.



Figure 4.13: Infographic/handout presented to supervisors (Page2)

4.5 Phase 3 data-finalizing the MOC

4.5.1 Objective 1

Objective1 : To establish whether a newly developed model of care for children with ASD focusing on motor proficiency and physical activity levels meets the expectations of teachers, clinical experts and parents.

During phase three, a modified nominal group discussion was carried out and the newly developed MoC was discussed to determine if it met the expectations of the teacher's, parents and clinicians previously questioned in the interviews in phase one. The nominal group discussion was carried out by the researcher using guiding questions falling within four main themes. The themes of the nominal group are presented below, and have been designated to either step four or five of the overall model of care development process.

The changes suggested in the nominal group discussion by the participants are presented after this and are later shown to be incorporated into the model. The final model is presented in concluding the MoC process at the end of this section.

4.5.2 Nominal group discussion <u>themes</u>

The nominal group discussion comprised of four themes:

1. Theme one: model implementation
2. Theme two: model domains
3. Theme three: visual aspects and design
4. Theme four: model efficacy measures

Theme one was designated to step four in the overall MoC design, which comprises the theoretical implementation process. Theme two and three informed the optimisation component of step five of the MoC process, while theme four informed the sustainability component in this step. Nominal group discussion data are presented under each relevant step in the next section.

4.5.3 Completion of model of care via theoretical implementation, optimisation and sustainability

STEP FOUR: Implementation

Step four of MoC development comprised of theoretical implementation as illustrated in Figure 4.1D below.

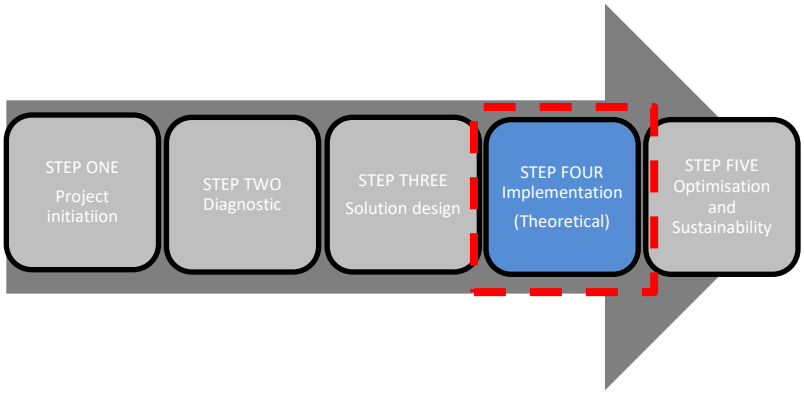


Figure 4.1 D: The MoC development process - Step four data

i. Theme one: model implementation

Two guiding questions were asked to gather information regarding model implementation. These are presented below with the findings from the discussion beneath.

Question 1: How do you feel the best way to implement the model would be ?
Question 2: Who do you feel should be responsible in implementing the model and why ?

The participants discussed who should be responsible for implementing the model and in which settings we would need to distribute the model in . Following the discussion with the participants, it was believed that effective implementation of the model of care would require a bottom-up approach, with a focus on community-driven efforts rather than relying solely on government involvement.

"I think the government should put it as high as possible so they can start making an awareness from the top. Ohh and then they can help to sponsor it too, everything needs money." -Parent 4

One of the parents, in particular, emphasised the importance of starting small using the passion of individuals within communities to drive the distribution of the MoC. In response to the initial suggestion by one of the parents stating the model should be implemented at a governmental

level, she stated that she was unsure about securing government funding, and stated that there were often problems in obtaining support. She therefore, advocated for engaging with volunteers and resources individuals already had access to, such as schools, doctors, and religious institutions, to initiate awareness and implementation efforts. She also stated that she would herself for example advocate for the implementation within her own community.

"I think that if we can maybe get individuals like a mom in a town or a for example, or maybe an occupational therapist or speech therapist, anything in a town that was OK.I will implement this. I will chase the stream and I will put it into our community and I will try to. Then you don't really need funds because the person will say, OK, I will do this in my time, and then when I have the time to do it, for example, I am, I can, I can see myself implementing this thing in our community."-Parent 7

Another parent, supported the idea of initially trying to involve the government for more greater awareness as well as funding, but also acknowledged that there were challenges with this approach. Importantly however, he highlighted the importance of obtaining financial resources as well as other resources (for example the use of volunteers) for initiatives like these. He also suggested that trying to access government departments to specifically support and initiate the process of implementation of the MoC would be beneficial to this process. Yet, there was some disagreement between participants on this point.

A very important point was raised by one of the parents regarding privilege, and potential challenges faced by parents in communities with reduced access to resources. She emphasised the need for having a more open mind-set and a greater perspective in being more understanding of individuals not having access to various resources. She also suggested that we would need to consider the differences of the socio-economic levels within South Africa- specifically in the rural areas, where they could have reduced or limited access to resources and support. This sentiment resonated with the group, which prompted a re-evaluation of the proposed strategies.

"I also do think that we also need to understand the privilege of the people on this call in terms of having to deal with these certain things. In my mind, I'm thinking about the parent in a rural South African community that does not have the exposure that we might have that does not have the resources that we might have and how they do. We expect that period, that individual, that community that has is riddled with struggle to be a champion in this particular regard. Yes, your child might be on the spectrum. Yes, your child might be, you know, non-neurotypical. But you're fighting so many other demons. I think we also need to think about it from a wider and deeper perspective." - Parent 5

The group then reached an agreement following continued discussion that distribution of the MoC should begin using a bottom up approach as initially suggested. The group agreed that distribution should begin by distributing information to healthcare professionals and practitioners. One of the clinicians supported this and also reported that there should be a focus on engaging local doctors and clinics, which often serve as the first point of contact for parents seeking assistance for their children. All of the participants agreed with this, and believed that this approach would be a practical way to reach families in need, as well as assist in facilitating referrals to relevant services.

"I think a lot of the time the parents go to the clinics for the first port of call and it doesn't go any further. So starting from there, because they often the ones that will then make the referrals as well as your profession, your health professionals."-Clinician 4

The group also discussed the potential role of schools and religious institutions in spreading awareness and facilitating community engagement.

Also, religious institutions, they also have a big following. So if you can get to them and then they can announce it in the places because people tend to think religion is a very life and death thing, so they will listen to that. More like Ohh this is my soul involved. Yeah. So if you can get the clerics too to say something that could be interesting."- Parent 4

Consensus was reached on the importance of community-led initiatives as well as using existing networks to effectively implement the MoC. While the majority of the participants acknowledged the challenges and how complex this process could be, they agreed on making use of practical solutions (such as engaging with community members and local professionals) in order to make a meaningful impact as a starting point.

The researcher will use the bottom up approach and distribute the completed MoC as described above to implement the MoC following completion of this study.

STEP FIVE a: Optimization and sustainability

Step five of MoC development comprised of optimising and considering sustainability of the problem as illustrated in Figure 4.1E below.

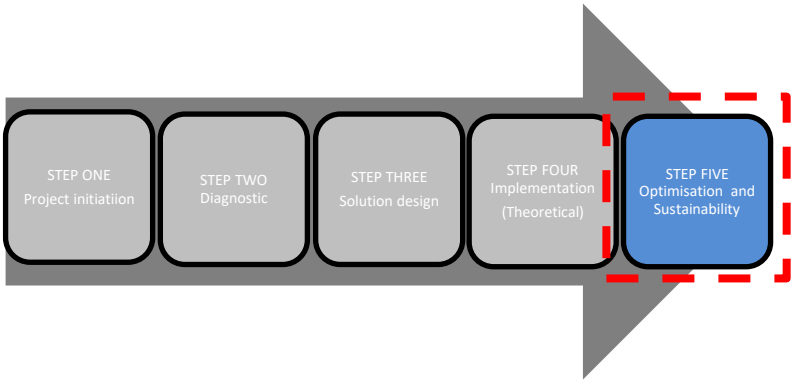


Figure 4.1 E: The MoC development process - Step five data

i. Theme two: model domains

Six guiding questions were asked to gather information regarding mode optimisation. These are presented below with the findings from the discussion beneath. Table 4.12 below presents the findings to summarise and rank the key suggestions and indicate what the appropriate changes would entail to accommodate these suggestions.

Question 1a: Starting at the centre of the model – does the inner ring make it clear the individual is central to the model?

Question 1b:Are you happy with this concept and component?

There was a group consensus regarding the fact that individuals with ASD should be central to the model. However, one participant suggested that the current model didn't adequately reflect the importance of other individuals in the support system, such as family, community, and healthcare providers. She proposed moving the black ring representing the key stakeholders/ support systems around (and therefore closer to) the individual, which would assist in highlighting their crucial role in the assessment, implementation, and monitoring processes. She suggested that by doing this, it would better draw attention to who would be the initial points of contact and support providers for the individuals. A discussion was had around this amongst the participants,

and a group consensus was reached to make this change, as they all believed this change would illustrate and potentially help foster a more inclusivity within the model.

"It's not showing support from the inner circle of the model where the support should start."- Teacher 2

"The black systems are the systems that would open my mind and bring you know that ,and hold and take me into the journey of educating me, making me away, giving me the diagnosis, helping me with assessments and all of that." -Teacher 2

Question 2a: Are you happy with the cyclical flow of the steps in the model?

The participants were happy with having a cyclical process within the model reflecting that certain steps should occur when managing a child with ASD. However there was a large discussion around the actual sequence of steps in addressing the children's motor issues. The researcher initially explained that the cyclical process should begin with education and awareness in order to make individuals aware that children with ASD could potentially have motor and physical activity deficits. This would then potentially lead them to want to better understand the motor profile of their children, which would lead to an assessment and the following domains in the cycle.

"You can't just start implementing stuff without even people realizing what it's about because so for me I think we need that step by step process."- Parent 4

"I think that will just give more the idea of how the journey is gonna go, because you're not gonna start with an implementation. You have to start with somebody who's gonna save your child and then implement the stuff and then monitoring the stuff."- Parent 7

Initially some participants argued that assessment should come before education. They suggested that understanding the specific issues through assessment was crucial for effective intervention. Other participants stated that individuals or entities such as schools or clinics may need to start at different points in the process based on their context or even depending if they were somewhere in the process already. Two parents specifically provided examples regarding their journey with their children and how for instance they had started in different parts of the cycle. They therefore, highlighted that in this instance there would need to be flexibility within the

cycle. They also reported that depending on where in the cycle the children would be, they would require different support.

"We started with assessment and then we did the motor profile and then we did the implementation and then we did the monitoring and obviously didn't have education. I went over and I started to educate people and do awareness for them, so I'm not sure if this is for the person inside [inner circle of model] because if you talk about education to the child, it's also gonna be the last state because every child's educational needs is different. But if you are talking about educating and awareness to the public, then I still think it must be the last step."-Parent 7

"I think you should start with awareness to people and based on the individual as the as the subject you're going to like a school and saying OK, this is what you must do with what these people, we have to educate them first."-Parent 4

"People start at different places."-Clinician 4

Due to the above insights a debate amongst the participants took place, in which they spoke about whether the numbers within the cycle needed to be removed in order to make the model more flexible. One parent felt strongly that numbering provided clarity and guidance, while other participants suggested that removing the numbers would allow for a more adaptable approach. The discussion continued and the group came to the consensus that the numbers should remain to guide the process, and present the ideal. They acknowledged that if an individual found themselves within a specific step, for example the fourth step, they would still be able to be guided by the cycle to move them through to the next step, and prompt them to continue the cycle until it was complete. This would therefore, still allow for flexibility while maintaining a structured approach and showing an ideal flow through the cycle.

"I think you must leave the numbers because if somebody educated me in school about autism then I would have known what to do with my voice. But because nobody educated me, we started at the assessment and in our in our personal life.
But because this is going to be something we can take out there to schools and the police patience and tell them guys, this is what we're gonna do, then I think we must have the numbering because it will give them a visual of what is going next."-Parent 7

"But the problem is this, if you imagine some school gets the system [model] and then they decide OK we will start with implementation and then they'll go to monitoring. It's not gonna work."- Parent 4

Question 3a: Are you happy with the headings?
Question3b: Is there any information/wording you feel needs to be included for any main step in the process?

The participants were happy with the domain names central to the cycle. However one parent indicated that she believed that in step three i.e. assessment, it would be important to reflect that feedback was integral during this process between all key stakeholders and that an optimal feedback process would better inform the next step of implementation. All the participants agreed with this sentiment. The researcher made the suggestion that the word "feedback" should be added in the third domain so that it would read as "assessment and feedback", while also adding bi-directional arrows to the key stakeholders to show that the feedback should include all of them. This idea was unanimously accepted by the group.

"Sometimes I feel I feel that there's not enough time given to the feedback session from their assessment and I don't know if maybe just by saying assessment, feedback automatically becomes part of that? But I have found that this is a part that is still lacking- even the parents when they come back with the assessment you ask them. OK, So what does this mean?
No, the assessment was done and then the report is here and then their recommendations at the end. But they really don't have in depth understanding."-Teacher 2

"Yeah, I definitely do agree with that. I think spending time with the feedback and I think it's important point of not just parents, but communicating with the whole team as well."-Clinician 4

Question 4: Who do you think the key individuals should be who feed into the model of care (presented on the black outer loop)
Question 5: Are any stakeholders missing or that should be removed?

All the participants were in consensus that the key stakeholders presented where relevant and should remain within the model. Two suggestions were made to improve the stakeholder component . The first one was made by one of the parents in which he stated that coaches should be added as key stakeholders as fitness professional where not represented.

"There's a question because when you spoke to me, you talked about sport and fitness and movement, I don't see that special thing."- Parent 4

The second suggestion was that the word "church" be changed to "places of worship" to be more inclusive of all religions. Both of these suggestions were unanimously agreed to by the group.

"I just a comment, not really to add, but just looking at it because you've got like "church", but I feel it's, you know there are so many places of worship, is there not another way to kind of incorporate, uh, different places of worship because you know you've got different religions that obviously will have all their support."- Clinician 4

Question 6: Do the outer rings accurately depict the setting and ecosystem of the model – do we need to change anything?

One participant suggested that the word "neighbours" should be changed to "community" to be more inclusive of individuals who may engage with an individual with ASD. This was unanimously agreed on.

"Maybe we can make neighbours, community. I'm not sure because I understand that it's like you're close. The people that's close this to you. It's your neighbors, but for example, when I started to do some education and awareness in our community, I realise that they didn't know what was happening."-Parent 7

Overall, there was consensus amongst the group that the models' outer rings made sense following that suggestion, and that they believed the outer rings accurately reflected the setting and ecosystem that the model found itself within.

The changes are summarised in order of rank in Table 4.12 on the next page, with the relevant changes the researcher would make to optimise the model.

Table 4.12: Table showing the suggested changes to the model in order of rank

	Model item	Suggestion	Resulting change
1	Key stakeholders (black ring)	The black ring where all key stakeholders are listed needs to be moved around the individual to indicate the support is directly next, and allowing for the professionals to plug into the central cycle of the model.	The key stakeholders ring was moved to surround the individual and their individual considerations.
2	Assessment domain	There was a discussion regarding how imperative feedback was in this step of the cycle. Suggestions were made to illustrate that feedback needs to include all key stakeholders and show that all key stakeholders need to be involved.	The word "feedback" was incorporated under the word assessment to read "Assessment and feedback" in step three of the cycle. Bidirectional arrows were added from the assessment domain to link to the now inner ring of key stakeholders to reflect this.
3	Key stakeholders (black ring)	Change the word "church" to "places of worship"	A change was made to replace the word "Church" with the words "places of worship" in order to be more inclusive.
4	Key stakeholders (black ring)	Add the key stakeholders "trainer/coaches"	A change was made to include the words "coaches" to be more inclusive.
5	First outer grey ring	Change the word "neighbours" to "community"	A change was made to replace the word "neighbours" with the word "community" in order to be more inclusive.
6	Model process (inner circle process)	There was a discussion around removing the number within the inner cycle. There was consensus to keep the numbers.	No change required

ii. Theme three: visual aspects and design

Three guiding questions were asked to gather information regarding the models visual aspect and design. These are presented below with the findings from the discussion beneath.

Question 1: Please tell me if you feel the model is easy to read?
Question 2: Please tell me if you feel the model is easy to understand and follow?
Question 3: Does the design need any visual improvement? (layout, colours, fonts, wording)

The participants where happy with the overall visual design of the model besides the changes of moving the key stakeholder ring to surround the individual, which was addressed earlier in the this chapter. The researcher stated that it was noted that the key stakeholder names were a little bit unclear and that this would be changed in the final design. One participant stated that he disliked the colour grey observed in the outer ring but, that that this his was personal preference. The group unanimously agreed to keep all the colours and fonts the same for the model, and thus no changes were necessary regarding the visual aspects and design.

iii. Theme four: model efficacy measures

Please tell me how you feel we can measure reach and efficacy of the model?

This question was not asked directly to the participants since a large discussion regarding implementation regarding who would be responsible for implementing the model was had earlier on. It was inferred there, that efficacy measures would be heavily dependent on who would be responsible for distributing the MoC and that strategies would need to be adaptable to each scenario. One parent indicated that it would be imperative to consider our South African context and adapt or expectations accordingly.

"In my mind, I'm thinking about the parent in a rural South African community that does not have the exposure that we might have that does not have the resources that we might have and how they do. We expect that period, that individual, that Community that has is riddled with struggle to be a champion in this particular regard. Yes, your child might be on the spectrum. Yes, your child might be, you know, non-neurotypical. But you're fighting so many other demons. I think we also need to think about it from a wider and deeper perspective"- Parent 5

iv. Final handout

At the end of the nominal group discussion, the handouts were presented to the participants as an example of what could be developed from the model. No comments or suggestions regarding any changes were received from the participants. No changes were therefore made to the provisionally designed handouts.

STEP FIVE b: Distribution plan

A distribution plan was developed by the researcher following information gained in step four of the development process. This is presented below.

Following the nominal group discussion the researcher understood that depending on which setting the model would be distributed in, to a different distribution plan may be needed. For example reaching individuals in schools would depend on getting permission from principals to send out to parents, while reaching individuals in a rural settings may require physically going to those areas to distribute at a ground level.

As a starting point the researcher will therefore, use organised bodies with already established databases of people through whom the model can be distributed - for example Autism South Africa to reach as many as possible initially as well as use the ground up approach suggested by the participants in targeting local communities and local clinical practices. The researcher will then reflect on how reach can be improved so that follow up distribution may be carried out in the most effective manner deemed possible. Future research will need to be conducted to observe whether various communities were reached. This will then inform whether distribution efficacy will be obtained.

4.6 Final model and handout

No changes to the handouts were made following the nominal group discussion, to refer to the handouts (see Figure 4.13 at the end of phase three). These handouts will be distributed on completion of this study. The researcher made all the suggested changes from the participants to the model. The final model is presented in Figure 4.14 below. The researcher developed a user guide for the model (Appendix T), at present it is a draft and will be implemented in a pilot study and refined before being finalised.

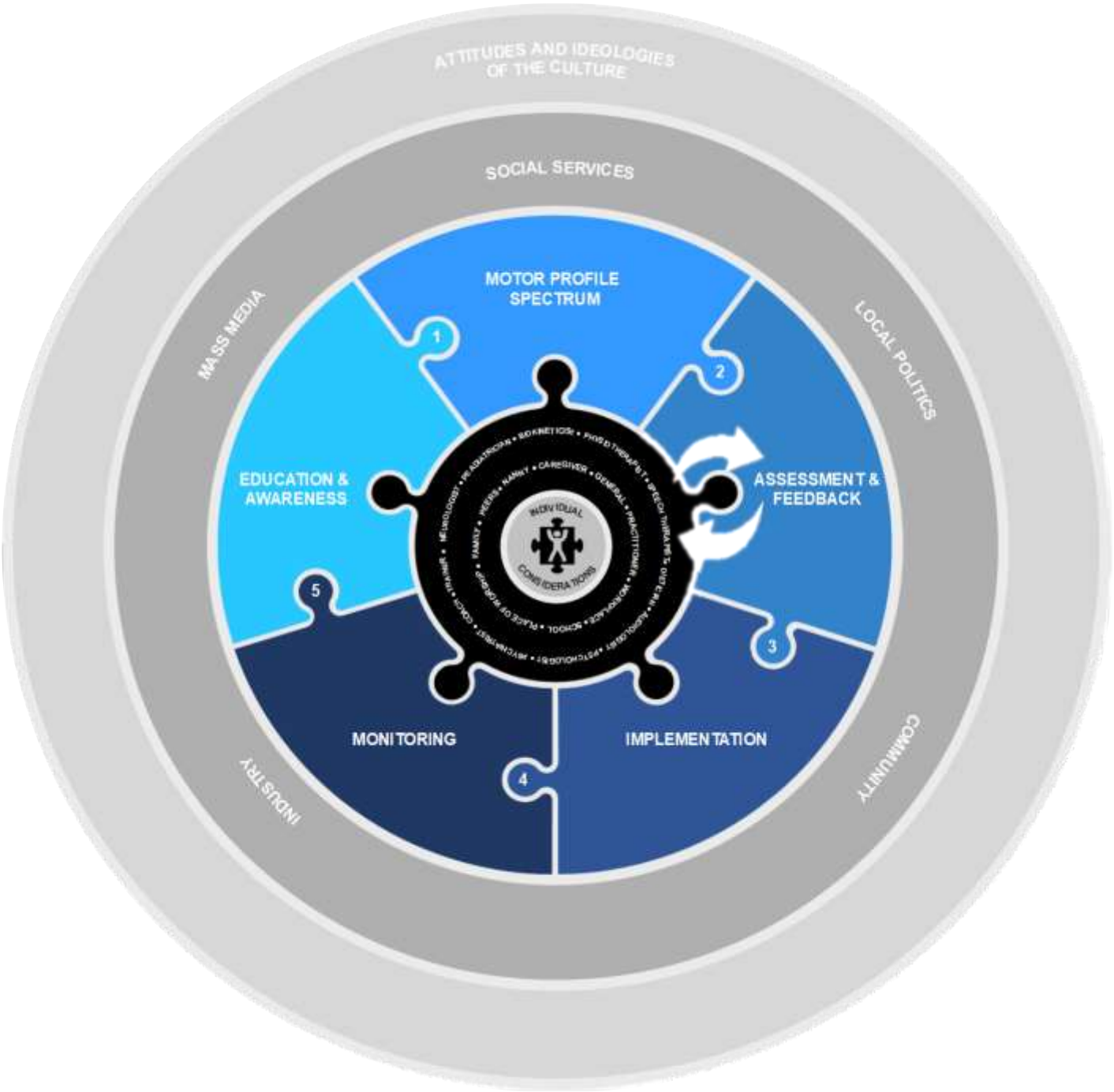


Figure 4.14 Model of care for children with ASD including motor proficiency levels and physical activity levels

CHAPTER 5: DISCUSSION

The subtopics that will be included in this chapter include: Introduction

5.2 Section A- discussion of phase one data
5.2.1 Discussion of demographic information
5.2.2 Discussion of teacher, clinician and parent perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD under identified themes
5.2.3 Discussion of teacher, clinician and parent expectations for the model of care developed in this study
5.3 Section B- discussion of phase two data: model development
5.3.1 Mode development and definitions of the major domains of the model of care
5.4 Section C- discussion of phase three data
5.4.1 Changes to the model following nominal group discussions

"I'm not autistic. I have autism. I also have brown hair and flat feet. So, I don't understand why I'm always 'the kid with Asperger's".[12]

5.1 Introduction

The primary purpose of this study was to develop a model of care that included motor proficiency and physical activity levels for children with ASD. For this study model development depended on the perceptions of teachers, parents, and clinicians on the current motor proficiency and physical activity levels in children with ASD, and how these could be improved through a model of care. The overall purpose of the discussion below is to critically discuss the main findings of this study, and compare them main findings to relevant research.

The discussion that follows comprises four sections guided by this study's three phases and relevant objectives.

5.2 Section A- discussion of phase one data

5.2.1 Discussion of demographic information

The majority of the sample interviewed for this study was female, with all groups having more females than males. Using snowball sampling as one of the sampling techniques could have influenced this, for example, most mothers who had children with ASD referred the researcher to other mothers who had children on the spectrum, as they often engaged with other mothers on ASD forums or in school settings. The majority of teachers who were interviewed in this study

were female which is representative of the South African gender distribution of educators- where approximately 70% of all educators are reported to be women,[201] and therapists in SA are female.

The parents that participated in this study had a mean age of 51.63 (±14.25) years, where the youngest parent was 35 years of age, while the oldest parent was 75 years of age. Other studies have often focused on younger parents (with younger children), and focused on early childhood and school-age issues.[202] The differences in ages between the parents of this study allowed for differing insights into their experiences with their children on the spectrum, for example, the older parents who had in turn, older children on the spectrum indicated that their children required continued support and that it would be essential to consider this in the model of care. The group of parents interviewed, had children on the spectrum, most of whom were male, which is representative of ASD in that the condition is more prevalent in males.[13, 50] The children on the spectrum, represented by their parents, had a reported mean age of 16 (± 9.81) years.

The mean age of the teachers was 39.5±8.7 years, with the group comprising of four mid-career teachers, and two approaching retirement. This allowed for insights to be obtained across a wide range of educational approaches and experiences. In a study by Robertson et al.[203] it was reported that more experienced teachers (mean age 45 years) were better equipped to manage the diverse needs of students with ASD due to their extensive professional experience. In addition, teachers and teaching assistants that were recruited for this study came from a variety settings including government and private sectors. They also had varied experience backgrounds including developmental teaching (which emphasises independent learning in an emotionally supportive atmosphere), special education/remedial teaching (which addresses learning gaps by re-teaching basic skills), as well as research backgrounds (for example, one of the teachers was concurrently teaching and conducting research at a university). This allowed for information to be more representative of the South African context were feedback and opinion was gathered from experiences from both the public and private sectors as well as varied teaching processes. Information regarding the age of the children the teachers taught was not collected and this may be deemed a limitation of this study.

The majority of the clinicians that participated in his study came from the private or tertiary sectors, which could be deemed a limitation of this study as this might limit the generalisability of the findings to public healthcare settings. There was also overrepresentation of biokineticists in the clinician group, however, this may be considered both a limitation and a strength. The experiences and expertise of biokineticists' in terms of physical wellbeing and exercise-based rehabilitation is

particularly relevant to this study given that the focus of the model being developed was to improve physical activity and motor challenges in individuals with ASD. Thus, their opinions and insight was considered valuable and appropriate. The clinicians had a mean age of 39.5 ±11.8 years, of which seven were under the age of forty. This indicates a younger professional demographic, which may indicate more recent training and familiarity with the latest ASD intervention strategies. It has been reported that although older clinicians provided valued insights due to their longer years of experience, they were often less familiar with more current treatment methodologies.[204] Therefore the current sample of clinicians may provide more contemporary insights and approaches into the management of individuals of the spectrum.

5.2.2 Discussion of teacher, clinician and parent perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD under identified themes

a) Motor proficiency and physical activity levels

In terms of motor skills, the participants of this study unanimously believed that the motor skills of children with ASD lay on a spectrum and were varied amongst children. They believed that the population as a whole however, had poor motor skill proficiency, and that they generally struggled with performing motor tasks as well as activities of daily living compared to their neurotypical counterparts. This is consistent with recent research studies that have reported that children with ASD show significant differences in global motor performance and complex motor skills compared to their neurotypical counterparts. [205, 206] Furthermore, research supports the above notion that motor proficiency is variable within the population, [69] and in fact it has been reported in numerous studies that it's the variability itself of motor function that is most characteristic of ASD. [129, 207, 208] It therefore is important that all references to motor proficiency in this population, should be reflected according to age-appropriate or developmentally appropriate milestones for each child.

In addition, the participants of this study also believed that children with ASD struggled with motor deficits throughout their life which is also consistent with research. For example, it has been reported that variables such as static and dynamic balance[94, 209] and locomotion deficits[210] continued into the later years of life in individuals who were on the spectrum. Continued intervention and support may therefore be necessary for individuals struggling with persistent deficits, and should be considered when developing holistic management plans for those on the

spectrum. In order to do this, further research on how services can be optimally integrated into management plans to assist individuals across their lifespan is needed, yet the majority of research funding is generally allocated to biological-based research.[211, 212] This therefore may be deemed a current barrier in improving long term management for this population.

The clinicians and teachers involved in this study reported encountering specific motor difficulties while working with children diagnosed with ASD. This was corroborated by the parents of this study, who reported that their children experienced at least one motor deficiency or encountered some challenges with motor-related tasks. This is consistent with recent research indicating that motor proficiency deficits are highly prevalent among individuals with ASD, with a parent-reported prevalence of 87%,[213] and observational studies reporting prevalence between 85%and 97%.[214]

The participants also reported that they believed that having reduced motor skills crossed over into other areas of their lives, the children had difficulties performing activities of daily living. This is in agreement with studies which have reported that activities of daily living are affected by atypical sensory and motor deficits, which in turn can reduce functional independence [215-217]. In particular, it has been reported that specific tasks such as dressing, grooming and bathing may be particularly difficult to perform for individuals on the spectrum due to them having visual processing issues.[215] The teachers, of the current study reported specific visual motor difficulties they had observed, which they stated also prevented some children from engaging in classroom activities effectively. The difficulties described by the teachers, may be as a result of the visual processing deficits as described above. In a study by Günal et al.[218] it was reported that motor impairments and cognitive deficits negatively affect daily living activities in children with ASD. Difficulties in performing everyday tasks as well as reduced independence of individuals on the spectrum may influence family functioning. For example, it has been reported that family life is often disrupted due to having to tend to the needs of children on the spectrum.[219] This MAY result in families having reduced time to spend on positive experiences,[219] and often interferes with core family relationships. Improving independence, and the performance of daily activities in children with ASD should therefore be considered essential areas to improve as part of their management.

Participants reported that they believed that poor praxis, motor planning, and reduced body control were common in individuals on the autism spectrum, along with limited body awareness. There is research to support this,[220, 221] and in fact, it has been reported that dyspraxia may be a core feature of ASD or even be considered an indicator of the neurological irregularities

associated with the disorder.[222] Teachers and parents described a concept of a "mind-body disconnect", where children's actions did not align with their intentions, often leading to them being mislabeled as having behavioral problems. The teachers in this study also highlighted that understanding autism should be understood as more of a sensory-motor disability rather than a solely cognitive-behavioural condition, and stressed the need for improved understanding and support. These ideas above are consistent with research that has reported that individuals with ASD demonstrate difficulties controlling movements at different levels of the primary and sensory-motor cortex. [223, 224]

Furthermore, the idea of a mind- body disconnect, was addressed in a recent study by Welch et al. [225] where they reported findings of individuals with ASD describing mind-body disconnect difficulties. They subsequently reported that rehabilitation experts should consider difficulties with movement control as being possible barriers to function for some autistic individuals. In addition, they reported that a mind-body disconnect could also lead to other potential barriers, such as arousal regulation difficulties, where individuals on the spectrum may be unable to control physiological and psychological activation levels. [229] They also advised that clinicians should carefully interpret the observed behaviours of those with ASD, and be try to obtain clear explanations for these behaviours directly from the individuals' perspectives. [229]

Other motor-related difficulties reported by both teachers and clinicians in this study included issues stemming from poor core muscle strength. Numerous studies have documented core deficits in individuals with ASD,[95, 226] and effective exercise interventions have been implemented to assist with these deficits in the past.[227-229] Core deficits have specifically been reported to correlate with optimal learning in the classroom setting,[230, 231] as well as in performing general activities or tasks, and hence these deficits need to remedied early on to mitigate the associated problems from occurring later on in individuals lives.

In addition to the difficulties highlighted above, the clinicians reported that they had also observed the following motor difficulties in children with ASD: having increased compensatory movements when needing to perform tasks, being clumsy, having vestibular processing and proprioceptive issues, poor breath control, and having poor posture. Clinicians and parents reported reduced ball skill proficiency, while parents also reported that some of their children had underdevelopment of body musculature. Numerous studies have confirmed the deficits listed above, [44, 79, 86, 87, 99, 113, 232] yet few studies exist on breath control in individuals with ASD and this area warrants further investigation.[233]

In terms of physical activity levels, there was consensus among all three participant groups that physical activity levels among children with ASD varied, which was similar to their beliefs that motor skill proficiency levels were varied within the population. Reduced or varied motor proficiency levels have been reported to influence physical activity levels in the general population, and the same is true for those on the spectrum.[234] In addition, all three groups in the study expressed concerns about overall low levels of physical activity within the ASD population compared to their neurotypical peers. This finding is in accordance with previous research reporting that individuals with ASD have significantly lower physical activity levels when compared to neurotypical individuals.[21, 22] Furthermore, the clinicians of this study highlighted that reduced physical activity levels often persist into adulthood, and that they had observed a general decline in physical activity levels as children aged. This issue however does not seem to only affect individuals with ASD, but seems to be the trend amongst all population groups.[137] Nonetheless, improving physical activity levels, particularly in older individuals on the spectrum remains important to include as part of their management. The parents of this study, expressed concerns that their children were not getting enough physical activity, which is consistent with the findings of a longitudinal study conducted by Dahlgren et al.[235] Addressing these concerns, is therefore essential, since regular physical activity has been shown to significantly improve the physical and mental- wellbeing of individuals with ASD.[96]

It should however be noted, that although the parents believed that their children were not getting enough physical activity they were also unaware of the general physical activity guidelines that direct how much physical activity individuals should be engaging in. This was an area of concern, and indicated that improved education on physical activity guidelines was needed in the future.

Importantly, there are no specific or adapted physical activity guidelines for children with ASD. Therefore, when the researcher interviewed the participants, the researcher asked whether children with ASD were meeting the general physical activity guidelines according to the ASCM. The researcher in all instances provided the participants with the general ACSM guidelines to allow for informed follow-up questioning. The majority of participants across the groups then reported that children with ASD were not meeting the ACSM general population guidelines. This indicated that despite their lack of awareness of the formal guidelines, they had an inherent understanding that their children were not getting enough physical activity. Given the reported variability in physical activity levels, the researcher then enquired as to whether the more active children where meeting the general guidelines. Once again, the majority of the participants

believed that even the generally active and/or hyperactive children were not meeting the ACSM general population guidelines. Many studies have reported similar findings,(236, 237) and therefore this would be important to consider in terms of any exercise intervention design.

The participants provided many reasons as to why they believed that physical activity levels were generally reduced amon children with ASD. These reasons varied yet the main reasons across the three groups included lifestyle, level of impairment, fitness level and associated fatigue, environment and setting, as well as the idea that people may not believe that physical activity was relevant to individuals with ASD. The idea that physical activity may not be relevant, is in contrast to the extensive research indicating its profound benefits in individuals with ASD.[14, 172] However, it hasalso been well documented that management strategies typically prioritise the core deficits of the disorder.[238] This, therefore, needs to be addresses through improved education and awareness as a matter of urgency.

The biggest reason cited as to why children were not meeting physical activity guidelines was related to a sedentary lifestyle, which the participants believed was influenced by urbanisation. It has been reported in numerous South African studies that the increased use of technology as well as urbanisation has influenced behaviours and has resulted in individuals becoming more sedentary.[239-241] This extends to individuals on the spectrum. In a review by Jones et al.[137] the findings from ten studies on sedentary behaviour in individuals with ASD were reported. They found that screen time ranged between 126 to 558 minutes per day, with an average of 271 minutes per day, while total sedentary behaviour ranged from 428 to 750 minutes per day, with an average of 479 minutes per day.[137] Overall, they found that sedentary behaviours were varied within children with ASD, yet that lifestyle modifications were necessary to encourage increased physical activity and reduced sedentary behaviours.[137] It has also been reported that implementing lifestyle modifications early on in childhood is important, as it creates a good foundation for lifelong vigor and well-being.[239]

Participants stressed that physical activity levels depended specifically on the individual's impairments, including cognitive and behavioral impairments. This is in alignment with the beliefs of the parents included Obrisnikovs's study[149] who reported that children's limited motor, social, and communication skills were major barriers to participation in physical activity. However, the participants of this study cautioned against limiting children based on their level of impairment, and advocated for children to be encouraged to engage with others and activities as much as possible. They also believed that any preconceived notions regarding an individual not being

allowed to participate with others, and in activities, due to their level of impairment would need to be challenged and/or dismissed.

Individuals with ASD, have been reported to be at a higher risk for developing sedentary behaviours, having reduced physical activity levels as well as having unhealthy weights.[242] The parents and clinicians of this study reported observing increased obesity levels in children with ASD, while parents specifically indicated that increased weight in their children led to reduced mobility. In a study by Hill et al.[152] which observed the trends in obesity levels in 5053 American and Canadian children with ASD, it was found that those on the spectrum have around a 33% prevalence of being overweight and obese compared to their neurotypical counterparts. At present no prevalence data is available for South African population groups. Therefore, the parent and clinician insights from this study are valuable to consider for future interventions. Interestingly, there was a study conducted in Kwa Zulu-Nata by Pillay et al.[243] which found that 10% of their participants with ASD (n=114) had gastrointestinal disturbances including constipation and food selectivity- which may contribute to obesity.[243] Further research is however needed to confirm this, as well as to determine prevalence rates, other contributing factors, as well as the effects obesity may have on individuals with ASD, within a South African context.

Despite the above concerns of the participants in this study regarding physical activity levels, they acknowledged that, similar to neurotypical children, there were individuals within the ASD population who enjoyed participating in physical activity.

b) General attitudes, and attitudes towards increasing motor skills and physical activity levels

Participants unanimously agreed that motor proficiency and physical activity levels for children with ASD were important, with the majority reporting that from their experience motor skills were not prioritised in treatment and management plans for individuals with ASD. This is consistent with current research - for example, Miller et al.[238] reported that many neurodevelopmental conditions including autism, had accompanying motor deficits that disrupted the functioning of the individual yet, were in some instances not assessed or ranked highly in terms of intervention planning and management. This lack of prioritisation of motor skills in South Africa was attributed to a relatively new understanding of motor-related deficits and motor planning difficulties. Despite this, participants recognised the potential benefits of improving physical activity and motor skills for children with ASD, as well as for neurotypical children. There is limited information regarding

whether the understanding of motor-related deficits and motor planning difficulties is a relatively new concept in the South African setting, however a South African study has reported, that there is a need for improved understanding and integration of motor-related deficits in developmental screenings.[244]

The participants of this study demonstrated a positive attitude towards including more physical activities in the lives of children with ASD, since they believed that physical activity was of value in promoting independence and performing activities of daily living. The idea that physical activity can significantly benefit children with ASD, in terms of promoting independence and improving their ability to perform daily activities has been frequently documented in the literature.[234, 245] Participants also emphasised the importance of early engagement in physical activity and early motor skill development and intervention for children with ASD. These beliefs are supported by research findings in the likes of Estes et al.[246] and MacDonald et al.[245] respectively.

c) Benefits and cross-over effects

Participants reported many benefits associated with engaging in more physical activity and improving motor skills in children with ASD, with the most commonly reported benefit being increased independence in the children. Furthermore, teachers specifically highlighted the long-term potential implications of motor skill deficiencies on independence, and expressed concerns that children who struggle with motor tasks may face challenges later on in life and become increasingly dependent on others to perform tasks on their behalf. The teachers' concerns about these issues are supported by research[247, 248] highlighting the critical need for early intervention and targeted support to mitigate these challenges.

Benefits relating to the core deficits of the condition were also reported. These included improved behaviour (in both home and school settings), improved cognition, as well as social and communication improvements. In a study by Pitetti et al.[249] it was found that continued physical activity improved cognitive function in adolescents with severe autism, and resulted in better academic performance and attention span- supporting the claim that physical activity contributes to cognitive benefits.

Other cognitive benefits reported by the participants included improved attention, improved learning and improved memory. This is again is consistent with research which has shown that engaging in physical activity such as aerobic activity may improve attention span, learning and

other classroom behaviours.[250] Furthermore, neuroimaging studies have shown that higher fitness levels in children correlate with increased volumes in brain regions associated with attention and coordination.[251] Conversely, the teachers of this study believed that reduced motor skills could affect learning and concentration- for example not being able to sit due to reduced core strength could prevent focus and engagement in class.

Following on, in a systematic review by Lang et al.[252] it was found that physical activity can lead to significant improvements in behaviour including reduced stereotypical behaviours and increased compliance to therapeutic interventions- again aligning with the above claims. Specifically, many of the parents of this study indicated that participating in general physical activity helped to regulate their children, reduced negative behaviours, helped with stimming and helped calm their children down. This is consistent with research, where numerous exercise interventions have been shown to reduced disruptive or maladaptive behaviours in individuals with ASD. [253-255]

Another area in which motor proficiency was believed to play a large role was communication. Specifically, clinicians indicated that language could be improved as a result of vestibular training and that it should be considered for individuals with communication difficulties. Studies have in indeed shown that there is a close association with language performance and vestibular function.[256] It has been found that vestibular dysfunction can lead to difficulties in maintaining eye contact, monitoring articulation, and interpreting facial expressions, all of which could potentially cause communication challenges as well as impair the ability to produce speech sounds, [256] therefore confirming the beliefs of the clinicians and highlighting the need to include this type of training for individuals who have communication difficulties.

The participants of this study reported that the type of activity could influence the behaviour of their children, and there is research to support this. For example, it was reported by Pan[257]and Bahrami et al.[258] that structured physical activities, such as organised sports and martial arts, are more effective in reducing behavioural problems and improving social interactions in children with ASD compared to unstructured activities. In a different study, by Petrus et al.[254] it was reported that the rhythmic and steady nature of aerobic activities seem to have a calming effect on children with ASD, while Radhakrishna et al.[259] reported that mindfulness and yoga-based physical activities can reduce anxiety and improve social communication.

Overall, the majority of the participants shared the sentiment that children with ASD, needed to get moving more frequently in a consistent manner with maximal engagement with others. They strongly believed that physical activity itself was a cost effective modality and that it should be pursued for all individuals on the spectrum to improve independence.

d) Assessments and appropriateness

One of the primary concerns voiced by teachers, clinicians, and parents revolved around assessments. They collectively expressed that issues related to accessibility, frequency, procedures, and content of assessments hindered effective diagnosis and testing. Accessibility issues were related to challenges in accessing appropriate assessment tools and resources. At present to the researchers' knowledge, there is no information available regarding how many South Africans have access to diagnostic assessments or motor skill-related assessments therefore this needs to be determined with future research.

Participants also highlighted concerns regarding the frequency of assessments, suggesting that they may not occur frequently enough to adequately monitor progress or identify developing issues. Similar concerns about the need for frequent assessments to monitor progress and identify issues are echoed in the study by Ozonoff et al.[260] Testing procedures were also identified as another area of concern, with participants noting inconsistencies or inadequacies in how assessments were administered. It has been confirmed that variability in the administration of ASD specific assessments (e.g. ADOS) can lead to inconsistent results,[261] making these concerns valid.

Furthermore, the clinicians specifically reported content-related issues, where they expressed that there was often uncertainty about what to include in assessments (relating to motor assessment variables) or encountering test items that were not suitable for children with ASD. They reported that these issues often stemmed from the children having difficulties in understanding instructions, performing complex tasks beyond their abilities, or experiencing sensory sensitivities that interfered with test performance. Staples and Reid addressed some of these difficulties in motor assessments, supporting the participants' concerns about the suitability of test items and the need for tailored assessment tools.[262]

Participants believed that assessments should be done as early on in the children's lives as possible so that early intervention could ensue. Numerous studies have reported the need for

early assessment,[263, 264] since early identification and intervention can lead to better developmental outcomes for children with ASD.[263] Furthermore, participants also believed it was important that feedback from assessments was given and shared between all the individuals working with the child so that holistic management plans could be developed and monitored. This is consistent with the findings of Stahmer et al.[265] and Keen et al.[266] who reported that shared feedback and collaboration between all the individuals involved in the child's management was a necessity of.

In terms of diagnosis specifically, clinicians believed that improved diagnosis for the ASD population is needed, specifically in terms of earlier diagnosis and that there is a need for improved diagnosis specific to motor testing- in particular, there was a suggestion of revision of the DSM 5 criteria to include motor deficits as being common issues amongst children on the spectrum. In a review by Miller et al., [238] entitled “Motor problems in autism: Co-occurrence or feature?” this notion was challenged. They recommended motor deficits as ASD specifiers should be incorporated into the diagnostic criteria, as a temporary solution, while research concludes whether these deficits are better explained as comorbid developmental coordination disorder.[238] Importantly a revision to the DSM-5 could facilitate early intervention of motor skills, as well as direct influence the need to manage motor skill deficits optimally.

Overall the participants of this study believed that motor assessments were often not done at all and that if they were, they were lacking in depth in terms of the items tested, or that there were important variables missing. There was consensus in the belief that there should be standard variables to test for, and that they should be carried out frequently to monitor progress.

e) Barriers to exercise and challenges in implementing exercise

i. Core deficit barriers

Teachers, clinicians and parents involved in the study reported numerous core deficit-related barriers encountered by children diagnosed with ASD, which were reported to influence the engagement in, and performance of physical activity related tasks. These core deficit barriers included: cognitive, sensory, social, and behavioural difficulties. This is consistent with other research, where various studies have reported the above-mentioned core deficit barriers influencing physical activity. For example, Pan et al.[267] reported that cognitive barriers, such as difficulties with understanding instructions, are common among children with ASD, and recommended that simplified instructions and visual aids be used to enhance participation. In

another study by Baranek et al.[268] it was reported that sensory sensitivities are significant barriers, for children with ASD in engaging in physical activities and, recommended that sensory accommodations be made, such as reducing noise and using tactile-friendly exercise equipment. Furthermore, MacDonald et al.[22] reported that social difficulties experienced by those on the spectrum could hinder physical activity participation confirming the reports of the participants in this study.

A comprehensive understanding of these "core deficit barriers" is therefore essential for developing targeted interventions aimed at promoting physical activity among children with ASD. This understanding is also crucial for fostering inclusive environments conducive to the engagement of individuals with ASD in physical activities.

ii. General barriers and challenges

Clinicians described many barriers that could potentially hinder physical activity participation among children with ASD. These barriers included: exclusion due to reduced motor skills, low self-confidence, children having comorbidities associated with ASD (including psychiatric conditions), socioeconomic factors, as well as resource limitations. Clinicians believed that children with ASD could be excluded from physical activities due to having reduced motor skills, and that their poor motor skills in turn, could dishearten them from further participation in physical activities. They also believed that having reduced motor skills could limit which activities they could engage in. This is corroborated in many studies that report that children with ASD, often experience motor impairment difficulties that can lead to lower participation, and have reported these deficits may result in increased frustration and decreased self-confidence, which further discourage engagement in physical activities.[269, 270] There is also an increasing consensus on the importance of designing physical activity-based interventions and programmes that are inclusive, adaptable , and that cater to the unique needs of children with ASD.[271] A study by Srinivasan et al. reiterated that that interventions should consider the varied abilities of these children, but that should also consider their preferences which in turn would result in greater participation, and importantly, the enjoyment of physical activities.[24]

Teachers and clinicians indicated that lifestyle factors (including sedentary behaviours) as well as safety issues could also be barriers to physical activity participation. Sedentary behaviours have been shown to be more common in children with ASD due to their preferences for solitary and

often screen-based activities,[236] and there is research reporting on the safety concerns described above. For example, in a study by Lang et al.[272] it was found that safety concerns are indeed a critical barrier in physical activity participation, and that there is a need for individualised interventions to ensure safe participation in physical activities for children with ASD. Specific safety concerns such as wandering off, or difficulties in understanding social norms contributing to adverse behavioural reactions are often cited in the literature.[272, 273]

Additionally, the teachers of this study specifically mentioned the influence that the condition itself (ASD) could have on physical activity participation, and that this would need to be considered in terms of being more inclusive, and accommodating for the individuals' differing needs and abilities when designing interventions in both educational and recreational spaces. Importantly, the presence of comorbid conditions, including psychiatric disorders, can further hinder or make it difficult for children with ASD to participate in physical activities, which also need to be considered. According to Matson and Goldin, comorbid psychiatric conditions have been reported to contribute to additional challenges in social and physical domains.[274]

Socioeconomic status and the availability of resources are also critical factors that influence physical activity participation.[275] A study by Must et al.[275] reported that socioeconomic differences can affect access to physical activity opportunities for children with ASD, with children from lower-income families having fewer chances to engage in such activities. In a South African context, the differences in socioeconomic status significantly impact access to, and participation in physical activities among children, including those with ASD. Research specific to South Africa highlights the challenges posed by socioeconomic inequality and the need for tailored approaches to support physical activity for all children.[276, 277]

The identification of core deficit-related and general barriers towards physical activity participation highlighted above, provide insight into the intricacies in working with individuals on the spectrum- all of which needed to be considered in the MoC design.

f) Individual considerations

Overall, teachers, clinicians and parents emphasised the importance of individualised considerations when implementing models for improving motor skills and physical activity levels among individuals with ASD. They believed that holistic, lifelong implementation was necessary, and believed that individuals with autism would continue to require assistance throughout their lives in most cases. The need for individualised,[271, 278] and lifelong interventions is widely supported in the literature. Schreibman et al.[279] for example, report that comprehensive and ongoing support is essential for individuals with ASD to achieve meaningful long-term outcomes.

Teachers highlighted the need for variability and flexibility within exercise-based interventions, and believed that factors such as frequency, intensity, time, type and preference of activities when designing the interventions would need to be considered. The participants also stressed that exercise-based programmes should be adaptable to each child's needs and should consider other factors like group versus lone activities, settings or environment (e.g. indoor versus outdoor), teaching styles of the instructors, and learning styles of the children, as well as socioeconomic factors. This is in accordance with Srinivasan et al. [280] who report that physical activity interventions should be designed to be sustainable and adaptable due evolving or changing needs of individuals on the spectrum. Furthermore, it has also been reported that incorporating a variety of activities, can enhance engagement and outcomes for children with ASD.[270]

Clinicians reported similar individual considerations to the teachers that would need to be addressed in the model of care. They added that considering medication and its effects on the children as considering variety within programmes would also be necessary and key factors to consider. This is consistent with research, for example, in a study by Aman et al.[281] who reviewed the effects of psychotropic medications on children with ASD, it was found that that these medications can have significant impacts on physical and behavioural outcomes.

Parents believed that those working with children on the spectrum needed to have a mindset change since children on the spectrum were very different to neurotypical children. They reiterated some of the teachers and clinicians beliefs regarding individualisation while emphasising trust, and the building of relationships between various professionals implementing interventions and the children they work with. They also believed that parents should be included in decision making processes. These beliefs, have been confirmed in other studies. For example, in a study by Schreibman et al.[279] the need for interdisciplinary collaboration to create comprehensive and cohesive intervention plans was deemed essential, while in a study by Wong

et al.[282] it was reported that family involvement and collaboration in the design and implementation of interventions for children with ASD was crucial for their success.

Overall there was a shared sentiment across the three participant groups that there was a need for collaboration between key stakeholders to promote physical activity and motor skill development in individuals with autism.

g) Education and a curriculum disconnect

All the participants in this study believed and emphasised the critical role education and awareness in supporting individuals with ASD would play in making the model successful. They all highlighted the need for an improved understanding of ASD, the benefits of physical activity, the importance of achieving good motor proficiency levels as well as why frequent motor assessments are needed to track progress. These ideas are consistent with the findings from other autism research, where studies have reported that it is important to educate the public, and key stakeholders to improve support systems for individuals on the spectrum. For example, studies by Bearss et al.[283] and Koegel et al.[284] reported that effective educational interventions which increased awareness and understanding amongst parents, teachers, and healthcare providers resulted in the improvement of outcomes for children with ASD. These studies support the idea that incorporating educational components into care models can improve the efficacy of interventions developed from them, by creating an informed environment that understands the unique needs of individuals with ASD .

Interestingly, parents believed that society in general doesn't value exercise and that people don't want to engage in physical activity anymore. They indicated that this belief would be important to change with educational strategies. Clinicians believed that there was a need to raise awareness for children, to get children to do more activity in general, as well as to make key stakeholders aware of the ACSM physical guideline criteria. Models of care designed for other population groups have also had educational components included within in them to improve the understanding of the condition or of certain concepts within the model. In fact it has been shown that including educational components into interventions often improves efficacy.[283, 284]

Importantly the majority of the participants also believed that educating individuals on the spectrum themselves was imperative. Parents highlighted the essential role of self-advocacy and

empowerment for individuals on the autism spectrum. The participants stressed the importance of providing children with clear, logical explanations about the benefits of therapies and engaging with them as active participants in their own journey of care. It has been well documented that patient education is an essential component in any intervention or therapy.[285] Therefore, educating individuals on the spectrum is no different, and should include the key principles of patient education as a whole including: tailoring teaching methods to suit the individual's readiness, background, culture, and comprehension; establishing a supportive environment built on trust, respect, and acceptance to foster effective learning; encouraging patients to set goals and assess their progress; and provide relevant material and opportunities for practicing skills.[285]

The importance of self-advocacy and empowerment for individuals on the autism spectrum, as reported by the participants in this study, is well-supported in existing literature. For example, in a study by Stoddart et al.[286] it was reported that empowering individuals with autism through education and self-advocacy training lead to better self-management of the individuals, as well as more positive outcomes. This study also provided insight into the need for education to be individualised and contextually appropriate, which aligns with the principles outlined by the participants in this study. Adapting educational strategies to fit the individual's understanding, cultural background, and readiness to learn is crucial for effective intervention .

There have been attempts at improving awareness in a South African context, however they were not well facilitated nor effectively carried out. For example, according to the South African Government News Agency, the Department of Health urged for the support for individuals with ASD and emphasised non-discrimination on April 2nd 2024 as part of the global initiative to increase autism awareness[287] However, no accompanying policy changes were made, nor any educational resources distributed within the country. This highlights the need for improvement in government advocacy strategies to be coupled with actionable plans and processes to guide change and facilitate support.

All the participant groups emphasised the crucial need for better training of clinicians and teachers working with children on the autism spectrum. Teachers and clinicians reported that they had gaps in their training whereby they were not trained to work with certain population groups- which in some instances included working with children on the spectrum. While parents indicated that they wanted to learn how to support their children's physical activity and motor skills and felt that they could benefit from training to assist with this. The need for improved teacher and clinician

training working with children with ASD, is another critical point supported research. In a study by Lindsay et al.[288], for example, it was reported that there are indeed gaps within teacher training programmes, and that there is a need for ongoing professional development to better equip teachers with the skills required to support students with ASD more effectively.

In terms of school and university curriculums, teachers and clinicians felt that there were substantial curriculum disconnects. The curricula in question, included remedial school curricula, and university curricula in the teaching and clinical fields. Teachers indicated that they were often under large amounts of pressure to meet strict curriculum timeframes, yet that the curriculum itself often prioritised non-essential activities for the children's development rather than the overall needs of children. They expressed frustration regarding this, and felt that in order to address this disconnect, that school curriculums needed to be revised and aligned with student and teacher needs. Similar findings have been reported in other research studies. For example, in a study by Darling-Hammond et al.[289] it was reported that rigid curricula often prevent teachers' from being able to address individual student needs, and their ability to adapt teaching strategies to create more inclusive and engaging classes. While in a another study, it was reported that it was necessary for curricula to be more flexible to allow teachers to integrate essential life skills and practical knowledge rather than adhering strictly to standardised tests and benchmarks.[290]

In the South African context, the curriculum disconnects described above are further exacerbated by differences in educational resources and infrastructure. According to research, South African schools, particularly those in disadvantaged areas, often struggle with inadequate facilities and insufficient support for teachers. This makes it even more challenging to implement effective and inclusive educational practices.[291]

Teachers also indicated that were discrepancies in policies between basic education in schools and university education. Furthermore, they believed that there was a need to include and integrate inclusive educational strategies into university curriculums so that teachers were better equipped to work with individuals with specific needs. They felt that this could be targeted through improved teacher training where they were provided with the necessary skills to work with any learners (whether they had disabilities or not , due the phasing out of remedial schools and special education.

These ideas are consistent with other research, where numerous studies emphasise the importance of inclusive education and teacher preparedness. For example, Florian and

Linklater[292] reported in their study, that inclusive education should be a fundamental aspect of teacher training programmes, ensuring that teachers are capable of addressing diverse learning needs in their classrooms. Similarly, Forlin et al.[293] reported that effective inclusion requires teachers to be adequately trained in remedial instruction and the use of inclusive practices.

h) Monitoring

Insights into four key areas related to the monitoring aspect of the model of care, was provided by the participants of this study . Firstly, the participants believed that it was essential to track the progress of individuals on the spectrum throughout their lives, in terms of whether they were achieving developmental milestones, achieving optimal motor skill proficiency levels, and meeting physical activity levels guidelines. This is in accordance with the recommendations of the Centers for Disease Control and Prevention. They report that it is important that continuous monitoring and screening from infancy through adulthood is carried out to ensure that children meet developmental milestones, and so that any delays can be identified early.[294] Similarly, the National Institute for Health and Care Excellence recommend ongoing assessment and monitoring of children with ASD to track developmental progress, while also advising that adjustments need to be made to interventions as needed. They indicate that monitoring should include evaluating motor skills and physical activity levels.[295]

Secondly, the participants believed that monitoring of the individual on the spectrum should be done on a day to day basis and include the monitoring of the performance of everyday activities.

Clinicians specifically advocated for consistent reinforcement to be provided to the individuals by means of positive movement cues, especially in cases where individuals struggle to perform activities or performed activities poorly. They believed that the consistent monitoring of daily tasks could allow for deficiencies to be identified early on in the individuals life and therefore guide optimal management. This is consistent with the findings of Case-Smith and Arbesman,[278] wo reported on the efficacy of daily monitoring and intervention strategies in improving the performance of daily activities in children with ASD.

Thirdly, the participants stated that there was a need for constant monitoring of interventions implemented to determine whether they were effective as well as a critical review of interventions. This is in accordance with the National Autism Centres guidelines for evidence-based practice for autism. Their guidelines emphasise the importance of ongoing monitoring and evaluation of

interventions to ensure they are effective, and they also recommend regular reviews and adjustments based on individual progress and outcomes. Similarly, Dawson and Burner[296] reported that constant monitoring and evaluation of interventions to determine their effectiveness was necessary.

Lastly, participants also believed that it was not only important to monitor individuals but also that feedback needed to be a part of the monitoring process. They stated that it was important that regular feedback be shared amongst all individuals involved in the child's management, not only in terms of the results of assessments but also on whether individuals were meeting their goals. They also believed that feedback should be shared between key stakeholders regarding successful, as well as failed interventions to inform future management plans. Research has shown that it is important that there is collaboration, monitoring and feedback among clinical professionals and families, and that regular communication and sharing of assessment results and intervention outcomes are crucial for developing effective management plans.[297]

5.2.3 Discussion of teacher, clinician and parent expectations for the model of care developed in this study

The participants' expectations for the model of care featured several key ideas, some of which aligned with many principles and practices found in existing research, while also presenting unique ideas.

Firstly, the participants stressed the overall goal of the model should be improving motor skills and promoting physical activity levels among children with ASD. In fact, many participants indicated that they “just wanted to get their children moving”. These expectations contributed to the development of a unique model that focuses on motor skills and physical activity, whereas in the past, models such as the TEACCH programme[298] and SCERTS model[299], addressed motor skills within the context of overall developmental goals rather than as a primary objective. Participants also stated that the model should improve everyday function, activities of daily living, and children's independence. They noted that exercise-based interventions could enhance motor skills and address issues like dysregulation and anxiety, and therefore should be considered in model development.

Secondly, the participants expected the model to demonstrate adaptability, flexibility, and individualisation to accommodate the diverse spectrum of abilities within the ASD population.

These ideas are consistent with established approaches in the management of individuals on the spectrum, for example models like the TEACCH programme[297] and the SCERTS model[299] emphasise tailored interventions based on individual assessments, while the Pivotal Response Treatment model uses child interests and choice to individualise interventions.[300] Participants believed a multidisciplinary approach, aiming to provide comprehensive support across various levels of impairment and socioeconomic levels in society was essential to making the model a success. Research supports this in that interdisciplinary teams, including educators, therapists, and medical professionals, are a hallmark of effective autism care models.[261]

Thirdly, the participants believed that assessment procedures were important, with clinicians stating that they would like comprehensive and standardised assessment guidelines to allow for improved assessment, as well as the assessment of relevant (evidence based) motor variables. They also advocated for, clear and measurable goals to be developed as part of patient care strategies, for optimal progress monitoring by all key stakeholders involved in the child' management, as well as a guide for promoting regular evaluation and adjustment of/to interventions where needed. The emphasis on standardised assessments and progress monitoring is a common feature in established models, ensuring that interventions are effective and goals are met.[56, 301] The participants also wanted the model to direct improved communication between educators, therapists, and parents, in terms of feedback. Parents, specifically stated that they wanted to me more involved in the assessments of their children, as well as in decision making in terms of what therapies or interventions their children needed. Family-centered approaches are integral to many autism care models, and research has shown that involving parents leads to better outcomes for children with ASD.[302] The Early Start Denver Model, for example is a model where this concept has been integrated into the management of individuals on the spectrum effectively, whereby the model incorporates parents as co-therapists, and emphasises the role of family in intervention.[301]

Moreover, the participants emphasised the importance of addressing barriers and personal difficulties faced by individuals with ASD and their families in engaging in physical activities and programmes to enhance motor skills. These included things like socioeconomic and lifestyle constraints, child-specific variables and many others. Many existing models do recognise the impact of these barriers and difficulties, but may not specifically include these considerations into their intervention planning. For example, models like the Early Start Denver Model and TEACCH address socioeconomic factors indirectly through individualised planning, but often not as a primary focus. [301][297]

All three participant groups believed that including an educational component to the MoC would be important. Clinicians highlighted that it would be important to educate key stakeholders on the benefits of physical activity, scientifically-based exercise programmes, as well as on the relationship between motor skills and general well-being. Parents specifically wanted educational resources to be included within the model or developed as handouts based on the model, that could provide guidance on developmental milestones, motor skill acquisition, and strategies to support their child on their educational and therapeutic journey. The strong emphasis on educating stakeholders about the benefits of physical activity and motor skills is less prominent in some existing models. [301][297] Furthermore, although some models do include education and training components, they are often not the priority, nor specifically targeted towards physical activity.

Overall, the participants expected that the proposed model should optimise motor and physical activity outcomes and promote motor development for children with ASD through multidisciplinary approaches and individualised interventions. They also expected that the model should guide management and care throughout the individuals life.

5.3 Section B- Model development

5.3.1 Model development and definitions of the major domains of the model of care

The model of care developed for this study followed the established guidelines to develop a model of care and used a five-step process as described in the methodology.[10] It was crafted based on insights gathered from participant interviews and drew on the sequence of prevention model by van Mechelen et al.[196] and the ecological systems theory by Urie Bronfenbrenner.[200] The developed model, comprises of five main domains, with individual considerations at its core, influencing each domain. These domains include: education and awareness, the individuals motor profile, assessment, implementation, and monitoring which were all derived from key themes consolidated using thematic analysis. The five domains of the model are encapsulated by relevant stakeholders who would engage with and support individuals with ASD in specific contexts, and lie within a broader ecosystem, including social services, media, industry, local politics, and

community members. The model is positioned within the overall attitudes and ideologies of our culture which envelopes the entire model.

The underpinning theories used in developing this model are critical to its structure and functionality. The sequence of prevention model by van Mechelen et al. [196] provides a systematic approach to prevention, emphasising a sequence of steps from identifying the problem to implementing and evaluating interventions. This model's stepwise approach is reflected in the five-step process used in the study's model of care. In contrast, Bronfenbrenner's[200] ecological systems theory emphasises the importance of understanding individuals within the context of their multiple environmental layers. This theory informs the broader outside ecosystem of the present model, recognising the influence of various stakeholders and environmental factors on individuals with ASD. Using a combination of these approaches provided the “ideal” path to follow for those needing management using sequential steps, while providing a broader social and cultural context for support systems to occur within. When compared to other underlying theories used in different models, such as the health belief model[303] and the social cognitive theory model[304], differences and similarities may be found. The health belief model is different in that its focuses is on individual perceptions of health risk and benefit, and this approach is effective in models that want to change behaviours through awareness and education. In the social cognitive theory model on the other hand, the underlying focus is on the interplay between personal, behavioural, and environmental influences, which is similar to Bronfenbrenner's ecological approach.[304] However, it places a large emphasis on the shared influence between these factors and observational learning. Considering the focus of the current model was to provide a guide on how target the motor skills and physical activity levels of children with ASD and improve them, approaches used to direct improvement of practical skills, within a broader context of support relationships was considered more appropriate.

In the model itself, the researcher believed that education and awareness needed to be the starting point in the cycle central to the current model of care since improved education could elicit change. Under the education domain the following could be considered: understanding ASD, the benefits of physical activity, and the importance of achieving good motor proficiency levels. In addition, it could include improved education of key stakeholders, including parents, teachers, therapists, policymakers, and the broader community as well as improved training for those requiring ASD-specific skills to administer effective management. Examples of other models that have included educational components in their approach include the Treatment and ducation of Autistic and related Communication-Handicapped children programme[297], which focuses on

structured teaching and modifying the environment to support learning. Another example is the social communication, emotional regulation, and transactional support model, which incorporates education about ASD, yet focuses on social communication and emotional regulation. The present model would have a greater emphasis on education physical activity and motor skills compared to the models described above.

Following on from the education domain, the researcher believed that understanding the motor profile of individuals with ASD would be necessary before targeted intervention could occur. Therefore the understanding the motor profile followed second in the central cycle of the model. Since participants highlighted that motor profiles where highly varied from child to child, it is important to understand which variables could be affected. Participants provided numerous specific motor variables to be considered, yet the researcher believed that including all the reported variables could overcrowd the model, while only providing a select few could lead people to believe that deficits only occurred in these areas. Therefore term profile was chosen guide the idea that numerous variables should be considered and a diagrammatic arrow was also included to indicate that deficits occurred at different levels of intensity. The present model is unlike other models in this regard, for example, the SCERTS[297] integrates motor skills within a broader context of developmental goals, while the present model would treat motor proficiency as the primary focus and guide individuals to determine and understand the motor profile of each individual on the spectrum.

Following the understanding of what motor deficits could entail in individuals with ASD, assessment could then follow to measure and confirm impairments. Therefore, assessment makes up the third domain in the central cycle in the model. Under this domain the following should be considered: carrying out comprehensive assessments as effectively as possible using adapted standard tools to inform tailored interventions, developing assessment guidelines encompassing various motor variables and domains, conducting frequent assessments with appropriate feedback mechanisms, setting appropriate individualised goals from assessment finding and monitoring to track progress. Existing models like the Early Start Denver Model[309] and the DIR/Floortime approach[305] focus on comprehensive developmental assessments yet do not specifically emphasise motor skill assessments to the extent the present model does.

The fourth domain presented in the central cycle of the model was implementation. This domain should guide the implementation process of exercise and physical activity based intervention. The following considerations fell under this domain: approach of intervention (multidisciplinary and

holistic being of priority), physical activity preferences, socioeconomic factors, programme design (frequency, intensity, time and type of intervention. Other considerations included individual barriers and how to overcome them as well as other individual considerations and lifestyle factors. Participants specifically advocated for interventions to be designed with the ultimate aim of integrating them into individuals' routine or daily life to improve independence and everyday daily activities. The present model would be the first model (to the researcher's knowledge) that would direct the integration of physical activity and motor skills-based interventions into daily routines as a primary goal.

Once implementation occurs , monitoring should occur to determine if said intervention is effective and successful. Thus monitoring was next in the central cycle of the model. This domain includes the ideas that there should be regular monitoring and evaluation as well as the tracking of progress of the individuals performance. Furthermore, the efficacy of the intervention itself would need to be monitored, and where emerging issues are identified, adjustments be made to facilitate improved efficacy. In this process providing regular feedback to individuals with ASD and their families would be paramount. Effective monitoring could inform future implementation and assist in developing future standardised practices and protocols and promote consistency across different settings. Continuous monitoring and data-driven decision-making are also emphasised in ABA[306] and ESDM[309] models; however, the present model's focus on motor skills and physical activity monitoring is more prominent.

Central to the central cycle of the MoC, is the individual and their unique considerations. It is postulated that these considerations need to be accommodated in all five domains discussed above. They would need to be considered by key stakeholders in a child's management. These key stakeholders envelop the five domains and therefore aim to guide that that stakeholders will engage and support and individuals across the five internal domains of the study. The outer rings of the model comprise of social services, mass media, industry, local politics, and other individuals who may interact with the child i.e. their community. The success of the proposed MoC may rely on the collaboration and support of these cohorts and thus these have been identified to guide understanding of how and why an interplay with them should be considered. Lastly, the most outer ring highlights the attitudes and ideologies of the culture and how this model would fall within this overarching system. Models like TEACCH[297] and SCERTS[297] also emphasise the importance of a supportive community and cultural context, therefore aligning with the present model's broader ecosystem approach.

5.4 Section C- discussion of phase three data

5.4.1 Changes to the model following nominal group discussions

Firstly, the adapted nominal group technique used in this study was believed to be highly effective by the researcher in order to refine the model of care. By providing participants with the model of care along with the developed handouts ahead of time, they had the opportunity to reflect more deeply and offer more thoughtful feedback, making the process more productive. This adapted technique also allowed for a good flow of data during the group discussion, since participants had already considered their thoughts and insights on the model and had some feedback ready for the researcher. The researcher believed the focus on four themes including implementation, domains, design, and efficacy helped to ensure a thorough review of the Model. Furthermore, pre-prepared, supervisor-reviewed questions also aided in a further streamlined discussion, making the process smooth and focused. Overall, the researcher believed this adaptation enhanced the quality of the feedback.

In terms of participant feedback: the participants of this study suggested several changes to the model following a nominal group discussion to optimise the model for children with ASD. They wanted the model to visually and conceptually place individuals with ASD at the center of the model, and surround them with key stakeholders such as family, community, and healthcare providers. The participants indicated that this change would better reflect the important roles that stakeholders play in the support and intervention processes. Importantly, participants also requested that the term "feedback" be added in the assessment phase of the model, as well as the inclusion of bidirectional arrows to encourage communication between all stakeholders. This changed also aimed to highlight the need for continuous feedback during the assessment process as well as bridge the current gap where the lack of feedback has been identified as an issue. This may ensure that all stakeholders remain informed and engaged throughout the process in the future.

The participants agreed on the cyclical process represented in the center of the model, yet they had a large discussion on the sequence of the steps. Participants specifically spoke about the placement of the assessment and education domains within the cycle, with some participants arguing that starting with assessment was important for a more informed intervention, while others advocated for flexibility depending on individual circumstances. A consensus was reached to keep the numbered sequence for clarity and guidance, and to allow for users to follow an ideal flow. It was believed that an individual could still completed the cycle even if they had begun the

process somewhere else in the cycle and thus, it was deemed that the model was successful in representing structure while still allowing for adaptability.

Lastly, suggestions were made to improve the model's terminology and visual design, and so that the model was more inclusive. Changes to terminology included: replacing the term "church" with "places of worship", replacing the term "neighbours" to "community" to broaden the scope of support, and adding "coaches" to the list of key stakeholders. The participants believed that making these changes would make the model more representative and inclusive of the various stakeholders that individuals with ASD could engage with.

CHAPTER 6: CONCLUSIONS, STRENGTHS AND LIMITATIONS, AND RECCOMENDATIONS

The subtopics that will be included in this chapter include:

6.1 Conclusions

6.2 Limitations of study

6.3 Strengths of study

6.4 Recommendations

6.5 Take home message

6.1 Conclusions

In conclusion, teachers, clinicians and parents argue that motor proficiency levels and physical activity levels in children with ASD have been neglected in the past, and a general a fundamental shift in mindset in key stakeholders is needed to focus on improving these deficits. Motor skill and physical activity level deficits can impact independence, general wellbeing and the performance of activities of daily life in home, school and community settings. Improving these deficits can result in overall improved quality of life and the better overall management of children on the spectrum.

According to teachers, clinicians and parents, improved diagnosis and management of motor skill deficiencies is needed. Importantly, improved education on the physical activity guidelines, the benefits of physical activity, as well as how physical activity-based interventions can be effectively implemented is needed. Furthermore, improved awareness of how motor deficits can affect the overall life of the individual is imperative.

It was reported that the training of key stakeholders is needed to assist in better understanding of the condition, how to manage the condition, as well as how to implement effective interventions. In addition, interventions need to be carried out using a holistic, multidisciplinary individualised approach whereby individual considerations are deliberated to make the intervention as

appropriate and effective as possible. Furthermore, implementation across the individual's environment and making motor activities part of daily routine is necessary. The monitoring of the CETentions and strategies needs to be conducted, with goals being set for individuals, and progress being tracked regularly. Feedback between key stakeholders throughout the process is needed.

The model of care developed in this study will assist in providing an overview of what process can be followed to improve physical activity and motor proficiency for individuals on the spectrum, and indicate who key stakeholders are in carrying out holistic multidisciplinary individualised management for individuals on the spectrum.

6.2 Limitations of study

- One of the main limitations in this study was in the recruitment of participants (particularly parents of individuals with ASD). It was challenging to find parents willing to discuss their children in interview format; however, enough parents were interviewed in the end to reach data saturation and inform the model.
- Another limitation was that most of the individuals who agreed to participate in this study preferred virtual settings, therefore, body language and other nuances may have been missed in the interview process. The researcher mitigated this by keeping field notes and probed the participant further if the researcher felt information was lacking or may have been construed differently..
- It would have been optimal to include more individuals living with ASD but given the restrictions of COVID and the complexities of interviewing this population only one,who was also a parent, was included at this stage.
- The model developed in this study provides a means to guide and improve physical activity levels and motor skills in children with ASD. Although motor skill proficiency is integral in carrying out numerous activities of daily life, and may influence the engagement in numerous other areas of an individual's life, this is only one area in which an individual on the spectrum may have difficulties. Therefore, this model needs to fit into a larger management plan for the individual. Similarly, physical activity levels are crucial to an individual's health, where individuals should be meeting physical activity guidelines. However, optimising physical activity levels should not be targeted in silos but rather integrated in the overall management of the individual. This MoC therefore, needs to be implemented in conjunction with other management strategies and interventions so that there is a holistic management plan for the individual.

- This MoC was developed by interviewing teachers, clinicians and parents who work with or have children who have a diagnosis of ASD. This model is therefore, specific to children on the spectrum. Importantly, it needs to be reiterated that general motor difficulties may persist throughout an individual's life, and in fact physical activity levels seem to decline with age which may contribute to further reduced motor skills. However, the researcher believes that this model may be appropriate for all ages of individuals on the spectrum since individual considerations are central to the model and need to be considered in all aspects of implementation. For example, age itself could be considered in terms of activity or intervention appropriateness. The researcher does however, acknowledge that slight adjustments may need to be made to the MoC for it to be specific to older adults - yet further research is needed in this regard.
- Overall reflexivity of limitations: future studies may need to optimize recruitment strategies within an autism context and further education on the benefits of conducting research within the population may be necessary to create buy-in. Individuals who have a diagnosis of ASD need to be engaged more frequently in studies such as these, when developing strategies and care pathways so that first-hand experiences and relevant information may be included in the strategies. Considering ASD is a spectrum, models, interventions and strategies focusing on managing specific areas of the condition should not be implemented in isolation, but rather as part of a larger management plan throughout an individual's life so that a holistic intention can occur.

6.3 Strengths of study

- One of the biggest strengths of this study was including the perceptions of parents, teachers, as well as clinicians in the models' development. The majority of research in the autism field does not consider parent input – especially in intervention/model design. Furthermore, although only one of the participants interviewed (parent 4) was on the spectrum, this provided important and critical first hand, insight into the perceptions and knowledge of motor and physical activity levels for this study, and an important perspective regarding individual considerations and barriers with regards to physical activity engagement.
- This study consolidated the findings (CERT analysis pg.56) regarding common reporting failures in exercise-based intervention studies (for 42 studies) conducted for individuals aged 0-22 years on the spectrum which provided novel insight in this area. The information highlighted the need for better reporting of methodologies and findings of exercise-based interventions for individuals on the spectrum. The analysis drew attention to the fact that

important information may not be documented in interventions, for example, how an individual may feel after performing exercise. Thus, considering that this is an important sensory barrier for some individuals on the spectrum - as well as other items stipulated by reporting criteria (listed in CERT guidelines) - these need to be reviewed and included in interventions in the future.

- The model of care developed in this study, is the first one to the researcher's knowledge that has been developed focusing specifically on motor proficiency levels and physical activity levels for individuals on the spectrum. This model therefore, bridges the much needed gap in guiding the process for the improvement of motor skill and physical activity levels for individuals on the spectrum.
- Overall reflexivity of strengths: In terms of the transferability of the findings to other contexts, the researcher feels that the overall model generated by this research may be applicable and adaptable to other contexts. Although interviews were conducted in a South African setting, the perspectives and knowledge regarding motor skills and physical activity levels obtained from parents, teachers and clinicians may be similar to parents, teachers and clinicians in other settings. Therefore, the final model in its current state may be used as a reference or starting point to guide other parents, teachers and clinicians in other contexts or countries and may eventually be adapted or adjusted to more specifically to consider other contextual intricacies.
- The model may also may be used as a starting point or baseline MoC for children with other neurodiverse diagnoses.

6.4 Recommendations

i. Based on the findings of this study in terms of the teachers, clinicians, and parent perceptions the researcher makes the following recommendations:
    - Education and awareness: there is a need for improved awareness regarding the fact that the majority of individuals with ASD struggle with motor impairments as well as reduced physical activity levels. There needs to be improved education of the benefits of exercise for individuals on the spectrum and education regarding how much physical activity these individuals need to meet. It is recommended that education and awareness is improved using multifaceted strategies across societal levels (government through to the individual) by any means necessary. The model of care handout developed in this study may be used as reference and distributed to assist with this - as a starting point.

- Motor profile: Motor skill proficiency levels and physical activity levels for the majority of individuals with ASD needs to be improved. The individual's motor profile and physical activity level need to be determined via an appropriate assessment after which a holistic motor management plan needs to be developed based on the individuals needs as well as their preferences.
- Assessment: An appropriate motor assessment tool specifically for individuals on the spectrum needs to be developed. The tool should include the assessment of common motor deficits described within the population and should be flexible/adaptable to accommodate the large variances within the Autistic population. At present, standard motor tools should be adapted as much as possible to accommodate individuals on the spectrum so that individual needs are met. Assessments should be carried out frequently and throughout the individual's life by relevant experts. Findings from assessments should be shared amongst key stakeholders to foster a multidisciplinary, holistic management approach. Individual considerations need to be considered at all times throughout the assessment process to ensure results accumulated are a true reflection of the individual's capabilities.
- Implementation: Exercise-based initiatives and interventions should be determined based on the findings of appropriate assessments conducted with individuals with ASD. The intervention needs to first, and foremost, take into account individual needs. Importantly, interventions and initiatives should initially be designed and pitched at a neurotypical level (as some individuals may not have deficits in certain areas), and only modified if/where needed. Considerations including individual barriers and common difficulties experienced by the individual need to be taken into account at all times and modified accordingly. Thus initiatives and interventions need to be flexible and adaptable and attempt to mitigate barriers wherever possible. These initiatives and interventions should be implemented as early on in the individuals life as possible and continue throughout their life to maintain function as well as improve quality of life.
- Monitoring: Following an assessment, set goals need to be established based on an individual's needs. Regular assessments need to occur to determine if the individual is making progress and feedback needs to be shared amongst key stakeholders at all times. Regular monitoring of whether the implemented initiative or intervention is effective is needed by those carrying out the intervention or those engaging with the process. In instances where goals are not being met or progress

is not being made, it may be that changes need to be made by the relevant individuals involved in the process.

- The model of care developed in this study may be used to guide the process of managing motor skill deficits and reduced physical activities within an ASD population. The model may provide a starting point to address the above-mentioned recommendations, yet further research is needed to clarify certain aspects (see below research recommendations).

ii. Research recommendations

- There is a need to determine the best methods for improving education and awareness amongst individuals working with individuals on the spectrum as well as those on the spectrum themselves regarding the benefits of exercise and physical activity guidelines. For example, individuals on the spectrum may need adapted strategies due to cognitive and social impairments.
- An appropriate motor assessment tool for individuals on the spectrum needs to be developed.
- Future research needs to determine if the model of Care developed in this study effectively guides the process of improving motor proficiency and physical activity levels of individuals on the spectrum.
- Further research is also needed to determine whether there is uptake and use of the model to guide the improvement of motor proficiency and physical activity levels of individuals on the spectrum.

iii. Clinical and policy recommendations

- School curriculums need to be reviewed to align with student and teacher needs in terms of motor skill proficiency levels and physical activity levels of children on the spectrum.
- Clinical university degrees need to be reviewed to determine if appropriate training of students, regarding the understanding and management of children on the spectrum, is included in curriculums.

6.5 Take home messages

- Teachers, clinicians, and parents perceive motor skill proficiency to be a common problem found within individuals on the spectrum, which can limit their daily function and general engagement in school, home and social settings.
- Teachers, clinicians, and parents believe that the majority of children with ASD have reduced physical activity levels compared to neurotypical counterparts, and that they are not meeting physical activity guidelines.
- Teachers, clinicians, and parents believe that a model of care developed to improve motor skills proficiency and physical activity levels in individuals with ASD would be of value in terms of management of the children.
- Key areas identified by teachers, clinicians, and parents in terms what needed to be included in a model of care development were: education, understanding that motor skills and physical activity levels fall on a spectrum, implementation of interventions taking into consideration individual considerations and barriers, as well as effective monitoring of interventions and strategies.
- The model of care and handout developed in this study may be used to guide the improvement of motor skill proficiency and physical activity levels in children with ASD.
- Models of care and management strategies should always be carried out and extend across an individual's lifespan.

"Do not fear people with autism, embrace them. Do not spite people with autism, unite them. Do not deny people with autism, accept them, for then their abilities will shine." - Paul Isaacs

REFERENCES

1. Neophytou N. 17 - The importance of motor assessment, and current motor assessment tools available for individuals with autism spectrum disorder. In: Papaneophytou NL, Das UN, editors. Emerging Programs for Autism Spectrum Disorder: Academic Press; 2021. p. 273-84.
2. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th ed. Arlington, VA: American Psychiatric Publishing;2013.
3. The American Heritage® Medical Dictionary. "Aspergers syndrome." [Available from: http://medical-dictionary.thefreedictionary.com/Aspergers+syndrome].
4. Ghaziuddin M, Tsai L, Ghaziuddin N. Brief report: a reappraisal of clumsiness as a diagnostic feature of Asperger syndrome. Journal of Autism and Develepmental Disorders. 1992;22(4):651-6.
5. Merriam-Webster's medical dictionary. "Down's Syndrome". Springfield, MA: Merriam-Webster, 2016. [Available from: https://www.merriam-webster.com/dictionary/Down%20syndrome]
6. Medical Dictionary for the Health Professions and Nursing. "Dynamic balance." 2012 [Available from: http://medical-dictionary.thefreedictionary.com/dynamic+balance].
7. Sanders J. Qualitative or quantitative differences between Asperger's disorder and autism?. Journal of Autism and Develepmental Disorders. 2009;39(11):1560-7.
8. De Long G. Autism: new data suggest a new hypothesis. Neurology. 1999;52(1):911-6.
9. Rapin I. Autism in search of a home in the brain. Neurology.1999;52(5):902.
10. Agency for clinical innovation.Understanding the process to develop a Model of Care In: Agency for clinical innovation, editor. Chatswood NSW:Agency for clinical innovation 2013. p. 1-16.
11. Merriam-Webster's medical dictionary. "Rett Syndrome". Springfield, MA: Merriam-Webster, 2016. [Available from: https://www.merriam-webster.com/medical/Rett%20syndrome]
12. Picoult J. House Rules. United States: Atria; 2010. 532 pp. ISBN: 978-0-7432-9643-4.
13. Centre for Disease Control. Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites. Morbidity and Mortality Weekly Report. 2014;63(SS02):1-21.
14. Monteiro CE, Da Silva E, Sodré R, Costa F, Trindade AS, Bunn P, et al. The Effect of Physical Activity on Motor Skills of Children with Autism Spectrum Disorder: A Meta-Analysis.International Journal of Environmental Research and Public Health. 2022;19(21):14081.
15. Ferguson L. The effect of an adapted physical activity program on motor performance and behaviour of children with autism spectrum disorder. [Thesis]. In press 2010.
16. Allenn J. Jogging can modify disruptive behaviours. Teaching Exceptional Children. 1980;12(2):66-70.
17. Bass M, Duchowny C, Llabre M. The effect of therapeutic horseback riding on social functioning in children with autism. Journal of Autism and Developmental Disorders. 2009;29:1261-7.
18. Casey A, Quenneville-Himbeault G, Normore A, Davis H, Martell S. A therapeutic skating intervention for children with Autism Spectrum Disorder. Pediatric Physical Therapy. 2015;27(2):170-7.
19. Ehleringer J. Yoga Therapy in Practice.Yoga for Children on the Autism Spectrum. International Journal of Yoga Therapy 2010;20:131-9.
20. Badia M , Riquelme I, Orgaz B, Acevedo R, Longo E, Montoya P. Pain, motor function and health-related quality of life in children with cerebral palsy as reported by their physiotherapists. BMC Pediatrics. 2014;14:192.
21. Borremans E, Rintala P, McCubbin J. Physical fitness and physical activity in adolescents with Asperger syndrome: a comparitive study. Adapted Physical Activity Quarterly. 2010;27:308-20.
22. Macdonald M, Esposito P, Ulrich D. The physical activity patterns of children with autism BMC Research Notes. 2011;4:4-422.
23. Potvin M, Snider L, Prelock P, nnn n, nnn n, nnn n, et al. Recreational participation of children with high functioning autism. Journal of Autism and Developmental Disorders 2013;43:445-57.

24. Srinivasan S, Pescatello L, Bhat A. Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. Physical Therapy. 2014;94(6):875-9.
25. World Health Organization. International Classification of Functioning, Disability and Health (ICF). Geneva: World Health Organization; [cited 2021 Jun 20]. Available from: https://www.who.int/standards/classifications/international-classification-of-functioning-disability-and-health.
26. Mazurek MO, Brown R, Curran A, Sohl K. ECHO autism: A new model for training primary care providers in best-practice care for children with autism. Clinical pediatrics. 2017;56(3):247-56.
27. Gidley-Larson J, Mostofsky S. Motor deficits in autism. In: Tuchman R, Rapin I, editors. Autism: a neurological disorder of early brain development. London, England: Mac Keith Press; 2006. p. 68-78.
28. Bryson SE, Rogers SJ, Fombonne E. Autism Spectrum Disorders: Early Detection, Intervention, Education, and Psychopharmacological Management. The Canadian Journal of Psychiatry. 2003;48(8):506-16.
29. Bauman M, Kemper T. The neurobiology of autism. 2nd ed. Baltimore, MD: John Hopkins University Press; 2006.
30. Geschwind DH. Autism: Many Genes, Common Pathways? Cell. 2008;135(3):391-5.
31. Boston JPGP. Biopsychology. Boston,Massachusetts: Pearson; 2011.
32. Gilberg C, Coleman M. The biology of autistic syndromes. 3rd ed. London, England: Mac Keith Press; 2000.
33. Neophytou N. The efficacy of a 12 week intervention in 11-16 year old adolescents with autism spectrum dissorder. [Masters Dissertation]. In press 2016.
34. Myers S, Johnson P. Management of children with autism spectrum disorders. Pediatrics. 2007;120(5):1162-82.
35. Zwaigenbaum L, Thurm A, Stone W, Baranek G, Bryson S, Iverson J, et al. Studying the emergence of autism spectrum disorders in high-risk infants: methodological and practical issues. Journal of Autism and Develepmental Disorders. 2007;37:466-80.
36. Frazier T, Youngstrom E, Speer L, Embacher R, Law P, Constantino J, et al. Validation of proposed DSM-5 criteria for autism spectrum disorder. Journal of the American Academy of Child and Adolescent Psychiatry. 2012;51:28-40 e23.
37. Huerta M, Bishop S, Duncan A, Hus V, Lord C. Application of DSM-5 criteria for autism spectrum disorder to three samples of children with DSM-IV diagnoses of pervasive developmental disorders. The American Journal of Psychiatry. 2012;169:1056-64.
38. Kent R, Carrington S, Le Couteur A, Gould J, Wing L, Maljaars J. Diagnosing autism spectrum disorder: who will get a DSM-5 diagnosis? Journal of Child Psychology and Psychiatry. 2013;54:1242-50.
39. Guthrie W, Swineford L, Nottke C, Wetherby A. Early diagnosis of autism spectrum disorder: stability and change in clinical diagnosis and symptom presentation. Journal of Child Psychology and Psychiatry. 2013;54:582-90.
40. Christensen D, Baio J, Braun K, Bilder D, Charles J, Constantino JN, et al. Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. MMWR Surveill Summ 2016;65(SS-3):1-23.
41. Landrigan P. What causes autism? Exploring the environmental contribution. Current opinion in Pediatrics. 2010;22:219-25.
42. Centers for Disease Control and Prevention. Screening and Diagnosis of Autism Spectrum Disorder. Atlanta: Centers for Disease Control and Prevention; [cited 2022 Jun 24]. [Available from: https://www.cdc.gov/autism/diagnosis/index.html].
43. Regalado M, Halfon N. Primary care services promoting optimal child development from birth to age 3 years. . Archives of Pediatrics & Adolescent Medicine 2001;155:1311-22.

44.Murray-Slutsky C, Paris B. Exploring the spectrum of autism and pervasive developmental disorders. Texas, USA: Therapy skill builders; 2000.
45.Page J, Boucher J. Motor impairments in children with autistic disorder. Child Language Teaching and Therapy. 1998;14(3):233-59.
46.Teitelbaum P, Teitelbaum O, Nye J, Fryman J, Maurer RG. Movement analysis in infancy may be useful for early diagnosis of autism. Proceedings of the National Academy of Sciences. 1998;95(23):13982-7.
47.Ratto AB, Kenworthy L, Yerys BE, Bascom J, Wieckowski AT, White SW, et al. What About the Girls? Sex-Based Differences in Autistic Traits and Adaptive Skills. Journal of Autism and Develepmental Disorders. 2018;48(5):1698-711.
48.Baxter A, Brugha T, Erskine H, Scheurer R, Vos T, Scott J. The epidemiology and global burden of autism spectrum disorders. Psychological Medicine. 2015; 45(3):601-13.
49.Zeidan J, Fombonne E, Scorah J, Ibrahim A, Durkin MS, Saxena S, et al. Global prevalence of autism: A systematic review update. Autism Research. 2022;15(5):778-90.
50.GBD 2015 Disease and Injury Incidence and Prevalence. Global, regional, and national incidence, prevalence, and years lived with disability for 310 diseases and injuries, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet. 2016;388 (10053):1545-602.
51.Atladottir HO, Gyllenberg D, Langridge A, Sandin S, Hansen SN, Leonard H, et al. The increasing prevalence of reported diagnoses of childhood psychiatric disorders: a descriptive multinational comparison.European Child & Adolescent Psychiatry. 2015;24:173-83.
52.Rutter M. Incidence of autism spectrum disorders: changes over time and their meaning. Acta Peadiatrica. 2005;94(2-15).
53.Fombonne E. Epidemiology of autistic disorder and other pervasive developmental disorders. Journal of Clinical Psychiatry. 2005;66(suppl 10):3-8.
54.Fombonne E. The prevalence of autism. Journal of the American Medical Association. 2003;289:87-90.
55.Matson J, Daniene N. Diagnosing comorbid psychiatric conditions: autism spectrum disorders. Psychiatric Times. 2009;26:38.
56.Odom SL, Boyd BA, Hall LJ, Hume K. Evaluation of comprehensive treatment models for individuals with autism spectrum disorders. Journal of Autism and Develepmental Disorders. 2010;40(4):425-36.
57.Greaves-Lord K, Skuse D, Mandy W. Innovations of the ICD-11 in the Field of Autism Spectrum Disorder: A Psychological Approach. Clinical Psychology in Europe. 2022 ;4(Spec Issue):e10005.
58.6A02 Autism spectrum disorder.In International statistical classification of diseases and related health problems.(11th ed.). [Internet]. Available from: https://icd.who.int/browse11/l-m/en#/http://id.who.int/icd/entity/437815624.
59.Cook J, Hull L, Crane L, Mandy W. Camouflaging in autism: A systematic review. Clinical Psychology Review. 2021;89:102080.
60.Happé F, Livingston LA, Shah P. Compensation in autism is not consistent with social motivation theory. Behavioral and Brain Sciences. 2019;42:e99.
61.Chen Y-L, Senande LL, Thorsen M, Patten K. Peer preferences and characteristics of same-group and cross-group social interactions among autistic and non-autistic adolescents. Autism. 2021;25(7):1885-900.
62.Mazza M, Pino MC, Mariano M, Tempesta D, Ferrara M, De Berardis D, et al. Affective and cognitive empathy in adolescents with autism spectrum disorder. Frontiers in Human Neuroscience. 2014;8.
63.Bölte S, Holtmann M, Poustka F, Scheurich A, Schmidt L. Gestalt Perception and Local-Global Processing in High-Functioning Autism. Journal of Autism and Developmental Disorders. 2007;37(8):1493-504.

64. Pfeiffer B, Piller A, Giazzoni-Fialko T, Chainani A. Meaningful outcomes for enhancing quality of life for individuals with autism spectrum disorder. Journal of Intellectual & Developmental Disability. 2017;42(1):90-100.
65. Rosello R, Martinez-Raga J, Tomas JM, Mira A, Cortese S. Cognitive and behavioral profiles in children with autism spectrum disorder with and without Attention-Deficit/hyperactivity disorder. Child and Adolescent Mental Health. 2022.
66. Downey R, Rapport MJK. Motor activity in children with autism: a review of current literature. Pediatric Physical Therapy. 2012;24(1):2-20.
67. Matson ML, Matson JL, Beighley JS. Comorbidity of physical and motor problems in children with autism. Research in developmental disabilities. 2011;32(6):2304-8.
68. Green D, Charman T, Pickles A, Chandler S, Loucas T, Simonoff E, et al. Impairment in movement skills of children with autistic spectrum disorders. Developmental Medicine & Child Neurology. 2009;51(4):311-6.
69. Fournier KA, Hass CJ, Naik SK, Lodha N, Cauraugh JH. Motor coordination in autism spectrum disorders: a synthesis and meta-analysis. Journal of Autism and Developmental Disorders 2013;43:445-57. 2010;40(10):1227-40.
70. Ming X, Brimacombe M, Wagner GC. Prevalence of motor impairment in autism spectrum disorders. Brain and Development. 2007;29(9):565-70.
71. Gillberg C, Coleman M. The biology of the autistic syndromes: Cambridge University Press; 2000.
72. Whitaker-Azmitia PM. Serotonin and brain development: role in human developmental diseases. Brain research bulletin. 2001;56(5):479-85.
73. T.M. DeLorey AH, S.G. Anagnostaras, G.E. Homanics, B.A. Minassian, A. Asatourian, et al., syndrome MltbsotG-ArhtepamotbcoA, J Neurosci, pp. 8505-8514.
74. Stanfield AC, McIntosh AM, Spencer MD, Philip R, Gaur S, Lawrie SM. Towards a neuroanatomy of autism: a systematic review and meta-analysis of structural magnetic resonance imaging studies. European psychiatry. 2008;23(4):289-99.
75. Enticott PG, Bradshaw JL, Iansek R, Tonge BJ, Rinehart NJ. Electrophysiological signs of supplementary-motor-area deficits in high-functioning autism but not Asperger syndrome: an examination of internally cued movement-related potentials. Developmental Medicine & Child Neurology. 2009;51(10):787-91.
76. McAlonan GM, Suckling J, Wong N, Cheung V, Lienenkaemper N, Cheung C, et al. Distinct patterns of grey matter abnormality in high-functioning autism and Asperger's syndrome. Journal of Child Psychology and Psychiatry. 2008;49(12):1287-95.
77. Ghaziuddin M, Butler E. Clumsiness in autism and Asperger syndrome: A further report. Journal of Intellectual Disability Research. 1998;42(1):43-8.
78. Noterdaeme M, Mildenberger K, Minow F, Amorosa H. Evaluation of neuromotor deficits in children with autism and children with a specific speech and language disorder. European child & adolescent psychiatry. 2002;11(5):219-25.
79. Kohen-Raz R, Volkman FR, Cohen DJ. Postural control in children with autism. J Autism Dev Disord. 1992;22(3):419-32.
80. Minshew NJ, Sung K, Jones BL, Furman JM. Underdevelopment of the postural control system in autism. Neurology. 2004;63(11):2056-61.
81. Moritani T. Neuromuscular adaptations during the acquisition of muscle strength, power and motor tasks. J Biomech. 1993;26 Suppl 1:95-107.
82. Iorga A, Jianu A, Gheorghiu M, Crețu BD, Eremia I-A. Motor Coordination and Its Importance in Practicing Performance Movement. Sustainability. 2023;15(7):5812.
83. Lopes L, Póvoas S, Mota J, Okely AD, Coelho-e-Silva MJ, Cliff DP, et al. Flexibility is associated with motor competence in schoolchildren. Scandinavian Journal of Medicine & Science in Sports. 2017;27(12):1806-13.
84. Miyahara M, Tsujii M, Hori M, Nakanishi K, Kageyama H, Sugiyama T. Brief report: motor incoordination in children with Asperger syndrome and learning disabilities. Journal of Autism and Developmental Disorders 2013;43:445-57.. 1997;27(5):595-603.

85.Rinehart NJ, Tonge BJ, Iansek R, McGinley J, Brereton AV, Enticott PG, et al. Gait function in newly diagnosed children with autism: Cerebellar and basal ganglia related motor disorder. Dev Med Child Neurol. 2006;48(10):819-24.
86.Rogers S, Cook I, Meryl A. Imitation and play in autism. In: Volkmar F, Paul R, Klin A, Cohen D, editors. Handbook of autism and pervasive developmental disorders. 1st ed. New Jersey: John Wiley & Sons; 2005. p. 382-405.
87.Leary M, Hill D. Moving on: autism and movement disturbance. Journal on Mental Retardation 1996 34:39-53.
88.Collier D, Reid G. A comparison of two models designed to teach autistic children a motor task. Adapted Physical Activity Quarterly. 1987;Q4:226-36.
89.LeBarton ES, Iverson JM. Fine motor skill predicts expressive language in infant siblings of children with autism. Developmental science. 2013;16(6):815-27.
90.Liu T, Breslin CM. Fine and gross motor performance of the MABC-2 by children with autism spectrum disorder and typically developing children. Research in Autism Spectrum Disorders. 2013;7(10):1244-9.
91.Fuentes CT, Mostofsky SH, Bastian AJ. Children with autism show specific handwriting impairments. Neurology. 2009;73(19):1532-7.
92.Mahone EM, Powell SK, Loftis CW, Goldberg MC, Denckla MB, Mostofsky SH. Motor persistence and inhibition in autism and ADHD. Journal of the International Neuropsychological Society. 2006;12(5):622-31.
93.Kindregan D, Gallagher L, Gormley J. Gait deviations in children with autism spectrum disorders: a review. Autism Res Treat. 2015;2015:741480.
94.Miller HL, Caçola PM, Sherrod GM, Patterson RM, Bugnariu NL. Children with Autism Spectrum Disorder, Developmental Coordination Disorder, and typical development differ in characteristics of dynamic postural control: A preliminary study. Gait Posture. 2019;67:9-11.
95.Salar S, Daneshmandi H, Panaghi L, Karimizadeh Ardekani M, Nazari Sharif H. The investigation of the relationship between core endurance with static and dynamic balance in children with autism spectrum disorder. International Journal of Sport Studies. 2015;5(1):48-56.
96.Ruggeri A, Dancel A, Johnson R, Sargent B. The effect of motor and physical activity intervention on motor outcomes of children with autism spectrum disorder: A systematic review. Autism. 2020;24(3):544-68.
97.Calhoun M, Longworth M, Chester V. Gait patterns in children with autism. Clinical Biomechanics. 2011;26(2):200-6.
98.Cunningham CB, Schilling N, Anders C, Carrier DR. The influence of foot posture on the cost of transport in humans. The Journal of Experimental Biology. 2010;213(5):790-7.
99.Fournier KA, Kimberg CI, Radonovich KJ, Tillman MD, Chow JW, Lewis MH, et al. Decreased static and dynamic postural control in children with autism spectrum disorders. Gait & posture. 2010;32(1):6-9.
100.Lord S. Dance and drama. In: Powell S, Jordaan R, editors. Autism and learning: a guide to good practice. London: David Fulton Publishers; 1997.
101.Vernazza-Martin S, Martin N, Vernazza A, Lepellec-Muller A, Rufo M, Massion J, et al. Goal directed locomotion and balance control in autistic children. Journal of Autism and Developmental Disorders. 2013;43:445-57.. 2005;35(1):91-102.
102.Mari M, Castiello U, Marks D, Marraffa C, Prior M. The reach–to–grasp movement in children with autism spectrum disorder. Philosophical Transactions of the Royal Society of London Series B: Biological Sciences. 2003;358(1430):393-403.
103.Esposito G, Venuti P. Analysis of toddlers' gait after six months of independent walking to identify autism: a preliminary study. Perceptual and motor skills. 2008;106(1):259-69.
104.Rinehart N, Tonge B, Bradshaw J, Iansek R, Enticott P, Mc Ginley J. Gait function in high-functioning autism and Asperger's disorder. European Child and Adolescent Psychiatry. 2006;15(5):256-64.

105.Vilensky J, Damasio A, Maurer R. Gait disturbances in patients with autistic behavior: a preliminary study. Archives of Neurology. 1981 38(10):646-9.
106.Jansiewicz EM, Goldberg MC, Newschaffer CJ, Denckla MB, Landa R, Mostofsky SH. Motor Signs Distinguish Children with High Functioning Autism and Asperger's Syndrome from Controls. J Autism Dev Disord. 2006;36(5):613-21.
107.Dowell LR, Mahone EM, Mostofsky SH. Associations of postural knowledge and basic motor skill with dyspraxia in autism: Implication for abnormalities in distributed connectivity and motor learning. Neuropsychology. 2009;23(5):563-70.
108.Ries JD. Ambulation: Impact of Age-Related Changes. Geriatric Physical Therapy-eBook. 2011:316.
109.Molloy CA, Dietrich KN, Bhattacharya A. Postural stability in children with autism spectrum disorder. J Autism Dev Disord. 2003;33(6):643-52.
110.Ament K, Mejia A, Buhlman R, Erklin S, Caffo B, Mostofsky S, et al. Evidence for specificity of motor impairments in catching and balance in children with autism. Journal of Autism and Developmental Disorders. 2015;45(3):742-51.
111.Freitag CM, Kleser C, Schneider M, von Gontard A. Quantitative Assessment of Neuromotor Function in Adolescents with High Functioning Autism and Asperger Syndrome. Journal of Autism and Developmental Disorders. 2007;37(5):948-59.
112.Memaria A, Ghanounib P, Gharibzadehc S, Eghlidib J, Ziaeea V, Moshayedid P. Postural sway patterns in children with autism spectrum disorder compared with typically developing children. Research in Autism Spectrum Disorders. 2013;7(2):325-32.
113.Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age and Ageing. 2006;35(suppl_2):ii7-ii11.
114Lim YH, Partridge K, Girdler S, Morris SL. Standing Postural Control in Individuals with Autism Spectrum Disorder: Systematic Review and Meta-analysis. Journal of Autism and Developmental Disorders. 2017;47(7):2238-53.
115.Memari AH, Ghanouni P, Gharibzadeh S, Eghlidi J, Ziaee V, Moshayedi P. Postural sway patterns in children with autism spectrum disorder compared with typically developing children. Research in Autism Spectrum Disorders. 2013;7(2):325-32.
116.Gepner B, Mestre D, Masson G, de Schonen S. Postural effects of motion vision in young autistic children. Neuroreport: An International Journal for the Rapid Communication of Research in Neuroscience. 1995;6:1211-4.
117.Schmitz C MJ, Barthélémy C, Assaiante C. Motor control and children with autism: a deficit of anticipatory function? Neurosci Lett. 2003;348:17–20.
118.Travers BG, Powell PS, Klinger LG, Klinger MR. Motor difficulties in autism spectrum disorder: linking symptom severity and postural stability. Journal of Autism and Developmental Disorders. 2013;43(7):1568-83.
119.Grimes P, Legg S. Musculoskeletal disorders (MSD) in school students as a risk factor for adult MSD: a review of the multiple factors affecting posture, comfort and health in classroom environments. Journal of the Human-Environment System. 2004;7(1):1-9.
120.Sugaono H, Tecchio J. Exercises training program: It's Effect on Muscle strength and Activity of daily living among elderly people. Nursing and Midwifery. 2020;1(01):19-23.
121.Totty MS, Wade E. Muscle activation and inertial motion data for noninvasive classification of activities of daily living. IEEE Transactions on Biomedical Engineering. 2017;65(5):1069-76.
122.Bhat AN, Landa RJ, Galloway JC. Current Perspectives on Motor Functioning in Infants, Children, and Adults With Autism Spectrum Disorders. Physical Therapy. 2011;91(7):1116-29.
123.Hardan A, Kilpatrick M, Keshavan M, Minshew N. Motor performance and anatomic magnetic resonance imaging (MRI) of the basal ganglia in autism. Journal of Child Neurology. 2003;18:317-24.
124.Kern JK, Geier DA, Adams JB, Troutman MR, Davis G, King PG, et al. Autism severity and muscle strength: A correlation analysis. Research in Autism Spectrum Disorders. 2011;5(3):1011-5.

125.Pan C, Frey G. Physical activity patterns in youth with Autism Spectrum Disorders. Journal of Autism and Developmental Disorders. 2006;36:597-606.
126.Yilmaz I, Yanardag M, Birkan B, Bumin G. Effects of swimming training on physical fitness and water orientation in autism. Pediatrics International. 2004;46:624-6.
127.Brand S, Jossen S, Holsboer-Trachsler E, Pühse U, Gerber M. Impact of aerobic exercise on sleep and motor skills in children with autism spectrum disorders - a pilot study. Neuropsychiatry Disieses and Treatment. 2015;11:1911-20.
128.Kim Y, Todd T, Fujii T, Lim JC, Vrongistinos K, Jung T. Effects of Taekwondo intervention on balance in children with autism spectrum disorder. Journal of Exercise Rehabilitation. 2016;12(4):314-9.
129.Wilson RB, McCracken JT, Rinehart NJ, Jeste SS. What's missing in autism spectrum disorder motor assessments? Journal of Neurodevelopmental Disorders. 2018;10(1):33.
130.Section on pediatrics. Selected assesment tools for evaluation of children with autism spectrum disorder in school-based practice (fact sheet): American Physical Therapy Assosiation; 2015 [Available from: https://pediatricapta.org/includes/fact-sheets/pdfs/15%20Selected%20Assess%20Tools%20for%20ASD.pdf.
131.Tidy C. Autism Spectrum Disorders EMS group; 2016 [Available from: http://patient.info/doctor/autistic-spectrum-disorders-pro.
132.Kern L, Koegel R, Dunlap G. The influenece of vogorous versus mild exercise on autistic stereoptyped behavious. J Autism Dev Disord. 1984;14:57-67.
133.Healy S, Nacario A, Braithwaite RE, Hopper C. The effect of physical activity interventions on youth with autism spectrum disorder: A meta-analysis. Autism Res. 2018;11(6):818-33.
134.Young S, Furgai K. Exercise effects in individuals with autism spectrum disorder: a short review. Autism Open Access. 2016;6(3):1-2.
135.Memari AH, Panahi N, Ranjbar E, Moshayedi P, Shafiei M, Kordi R, et al. Children with Autism Spectrum Disorder and Patterns of Participation in Daily Physical and Play Activities. Neurology Research International. 2015;2015:531906.
136.Bandini LG, Gleason J, Curtin C, Lividini K, Anderson SE, Cermak SA, et al. Comparison of physical activity between children with autism spectrum disorders and typically developing children. Autism. 2012;17(1):44-54.
137.Jones RA, Downing K, Rinehart NJ, Barnett LM, May T, McGillivray JA, et al. Physical activity, sedentary behavior and their correlates in children with Autism Spectrum Disorder: A systematic review. PLOS ONE. 2017;12(2):e0172482.
138.Manjiviona J, Prior M. Comparison of Asperger syndrome and high-functioning autistic children on a test of motor impairment. Journal of Autism and Developmental Disorders. 1995;25(1):23-39.
139.Reynolds S, Bendixen R, Lawrence T, Lane S. A pilot study examining activity participation, sensory responsiveness, and competence in children with high functioning autism spectrum disorder. Journal of Autism and Developmental Disorders. 2011;41:1496-506.
140.Rigoli D, Kane RT, Mancini V, Thornton A, Licari M, Hands B, et al. The relationship between motor proficiency and mental health outcomes in young adults: A test of the Environmental Stress Hypothesis. Hum Mov Sci. 2017;53:16-23.
141.Healy S, Nacario A, Braithwaite RE, Hopper C. The effect of physical activity interventions on youth with autism spectrum disorder: A meta-analysis. Autism Research. 2018;11(6):818-33.
142.Tomchek S, Dunn W. Sensory processing in children with and without autisdm: a comparitive study using the short sensory profile. American Journal of Occupational Therapy. 2007;61:190-200.
143.Dawson G, Watling R. Interventions to facilitate auditory, visual, and motor intergration in autism: a review of the evidence. Journal of Autism and Developmental Disorders. 2000;30:415-21.
144.Ben Sasson A, Hen L, Fluss R, et al. A Meta- Analysis of sensory modulation symptoms in indivisuals with autism spectrum disorders. Journal of Autism and Developmantal Disorders. 2009;39:1-11.

145.Connaghan KP, Baylor C, Romanczyk M, Rickwood J, Bedell G. Communication and Social Interaction Experiences of Youths With Congenital Motor Speech Disorders. American Journal of Speech and Language Patholology. 2022;31(6):2609-27.
146.Sasson NJ, Faso DJ, Nugent J, Lovell S, Kennedy DP, Grossman RB. Neurotypical Peers are Less Willing to Interact with Those with Autism based on Thin Slice Judgments. Scientific Reports. 2017;7(1):40700.
147.Pan C. The efficacy of an aquatic program on physical fitness and aquatic skills in children with and without autism spectrum disorders. Research in Autism Spectrum Disorders. 2011;5:657-65.
148.Rimmer J, Rowland J. Physical activity for youth with disabilities: a critical need in an undeserved population. Developmental Neurorehabilitation. 2008;11:141-8.
149.Obrusnikova I, Miccinello D.Parent perceptions of factors influencing afterscchool physical activity of chilren with autism spectrum disorders. Adapted Physical Activity Quarterly. 2012;29:63-80.
150.Curtin C, Bandini L, Perrin E, Tybor D, Must A. Prevalence of overweight in children and adolescents with attention deficit hyperactivity disorder and autism spectrum disorders: a chart review. BMC Pediatrics. 2005;5:48.
151.Schreck K, Williams K. Food preferences and factors influencing food selectivity for children with autism spectrum disorders. Research in Developmental Disabilities. 2006;27:353-63.
152.Hill AP, Zuckerman KE, Fombonne E. Obesity and Autism. Pediatrics. 2015;136(6):1051-61.
153.Matson JL, Nebel-Schwalm MS. Comorbid psychopathology with autism spectrum disorder in children: An overview. Research in developmental disabilities. 2007;28(4):341-52.
154.Matson J, Sturmey P. International handbook of autism and pervasive developmental disorders. New York: Springer; 2011.
155.Ghaziuddin M, Ghaziuddin N, Greden J. Depression in persons with autism: implications for research and clinical care. Journal of Autism and Developmental Disorders. 2002;32:299-306.
156.Mash E, Barkley R. Child Psychopathology. New York: The Guilford Press; 2003.
157.Amr M, Raddad D, El-Mehesh F, Bakr A, Sallam K, Amin T. Comorbid psychiatric disorders in Arab children with Autism spectrum disorders. Research in Autism Spectrum Disorders. 2012;6(1):240-8.
158.Russell A, Jassi A, Fullana M, Mack H, Johnston K, Heyman I, et al. Cognitive behavior therapy for comorbid obsessive-compulsive disorder in high-functioning Autism Spectrum Disorders: a randomized controlled trial. Depression and Anxiety 2013;30(8):697-708.
159White S, Oswald D, Ollendick T, Scahill L. Anxiety in children and adolescents with autism spectrum disorders. Clinical Psychology Review. 2009;29(3):216-29.
160.Bhat A, Landa R, Galloway C. Current perspectives on motor problems in infants, children, and adults with autism spectrum disorders. Physical Therapy. 2011;91:1116-29.
161.Kamal Nor N, Ghozali AH, Ismail J. Prevalence of Overweight and Obesity Among Children and Adolescents With Autism Spectrum Disorder and Associated Risk Factors. Frontier Pediatrics. 2019;7:38.
162.Shenoy MD, Indla V, Reddy H. Comprehensive Management of Autism: Current Evidence. Indian Journal of Psychology Medicine. 2017;39(6):727-31.
163.Fuentes J, Hervás A, Howlin P. ESCAP practice guidance for autism: a summary of evidence-based recommendations for diagnosis and treatment. European Child & Adolescent Psychiatry. 2021;30(6):961-84.
164.Lai M-C, Anagnostou E, Wiznitzer M, Allison C, Baron-Cohen S. Evidence-based support for autistic people across the lifespan: maximising potential, minimising barriers, and optimising the person–environment fit. The Lancet Neurology. 2020;19(5):434-51.
165.Slade S, Dionne C, Underwood M, Buchbinder R. The Consensus on Exercise Reporting Template (CERT): An internationally-endorsed reporting guideline for exercise interventions. Journal of Science and Medicine in Sport. 2017;20:57.

166.Tse AC, Yu C, Lee PH. Comparing sleep patterns between children with autism spectrum disorder and children with typical development: a matched case–control study. Autism. 2020;24(8):2298-303.
167.Arzoglou D, Tsimaras V, Kotsikas G, Fotiadou E, Sidiropoulou M, Proios M, et al. The effect of [alpha] tradinional dance training program on neuromuscular coordination of individuals with autism. Journal of Physical Education and Sport. 2013;13(4):563.
168.Lourenço C, Esteves D, Corredeira R, Seabra A. Children with autism spectrum disorder and trampoline training. Wulfenia Journal. 2015;22(5):342-51.
169.Cai KL, Wang JG, Liu ZM, Zhu LN, Xiong X, Klich S, et al. Mini-Basketball Training Program Improves Physical Fitness and Social Communication in Preschool Children with Autism Spectrum Disorders. Journal of Human Kinetics. 2020;73:267-78.
170.Djordjević M, Memisevic H, Potic S, Djuric U. Exercise-Based Interventions Aimed at Improving Balance in Children with Autism Spectrum Disorder: A Meta-Analysis. Perceptual and Motor Skills. 2021;129(1):90-119.
171.Healy S, Pacanowski CR, Williams E. Weight management interventions for youth with autism spectrum disorder: a systematic review. International Journal of Obesity. 2019;43(1):1-12.
172.Liang X, Li R, Wong SHS, Sum RKW, Wang P, Yang B, et al. The Effects of Exercise Interventions on Executive Functions in Children and Adolescents with Autism Spectrum Disorder: A Systematic Review and Meta-analysis. Sports Medicine. 2022;52(1):75-88.
173.Lin X, Zhang X, Guo J, Roberts CK, McKenzie S, Wu WC, et al. Effects of exercise training on cardiorespiratory fitness and biomarkers of cardiometabolic health: a systematic review and meta-analysis of randomized controlled trials. Journal of the American heart association. 2015;4(7):e002014.
174.Franz L AK, Chambers N, Viljoen M, Baumgartner JN, de Vries PJ. Autism in South Africa: Building Greater Awareness and Support 2018 [Available from: https://www.autismparentingmagazine.com/autism-south-africa-awareness/.
175.L G. Autism: Massive service delivery gap for children and adults in public healthcare 2023 [Available from: https://health-e.org.za/2023/03/31/autism-massive-service-delivery-gap-for-children-and-adults-in-public-healthcare/.
176.Pillay S DM, de Vries PJ. Are we on our own? The state of support for ASD in our education system 2023 [Available from: https://www.autismresources.co.za/blogs/surviving-school/are-we-on-our-own-the-state-of-support-for-asd-in-our-education-system.
177.The NA Approves South African Sign Language as the 12th Official Language [press release]. 3 May 2023 2023.
178.Guler J, de Vries PJ, Seris N, Shabalala N, Franz L. The importance of context in early autism intervention: A qualitative South African study. Autism. 2017;22(8):1005-17.
179.Kong X, Liu J, Chien T, Batalden M, Hirsh DA. A Systematic Network of Autism Primary Care Services (SYNAPSE): A Model of Coproduction for the Management of Autism Spectrum Disorder. Journal of Autism and Developmental Disorders. 2020;50(5):1847-53.
180.Green J, Leadbitter K, Ainsworth J, Bucci S. An integrated early care pathway for autism. The Lancet Child & Adolescent Health. 2022;6(5):335-44.
181.Parellada M, Boada L, Moreno C, Llorente C, Romo J, Muela C, et al. Specialty care programme for autism spectrum disorders in an urban population: A case-management model for health care delivery in an ASD population. European Psychiatry. 2013;28(2):102-9.
182.Koushik NS, Bacon B, Stancin T. An interprofessional care model for evaluating autism spectrum disorders (ASDs) among low-income children. Clinical Practice in Pediatric Psychology. 2015;3(2):108.
183.Gordon T, Booysen F, Mbonigaba J. Socio-economic inequalities in the multiple dimensions of access to healthcare: the case of South Africa. BMC Public Health. 2020;20(1):289.
184.Davidson P, Hickman L, Graham B, Halcomb E, Phillips J. Beyond the rhetoric: what do we mean by a'model of care'? Australian Journal of Advanced Nursing, The. 2006;23(3):47-55.

185.Booth A, Hannes K, Harden A, Noyes J, Harris J, Tong A. COREQ (Consolidated Criteria for Reporting Qualitative Studies). Guidelines for Reporting Health Research: A User's Manual2014. p. 214-26.
186.Coyne IT. Sampling in qualitative research. Purposeful and theoretical sampling; merging or clear boundaries? Journal of advanced nursing. 1997;26(3):623-30.
187.Cresswell J. Qualitative inquiry & research design: Choosing among five approaches. 2013.
188. Simpson, T.T.B. (2022) Speech audiometry accuracy and reliability: Speech-to-text technologies vs the audiologist's ear, Speech Audiometry Accuracy and Reliability: Speech-to-Text Technologies vs the Audiologist's Ear. dissertation. Research Space.
189.Krefting L. Rigor in Qualitative Research: The Assessment of Trustworthiness. The American Journal of Occupational Therapy. 1991;45(3):214-22.
190.Braun V, Clarke V. Using thematic analysis in psychology. Qualitative research in psychology. 2006;3(2):77-101.
191.Krueger RA, Casey MA. Focus groups: A practical guide for applied research: Sage publications; 2014.
192.Harvey N, Holmes CA. Nominal group technique: an effective method for obtaining group consensus. International journal of nursing practice. 2012;18(2):188
193.Muzikar D. The Autism Puzzle Piece: A symbol that's going to stay or go 2015 [Available from: https://the-art-of-autism.com/the-autism-puzzle-piece-a-symbol-of-what/.
194.Ward-Sinclair J. Which Colour Represents Autism? 2019 [Available from: https://autisticandunapologetic.com/2019/03/30/which-colour-represents-autism/.
195.Jones G. The Ultimate Guide to Autism Friendly Colours 2021 [Available from: https://www.experia.co.uk/blog/ultimate-guide-to-autism-friendly-colours/.
196.van Mechelen W, Hlobil H, Kemper HCG. Incidence, Severity, Aetiology and Prevention of Sports Injuries. Sports Medicine. 1992;14(2):82-99.
197.Oyama S. The ontogeny of information: Developmental systems and evolution: Duke university press; 2000.
198.Bowen M. The use of family theory in clinical practice. Compr Psychiatry. 1966;7(5):345-74.
199.Sameroff A. Transactional models in early social relations. Human development. 1975;18(1-2):65-79.
200.Bronfenbrenner U. Ecological models of human development. International encyclopedia of education. 1994;3(2):37-43.
201.Wills G, B B. The South African case of gender imbalances in school leadershipand management. Male Managers, Female Teachers: Teacher Demographic Divide1 10 July 2023. p.https://tdd.sun.ac.za/downloads/notes/MaleManagersFemaleTeachers (20July202023).
202.Hock RM, Timm TM, Ramisch JL. Parenting children with autism spectrum disorders: A crucible for couple relationships. Child & Family Social Work. 2012;17(4):406-15.
203.Robertson K, Chamberlain B, Kasari C. General education teachers' relationships with included students with autism. Journal of Autism and developmental disorders. 2003;33:123-30.
204.Jacobs D, Steyaert J, Dierickx K, Hens K. Physician View and Experience of the Diagnosis of Autism Spectrum Disorder in Young Children. Frontiers in Psychiatry. 2019;10.
205.Odeh CE, Gladfelter AL, Stoesser C, Roth S. Comprehensive motor skills assessment in children with autism spectrum disorder yields global deficits. International Journal of Developmental Disabilities. 2022;68(3):290-300.
206.Zampella CJ, Wang LAL, Haley M, Hutchinson AG, de Marchena A. Motor Skill Differences in Autism Spectrum Disorder: a Clinically Focused Review. Current Psychiatry Reports. 2021;23(10):64.
207.Unruh KE, Martin LE, Magnon G, Vaillancourt DE, Sweeney JA, Mosconi MW. Cortical and subcortical alterations associated with precision visuomotor behavior in individuals with autism spectrum disorder. Journal of Neurophysiology. 2019;122(4):1330-41.
208.Parma V, de Marchena AB. Motor signatures in autism spectrum disorder: the importance of variability. Journal of Neurophysiology. 2016;115(3):1081-4.

209.Lim YH, Partridge K, Girdler S, Morris SL. Standing Postural Control in Individuals with Autism Spectrum Disorder: Systematic Review and Meta-analysis. Journal of Autism and Developmental Disorders. 2017;47(7):2238-53.
210.Eggleston JD, Harry JR, Hickman RA, Dufek JS. Analysis of gait symmetry during over-ground walking in children with autism spectrum disorder. Gait Posture. 2017;55:162-6.
211.Den Houting J, Pellicano E. A portfolio analysis of autism research funding in Australia, 2008–2017. Journal of Autism and Developmental Disorders. 2019;49:4400-8.
212.Roche L, Adams D, Clark M. Research priorities of the autism community: A systematic review of key stakeholder perspectives. Autism. 2021;25(2):336-48.
213.Bhat AN. Is Motor Impairment in Autism Spectrum Disorder Distinct From Developmental Coordination Disorder? A Report From the SPARK Study. Physical Therapy Journal. 2020;100(4):633-44.
214.Kilroy E, Ring P, Hossain A, Nalbach A, Butera C, Harrison L, et al. Motor performance, praxis, and social skills in autism spectrum disorder and developmental coordination disorder. Autism Res. 2022;15(9):1649-64.
215.Ahmed S, Waseem H, Sadaf A, Ashiq R, Basit H, Rose S. Daily living tasks affected by sensory and motor problems in children with autism aged 5–12 years. Journal of Health Medicine and Nursing. 2021;92:7-12.
216.Yousaf F, Iftikhar K, Naz AM, Zahra SM, Altaf K, Azmat R. Effects of Sensory-Motor Issues on The Performance of Activities of Daily Livings in Autism Spectrum Disorder: JRCRS. 2018; 6 (1): 3-9. Journal Riphah College of Rehabilitation Sciences. 2018;6(1):3-9.
217.Travers BG, Lee L, Engeldinger A, Taylor D, Ausderau K, Skaletski EC, et al. Associations among daily living skills, motor, and sensory difficulties in autistic and nonautistic children. The American Journal of Occupational Therapy. 2022;76(2):7602205020.
218.Günal A, Bumin G, Huri M. The Effects of Motor and Cognitive Impairments on Daily Living Activities and Quality of Life in Children with Autism. Journal of Occupational Therapy, Schools, & Early Intervention. 2019;12(4):444-54.
219.Werner DeGrace B. The everyday occupation of families with children with autism. The American Journal of Occupational Therapy. 2004;58(5):543-50.
220.Bhat AN, Srinivasan SM, Woxholdt C, Shield A. Differences in praxis performance and receptive language during fingerspelling between deaf children with and without autism spectrum disorder. Autism. 2018;22(3):271-82.
221.Schauder KB, Mash LE, Bryant LK, Cascio CJ. Interoceptive ability and body awareness in autism spectrum disorder. Journal of experimental child psychology. 2015;131:193-200.
222.Dziuk M, Larson JG, Apostu A, Mahone EM, Denckla MB, Mostofsky SH. Dyspraxia in autism: association with motor, social, and communicative deficits. Developmental Medicine & Child Neurology. 2007;49(10):734-9.
223.Torres EB, Brincker M, Isenhower RW, Yanovich P, Stigler KA, Nurnberger JI, et al. Autism: the micro-movement perspective. Frontiers of Integrated Neuroscience. 2013;7:32.
224.Donnellan AM, Hill DA, Leary MR. Rethinking autism: implications of sensory and movement differences for understanding and support. Frontiers in integrative neuroscience. 2013;6:124.
225.Welch C, Cameron D, Fitch M, Polatajko H. Living in autistic bodies: bloggers discuss movement control and arousal regulation. Disability and Rehabilitation. 2021;43(22):3159-67.
226.Salar S, Daneshmandi H, Karimizadeh Ardakani M, Nazari Sharif H. The relationship of core strength with static and dynamic balance in children with autism. Annals of Applied Sport Science. 2014;2(4):33-42.
227.Salar S, Daneshmandi H. The Effect of 8 Weeks of Core Stability Training Program on Lumbar-Pelvic Function in Children with Autism Spectrum. Sport Sciences and Health Research. 2016;8(1):67-81.
228.Clapham ED, Shim M, Lamont LS, Armitano C. A Case Report Illustrating the Implementation of a Therapeutic Surfing Intervention for an Adolescent with Autism. Palaestra. 2018;32(2).

229.Astorino T, Baker J, Brock S, Dalleck L, Goulet E, Gotshall R, et al. Beneficial effects of clinical exercise rehabilitation for children and adolescents with autism spectrum disorder (ASD). Journal of Exercise Physiology online. 2012;15(2):71-9.
230. PF K, Partini N. The Implementation of Yoga Teaching in Improving Elementary School Students' Learning Concentration. In: Proceedings of the 2nd International Conference on Sociology Education (ICSE 2017) - Volume 2. SciTePress; 2018. p. 149-155. ISBN: 978-989-758-316-2.
231.Lengel T, Kuczala M. The kinesthetic classroom: Teaching and learning through movement: Corwin Press; 2010.
232.Page J, Boucher J. Motor impairments in children with autistic disorder. Child Language Teaching and Therapy. 1998;14:233-59.
233.Ming X, Patel R, Kang V, Chokroverty S, Julu PO. Respiratory and autonomic dysfunction in children with autism spectrum disorders. Brain and Development. 2016;38(2):225-32.
234.Fournier KA, Hass CJ, Naik SK, Lodha N, Cauraugh JH. Motor coordination in autism spectrum disorders: a synthesis and meta-analysis. Journal of Autism and Developmental Disorders. 2010;40(10):1227-40.
235.Dahlgren J, Healy S, MacDonald M, Geldhof J, Palmiere K, Haegele JA. Physical activity and screen time among youth with autism: A longitudinal analysis from 9 to 18 years. Autism. 2021;25(4):1090-9.
236.Bandini LG, Gleason J, Curtin C, Lividini K, Anderson SE, Cermak SA, et al. Comparison of physical activity between children with autism spectrum disorders and typically developing children. Autism. 2013;17(1):44-54.
237.Pan CY, Frey GC. Physical activity patterns in youth with autism spectrum disorders. J Autism Dev Disord. 2006;36(5):597-606.
238.Miller HL, Licari MK, Bhat A, Aziz-Zadeh LS, Van Damme T, Fears NE, et al. Motor problems in autism: Co-occurrence or feature? Developmental Medicine & Child Neurology. 2024;66(1):16-22.
239.Squillacioti G, De Petris S, Bellisario V, Borgogno Mondino EC, Bono R. Urban environment and green spaces as factors influencing sedentary behaviour in school-aged children. Urban Forestry & Urban Greening. 2023;88:128081.
240.McVeigh J, Norris S, de Wet T. The relationship between socio-economic status and physical activity patterns in South African children. Acta Paediatrica. 2004;93(7):982-8.
241.Kok P, Collinson M. Migration and urbanisation in South Africa: Statistics South Africa; 2006.
242.McCoy SM, Morgan K. Obesity, physical activity, and sedentary behaviors in adolescents with autism spectrum disorder compared with typically developing peers. Autism. 2019;24(2):387-99.
243.Pillai S MM, Aldous C. A study reflecting the demographics and comorbidities of children diagnosed with autism spectrum disorder at initial presentation to the KwaZulu-Natal Children's Hospital. . S Afr j child health 15(3):125-9.
244.van der Linde J, Swanepoel de W, Glascoe FP, Louw EM, Vinck B. Developmental screening in South Africa: comparing the national developmental checklist to a standardized tool. Afr Health Sci. 2015;15(1):188-96.
245.MacDonald M, Esposito P, Ulrich D. The physical activity patterns of children with autism. BMC Research Notes. 2011;4(1):422.
246.Estes A, Zwaigenbaum L, Gu H, St John T, Paterson S, Elison JT, et al. Behavioral, cognitive, and adaptive development in infants with autism spectrum disorder in the first 2 years of life. J Neurodev Disord. 2015;7(1):24.
247.MacDonald M, Lord C, Ulrich DA. The relationship of motor skills and social communicative skills in school-aged children with autism spectrum disorder. Adapt Phys Activ Q. 2013;30(3):271-82.
248.Provost B, Lopez BR, Heimerl S. A comparison of motor delays in young children: autism spectrum disorder, developmental delay, and developmental concerns. J Autism Dev Disord. 2007;37(2):321-8.

249.Pitetti KH, Rendoff AD, Grover T, Beets MW. The efficacy of a 9-month treadmill walking program on the exercise capacity and weight reduction for adolescents with severe autism. J Autism Dev Disord. 2007;37(6):997-1006.
250.Bass CK. Running can modify classroom behavior. Jouranl of Learning Disabililities. 1985;18(3):160-1.
251.Chaddock L, Erickson KI, Prakash RS, Kim JS, Voss MW, Vanpatter M, et al. A neuroimaging investigation of the association between aerobic fitness, hippocampal volume, and memory performance in preadolescent children. Brain Research. 2010;1358:172-83.
252.Lang R, Koegel LK, Ashbaugh K, Regester A, Ence W, Smith W. Physical exercise and individuals with autism spectrum disorders: A systematic review. Research in Autism Spectrum Disorders. 2010;4(4):565-76.
253.Celiberti DA, Bobo HE, Kelly KS, Harris SL, Handleman JS. The differential and temporal effects of antecedent exercise on the self-stimulatory behavior of a child with autism. Research in Developmental Disabilities. 1997;18(2):139-50.
254.Petrus C, Adamson SR, Block L, Einarson SJ, Sharifnejad M, Harris SR. Effects of exercise interventions on stereotypic behaviours in children with autism spectrum disorder. Physiotherapy Canada. 2008;60(2):134-45.
255.Oriel KN, George CL, Peckus R, Semon A. The effects of aerobic exercise on academic engagement in young children with autism spectrum disorder. Pediatric Physical Therapy. 2011;23(2):187-93.
256.Efimova VL, Nikolaeva EI. The Role of the Vestibular System in the Development of Specific Language Disorders in Children. Human Physiology. 2020;46(3):306-11.
257.Pan C-Y. Age, social engagement, and physical activity in children with autism spectrum disorders. Research in Autism Spectrum Disorders. 2009;3(1):22-31.
258.Bahrami F, Movahedi A, Marandi SM, Abedi A. Kata techniques training consistently decreases stereotypy in children with autism spectrum disorder. Research in Developmental Disabililies. 2012;33(4):1183-93.
259.Radhakrishna S, Nagarathna R, Nagendra HR. Integrated approach to yoga therapy and autism spectrum disorders. J Ayurveda Integr Med. 2010;1(2):120-4.
260.Ozonoff S, Young GS, Carter A, Messinger D, Yirmiya N, Zwaigenbaum L, et al. Recurrence risk for autism spectrum disorders: a Baby Siblings Research Consortium study. Pediatrics. 2011;128(3):e488-95.
261.Lord C, Risi S, Lambrecht L, Cook EH, Jr., Leventhal BL, DiLavore PC, et al. The autism diagnostic observation schedule-generic: a standard measure of social and communication deficits associated with the spectrum of autism. Res Dev Disabil. 2000;30(3):205-23.
262.Staples KL, Reid G. Fundamental movement skills and autism spectrum disorders. Res Dev Disabil. 2010;40(2):209-17.
263.Zwaigenbaum L, Bauman ML, Choueiri R, Kasari C, Carter A, Granpeesheh D, et al. Early Intervention for Children With Autism Spectrum Disorder Under 3 Years of Age: Recommendations for Practice and Research. Pediatrics. 2015;136 Suppl 1(Suppl 1):S60-81.
264..Johnson CP, Myers SM. Identification and evaluation of children with autism spectrum disorders. Pediatrics. 2007;120(5):1183-215.
265.Stahmer AC, Collings NM, Palinkas LA. Early Intervention Practices for Children With Autism: Descriptions From Community Providers. Focus on Autism Other Devevelopmental Disabilities. 2005;20(2):66-79.
266.Keen D, Couzens D, Muspratt S, Rodger S. The effects of a parent-focused intervention for children with a recent diagnosis of autism spectrum disorder on parenting stress and competence. Research in Autism Spectrum Disorders. 2010;4(2):229-41.
267.Pan CY, Tsai CL, Hsieh KW. Physical activity correlates for children with autism spectrum disorders in middle school physical education. Research Quartetly for Exercise and Sport. 2011;82(3):491-8.

268.Baranek GT, Foster LG, Berkson G. Sensory Defensiveness in Persons with Developmental Disabilities. The Occupational Therapy Journal of Research. 1997;17(3):173-85.
269.Bhat AN, Landa RJ, Galloway JC. Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. Physical Therapy Journal. 2011;91(7):1116-29.
270.Pan CY. School time physical activity of students with and without autism spectrum disorders during PE and recess. Adapt Phys Activ Q. 2008;25(4):308-21.
271.Healy S, Msetfi R, Gallagher S. 'Happy and a bit Nervous': the experiences of children with autism in physical education. British Journal of Learning Disabilities. 2013;41(3):222-8.
272.Lang R, O'Reilly M, Healy O, Rispoli M, Lydon H, Streusand W, et al. Sensory integration therapy for autism spectrum disorders: A systematic review. Research in Autism Spectrum Disorders. 2012;6(3):1004-18.
273.Rice CE, Zablotsky B, Avila RM, Colpe LJ, Schieve LA, Pringle B, et al. Reported wandering behavior among children with autism spectrum disorder and/or intellectual disability. The Journal of pediatrics. 2016;174:232-9. e2.
274.Matson JL, Goldin RL. Comorbidity and autism: Trends, topics and future directions. Research in Autism Spectrum Disorders. 2013;7(10):1228-33.
275.Must A, Phillips S, Curtin C, Bandini LG. Barriers to Physical Activity in Children With Autism Spectrum Disorders: Relationship to Physical Activity and Screen Time. J Phys Act Health. 2015;12(4):529-34.
276.Van Heerden MS, Grimsrud AT, Seedat S, Myer L, Williams DR, Stein DJ. Patterns of substance use in South Africa: results from the South African Stress and Health study. South African medical journal. 2009;99(5).
277.Draper C, Basset S, de Villiers A, Lambert EV. Results from South Africa's 2014 Report Card on Physical Activity for Children and Youth. Journal of Physical Activity and Health. 2014;11 Suppl 1:S98-104.
278.Case-Smith J, Arbesman M. Evidence-based review of interventions for autism used in or of relevance to occupational therapy. American Journal of Occupational Therapy. 2008;62(4):416-29.
279.Schreibman L, Dawson G, Stahmer AC, Landa R, Rogers SJ, McGee GG, et al. Naturalistic Developmental Behavioral Interventions: Empirically Validated Treatments for Autism Spectrum Disorder. Journalof Autism and Developmental Disorders. 2015;45(8):2411-28.
280.Srinivasan SM, Pescatello LS, Bhat AN. Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders. Physical Therapy Journal. 2014;94(6):875-89.
281.Aman MG, Langworthy KS. Pharmacotherapy for hyperactivity in children with autism and other pervasive developmental disorders. Journal of Autism and Developmental Disorders. 2000;30:451-9.
282.Wong C, Odom SL, Hume KA, Cox AW, Fettig A, Kucharczyk S, et al. Evidence-Based Practices for Children, Youth, and Young Adults with Autism Spectrum Disorder: A Comprehensive Review. Journal of Autism and Developmental Disorders. 2015;45(7):1951-66.
283.Bearss K, Johnson C, Smith T, Lecavalier L, Swiezy N, Aman M, et al. Effect of parent training vs parent education on behavioral problems in children with autism spectrum disorder: a randomized clinical trial. Journal of the American Medical Association. 2015;313(15):1524-33.
284.Koegel LK, Bryan KM, Su PL, Vaidya M, Camarata S. Parent education in studies with nonverbal and minimally verbal participants with autism spectrum disorder: a systematic review. American Journal of Speech-Language Pathology. 2020;29(2):890-902.
285.Patient education. American Academy of Family Physicians. American family physician. 2000;62(7):1712-4.
286.Stoddart K, Burke L, Muskat B, Manett J, Duhaime S, Accardi C, et al. Diversity in Ontario's youth and adults with autism spectrum disorders: complex needs in unprepared systems. Toronto, ON: The redpath centre. 2013.
287.Department calls for support for those living with autism [Internet]. 2024.

288.Lindsay S, Proulx M, Scott H, Thomson N. Exploring teachers' strategies for including children with autism spectrum disorder in mainstream classrooms. International Journal of Inclusive Education. 2014;18(2):101-22.
289.Darling-Hammond L, Schachner ACW, Wojcikiewicz SK, Flook L. Educating teachers to enact the science of learning and development. Applied Developmental Science. 2024;28(1):1-21.
290.Shulman LS. Those who understand: Knowledge growth in teaching. Journal of Education. 2013;193(3):1-11.
291.Spaull N. Schooling in South Africa: How low-quality education becomes a poverty trap. South African child gauge. 2015;12(1):34-41.
292.Florian L, Linklater H. Preparing teachers for inclusive education: using inclusive pedagogy to enhance teaching and learning for all. Cambridge Journal of Education. 2010;40(4):369-86.
293.Forlin C, Loreman T, Sharma U, Earle C. Demographic differences in changing pre-service teachers' attitudes, sentiments and concerns about inclusive education. International Journal of Inclusive Education. 2009;13(2):195-209.
294.Centers for Disease Control and Prevention. Developmental Monitoring and Screening for Health Professionals [Internet]. Atlanta: CDC; 2023 [cited 2024 Jun 25]. Available from: https://www.cdc.gov/ncbddd/actearly/screening.html
295. Bai D, Yip BHK, Windham GC, Sourander A, Francis R, Yoffe R, et al. Association of genetic and environmental factors with autism in a 5-country cohort. Journal of the American Medical Association Psychiatry. 2019;76(10):1035-1043. Available from: https://pubmed.ncbi.nlm.nih.gov/31999412/
296.Dawson G, Burner K. Behavioral interventions in children and adolescents with autism spectrum disorder: a review of recent findings. Curr Opin Pediatr. 2011;23(6):616-20.
297.McLean ME, Snyder P, Smith BJ, Sandall SR. The DEC Recommended Practices in Early Intervention/Early Childhood Special Education: Social Validation. Journal of Early Intervention. 2002;25(2):120-8.
298.Mesibov GB, Shea V, Schopler E. The TEACCH approach to autism spectrum disorders: Springer Science & Business Media; 2005.
299.Rubin E, Prizant BM, Laurent AC, Wetherby AM. Social communication, emotional regulation, and transactional support (SCERTS). Interventions for autism spectrum disorders: Translating science into practice: Springer; 2013. p. 107-27.
300.Koegel RL, Koegel LK, Kim S, Bradshaw J, Gengoux GW, Vismara LA, et al. Pivotal response treatment for autism spectrum disorders: Paul H. Brookes Publishing Company; 2019.
301.Rogers SJ, Dawson G. Early Start Denver Model for young children with autism: Promoting language, learning, and engagement. New York, NY, US: The Guilford Press; 2010. xvii, 297-xvii, p.
302.Dunst CJ, Trivette CM, Hamby DW. Meta-analysis of family-centered helpgiving practices research. Ment Retard Dev Disabil Res Rev. 2007;13(4):370-8.
303.Champion VL, Skinner CS. The health belief model. Health behavior and health education: Theory, research, and practice. 2008;4:45-65.
304.Schunk DH. Social cognitive theory. 2012.
305.Greenspan S, Wieder S. DIR®/Floortime™ model. The International Council on Developmental and Learning Disorders. 2008.
306.Cooper JO, Heron TE, Heward WL. Applied behavior analysis. 2007.
307.Swansea University. Guidance on identifying and minimising participant distress during interviews and focus groups [Internet]. Swansea: Swansea University; [cited 2024 Jun 25]. Available from: https://www.swansea.ac.uk/media/guidance-on-identifying-and-minimising-participant-distress-during-interviews-and-focus-groups-(2).pdf

LIST OF APPENDICES

Appendix A: Autism Spectrum Disorder Diagnostic Criteria

Appendix B: Data from 34 studies using the consensus on Exercise Reporting Template (CERT) (modified to summarise all studies on one form)

Appendix C: Summary of the characteristics and findings of the studies included in the CERT review

Appendix D: Guiding principle for a model of care According to the Agency of Clinical Innovation (ACI)[10]

Appendix E: COREQ (Consolidated criteria for reporting qualitative research) 32 item checklist

Appendix F: Word clouds of participants (parents, clinicians and teachers)

Appendix G: Field notes

Appendix H: Reflective/reflexive journal

Appendix I: Permission letter from schools

Appendix J: Information sheet

Appendix K: Consent form for interviews

Appendix L: Questions for phase one interviews

Appendix M: COVID protocol

Appendix N: Audio recording permission form

Appendix O: Distress protocol

Appendix P: Nominal group final questions

Appendix Q: Guideline of interaction for nominal group interview

Appendix R: Research ethics certificate

Appendix S: Reflective statement of researcher

Appendix T: Complete sample of verbatim quotes per theme and category- per group of study participants.

Appendix U: Model User Guide

Appendix V: Turn it in report

Appendix A – Autism Spectrum Disorder Diagnostic Criteria

Autism Spectrum Disorder

Autism Spectrum Disorder

Diagnostic Criteria **299.00 (F84.0)**

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.
2. Deficits in nonverbal communicative behaviors used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.
3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behavior to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior (seeTable 2).

B. Restricted, repetitive patterns of behavior, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).
2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns of verbal or nonverbal behavior (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat same food every day).
3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g., strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interests).
4. Hyper- or hyporeactivity to sensory input or unusual interest in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

Specify current severity:

Severity is based on social communication impairments and restricted, repetitive patterns of behavior (see Table 2).

C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities, or may be masked by learned strategies in later life).

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

E. These disturbances are not better explained by intellectual disability (intellectual developmental disorder) or global developmental delay. Intellectual disability and autism spectrum disorder frequently co-occur; to make comorbid diagnoses of autism spectrum disorder and intellectual disability, social communication should be below that expected for general developmental level.

Note: Individuals with a well-established DSM-IV diagnosis of autistic disorder, Asperger's disorder, or pervasive developmental disorder not otherwise specified should be given the diagnosis of autism spectrum disorder. Individuals who have marked deficits in social communication, but whose symptoms do not otherwise meet criteria for autism spectrum disorder, should be evaluated for social (pragmatic) communication disorder.

Specify if:

With or without accompanying intellectual impairment

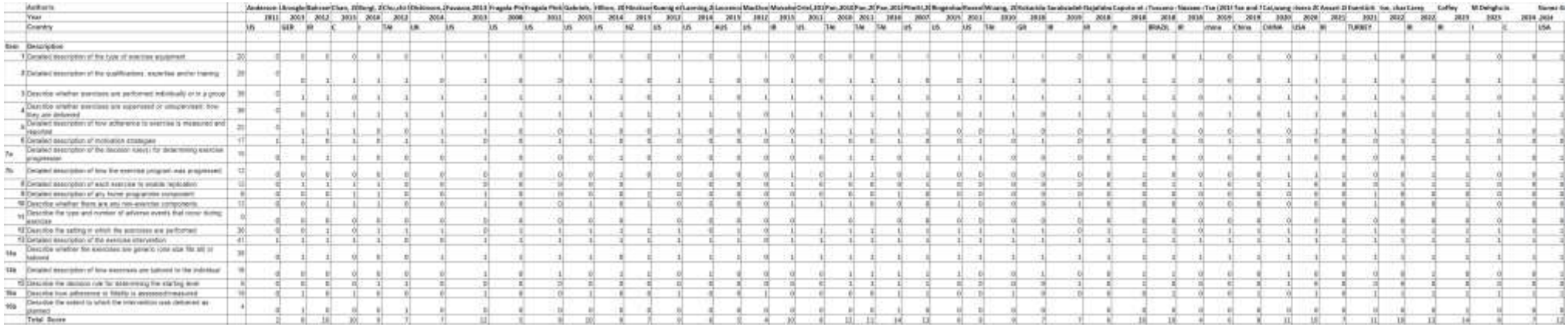
With or without accompanying language impairment

Associated with a known medical or genetic condition or environmental factor (**Coding note:** Use additional code to identify the associated medical or genetic condition.)

Associated with another neurodevelopmental, mental, or behavioral disorder (**Coding note:** Use additional code[s] to identify the associated neurodevelopmental, mental, or behavioral disorder[s].)

With catatonia (refer to the criteria for catatonia associated with another mental disorder, pp. 119–120, for definition) (**Coding note:** Use additional code 293.89 [F06.1] catatonia associated with autism spectrum disorder to indicate the presence of the comorbid catatonia.)

Appendix B – Data from 42 studies using the consensus on Exercise Reporting Template (CERT) (modified to summarise all studies on one form)



Appendix C– A summary of the characteristics and findings of the studies included in the CERT review.

7.1 Summary of characteristics and finding of CERT analysis

Findings consolidated from Healy et al. [133] and Ruggeri et al. [96], along with 8 additional studies selected by the researcher.

Authors	Country	Population (n ; age in years) With a diagnosis of ASD	Study Design	Intervention details: Type; frequency, duration	Outcome variables	Findings
Anderson-Hanley et al., 2021	USA	22;12-15	QE	Pilot 1: Exergaming-one controlled task and Dance Dance revolution; 20 min, 1 session. Pilot 2: Exergaming-cyber cycling; 20 min, 1 session.	C	A one session pilot exergaming session resulted in repetitive behaviours decreasing significantly after cyber cycling, while performance on controlled motor task improved compared with the control condition.
Arzoglou et al.,2013	Germany	5;16	E	Traditional Greek dance; 34–45min, 3×/wk, 8wks	P	An 8-week traditional Greek dance programme resulted in improved body coordination/balance and speed and agility of children with ASD.
Bahrami et al.,2012	Iran	30;5-16	E	Kata techniques instruction; 4x/wk,14 weeks (a total of 56 sessions)	A	Kata techniques instruction four times per week for 14 A 14 week kata technique intervention significantly reduced stereotypy in the exercise group, compared to a control group
Chan, 2013	China	20;6-17	E	Group training in *Nei Yang Gong* (experimental group); 5-45 min, 6 x/wk,4 wks or progressive muscle relaxation (control group); 20 min, 1-5 x/wk,4 wks	A	Four week intervention showed that the experimental group demonstrated significantly greater improvement in self-control, and showed enhanced EEG activity in the anterior cingulate cortex, a region that mediates self-control compared to the control group.
Borgi, 2016	Italy	28, 5-15	E	Equine assisted; 60–70min, 1×/wk, 24wks	COM	A 6-month equine-assisted therapy program did not result in improved motor skills of children with ASD, compared to a control group.
Chu and pan, 2012	Thailand	42, 7-15	E	Aquatic training with trained sibling versus trained peer assisted versus untrained peer; 60min, 2×/wk, 16wks	COM	A 16-week aquatic programme, with 3 different instructional conditions, did not result in improved swim skills of children with ASD among groups.
Dickinson, 2014	United Kingdom	100, 5-15	E	Sports video games (Nintendo Wii); 15min, 3×/wk, “3 academic terms”	P	A computer-based activity game for 3 academic terms resulted in improved cardiovascular fitness, strength, and speed and agility of children with ASD, compared to a control group.
Favazza, 2013	USA	233, 5-15	E	Motor skill lessons with trained teachers ; 30 min, 3xwk, 8 wks (24 sessions in total)	P	An 8 week intervention rusted in mean gains of 7–9 months on the Peabody Developmental Motor Subscales compared with mean gains of 3–5 months for the control group. Children also improved significantly on the gross motor subscale of the Vineland Teacher Rating Form.

Fragala-Pinkham, 2008	USA	16, 5-15	QE	Aquatic training with trained physical therapy students or aquatic staff , 45-60 min; 2x/wk; 14 wks	P	A 14 week aquatic intervention resulted in significant improvements in the half-mile walk/run, but not for secondary outcomes of strength or motor skills.
Fragala-Pinkham,2011	USA	12, 5-15	QE	Aquatic skills, warm up, cool down, stretches, 40min, 2×/wk, 14wks	P	An 18-week aquatic exercise programme did not result in improved swim skills, cardiovascular fitness, or strength in children with ASD, compared to a control group.
Gabriels, 2015	USA	116,5-≥15	E	Hippotherapy, 60min, 1×/wk, 10wks	COM	A 10-week hippotherapy programme did not result in improved motor skills or praxis of children with ASD, compared to a control group.
Hilton, 2014	USA	14,NR	QE	Speed-based game (Makoto arena); 2min, 3×/wk, 10wks	COM	A 30-session exergaming programme resulted in improved speed and agility, strength, and speed within the exergame of children with ASD.
Hinckson, 2013	USA	17,12-≥15	QE	School-based physical activity and nutrition programme by a community pediatric physiotherapist and dietician. 120 min, 2xwk; 10wks.(18 sessions in total)	COM	A 10-week school-based physical activity and nutrition intervention resulted in improved walking distance post program where participants walked 51 m further in the six minute walk test. There was also a substantial reduction in the consumption of confectionery and chocolate at the two measurement points.
Koenig et al., 2012	New Zealand	24;5-12	N	Yoga training facilitated by occupational therapists using an instructional DVD. 15-20 min 5/wk;16wks.	A	A 16 week yoga intervention resulted in significant decreases ($p < .05$) in teacher ratings of maladaptive behaviour, as measured with the Aberrant Behaviour Checklist, compared with the control participants.
Lanning, 2014	USA	13, 5-15	E	Equine assisted; 60min, 1×/wk, 12wks	COM	A 12-wk equine-assisted programme did not result in improved physical functionality of children with ASD, compared to a control group.
Lourenco, 2015	Australia	17, 5-15	E	Trampoline; 45min, 1×/wk, 20wks	P	A 20-week trampoline training programme resulted in improved motor skills, body coordination/ balance, speed and agility, and strength of children with ASD, compared to a control group.
MacDonald, 2012	USA	42, 9-18	E	Two-wheel bicycle intervention with qualified instructors; NR	P	After five days of training, 85.4% of children with ASD successfully demonstrated the ability to ride the bicycle more than 100 feet.
Movahedi, 2013	Iran	15	E	Kata technique training; 14 wks	A	A 14 week kata training intervention significantly improved social dysfunction in the exercise group.
Oriel, 2011	USA	9, 5-11.9	E	Jogging task and classroom task (crossover after 3 weeks). 15 min, 1x daily, 12 days.	C	The 6 week intervention resulted in statistically significant improvements in correct responding following exercise ($P < .05$). No significant differences were found for on-task behaviour or stereotypic behaviours.
Pan, 2010	Thailand	16, 5-11.9	QE	Aquatic skills, warm up, cool down; 90min, 2×/wk, 10wks	COM	A 10-week aquatic programme resulted in improved swim skills of children with ASD, compared to a control group. These skills were maintained over 10 wks.

Pan, 2011	Thailand	15, 5-11.9	QE	Aquatic skills, warm up, cool down; 60min, 2×/wk, 14wks	P	A 14-week aquatic intervention resulted in improved swim skills and strength of children with ASD, compared to a control group. These improvements were maintained for 14 wks.
Pan, 2016	Thailand	22, 5-11.9	E	Accelerometer tracking. Physical activity was recorded every 10 seconds by using accelerometer for up to 5 weekdays and 2 weekend days.	COM	Participants with ASD were less physically active overall and engaged in moderate-to-vigorous physical activity for a lower percentage of time compared with participants with typically developing controls during weekdays. Participants with ASD had significantly lower scores on all physical fitness measures, except body composition.
Pitetti, 2007	USA	10,>15	E	Walking treadmill intervention. 15-30 min; 3x/wk;9 months	P	The nine month treadmill walking intervention resulted in significant increases in mean monthly treadmill walking frequency, speed, elevation, and calories expended coupled with a reduction in body mass index.
Ringenbach, 2015	USA	10	QE	Voluntary cycling, assisted cycling therapy or no cycling. Single session on alternating days.	COM	The intervention resulted in the participants' inhibition improving significantly, with improvements in cognitive planning and set-switching following assisted cycling therapy. No improvements in inhibition, cognitive planning, or set-switching were observed following voluntary control cycling or no intervention.
Rosenblatt, 2011	USA	24;3-16	QE	Multimodal yoga, dance, and music therapy assisted by parents and caregivers; 45 min, 1/wk, 8wks	A	An 8-week multimodal yoga, dance, and music therapy programme resulted in significant (p=0.0003) improvements in the core features of autism on BASC-2 scale.
Wuang, 2010	Thailand	60, 5-11.9	E	Simulated horse riding; 60min, 2×/wk, 20wks	COM	A 20-week simulated horse riding programme resulted in improved, visual-motor control, body coordination/ balance, reaction speed, strength, speed and agility, and manual coordination of children with ASD, compared to a control group.
Kokaridas et al 2018	Greece	10; 9	QE	Indoor climbing; 40min, 2×/wk, 12wks	P	A 12-week indoor climbing programme resulted in no difference in hand grip strength and an increase in traverse speed of typically developing children versus children with ASD.
Sarabzadeh et al. (2019)	Iran	30;6-12	E	Tai Chi Chuan training, 60min, 3×/wk, 6wks	P	A 6-week Tai Chi training resulted in improved balance and ball skills of children with ASD, compared to a control group
Najafabadi et al. (2018)	Iran	26;5-12	E	Sports, play, and active recreation for kids, 40min, 3×/wk, 12wks	P	A 12-week motor skills programme resulted in improved balance in children with ASD, as compared to controls.
Caputo et al. (2018)	Italy	12;6-12	QE	Aquatic skills: emotional adaptation, swimming, 45min, 1–2×/wk, 10mo	P	A 10-mo aquatic programme resulted in improved both swim and motor skills in children with ASD.

Toscano et al. (2018)	Brazil	64;6-12	E	Strength, balance, and coordination, 40min, 2×/wk, 48wks	P	A 48-week exercise programme resulted in improved reported physical functioning of children with ASD, compared to a control group.
Navaee et al. (2018)	Iran	20;6-10	QE	Throwing task with positive normative feedback, 1× with retention the next day	P	A throwing task with positive normative feedback resulted in no difference in throwing accuracy at acquisition or retention as compared to controls in children with ASD.
Tse (2019)	China	65;9-12	E	Throwing task with internal versus external attention of focus, 1× with retention/ transfer the next day	COM	A throwing task with an internal attentional focus versus an external focus and no focus resulted in similar skill acquisition across all groups but improved retention and transfer of children with ASD in the internal focus group compared to the other groups.
Tse and Masters (2019)	China	48;9-12	E	Basketball-shooting task with visual analogy, verbal analogy, explicit instruction, and control, 6 training blocks of 15 trials in 1day	COM	A modified basketball shooting task with 4 different types of instruction resulted in improved retention and transfer with instruction using visual analogy for children with ASD.
Cai, Wang 2020	China	18;3-6	QE	Mini-basketball training programme. 40 min, 5x/wk, 12 wks.	COM	A 12 week mini basketball training programme resulted in significantly better performances in working memory($p < 0.01$) partial and regulation ($p < 0.05$) as compared to the control group. The intervention group also had significantly improved core symptoms of ASD in social communication ($p < 0.05$), and repetitive behaviours ($p < 0.05$).
Rivera, 2020	USA	25;8-17	QE	Judo programme with a Judo-certified instructor. 45 min, 1x/wk 8 wks.	COM	An 8 week judo intervention resulted in no significant changes in ABC scores in children with ASD, however, 78% of parents observed improvements in both social skills and self-esteem in their children with ASD.
Ansari, 2021	Iran	20;6-14	E	Aquatic exercise skills training. 60 min, 2x/week, 10 weeks.	COM	A 10 week aquatic skills intervention resulted in improve sleep quality and a reduction in the serum levels of IL-1β and TNF-α in children with ASD compared to a control group.
Esentürk, 2021	Turkey	14;	QE	WhatsApp-based physical activity facilitated by the participants' parents.	P	Parents reported that WhatsApp-based physical activities were a feasible intervention to increase the physical activity level of their children with ASD and stated that the contents of the physical activity shared in the WhatsApp group were useful.
Tse et al., 2022	China	18;8-12	E	Cycling intervention hosted by a professional cycling instructor. 60 min, 5x/wk, 2 wks. (10 sessions in total.	COM	A 2 week cycling intervention resulted in significant improvement in sleep efficiency, sleep onset latency, and sleep duration.
Carey et al., 2022	Ireland	24;5-18	QE	A school-based exercise programme by a trained health science graduate. 60 min,3x/wk, 16 wks.	A	A 16-week exercise programme significantly reduces total anxiety (using the anxiety scale) ($p < 0.001$), performance anxiety ($p < 0.001$), anxious arousal ($p < 0.001$), and uncertainty ($p < 0.001$) (as reported by

						teachers).Results demonstrate that 16 weeks, as opposed to 8, may be necessary to have a significant effect on in-school anxiety.
Coffey et al., 2023	Ireland	78;4-12	QE	School based integrative neuromuscular training intervention by trained professionals and teachers. 60 min, 3xwk; 8wks.	P	An 8 week intervention resulted in significant improvements of physical fitness ($p < .05$) pre- to post-intervention (20 m sprint [$p = .044$], standing broad jump, sit and reach, handgrip and stork balance [$p < .001$]). Children with severe symptoms of ASD showed significant improvements in standing broad jump ($p = .001$ [mild vs severe], $p = .012$ [moderate vs severe]), sit and reach flexibility ($p = .002$ [mild vs severe], $p = .042$ [moderate vs severe]), and handgrip strength ($p = .001$ [mild vs severe], $p = .004$ [moderate vs severe]) tests in comparison to children with mild and moderate symptoms of ASD.
M Dehghani et al., 2023	Iran	24;7-11	E	Sports, play, and active recreation intervention by a physiotherapist with 10 years of professional experience. 45 min 3x/wk, 8 wks	P	An 8 week intervention resulted in positive effects on kinetic walking characteristics in children with ASD including significant improvements in first peak of vertical ground reaction force, loading rate, and peak pressure at the medial heel region (all $p = 0.001–0.49$).
Ju et al., 2024	China	9;<18	E	Yoga intervention with a qualified instructor. 45-50 min,3x/wk, 8 wks	COM	An 8 week yoga intervention, significantly reduced irritability and social withdrawal in children with autism. Significant improvements in ball skills and static and dynamic balance were also found.
Annabel Nunez-Gaunaurd ,2024	USA	18; >18		Telehealth intervention using telehealth and remote technology. 60 min, 1x/wk, 12 wks		A 12 week telehealth intervention resulted in no changes in BMI or waist to hip ration at post-intervention. Participants had significant increases in self-reported physical activity scores (GSLT-PAQ) ($p = 0.002$), and steps per day ($p = 0.015$).

Notes: Design: Country: USA, United States of America. Study Design: QE, Quasi-Experimental; E, Experimental. Outcome variables: C, cognitive; P, psychomotor; A, affective; COM, combined. Table abbreviations: n, number of participants; NR, Not Reported; wk,week; wks,weeks; ASD,Autism Spectrum Disorder.

Appendix D– Guiding principles of a model of care [26]

The guiding principles of a MoC are that it:

- is patient centric
- has localised flexibility and considers equity of access
- supports integrated care
- supports efficient utilisation of resources
- supports safe, quality care for patients
- has a robust and standardised set of outcome measures and evaluation processes
- is innovative and considers new ways of organising and delivering care
- sets the vision for services in the future

Factors for consideration when you are developing a MoC are that:

- it is based on the best available evidence
- it links to strategic plans and initiatives (local, national, state)
- it is developed in collaboration with clinicians, managers, health care partners, the community, and with patients, their carers, and or organisations that represent them
- costing, funding and revenue opportunities for the MoC are identified, and assessed
- it extends across the patient journey through different care providers
- specialty and priority populations of patients have been considered

Appendix E – COREQ (Consolidated criteria for reporting qualitative research) 32 item checklist

Developed from:
Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007. Volume 19, Number 6: pp. 349 – 357

No. Item	Guide questions/description	Reported on Page #
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the interview or focus group?	Pages 89-91/ Table 4.1-4.2
2. Credentials	What were the researcher's credentials?	Pages 89-91/ Table 4.1-4.2
3. Occupation	What was their occupation at the time of the study?	Pages 89-91/ Table 4.1-4.2
4. Gender	Was the researcher male or female?	Pages 89-91/ Table 4.1-4.2
5. Experience and training	What experience or training did the researcher have?	Pages 89-91/ Table 4.1-4.2
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	Pages 89-91/ Table 4.1-4.2
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	Pages 89-91/ Table 4.1-4.2
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Pages 89-91/ Table 4.1-4.2

Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Page 72
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Pages 73-75
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Pages 73-75
12. Sample size	How many participants were in the study?	Page 73
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Page 73
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Pages 72-73
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	Page 73
16. Description of sample	What are the important characteristics of the sample? e.g.	Pages 73-74

	demographic data, date	
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Page 75; Appendix L
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	Page 76
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Page 76
20. Field notes	Were field notes made during and/or after the interview or focus group?	Page76; Appendix G
21. Duration	What was the duration of the inter views or focus group?	Page 76
22. Data saturation	Was data saturation discussed?	Page 76
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	Page 76
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Pages 78-80
25. Description of the coding tree	Did authors provide a description of the coding tree?	Pages 78-80
26. Derivation of themes	Were themes identified in advance or derived from the data?	Pages 78-80 Themes were derived from the data
27. Software	What software, if applicable, was used to manage the data?	Pages 80
28. Participant checking	Did participants provide feedback on the findings?	Page 84: Yes, in nominal group technique discussions
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	In results: Pages 92-167;Appendix T
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Yes: In results: Pages 95-170;
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes: Tables 4.5-4-9 and in Figures 4.2- 4.5
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes: Tables 4.5-4-9 and in Figures 4.2- 4.5

Appendix F – Individual and overall word clouds (teachers, clinicians, and parents)

Teacher 1



Teacher 2



Teacher 3



Teacher 4



Teacher 5



Teacher 6



Clinician 1



Clinician 2



Clinician 3



Clinician 4



Clinician 5



Clinician 6



Clinician 7



Clinician 8



Clinician 9



Clinician 10



Clinician 11



Parent 1



Parent 2



Parent 3



Parent 4



Parent 5



Parent 6



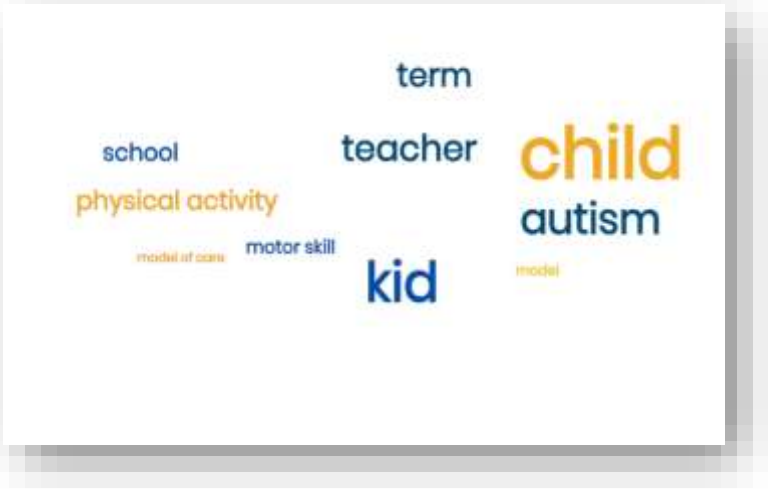
Parent 7



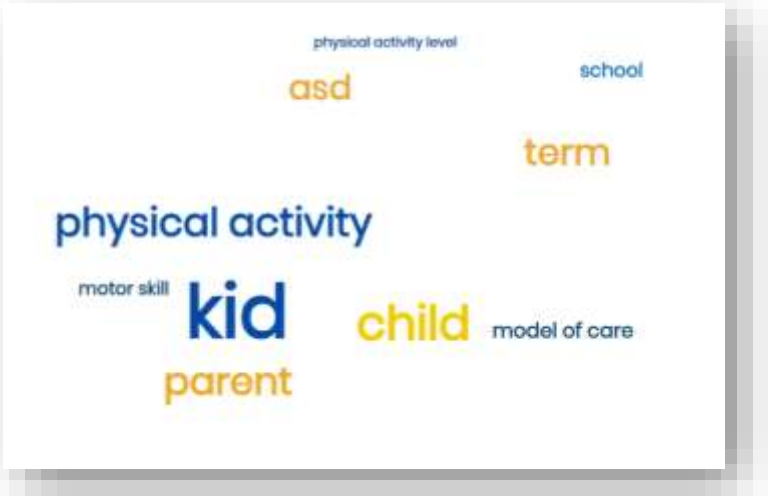
Parent 8



Overall Teacher word cloud (Top 10 words)



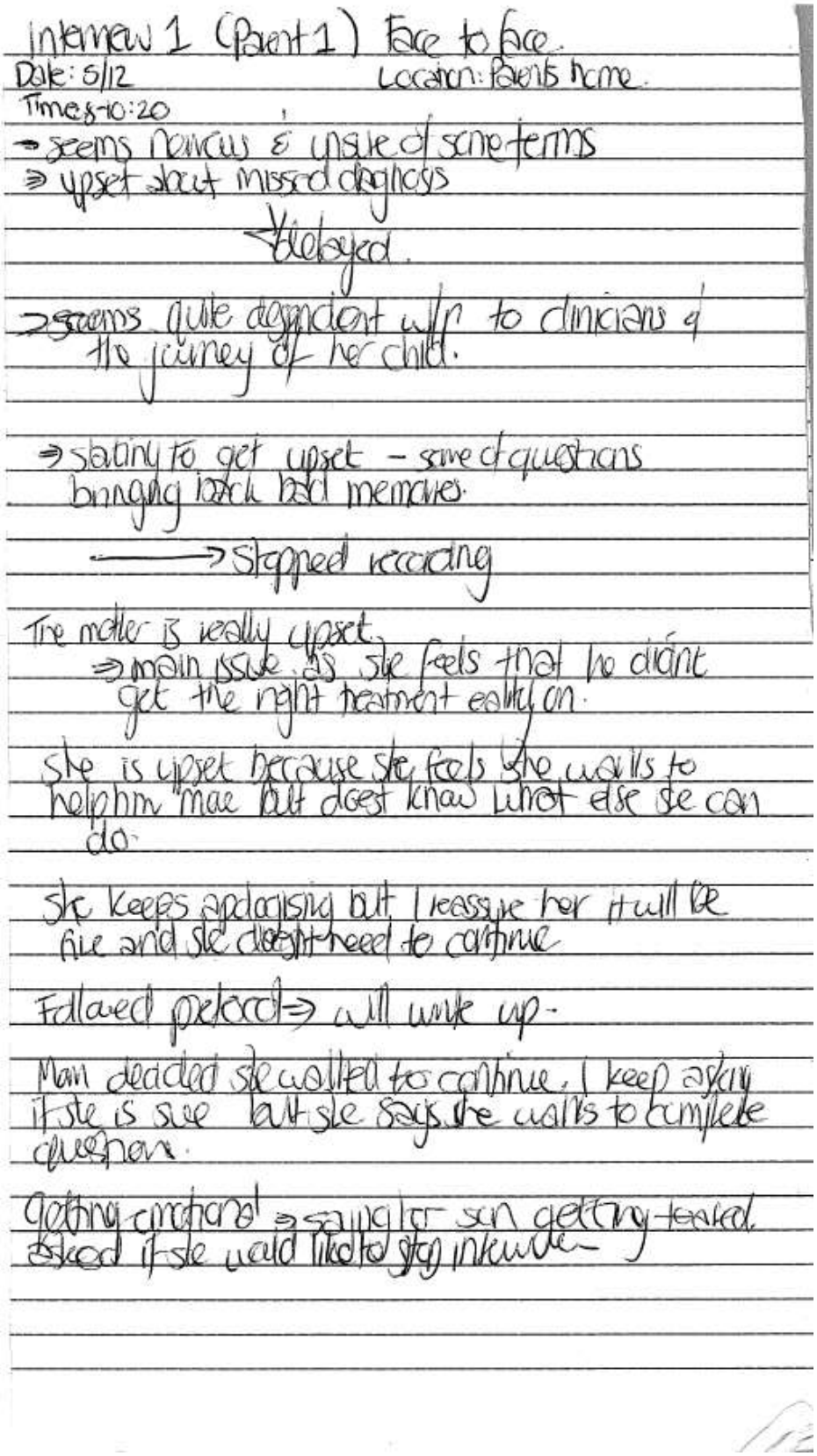
Overall Clinician word cloud (Top 10 words)



Overall Parent word cloud (Top 10 words)



Appendix G – Field notes (sample pages)



Interview 1 (Parent 1) Face to face.
Date: 5/12 Location: Parents home.
Time: 10:20
→ seems nervous & unsure of some terms
⇒ upset about missed diagnosis
↳ delayed.
→ seems quite cognizant with to clinicians of the journey of her child.
⇒ stating to get upset - some of questions bringing back bad memories.
→ Stopped recording
The mother is really upset.
⇒ main issue as she feels that he didn't get the right treatment early on.
She is upset because she feels she wants to help him more but does know what else she can do.
She keeps apologising but I reassure her it will be fine and she doesn't need to continue
Followed protocol → will wake up.
Mom decided she wanted to continue, I keep asking if she is sure but she says she wants to complete questionnaire.
Getting confused ⇒ seeing if son getting tested. Asked if she would like to stop interview

parent plan it / yes he selft to get sen xhre

can sense a bit of frustration

seems he isn't getting enough exercise but he says he does sometimes but then gets tired.

* Education NB ⇒ why they need to be x

parent + teachers

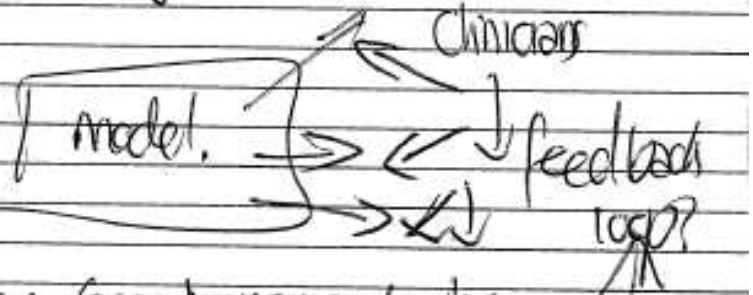
X ——————————— X

- was a tough interview. I was worried I had really upset her. She doesn't want to be reffed for oversetting.
- She got quite emotional and you can sense she deeply cares for her son and only wants the best for him.

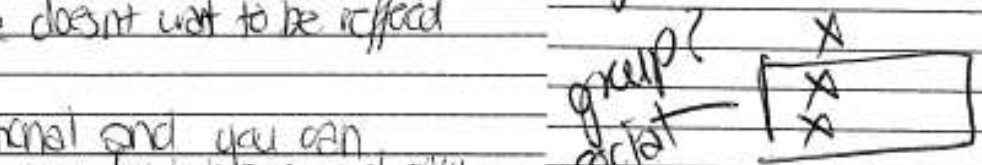
Interview 2 (Clinician 1). Teams
Date 08/19 Location (virtual)
Time: 12:59 Interviewer at home
participant at home

⇒ Research based + clinical experience

multidisciplinary ⇒

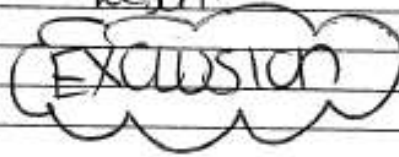


* Finances (speech one year / motor graded ⇒ Parents do some things



⇒ Neurologists job? ↗ who should be doing this?

Need to know level of motor skills can/can't limit the child ⇒ make feel inferior for no reason?



NB! → isolation

⇒ Never received a report ↗ impairment?

No comms between professionals

must be of value.

Unsafe?

⇒ Parents may be limiting others brain related rebuttals?

⇒ Replication ⇒ lack of understanding

use a sensory room? vs like?

↓

assist in expending energy.

school is more loose = consideration

ie dependent on situation of task/age?

parents acculturated

NOT GUIDED ACTIVITY ⇒ Education?

more meaningful activities needed

Real world application

Using sport to teach flexibility?

* Rigid rules

motivation

PA helps to connect.

Interview 3 (clinician 2).

Date: 01/31 Location: Wits (Teletalk)

Time: 11:25

sensory integration ⇒ praxis motor planning

motor depends on spectrum

Tests ⇒ not understanding what need to do

The children ABA

↓ ↓

verbal instruction vs demonstration

* "what the parents want"

- PRAXIS

"I like a team approach"

* Intensity needs to be considered.

↓

individual

UK ⇒ Motor ABC.

certain test ⇒ individual tests not standardised protocol

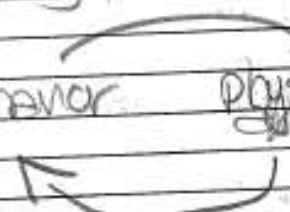
* if OT works in a specific area ⇒ specific tests get used ⇒ planning - Not always based on

Assessment

- copying
- individualised
- fine motor

OT ⇒ motor component cognitive cognitive behaviour sensory.

coms — Play — behaviour
activity ⇒ regulation



upset ⇒ run, spin etc

less active

consideration ⇒ texture

vestibular

lessen anxiety

* show them this is what we need to do - helps with anxiety

kits need more explanation on what can do with the equipment

parents ⇒ cope ⇒ extra work further on to get them off ph

mental energy

NOT thinking parent would do more behaviour with kid unless part of routine

expect school to do it

PARENT EDUCATION!

Demand on parent needs to be low

* practical advice

form of letter

calm

groups - small groups 4 MAX?

* Depends on the day

- could at risk of office - dispatching -

Training + follow up

Not using ⇒ "too afraid" ??

(argues

Must be adaptable ⇒ must take consideration of what's available

⇒ anything feel outside ⇒ distracting

vestibular ⇒ calming effect

FUN ⇒ NB! + PLAY

* supervision

⇒ gut health ⇒ linked to PA

⇓

interception

⇒ give me a book to read on

Interview 4 (clinician 3) MS teams.
DATE: 10/20 Location: Virtual
TIME: 12:03 Interview at home, participant at work

* Boss need to run after kids to try get interventions done

① Step are they on spectrum
* widening diagnosis late
↓
Need to start early
lack of skill vs lag → developmental?
* Eg trauma = affect motor skills.

* motor proficiency for me is a spectrum as well. I don't see it as times

overstimulation → could result in not being able to do motor tasks. — ? why

* Motor skill assessment — how they feel in the day
Earlier on in the day — Parents report more true to peer
* stimulation, interaction & fatigue

Need to do more training early on - steering

understanding capacity.
cognitive level
Time of day

Physical activity also a spectrum

sensory trigger → sweat + Pons + muscle saves

* game settings vs product.
game modifications = Mae intended.

* Emotional outlet

* Model = what if they don't like exercise??

start early ⇒ games must not trigger sensory issues
needs → Deviations from norms
Norms

* research papers → use of VR, Exergames, Exertainment

(create a positive relationship with exercise)

NS6

ADVANCEMENT OF KNOWLEDGE

Who? ⇒ Universities
⇒ Teacher curriculum ⇒ special needs education

"Every teacher must be able to teach any child"

Awareness to teachers themselves

Societal level + educational level.

Diagnostic tools ⇒ should help me where they already have an interest + the motor skills

+ parental involvement + teacher + deficiencies

parent education ?

OT

Maths Excuse

PA with ranging.

Now

Fear

*Indicators | low manners

Not meeting - not their fault ⇒ only focus is on communication.

Diagnosis slow ⇒ management interfered with

Division of responsibility NS3

No proper collaboration.

working in silos ⇒ PE; OT; Ψ.

* Model must be inclusive of different professionals

The assumption it seems - is that PA is not relevant to them

should be a focus

PA ← regulation, emotional interaction incapacitated in environment ? inclusion

MOC - in role of parents types of professionals ⇒ holistic

through out the lifespan

adulthood.

"you don't stop being autistic

Interview 6: Clinician 4

DATE: 11/15
TIME: 13:21
LOCATION: VIRTUAL (TEAMS)
Researcher at home, participant at home

⇒ 4 – 15/16 years

*Building blocks ⇒ feedback, apprioception, motor planning, strength, co-ord., quality of movement

MABC ⇒ Not accurate ⇒?

Reduced motor prof. ⇒ sensory feedback specifically

ADLs ⇒ Reduced OR quality ↓

Motor task ⇒ (why) the they are falling behind.

compensating using effort

Focus = behaviour ⇒ / trimming
motor skills on backburner / ignored

Behavioural exhaustion
emotional issues

observation checklists

① postural control
② core strength
③ stability
④ movement quality
⑤ isolated movements

Sensory
BODY AWARENESS

MABC ⇒ motor planning

↓ Missing ⇒ Quality of movement
compensation
Bilateral coordination.

Appropriateness of tests ⇒ linked to level of functioning.

Barriers ⇒ auditory processing / ↓ further distance, visual feedback ↓ eyes open / eyes closed

How are they doing tasks ⇒ Not only can they do it

what is affecting their everyday lives?
must find out

Ask parents for starting point?

Fluctuating PA levels

Barriers to PA

INTEROCEPTION

PA → engagement → arousal levels.
self regulation + help sensory regulation.

EDUCATION ⇒ parents, teachers + children

how feel in PA → V "
explain why feeling like that
Body awareness
overt explanation + understanding body

Interview 4: Parent 2
Date: 11/21 Location: virtual
Time: 11:38 Researcher@home, Parent@home, child at home

parent could only do virtual ⇒ looking after baby while son (autistic) at school

+ feeding ⇒ difficult.

simple tasks + life skills = blow nose, blow balloons

Not all the same — struggle sensitivity — Not receptive

parents telling professionals what kid can/can't do better than ass.

+ child willing to participate + consideration

+ ask parents questions

+ have parent presentness. be part of ass. to help kid participate more

How?

prepare parent → to help prepare child.

Baby crying in background — difficult to hear

Not here? Africa?

+ Daycare = ✓ feedback parent needs to ask

Roles of family in care

Guideline of activities

therapist = parents intervention to assist

limited finances therefore other therapies he needs.

Co-guideline for parent to do with him at home programmes from all professionals so parents can help them

"kids crave the most to be understood."

Parent not understanding some of the feedback

NB be able to understand + express himself

be able to EXPLAIN THE WHY

visual charts helpful.

child dependent = PA

FINANCES

(Too many people) consideration

PA = makes him happy

spinning = stimming

Interview 8: Parent 3

Date: 11/22

Time: 09:04

Location: Virtual via Researcher @ home + pedagogue

⇒ No setbacks

⇒ understanding for kids

⇒ Awareness

Why is it NB?

MOTIVATION

Pro bios → speech schooling

interactions ⇒ Barriers ⇒ Social

support integrate

Leisure spaces Regular

Parent training → programme → Pilot programme

Funders

subsidies

EMPOWER PARENTS

⇒ ADLs → independence → ADLs

⇒ Social skills → sensory issues

⇒ choices — individual preferences

POLICY

consider individual sensory profiles!

OPTIONS

(Face to face)

Interview 16: Clinician 10
Date: 11/12.
Time: 11:10pm
Location: Ψ practice
Interview at his office.

* hypo / vs hypo ⇒ spectrum
* Medication influence
* Not testing motor skills
* comorbidities ⇒ Low = low motor skills?

hyper / hypo

* PA ⇒ + motor skills = independence
* Meds → weight ↑
↑ Motion ↓ function. NB!

* → motor skills · independence
→ peace of mind for parents
+ targeted exercise to what each kid needs
* Ref includ Functional → feeding.
ADLs
Apraxias - Special consid.
→ music + FUN
sensory ⇒ textures
* careful what put in mouths
* dependence → ↓ independence
teething ✗.
* bowel
* consider thickened fluids ⇒ knee pain

+ holiday / home sometimes not getting PA.
Treadmills ⇒ simple movements
↓
easy to copy ⇒ games?
⇒ correct way to do movements
↳ Bend / crouch
+ Make it a habit / ritual
part of day ⇒ before brushing eg.
* COST EFFECTIVE

Interview #7: PARENTS.
Date: 2/12
Time: 17:30
Location: Baby plant home
Researcher name.

spectrum ⇒ variability
NO motor asst
Africa + Europ experience
⇒ maybe not up to par
child never tested. ⇒ IQ
Parent view NB ⇒ instinct
⇒ Early intervention
Training to pick up issue (educators otherwise can miss things
ADLs + basic motor ⇒
* Admit lack knowledge ⇒ except basic everyday knowledge.
* Advocate for PA
LIFESTYLE
hyperactivity

Interview #8: PARENTS
Date 13/12
Time: 10:02
Location: Baby plant home Researcher name.

⇒ 2 years old ⇒ contacted OP.
⇒ physical issues
↔ Time → Buy in from parents MUST.
↓
get involved with child - build relationship
⇒ work together - parents involved.
↓ ⇒ integrate parents into decision making! NB.
⇒ breathing
⇒ outdoors
small wins
! ⇒ Games.
⇒ FINANCE ! big issue
many therapies OT, physio, speech
⇒ NB to get active
⇒ son will not engage
⇒ is min sessions/week ⇒ spread
↳ different themes
← stress, anxiety, coping/weight + Education

Interview #: Parent.
Date: 12/13 Location: Virtual.
Time: 14:35

very active family ⇒ can see the relationship
⇒ kids struggle but are active
⇒ spends alot of time with her children

* early intervention ⇒ benefit

* Midpoint crossing easily can

* Not knowing what they are supposed to do = problem ⇒ guided into based on what supposed to be able to do

⇒ focus on cognitive ⇒ "body will missing something"

⇒ wants to know how to help ⇒ to get better

* places for parents to go to watch kids be active but also get a break.

⇒ very motivated generally concerned about physical kids under stress.

⇒ more activity ⇒ need more activity
⇒ inclusion + better family relationships.

Interview 20 Teacher 3
Time: 5pm
⇒ [illegible]

* learn about [illegible]
⇒ Activity in [illegible]

⇒ No [illegible]

⇒ screening tool for details.

⇒ very [illegible]

PE = [illegible]

Not a focus in SL ⇒

⇒ [illegible]

Interview 23: Teacher(6) pineapple
Time: 3pm Location: Boathouse (Cwrdd Research Room)

communication ⇒ walkaton.
NB how made not only if
⇒ motor = ↑ between waves.

Brain-body disconnect ⇒ so teach (how) to do moments.

ADLs; ⇒ house activities.

Auto movement VS New
easy more difficult

learning style ⇒ movement, sound + visual NB consider
+ lack of access ⇒ community education
— 'LAZY' ⇒ link to clinicians NB!
⇒ Exclusion ⇒ people give up cos so hard to work with them

CONTROL OF BODIES

⇒ keeping kids back in school ⇒ curriculum

understanding of ASD ⇒ new perspective

Interview 24: Teacher 6
me: Location

⇒ Confused with CP?
low/unchanal skills ⇒ ↓ motor ⇒ ↑ time to impide

NB ⇒ Multidisciplinary team

No testing ⇒ just diagnosis

Classroom ⇒ learning ↑ PE; logistics (how get around) participation

⇒ Technology ⇒ not writing but using smartboards etc.

sensory + behaviour ⇒ meltdown

Don't like to follow instructions

↑ tech + ↑ awareness

⇒ coordination, fine motor-writing, tracing

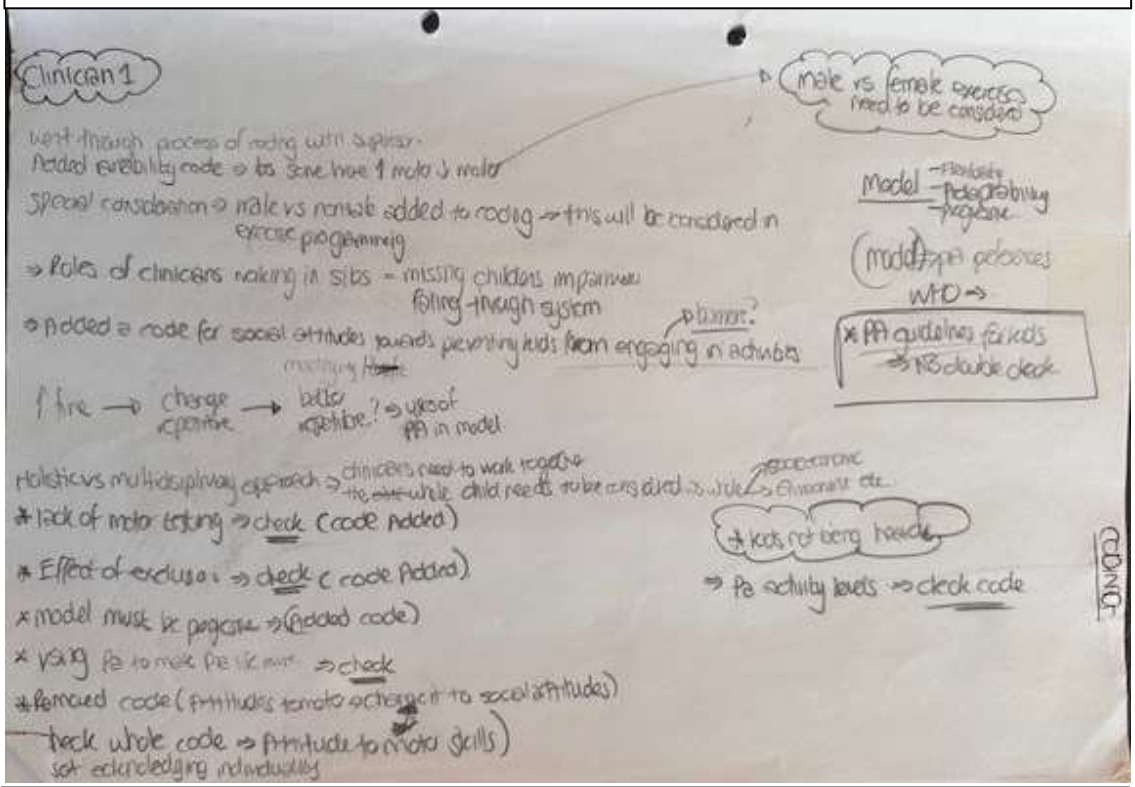
↑ music ⇒ better response + consideration

Early intervention. NB

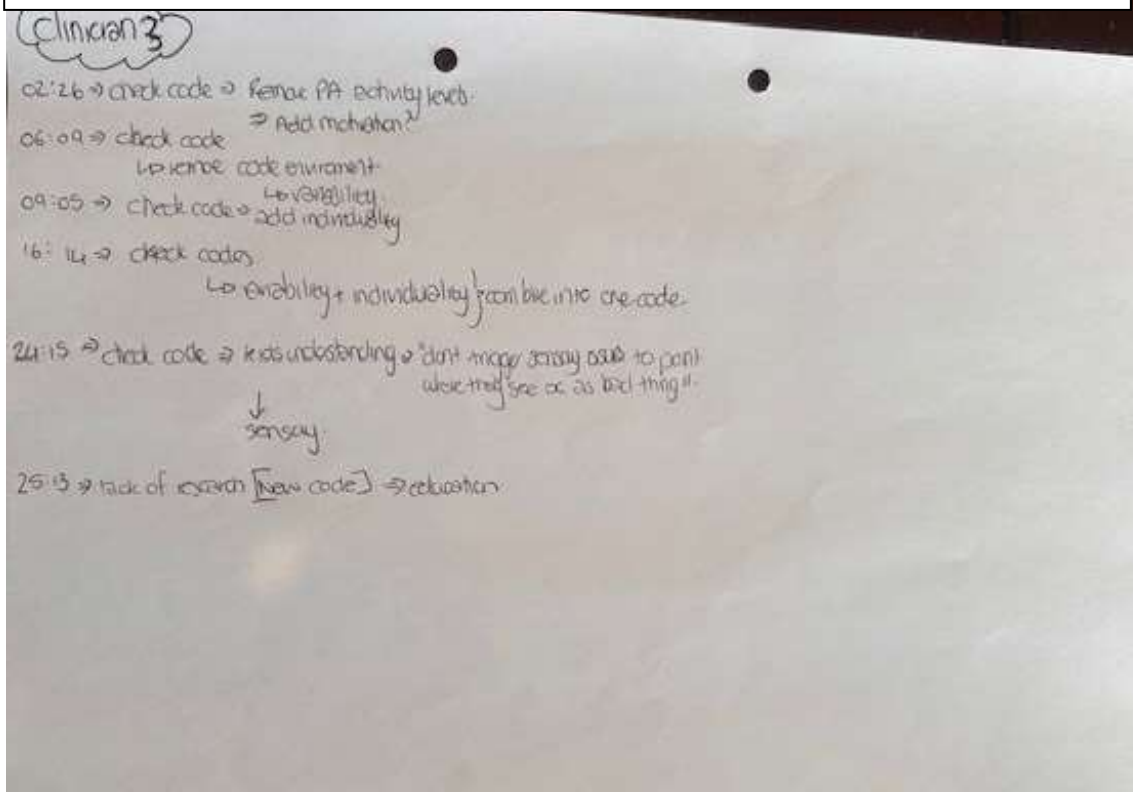
↑ severity of motor skills ⇒ ↓ appropriate responses
↑ intelligence ⇒ and know how to manipulate

Appendix H– Reflective/reflexive journal (sample pages- full journal can be provided on request)

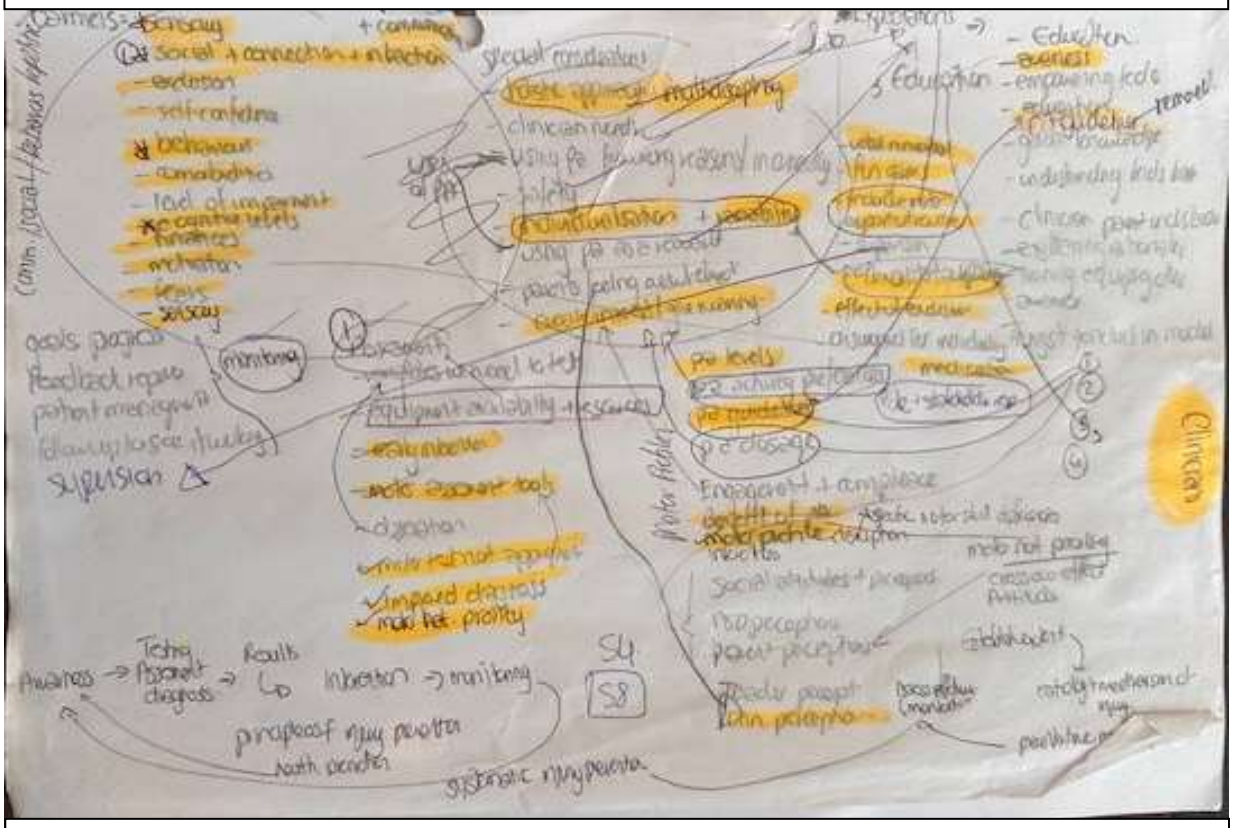
SAMPLE : CODING CHANGES FROM SUPERVISORS



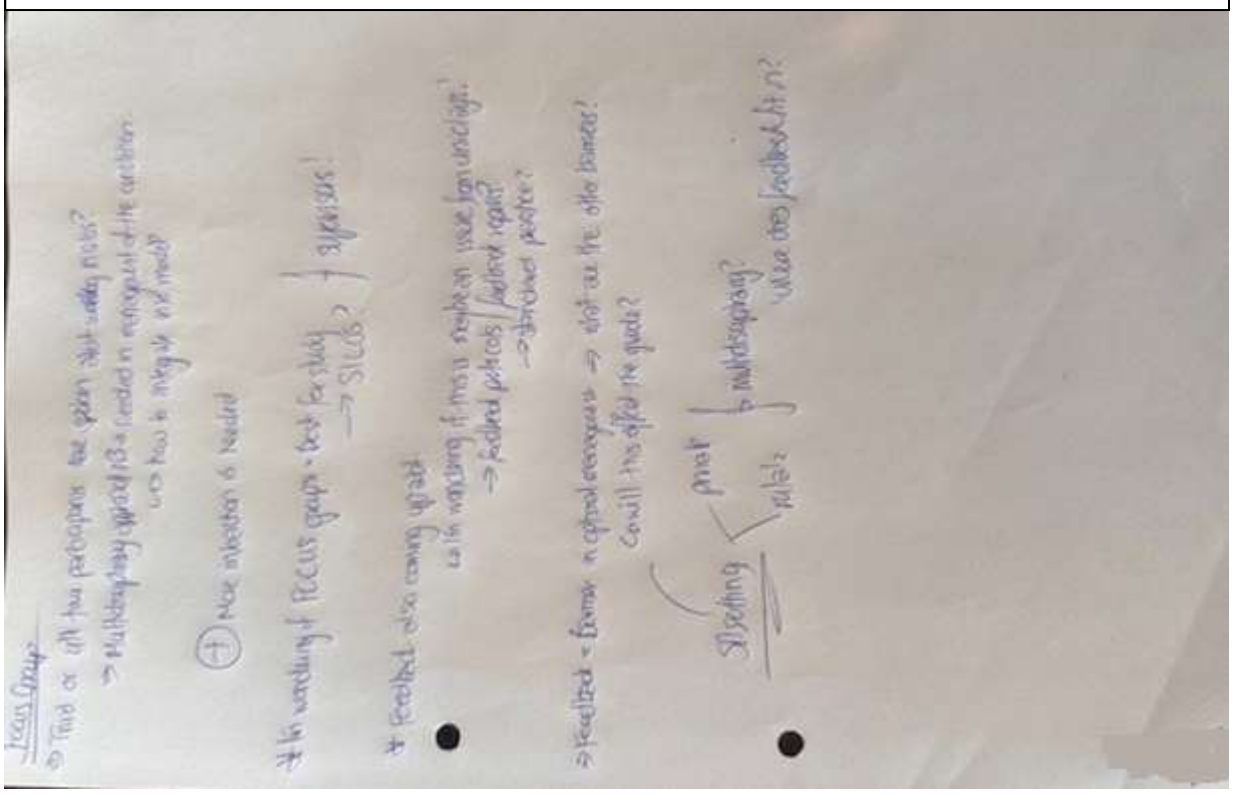
SAMPLE : CODING CHANGES FROM SUPERVISORS



SAMPLE : CODES – FINDING LINKS BETWEEN CODES



SAMPLE : INITIAL THOUGHTS ON FOCUS GROUP NOT BEING BEST IDEA



Appendix I – Permission letter from schools to conduct research

Permission from FootPrints School

WITS UNIVERSITY

SCHOOL PERMISSION LETTER (PENDING)

STUDY TITLE: A model of care for which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

I SHARON ROWE (print name), Principal of FOOTPRINTS SPECIAL NEEDS SCHOOL (print school's name), at 20+24 JAN E MARAIS ST (print street address of school) hereby confirm that:
BRANDHOF, RANDBURG

☑ I have been informed of the study by Natalia Neophytou
☑ I agree to send the study information sheet through to the parents and teachers of the school.
☑ I have read and received a copy of the written information regarding the study and have had the opportunity to discuss the details, and ask questions (which have been answered to my satisfaction) with the principal researcher.
☑ I am aware that the results of the study will be anonymously processed into a model of care that these details may be submitted to scientific conferences and written up in academic publications. In view of the requirements of the research, I agree that the data collected during the research, may be used for the advancement of knowledge as described.
☑ I am fully aware that I may, at any stage withdraw my consent as well as the consent of my school.

Contact details:

Principal Investigator:

Natalia Neophytou, Lecturer , MSc(Med); BHSc (Hons)
Centre for Exercise Science and Sports Medicine, University of the Witwatersrand
Tel: (011) 717 3368
Cell: 084 847 2977
Email: natalia.neophytou@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Principal: SHARON ROWE
Date: 24/2/2022
Place: RANDBURG
Signature or mark

Witnessed by:

Name of Witness: Emma Howard
Signature:
Date: 24/02/2022

Appendix J – Information sheet/ Letter to invite parents, teachers and clinical experts to be interviewed

PARTICIPANT INFORMATION SHEET

Hello,

My name is Natalia Neophytou and I am currently completing my PhD at the University of the Witwatersrand. As part of my degree, I am conducting a study to develop a model of care to assist in improving motor proficiencies and physical activity levels of children with autism and I would like to invite you to be a part of my interview process. At present there is no specific model of care focusing on motor proficiencies and physical activity in autism, and this study aims to bridge this gap. This study has been approved by the Human Research Ethics Committee of the University of the Witwatersrand.

TITLE

The title of my study is: A model of care for which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

PURPOSE OF THE RESEARCH

The specific aim of the study is to develop a model of care (MoC) to improve the management of children with ASD. No formal comprehensive MoC for the management of ASD currently exists. Furthermore, although core deficits have been clearly defined in the ASD population, and subsequent treatments developed to target the core deficits individuals with ASD often have several comorbid motor difficulties. Due to a lack of regular motor assessments being carried out within the population, as well as the lack of knowledge regarding the benefit of targeting these difficulties to assist with general functioning , motor proficiency training is often being neglected/ not targeted in the population. Motor impairments often lead to reduced performance in activities of daily living which can further lead to disruptions in social, physical and mental well-being.

Furthermore, the decreased level of physical activity in this population may further exacerbate motor deficiencies and thus compound the problem.

A novel model of care that provides a framework on how to optimally manage an individual with ASD including core deficits, motor proficiency and physical activity levels would benefit the population tremendously. If these core deficits, motor deficiencies and reduced physical activity levels are identified earlier in the individuals life, and a comprehensive model of care is developed to target these issues, improvements may occur in the quality of life of the individual, as well as their related social and behavioural realms.

PROCEDURES

Prior to the development of the model , clinical experts , parents and teachers working with individual with ASD will be interviewed to provide insight into what the model of care should entail.

Interviews will take place face to face at a preferred location of your choosing or virtually. Interviews will take approximately 60 minutes and will be conducted by the principle researcher. Interviews will follow all COVID protocols and will be conducted at a time at your convenience. The model of care will then be developed based on information gathered at the interviews as well as from the most current literature.

Focus group interviews will be conducted again following the creation of the model of care to determine if your expectations have been met, and these will take approximately 120 minutes. Each participant will be asked to sign consent to be audio recorded for the interviews and focus groups so that interviews may be transcribed accurately.

Any changes to the model of care will then be made based on the feedback gathered from the focus group.

The model of care handout will then be developed and sent though to you and clinicians in the field to inform change and so that best practices are followed.

If you would like to be interviewed to provide input for the newly developed model of care please contact the principle investigator.

POTENTIAL RISKS AND DISCOMFORTS

All COVID protocols will be followed during the interview processes.

If an accident should occur, I am qualified in first aid, as well as basic life support training and will be able to provide the appropriate attention needed.

PAYMENT FOR PARTICIPATION

There is no payment for participation in this study.

CONFIDENTIALITY

The information that is obtained during the course of the study will be treated as privileged and confidential. The information will be used for statistical analysis and scientific purposes with your right to privacy retained. No mention will be made of any identifying information such as your child's name or his/her school in order to protect his/her anonymity.

PARTICIPATION AND WITHDRAWAL

If you would be willing, it should be understood that you may withdraw yourself from the study at any time without reason, and without prejudice.

ENQUIRIES

If you have any further questions or concerns regarding the research, please feel free to contact:

Principal Investigator: Natalia Neophytou, Lecturer , MSc(Med); BHSc (Hons)

Centre for Exercise Science and Sports Medicine, University of the Witwatersrand
Tel: (011) 717 3368
Cell: 084 847 2977
Email: natalia.neophytou@wits.ac.za

Thank you for reading this invitation and information sheet.

Natalia Neophytou

Appendix K – Informed Consent form for interviews

PARTICIPANT CONSENT SHEET FOR INTERVIEW & NOMINAL GROUP

Project Title: A model of care for which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

1. I have been given a Participant Information Sheet which explains the nature and processes involved in this study, which is attached hereto;
2. I was given time to read it, or had it read to me, in the language I best understand;
3. I was given time to ask any questions I wanted to and found any answers given to me to be reasonable and satisfactory;
4. I believe I fully understand why the study is being conducted and what the intended outcomes will be;
5. I understand that there will be no immediate benefit to me, should I agree to participate, nor will I receive any payment; conversely, participation will not cost me anything but my time;
6. I understand that, even if I initially consent to take part in the study, I may subsequently withdraw at any time and would not be required to give any reasons; if that happened, any data collected about me for the purposes of the study would immediately be destroyed, unless I give consent for it to be retained
7. I have been given a range of contact details, listed below. If I require further information or become concerned about any aspect of this study I am free to speak to any of these contacts.

Contact details:

Natalia Neophytou, Lecturer , MSc(Med); BHSc (Hons)
Centre for Exercise Science and Sports Medicine, University of the Witwatersrand
Tel: (011) 717 3368
Cell: 084 847 2977
Email: natalia.neophytou@wits.ac.za

Professor CB Penny, Chairperson of the Human Research Ethics Committee (Medical) at the University of Witwatersrand, on telephone no. 011 717 2301, or by e-mail at Clement.Penny@wits.ac.za.

Ms. Z Ndlovu or Mr Rhulani Mkansi, Committee Secretariat, telephone nos.: 011 717 2700 or 1234, or by e-mail at: Zanele.Ndlovu@wits.ac.za or Rhulani.Mkansi@wits.ac.za

Name of Participant: _____
Date: _____
Place: _____
Signature or mark _____

Witnessed by:

Name of Witness: _____
Signature: _____
Date: _____

Appendix L– Questions for phase one interviews

INTERVIEW QUESTIONS

	Questions
	THEME 1 : MOTOR PROFICIENCY
1	Please tell me about your knowledge regarding motor proficiency levels in individuals with ASD?
2	Please tell me what your perception regarding motor proficiency levels in individuals with ASD? _____ Do you think motor skill assessment would be of value? Do you believe there is a need to conduct motor assessments in children with ASD? Do you believe motor assessments are being readily done for children with ASD?
3a	Please tell me what how you feel towards improving motor proficiency levels in individuals with ASD?
3b	Do you believe identifying motor impairments effectively in children with ASD could assist in better overall management and patient care for the individual?
3c	Do you believe a comprehensive model of care developed for children with ASD will be of value in improving motor impairments in individuals with ASD?
4a	Please tell me what about any motor assessment tools specific for ASD you may have come across? (Please name them):
4b	Are you aware of any models of care that include motor proficiency levels in individuals with ASD? If yes , please name them :
4	How do you feel with regards to the motor assessment tools used at present, are they comprehensive enough for a child with ASD? (If no, please list the variable/s you feel are often not assessed)
5	Which variables would you expect to be included in a newly developed comprehensive model of care focusing on motor proficiency? Please list variables:
6	Which , in your opinion do you think are the most important motor skills that need to be tested in your and why? What would you personally like to see be included in a model of care that targets motor proficiency?

	Questions
	THEME 2 : PHYSICAL ACTIVITY LEVELS
1	Please tell me about your knowledge regarding physical activity levels in individuals with ASD?
	In your experience, what kind of physical activity do individuals with ASD enjoy?
2	Please tell me about your perception regarding physical activity levels in individuals with ASD? _____ Do you think individuals with ASD participate in adequate physical activity Of the individuals you have worked with are you aware if these individuals meet the physical activity guidelines outlined by ACSM? (will provide criteria to person)
3a	Please tell me about how you feel about improving physical activity levels in individuals with ASD?
3b	Do you believe improving PA in children with ASD could assist in better overall management and patient care for the individual?
3c	Do you believe a comprehensive model of care developed for children with ASD will be of value in improving PA in individuals with ASD?
4b	Have you come across any models of care that include improving PA levels in individuals with ASD? If yes , please could you name them :
6	How do you think PA may be improved in this population?
7	Please tell me about what would you like to see in a model of care that specifically targets PA?

Appendix M – COVID protocol for interviews and nominal groups

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

COVID PROTOCOL

1. If interviews are conducted virtually each participant is requested to follow standard COVID practices:
    a. All interviews and focus groups will be conducted in a well ventilated area.
    b. Individuals are required to sanitise and wear PPE at all time (PPE will be provided by the researcher prior the interviews commencing). Additional PPE will be available if any PPE malfunctions.
    c. A safe distance of 1.2m needs to be maintained at all times.
2. If interviews are conducted in person each participant is requested to follow standard COVID practices:
    a. All interviews and focus groups will be conducted in a well ventilated area.
    b. Individuals are required to sanitise and wear PPE at all time (PPE will be provided by the researcher prior the interviews commencing). Additional PPE will be available if any PPE malfunctions.
    c. A safe distance of 1.2m needs to be maintained at all times.

Appendix N – Audio recording consent form

UNIVERSITY OF THE WITWATERSRAND

CENTRE FOR EXERCISE SCIENCE AND SPORTS MEDICINE

AUDIO RECORDING AND TRANSCRIPTION CONSENT FORM

A model of care for which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder Researcher: Natalia Neophytou

Affiliation: Centre for Exercise Science and Sports Medicine, University of the Witwatersrand

This study involves the audio recording of your interview and focus group sessions with the researcher.

- Only the research team will be able to listen to the recordings. The recordings will be transcribed by the researcher and erased once the transcriptions are checked for accuracy.
- Neither your name nor any other identifying information will be associated with the audio recording or the transcript.
- The transcripts of your interview may be reproduced in whole or in part for use in presentations or written products that result from this study.
- Neither your name nor any other identifying information (such as your voice) will be used in presentations or in written products resulting from the study.

By signing this form, I am allowing the researcher to audio record me as part of this research.

Participant's Signature: _____ Date:_____

Appendix O – Distress protocol (Adapted from **"***GUIDANCE FOR IDENTIFYING AND MINIMISING PARTICIPANT DISTRESS DURING INTERVIEWS AND FOCUS GROUPS)"*[307]

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

DISTRESS PROTOCOL

Prior to the interview: Prior to conducting the interviews and focus group sessions, the researcher will practice mock interviews in liaison with the supervisor. These interviews will provide the researcher with an opportunity to identify any questions that might lead to distress and where appropriate, take steps to rephrase or change these questions.

During the interview: At the beginning of the interview the researcher will remind the participant that they can stop the interview/ focus group at any time, that they can choose not to answer questions, and that there are no right or wrong answers to questions (so there is no fear of 'saying the wrong thing').

Once the interview begins, the researcher will be required to be aware of any potential indications of distress (e.g., withdrawing, visible upset, declining to answer numerous questions, shifting in seat, looking away from the interviewer, asking for the interview to end) and should air on the side of caution in all instances. If there is even the slightest indication that participants might be distressed students must immediately follow the procedure below:

1) The recording will be immediately stopped and the participant will be asked if they are ok. At this point the participant will be asked if they want to take a break/end the interview/continue talking – the participant's decision will be final. If the participant decides to take a break and continue with the interview, confirmation will be sought that the participant is actually comfortable continuing and they will be reminded there is no penalty for withdrawing.
2) If the participant wishes to continue but remains distressed, the interviewer will make the decision to drawn the interview to an end. At this point, the interviewer will commit to providing the participant with an opportunity to talk and ensure the participant is not visibly distressed when leaving the interview.
3) If the participant remains distressed and the researcher does not feel capable of managing the situation they will contact their respective supervisor who will be available at all times during

interviews by phone contact. Depending on the situation, the supervisor will either provide guidance to the student, speak directly to the participant over the phone, or make attempts to go and meet with the researcher and the participant.

4) If the participant has become distressed at any point in the interview, the student will ensure the participant has the contact details of the rest of the research team and remind them that they are free to contact any member of the research team if there is anything further they would like to discuss.
5) The interviewer will also offer to provide the participants with a list of local contacts (e.g., counselling services, sport psychology services) if they would like them.
6) Following the interview, the student will debrief the interview with their supervisor and (if necessary) other senior members of the research team. A written record of the incident and the procedures followed will be made.

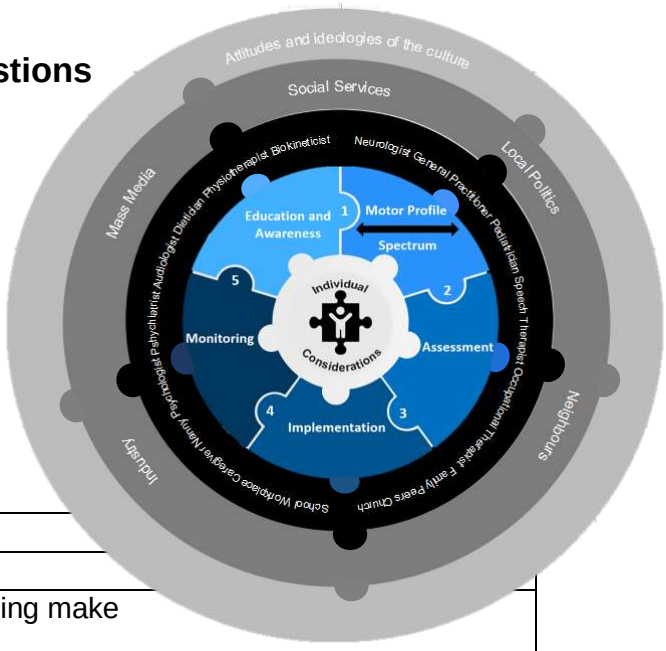
Appendix P – Nominal group guiding questions

A model of care which includes

motor proficiency and

physical activity levels for

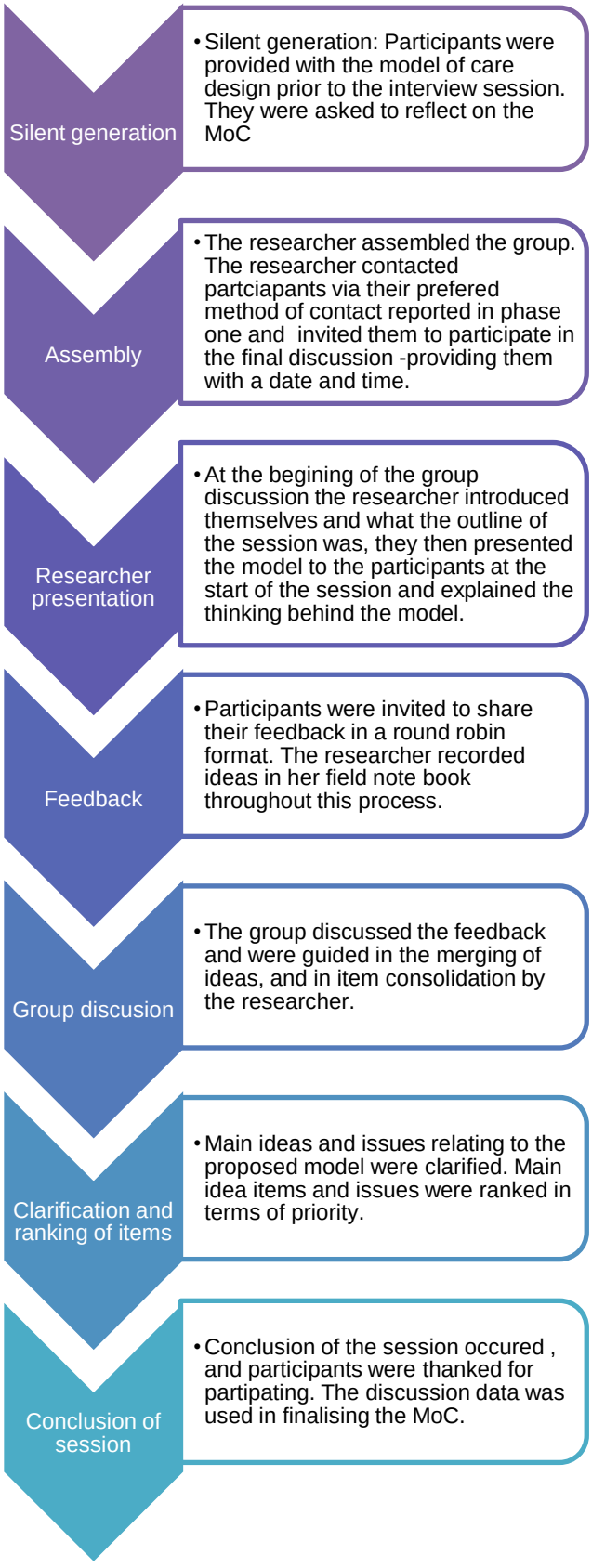
children with Autism Spectrum Disorder



	Questions
	THEME 1 : MODEL DOMAINS
1	Starting at the centre of the model – does the inner ring make it clear the individual is central to the model? Are you happy with this concept and component?
1b	Are you happy with the cyclical flow of the steps in the model?
1c	Are you happy with the headings? Is there any information/wording you feel needs to be included for any main step in the process
2	Who do you think the key individuals should be who feeding into the model of care (presented on the black outer loop) Are any stakeholders missing or that should be removed?
3	Do the outer rings accurately depict the setting and ecosystem of the model – do we need to change anything?
	THEME 2 : VISUAL ASPECTS AND DESIGN
4	Please tell me if you feel the model is easy to read?
5	Please tell me if you feel the model is easy to understand and follow?
6	Does the design need any visual improvement? (layout, colours, fonts, wording)
	THEME 3 : MODEL IMPLEMEMATION
7	Please tell me how you feel the best way to implement the model would be?
8	Please tell me who you feel should be responsible in implementing the model and why?
	THEME 4 : MODEL EFFICACY MEASURES
9	Please tell me how you feel we can measure reach and efficacy of the model?
	THEME 5: OVERALL CHANGES IN ORDER OF RANK
10	Please can you provide me with your suggested changes in order of priority

Appendix Q – Guideline of interaction for nominal group interview

Stages of the Nominal Group Technique



Guideline of interaction for step three to seven

Introduction by facilitator (5-10 minutes)

The facilitator introduces themselves and their supervisor and welcomes all the participants. The facilitator asks permission for the session to be audio-recorded. The facilitator then explains the nominal group technique process The facilitator explains the flow of the session and themes and lets the participants know how the feedback process will work. The facilitator then explains the context of the session and provides information on the model and how the components should work within the model.

Feedback: (25-30 minutes)

The facilitator begins with the guiding questions and requests feedback from all participants in a round robin format. The facilitator will constantly encourage all participants to provide feedback and intervene if participants are not all provided with fair chances to speak.

Group discussion: (10-15 minutes)

The group is guided in discussing the main ideas of the group. Discussions around differencing of opinions will encouraged and the facilitator will guide the group to reach consensus on main ideas and questions they may disagree on.

Clarification and ranking: (10-15 minutes)

The facilitator will guide the participants in ranking the main issues and changes they need made to the model. The facilitator will make sure to explain that it is important that the participants reflect on their personal feelings and beliefs, rather than thinking about what the other participants may expect or want changed in the model.

Conclusion: (5 minutes)

The facilitator will clarify the final model changes and then thank all the participants for participating in the session and in the study.

Appendix R – Ethics clearance certificate

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

R49 Ms N Neophytou

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M220241

NAME: (Principal Investigator)	Ms N Neophytou
DEPARTMENT:	School of Therapeutic Sciences Centre for Exercise Science and Sports Medicine Medical School University
PROJECT TITLE:	*A model of care which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder*
DATE CONSIDERED:	2022/02/25
DECISION:	Approved unconditionally
CONDITIONS:	
NOTE:	If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za>
SUPERVISOR:	Professor J Potterton and Dr G Torres
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2022/04/19

This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report.** When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **February** and therefore reports and re-certification will be due in the month of **February** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Signature of Principal Investigator

Date

Appendix S- Reflective Statement of the researcher

As the researcher of this qualitative PhD thesis, which focuses on developing a model of care for individuals on the autism spectrum, specifically addressing motor skills and physical activity levels, I recognise that my positionality plays a significant role in shaping both my perspective and approach to this thesis. This reflective piece is therefore crucial to understanding the ways in which my background, personal experiences, and cultural context informed my engagement with participants, the research process, and the final outcomes of this research.

In terms of my upbringing and culture: I am a white South African woman with Greek and Cypriot heritage. I grew up in in South Africa, and am the daughter of immigrant parents. My mother was born in Greece and my father from Cyprus, which I understand gives me a unique cultural perspective through which I view and perceive the world. Greek was the first language I learned, and although I was raised in a predominantly English-speaking society, the majority of my early experiences were strongly influenced by Greek culture. At home, we spoke Greek, followed Greek traditions, and were brought up with values that emphasised family and community which has certainly influenced how I engage in my own community as well as how I approached the development of the Model of Care. I believe that being both South African and Greek-Cypriot, has influenced the way I approach and engage with different communities, individuals in the workplace and other organisations. I am also aware that my upbringing in a suburban environment, where I attended private school and later university, gave me certain privileges in terms of access to education as well as many other opportunities, which I fully understand is not something all individuals in my research context may have experienced.

In terms of the research subject matter: I have to acknowledge that my positionality as a researcher is deeply related to my personal connection with the subject matter. My younger brother, who was diagnosed with autism at the age of 17, struggled throughout his life with many of the challenges which I explored in this research. Being diagnosed very late, meant that he did not receive the early interventions that I mention frequently in the thesis, that could have significantly improved his quality of life- particularly in terms of motor skills and physical activity. Furthermore, he also had low muscle tone which led to reduced engagement in physical activities compared to others, which I observed firsthand throughout his life. It needs to be noted that although he had access to opportunities to improve his wellbeing, he experienced many personal barriers as well as autism specific barriers which often prevented him from engaging in these opportunities. This provided firsthand insight regarding barriers towards the engagement of

therapeutic modalities which helped me understand this area clearer in a sense. His experiences, and my role in assisting him, including helping him to complete a Midmar Mile (a swimming event) were some of the motivating factors for conducting this research. My brother's journey was, was essentially the main reason for my academic interest in autism and motor development, and his struggles were personal to me long before they became the subject of my academic research.

It is important to note that my brother, tragically passed away during the final year of my PhD due to the mismanagement of his condition. His death was a shocking and painful reminder of the large gaps, and lack of protocols in the care for individuals with autism. The loss of my brother not only made the completion of this research emotionally challenging, but it also made it a matter of urgency for me to complete the development of this model of care that addresses these very gaps as well as plan future search to address further gaps picked up in this research. His death highlights the real-world urgency and significance of this work. It became no longer just an academic exercise; but deeply personal to me. In many ways, this research is therefore a tribute to him, and to all the individuals and families who struggle with limited, and in many instances, unguided care for autism.

In terms of the subject matter regarding physical activity and exercise: my field of expertise is in Biokinetics which influenced my decision to specifically research and develop a Model of Care in this field. Furthermore, reflecting on my own engagement with physical activity (like swimming, tennis, hockey, and netball) has also shaped my understanding of the benefits of exercise for individuals, which may be applied similarly to those with autism. Engaging in physical activity throughout my life, provided me with an outlet to manage my own emotions and stress as well as provided source of strength and confidence, and I believe that encouraging similar experiences for children with autism can help to improve not just their motor skills but their overall quality of life. This personal belief informs my work, particularly in advocating for physical activity as a core component of the model of care. I do however acknowledge that this belief could introduce bias into the work, however every endeavor was made to interpret all the data in a fair and unbiased manner- ensuring cross-checking of all data by my supervisors as well as accepting all feedback throughout the write up process.

It became clear from personal experiences in terms of my brothers' care- that multidisciplinary care and holistic support resulted superior management for individuals on the spectrum and that it was needed for future management strategies since autism is such a complicated condition.

This definitely influenced my work in that it was very interdisciplinary in its nature- involving interviews with teachers, clinicians, and parents.

A Reflection on potential bias: while my personal experiences have provided valuable insights and a deep emotional connection to the topic, they also introduce potential biases. I am aware that my privileged background, my personal relationship with autism through my brother, and my professional position as a lecturer could influence how I interpret data and engage with participants. This awareness has encouraged me to remain reflexive throughout the research process. I have made a conscious effort to listen openly to the experiences of parents, teachers, and clinicians, acknowledging that their experiences and their reality may be different from my own. Furthermore, I also recognise the larger societal and cultural contexts in which this research took place may be a source of bias. South Africa, has a history of inequality as well as a diverse cultural landscape often termed the “cultural melting pot”, which in itself may result in unique challenges but also opportunities for developing Models of Care for autism which are inclusive. I am aware that the cultural attitudes toward disability, access to healthcare, and socioeconomic differences may all play roles in shaping the experiences of individuals with autism and their families. As a researcher, I tried to navigate these complications with sensitivity, and tried to ensure that the Model of Care I proposed was adaptable and responsive to the varied needs of South African communities. I do believe that I need to pilot the model in rural settings specifically, to establish if it would be appropriate in that context since only one of the participants provided information relating to this context.

In conclusion, my positionality as a researcher is shaped by a complex interplay of personal, cultural, and professional factors. My Greek-Cypriot heritage, my upbringing in suburban South Africa, my academic background, and, most importantly, my relationship with my brother have all influenced this research. While my personal connection to the topic has driven my passion and commitment, I remain conscious of the need for reflexivity and objectivity. This thesis is not just an academic contribution, it is a deeply personal journey aimed at improving the care and support available to individuals with autism, inspired by my brother’s life and legacy.

Appendix T-Complete sample of verbatim quotes per theme and category per group

i. Teacher perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Theme 1: A brain body disconnect- "Their body is not their friend"

e) Specific motor skills and/or deficiency (Motor profile)

Overview of findings	***Teacher statements***
All of the teachers indicated that they believed children with ASD had variable levels of motor proficiency. Overall however, the teachers indicated that in general children with ASD had reduced motor proficiency levels and that they struggled with performing motor tasks. One teacher indicated that in some instances they would have to assist children in the classroom with nearly all motor related tasks and that these children required far more attention due to this.	*"It's wide ranging in the sense that some people with autism do not really display any kind of mobility problems at all."-Teacher 1*
	"Well, from my knowledge, it's really it's [Motor proficiency] variable, right?"- Teacher 5
	"I think it's so varied across the spectrum"- Teacher 5
	"It depends. Obviously, we have three type of autism Yeah. Level one, two and three. And other things as well,"-Teacher 4
	"I know it's not very good, but what can I tell you, autism kids struggle with motor skills, big and small, even with the fine, or you know, like jumping rope or something like that. I know it's difficult for them."-Teacher 1
	"No, they're, they're very important[motor skills], a lot of them, you know, with time and with working on it and helping them they do get better, but a lot of them[motor skills] are very poor."-Teacher 5
	He does not do anything. Firstly, he struggles with his fingers. How to hold a pencil. So it means we are doing everything for him. It shouldn't, so the child needs more care. They need more attention than other kids."-Teacher 4
	"And that's, that's, that's the slide here , you know, it's only you know, in terms of interaction ordinarily such a person would not be so much affected in terms of their mobility, but when you go to the other extreme where it is not only seen in interaction, but also in physical attributes, and you might find that, yes, the mobility is really tested. But also it depends and this is where, you know, in the intricacies of autism come in because yes, we are saying there's a social aspect, but there's also a physical aspect, but the mix of the two can actually be quite hectic"-Teacher 1
One teacher believed that individuals with ASD may could be highly proficient in sporting or physical activity tasks due to the nature of the condition being on a spectrum.	*I think it's also possible that they may be quite proficient on a certain sporting or physical activity that involves you know, intense movements, and that can be you know, on the same level as being able to do maths in a in a in a way that is above the normal way of functioning. So, I would say that the same variability that we see in terms of social interaction and certainly of mental ability is detectable when it comes to movement as well. Teacher 1*
One of the teachers indicated that she believed that it's not only individuals on the spectrum that are struggling with motor proficiency deficits but rather that all children are struggling - including neurotypical children.	*"I did observe that most of them came up with difficulties where they would either require to have OT for low muscle tone, or they would require to have speech therapy as well for language difficulties and the fine motor. I did also observe the fact that most of them did not have those well-developed muscle tone, either the gross motor or the low muscle tone, but then it's puzzling me Natalia, because I would have thought that that was an apparent symptom for children who are on the spectrum but these days, even typical children are struggling in those areas."- Teacher 2*
	"It is not just something that now you would say, okay, you would expect would be an expected thing that if a child has his this on the spectrum, they also would have those comorbid difficulties like having fine motor skills, gross motor poor, poor motor, poor gross motor skills, and other issues, but it's just seeing even in children that are functioning."-Teacher 2
One of the teachers stated that she believed ASD was a sensory motor disability as opposed to a cognitive behavioural disability.	*So I see autism specifically as what is known as sensory motor disability, as opposed to a cognitive or behavioural disability."-Teacher 5*
	"For me, a lot of the behaviour is because they're struggling with their sensory and the motor cortex, not necessarily because they're behaving normally or, you know, those challenging behaviours. So that's my perception of autism"-Teacher 5

	"Well as the as far as I know, autism doesn't really manifest itself in terms of mobility to the extent that you know, other, you know, brain, you know, things that affect the brain can actually cause mobility problems. It certainly can, but I think it is more by extension rather than directly that a person of autism would have movement problems."-Teacher 1
The majority of teachers indicated that they believed motor skills were important and that it would benefit the children to improve them (this was for both children with ASD and neurotypical children). Teachers believed that motor skills were needed for the optimal performance of activities of daily living. One teacher indicated that she believed that motor skills were part of foundational skills that children needed for optimal functioning. She compared motor skills to being like a foundation of a home and that without them the house would collapse. One teacher indicated that she believed that improving motor skills should extend to other populations too such as children with Downs syndrome and ADHD (Attention Hyper Deficit Disorder) for example.	*"Look at like activities of daily living, how do you wash dishes, breaking that down into motor movements, that you then encourage their body in order to do it. So I think motor programmes are very, very beneficial. And important."-Teacher 5*
	We still have all those research that are talking about laying the foundational skills before former formal skills, then, definitely, you can't just build a house without a foundation. It's gonna fall down."-Teacher 2
	Do you think that improving physical activity is important in the children? "Yes, in autism and children in mainstream it is very important."-Teacher 6
	"So it's definitely something that should come into [management] especially when you're looking at kids with autism, kids with ADHD, your Down's kids, you know, it's not just specific to ASD."-Teacher 3
	"So for me motor is critical when I work with my kids and I'm looking at how they move and what they're doing when they're moving." Teacher 5
Teachers indicated that improving mobility and motor function could improve their ability to interact with others and thus that it would be important to improve just based on the social benefit. They indicated that the more frequently they participated in motor related activities an therapies the more advanced they became compared to other children. Overall they believed that those engaging in motor activities performed better overall. Teachers believed that improving motor skills would help them perform every day more proficiently and they indicate that it would help them perform those tasks better later on in their lives. More specifically they indicated engaging in motor activities physical assists in improving coordination and balance. They also indicated that engaging in physical activities were beneficial as long as they actively engaging in them.	*If they are able to, you know, to be mobile to be able to participate in things that involve mobility, their overall ability to interact with the people surrounding them would be highly improved. Therefore, this is absolutely crucial to do."-Teacher 1*
	"Yes , it is, the same kids that you know, the kids who attending everything. Like there was a child I used teach, who - two years ago –so she was the only child, a three year old child. She's was doing OT and speech therapist twice a week. On Monday, she would see OT, and Thursday she would see speech therapist, it means that child advanced more than other kids."-Teacher 4
	"They do better?" Teacher 4
	"They must be active in some ways, because it's a very important for balance- ya. They say motor skills , and coordination and I forget the word, let's say it helps the kids." It helps with balance as well."-Teacher 4
	"Improving those motor skills will help them for later on in life. You know, something as simple as tying your shoelaces doing up your buttons, brushing your teeth, brushing your hair, all of those sort of like motor planning skills can be done through physical activity strength, and we have a lot of kids with very, very low muscle tone. So it'll all improve on that which then helps them later in life."-Teacher 3
	"Look I think physical activity, you know, it has its benefits for a lot of them as long as it's done."-Teacher 3
The teachers reported common motor difficulties. Motor difficulties reported included deficits in handgrip and manual dexterity, proprioception, motor planning, apraxia and dyspraxia, muscle tone, and gross motor skills. Overall they indicated that children with ASD struggled to control their bodies.	*"You try to find every kind of position you want to sit in and you just can't feel your chair you can feel your way with the position between space in the in the desk and the in the table, the table and in your chair."-Teacher 2*
	"I did observe that most of them came up with difficulties where they would either require to have OT for low muscle tone, or they would require to have speech therapy as well for language difficulties and the fine motor. I did also observe the fact that most of them did not have those well-developed muscle tone, either the gross motor or the low muscle tone."-Teacher 2
	"Yes, as I said, something as simple as holding a pencil and writing. You know, how much pressure do I put on it? Have I put enough pressure on it, how do I turn the page? How do I pick up my book? How do I sit on the chair? Do I sit on it too hard? Do I sit on it too soft? How do I get out of my chair and walk towards the door? How do I go downstairs? All of these things that you see in the school setting are part of the motor planning issues."-Teacher 3
	"I've got my niece is in grade 10. When I look at her pencil grip is utterly shocking. And even when she's holding things in the house, you asked her to open a can. She struggles, I can't do it. I can't open it. She's bright, She's bright. She's doing all sorts of things academically."-Teacher 2

	"She cannot use her hand because she can't. What's the word I'm looking for? You know when you put them up in the water and you want to take off that, wringing, she can't do tha.t"-Teacher 2
	"That child can't do anything like holding a pencil, he lacks in everything."-Teacher 4
	"we look at apraxia and we look at dyspraxia"- Teacher 5
	"I think to some extent, yes. I think it's still hard and it's a challenge some days and it's tricky for them to control their bodies. Sometimes. But I think for the most part, yes."-Teacher 5
Teachers overall believed that motor skills were not a priority in terms of treatment and management in individuals with ASD. The indicated that often cognitive, and behavioural deficit stake precedence and that academic performance is often the focus in the school setting. One teacher indicated that it may not be a priority as she believed that the understanding of motor related deficits and motor planning difficulties is something relatively new in South Africa.	*It's an area [motor] that is really interesting to me, and I find that it is often ignored."-Teacher 5*
	It gets overlooked all the time. And we just Yeah, it's a big part of it, that we shouldn't be overlooking."-Teacher 5
	"So again, going back to we see autism as something that you know, we are perceiving it again, as that cognitive or that havioural difficulty. We're not looking at it from a motor perspective. So we ignore that side. We then don't focus on movements and exercise with them. And I think also because it's hard, so a lot of people kind of give up."-Teacher 5
	"It's something that's lacking here, you know, there is a big focus on the academics with our kids, but not really a focus on looking at motor planning, the social skills, the play skills, the executive functioning skills, the emotional regulation skills, so ya that's something that could definitely be addressed."-Teacher 3
	"I don't, I don't know of any programme that focuses on you know, people with neurodevelopmental disabilities, in terms of being able to move, being able to compete in sports that you know, need movements."- Teacher 1
	"If mobility was something that was taken seriously in terms of people with autism in South Africa in general, then would see people with autism in South Africa being actually successful in areas where movement proficiency is actually a really important thing." -Teacher 1
	"Read any article about you know, students with autism, read any article about people with autism and functioning in society or whatever. It's always focused on, they were not able to communicate, now they can communicate. I have rarely ever seen anything that says, well, that person was not allowed to move or play sports or exercise, but now they can, after you know certain experts have been helping them." -Teacher 1
	"I think because an understanding of the motor planning issues is relatively something new."-Teacher 3
One teacher stated that she felt that in the past children who struggled with motor related tasks (eg gripping a pencil), would often continue to struggle without support or help but that they would somehow come up with mechanisms to cope and continue their leaning journey.	*"You could see people holding a pencil and using that thumb wrap and it wasn't something shocking because at the end of the day, they were able to produce letters, the orientation of the letters was the same as yours who was holding it on a tripod grip. I can understand the difference between a palm grip obviously for a person who's like 15 was still holding a pencil like that and, and not using either the thumb wrap or that tripod grip, but I'm just saying that we filtered through the cracks, even though we did not have the support and help."-Teacher 2*
The majority of teachers indicated that they were not aware of motor assessments being done for children with ASD. One teacher indicate that she believed that motor testing was a new thing that was being done in children with ASD and one teacher indicated that in some instances the teachers would have things planned to observe motor proficiency. Overall teachers all the teachers believed that conducting motor assessment would be important to determine the level of assistance they need when performing motor tasks as well as to identify what the individuals need in terms of which professionals to see and how they could help them. One teacher indicated that a screening tool would be useful but that she didn't know which variables would need to be tested. Teachers indicated that assessments they had come across were related to social and cognitive functioning and	*"Well, probably not. In fact, I haven't really heard of those in your, you know, normal school context for an autism child."-Teacher 1*
	I haven't really heard of those in your, you know, normal school context for an autism child. So I would say, yeah, in South Africa, probably not".-Teacher 1
	"If we talk of diagnosis in South Africa, this is something that has for a long time, been virtually non existent. So there were no official standards in terms of determining if a person is autistic or not, I think until, if you not more than 10 years ago, as when they were actually ways that were, you know, put up to say that if a child is found to be like this, then they are autistic in the South African context. So if on diagnosis, we have already been so slow, then the overall management is not going to be to be good."-Teacher 1
	"So even that assessment equipment itself is not in abundance, because this this condition this disorder is not one of the top agendas of government, whether its health, whether it be education."-Teacher 1
	"The motor assessments in kids with autism, I can say, is still pretty new."- Teacher 3
	And have you noticed that the children gets their motor skills tested? In the school that you work at? "Yes. In class, we as teachers, we have things planned."-Teacher 4

whether children were able to comprehend academic tasks. They therefore indicated that this needed to be remedied.	*"I think that in the context of cause of during the assessment in order to be able to help them as they have needed certainly is important. So I think an assessment, you know, gives you an idea of how much they can do without help and how much they need to do with help. So yeah, I would definitely vouch for that. You do need an assessment."-Teacher 1*
	"Remember that when you do a diagnosis, when you do an assessment and you try to understand the overall health state of a person, it is not only to help them, but it is also to help those who help them so other professionals that are actually you know, relevant in the life of this person with autism needs to be need to be brought into the knowledge of, you know, where this person is, how they function and how they can actually help them."-Teacher 1
	"Yeah, I don't know. They'd obviously need to be some sort of, like screening tool. Or something. No, I couldn't, I wouldn't , there isn't a set of variables, I don't know."-Teacher 3
	"Ya there is a need, because by doing those tests you will see how the child, like is, how the child's body functions, or how the child's muscle and everything bonds, everything it, the test it is it is needed."-Teacher 4
	"No. We've got a physio that works with my kids. And I know that he is trained in the MNRI method, I can't remember what it stands for, but other than that, as far as I know, there isn't a motor assessment that's been done on them."-Teacher 5
	Yeah, I haven't. In fact, most of the assessment tools that I've come across are just social and mental. So they are more about whether the child is able to understand other people whether they are able to comprehend setting, you know, academic things. So yeah, I think that's something that I will also need to look into, because it's certainly an aspect that that exists, right mobility, but yeah, I haven't really come across such assessment tools as yet."-Teacher 1
	So we do just basic movement with them. We've got a physio that comes in once a week to see some of the kids and we focus heavily on coaching their bodies, so coaching the motor throughout the day, but in like a general programme, no, I haven't seen anything.-Teacher 5
	Yeah, I'm not I'm not so sure about the exact ones because from my experience, it hasn't really been about mobility-teacher 1
	And then do you think that it's important to do these motor tests with the children? "Yes, it is very important."-Teacher 4
	"Yes, it [motor assessments] would be a value."-Teacher 5

f) Reduced pa levels

Overview of findings	***Teacher statements***
Overall teachers believed that physical activity levels varied from child to child but that overall they were not meeting physical activity guidelines. They indicated that similar to neurotypical children there were children who enjoyed participating in physical activity and those who did not. One teacher indicated that the children she worked with seemed to be active but that for some children even going to the bathroom and back would be enough for some children. One teacher indicated that physical activity should be improved in everyone. He stated that he believed that reduced physical activity levels were an issue across population groups. He also stated that it(PA) doesn't receive enough focus and that it may be perceived that it is not relevant for children on the spectrum. Furthermore he indicated that in some instances people did not provide	*"It's different from child to child."-Teacher 3*
	"Well, from my knowledge, it's really it's variable, right?"-Teacher 1
	"So we have a lot kids and that's where you will discover that this child, likes to engage in activity or this child not."- Teacher 4
	"So we do get a lot of physically active kids. You know, kids that love running kids that love cycling, kids that love swimming, kids that love playing soccer, kids that love playing rugby. But it's different from child to child."-Teacher 3
	"I would say most of my kids are active enough-ish, ha ha , -ish, (meaning enough-ish) just the fact that I have to walk to the bathroom might be enough physical activity for some of them."-Teacher 3
	"Other kids like to interact with their peers. Yeah, these kids, you just see them sitting, and not playing with anything at all or not engaging with any activity. It depends on what type of autism and what level."-Teacher 4
	"It depends from kid to kid, you know, the kids I've worked with over the years, we've got some incredibly physically active kids who actually enjoy sport. And then I've got some gamers, who do not like physical activity at all. But it's exactly the same as their typical peers. You know, you've got sporty active kids and you've got kids who don't like sports."-Teacher 3

opportunities for them to engage in physical activity due to it not being deemed relevant or important. They indicated that the children had various preferences in physical activity and that that should be an individual consideration when developing interventions. (See teacher theme 3) for them.	*"So I think that can vary from almost and I'm using this word in inverted commas, but kind of very lazy look where they start and they sit on a couch all day, right through to very, very busy where they're running and they're up and down and all over the place all day. So I think you've got a spectrum there within itself."-Teacher 5*
	"Definitely not. Even the ones that are really busy or not, they're not getting, I think because it's hard for them."-Teacher 5
	"Other kids like to interact with their peers? Yeah, these kids, you just see them sitting, and not playing with anything at all or not engaging with any activity independent third, it depends on what type of autism and what level."-Teacher 4
	"It depends, You've got, you if you go to an autism specific school and you're look at the playground and you've got some of those kids that are quite active and some that are just standing there."-Teacher 3
	But it should be improved and it should be a major focus for helping them to adapt to the school environment. So I would say that, yeah, it needs to be focused on because it will be improved if it does receive enough focus."-Teacher 1
	I think it can be improved in everyone. First of all, but certainly in this population, because the assumption it seems in most cases is that it is not relevant to them. "Teacher 1
	"No, So I think I also want to start it on the general level. People are not reaching that requirement in general. Right. And I think that individuals with autism are also not reaching that and it's not their fault. It is because the people that are responsible for taking care of them have only folks focused on the social aspect. So we are not given them the opportunity, the opportunities to participate as they would want to or as they would need to in physical activity, so they're not getting as much physical activity as they need, neither are they given the chance to do so".-Teacher 1
	Some do and some don't. some really enjoy outdoor activity or indoor activity, but other they don't , they get bored, especially when its long.- Teacher 4

a) A brain body disconnect and motor cross-over effects

Overview of findings	***Teacher statements***
Teachers indicated that children on the spectrum often had a "brain body disconnect" where if they were given a task often they would want to cognitively (brain) perform the task but that their body would not perform the task (disconnect). Teachers indicated that this could often contribute to them not physically being able to perform motor tasks as they often were not in control of their bodies. They also indicated that in this sense other individuals often perceived them as being naughty or disruptive or having behavioural issues as they did not do what they were being asked to do but that often it was more a matter of them not actually being able to do the activity requested. This also extended into other areas of their lives and teachers reported numerous cross over effects due to reduced motor skills.	*"I think it just it has a lot to do with their impulse control of their body. As I said before, not being in control of their body. You know, their brain says one thing and their body does something else. A lot of Autistics, teenagers, young adults, you know they and this is where we get a lot of our information from they're saying that, you know, my body doesn't do it, or my body's not my friend, that my doesn't do what I want it to do."-Teacher 5*
	"Most definitely, because it affects things like their sitting, and turning the pages in a book, and if you if look at the visual motor side of it- looking from a book to a screen, or a screen to a book, from the teacher to the book, there's so much; and a lot of the research in autism at the moment, especially in the states, is that mind body disconnect-So my brain says one thing and my body does something completely different. And you know, a lot of people see that as, as behaviours, but it's not, they're not always in control of their bodies.-Teacher 3
	What a teacher might be seeing as a you know, the kid being defiant, or the kid being disturbing or the kid not being able to sit still. Maybe it's something that they just not in control of."-Teacher 3
	"I think it's still hard and it's a challenge some days and it's tricky for them to control their bodies."-Teacher 5
	"So they go out into the public and they behave differently on the outside and it's not because they're trying to be different or trying to be difficult or otherwise but it's how their body responds to the environment or whatever is going on inside them as well."-Teacher 5
	"For me, a lot of the behaviour is because they're struggling with their sensory and the motor cortex."-Teacher 5

One area in which motor proficiency plays a large role was reported to be communication. One teacher indicated that in some instances where children on the spectrum had difficulties with communication and were provided with a means to communicate for example teaching them sign language – that in some instances the children were not physically able to make the signs due to their poor motor skills. Therefore motor skills directly compromised their ability to communicate with others.	*"If you look at children who do not speak, they get given Makaton sign language, which is great for some children, but for a lot of our guys that motor planning and that execution of the motor skills is really hard. So they struggle then to make the signs and it's taken as a they don't understand why they can't do it. And it's not a they might not be able to do it, but it's not a case of I don't want to actually physically can't get my bass to make that sign."-Teacher 5*
	"A lot of guys when they get to what we call open communication and start communicating through typing have said that they have a brain body disconnect, and the way to help them is by coaching the body and getting the body to perform motor movements that aren't just automatic, but what we call purposeful movement."-Teacher 5
Teachers reported that often academic time or learning time was reduced because teachers needed to facilitate poor perceptual or motor skills first. In some instances no academic work could be done due to needing to focus on other motor issue first. In other circumstances academic time was lost due the children needing to go for therapy due to their reduced motor skills. One teacher indicated that in some instances children could not move beyond a specific grade or are held back due to reduced motor skills. She indicated that in these instances children often got bored, and did not make any further progress – she indicated that that should be considered in future. Teachers also indicated that reduced motor skills could affect learning and concentration- for example not being able to sit due to reduced core strength could prevent focus and engagement in class. They also indicated that reduced sensory motor skills and being kept back as result of that could make the children bored and less likely to engage further in academic settings.	*"So much time is lost from a child trying to adjust because of the lack of developed perceptual skills."-Teacher 2*
	We didn't even look at academics. The only thing we were doing was perceptual skills. And in those perceptual skills, we had to drill all of these things that I'm talking about, making sure they go on the monkey bars, making sure they go on the jungle gym, go down the fireman's pole. Crossing the midline jump on the on the on the bench from right to left, right to left and right left all the way.-Teacher 2
	"We spend the whole time doing that because it's needed for them to be able to sit down and start writing lines. Because if they don't have that, that strong build up core muscle, how are they going to be able to sit on the chair, even focus? Because when you slouching on the chair, you're going to end up falling asleep and missing out."-Teacher 2
	"And so to speak, in a lack of a better word, that in a class of 20, you could have 11 children going for OT, so even it's taking our academic time because the minute you start your lesson, the therapist is at the door."- Teacher 2
	"So this child has to go out for therapy, so they losing out on the Maths hour, they losing out on the literacy hour, they losing you know what I mean?"-Teacher 2
	"And then also giving more access to appropriate education and not just very basic education. A lot of our guys get, you know, stuck with grade R or grade one education and they don't get moved beyond that. So a lot of them are very, very bored and then a better understanding of that sensory motor condition and not just autistic children are naughty."-Teacher 5
	"Even the tiniest thing of every other child in the classroom has issues with focus and concentrating."-Teacher 2
Teachers indicated that repetitive and restricted behaviour could lead to an individual not readily engaging in motor related tasks or physical activity due to having preference in engaging in their preferred activity.	*But when we when we look at the compulsion for certain things, because one of the things about autism is that there is, you know, this one interest that the person has, that there's this thing that they do all day, every day, and they cannot take their eyes off a certain thing for what it could be an object that they hold in their hand. For another person. It may be the color of clothes they wear, but for whatever it may be, even movement related to the extent where they move their hand in a certain way the whole time , or their foot in in a certain way the whole time. So in cases where you need them to eat more by a certain way that can stand in the way so you can actually affect their mobility.-Teacher 1*
Teachers stated that a lack of motor skills could influence independence and prevent children from doing specific vocational tasks for example dressing, feeding, and being able to go to the bathroom independently. They indicated due to their reduced motor proficiency levels that they required more attention and one on one assistance as well as increased facilitation in the school setting. One teacher indicated that difficulties in performing motor tasks or being able to perform motor task may compromised the individual later on in life in terms of independence and relying on other people to do the tasks for them.	*"He can't even hold the pencil let alone teach himself let alone open his zip, it means that mean that he is facilitated in all areas of his life?"-Teacher 4*
	"So firstly we will see, in what area doe this child need help, whether its basic feeding himself, or in the toilets. Okay, of course we are teaching them to be independent. But these is kids they can't be independent and they depend on you, at school they depend on the teachers, at home it depend on mommy or parent or carer."Teacher 4
	"Something as simple as holding a pencil and writing. You know, how much pressure do I put on it? Have I put enough pressure on it, how do I turn the page? How do I pick up my book? How do I sit on the chair? Do I sit on it too hard? Do I sit on it too soft? How do I get out of my chair and walk towards the door? How do I go downstairs? All of these things that you see in the school setting are part of the motor planning issues."-Teacher 3
	Glad to see how she's gonna cope when she has a child. Probably she will talk because she'll find somebody who can do it. And who's that somebody who will be able to do it is that child that was

	deprived of the good education in the township, but it was exposed to these skills on an ongoing basis. Teacher 2
Teachers indicated that specific motor deficits could influence other motor skills. For example poor balance and vestibular/sensory processing could prevent them from riding a bike.	*"So during physical, physical activity with them, I mean, even something as simple as riding a bike, a lot of our kids don't have the motor planning to ride a bike. The balance, but then that also becomes a sensory thing with their vestibular and the balance."-Teacher 3*

c) General barriers

Overview of findings	***Teacher statements***
Overall teachers believed that there were many barriers individuals on the spectrum experienced toward engaging in physical activity , and one teacher indicated that it was due to not understanding the condition properly, and that if it was understood as more than just being a cognitive or behavioural disability barriers would be considered and understood better too. General barriers the teachers reported were teaching settings, finances and access to resources, therapies interfering with class time, lifestyle, the condition of ASD as a whole leading to exclusion as well as other factors related to exclusion.	*"Communication is obviously a big one, access to education because again, people just see the behaviour and they think that that's all there is to it." Teacher 5* *"So there's so much that that is a barrier for autistic individuals that people are not realizing, and again because we are stuck on seeing it as a cognitive or behavioural disability, and we're not looking past that."-Teacher 5*
Firstly in terms of the teaching environment, teachers indicated that in a government setting where one teacher was responsible for 60 or more children that individualised attentions was not often possible in terms of assisting with motor deficits or emotional support since the teachers where often overwhelmed and just trying to keep up with their own work. On teacher also indicated that it was dependent on teachers or staff whether they were actively involved in activities or not. In terms of the school setting itself one teacher indicated that in some instances the type of school could limit the types of physical activities the teachers could do with the children- for instance she reported that in the smaller schools she was often able to take the children to a park or go for a walk but that she wasn't able to do that in mainstream school settings. in another scenario she explained that she believed that children had become a product in that often activates where put together to demonstrate things for parents that were not necessarily relevant or beneficial for their development. She stated that many hours of class time was often used to put together activities to show off how well he children were doing for example Christmas carol concerts or "the best cricket match". In these instances she stated, that the activities were put together for the parents benefit but that she felt the hours of prepping for the activity often resulted in the loss of certain skills since they were not able to get to them.	*Teaching in a public government school were I had 60 Something children in the class. Do I really care how you're holding your pencil? No, do I really care if your mum and dad were fighting last night? no. Then I'm Also drowning myself. I still have to deal with marking all these 67 books and making sure that you understand the concept and this and that and the pressure from the department saying by this time I need to have covered 12345."-Teacher 2*
	"Well it should do because it's a perfect time to facilitate it, but it all depends on the staff, whether they just stand there and watch or they're actively involved."-Teacher 3
	"So the rest of the time, we were able to sort of go for a walk. We were able to go to parks but that is something that cannot be done in a mainstream school."- Teacher 2
	"Its all about that. And once you come to such environments, like where I am, it becomes a product. Right? So once it becomes a product, yeah, this is where I'm coming to the critical parts now where I'm seeing a need to be politically correct, but what I'm saying the whole environment becomes a business and you're selling a product by the third term or the fourth term, you've got to make the best show for Christmas carols, you've got to do the best show because the parents are gonna look up to that and that and they're wanting to see their child in that."-Teacher 2 *"How much time that they take off academic time.Make sure you produce the best or you what's the word I'm looking for? You put together the best Christmas carols for the grade Rs. You put together the best a cricket match for the grade 2s. You know what I mean? Yeah, it's not. I mean, in the end, that's actually not relevant to the development whatsoever, but it's like it's To show the parents like you say it's like the end product when the main experience."-Teacher 2*
	But I'm just saying yet on the other hand, we are sitting with children who are losing so much skills that we ourselves also say are very valuable skills, but then we take too much time focusing on irrelevant , Yeah, yeah, yeah, yeah. Yeah."-Teacher 2
Teachers reported that one of the biggest barriers for children not being able to improve their motor skills or engage in	*"I barely afford the school fees, but my child needs OT. Then what? I want my child to be here, because I know it's a bright future for my child."-Teacher 2*

physical activity was the cost or financial aspect that these would entail. Teachers indicated that often parents were not able to afford therapies like OT and often families would be reliant on the red cross for assistance. In these cases parents where often on waiting lists or only had access to minimal resources as provided by the Red Cross or other bodies. Teachers reported that some schools did not have therapists part of the school and that when it was advised that children needed occupational therapy for example that parents were not able to afford it. Teachers also indicated that the types of schools and their offerings could also be a barrier for the children in that township schools perhaps only offered one type of extra mural activity while private schools offered many more so the children had more exposure to motor related opportunities. In these instances the teachers reported that there could still be financial implications if the children wanted to participate in other activities that the schools did not offer and often this prevented them from participating since parents were not able to afford this.	*"It depends on all sorts, other kids are getting enough help-OT speech therapists because they have money or they can afford it ,while other kids cant. Like other kids are ,they're depending on Red Cross. And to get the red cross, an appointment, they must go each week-we're so dependent on each families. Teacher 4."-*
	"So it comes down to being able to get the resources and also their finances"-Teacher 4
	"As you see come costly, not parent, not anybody can afford it now."-Teacher 4
	"But now I get told over and above the OT might your child is going to I mean, I mean being at this type of school, your child is going to need OT and I can afford it because I've got to pay what 400 500 Rand for 30 minutes. I don't have, twice a week. That's 1000 Rand a week. I don't have it."- Teacher 2
	"And, and the fact that if you're not in a Township School, you only may be just exposed athletics, right. And because there's no resources and if you're in your private school, you are exposed to cricket, hockey. Ballet gymnastics but extra still, parents have to pay extra for those things. And it becomes sort of a financial issue as well."- Teacher 2
	"Over and above that. Every afternoon. There's a company that comes in, which is outsourced. If you want your child to do more cricket, you've got to pay for that. If you want your child to donate, or you've got to pay for that if you want your child to do karate, you've got to pay for that. You know what I mean?"-Teacher 2
	"But in the new ages way it's very critical as well it's outsourced and that brings financial implications to it."-Teacher 2
	"Yeah, it's an extra cost on top of that extra enormous amount of money that they are paying for school fees."- Teacher 2
Following on, teachers also indicated that a lack of access to resources was also a barrier for the children. Teachers believed that those not getting any professional help with regards to having access to doctor, nurses or appropriate education could hinder their progress. One teacher indicated that she had seen the big gap between the children's development between those who had access and were regularly getting the therapies they needed as compared to those who were "just living and growing". One teacher also indicated that physical resources needed in the classroom or teaching was also a problem – she indicated that having access to more resources could assist the teachers with carrying out better classroom activities and assist with teaching the children in a more visual manner.	*Firstly they will need professional help, doctors, nurse, educations, appointment following and then at home or at school we take after that. Firstly we take from the professional what is needed for the Teacher 4*
	So just with after the challenges the child is just living normal lives, not getting any professional help. And we see when they grow there is a big difference , a big gap. Teacher 4
	The other kids, you will see other kids will never see OT in his whole life. He never see a speech therapist. It's mean is just living and growing. Teacher 4
	So just with after the challenges the child is just living normal lives, not getting any professional help. And we see when they grow there is a big difference , a big gap. Teacher 4
	I will say resources, yes like the most important things- they learn through resources through stuff through numbers, letters buzzer so if needed, really, they are more about visions, particularly they're more about visions. Teacher 4
	To make their lives easier we say we need professional help. Teacher 4
	we need a sponsor someone to sponsor is to pay those doctors to pay those expert to pay those people to help the kids to come to the school? Teacher 4
	Yeah, and the support services and everything is so much better. I mean, it's not always better but the parents have access to respite they have access to transport they have access to if the kids need nappies, if they need one on one support at school. Ya It is better. Teacher 3
	Well, I'll take it back to my own experience of myself and the people that are born in my generation. Okay. Yeah. So, so we we never had opportunities to go for either physio or occupational therapy to correct pencil grip or to strengthen, fine motor muscles and things like that. Were just taught how to hold the pencil and get on with it. Yeah. Teacher 2
On the other hand teachers indicated that overly frequent amounts of therapy could also hinder the children's academic performance where by a child needing to go for OT 5 times in a week in a school setting would mean five hours of academic time was lost. They also indicated that often this was very disruptive to teaching.	*The frequency of teaching them. Yeah, I've never heard of a child going to OT 5 days a week."- Teacher 2*
	"It's taking our academic time because the minute you start your lesson, the therapist is at the door."- Teacher 2

Teachers believed that lifestyle was a large barrier towards children having being motor proficient or participating in enough physical activity. One of the issues teachers mentioned was that often there was no reinforcement of improving motor skills when the children went home. They indicated that in the past engaging in basic tasks and playing with others allowed for motor skills to be practiced incidentally but since children where no longer participating in these activities that motor sills now needed to be taught. Techers believed that there was a contrast between children who had high and low socioeconomic status. One teacher believed that children with a higher socio economic status and who lived in urbanized areas often were encouraged and often enabled to be sedentary where they were made to sit in front of the television or iPad and motor related tasks like making food, carrying plates or running a bath was all done for them. The teacher also indicated that by performing tasks for the children that they were slowly losing their ability to be independent. She believed, that in contrast the children in the townships were playing on the streets and performing tasks of daily activity that assisted in improving their motor skills (e.g washing socks) since they were practicing them more often. Specifically teachers believed that in general lifestyle was not supporting development. Examples including not being able to play outside due to safety concerns or neighbors complaining as children were too loud , being driven to school versus walking, and not doing chores (hanging washing, polishing shoes, going to the shop) where some of the examples provided by the teachers supporting this idea. One teacher also indicate that she no longer observed children on the playground playing traditional games that required motor skills and thus these skills were not being facilitated in those scenarios either. Teachers indicated that not practicing motor skills due to these lifestyle issues often meant that motor skills needed to be practiced in the school setting which resulted in other issues.	*So I'm talking about when they go home, they aren't involved in any activities that will facilitate what they are learning to use those fine motor muscles to use those crossovers with gross motor muscles. They go home they sit down, the plate is put in front of them and the water is run for them and this and that you go back into the township, the very same children very same age group. You see them on the streets, running around, playing hopscotch, playing these, climbing trees, playing with the you know that game you play with the wheel where you put one booth on the side and the other one or the side , isn't that bilateral integration?."-Teacher 2* *Even at play time, the games that are being played at play time, like when I was at school during play time, the games we used to play with so many different games, even those traditional games are lost. Tell me about you know, when you put the stones down in a circle and you throw one up and you drag the stones, isn't that hand eye coordination. Have you ever seen any child's playing that these days no."-Teacher 2* *Our lifestyle was also having an effect in supporting in our development, besides being put into OT, the fact that you were playing outside, we get exposed to building up those muscles early In our in our, in our, in our, in our in our in our stages of development."-Teacher 2* *"People believe too much in witchcraft. So with most parents, it's like they don't actually believe in autism"-Teacher 6* *There's no other way was a sense of independence, right? We were teaching them like you say to wash their own socks. Were now everything is done for them. So there is no need to do that but in in not learning that they losing their independence or they not."-Teacher 2* *"This is the lifestyle that we are living. I personally cannot send my child to go and play the tire on the streets. I can't , safety doesn't allow the kind of environment where I live in it's in a complex it's not allowed even then playing outside sometimes. You'll hear other neighbors complaining you making noise you know, not allowed so what am I going to do with her she has to come back home, sit in front of the TV and be, or read a book or whatever."-Teacher 2* *They not been picked up by a car, or any improper by a car and they still get the chance to go and play with friends after school. Incidentally, they also getting this activity in the day.Teacher 2* *You sort of like incidentally learned to move the tire by using both of your hands at the same time. So I'm thinking, what is it? What is it? So that is why if my child gets diagnosed with an OT issue, as mentioned, and they go once a week for therapy, but then they come home and they sit in front of the TV. I'm not even asking them to wash the dishes to polish their shoes because that's where you get all that practice of using those muscles. You know what I mean? Reinforce and strengthen the muscles. Somebody's going to polish the shoes for her someone is going to wash for her, so when are those muscles going to spread and become strong and be able to, to sort of be stimulated when she goes back to OT the next week in the next week and the next week in the next week."-Teacher 2* *You've got to hang the washing on a high line. You've got to run to the shop, you've got to climb a tree to get fruit in whatever from the tree, all of those things. So if these children are not exposed to those skills, then they've got to be taught. Teacher 2* *So previously, going back to saying you used to get all of those skills incidentally from the skills from the activities and tasks that you would be doing around at home throughout the year, throughout the month throughout the week. Teacher 2* *"So you take your child to OT because you want to address these issues. But when they go home, there's nothing to reinforce the skills that they're learning in, in OT, incidentally."-Teacher 2* *So the only way now that they would learn them is by being taught. We learnt them because you had to come back home and wash your socks. You've got to apply soap on a sock. You've got to you've got to rub the sock in between your hands. You know, that's a skill that's teaching and scraping your muscles."-Teacher 2* *Because I keep going back to the fact that we can change the era we cant change the times that we live in, we cant change the environments that we stay in that we reside in. So now, most of the time that has to be utilized unfortunately it is at school"-Teacher 2* *"But now, still being a person who lives in the township and grew up there and keep going back there I'm looking at these different lifestyles and the children coping up until grade 12 without getting the therapies. The lifestyle that these children go through in their development from early*

	years all the way up to matric and our children in private schools or previously model C schools and their lifestyles back home. I think there's a lot of impacts that is caused by the lifestyle."- Teacher 2
On teacher indicated that another barrier for children may be the condition of ASD itself , where it was important that children should not be limited by their level of impairment but rather should be encouraged to engage with others and activities as much as possible and that there should not be a preconceived idea that they should be limited due to their impairments.	*"Then you have these kids, they are getting teaching, they're learning, there playing with other kids, it's very important. So not to be limited the level themselves. I mean, that the spectrum they find themselves in."-Teacher 4*
Teachers reported that another barrier was exclusion where individuals on the spectrum are often excluded from participating in activities because if their condition which in turn does not facilitate the improvement of motor skill proficiency. One teacher indicated that in general in South Africa policy as well as practice was not including of students with disabilities which included individuals on the spectrum. One teacher also believed that the motor proficiency of the individual could lead to them being excluded from engaging in sports as well as the individual not being interested in sport itself. It was believed that often in instances where an individual was not interested in engaging in a specific sport that no accommodation was made for them to have an opportunity to engage in a different activity. Lastly, it was believed that in some instances children are limited by the teachers themselves in that they are worried the child may get scared or that the activity may cause harm to the individual – this leads to exclusion of the individual from participating in certain activities.	*"So when we talk about the inclusion of students with disabilities, it's not common in terms of policy in South Africa, it's not common in terms of you know, practice itself."-Teacher 1*
	"And the first thing that comes to mind for me is sports. Right? Because if if the proficiency of a person to move is compromised, so there are certain sports that they cannot be involved in now, if they have an interest that's going to actually limit them so I would say that yes, we definitely need to up our game in that respect."-Teacher 1
	"Because if others are playing football, it seems that the, you know, the one with autism is not really interested in football, so they wouldn't give another activity such as you know, playing chess you can play chess while others play football."-Teacher 1
	Now, I don't want to and this is also you know, the way that I think that the education system and setting individual teachers can actually limit the children because once you know, oh, this child has autism, so let's not make them run around because if they, you know, connection to someone while running may, you know, cause them all this harm and they may be scared.Teacher 1

Theme 3: Individual considerations- "You don't stop being autistic"

Overview of findings	***Teacher statements***
Overall the teachers believed that there were many individual considerations that should be considered for implanting a model of care for improving motor proficiency and physical activity levels. Overall, they believed that considering implementation throughout an individual's life was imperative since people on the spectrum "don't stop being autistic" and that implementation should be holistic and should facilitate support and the need for assistance at all times it is needed. One teacher believed that although children needed to meet certain goals there were numerous factors that teachers and other therapists were not considerenting. Teachers reported that the following things should be considered in terms of the programme or intervention: being variable and flexible, frequency, intensity, time and type, supervision and instruction needed to guide the programme, making it fun and interesting, implementing it as part of the children's routine,	*"Yeah, you don't you don't stop being autistic. So because you don't stop being autistic. Then you have to be able to receive the assistance that you need at every time that you are autistic, which is all the time. So, yeah, it needs to be a holistic approach and certainly one that spans the whole lifespan of a person."- Teacher 1*
	"They need the aid almost every time of the lives."-Teacher 4
	"You need to meet certain goals but there's so many other influencing factors that we're not actually considering."-Teacher 2

They also believed it was important to consider the level of impairment, physical activity preferences, motivation and lifestyle of the individual. Teachers believed considering the environments, socioeconomic status of the family as well as facilitating the understanding rational behind the intervention or programme would be important to consider.	
In terms of variability teachers indicated that developing individualised programmes that were tailored to the needs of the individual needed to be considered. They indicated accommodating specific dislikes and likes as well as considering levels of impairment was necessary. They indicated that the model needed to be adaptable due to the high variability between individuals on the spectrum. They indicated that things like emotional understanding, proprioceptive and interceptive ability , social skills , egocentricity, being verbal or non-verbal, as well as other impairments would need to be considered. At the same time teachers believed that although these deficits needed to be considered that those implanting the programmes should be careful not to limit the individuals based on their impairments.	*"So I think again, that depends very much on each individual. You know, I think some kids are going to need more intensive physical programmes versus others who won't need as intensive stuff depending on them as an individual. So some of the kids have great core muscles, but others really don't. And then I think you're going to have to look at very individualised programmes."- Teacher 5*
	"So you need to find out which activity they dislike so that we mix activity. This other child doesn't like to touch anything, like foam, not soap, like water, nothing. This child like more jumping , so its just means that you have to accommodate each child certain needs when it comes to activity and games."-Teacher 4
	"My concern would be is how adaptable could the model be right? Because we're talking about autism which is a disorder that is very dynamic, right? The levels of intensity that exist in in people that are affected with autism is quite broad, it's quite wide"-. Teacher 1
	"Now the question therefore would be, will a model be one that is only applicable and able to help in terms of mild, you know, forms of autism, or what if it's on the extreme side? So if it is adaptable enough, then I think that definitely that will be able to help everyone or as many people as possible, right."-Teacher 1
	It depends on the interoception and their proprioceptive and their vestibular, and stuff like that .Teacher 3
	So because it affects the brain in a way that for example, they become very egocentric, right? They're not able to understand the emotions of other people."-Teacher 1
	We are saying there's a social aspect, but there's also a physical aspect, but the mix of the two can actually be quite hectic because if, for example, we consider that you know, people with autism normally have this compulsive."-Teacher 1
	"There is class that takes only nonverbal kids and non active kids have their own class and then they're helping them according to their needs, according to the level of physio. Then you have these kids, they are getting teaching, theyre learning, there playing with other kids, its very important. So not to be limited the level themselves. I mean, that the spectrum they find themselves in."-Teacher 4
In terms of an exercise based programme or intervention, teachers indicated types of activities needed to be considered for example whether exercise should be used to calm the individual or get their heart rate up. They believed considering how the programme should be taught in terms of learning style as they indicate that children were not only visual learners but also auditory and kinesthetic learners. They reported that type of moment should be considered where by individuals should identify whether they are able to do automatic moments versus purposeful moments and if assistance is needed in performing those activities. One teacher indicate that ASD should be considered in terms of sensory and motor aspects as well as implementing programmes to include the performance of daily activities so that they can be more independent. In terms of frequency teachers believed that engagement in physical activities was	*So if you think of something like swinging, swinging is quite a calming activity. So that would then go against what they say because it's, you know, it's not really a get that heartbeat up, it's more a get that heartbeat down."-Teacher 3*
	A lot of people think that autistic individuals are all visual learners, and to some degree, yes, they are, but they're also Auditory and Kinesthetic learners. Teacher 5
	The balance, but then that also becomes a sensory thing with their vestibular and the balance. But you know, not pushing it on certain kids because for them the physical activity might actually be hurtful. Teacher 3
	I think for me, one of the biggest areas is looking at what is automatic movement versus what is intentional or purposeful movement."Teacher 5
	but also, more focus on the disability from a sensory and motor perspective.Teacher 5
	I think you could look at activities of daily living because a lot of them because a lot of them struggle with that. And even though we are giving access to communication, if you can't do those basic activities of daily living, then you're not going to be independent.Teacher 5
	You see, the frequency as well is just not enough. So that is why you find a child going to OT for three years, four years, because actually it is needed the only time they get exposed to a swing

not enough and that this needed to be considered in terms of implementation since those engaging in more activity developed better. One teacher stated that effectiveness needed to be considered since improving frequency did not necessarily automatically mean it would be effective.	*you know, for the proprioceptive or orbody in space feeling whereas we used to get that from clubbing into cheese every day of the school.Teacher 2*
	Yes , it is, the same kids that you know, the kids who attending everything. Like there was a child I used teach, who - two years ago –so she was the only child, a three years old child. She's was doing OT and speech therapist twice a week. On Monday, she would see OT, and Thursday she would see speech therapist, it means that child is advanced more than other kids.Teacher 4
	What is worrying me right now is how does this, How does it happen? That these children that's been diagnosed as double R or R and they attend the OT for two to three years and still the same thing doesn't get sorted out.Teacher 2
	I'm having issues with being on therapy to address these issues and not seeing results.Teacher 2
Teachers stated that it physical activity programmes should be integrated as part of the children's routine or part of their after mural school activities.	
	"Oh, yeah, no, it should be should be part of their daily programme. Okay."-Teacher 5
	"Okay, so why can't it be on Monday? They all do to cricket on Tuesday, they all do rugby on Wednesday. You know They now it's just part of their week"-.Teacher 2
Teachers reported that considering individual activity preferences would be very important. They also believed that considering sensory barriers could influence their preferences and that that needed to be considered. Once again they indicate that the model should facilitate variability within the children's preferences. They also reported that resource availability to accommodate preferences needed to be considered. Overall teachers provided some information on what they had observed children to enjoy and also what they seemed to dislike. In terms of likes they reported children enjoyed automatic activities, indoor activities , dancing, hoola hooping, jumping, trampoline, cycling, running, swimming and sliding. In terms of dislikes they reported contact body sports, activities that required a lot of mobility and activities that activated their sensory triggers as activities the children didn't want to engage in. Overall however these likes and dislikes were child dependent.	*"when the motor gets slightly harder, so for example, riding a bike, that's where I think the breakdown comes in and they don't enjoy it so much because it's harder to do. So when it's an easy action. Then it's then it's enjoyable."- Teacher 5*
	"We put a shaving cream ,men's shaving cream, in a basin or in a tray, plastic tray. So you will put the foam there , for them to touch it, its like soft in between their fingers – others like but other find it very dirty, they don't like it. Like I say it depends on the kids."-Teacher 4
	"So you need to find some things in between. Like what do we like? The first thing is to know the kids needs and then cater after their needs."-Teacher 4
	"He doesn't like to touch, like there is an activity- a motor skill activity with fingers an activity with fingers. We use a shaving cream."-Teacher 4
	"We put a shaving cream ,men's shaving cream, in a basin or in a tray, plastic tray. So you will put the foam there , for them to touch it, its like soft in between their fingers – others like but other find it very dirty, they don't like it. Like I say it depends on the kids."-Teacher 4
	Y"es, we have a resource we use. Okay, we we use hoola hoop, we have like a gate, we use let's open the open the gate and the child tries to try to run from the back."-Teacher 4
	If it's enjoyment, kind of the very automatic stuff. So like dancing when they can start jumping and then just continue jumping. That's a big one. For some of them, it's raining or spinning. A lot of them really, really seem to enjoy swimming. And I think that's a sensory aspect to, to that one."-Teacher 5
	"Lets say in the park, they like jumping, let's say the park , sliding, jumping and is in other things more difficult …Yeah, trampoline."-Teacher 4
	"Okay. So the whole body is moving, -jumping and everything, throwing, its like they love trampoline a lot."-Teacher 4
	"Okay, and then what have you noticed that they don't like? *Contact, body contacts. They hate Body contact."-Teacher 4*
	"You know, kids that love running kids that love cycling, kids that love swimming, kids that love playing soccer, kids that love playing rugby."-Teacher 3
	"But in terms of the kids preferences, at least what I was getting from that from the teachers was that most of them prefer things that are indoors and do not include a lot of movements. So they would rather play chess they'd rather be on their phone or something, but yet they seem to avoid things that have intense mobility attached to them."-Teacher 1
Overall teachers believed that children on the spectrum needed a lot more attention than other children and that therefore supervision needed to be considered. They also believed that they require more instructions since they sometimes struggled to understand instructions. They indicated that repeating instructions as well as allowing for	*"They need more attention than other kids.Teacher 4* *So it means we are doing everything for him. It shouldn't, so child needs more care*
	"So a lot of our guys can engage in very automatic movements such as running or jumping on a trampoline or staying in a swimming pool. But when it comes to giving them specific instructions to complete something, or to do something, that's where the breakdown is happening."-Teacher 5

more practice time would assist individuals complete tasks. Lastly they believed that supervision should entail observing quality of the movements they are performing and not just whether they are meeting milestones. They reported environment and setting should be considered for example avoiding noise and bright lights.	*S"o if it's a movement that's been practiced over and over again, and it's become automatic, that's fine. As soon as it's a new movement that we've got to start teaching them, that's where the difficulty is coming in. So it's that difficulty getting the instruction to go from the brain to the body, if that makes sense in some way."-Teacher 5*
	Sure, they might be able to do it automatically, but when that instruction is given, how are they able to do? So you know, yes, they might have movement and I think a lot of the time people think all autistic children meet their developmental milestones often, but we don't look at how they're moving."-Teacher 5
	"Firstly you need to divide them by verbal or non verbal kids. "-Teacher 4
	"You need to avoid noise as well as noise and some are funny with the lights."-Teacher 4
Overall teacher indicted that strategies, intervention and programmes should strive to make exercising and engaging in physical activity fun and interesting and that programmes should not be long and drawn out as it may reduce interest and motivation. One teacher believed that because trying to get children to exercise is difficult that often people give up and that motivating these people would be important to consider.	*Body, ah, we put music dancing, jumping through the music to make it fun. We are doing activity but through fun activity."-Teacher 4*
	but other they don't , they get bored, especially when its long."-Teacher 4
	"So to make it more interesting, we used to keep it short in ECD.We used to keep it short and it tend to work for them because if it's too long, it will be bored. And lose interest easily on that. We need to make it fun but short."-Teacher 4
	"We don't We then don't focus on movements and exercise with them. And I think also because it's hard, so a lot of people kind of give up."- Teacher 5
Teachers believed that the programme or intervention would need to consider breaking down moments and trying to get children to understand how to carry out movements instead of just being prescriptive in terms of telling them what to do.	*"Looking at kind of coaching them through something, so it's not just about telling them, but about coaching them through like how to complete a task, how to complete a worksheet, especially if you're looking at things like you know, the sciences with the experiments, or the PE classes or the playground or anything like that. The kids would need help on how to motor their way through those activities."-Teacher 3*
	A lot of guys when they get to what we call open communication and start communicating through typing have said that they have a brain body disconnect, and the way to help them is by coaching the body and getting the body to perform motor movements that aren't just automatic, but what we call purposeful movement. So by focusing on helping them learn specific movements, so that they become automatic, and it's basically movements that we think of as automatic that they can do, so that they can engage in those movements."-Teacher 5
	"You know, for example, like a star jump, if you went into those thoughts and breaking that movement down into basic steps so that they can continue to it and then you put them all together to then complete that step. But you can take it a step further and look at like activities of daily living, how do you wash dishes, breaking that down into motor movements, that you then encourage their body in order to do it. So I think motor programmes are very, very beneficial. And important. Thank you. I think that answered your question."-Teacher 5
In terms of socio economic, emotional and interpersonal factors teachers believed that all areas of the child's context should be considers as well as other general life stressors for example moving house, family breakups or deaths in the family since those could interfere with the ability to cope with certain daily tasks. Teachers believed that in these instances that having realistic expectations of the child's ability to cope and engage with certain activities is needed.	*I, I think also with the era that we've just come from and going back again to the lifestyle where there's lots of break up in families and movement happening quite frequently changed basically, I really think that we are expecting too much out of these children when they have to deal with a lot of emotional as well. Things that we don't take note of, you know, when it is said that the three most traumatic things in life are death, divorce and moving. How often is parents do we move from one place to another and we just feel like our kids are just gonna cope with it. And because they're smiling, they're happy they found their own room in the new house and we just think it's, it comes naturally for them to be able to settle in and cope. And you just mentioned it in passing to the teacher. Oh, no, we've just moved houses. Just check on her if she's okay, she's fine. The in-depth of that, move, that change, that transfusion. We are never sure how much it does to a child's life. The most important thing she needs to sound out all the sounds, but what about the fact that she is dealing with the fact that the dad is not present in her life as well? Teacher 2*
	And then the social side of your physical activity or physical sports, obviously, that then can also become a problem. You know, especially when you do teams and you've got a friend that's on the other team. I'm going to kick the ball to my friend because he's my friend. I don't understand the rules behind the sport."-Teacher 3

Teachers believed that an important consideration overall was that interventions, therapies or programmes needed to be carried out in a holistic manner , in a multidisciplinary way where regular feedback was exchanged on how the child was doing. One teacher believed that there seemed to be a division of responsibilities and that often deficits were overlooked because of this. The teacher indicated that a multidisciplinary approach would be highly beneficial to people on the spectrum	*Another thing also on the management aspect is that they there seems to be division of responsibilities to the person with autism in South Africa, rather than a collaboration of efforts. So if the problem has to do with anxiety in a school situation, you send the child to the school psychologist in the school psychologist will deal with the child alone, right? Teacher 1*
	Anything to do with, you know, physical activity. Of course, you're going to send the child to the PE teacher, but it seems that there isn't a proper collaboration to say, Okay, I'm an OT. You are a psychologist. You are a PE teacher. What can we do together? But it's rather than Okay, me as a PE teacher, I have failed to help this child. I'm going to pass them over to the next person, which is a psychologist and then after that, they can go to the O T. There isn't really any form of engagement where all are present and all are working together."-Teacher 1
	also inclusive of different professionals, imagine the impact that can have if different professionals, the teacher, the psychologist, occupational therapist, and psychologist, I actually included in the model of care, then certainly that will benefit the person with autism"-.Teacher 1
	"so other professionals that are actually you know, relevant in the life of this person with autism needs to be need to be brought into into the knowledge of, you know, where this person is, how they function and how they can actually help them."-Teacher 1
	Anything to do with, you know, physical activity. Of course, you're going to send the child to the PE teacher, but it seems that there isn't a proper collaboration to say, Okay, I'm an OT. You are a psychologist. You are a PE teacher. What can we do together? But it's rather than Okay, me as a PE teacher, I have failed to help this child. I'm going to pass them over to the next person, which is a psychologist and then after that, they can go to the O T. There isn't really any form of engagement where all are present and all are working together. Teacher 1

Theme 4: Education and training: "We need experts"

Overview of findings	***Teacher statements***
Overall teachers believed that there was a need for improved education regarding ASD as well as improved education regarding the benefits of physical activity and the need for having good motor proficiency levels. Teachers believed that overall people had a limited understanding of Autism and that even though over time understanding the condition had improved there is still a lot of education that is needed. It was believed that professional often had an outdated understanding based on what they had been taught previously or believed certain inaccuracies for example one teacher indicated that she felt professional belied that in instances where children could not move or speak correctly that sometimes people automatically believed the child was not understanding an instruction while it could be due to something else (i.e. the brain body disconnect). One teacher also indicated that previously treatments and strategies were often based on theory or people perceptions yes in more recent times there is more advocacy and information coming from individuals on the spectrum regarding motor planning and that that needs to be considered. She stated that more information needs to be gathered from people on the spectrum themselves since they were the experts on autism and that educating individuals on the spectrum was also important. In addition she stated that	*So I think our understanding is still very limited in autism. I think we've come a hell of a long way from even three years ago, but I do think our understanding is still very limited Teacher 5*
	The informing processes is quite important, I would say."-Teacher 1
	An understanding of the motor planning issues is relatively something new.-Teacher 3
	And I think because we don't have that knowledge. So again, going back to we see autism as something that you know, we are perceiving it again, as that cognitive or that lbehavioural difficulty. We're not looking at it from a motor perspective."-Teacher 5
	I think parental involvement is something that I think would actually be quite helpful to the model of care because what you see is that, you know, most of the time, parents are detached from the process of education, educating their child with autism, and certainly even you know, in their training in physical activity, where in most cases in the parents mind, it's just okay."-Teacher 1
	Why? Is the solution something that has to do with little or no movement? There is There isn't really research to support that to say give them as little movement as possible."-Teacher 1
	I think again, it goes back to what professionals have previously taught and to the understanding that we have of autism based on the dominant research in that we believe because a child can't speak or can't move appropriately, that they don't understand when they do understand. Teacher 5
	You know, we've got a lot of kids coming through. A lot of teenagers a lot of adults telling us about their motor planning where before there wasn't. We didn't have a lot of advocacy by autistic adults, autistic teenagers. So it was more done on theory and other people's perceptions. Teacher 3
	Were now you know, we tend to be more I don't know about other people, but I tend to seek the guidance of my autistic teenagers , my autistic adults Especially when I'm working with the younger kids, I asked them, you know, what was it like for you? And how do you think I should do this? So using, they're experts on autism, so using them, and I think before they there wasn't, and I saw, I

more individuals helping people of the spectrum should seek the guidance of those on the spectrum. One teacher believed that at present she felt that the understanding of autism was very much related to cognitive and behaviourbehaviouralbehavioural deficits and that she believed it should be understood in a different way – in terms of it being a sensory motor disorder instead. Teachers indicated that they believed educating parents specifically on being able to educate their children about physical activity as well as on physical activity itself was important as they believed that parents were detached from teaching their children the benefit of exercise and in some instances did not know if their children where performing adequate physical activity or engaging in enough motor related activity. It was believed that the model needed to change the perspective of only having interventions as an additional strategy but rather reeducating on the idea of integrating motor skills and reinforcing them on a day to day basis instead. Teachers indicated that a lack of understanding of the condition could limit the progress of children in that they could be excluded from activities due preconceived barriers. Teachers also indicated that access to education was needed and that was an important area that needed to be improved.	*think autism when you look at education it's still a new thing. Education for autistic individuals is still a new thing."-Teacher 3* *And then you and then things started changing and then research came up in education and even understanding about the fact that things like fine motor skills can be addressed by going into OT, there is thumb wrap , there is tripod grip, there is this and that . Teacher 2* *"For example, what I was saying is these models could change the perspective of having these people that are trained to reinforce and develop the skills to run these models or to run these programmes in isolation of the school. It will become so much better maybe, I don't know."-Teacher 2* *"Now, I don't want to and this is also you know, the way that I think that the education system and setting individual teachers can actually limit the children because once you know, oh, this child has autism, so let's not make them run around because if they, you know, connection to someone while running may, you know, cause them all this harm and they may be scared."-Teacher 1* *"I think we need to really consider communication access which we don't. So a lot of our schools forget about the communication side, which is a human right. I think there needs to be a better holistic view of autistic education."- Teacher 5* *"Access to education"-Teacher 5* *"Read any article about you know, students with autism read any article about people with autism.And functioning in society or whatever. It's always focused on, they were not able to communicate, now they can communicate. I have rarely ever seen anything that says, well, that person was not allowed to move or play sports or exercise, but now they can after you know certain experts have been helping them. So we are not given them the opportunity, the opportunities to participate as they would want to or as they would need to in physical activity, so they're not getting as much physical activity as they need, neither are they given the chance to do so."-Teacher 1*
Teachers believed that in general in South Africa in people had a poor understanding of neurodevelopmental disabilities. Teachers believed that there was a need for further research to advance the knowledge and understanding of autism so that when deficits where observed that individuals could seek out appropriate therapies or assistance to improve their lives.	*So realizing that in the South African context is, you know, neurodevelopmental disabilities, very, very much not known by your average South African, right Teacher 1* *But what you can do for yourself as a researcher, and other researchers as well, is to make sure that the knowledge gets advanced. I think that's the best thing that you know, would actually set the ground for the development of a model at all that we need to make sure that as many people as possible know about autism spectrum disorder, so that they can be able to see the symptoms and then when they do they can be able to seek help. Teacher 1-*
In terms of training teachers believed that there was a need to improve training for individual to work with children on the spectrum. One teacher indicated that in some instances implementation of programmes was based on trial and error due to lack of training or information access. Another teacher indicated that she had improved her skills due to collaborating with other professionals as well as individuals on the spectrum and that she didn't have any training on special needs individual when she was training to be a teacher. They believed improved training was necessary as individuals on the spectrum were not only in remedial schools but that there were many in mainstream schools and teachers found it difficult to assist them due to a lack of training.	*"I'm not sure what plan they follow. I think it's sort of like a trial and error."-Teacher 3* *As I say there is a book we follow? Okay.And there is a workshop we attend, like we is like we tend toplay to to renew our knowledge through workshopsWe do it online with expert to show us what to do.* *We do it often yeah we do it often wherever there is workshop we attended. But um How do you find out about the workshops?Teacher 4* *"So basically, that's something I've just learnt on the job and learning with my in collaboration with OTs and other professionals and also from the Autistics themselves. If I think about my teacher training way back, we didn't even do special needs in my teacher training."-Teacher 3* *Definitely, because if you look at the incidence of kids on the spectrum, you know, they're not just in our special schools, our specific learning difficulty schools or our remedial schools, they're in our mainstream schools, and those teachers find these kids are the hardest because they've got no background on ASD at all. So ya, their definitely has to be a lot more in teacher training."-Teacher 3*

One teacher believed that training should include training on how to assist individuals who are struggling with specific deficits (e.g. speech, motor , auditory processing) so that they could assist them at a basic level in a classroom setting instead of being dependent on other professionals. Overall teachers believed that teachers should be upskilled so that they were able to teach all children whether they were neurotypical or not.	*"And I think teachers need to be trained in their training programmes as well. So why do you have been trained in pedagogy, pedagogy and didactics and whatever. Also get a training of when you come across a child who's struggling with speech, what do you do auditory processing, what do you do? Fine Motor Skills. What What exactly do you do like a module? That's that's giving the basic meaning of what they could apply in class rather than saying, Okay, I've observed that you can hold the pencil go to OT observe that you can or you can claim a monkey bar go to OT that makes it because that is that is what is happening now."-Teacher 2*
	Rather than every teacher must be able to do to teach any any child because that's the kind of education system that has been legislated in South Africa. It's an inclusive system, where special schools are going to end up being phased out or reduced, as it is put so it is important to make sure that teacher training itself, we raise and we raise awareness on teachers themselves, but also so it's also dependent on departmental collaboration you have that the Department of Social Development, that's a very crucial department in terms of, you know, teaching people about, you know, things that are affected because it has far reaching abilities. Teacher 1
	"So, a couple of years ago, I attended something called spelling to communicate training, which opened up my eyes to just how important the motor as big for its autism is."-Teacher 5
One teacher believed that better training needed be implemented at university level. Since after they had complete they degree they could take their knowledge an implant it into various teaching settings .	*So there are different stakeholders, but the first and I think the most effective would be the universities, why universities because universities train teachers, right? So whatever you know, level, that teacher is gonna go to whatever school they're gonna go to, wherever they learnt at university comes in handy, right?*

Theme 6 : A curriculum disconnect: Disconnecting child and teacher needs

Overview of findings	***Teacher statements***
Overall teachers believed that the teaching curriculum does not always meet the needs of the children and in some instances does not meet the needs of the teachers. Teachers believed that there was need for curriculum review specifically in terms of integrating more motor related activities into the curriculum. Teachers believed that therapies and interventions should be included in the curriculum as apposed being done in isolation – in that way costs would be reduced for parents and children would have greater access to the therapies they may need. They indicate that these strategies should be seen as standard practice as opposed to additional things children should be engaged in. It was also stated that reviewing access to specific sports could also assist in children being able to learn more incidental skills. Teachers stated that therapies should be reviewed to make sure they are implemented to benefit the children. One teacher believed that there should be improved communication access which is a basic human right as well as improved ASD specific education in schools. Teachers believed education should be appropriate and not just basic. They believed that reviewing the curriculum to meet the needs of the children there would not be instances where children are being prevented from progressing through grades based on general curriculum rules.	*And and they need to be part of the curriculum rather than being done in isolation. Teacher 2*
	Why can't these people be integrated into the curriculum? So that's a standard sort of practice."-Teacher 2
	I think we need to really consider communication access which we don't. So a lot of our schools forget about the communication side, which is a human right. I think there needs to be a better holistic view of autistic education."-Teacher 5
	So I guess in my opinion, is that II these therapies are to benefit the children, because now we can look back, this is where we are. This is where we are. Teacher 2
	"And then also giving more access to appropriate education and not just very basic education. A lot of our guys get, you know, stuck with grade R or grade one education and they don't get moved beyond that. So a lot of them are very, very bored and then a better understanding of that sensory motor condition and not just autistic children are naughty."-Teacher 5
	But the kind of sports that is being done now. I'm not sure how much of it is is actually helping to facilitate in the development of these skills. Teacher 2
	"What is it that the curriculum is doing? To make sure avoid ive ben in grade R for seven years? And believe me, for the first time, hold him. We didn't even look at academics. The only thing we were doing was perceptual skills. And in those perceptual skills, we had to drill all of these things that I'm talking about, making sure they go on the monkey bars, making sure they go on the jungle gym, go down the fireman's pole. crossing the midline jump on the on the on the bench from right to left, right to left and right left all the way. And we spend the whole time doing that because it's needed for them to be able to sit down and start writing lines. Because if they don't have that, that strong build up core muscle, how are they going to be able to sit on the chair, even focus? Because when you slouching on the chair, you're going to end up falling asleep and missing out."-Teacher 2

For example one teacher stated that if children were not able to write lines they were held back from the next grade and because of that so much focus was put on this singular skill that other skills were remiss. In other instances teachers would need to focus on skills like core strength so that a child would be able to sit in a chair or be able to concentrate which would mean academic time was lost. They stated that often children are held back which in turn makes them bored or complacent and that in these cases not much is being done to facilitate the development of their lacking skills.	
Teachers believed that often curriculum activities where being conducted for the wrong reason while relevant skills were being discarded. They also indicated that there were very stringent timeframes dictated by the curriculum that would create a lot of frustration for teachers to push children to get to specific targets while they believed other more important needs of the children were not being met.	*In our in our, in our, in our, in our in our in our stages of development. So Right, is part of the curriculum. But I really feel that also I don't know I don't know whether they that is design of the curriculum is still not giving these children what they need in terms of the sports section of the curriculum to provide them with these skills to build up these muscles. I'm not sure if it's doing that. So previously, going back to saying you used to get all of those skills incidentally from the skills from the activities and tasks that you would be doing around at home throughout the year, throughout the month throughout the week. And then we would have sports as well. But the kind of sports that is being done now. I'm not sure how much of it is is actually helping to facilitate in the development of these skills."-Teacher 2*
	Its all about that. And once you come to such environments, like where I am, it becomes a product, right? So once it becomes a product, yeah, this is where I'm coming to the critical parts now where I'm seeing a need to be politically correct, but what I'm saying the whole environment becomes a business and you're selling a product by the third term or the fourth term, you've got to make the best show for Christmas carols, you've got to do the best show because the parents are gonna look up to that and that and they're wanting to see their child in that."-Teacher 2
	we were focusing as well on timeframes now. Because even in the environment where I'm at right now to just get frustrated, the fact that you've got this book and by this time, you must be on page number so and so."-Teacher 2
	How much time that they take off academic time.Make sure you produce the best or you what's the word I'm looking for? You put together the best Christmas carols for the grade Rs. You put together the best a cricket match for the grade 2s. You know what I mean?- Teacher 2
	Yeah, it's not. I mean, in the end, that's actually not relevant to the development whatsoever, but it's like it's To show the parents like you say it's like the end product when the main experience. Teacher 2
	But I'm just saying yet on the other hand, we are sitting with children who are losing so much skills that we ourselves also say are very valuable skills, but then we take too much time focusing on irrelevant , Yeah, yeah, yeah, yeah. Yeah.Teacher 2
One teacher believed that there were proper policies on the tuition of learners in basic education in schools yet that this was not the case for universities where he believed universities did not have proper policy imperatives. He believed that the curriculums at a university level needed to be reviewed to include inclusive educational strategies so that all teachers would have appropriate skills to teach all children as per the south African legislation. Importantly he stated that remedial schools and special education is slowly begin phased out and therefore this needs to be addressed.	*So it seems that we have proper policies on the tuition of learners in basic education, schools, basically your primary and high school, but when it's the higher education, there isn't really proper policy imperatives for universities to follow Teacher 1*
	So within our curriculum at universities, where we are educating the teacher which incorporate special needs education, to the level that we are not just saying that if you specialize in special education or inclusive education that you will learn about how to teach learners that are affected. you know, with this or that but rather than every teacher must be able to do to teach any any child because that's the kind of education system that has been legislated in South Africa. It's an inclusive system, where special schools are going to end up being phased out or reduced, as it is put so it is important to make sure that teacher training itself, we raise and we raise awareness on teachers themselves, but also so it's also dependent on departmental collaboration you have that the Department of Social Development, that's a very crucial department in terms of, you know, teaching people about, you know, things that are affected because it has far reaching abilities. To inform. So the educational department is not going to on its own be able to do so. So what I'd say is that we don't only need to inform on the educational level, but rather, you need to start on the

	societal level and then progress of course, the educational level is very difficult to teach something in school and say nothing of it in society and have it actually been impact. Teacher 1

ii. Clinician perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Theme 1: A spectrum of motor proficiency and physical activity levels

Specific motor skills and/or deficiencies (Motor profile)

Overview of findings	***Clinician statements***
The majority of the clinicians (n=7) felt that motor skill deficiencies seem to occur on a spectrum themselves whereby some children do not experience extreme difficulties whereas others do. One clinician stated that children are either hyperactive or hypoactive. One clinician indicated that it's a given fact that individuals on the spectrum have reduced gross motor proficiency compared to their neurotypical counterparts. It was also stated that engaging in physical activity is a necessity for children on the spectrum.	*"The children in the school it's almost a given fact that their gross motor proficiency will be much, much more lower than neurotypical children."-Clinician 8*
	"Every individual is different. Like I said, it's, motor proficiency is a spectrum in my eyes. -Clinician 3
	"The motor proficiency for me is a spectrum as well. I do not see it as linear." -Clinician 3
	"You get the hypotonic ones and the ones that are absolutely hyperactive" -Clinician 10
	"Motor proficiency in kids with a on the spectrum are quite, it's quite poor."-Clinician 7
	"I do think that physical activity is definitely a massive, massive necessity for these kids."-Clinician 11
All of the clinicians (n=11) reported specific motor difficulties that they had come across while working and treating children with ASD. Common issues reported by clinicians were poor tone (n=3), poor tone specifically in the core (n=3), poor praxis and motor planning (n=3), gait (n=3), increased tone, poor balance (n=3), poor body awareness (n=3) and poor coordination and body control (n=3), and poor breath control(n=1).	*"There were some kids who had low tone, some kids had very high tone. Many of them very poor, fine motor skills, a few you saw with the gross motor skills, they were definitely lagging behind." -Clinician 1*
	"They struggle with their muscle tone, and their coordination and because of the low muscle tone, all the other motor proficiencies or, or they are not proficient as they should be in coordination- they are clumsy, poor motor skills, motor planning, bilateral integration. I basically I see it all through from the very little ones to the older ones, right through." -Clinician 8
	"We've also found balance is a bit of an issue, again directly correlated with the core strength and the control of that core."-Clinician 9
	"They struggle with praxis, motor planning and that sort of thing."-Clinician 2
	"I do see that are not proficient that they do have all kinds of trouble with planning with balance."-Clinician 8
	"Their poor body awareness"-Clinician 8
	"toe walking, [and] not necessarily that great on doing things like climbing and coordination"-Clinician 2
Other motor deficits reported by the clinicians were poor gross and fine motor difficulties (n=2), bilateral integration issues (n=2), difficulty performing activities of daily living (n=2), being clumsy (n=2), having reduced mobility and flexibility (n=2), having poor posture (n=1), having increased compensatory movements (n=1) and having vestibular processing, having reduced quality of	*"In terms of independence, feeding themselves, that kind of thing. Some of these children don't feed themselves". "They don't actually have the ability to feed themselves, the really severe group."-Clinician 10*
	"their activities of daily living, which include their motor skills, things like dressing things like especially handwriting we do a lot of I find it is either reduced or the quality of them all, the quality of the end product is usually good but they are compensating so much."-Clinician 4

movement and proprioceptive issues (n=1). One clinician indicated that in terms of independence the individuals struggled with feeding themselves and dressing themselves as well as they struggled to write. This clinician also indicated that although they could perform movements that they were compensating a lot .	*"Have poor motor patterns and poor posture"; "their motor proficiency is not up to par" -Clinician 7*
	"…poor proficiency in most movements."-Clinician 5
	"{They] tend to have extremely poor posture, and you'll see it in the way that they walk a lot of toe walking, hunched shoulders, their, core muscle tone is almost non-existent."-Clinician 7
	"A lot of my children with ASD really do struggle with the vestibular and proprioceptive processing."-Clinician 4
A few of the clinicians reported motor problems that influenced other motor skills and/or spoke of a link between different skills. This was something that the researcher would need to consider when developing the model of care.	*"What they struggle the most with the motor proficiency? It's really the quality of their movements. I find a lot of them because of that, more from the sensory feedback from what I see." [Due to sensory feedback issues, quality of movement is affected].-Clinician 4*
	"Number one, a lot of them struggle with their general balance? Usually because of that vestibular feedback is not great as well as the neuromuscular difficulties."-Clinician 4
	"The other thing is a lot of my kids with ASD don't have very good interoception they don't actually understand what's going on in their body. They don't they're not able to process that information, and then some of them struggle with general day to day organization." -Clinician 4

a) Reduced PA levels

Overview of findings	***Clinician statements***
The majority of the clinicians (n=7) reported that to their knowledge children with ASD had reduced physical activity levels overall. One clinician mentioned that physical activity levels decreased as the children aged. Three of the clinicians stated, that similar to motor deficits, physical activity levels were varied across the children. Two clinicians stated that some children had increased physical activity levels and where meeting physical activity guidelines- particularly the hyperactive children- yet that it was child dependent. One clinician reported that she observed the motor deficiencies through different ages of children on the spectrum. One clinician indicated that similar to neurotypical individuals you have children who enjoy and other who don't enjoy participating in physical activity.	*"It tends to be poor. Other than therapy, most of them don't get anywhere close to normal physical activity levels."-Clinician 5*
	"It is definitely a general problem" [Physical activity levels]-Clinician 8
	"With the physical activity, number one, like I said is they are not getting enough."-Clinician 4
	"I think they tend to be less active. Apart from the, you know, the spinning, the stereotypical behaviour. They do tend to be a little bit less moving."-Clinician 2
	"At school as the kids got older, they were more sedentary at break, especially ones who weren't included in activities because they weren't physically capable"-Clinician 1
	"They have such difficulty in general with their activity levels. If there's like activity levels where, we'll often find them increased or decreased or both. They fluctuate."-Clinician1
	"Some of them are walking less than 2000 steps a day."-Clinician 11
	"Some of them whose parents push them to do a bit more therapy are [meeting PA levels]. Others just do it just once a week"-Clinician 7
	"The hyperactive ones yes, the poor mothers would like them to be stiller, quieter? -Clinician 10
	"It really depends on the child. Yeah. So what do you think, so obviously, you've got the kids that really enjoy the physical activity and then you have the kids that don't want to participate?"-Clinician 5

The majority of the clinicians (n=6) stated that children with ASD were not meeting the ACSM general population guideline of participating in moderate exercise for 30 minutes per day for 5 days of the week. One clinician stated that although the children were very active or hyperactive they were not meeting the guidelines. Three clinicians reported that there was variability in physical activity levels and that this extended into their adult lives.	*"So with regards to the child population, I would say they do reach the 150 minutes a week but that's also child dependent. But when you look at the adults in autistic population, yes, there are a few of them who train consistently, but there are also those who just do not want to do any sort of physical activity."-Clinician 3*
	"I mean, at school I think they try but I don't think I don't think they are meeting the guidelines."-Clinician 2
	"No, definitely not" [In response to if children are meeting guidelines]-Clinician 9
	"I mean, at school I think they try but I don't think I don't think they are meeting the guidelines."-Clinician 2
	"The majority of the kids are meeting." "I mean, the majority of the kids I worked with are very hyperactive, very active. "Clinician 1
	"Ha ha ha no, I don't even do that"- Clinician 8
Many of the clinicians mentioned that physical activity levels would be dependent on whether they were at school or home as well as the kind of school they were attending. One clinician specifically mentioned private schools seemed to offer and encourage physical activity. One clinician stated that she felt children overall were meeting the guidelines, yet those who stayed at home and not attending school were not.	*"Yeah, the kids that were in schools, yes, the kids that were at home, so no."-Clinician 1*
	"They do have physical exercises; even during COVID they had online physical activity."[Private school offerings]-Clinician 10
	"Well my son goes to a very posh private special needs school. Unity? So I think they're there but I don't know about other facilities. It's you know, maybe he would have been left to do his own thing."-Clinician 10
The clinicians provided some reasons as to why they thought the children had reduced physical activity levels. Clinicians mentioned that the decreased physical activity levels could be attributed to laziness (n=3) as well as poor aerobic capacity (n=1), which meant that they fatigued easily. In addition some clinicians perceived that children with ASD would use more energy than their neurotypical counterparts when performing simple tasks (n=2).Two clinicians stated that their reduced physical activity levels may be due parents being 1) too overprotective with their children preventing them from doing physical activities, or 2) struggling to cope with their behaviours therefore not allowing them to do engage in physical activities.	*"I think parents are also struggling just to get them or just to cope with them and the behaviour that they don't always let them do activities or physical activities."-Clinician 2*
	"They struggle to sort of control their body. A lot of the time and then it uses up a lot more energy than it should for neurotypical child"-Clinician 9
	"Parents tend to be extremely overprotective with kids with ASD"-Clinician 6
	"They quite lazy, but this all the ones I've got but at the same time I also find that a lot of them they aerobic capacity is quite low again."-Clinician 9
	"And I also find our autistic children especially the lower functioning ones, with the extremely low muscle tone, they are lazy and they, they do not like to take part in sports, in just moving around tires them out immensely."-Clinician 8
	"Some of the others will just literally go to the playground and they will lie down there as fast as they can, for as long as they can until break time is over. But those are normally the children that are also overweight, they're all overweight, and they are lazy. They get physically exhausted, so much easier."-Clinician 8
	"I was shocked at how overweight some of those children are. It's a pandemic."-Clinician 10

b) Benefits and reported cross over effect of motor skills

Overview of findings	***Clinician statements***

The overall perception of the clinicians (n=11) was that improving physical activity as well as improving motor skills would benefit children with ASD. The clinicians made particular reference to the fact that having good motor skills and physical activity levels could increase independence (n=2), improve general well-being(2), improve daily functioning(n=1), allow them to be more productive, improved mood as well as providing a sense of value and purpose(n=1).	*"I Think that the physical activity works hand in hand with the motor skills to sort of elevate their ADL's and their general well being."-Clinician 9*
	"It makes them more independent as well? When they able to do a lot of the things by themselves it gives them more energy to use productively and it gives them a means to be more productive."-Clinician 7
	"But what I do know is that physical activity and things of that nature actually do tend to improve, obviously, their daily function because they get to do more things more efficiently and proficiently over time."-Clinician 6
	"Physical activity-it just broadens everything in life, it ups your emotional well-being and ups the way you feel about everything."- Clinician 6
	"They experienced a lot of uplifted spirits"- Clinician 8
	"And it gives them a sense of value, a sense of purpose, not a sense of being behind in everything." Clinician 1
The clinicians stated that other benefits included improved concentration and focus in class (particularly after exercising early in the morning), improve sense of calm in class, improved co-ordination, improved sleep , improvement in mood, improvement in emotional control, improvement in behaviour , improvement eating behaviour, improved social participation, boosted immune systems, and improved overall engagement in the world (school and home settings) and emotional well-being. One clinician stated that physical activity is a good way to connect with a child.	*"So especially the kids that do the bio sessions with me at 7:30 in the morning, they generally have the best focus in class."-Clinician 9*
	"Increased concentration."-Clinician 8
	"I see the improvement in the, their overall coordination and concentration if we get them to be a little bit more physical physically active."- Clinician 8
	"The kids sleeping better, eating better, calmer in class"[with regards to engaging in physical activity]-Clinician1
	"They sleep a bit better in the morning, they're not as less likely to have an episode."- Clinician 7
	"They tend to have poor immune systems and you know, all of those things that exercise can help with."-Clinician 5
	"I think social participation is the biggest thing, and behaviour."-Clinician 2
	"I think it will make a huge difference in generally their every day engagement in the world in their from an activity perspective, from their schoolwork, home settings, social."-Clinician 4
	"A really great emotional outlet as well."-Clinician 3
	"Physical activity, which doesn't have that cognitive load doesn't have that pressure, where it's more freeing is a really great way to connect with the kid."-Clinician 1
	"So with [Childs name], exercise has been really valuable when he exercises and is active, it makes a massive difference to his emotional lability and his emotional control." -Clinician 11
The clinicians also reported that physical activity is a means for a child to better regulate sensory issues, vestibular problems, proprioceptive processing as well as improve language deficits. One clinician stated that physical activity provides opportunities for them to work through sensory barriers.	*"It gives them the opportunity to work through sensory barriers."[swimming]."- Clinician 6*
	"With the vestibular input where they, where they do motor activities, [and then] the language improves.- "Clinician 2
	"And the movement depending on how, how much input we give, that sometimes it improves their language."-Clinician 2
	"So helping them to regulate as well as helping them on a more sensory level because a lot of my children with ASD really do struggle with the vestibular and proprioceptive processing. And we know movement will increase that"-Clinician 4

Because there is such a large cross over effect of motor skills into daily activities clinicians stated that reduced motor skills would impact other areas of their lives negatively if they were impaired. They provided classroom (e.g handwriting) and activities of daily life examples. One clinician indicated that those engaging in physical activity progress better and those who don't engage in physical activity decline in function over time – they particularly made reference to posture and cognitive abilities as examples.	*"We're finding a lot more progress with the kids who are involved in physical activities, but it's the ones who aren't we notice everything decline, their posture; they're on their phone the whole day; their mental and cognitive abilities."-Clinician 7*
	"They just fall behind in the class when it comes to fine motor- they fall behind in class because they can't write as fast and everyone's like, well, they're just slower and it's like, maybe it's because they can't hold a pencil."-Clinician 1
Overall, clinicians reported that children with ASD needed physical input, and that they thought motor skills were important - that in most cases children just need to get moving and that physical activity intervention is a cost effective means of therapy.	*"Physical activity should definitely be advocated for them "-Clinician 7*
	"They definitely need physical input."-Clinician 2
	"I always think motor skills is important."-Clinician 10
	"So often, it is just a case of you need to get this child moving."-Clinician 5
	"I think they deserve the best therapy that the parents can afford. And I think it's, I think physical activity is very cost effective. It's not expensive."-Clinician 10

Theme 2: barriers to exercise and challenges in implementing exercise

a) Core deficits and daily struggles

Overview of findings	***Clinician statements***
In terms of social barriers , clinicians reported self-regulation deficits , being introverted or shy and being part of different social groups could also dictate whether a child was active or not and that exclusion was a risk of not being able to engage socially. One clinician indicated that they may need to reduce arousal or calm down before being able to engage in further interaction which could prevent typical participation in exercise. In terms of interaction and communication barriers one clinician stated that children who were shy may lead children to respond to the clinician in an altered way.	*"And he has to learn to calm down again, and then soak yourself up and build yourself up for the next interaction"- Clinician 3*
	"Some kids are very introverted, so they won't want to work when someone else's in the room." -Clinician 9
	"But it's also their peers, so the kids so the kids in school, if they make friends with the lazy guys, they end up being lazy"- Clinician 7
	"We know that as a social exclusion comes in because suddenly they're you know, they can't play with the other boys the same way when it comes to sports and things like that."-Clinician 1
	"The kids might be shy, they might not, like, respond to you properly"-Clinician 3
In terms of behavioural barriers, screaming, shouting, banging and tantrums were cited by four clinicians regarding the fact that they may be barriers to physical activity. Furthermore, one clinician stated that poor body awareness could exacerbate behavioural problems and influence the engagement in physical activities. In one instance a clinician indicate that she needed to take children one on one as they may be disrupted to others due to their adverse behaviours.	*"So I've got another one sit under my oak tree at the back. And scream and shout and bang everything."-Clinician 10*
	"They might have an outburst they don't know themselves as well as an adolescent might know themselves."-Clinician 3
	"I had to take my two patients completely alone and you know, entirely kind of isolated, because they used to distract all the other people so much that no one could get done what they had to get done."-Clinician 6
In terms of cognitive barriers, the majority of clinicians stated that impaired cognition would influence the	*"I'm not always sure if they understand what they're supposed to do."-Clinician 2*

understanding of tasks – specifically in performing motor skills and in some instances performing motor skill related tests. Two of the clinicians stated that individuals with ASD have poor interoception hence they can't understand what is going on in their body. Many of the clinicians stated that cognitive barriers should be considered when deigning the model. They stated that once they understand what is expected from them it may allow for improvements in other aspects.	*"Because of the poor understanding because sometimes they do not understand instructions."-Clinician 8*
	"Kids with ASD don't have very good interoception they don't actually understand what's going on in their body. They don't they're not able to process that information."-Clinician 4
	"It will make a difference because as soon as a child can understand what is expected of them participating in certain activities. Following instructions, it improves. The concentration improves. And so does their coordination."-Clinician 8
In terms of sensory barriers, one clinician spoke of sensory barriers influencing testing (i.e not being able to use electrodes due to skin sensitivities or using specific coloured objects). Furthermore, it was stated that sensory triggers or negative sensory reactions could prevent a child from performing a motor related task. Furthermore clinicians reported that sensory issues could potentially aggravate or worsen other motor abilities. Importantly it was stated that some children may dislike engaging in physical activity due to not liking the result of the physical activities have their bodies i.e feeling sweaty, feeling normal muscle pain after exercise and/or not understanding increased heart rates.	*"Maybe even putting electrodes on the children, and I know you don't want to go there."-Clinician 8*
	"There was a girl in school a few years ago that refused to touch the colour green! During some gross motor time activities for midline crossing, she refused to pick up and pass on green beanbags."-Clinician 8
	"They're extremely sensitive to sensory input. And obviously, if you have like a little bit of a setback on sensory feedback, you are automatically going to have a setback on proprioception, which automatically translates into that balance and those types of things."-Clinician 6
	"She hates absolutely hates exercises like running because it makes her sweaty."-Clinician 3
	"Because of the way it makes them feel. Like that's really with regards to DOMS and like muscle soreness and stuff afterwards." -Clinician 3

b) General barriers and challenges

Overview of findings	***Clinician statements***
In terms of exclusion, being a barrier clinicians reported that children with ASD may not have opportunities to engage in physical city since people may not want to work with them and that they are often labelled as being "difficult". It was also stated that motor difficulties that children with ASD had may in themselves exclude them from participating and that in some instances they may be discouraged to do motor tasks due to having poor motor skills. One clinician indicated that there may be instances where individuals are physically active but may be excluded because of being "difficult"	*"They are considered quote unquote high risk that they - they fall under the stereotype of difficult to deal with?"-Clinician 3*
	"You'll find a lot of people shoowing ASD kids away because they, they are difficult to work with, especially if they do have sensory impairments as well."-Clinician 6
	"Social exclusion comes in because suddenly they're you know, they can't play with the other boys the same way when it comes to sports and things like that." Clinician 1
	"I think that we are missing a trick with some kids who are very physically active.I think could benefit even more, but I probably excluded because they're difficult. "-Clinician 11
	"Being told that you don't have good power control of your muscles, so you're not allowed to pick up the hamster, or cuddled the kid or cuddle the puppy or hold your little sister. It's, we're constantly alienating the kids."-Clinician 1
Clinicians (n=3) reported that individuals with ASD having poor self-confidence influenced participating in physical activities. In particular it was stated that having failed at something previously may result in the child	*"They know that their bodies are not, not capable of doing a lot of the things that other kids can so they don't, don't want to try because they've you know, they've tried to do stuff in the past and not been able to they are just scared to try."-Clinician 5*

being scared to try doing same or different tasks in the future.	
In terms of comorbidities being a barrier to physical activity, clinicians reported that psychiatric conditions could prevent typical activity participation. One clinician indicated that the overlapping conditions may result in not knowing how to treat the children effectively and that knowing if they have comorbid conditions and conducting family history is important . One clinicians indicated that certain types of ASD i.e those with Asperger's could be more likely to have associated conditions i.e anxiety and that that should be considered.	*"There's so many overlaps. I don't always know what I'm treating."-Clinician 10*
	"There's all kinds of psychiatric conditions and forms of being ADHD, bipolar, anxiety, OCD, stuff like that. All those conditions. And family history score is important. Doesn't mean because you are autistic , you don't have any of those other psychiatric conditions that you can inherit.-Clinician 10
	"The Asperger kiddies are very anxious overall." Clinician 2
The majority of clinicians stated that level of functioning of the participants might dictate physical participation and engagement in specific tasks and even therapy. Two clinicians indicated that due to their level of functioning they spend a lot of time in therapy and that decreases time available to participate in other things such as physical activity. One clinician indicated that knowing the level of function would allow her to better prepare for her sessions as it may influence how the child engages with her materials.	*"It depends on their level of functioning.-Clinician 4*
	"Definitely not[active], the problem is that these kids are spending too much time in therapy.-"Clinician 11
	We need to know if the child you know is going to have difficulty sitting if we need a special chair, something like that." "From just from a professional perspective, I need to know if a kid doesn't have the fine motor skills to interact with some of my materials." Clinician 1
The majority of clinicians stated that motivation was a large barrier in getting children to participate in motor tasks and physical activity. One clinician mentioned that motivating the parents to take their children to therapy is a barrier in itself.	*"They don't always want to."[engage in physical activities]-Clinician 8*
	So yes. If I can't even motivate myself, I think the parents are really, really struggling to motivate the children to do 30 minutes of exercise a day-Clinician 8
	"They can be difficult to work with the most important thing motivating."- Clinician 7
	"…will just improve that motivation from the patient side."-Clinician 6
	Understand what drives them and what motivates them and then try and bring their experience of the world closer to the general experience of the world.-Clinician 1
Four clinicians stated that finances and having optimal resources may be barriers to physical activity in children with ASD. One clinician indicated exercise is a cost effective therapy.	*"The parents don't always have access to occupational therapy. You know, karate, monkeynastix, two they don't always have the money to let their children take part in sports like that."-Clinician 8*
	"It's obviously just the elite few that can come to private therapy."-Clinician 5
	"Finances is huge, resources are a big problem, especially in our country- we have to be aware of that."-Clinician 1
	"It also depends on, you know, your level of socio economic, you know if it's low or high. I know that in low socio economic environments they are just so struggling to keep their head above water."-Clinician 2
	I think they deserve the best therapy that the parents can afford, and I think it has, I think physical activity is very cost effective, it's not expensive. You really don't need to spend a fortune."-Clinician 10

Theme 3: A lack of assessments and appropriateness

a) Current motor assessment tools and appropriateness

Overview of findings	***Clinician statements***
The majority of the clinicians felt that motor skill tools were not appropriate for children with ASD. Clinicians stated that issues with motor assessment tools included children not being able to understand instructions therefore making them inappropriate, no norms to compare data with, needing to adapt assessments since there are not motor assessments specific to ASD and not being able to assess critical deficits in the population using standard tools. In some instances clinicians indicated that sometimes they don't know what to do with them. They felt that there should be guideline for how to assess the children as well as an outline of what should be tested. Clinicians stated that they made use of the Jean Ayres clinical observations scales, STOTT , BOT, MABC tests, Milers assessments, *SIT test and the EASY-OT.* They indicated that there are variables that are often not measured and that we need to consider that. One clinician indicated that she feels that it's not even about identifying motor impairments but rather identifying how you can increase body mind connection. One clinician stated that she felt healthcare practitioners are covering most of what needs to be assessed in children with ASD.	*"No, it's not appropriate. Yes, it could be better."-Clinician 1*
	"Why isn't there international tests and standards for special pops like ASD."-Clinician 6
	"I have not found anything specific to ASD when it comes to motor, motor screenings."-Clinician 3
	"There should be a sort of standard guideline or outline of things that should be tested." "A guideline for how to assess would be amazing in terms of like, what are your common challenges"-Clinician 5
	"And then we sit with them and we get them. And you're like, OK, I don't know what to what to do, how to test with them, like, how to work with them."-Clinician 9
	"I don't have any proper normative data or like a guideline as to what how normal is normal." Clinician 3
	"So we adapting as per the kids that come in, umm, and again, each of those kids is different."-Clinician 9
	The movement ABC doesn't give you the opportunity for quality of movement and for those compensatory things"…. "it's just not looking at the quality of the movements as well".-Clinician 4
	"I actually think like the neuro feedback on the muscles are something that we are missing."-Clinician 6
	"*I think that it's not even about identifying motor impairments. I think it's about identifying how you can increase body mind connection. So um whether it is that the child likes yoga and you can get them to the yoga."-Clinician 11*
	"I still use the, it's the Jean Ayres clinical observations scales." "I realized early on that even just understanding those instructions are very, very difficult for them." – Clinician 8
	"So I because you've got to follow the instructions, there are a lot of instructions going on in there, so my ASD children that struggle with auditory processing or a sort of low functioning-we cannot do that movement ABC."-Clinician 4
	"I think I think bios are healthcare practitioners are covering most of what needs to be assessed, or needs to be done, they are obviously one or two things we need to work around." Clinician 7

b) Motor testing is not standard

Overview of findings	*Clinician statements*
The majority of the clinicians felt that motor assessments were not standardised in the ASD population and one stated that there are no evidence based policies advocating for motor testing to be done. The majority of clinicians felt that it should be standardised, as well as tracked across their development. One clinician stated that assessments were specific to the field of specialisation the clinician was in.	*"I haven't seen any standardised assessments actually being used."-Clinician 1*
	"So there's not really an evidence based policy that says for ASD, you have to do these"-Clinician 2
	"I think it should be a standardised thing that should be marked, I really do, and tracked across their development. Clinician 1
	"If we work in a specific area that area, specifies what tests we're going to use."-Clinician 2
Clinicians provided insight into what variables they test. Clinicians reported testing running and walking unassisted, static and dynamic balance skills, throwing and catching skills, functional movements, general strength, motor fluency and the ability to repeat motor behaviours, observational tests to determine quality of movement, praxis, fine and gross motor skills, sensory integration, grip strength and range of motion. One clinician indicated that she doesn't always do full assessments as she knows what motor proficiencies she would find. One clinician indicated that when she does her testing she tries to apply it to their personality as well.	*"I don't always do a full assessment of their motor proficiency anymore, because it's almost as if you know what it's going to be like."-Clinician 8*
	"So I think hypermobility and and strength assessment is vital and with these kids and I definitely would include it in a model of care that we do in an assessment."-Clinician 11
	"I look at their ability to like run a walk unassisted, how is their balance etc. And like static versus dynamic balance and I also look at their throwing and catching skills. And I also do functional movements with them and just to see how they do it."-Clinician 3
	"We look at motor components pertaining to those functional things."-Clinician 2
	"When I'm assessing them as well that you kind of have to apply to their personality to a large extent as well."-Clinician 11
	I look at the fine and gross motor skills."-Clinician 3
	"OT, we use the SIT or the new test the EASY-OT so that's for sensory integration."-Clinician 2
	"Observation. Like, are they actually able to climb"- Clinician 2
	"Motor fluency, and, you know, the ability to repeat motor behaviours, the imitation, the fine motor skills."-Clinician 1
	That I don't test because I'm not an OT or anything-Clinician 10

c) Motor testing is not a priority

Overview of findings	*Clinician statements*
The majority of the clinicians stated that motor skills are not a priority in the management in children with ASD. It was sated that the focus of management generally included behavioural, cognitive, emotional and speech therapies as well as other general health issues. Overall, the general sentiment of the group of clinicians was that motor assessments and motor therapies were not enough and even often ignored.	*"I think most of the focus with his kids is around sort of their behaviour, their stimming, their general adaptive behaviours and a lot of the times I find the motor skills were kind of put on the backburner. They're ignored."- Clinician 4*
	"It definitely doesn't seem to be a priority and the treatments once their gross motor skills are stabilized enough for independence in terms of walking, getting in and out of the shower, it seems to fall to the wayside in their treatment plans." "But for the rest of the kids, there was no intervention, or focus on it at all."-Clinician 1
	"The physical activity aspect of autism is largely ignored and in preference to the speech lack and the and the health issues and the emotional liabilities and the behavioural sides of things."-Clinician 11
	"I don't actually think that there, there is not much being done for it, if that makes sense."-Clinician 6

	"We neglect it. We think that having PE at school if it's still called that - is enough, and it's not." Clinician 1
	"I've noticed it's mostly cognitive behavioural therapy that they would offer and then your usual OT and speech and the speech and audiology."-Clinician 3

d) Early intervention and improved diagnosis is needed

Overview of findings	***Clinician statements***
Clinicians stated that to they felt that improved diagnosis for the ASD population is needed, specifically in terms of earlier diagnosis. The clinicians indicated there is a need for improved diagnosis specific to motor testing as well as a need to screen for impairments. One clinician stated that there the DSM 5 criteria should be revised in terms of adding other deviations/deficits as part of the criteria.	*"We need to find a way to diagnose and start treating them at an early stage." "So I believe that early like motor skill training, or not training, but screening, even during the fundamental phases would be highly beneficial.-Clinician 3*
	"We need to start early. It's all about creating the positive relationship with exercise for these individuals."-Clinician 3
	"We know earlier intervention, the better. More intensive early intervention, the better."-Clinician 1
	"The DSM five criteria should look at including like, like other deviations in onto the spectrum. I know a lot of people who are being diagnosed in their adulthood now."-Clinician 3

i. Clinician knowledge, perception and insight into how motor proficiency and physical activity levels can be improved

Theme 4: "It's not one size fits all"

a) General

Overview of findings	***Clinician statements***
In general clinicians stated that approaches to improve physical activity and motor skills should be considered , specifically a holistic and multidisciplinary team approach was advocated for. One clinician indicated that we could consider implementing specific professions in schools (Biokinetics) to specifically target motor proficiency.	*"I think my ideal would be a holistic plan, with the one chapter of it being the motor intervention, but with ways that they could be multidisciplinary meetings and check ins with each other."- Clinician 1*
	"You know, so I think that's maybe where an OT and a Biokineticist can work well together with the OT, maybe do some of the assessments and then with the help of the Biokineticists, we can work on the, the motor things."-Clinician 2
	"I like a team approach. Were everyone and the speech therapist and everyone works together." Clinician 2
	"I think Biokinetics needs to be introduced to the schools, to train to carry with his bags, posture, all those kinds of things. *I think a biokineticist should be part of the PT programme."- Clinician 10*
General special consideration the clinicians stated that should be considered was programme design. These included time of day (with a preference for morning sessions), level of assistance needed , dosage , intensity (high intensity may have adverse effects) and frequency of physical activity (n=6), type of intervention i.e. graded, interventions, activity preference i.e. water	*"The morning seemed to work better for the kids, especially if they've got a day full of school and different activities and things like that, because you've also got the sensory overload and you've got all of those different factors coming in." Clinician 9*
	"They became so tired that it wasn't fun to them anymore. And it was it was hot and it was in the sun so maybe make it a little bit less daunting to them a little bit less tiring"-Clinician 8
	"I'd say at least 45 minutes to hour and a half a day.

vs land based activities, considering online activities or including technology, using structured activities, considering environment and mode i.e. group vs one on one activities and supervision(more supervisors is better). Keeping environments familiar and making sure the environment doesn't trigger sensory sensitivities. It was stated that individuals with empathy and a good understanding of others would be good instructors.	*I'd say moderate intensity exercise. Intensity tends to put them in a non responsive state"-Clinician 7*
	"So you also need to look at the intensity of the motor input."-Clinician 2
	"Keep it like short bouts of exercise that way they're not too sweaty and you don't trigger their sensory issues as well to the point where they see exercise as a bad thing."-Clinician 3
	"They think one session a week will solve the problem but doesn't really I think it needs more so more frequencies are important."-Clinician 7
	I don't think I don't think a big group would be a good start. I think that if you're gonna do group activities that need to be very small, very controlled groups, and I think groups would be more problematic than learning activities. But in the other hand, these kids also do need to learn how to integrate, and sometimes this might be a way that they can learn to communicate. So yeah, I would probably say and you need to need to be dependent on the child, but I would probably earn this earn size, earn the side of smaller groups rather than larger groups."-Clinician 11
	"Graded intervention"-Clinician 1
	"Inside the water they managed to overcome the sensory barriers basically and they really flourished in terms of being able to maneuver around things in the water"-Clinician 6
	"Doing online classes and studies."-Clinician 10
	"Things like that can be measured, technically or electronically, that may be an advantage."-Clinician 8
	"It has to be very structured."- Clinician 8
	"Keeping the environment sort of familiar to them. So often will work in like the same area of the gym."Clinician 5
	"Avoid noisy environments with too many other visual and auditory distractions as well as bright/ flickering lights or bright sunlight. Too hot or too cold and even the temperature and the textures of objects that the persons will have to hold onto/ step onto/catch/ or walk over"-Clinician 8
	You need like a lot of hands, even if it's, you know, a staff, just to kind of make sure the kids are doing the right thing or trying or, you know, just standing there picking their noses.Clinician 5
	I'm just in terms of that, do you think if we had guided exercise, do you think it would be better if it was led by another person on the spectrum in your opinion? I just think you need someone who's got sensitivity. I I think that having someone on the spectrum is great, but the only problem with having someone in the spectrum is that there are also struggling with the same things as these kiddies are struggling with, and sometimes those clash. So I think that the most important thing is actually somebody who has an understanding or has an empathy."- Clinician 11
	"One on one because it's the kid is different.I cant,Put two kids in the same session because one will seek the attention of the other and the other one will want nothing to do with theother.One will be scared of the other."-Clinician 9

Other general special considerations the clinicians stated that should be considered regarding a motor or physical activity programme were things like making the activities fun, using colour to improve understanding, using a variety of tasks, creating interest, consdering competition based activities (some may enjoy while in others it may increase anxiety), and getting the children to engage in meaningful tasks. It was suggested that it would be of value to give them motor based habits and rituals and consider including it into their basic schedule.It was also states that it would be important to build a positive relationship between the child and physical activity.	*"Game type exercises where they don't realize what they're actually doing".Clinician 9*
	"Our special needs children love music. They love dancing and all of it. So incorporate that into it as well, to make it more fun."Clinician 10
	"Maybe using a lot of colour coding" …."that would maybe make instructions a little bit easier".-Clinician 8
	"Might react well to music based things."-Clinician 9
	"I could give them so much more variety."- Clinician 10
	"I think if we can get them interested in the activity that's a bit more meaningful." Clinician 1
	"I would think a fun part , it should be fun it should be, many of our children understand a competition element."-Clinician 8
	A lot of the other kiddies that I've dealt with who are on the spectrum, they are not always competitive and the competitiveness increases that anxiety and makes it makes it much more difficult for them.-Clinician 11
	"If they could have little habits and rituals, they love little ritual motoric rituals if you can give them a motoric ritual they do before they brush their teeth, do five jumps or whatever it might be." Clinician 10
	So when we are to maybe start targeting physical activity, we need to consider sort of including it into their basic schedule. So it's something that they need to sort of tick off when they a spart of the day."I" think that will definitely make a difference to some of them that you understand and it's motivated enough." Clinician 8
General special considerations the clinicians stated that were related ASD specifically, included how individuals react with the clinician and others, adverse behaviours and how that would affect interaction with the clinician and others around them, cognitive abilities , social deficits, and sensory deficits. It was also stated individuals whoa re non verbal vs verbal would have additional things to consider . One clinician indicate that some individuals on the spectrum don't know their own limits and this could have adverse effects for the child and that this would need to be facilitated and education for the child needed. This linked to the safety of the child as well and that we should consider other safety related issues. Furthermore clinicians indicated that some children can't be tested , that demonstration may be difficult due to poor body awareness. It was also stated that allowing parents in therapy sessions could be of value or could be distracting and that it would be child depended. They mentioned that shorter sessions may be better due to limited attention spans and that it is important to listed to feedback the child is giving for	*"You kind of also have to build that relationship".-Clinician 7*
	"One of the commonalities that I would say is that they don't know their own limits, so they've, it's really difficult for them to judge that they don't have good body perception."-Clinician 11
	There seems to be definitely a qualitative difference between kids who are verbal and nonverbal, their ability to engage with tasks to respond to treatments. It really feels like they need very different interventions." Clinician 1
	"I think there is that element. I know with some of the kids it's also a safety issue because they have insensitivity to pain." Clinician 1
	"Some kids will be testable, and some kids wouldnt be testable. I've had a little boy that just ran around for the first two sessions while I spoke to his mother."Clinician 5
	"They can also not always imitate when you demonstrate to them because of their poor body awareness.-Clinician 8
	"It also seems that it comes down to like understanding of the activity"-Clinician 8
	"They're extremely sensitive to sensory input."-Clinician 6
	"So we generally don't bring the parents in for the assessments because again, the some kids act up with the parents around, some won't let go of mom and dad and things like that."-Clinician 9
	"If you're a coach, you need to kind of listen to them. So if it is that they're going, but that hurts me.It hurts them.

example if they say an activity is hurting them, the activity should cease.	*You know, they, they're they're kids aren't supposed to feel pain. So if it is that they're feeling pain and then you know, that's something that we have to just agree to and.And yeah, so I think that we need to be sensitive to their feelings about how they feel with pain and."-Clinician 11*
	"The attention span is not great."-Clinician 5
Clinicians mentioned a further two considerations which included the effect of medication on the body, and the effect on other family members if children with ASD were to participate in motor interventions i.e how does it affect other family members when a child with ASD is going to different therapies . One clinician indicated that children should not be forced to participate as it may lead to a fear of participation.	*"Once on medication that hyperactivity is definitely is far more normalized. You don't want to sedentary but you don't want this absolute phonetic hyper activity."-Clinician 10*
	"Medication can definitely influence weight, but the weight is also genetic."- Clinician 10
	"If you force them, you're going to build up that other side of it where they developed their calculate just so quick to develop fear and anxiety that's and you're going to limit the benefit that they get out of physical activity. "Clinician 11
	"You also have to consider the rest of the family if mom is taking little Sam to rehab every day, where does that leave his sister?"-Clinician 1

b) Individualisation, variability and flexibility of the proposed model of care

Overview of findings	***Clinician statements***
The clinicians (n=8) stated that the model would need to be able to be adaptable to account for the variability of the children and that it should be presented in a way were it can be used on an individual level. In some instances, if the individuals experience a symptom (i.e pain) with PA it may not even be appropriate at all.	*"Everything obviously needs to be individualised"-Clinician 9*
	"So, I would actually recommend just that individualised attention is something that they, I think, also appreciate."-Clinician 6
	"I think we need to be aware of the fact that sometimes physical activity causes these kids physical pain, which I don't think we truly understand actually." Clinician 11
	"Different people have different capabilities, etc."-Clinician 3
Clinicians stated that the programme should be flexible and adaptable since a person may present differently on a day to day basis. Furthermore clinicians stated that it should be flexible enough to accommodate comorbidities whether they were orthopaedic, speech related, mood related, level of impairment related, core deficit related etc. Clinicians also stated intensity should be flexible as well as the type of activity the child could engage in. Having flexibility in terms of how to motivate them, and that activity should be tailored to the individual. Impratntly one clinician indicate dthat there was no "particular modelling as far as exercise capacity is concerned" and that that would need to be considered when doing physical activity with the children.	*"It depends on the day, on the kid, on literally the weather."-Clinician 9*
	"Because they are so different. It's, it's difficult to sort of pitch it at the right level. "-Clinician 5
	"In, everything obviously needs to be individualised like I do, have the nonverbal kids so working with them is extremely difficult in comparison to the kids on the higher end of the spectrum."-Clinician 9
	"That we can get, in the sense that you can find one that that's an activity that's more suited to that individual.-"Clinician 7
	"Take into account they're a bit like Crocs sometimes, you know, if you look at a certain population, so it's got a knee problem. Somebody's got a hips problem some are hypomobile. I think the biokineticist needs to realize it's not one size fits all."-Clinician 10
	I suppose again, each child is different but you have to figure out what, what motivates them. Some of them are motivated by being stronger and if you keep reminding them that they have to do this because they want to get stronger. Some of them are motivated by the chips they get afterwards?Clinician 5
	"I feel like they they don't really know what they enjoy. Because every time they come, they want to try something else."-Clinician 5

	"And then obviously, just the physical effort, for some cases is much more than others, the low tone ones, you know just to get up off the couch and go for a walk is it is much more of an effort than it is for another child."-Clinician 5
	"There is no particular modelling as far as exercise capacity is concerned." -Clinician 11
	"Make it adaptable, so that if they have equipment that they don't need to necessarily go and buy a new kit, but may be able to adapt so that they can do what they can with what they have."- *Clinician 2*
	"The take home point is the fact that you know once you've meeting autistic kids, you've only met one, and we don't understand this, and like if you think you do, you don't, you don't understand the complexity of it." -Clinician 11

c) Role and stakeholder responsibility

Overview of findings	***Clinician statements***
One clinician had the perception that we should ask teachers to include PA into their curriculum and that they would benefit from a programme that they could use with the kids. One clinician indicated that they felt motor assessment were being done by others before they got to them.	*"The teachers can also benefit from a specific programme even that they can use for the kids to get them physically active because not every school or placement has OTs, physios or Biokineticists."-Clinician 2*
	"Ask teachers to incorporate as part of the curriculum"[PA activities]- Clinician 2
	"I think in some way, the teachers have had some Biokinetics training."-Clinician 10
	"A lot of the parents as well, and a lot of the psychologists and psychiatrists in Europe, the paediatric neurologists that I've spoken to they all say that oh, no, all they need from a bio is posture control. Yeah, that's it. And sometimes the kids don't even come to us."-Clinician 3
	"If they come from physio, then I assume that the physios have done them or OTs have done them."[Motor assessments]
One clinician felt that the demands on the parents need to be low, one indicated that they felt that parents expected schools to improve physical activity levels, and one indicate that they felt they needed to chase parents to improve pa levels in the children. One indicated that she felt parents One clinician indicated that she felt parents don't always follow up on recommendation made to them and one felt that parents were dismissive of improving Pa.	*"I just think the demands on the parents need to be low."-Clinician 2*
	"I think by giving a parent that programme I don't think they'll [kids] do it."-Clinician 2
	"So I think a lot of the time they are[parents] expecting the school to do it"-Clinician 2
	"I feel that the parents are generally a big influence when it comes to a lot of these things because they deal with the child more than us."-Clinician 9
	"We have to essentially run after them and basically make the parent realize that no, the kid needs a lot more than that."-Clinician 3
	"I think getting it out to the facilitators or the carers is in the main thing and then educating them on the benefits is the main thing."-Clinician 7
	"I think they just see what you can see how finished the parent is and then the carers end up taking a lot of responsibility." Clinician 7
	"I think that's where the crux of the matter is, parents cannot always follow up on the recommendations, that we as OTS make to them, like even simple things, take them for horse riding, swimming, jumping on the trampoline, very often our children when

	we see them for a baseline assessment and we see them after a few years again. It's very often that nothing has changed." Clinician 8
	"The parents can still try to let them take part in , just take themselves to gym and just take them for a walk each day so all of them are overweight." Clinician 8
	"I found that family attitudes were very dismissive of it? You know, oh, that is just part of his ASD. He is clumsy. It's fine."-Clinician 1
	"We've almost got such a focus on the brain now. That the families that we know, the parents were really advocating for the kids and trying their hardest. They almost wouldn't do anything that didn't have a brain rationale to it."-Clinician 1
One clinician felt it wasn't the parents fault that pa wasn't being done but rather that the children themselves dint want to take part in certain activities, while one felt that in most instances children just went along with their schedules.	*"It's not the fault of only the parent. It is very often the children that also do not want to compete and to take part in certain activities."-Clinician 8*
	"The kids themselves, I found that they kind of just go along with what their schedule is."-Clinician 7

d) Physical activity preferences

Overview of findings	***Clinician statements***
In general clinicians stated that children with ASD had various preferences as well as strong dislikes in specific instances if sensory issues were present. When it came to liked physical activities, clinicians reported children enjoyed running, playing with balloons, engaging in all consuming activities ,activities that where rhythmic and mixing activities up. One clinician noted it could vary in different age groups, and another indicated that children liked variety in terms of exercise.	*"Again, it depends from child to child, so I've got one that absolutely loves being in the pool, one that reacts only when there's exercise or sort of competitive games."-Clinician 9*
	"I see that on the playground, some of them. They love running around playing chase, all around the background."-Clinician 8
	You know what, they loved for example, playing with a balloon, touching a balloon , playing and touching because it's, it's slower, and it's their slower reaction time. Also beanbags crossing of the midline with a beanbag activities singing a song. Things like that things, things with rhythm, They really love rhythm. -Clinician 8
	"They do like to sort of mix stuff up." Clinician 5
	"Consuming activity."-Clinician 1
	So also with the little ones, I'm not sure about the other ones but the little ones things like the jungle gym."-Clinician 2
Three clinicians stated children enjoyed water based activities, one reported an enjoyment for animal-based activities,and one stated they enjoyed yoga for proprioceptive-based exercises.	*"So I must say that we tried like a few dry type of activities, but they really flourished in the water. "Clinician 6*
	The kids seek out a preference quite a lot of the kids seek out water."- Clinician 1
	"So I know kids love horse riding and suppress the sympathetic nervous system." "Anything animal related"-Clinician 5
	"One of the teachers at the beginning of this year still she did yoga with it and like real PT and the children enjoyed it tremendous. All the learners."-Clinician 8
Some clinicians stated that individuals with ASD showed a strong preference for proprioceptive, jumping, bouncing and obstacle course activities. It was state that they enjoy balance and play type activities.	*"When they have to push and pull, and anything with proprioception, they're quite like."-Clinician 2*
	As I said, the trampoline is a good proprioception through the legs, anything with pushing and pulling through the arms you know, crawling through tunnels"-Clinician 2

	"They're also like going into those therapy balls."-Clinician 2
	"They like jumping activities."-Clinician 2
	An obstacle course. Where you have to go through three or four times."-Clinician 2
	"They enjoy seem to enjoy a lot of balance play activities."- Clinician 7
	"But I find often they quite like, like bouncing stuff. Jumping on the trampoline or bouncing on a ball."-Clinician 5
One clinician indicated that although here were some activities children with ASD enjoyed some expressed strong dislikes for certain activities and one stated that they preferred to engage in activities they were comfortable with.	*"To that as a whole, that entire question is also a spectrum? Because I have a 13 year old autistic child who loves archery and loves kickboxing, but she hates absolutely hates exercises like running because it makes her sweaty."-Clinician 3*
	"A lot of them stick to activities that they kind of are comfortable with"-Clinician 7

Theme 5: Education: "They need more overt explanations and understanding their body"

Need for education and awareness

Overview of findings	***Clinician statements***
Overall, clinicians reported a lack of education and a need to educate parents, other clinician's teachers and school on physical activity and motor skills. Clinicians felt that there was a need to raise awareness to get children to do more activity as well as to make people aware of the ACSM criteria , and provide them with the guidelines. They felt that overall that exercise is beneficial and that role players (parents, teacher,facilitators, carers, coaches and other clinicians) should be made aware that PA is beneficial and educate them in what the benefits may be and what the children may need. In addition, one clinician indicated that she would like to see some guidelines or some information about how individuals should actually feel after physical activity. One clinician indicated that there was a need to understand PA better so that it can be used it in a lot of different ways, for example to lessen anxiety. The clinicians advocated for teachers and parents to be educated on the benefits so that they do not exclude individuals from participating in activites. And that carers should also be educated on physical activity benefits. on That overall that exercise is safe for individuals with ASD to perform and that there are trained experts and professionals that can assist. Lastly the clinician stated that it was important to educate the children, to educate them on the benefits and what they could gain from exercising, to educate them on how they should feel when performing exercise	*"Raising awareness to get them to do more activity"-Clinician 7*
	"No, 99% of my patients, even my neurotypical patients, they don't even know those exist"[PA guidelines]."Clinician 9
	"Its about if you know that their motor skills and proficiency is not that good, what to do about that?"-Clinician 8
	"And there's so much research saying that, you know, exercise is beneficial. Yeah, we just need more research to back up exercising the ASD population."-Clinician 3
	I think it'll help also give the guidelines as well."- Clinician 4
	"I'd like to see some guidelines or some information about how they should actually feel after physical activity." -Clinician 4
	"To understand it so you can use it in a lot of different ways. So, sometimes to show them this is what we at the beginning, this is what we're going to do to lessen the anxiety."- Clinician 2
	"Then educating them [parents] on the benefits is the main thing."- Clinician 7
	"But the things were so parents need to take home a lot of the stuff and you try to explain it to them and they're not necessarily always understanding because you have nothing to show them. Say, listen, this is where your child falls on the scale that we measuring specifically." Clinician 9
	"I think for the parents, it's parent education because the parents are the first line of anything. So I think that education that is by far the most important." Clinician 9
	"Because I think just as we as therapists, obviously lack knowledge. I think parents with kids with ASD lack even more knowledge." Clinician 6
	"I think carers is education as well- "Clinician 7
	"I've had kids drop out in the past, because the parents didn't realize that the kids do not like being sweaty." Clinician 3

and to try and create a positive relationship with physical therapy for them, and slowly building it up. Interestingly two clinicians reported that they felt they were never trained optimally or covered information needed to work in the motor setting with children on the spectrum when they were studying. One clincician indicate dthat education is needed but also a follow up to see if people ehave understood what thay have been educated on	*We can go to the therapists and then as well as just the teachers that the kids are seeing. Just making them aware of teachers is a very important one because they also spend a lot of time with the kids a lot of the time. kid has one facilitator or teacher throughout the day."-Clinician 7*
	"The schools need to know because what I often see is kids are told like no, don't play on the jungle gym. You've got a problem. Where does that leave the kid? Everyone else is on the jungle gym?"-Clinician 1
	"Its the need for us to go out and explain to these healthcare professionals, that exercise is safe, we are trained experts, professionals, we are not personal trainers."-Clinician 7
	"My only issue with that is that a lot of the psychiatrists and your pediatric neurosurgeons are pediatric neurologists. They're not aware of the benefits of the exercise."-Clinician 3
	"I mean, other researchers, the neurologist and psychiatrists not being aware about the benefits of exercise essentially."-Clinician 3
	"you have to kind of educate the coach almost as much as you need to educate the parents as well, because your approach to these kids has to just be so individualised."-Clinician 11
	"All I can say is through research and time, hopefully and like not even patient education, but other healthcare provider education. We can change that attitude with anything that's needed."-Clinician 3
	"Because they don't always see the what they will gain from going to gym."-Clinician 8
	"I find that they, they struggle to understand what their body is feeling like what actually feels good, what actually feels not so good, what's actually safe, what's not safe."-Clinician 4
	"So, its also just about why, because we can tell them because it's good for you. But they need more than that. They need more overt explanations, and understanding their body."-Clinician 4
	"Starting to create a positive relationship with physical therapy for them, and slowly building it up"-Clinician 3
	It's not something that we've really covered. Sort of in postgrad or undergrad"-Clinician 4
	"But I feel and this is something that I like raised with the university as well. I feel there's quite a very big lacking and gap in the teaching of Special pops [populations], you know, at a undergrad level." Clinician 6
	"I think lots of training will be needed and not just training but also follow up"-Clinician 2
	"The caregiver needs to be well trained, and that that there needs to be follow up"-Clinician 2

Theme 6: Monitoring/tracking progress: "I've never in my life received a full on report"

Goals, progress and feedback

Overview of findings	***Clinician statements***
The majority of the clinicians (n=7) felt that it would be important to have goals for the child to meet as well as plan to meet the goals. The clinicians indicated that the plan should allow for growth of the individual. They indicated that parents wanted to see physical changes and progress when attending therapies. One clinical indicated that *parents could not always follow up on the recommendations* and this could be barrier for their child's progress.	*Yeah, I think goals is, yeah, something?And then we can kind of show the parents like this and this is where your child is.This is the goal we are aiming towards and this is how we are going to look at getting there."-Clinician 9*
	"They[parents] almost want to see physical changes if that makes sense. So for example, your child comes in with kyphosis and now we've corrected that."-Clinician 9
	"I think that's where the crux of the matter is, parents cannot always follow up on the recommendations"…" very often our children when we see them for a baseline assessment and we see them after a few years again. It's very often that nothing has changed."-Clinician 8
	"Anything that would have a growing aspect to it and improvement aspect to it."-Clinician 1
	"Give them a goal." Clinician 1
In terms of feedback and tracking progress one clinical indicated that she had never received a motor report in all her years of practice. One clinician indicated that it would be important to have a scale of function to observe and feedback progression of the children. One indicate that it would be important to track progress to encourage the child when they are improving .Importantly it was stated that the children themselves should have frequent daily feedback or cues throughout the day to cue better movement patterns and postures.	"*I've actually never in my life received a full on report."-Clinician 1*
	Umm, I don't know again like a sort of like a scale. *So you can show them where your kids started, where they are currently, what we're aiming towards again, that type of thing."-Clinician 9*
	"You have to look at them. It's like them versus them. And you look at their progress on the day."-Clinician 3
	Just constant reminders, if they if they tend to hunch or if they tend to slouch to one side or if they tend to have one on this? You know? In a strange position if you keep telling them you know, the better way to do it, and I think that they can still build habits, hopefully, better habits. Clinician 5
	But if you have a quantifiable measure, you can actually when they hit that dip, especially in the motivation, you can actually retest and be like. No, but you are improving-Clinician 2

iii. Parent perceptions, knowledge and insight of motor skills and physical activity levels in individuals with ASD

Theme 1: "People are unfit, overweight and unhealthy"

Overview of findings	***Parent statements***
All of the parents interviewed for this study reported that their children had motor deficiencies. They reported that in general they perceived most of the children on the spectrum to have some form of motor deficits or that they struggled with motor related tasks and that is was a common issue. In some instances the parents indicated that they did not know why the children had motor difficulties but just that they had observed them in their own children and in others.	*"From what I saw, in the schools, it was a common issue [motor deficits]."-Parent 1*
	"I don't have a clear understanding of why it is that they struggle. But I know that kids with autism does struggle with motor skills."-Parent 2
	now I don't think the average kids get that much exercise in.Parent 7
	"I lived in many places over the years for kids now I think most people are doing nothing. They are Phone kids, they just useless. Its like what the hell like, like remember when we were in the 70s 80s we used to play an outside and run around, now these kids cant even do that. Parents have to put them in a gym to get them a

The parents reported that they felt the motor proficiencies of kids on the spectrum were varied where some had good and some had poor motor skill levels- and that it was as if the motor impairments lay on a spectrum as well. One parent indicated that not even neurotypical children get a lot of exercise. One parent indicated that she had seen that some children aren't able to sit while others are active. On of the parents who was on the spectrum himself stated that he felt most people are below the standard and that he feels that modern children aren't able to do things that kids in the past were able to due since they are living sedentary lives. He also stated that physical activity make you feel good after doing it and advocated to improved physical activity levels.	*little movement and to make them do one pushup, it's completely useless in my opinion most of the people nowadays are way below standard."-Parent 4-*
	"I don't think autism from my knowledge actually presents a same way. In, you know, children that are on the spectrum. I think it's called a spectrum for exactly for that particular reason is because what happens in one child is very, very different. But from a motor perspective, I suppose depends, you know, they can either, you know, have difficulty with sort of like fine motor, gross motor or a little of both in our particular set of circumstances." -Parent 5
	Autism is a spectrum, so you're gonna have some kids like me with like, super high on the level."-Parent 4
	"We generally know that they have limited motor skills, its one of the issues. So both gross motor and fine motor seems to be a challenge. Yeah, so that's what I can say. It's, it's common, and it's something that we observe with our child as, well"-Parent 3
	"Some were very active and some battled to sit or to stand or to run"- Parent 1
	I'm all about as much as our children neurodiverse, I'm all about creating a set of circumstances that allows them to thrive, so that kind of intervention would allow our kids to thrive.-Parent 5
	it makes you feel good and achieve small things, especially when it's physical. Parent 4- I can train and feel good. That makes me feel good.-Parent 4- *"People are unfit are overweight and unhealthy "Parent 4-*
The parents reported specific motor difficulties that they had seen in their children. Common issues reported by parents were low muscle tone, poor fine motor skills such as writing difficulties, gross motor skills, underdevelopment of body musculature, midline crossing issues, poor flexibility and strength, balance issues, coordination difficulties, and poor balls kills ,poor body perception skills, poor general strength , weight issues contributing to reduced mobility.	*"A lot of them have low muscle tone"-Parent 5*
	"Autism kinds struggle with motor skills, big and small, even with the fine or you know, like jumping rope or something like that. I know it's difficult for them. That's very difficult for them. I think it's because the body perspective doesn't really know what to do."- Parent 7
	"It's also the finer motor skill skills like with his writing, and doing little things. He battles to put things together, he battles a lot more than their normal children"- Parent 1
	" It's also under development of the muscles"-Parent 7
	"He's got a big problem with a crossing of from left to right and try to leave side of the body."- Parent 6
	"Because that's what us autistic people can't touch their toes"- Parent 4
	"They can't do push ups, they can't bend down and get on their knees because they're quite fat."- Parent 4
	"He can't write properly."- Parent 6
	"Balance is a problem."-Parent 7
	"The areas that there are areas that he struggles with, you know, as much as he can walk and run, sort of like a coordination of those movements. He struggles with like, catching a ball." -Parent 5
Other motor deficits reported by the parents were fatigue and difficulties with performing daily activities	*"He battles to do a few things like walking up and down stairs. He can swim very well. Also his strokes are not what they should be. But the biggest problem is, you know, he gets tired."-Parent 1*

and vocational activates i.e climbing stairs, feeding , bathing, brushing teeth.	*"Ok so um, you know, personally, my experience with my son is he's not able to feed himself for instance, holding a spoon and a fork is quite difficult for him to navigate that from the bowl to the plate to his mouth."-Parent 2*
	"And things like, I don't know, if its bathing himself, you know, being able to hold his hand out, sort of like to sort of like bath himself properly. Hold his toothbrush in a way that sort of like would make sense. So we so we've actually got a special kind of toothbrush. So it's those sort of like simple life everyday life things really"- Parent 5

b) Reduced PA levels

Overview of findings	***Parent statements***
Parents overall, reported that there was variability in physical activity levels to their knowledge. The majority of the parents stated that children with ASD were not meeting the ACSM general population guideline of participating in moderate exercise for 30 minutes per day for 5 days of the week. On indicated that she felt that children in general don't meet those guidelines. One parent stated that although their children were very active or hyperactive they felt that they were the exception to the rule and that in general children with ASD were not meeting the guidelines. In instances where parents could not give information on what they thought general physical activity levels were like for ASD kids they spoke about their own chidrens phyical activity levels which seemed to vary from parent to parent. On eof the parents indicated that physical activity needed to be improved and that we need to find innovated way to improve pa.	*"I know a lot of ASD kids are not active. I know."- Parent 7*
	"No, I don't think, I don't even think that kids , neurotypical kids are meeting that right now. They're all sitting in front of the iPads. And gaming (laughs a lot)" "I don't think they're getting enough. Not at all."-Parent 5
	"Inactive? Definitely inactive. He actually has to be pushed to do anything physical." -Parent 1
	"Well, I don't find there is a lack of physical activity with my son". "I know that there different levels" -Parent 2
	"It depended on the individual. "Parent 1
	"They're not getting the amount of physical activity level that they should."-Parent 3
	"We need to improve it. And we need to find innovative ways in which to do it." Parent 3
	"Because me and my husband are natural, active people. We get our boys very active, very quickly, like we walk and we run and we swim and we do the bike riding is now our next step with the boys. And I've noticed that it's not the typical household you know, people don't go for a walk anymore." Parent 7
There was a distinction made between verbal and non verbal individuals on the spectrum where one parent felt that non verbal individuals were not meeting guidelines due to barriers including parent fears in encouraging the children to participate in physical activities and prioritizing other fundamental needs before advocating for physical activity participation.	*"Nonverbal autistic people are not getting it because parents are so stressed out just trying for them be normal or like go to the toilet to listen, to eat and to stuff like that, they don't have the energy to make them do physical stuff. They just throw them in a laptop, play with that. do your thing, and I find sometimes that parents are scared of kids who are autistic, they are so scared to tell them don't do this."- Parent 4*
Many of the parents mentioned that physical activity levels would be dependent on whether the school they are attending and that it also could depend on their socioeconomic status. One parent indicated that reduced physical activities were influenced by urbanisation and changes in lifestyle. She indicated that in the urban areas parent drive their children to school, allow them to play with iPad, and generally do not play with other outdoors for fun.	*"Usually it depends on like if in the school environment if they're getting it? or, in their home environment, so I find that I can't give like the exact percentage. Maybe some of them are getting it but not all." Parent 3*
	"It's a lifestyle thing, guys. I think if we were having this conversation, and we were in my village where I come from kids over, they don't have there's no Wi Fi, there's no iPads, they're outside running around, walking to school, and cetera, et cetera. But in urban areas, we're driving our kids to school, they do have iPads, they have you know, we don't they don't I played outside growing up like with a neighbour kids and my son doesn't do that."-Parent 5
	"Especially here in 3rd world Africa it's worse. I think it varies every child is different levels, so their circumstances are different."-Parent 3

c) Benefits and reported cross over effect of motor skills

Overview of findings	***Parent statements***
Many of the parents indicated that participating in physical activity helps regulate their children, it helps with stimming and that it calms their children down. In fact one of the parents who is autistic himself, stated that he feels that exercise has a calming effect on him and helps him to function better as well as allows him to achieve small things which encourages him further. One of the parents indicated that exercise should be one of the first things parents should do in the day with them as it allows for better engagement with the child , as well as the child being more calm during the day. One of the parents indicated that their child had realized that performing exercise activities helps him and that it helps maintain his function.	*"I think that's why it's so important for me because it regulates them. It's a learning opportunity and helps them to just be more calm."-Parent 7*
	"He's got a trampoline which we have put in his room and then I gave him the office chair because he loved the office chair so much, so now he sits in the office chair and he spins on the office chair. So that definitely helps with stimming-Parent 2
	"If its first [PA] you have a calm kid, you have a kid that will listen to you, you have a kid that will be engaged with you."-Parent 7
	"Physical calms them down, physical calms, everybody down , because you do some things you get endorphins all the other stuff dopamine , it makes you feel good and achieve small things, especially when it's physical.""And I think specially, like for me, physical activities are a form of calming me down." -Parent 4
	"My son actually enjoys doing certain physical things because he actually he realizes that it's helping him and if he doesn't do the exercises, he deteriorates very quickly."-Parent 1
	"I think that also stimulates the brain with what you know, with what he's doing, it makes life a lot easier for him."-Parent 1
One of the benefits of physical activity reported by the parents was that it is a cost effective therapy, that can assists their children in being more independent which should be a key focus when managing these children. It was stated that it would be beneficial across all aspects of their life whereby if they have improved motor skills and can do specific task they would be less reliant on others around them.	*"Those therapies on their own are not that expensive. I mean they are far less expensive than say for instance his psychiatrist or psychologist." -Parent 6*
	"From an independence perspective, if we can get them as independent as possible and a big part of that independence is is from a motor perspective. So it definitely should be a key focus from a therapeutic point of view."- Parent 5
	"It's something like across all aspects of their life, you know, it's like you know, if they can't for example, carry a cup of tea. You know, from the kitchen to the lounge, you know, it's like a motor skill, right? I mean, then they're always going to be dependent on someone making them a cup of tea"-Parent 3
The parents stated that other benefits included improved sleep , improvement in mood, improvement in concentration, memory and improvement in appetite. One parent specifically mentioned that there was also value in starting physical interventions early on in the children's lives. They indicated that the more physical activity they do the more they continue to do. They indicated the earlier they begin angagign with physical activity the better .	*"But when he does his sport, I feel that he's in a far better mood. He's more relaxed, he sleeps better at night. And I find that the physical activity really helps him tremendously and even with sums- he loves doing maths, well arithmetic. And I find when you start doing his exercises here, he seems to concentrate a lot better." -Parent 1*
	"I think it'd be very beneficial, the more they do I think the more active they become, and I think they, it relaxes them mentally, and they sleep better at night, which they need. Otherwise, they're very, very cranky in the morning."Parent1
	"I think it is, like a mood stabilizer. It's also good for the appetite, you know, so then they can eat better. Yeah. I mean, it's good for all of us." -Parent 3
	It helps them to relate, to remember, to tell me, there are so many things that they can do, its so much more than just being active.-Parent 7
	Because I know that my both my boys started two years as soon as we realized there was something not right and I look at their friends that has started it later on, or not at all, and I can see the difference in their muscle development.-Parent 7

Theme 2: Barriers: it's not that they don't want to, it's that they cannot.

a) Core deficits :

Overview of findings	***Parent statements***
Overall, parents described many barriers toward physical activity and one parent mentioned that in some instances it wasn't about the children wanting to do tasks but that they actually couldn't. Barriers that were mentioned that were directly related to the core deficits of ASD children included social barriers, interaction and communication barriers , cognitive barriers and sensory barriers. Social barriers cited included a lack of *social integration and social support and a preference not to engage in team activities. Another barrier was lack of understanding of social cues.* *Parents mentioned that not being to understand activities or not understanding how to participate in the activities could be barriers for them.* Parents indicated that the largest barriers were the sensory issues their children had as that prevented them from actually engaging with certain types of physical activity and dictated which mode of activity they could tolerate. They indicated sensory deficits could trigger negative behavioural responses. The mentioned that some children did not like to engage in social activity as sweating was a sensory discomfort.	*"You must understand that about a lot of autistic children, it's not that they don't want to, it's that they cannot." Parent 6* *"So I really think one of the things that is really holding our kids back is this lack of social integration and social support like for my son, he's not interested in team sports."-Parent 3* *"From what I noticed, they find it difficult to mix with other children."-Parent 1* *"A lot also has to do with sensory issues. So sort of an example, going to the park becomes a sensory meltdown because it's like too many things going on you know, like that. The sun is too strong. This is this is, this is this, this is that so every little thing becomes a challenge."- Parent 3* *"But if it's just a matter of not being able to understand like the concept, like he can't blow his nose, as much as I've been trying to teach him, you know to blow his nose, he can't do that, so I don't know if that fits in there"- Parent 2* *"Because he was so little, you cannot get him to participate in things he does not understand."-Parent 6* *"In my son's case, he's got a mild intellectual disability it's like, how do you get them to understand why it's important? So those are our challenges."-Parent 3* *"He doesn't like sweating because he's autistic." I can't enrol him in soccer. I can't enrol him in in tennis. I can't enrol him into anything else that's outside because he doesn't want to sweat."- Parent 6* *I don't understand that social stuff."-Parent 4*

b) General barriers and challenges

Overview of findings	*Parent statements*
Parents indicated that service providers may be too fearful in working with their children and thus they could be excluded from the opportunity of receiving therapies. Furthermore parents indicated that in some instances schools did not want to take their children due to having too many comorbidities which resulted in then not participating in school related physical activities.	*"They [service providers] are scared and they don't really know how to work with them"- Parent 4* *"They didn't take X because X has got too many additional uh disorders to just autistic and they asked for a IQ and educational risk assessment and he ranked very low. But my psyc,, ag his psychologist assured me that even that he ranked low. It's because he's got lacking skills. The work wasn't done properly. Uh, that he's highly intelligent, but they only see the scores, and they decided, no"-Parent 6* *"The large schools take only take children with high functioning autism."- Parent 6*
The majority of parents indicated that one of the largest issues was that their children had low motivation and may not be interested in participating	*"As soon as there are rules , then he looses interest in the activity." Parent 7* *"Its not safe , hulle is nie lus nie, [they don't feel like it] , they don't want to, its that kind of stuff."-Parent 7*

in exercise or physical activity and that this was one on the big causes for reduced physical activity levels. On of the parents indicated that they did not feel that taking them to therapies was becoming useless as the her child would not engage in the therapies- she indicated that at this point it would be more beneficial to provide an understanding and get a buy in from her child first before engaging in further therapies. One parent indicated that self-confidence may be a barrier to participation. One parent indicated that their child did not enjoy certain physical activities and that was a barrier for participation.one indicated that sometime the children just don't feel like engaging with pa and another stated that if pa is too complicated or has too many rules they lose interest.	*"It's always nice to sit and listen to somebody and you're so motivated but then you have to do it. For a week, a month a year. It's good , but then it starts to feel like work."-Parent 7*
	"He doesn't have that interest and he doesn't have the motor skills to actually do it." Parent 3
	"So like I said, there's no point going for OT in and you don't do what the OT tells you to do at home. There's no point going for swimming twice a week. But then when we take you to the gym you don't swim, you know that kind of stuff."- Parent 3
	They want to lie around most of the time because they feel that they can't do anything more than what they think they can, and I'm sure with stimulation they can do a lot more."-Parent 1
	"The biggest problem, I think is interest, they actually get bored. And they like to see if you can actually think of new things for them to do or things that they feel are beneficial to them. I think boredom is one of the big things with them and then they start lying around and not willing to do anything."-Parent 1
	"I mean, he's had OT over the years and had assessments you know, we've come to the point where if its like ,if he's not motivated, I'm at the point where I'm like, like, why should I do all of this?"- Parent 3
	Uh, so for him that was not fun at all. He did not enjoy it."-Parent 6
Parents indicated that one of the biggest barriers was finance as and a lack of resources which prevented their children doing various physical related activities. Some facilities have better resoirces and can faclittate exercise beter i.e having a jungle gym on the grounds One parent indicated that they understood that exercise was a cost effective therapy yet that with paying for many other therapies the costs added up to a lot of money. *One parent indicated that she felt that a big barrier was that in general people want instant results and that taking children to therapy and not getting instant results may lead to poor compliance of parents taking their kids to therapies. Another parent indicated that even when offering therapies (the parent offered martial arts classes) that parents would not be compliant in bringing children to participate in the class .*	*"I think the biggest issue is the finances"-Parent 6*
	Everything is, finances it determines a lot of like, poorer people they are just struggling to survive."- Parent 4
	"So now you pay paying for a private school and you have to pay for horse riding and you have to pay for this and you have to pay for that. So I think sometimes these things just lag behind because parents don't have the money."-Parent 6
	"And the other thing is that therapies on their own are not that expensive. I mean they are far less expensive than say for instance you his psychiatrist or psychologist but if you have to pay for all these therapists out of your pocket, it's going to add up and I think that's a great contributor to the fact that people don't do these things because they cannot afford it." Parent 6
	"They[parents] are all working or not everyone can say okay, let's go to park and then afterwards take it you to wimpy or something, you know, we have to understand also the financial constraints of other people"-Parent 3
	They've only got a playground with the little house on it and all of that."- Parent 6
	"We live in a society where people want instant results. So if they don't see instant results, they will take the child out of physiotherapy." Parent 6
	"Fails, because you try with the kids thing- they don't come, then the parents don't want, and people don't do anything. That is a social marketing problem, it just fails.

Theme 3: A lack of motor assessments and a need for specific variables to be measured

a) Current motor assessment tools , appropriateness and missing variables

Overview of findings	***Parent statements***

The majority of parents reported that their own children had not had motor assessments done. They also believed that motor assessments were not being readily done for children with ASD. One parent indicated that although her son had attended remedial schools here son was only diagnosed with ASD when he was 17, while another parent indicated that if the principle at the school her son was attending did not have first hand experience with ASD, that she felt his diagnosis would have been delayed or missed. Parents indicated that in most instances other assessments for example for speech or behaviour was done but not for motor skills. Parents indicated that if an assessment was done it was done once as a part of a school readiness assessment and that there were no follow up assessments. One parent indicate that his children had had motor skill assessments overseas in Switzerland but not in South Africa. On parent indicated that she only realized that her son had motor skill deficiencies when she had observed other kids performing task that he couldn't Parents believed that assessments were needed and they advocated for early intervention. Parents indicated that they felt that assessments would be of value in providing information on what each child needs based on deficit so that time is not wasted on unnecessary therapies and treatments.	*"No, I haven't seen anything."-Parent 1* *Has your son had any motor assessment?* *"No he has not"-Parent 5* *"Definitely not in schools because he went to a special school and they didn't even realize that he had autism. I only found out afterwards, after he was about 17, when I went to a psychiatrist, they had psychologists at school, but they didn't pick up that he had autism, which was surprising because it was a school for children that were a little bit delayed."-Parent 1* *"My son went to a special school for 10 years, and they never picked up that he was autistic. They had psychologists, they had all sorts of specialised teachers and everything. And I think they should have been able to pick up that he was autistic. Maybe we could have helped him when he was much younger, and he would have been better off at the moment. So I think they need to have somebody there that can pick up certain traits especially when they're doing gym or playing sport."-Parent 1* *Do you believe that motor assessments are being readily done for these kids? "In my experience, no." -Parent 5* *"I never had one. We just had like a speech therapy and a occupational therapy, assessment of the voice. -Parent 7 "* *"The first time I heard about it is when you emailed, and when you put the add on, and I was like, this would actually be a great tool."-Parent 7* *"They did. In Switzerland when we lived there. They did an athletic assessment at school, they throw balls, they do stuff, they check how far they can jump , they do basic hopping and skipping, play with balls or kind of stuff. they did all kinds off stuff . I don't know what they call it but they did all this kinds of testing. In Cape Town they don't really do much of that. Kind of lacking in that stuff."-Parent 4* *"I don't know if it was like an actual motor skill assessment, but he's had assessments by a neuro development physiotherapist, I just have to go into the report and see whether it was an actual motor skill."-Parent 3* *"No, no, she actually did motor assessment"-Parent 6 -* *"The only reason she picked it up is because her son had a you know, he was autistic. So I don't think- if she didn't have that personal experience. It would have been something she would have picked up. -Parent 5* *"Do you understand , there's no , I don't expect them to have another assessment next year ,there was no discussion about ok you're going to see how far he's progressing and maybe needs therapy"-Parent 2* *Ya, ya , ya Im also a big believer in ealy intervention.* *Parent 7* *"An assessment would be a great idea, at least that way we know where this particular kid is and what to focus on. And we don't spend time doing things that are unnecessarily we could just literally focus on what that particular kids need and then put our focus there."-Parent 5*

	"When I haven't seen any, so I would like to actually have a look at one of these programmes that might be very beneficial to him."-Parent 1
Parents believed that assessments were often not a true reflection of their child's capabilities. They indicate that certain things could influence testing, for example one parent indicate that her child was not receptive to testing, one indicated that if her child was better prepared for the test in terms of what to expect that he may have performed better. One parent indicated that because parents spend a large amount of time with their children that often they observe deficits or problems that are not measured in assessments or due to stringent timeframe of assessments not all things can be measured. They indicated that parents should be involved in assessment in some way to assist in providing feedback and to assist in drawing attention to specific issues the parents may have picked up. One of the parents indicated that assessments are not appropriate and that there should be a standard on what to test for. One parent indicated that assessments used should be specific to ASD.	*"I've taken my son for assessment for school and part of the assessment was skills. And what I've noticed is that it wasn't a clear analysis of what he can and cannot do, because he's not like really receptive. And, you know, were as I was able to tell them, I know that he can do this. I know that he can't do that, that was a better indication to them than him physically being there and doing the assessment. Yeah. So I'm not I'm not really sure whether the assessment is going to anything unless you going to do it that way. But having a kid assessed, you know, in person at a specific time. That's very difficult."-Parent 2*
	"I knew they were going to test him on certain things, but I didn't know what exactly to expect. Kind of like more. If I had known that that was what they were going to ask about. Maybe I could have told him, you know, this is what you're going to be asked to do whatever , just to mentally prepare him and then maybe he would have been more receptive I dunno."- Parent 2
	"You with your child the whole afternoon and the evenings and you notice specific things? Umm that they might miss because they working their assessments are say an hour session or an hour and a half session plus an hour and a half session which is 3 hours sessions in three hours. You can only gauge as much information. As you can get out of three hours. So I would say get the parents involved."-Parent 6
	"Yes, I think it's good for autistic people, especially some of them might have like, issues with their bodies, could happen, like any human so to have a standard how to test- motor tests not appropriate."-Parent 4
	"So I think I think there is definitely a need for an assessment that takes into account autism, you know."-Parent 3
	"There are things that they might miss because, like I said, although they spend a lot of time at school, you spend the most time with them."-Parent 6
Parents provided insight into what variables they would like to be seen tested. The majority of parents indicated that functional and everyday tasks should be assessed. Tasks they specifically mentioned were tying shoelaces, carrying a schoolbag, moving and carrying dishes from one place to another and picking up items They indicate that assessments should include a measure to indicate to what extent an individual can perform tasks independently so that appropriate care may be provided. Parents indicated that being able to perform gross motor skills like running, hopping, climbing, cathching, rolling around and jumping would	*"So what I will say for my kids was important to do those things like run, jump, climb, hop, balance, stretch, and when they fall on the ground, to learn movement on the ground, rolling around, so to use all that different muscles to be able to do those things, you know, like, like, like, like monkeys playing around ." -Parent 4*
	"A walk test, a little running test, or climbing, something like this, that actually helps the balance. I found that balancing was also one of the problems that he's got."-Parent 1
	"Tie shoelaces ride a bike and undress themselves"-Parent 3
	"Carry items, like, you know, shopping bag, school bag, dishes, to and from one place to another without breaking them, or spilling something, I would imagine that they would actually try and see how well developed the muscles are and how they're coping was just every day, walking, doing things, picking up things and just everyday chores"-Parent 1

be important to test as well as balance, mobility flexibility.	*"I would imagine that they would actually try and see how well developed the muscles are and how they're coping was just every day, walking, doing things, picking up things and just everyday chores."-Parent 1*
	"But when I as a mom, when I say okay, I think you shouldn't be doing this and he's not doing it. Can we? What kind of tools can we assess whether he's just been lazy? Or if there's something there you know, that kind of thing. That way, if we catch things that you know, that are not right earlier, then we can start dealing with him earlier instead of having to wait like when he's a year old or two years old, and it's still not walking or when he's still not sitting upright by himself. Those kinds of things, if that makes sense"-Parent 5
	"I think things like to what extent is the person able to independent independently perform certain tasks or certain daily activities"-Parent 3
	"And obviously, as a parent, I feel that obviously I want to be as honest as possible, because this is going to give an indication of what is lacking and how I can help him to better that. And I think that's the point of the assessment. Yeah. Yeah. So that's what I think. I mean, you can do the assessment. I think he's obviously you need to be aware that this is a possibility that you wont be able to assess everything that day." -Parent 2
	"So I think you can do all of the general assessment, but then also have the parent answer if they are able to do that or not."-Parent 2

b) Motor skills are not a priority

Overview of findings	***Parent statements***
The parents believed that motor skills are often neglected and that often therapies target core deficits such as speech and that motor skills are sometimes forgotten about. One parent indicated that parents are often focused on finding schools for their children to attend that motor skills fall by the way side. Overall parents indicated that motor skills should be tested so that a baseline can be established for the child. In this way targeted therapies can commence.	*"You know what it feels to me like these days. It feels like that. Therapy and parents and the doctors all are pushing our kids mentally, but the body went missing somewhere."-Parent 7*
	Ya no, it's definitely worth it. Because then at least you have a baseline of where he was as well." -Parent 2
	"The so called priorities in the autism sector-from what I can see, the one is, especially for those children who have limited speaking skills, speech, and so people are like more focused on getting them to speak or to communicate. So that seems to be like obviously one of the biggest priorities and the other is just in terms of schooling, you know, so like which school do they need to go to- a special school or a school for autism. So parents are so just obviously focused on those two components. I think that you know, other things are less important than those two."-Parent 3

iv. Parent knowledge, perception and insight into how motor proficiency and physical activity levels can be improved

Theme 4: "You have to have a mindset change because otherwise you're gonna miss the boat"

a) General

Overview of findings	***Parent statements***
One of the biggest considerations parents reported to the researcher in building a model and getting individuals who engage with exercise professionals was considerations relating to the exercise professional themselves. One of the biggest concerns for parents was their children being able to trust and relate to the person who would be working with them and being able to trust them. Overall parents indicated that therapists should consider making therapies fun, be actively participating in sessions, be consistent in administering intervention, and provide consistent feedback to parents. One of the parents who is on the spectrum themselves mentioned that he believes that he is able to communicate better than neurotypicals' with those on the spectrum. This is an important consideration when conducting an intervention in terms of who should be responsible for leading sessions and communicating instructions. One of the parents indicated that doing tasks with their children might provide a sense that everything is ok.	*"It's also about trust. He builds a trust relationship with this specific person. If he finds them trustworthy, he will work with them better. Its this, children pick up on these things very quickly, If it doesn't trust the person, he will refuse."-Parent 6*
	So I think they need to have somebody there that can pick up certain traits especially when they're doing gym or playing sport"- Parent 1
	"And the other thing is being with your child, you know kids feel so so quickly that they're not part of something or they're not worth something and I think just do activity with your child like a mom and a dad. Doing something with your child isn't enough for to tell them that they are okay, its fun to do something with them. Even if they don't do it the way you want it to be done. And they can do it the way they want"-Parent 7
	"That is like easier for me to communicate and tell autistic kids like. No, to do this and do that and tell him no you can't do that."-Parent 4
	So there's also sort of a trust aspect there where the parent needs to trust their therapists to also make the right decisions. Trust And the only way? That we trust them is through seeing results"-Parent 6
	"Be playful. Participate in their therapy.You will have to be actively participating." "The fact that she participates with him in most of the of the activities, uh, makes a huge difference."-Parent 6
	"I get regular feedback on what she's doing. I get videos from her on what she's doing, and it's amazing, and it's amazing that she gets him to participate, but the way she gets him to participate is she does the things with him."-Parent 6
	"You will have to do it consistently. You can't just do it at first and then think you going to let them do things on their own."-Parent 6
Overall parents indicted that those working with children ion the spectrum needed to have a mindset change so as not to miss anything important as children on the spectrum were very different to neurotypical children.	*"Our divergent children are totally different from normal children.You have to have a mindset change because otherwise you're gonna miss the boat."Parent 6*
General special consideration the parents stated that should be considered was exercise programme design if exercise were to be implemented. Parents mentioned the environment and safe spaces, frequency of exercise intervention, mode and type of exercises to include or make use of for the children, equipment usage, and implementation in the routines of the children. One parent indicated that visual instructions could be of benefit when explaining tasks. Parents indicated that the length of sessions	*"So if we can have safe places they can go to be active and to enjoy the activity in a safe environment because I also know that autism kids likes to run away and walk away. I think that'd be more motivating for parents. Okay, let's go somewhere. Our kids can have fun. We can maybe just sit for five seconds and watch them." Parent 7*
	"Ya like so having picture of things so that you can say this is this, and having kind of like a story telling experience. Like I've got one for the toilet , he is still not potty trained. So, every time I show him the chart, it will say, you pull down your pants, use the toilet, you wipe etc. and the only thing he wants to do is flush the chain and wash his hands."- Parent 2

would to be considered for example doing shorter sessions on alternate days or longer sessions depending on the child. Another consideration parents mentioned was that the more activity you did with your child the more you would need to do. This was an important point regarding considering progression on the programme. Parents indicated that physical activity could be directed (or even themed) and used for different things- for example to calm a child down using directed dynamic physical activity or yoga, to improve flexibility or even to improve social skills. Parents indicated that instructions may need to be repeated , that attention spans should be considered. One parent indicated that implementing exercises should be graded and integrated slowly over time so as to not overwhelm the children.Parents indicated that considering implementing activities as part of their routine may be beneficial, as well as throughout their lives.	*"Say instead of like walking like 20 minutes with my boys now, we have to work like 40 to 45 minutes for them to actually feel like we had some physical activity right now. But now I don't think the average kids get that much exercise in."-Parent 7*
	"Where the autistic people can feel safe, and where they can feel sort of like supported and no stigma, you know, that sort of thing." *Parent 3*
	So I think something like that maybe, autism gyms or play gyms. *Parent 7*
	"for example, like you have autistic hour, you know, like in certain venues, so they dim the lighting the switch of the music, that kind of stuff. So maybe to have them not just in April when its autism awareness month, but to have it on a regular basis."-Parent 3
	"So if you can do, like directed good dynamic, physical activity, I think with kids , especially autistic kids that's good for them to kinda calm down, you know, like release and focus."-Parent 4
	"I think maybe if they could break it down to sort of like, maybe 10 minutes or 15 minutes. Every other day. That might be a better idea." -Parent 5
	"Better have like specific themed 15 minutes sessions."-Parent 6
	"So we need something like maybe like a Saturday morning, you know, in different venues on a regular basis."-Parent 3
	"They can't focus that long, on certain things so I have to slow down and repeat it and do it much slower. And now they do it on their own."-Parent 4
	"So we need something like maybe like a Saturday morning, you know, in different venues on a regular basis. I think parents they very happy to pay for that you know, to save raging group classes, you know, because we could have a slot on a Saturday with this time to this time and you know, maybe we can do like one weekday afternoon started interest so they can get their physical activity. It can be very targeted, and at the same time, they can have that social, social aspect. And that I I think is like one possible solution, you know, Parent 3
	"some funny like dynamic thing like gymnastics or fighting and stuff like that. So the more the more movement, the more stretching the more mobility the better. And I think specially, like for me, physical activities are a form of calming me down. And I just like it so I think a lot of like autistics I met and those two boys , they are physical , they stim and they like doing physical things like the one will spin around and shake his whole body the other one is moving around and walking around and stuff. And for me even now when Im talking Im moving my hands."Parent 4
	"it took a while for him to get used to the swing"-Parent 6
	"Next year we will implement the swimming. We don't want to overwhelm him now."-Parent 6 -
	"Other kinds of exercises that are not necessarily going to get your heart rate up like yoga or pilates and that because that's also really good for your muscles, apparently."-Parent 5
	It's part of our routine and I think routine is also very, very important for kids". "They know at four o'clock in the afternoon, we're going for a walk"- Parent 7

	"Even if he doesn't do his exercises for a whole week I find that he actually battles to get up and down stairs, which is a problem if you have stairs in your home or wherever he needs to go to."-Parent 1
	The stuff,-it's it's heavy, and they love that heavy input.- Parent 7
	"It's part of our routine and I think routine is also very, very important for kids".-Parent 7
	"But I think start with with kids, okay. And get them into a routine? But I think there's so many like young adults. That also could benefit from this because it's not the end of the world at 25 and useless. You can still become something physically. Yeah. Even if even if we started 25 you get it .Because at these autistic schools sometimes they are older kids,there like 18 1716 year olds in their schools and they have done nothing too, you know. So what about them ?"-Parent 4
Other general special considerations the parents stated that should be considered regarding a motor or physical activity programme were things like making activities fun and interesting, using incentives and avoiding to many rules and using heavy input techniques.	*They did obstacle courses and when he was old and now they did obstacle courses and stuff like that. To make it more fun and interesting."-Parent 6 -*
	"he loses interest as soon as there are rules"-Parent 7
	"He does not like PE except if they make it very interesting for him."-Parent 6
	"So she would use it as an incentive because she's got a whole lot of balls in a pit, and he loves the balls and the pit. *So she would say, OK, at the end of the session you can have 5 minutes of playing in the balls and the pit, you know.* *So its a it's a carrot in front of the nose."-Parent 6*
General considerations the parents stated that were related ASD specifically, included interaction (specifically differences with non verbal and verbal children) , social deficits , and sensory deficits. They indicated that sweating and loud noise, may be a sensory trigger for some children. Importantly two parent indicated that children on the spectrum doesn't always get along with others and that this could influence whether interventions were administer in one on one formats or group formats. They also indicated that they may have cognitive barriers in terms of understanding what is needed from them and that time for repetition and practice would be necessary to consider.	*So it depends which non vocal, so you get some that listen and to stuff , and you get those nonverbal ones who don't listen at all and just do their own thing. "-Parent 4*
	"He doesn't like sweating, so he will not participate in outdoor activities because he hates sweating. He does not like it at all."-Parent 6
	"He doesn't like walking barefoot on grass."-Parent 6
	"It, also each family would also have different needs depending on the children's sensory profile, because everyone is obviously different. But it would be good to check in maybe, like we have options of one indoor venue and one outdoor venue."-Parent 3
	"We are not people friendly."-Parent 4
	"Because he was so little, you cannot get him to participate in things he does not understand."-Parent 6 -
	"No loud music, because for some people, they don't like the loud music , you know something very muted , very calm"-Parent 3
	"Yeah, So different ones enjoy different things, it just depends on what they've been exposed to what their sensory triggers are."-Parent 3
	"So an individual sport is probably the best thing for them. Well, well, that's what I found with mine."-Parent 1
	"It can be very targeted, and at the same time, they can have that social, social aspect." -Parent 3
	"I do feel that the visual charts, are very helpful."-Parent 2

	"My child is my child has anxiety. My Child is hyper. My child is all over the place. My child is this. My child is that."-Parent 6
	I think practicing is really important to these kids. Yeah. Repetition. So that they learn, obviously the, you know, different kids learn different ways. Like Some of the more visual learners, some of them are learning through play. You just have to understand what works, what works for your kid."-Parent 2
Parents mentioned that it would be important to consider that the person working with the child would understand what the child needs and consider involving the parents when a therapist felt uncomfortable. One parent (who was on the spectrum) felt very strongly that guidelines for physical activity should not be adapted unless they need to be. He advocated for individuals on the spectrum to be encourage to meet neurotypical guidelines and standards wherever possible and only for adaptations to be made if the child needed them to be made. Furthermore, he indicated that if an intervention or therapy was to be included as part of an individuals routine it would need to make very clear sense to the individual before they would adopt it.	*"For me the most important with my son is that he is able to understand and express himself because that way, he will be able to communicate what he needs."-Parent 2*
	It's always a good idea to get the parents involved. To for them to #1 understand what you have planned #2 their concerns. If it's not under what you've planned, their specific concerns and make it a collaborative experience. It makes you feel included in decisions and, funny enough, at makes a huge difference. Parent 6
	Not to lead, The thing with autistics is that , we like blank procedures and things okay. We follow procedures and routines and stuff. I like that. Most of us you can google it , we like that. We follow a route to school we wear the same clothes we eat the same way we brush our teeth the same , you know it's these routines but it's changeable but it's not changeable by others. And we don't follow others routines . So if someone else comes and says do the routine like this, it doesn't make sense. So I'm not following it and I think that's typical quality amongst Autistics. They will change and follow routine if it makes sense to them. But you can't force them to do it because then they just wont.You know, Its going to be difficult."-Parent 4-
	But I think start with With kids, okay. And get them into a routine? But I think there's so many like young adults. That also could benefit from this because it's not the end of the world at 25 and useless. You can still become something physically. Yeah. Even if even if we started 25 you get it Because at these autistic schools sometimes they are older kids,tehre like 18 1716 year olds in their schools and they have done nothing too, you know. So what about them ?"Parent 4-
	"And I think the other issue is, you know, what happens when they adults, you know, it's a whole different is, you know, the whole different ball game."-Parent 3

b) Individualization, variability and flexibility of the proposed model of care

Overview of findings	***Parent statements***
Overall, the parents stated that the model would need to be able to be adaptable to account for the variability of the children and that it should be presented in a way were it can be used on an individual level. They advocated for having choices for the children that would allow them choose what they preferred on an individual level. One of the parents -who also runs martial arts classes for individual on the spectrum- indicated that in some instances individuals on the spectrum could perform better than neurotypical with regards to following instructions or listening acutely, while others can't focus or struggle to listen or had comorbidities affecting function. He indicated,	*"You know, they might not be very strong on their legs or on they lay on their hands or whatever. I know my son could not catch a ball. Other children can, so I think it all depends on the individual."-Parent 1*
	"Cater to the needs specifically to those needs."-Parent 6
	"So I think the ideal would be to give choices in with the with the individuals preferences, so you know, so it would be like I said, some people like energetic exercise, some people like moderate exercise, some people like it indoor, some people like it outdoor, it will be about having different options available.-"-Parent 3
	"They differ in terms of ability."- Parent 5
	They usually ask him X what would you like to do next?

therefore, that programmes would need to be adaptable to accommodate all individuals on the spectrum. Furthermore, he indicated that for being able to be flexible and adapt programmes would be imperative for children who are non-verbal.	*Parent 6 -* *It, also each family would also have different needs depending on the children's sensory profile, because everyone is obviously different. But it would be good to check in maybe, like we have options of one indoor venue and one outdoor venue.-Parent 3*
	So I think the ideal would be to give choices in with the with the individuals preferences, so you know, so it would be like I said, some some people like energetic exercise, some people like moderate exercise, some people like it indoor, some people like it outdoor, it will be about having different options available. *Parent 3*
	So autism is spectrum so even in my class now, there are some autistic people, that's like me, and with my children I needed to be really technical and detailed because they can fit in and listen and understand and it's something that I and they can just do. So they in some way even do it better than they listen more than the normal or neurotypicals, however you get autistic people that have comorbidities like aspaxia , I don't know what it's called, but your brain can put together the things that your thinking and your body don't work correctly . So those ones, you have to adjust a lot because they don't always listen and they just cant focus, so I just need to get them like connected because I function in a similar way so it's easy for me to to motive to keep someone interested"-Parent 4-
	"So those ones[nonverbal], you have to adjust a lot because they don't always listen and they just cant focus, so I just need to get them like connected because I function in a similar way so it's easy for me to to motive to keep someone interested ."-Parent 4

c) Role and stakeholder responsibility- Poorly defined roles and expectations

Overview of findings	***Parent statements***
Parents believed that it would be necessary that there is a designated person or people who take responsibility to implement or carry out physical activity based interventions. Furthermore, they believed that the model should guide implementation so that it can be carried out consistently by the individuals responsible.	*"I'm not sure how Practical it will be if somebody doesn't take responsibility for it."-Parent 7*
	"Yeah, but it's something which should be worked on and ideally in a in a like consistent manner, by everyone. So by the school setting, by the parent or caregiver and by the therapists,"Parent 3
Parents perceived that the model of care should include implementation in school settings, and that in those instances teachers should be responsible in carrying it out. One parent indicated that the responsibility for improving physical activity in children with ASD lay with other individuals such as carers.	*"I think the teachers should actually take it upon themselves to try and see what every individual child needs. I think that is more important, is to isolate what the problem is. And then kind of target the, the areas that the child needs to work on."-Parent 1*
	"I think that's got to be something that has to go into the schools."-Parent 1
	"I would rather try to implement the activity, more in like a school environment because school and it's hard because my boys were in like a special needs school, but they weren't doing anything very active with the kids."-Parent 7

	"Somebody else is going to have to improve physical activity. I feel like that's kind of like the caregivers."-Parent 2
	"And I think it's all the same reason I think that the teachers are so tired, they can't really play with them." -Parent 7
Parent indicated that they believed certain clinicians had differing scopes and were responsible in improving specific thing within the children. Parents stated that Occupational therapists were responsible for improving on fine and gross motor skills, and body perception , while physios worked on gross motor skills, strengthening muscles available and improving muscle growth and balance. One parent indicated that going to an occupational therapist helped he in understanding her child better. On parent, in particular indicated that she would often advocate for parents to seek the help and assistance from physios, occupational therapist and psychologists. Two parents indicated that they felt that their wasn't a lot of information being provided to them from doctors in terms of developmental milestones children should be meeting, as well as general guidance for their children in terms of management.	*"The OT yes, definitely, we work specifically on fine and big, body perception, where are my body now and what is it supposed to do now and your stuff like that."-Parent 7*
	"I remember when I was small, and the doctor told me like, Okay, on this age, he needs to know this and this and this and you have to buy this book. So you need to know what to teach them know what to have to understand."-Parent 7
	"Well, we try and give him a few exercises to do. But we haven't really gone to professionals to do this."-Parent 1
	"Like the physio would work more on gross motor skills and muscles available and muscle growth and balance, that was something they worked on as well."-Parent 6 So and the OT worked also and gross motor skills, but she worked on fine motor skills as well, which the physiotherapist also worked on it, but not as intensely as the OT."-Parent 6
	"Most of the times I would tell them physio and get a psychologist. Umm, because this psychologist for my son has made the world of difference. I go see an OT so that she can help me understand my child better."-Parent 6
	"There isn't a lot of guide guidance coming from doctors and so on."-Parent 2
Parents stated that often it would be up to the parent to teach or provide activities for the child to do. One parent believed that it should be the responsibility of the parent to make sure their children are meeting optimal physical activity levels and get them active. One parent indicate that although she felt it was up to her to get her children active , that sometime she was tired or not in the mood to be able to motivate and get the children to participate in exercise .One parent indicate that she would try and get her son physically active but that she had not seeked professional help for it. Parents indicate that they felt that there was a need for better advocacy in improving motor skills from Autism bodies such as Autism South Africa as they felt not enough was being done for the children.	*"We, we did. We taught him a lot of things before, before he were supposed to know it with his body."-Parent 7*
	"So at the end I still think everything comes back home. It's still the parents responsibility to take responsibility for this for the active. So I think if we can maybe encourage activities at school, but also at home for the autism kids."-Parent 7
	"So yes, parents on the whole are like, there should be a bigger movement in the councils in the government's to get people up to a certain standard of you know, and parents shouldn't give kids the I didn't give my kids you know, the choice."-Parent 4
	"Well, we try and give him a few exercises to do. But we haven't really gone to professionals to do this."-Parent 1
	I still sometimes when I had very long day, I'm just not in the mood to go for a walk now because it's an emotional strain because you have to observe everything around you. And then you have to remember that, they're going to run away from you if something gets their attention, they're going to bolt for it . So I get it, I get it Parent 7
One parent indicated that he believed that councils and government should be more active in getting individuals active to a certain level. He also indicated that from a	*So So maybe, based on your findings, you can then approach like, social development , department for person with disabilities or woman and disabilities or whatever, whatever long name it's got, and then say that look, this is what we've*

parenting perspective that parents should not afford their children the choice to be inactive- that they should make sure that they are meeting minimum criteria.	*identified as a need and we need to find a way to make us more accessible to the community and things like that-Parent 3*
	"I mean, you know, even autism south Africa they're not doing enough of these things. They're not doing enough to say that, okay, you know, we're going to set up"-Parent 3
	So yes, parents on the whole are like, there should be a bigger movement in the councils in the government's to get people up to a certain standard of you know, and parents shouldn't give kids the I didn't give my kids you know, the choice."-Parent 4

a) Physical activity preferences

Overview of findings	***Parent statements***
In general, clinicians stated that children with ASD had various physical activity preferences as well as strong dislikes specially in if sensory issues were present. When it came to liked physical activities, parents stated that their children enjoyed running, playing with balloons, engaging in all consuming activities, cycling, bouncing, swimming, and participating in activities that where rhythmic. They started their children also liked to mix activities up and engage in physical activities including animals. One parent who was on the spectrum indicated that he believed children with ASD like to move and will generally try to do physical activity tasks and if they can do it they would do more of it. He also indicated that stimming and stereotypic behaviours were generally motor based. They indicated that they did not enjoy team sports, and it would depend if the child preferred indoor or outdoor activities. The majority of the parents indicted that likes and dislikes of physical activities where very much child dependent and that that would need to be considered in the model. One parent noted it could vary in different age groups. In one instance one parent, indicate that their child didn't like doing physical activity and that she believed it was due to her child not	*"Things that I know all that. I is now [child's name] and [child's name] is now 7 seven , he likes bicycle. So we are now now we even I mean, [child's name] is like 8 years old and now we are starting bicycle only-Parent 7*
	And I just like it so I think a lot of like autistics I met and those two boys , they are physical , they stim and they like doing physical things like the one will spin around and shake his whole body the other one is moving around and walking around and stuff. And for me even now when I'm talking I'm moving my hands."-Parent 4
	They did obstacle courses and when he was old and now they did obstacle courses and stuff like that.Parent 6
	"He doesn't like it and I think it's because of the the motor skills that he lacks."-Parent 6 -
	"You will play outside, not play, you would walk outside for a little while when he gets hot he'll go in, uh, but he doesn't play outside like he doesn't play outside like normal children."-Parent 6
	"Those and those little you know, those little black bikes, yeah, that everybody in complex hates because they make so much noise? Yeah. They like running around. They sort of like like running, they like riding those particular bikes as well."-Parent 5
	"Running around like headless bloody chickens".-Parent 5
	"He's not interested in team sports. Parent 3
	"Ok so the autistic ones , besides the ones with problems, okay. I think they'll just like moving and stuff you see, you can watch them . They'll try things. The will Try things and you can start it ,I think humans even Autistics. We like to be like, trying stuff and if we do it, we will do more of it , aha you see that.-"Parent 4
	"Again its so different I mean, because each child is different. So some of them like the very like you know, like for example, you know, this bounce system they've put in place and my son doesn't like it, but other autistic children that we know they like it, you know?"-Parent 3
	"So it's, it's, it's all different. I mean, that's the thing which My son loves, which I can't really find here in Joburg, is those pedal cars that you find in Durban on the beachfront?-Parent 3

having the motor skills to perform the activity. One parent state that their child enjoyed doing activities that were close to the ground, as they felt more stable.	*"Because it's close to the ground, so he doesn't have this feeling of you know, feeling unstable."-Parent 3*
	"Sometimes he'll enjoy a walk in the park. Sometimes he won't. It just depends."-Parent 3
	"Yeah, So different ones enjoy different things, it just depends on on what they've been exposed to what their sensory triggers are."-Parent 3
	"I think it's all dependent on the child."- Parent 2 -
	"So, but he likes obstacle courses he likes playing, kicking ball and loves animals, he loves playing with the dogs-Parent 2 -
	"No, he didn't want to participate in any sport except swimming because he enjoyed doing that. I think because he was buoyant, which made it easier for him to do it. But anything else? He didn't like. He didn't like running. He didn't like playing like soccer or anything, because they can't coordinate."-Parent 1

Theme 5: Education and awareness: "It's really frustrating when you are being told to do something, but you don't understand why"

Overview of findings	***Parent statements***
Overall parents believed that improved education and increased awareness is needed amongst key stakeholders (e.g parents, teachers, therapists) working with individuals on the spectrum as well as for those in charge of developing policies and in the government sectors. They believed that education and a better understanding on what children on the spectrum need is crucial. Parents believed that educating parents should be a priority as well as educating nannies and other individuals that work with their children on a day to day basis. Overall, the parents believed that society in general doesn't value exercise and that people don't want to engage in physical activity anymore. They indicated that a changes need to happen on a societal level where education on the benefits of exercise needs to be carried out, as well as trying to assist people in understanding why they need to participate in physical activity. One parent suggested that research needs to be conducted on how to improve the marketing aspect of	*"More understanding I think , by the parents by the teachers,"-Parent 1*
	"Educating the people in charge, On what sort of things on what the children need."-Parent 1
	Because it feels like me, to me, we're living in a society that people don't want to exercise, people don't want to go outside anymore. And just to get them to realize that okay, it is not just good for me. It is good for me and my mind and my body its good for everything. Even when I'm not feeling good. If I just go for a walk I will feel better.-Parent 7
	"Maybe describe the benefits of exercise. Umm or Muscle, muscle functioning or whatever send out a mail A. You know, starting sending out a message every two weeks"-Parent 6 -
	"It's really frustrating when you're being told to do something, but you don't understand why." -Parent 2
	"tell them[parents] the benefits" Parent 6 -
	"You know, market it, you know, do some research on on marketing and wowing people into participation."-Parent 6 -
	They don't have access to information and for them, it's more difficult to get them into , you know the priority is like many other things.-Parent 4
	So it's really important that I think that they are also trained on autism, you know, all disciplines that deal with like motor skills. Typically, nowadays,you know, but just have a lot more awareness.Parent 3
	No the first time I heard about it is when you emailed, and when you put the add on, and I was like, this would actually be a great tool."-Parent 7

getting people active. And one parent indicated that there needs to be improved access to information.	*I think you can use platforms like Autism, South Africa because they are a lot of parents on it.Make them aware of it." -Parent 6*
	"Just have a lot more awareness. -Parent 3
Parents stated that there is a need to have a guideline on what their children should be able to do- and that their should be education regarding hat their children could be able to do at various ages in terms of their motor skills. They also indicated that a guideline of activities for hat they could do with their children would be helpful.	*" I think education starts with the parents"- Parent 4*
	You should also to speak to nannies who look after moto neurodiverse kid"-Parent 5
	There's many times that I have to tell the parents speech and OT and physio, speech and OT and physio speech and OT and physio and it's like the people aren't educated to know these things."-Parent 6 -
Parents came up with some strategies to improve awareness – for example hosting awareness campaigns, or using already established platforms like autism south Africa to create awareness on physical activity and motor profile deficits.	*"For instance, at what age is my baby supposed to jump on one leg or to jump like a little horse or to do the padda spring? You know, all those things, when I saw my sisters child doing that, and I'm like, Oh, my boy supposed to do that. And then I went and Googled it and see. Ok Okay, it is between this ages you are meant to do that. And then I jump in and I start doing these things with my boys. But it also it always felt to me it was a little bit too late. It was something we could have done earlier. If I knew that was something my boys were supposed to do."-Parent 7*
In terms of motor assessments, one parent indicated that improved awareness or education on what assessments could entail would be beneficial for both the parents as well as the child in terms of the parent being able to prep the child. The parent also indicated that following the assessments that improved education on what the feedback meant or what it entailed was needed.	*"you only realize that something is not right. When you see that other kids their age are doing something , they are not doing yet."Parent 7*
	"And that can be part of like the awareness. If we do like an awareness campaign that we can put that in there so that parents can refer to it."-Parent 7
	"I just felt that I didn't understand the feedback as well from that assessment." Parent 2 -
	"I don't have a clear understanding of why it is that they struggle.-Parent 2
	No, I think the the biggest issue is the fact that they[parents] don't realize that they children need physio.Uh, or OT or speech therapy because.I've given advice to so many people to, say, get your child at least to speech and OT therapy because they're biggest problem is that their children are not speaking or fine or motor skills."-Parent 6
	If I had known that was what they were going to ask about[in and assessment]. Maybe I could have told him, you know, this is what you're going to be asked to do whatever , just to mentally prepare him and then maybe he would have been more receptive I dunno".-Parent 2 *Yeah, like I didn't know when I went through for the assessment , I had no idea what the assessment was going to be about. Yeah.* *Parent 2*
	"So I think, a guideline on activities what you could do with your child, because those are things that are not, like I'm saying the school where he is at now. They don't give me guidelines to say okay, you can do this activity with him, this will help"-Parent 2
Parents advocated for increased training specific to ASD for those working closely with kids with ASD. One parent indicated that she dint understand why individuals are not being trained on how to work with	*Maybe my exposure level lenses has/have opened up a little bit more, but I'm just thinking that it's something that we the same way we train you know, early childhood development for neurotypical kids. Why are those providers also not being trained on neurodiverse kids? as a standard and not something as a specialization if that makes sense? Parent 5*

neurodiverse children and that she felt that was a problem. Parents suggested that parents could be trained or empowered on how to improve physical activity levels as well as how to improve motor skills. In this way parents could be invled in facilitating the process of improving physical activity and motor skill levels. Importantly parents indicated that there was a large need to educate the children themselves on why they needed to do specific therapies, to assist in helping them understand as to why doing specific therapies is important. Furthermore, one of the parents (who was on the spectrum) provided insight into how this can be improved. He indicated that a clear logical explanation needed to be provided (this needed to be specific to the individual), and that a buy in was needed. He indicated that individuals' on the spectrum needed to understand the benefits, what they could get out of the interventions and why they would need to participate in the activities.	*there isn't a lot of guide guidance coming from doctors and so on.* *Parent 2*
	Like now, I even I'm just even stopping all the therapies and extracurricular until you understand why we're doing everything *Parent 3*
	But in some way you need to explain to them that it makes sense that it's a good thing.- Parent 4 *"It needs a logical backing"-Parent 4* *"They got the buy in, some logical thing was explained to them, its logical that it's a good thing to have a degree it's a good thing to be physically fit and then they just run themselves. So you need to get an initial buy in for Autistics, you know what you cant force them because then they will do it"-Parent 4* *"No, the actual thing is not a good explanation ,they need to know why it's a good thing to do." "So they need to give you okay, what would it give you to do that? What will you get out of it , why you why you need to do it?"-Parent 4*
	so to understand what's going on in his mind so that we can then then once I know like, he's settled or we got the things under control. Then I can go back to my own kind of awareness and advocacy work, you know.-Parent 3
	I think I think that maybe the parent can help to prepare the child through the assessment and then have the parent there when they do the assessment. Yeah, like I didn't know when I went through for the assessment , I had no idea what the assessment was going to be about. Yeah.
	maybe explaining to them that they need to do certain things, physical activities and that and how it will benefit them? Sometimes very difficult to get through to them, but maybe you can show them in certain ways or have some sort of goal that they can get to or a prize or something once they actually do it better. *Parent 1*
	"Yes, yes because I mean I know that. Whenever there's something that's coming up, tell him in advance, you know, we going here, this is what's going to be done and what we're going do, then it sort of helps him prepare and to be as calm an then there's no arguments with him because he knows what's coming."Parent 2
	But if it's just a matter of not being able to understand like the concept, like he can't blow his nose, as much as I've been trying to teach him, you know to blow his nose, he can't do that, *Parent 2 -*
	Yes, yes because I mean I know that. Whenever there's something that's coming up, tell him in advance, you know, we going here, this is what's going to be done and what we're going do, then it sort of helps him prepare and to be as calm an then there's no arguments with him because he knows what's coming. Parent 2 -
	Three things parents should should not give kids the option is what kind of morals they have, you know, that comes from the parents anyway, obviously if the parent is a immoral person it's difficult to get away parents anyway. Which keeps kids are moral initially, like the first seven years you know, and then your you know, the education you go to school and you have no choice in that and your physical and

	your health, physical minimum, patients should do that. And then it should continue right through not stop going when you .Parent 4
	Maybe my exposure level lenses has/have opened up a little bit more, but I'm just thinking that it's something that we the same way we train you know, early childhood development for neurotypical kids. Why are those providers also not being trained on neurodiverse kids? as a standard and not something as a specialization if that makes sense.-Parent 5
	Yeah, so like, I think, again, you know, I suppose my story is very different, like when Because [child's name] went to play school in the beginning. And I had the fortunate experience of having a mom who was the principal at the school whose son had autism, So she said, [Parents name] , we have noticed 12345, we have noticed 12345. So I think even from an early childhood development perspective, if those service providers had some kind of training, to, because I think the only reason she picked it up is because her son had a you know, he was autistic. Si I don't think, if she didn't have that personal experience. It would have been something she would have picked up. I don't know if"-Parent 5-
	I mean, I think it's cool. It could be a way to try to empower like I mean, there's not a single moms, you know, they're all struggling financially. You know you could train a couple of them and you could get them to run the programme. They understand autistic kids so they know which kid is having a meltdown which having a trigger you know, don't come in my space, you know, wherever they can, they can, you know, and keep getting continuous training so that they can, you know, grow the programme. Parent 3
	"Sometimes Maybe even if a programme is designed, yeah, certain parents can be trained on it. Yeah. And then and then it could be done."-Parent 3

Theme 6: A lack of monitoring/tracking progress: "You must ask what's going on"

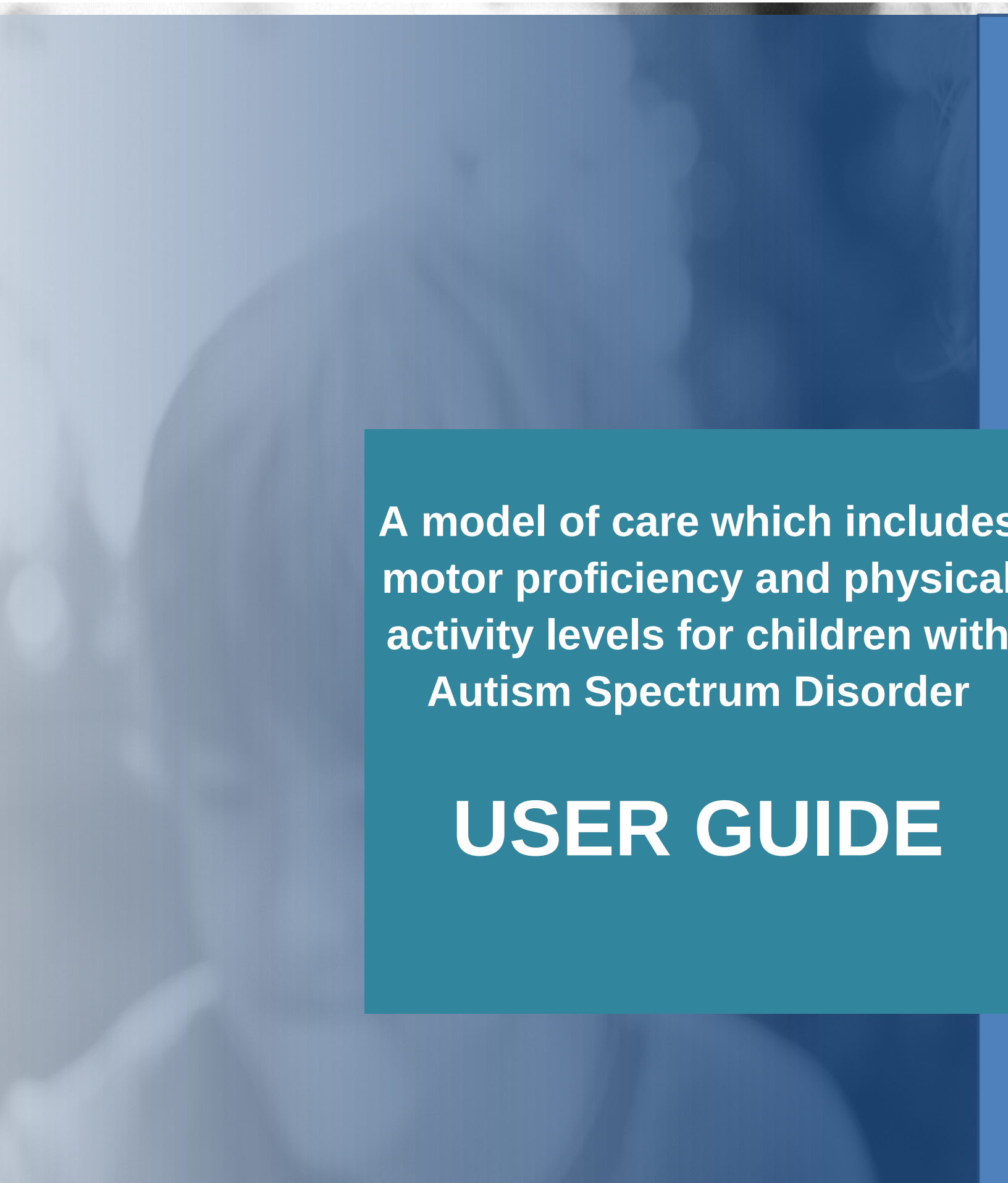
Overview of findings	***Parent statements***
The majority of the parents felt that that monitoring the progress of motor skills was important as well as receiving feedback on if these motor skills were being improved. They also indicated that setting goals for the patient was important. Parents indicated that in general if an assessment was carried out that there generally was no talk of follow up or additional assessments. They also indicate that following assessments often there was no indication of what the child would need following the assessment i.e would the child need to go for a specific therapy or not. On parent indicate that they often didn't know what their	*And I get regular feedback on what she's doing.I get videos from her on what she's doing.And it's amazing.Parent 6 -*
	Because I haven't read it, I cannot honestly answer you, but I think it's necessary for the parent to know where your child is and where he where she plans to go with him.Parent 6 -
	"I don't think they will always hear you because we live in a society where people want instant results."-Parent 6
	The only way that we trust them is through seeing results -in the long term not short term, but in the long term or small results you with autistic children."-Parent 6 -
	"Uh, so you can start with something that's relative to autistic parents, and you can read through some of the comments."-Parent 6

child was unable to do , and only when they observed other children that they understood – in this instance they indicated that having feedback from professionals as to what their child should be able to accomplish at specific ages would be important. Two parents indicated that they were provided with feedback reports following assessments, and one of the parents stated that she had not read the report provided to her. Parents felt that it was important for them to understand what the therapists wanted to do with their children and that they They stated that in most instances it was up to them (the parents) to ask how the child is doing , if there were things they could do at home with their child and what the interventions were focusing on. One parent indicated that it was not the same everywhere in terms of setting – i.e she indicated remedial schools may have more feedback. One parent provided examples of her son working with a biokineticist in which she received updates and videos and that she felt that that was a good example of receiving feedback. She indicated that for her seeing results assisted her in trusting the therapist working with her child. She also indicated that she believed parents with children with ASD felt that any small improvement was something to celebrate and that most parents didn't take improvements in their child for granted. One parent stated that an approach to carrying out interventions would be to have small polls following classes or sessions where individuals could vote on what they wanted to happen next or to provide feedback on current strategies – in this way providing interactive feedback throughout management of the child.	*"Let us know what you think. Ohh whatever and just take a poll and see whether the people are interested, whether it whether it's worth while doing it because it doesn't help if you're putting in all this effort and nobody's watching."-Parent 6* *"So in other words, there was no talk of like a follow up. No talk of how you are going to progress with him, etc. So they're basically doing like a baseline but then yeses. And Honestly, I wish there were more kind of feedback, but then again it also depends on where your child is attending."-Parent 2* *"Like you must ask what's going on? What do you think? You know, where as if he was at a special needs school. There might be more feedback from them saying, you know, this week we focused on this and there is not much improvement. Can you do this with him at home?."-Parent 2* *There was no discussion about ok you're going to see how far he's progress and maybe needs therapy.Parent 2 -* *Or when they are doing something before the other kids are doing it, then you're like, oh goodness, is this supposed to happen? Is this supposed to be developed? So I think in terms of, you know,when I was, when the babies were smaller I was doing practica with them. And they had all the things you have to do with your care and development and what not.-Parent 7* *So ya , I'm not really sure because as they get older, you see that something's missing. And then you're like, and how do you test? That? That is my question? How can I test that My boy, do have a strong core? do have the sense of my left side and my right side.?* *Parent 7* *"Because I haven't read it, I cannot honestly answer you, but I think it's necessary for the parent to know where your child is and where he where she plans to go with him."-Parent 6* *"Although he's had OT and he's had like, even physical physiotherapy and so on. But from what I experienced is that maybe there wasn't like a set goal that was that was laid out to say let's work towards this.-Parent 3* *I think it's necessary for the parent to know where your child is and where he where she plans to go with him.Parent 6 -* *"Some Take milestones for granted. We don't. "If we see something has improved, not even if it hasn't been totally fixed, it's just been improved. You know, it's something to celebrate."-Parent 6* *they did the assessment as well and they actually had a one on one feedback with me , where they went through the entire thing. And they also gave me a hard copy. At the school they also had similar, but I just felt that I didn't understand the feedback as well from that assessment."-Parent 2*

Feedback /Tracking progress	*There was no discussion about ok you're going to see how far he's progress and maybe needs therapy.Parent 2 -* *Or when they are doing something before the other kids are doing it, then you're like, oh goodness, is this supposed to happen? Is this supposed to be developed? So I think in terms of, you know,when I was, when the babies were smaller I was doing*

	practica with them. And they had all the things you have to do with your care and development and what not.-Parent 7
	So ya , I'm not really sure because as they get older, you see that something's missing. And then you're like, and how do you test? That? That is my question? How can I test that My boy, do have a strong core? do have the sense of my left side and my right side.? *Parent 7*
	"Because I haven't read it, I cannot honestly answer you, but I think it's necessary for the parent to know where your child is and where he where she plans to go with him."-Parent 6
	"Although he's had OT and he's had like, even physical physiotherapy and so on. But from what I experienced is that maybe there wasn't like a set goal that was that was laid out to say let's work towards this.-Parent 3
	I think it's necessary for the parent to know where your child is and where he where she plans to go with him.Parent 6 -
	"Some Take milestones for granted. We don't. "If we see something has improved, not even if it hasn't been totally fixed, it's just been improved. You know, it's something to celebrate."-Parent 6
	they did the assessment as well and they actually had a one on one feedback with me , where they went through the entire thing. And they also gave me a hard copy. At the school they also had similar, but I just felt that I didn't understand the feedback as well from that assessment."-Parent 2

"Broken pieces shine"-Amy Lee



A model of care which includes motor proficiency and physical activity levels for children with Autism Spectrum Disorder

USER GUIDE

TABE OF CONTENTS

1 Introduction

2 Model components

3 Things to consider

4 Application of model components

5 Case Example

Introduction

This user guide aims to intentionally address the gap in standardised management and care for individuals on the spectrum with a focus on improving physical activity and motor skill deficits. It is intended for use by clinicians, parents and teachers. It serves to guide care for an individual on the spectrum making use of a model which provides an overview of what process can be followed to improve physical activity and motor proficiency for individuals on the spectrum, and indicate who key stakeholders are in carrying out holistic multidisciplinary individualised management for individuals on the spectrum.

Figure one below illustrates the Model of Care in its totality.

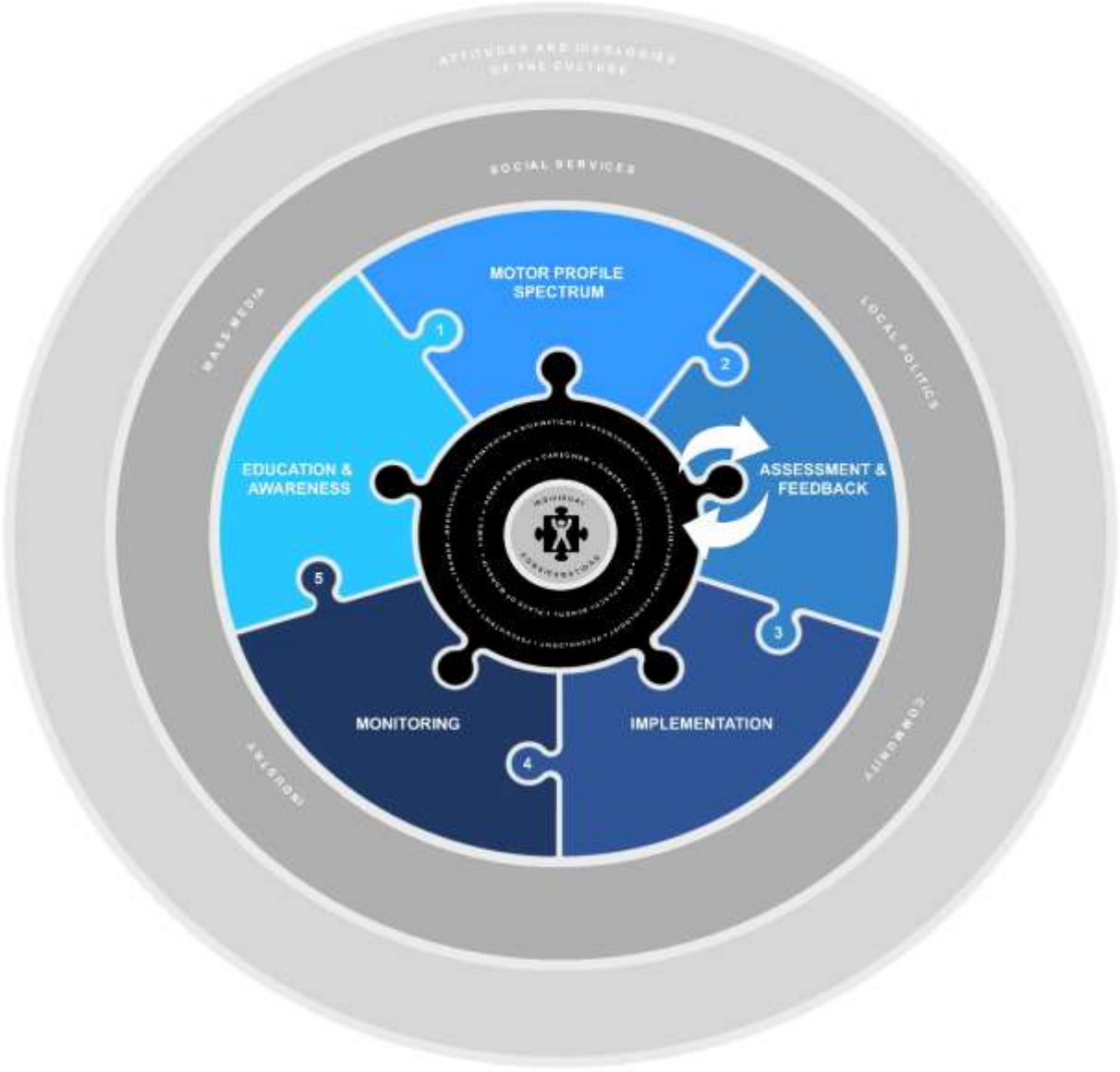


Figure 1: Model of care for children with ASD including motor proficiency levels and physical activity levels.

Model Components

The model, comprises of five main domains at its core with individual considerations at its core, influencing each domain. It is comprised of 7 main elements in its design as illustrated by Figure 2 below. Explanations of the various elements and components of the Model of Care are explained in the following pages. The five central domains include: education and awareness, the individual's motor profile, assessment, implementation, and monitoring. The five domains of the model are encapsulated by relevant stakeholders who would engage with and support individuals with ASD in specific contexts, and lie within a broader ecosystem, including social services, media, industry, local politics, and community members. The model is positioned within the overall attitudes and ideologies of our culture which envelopes the entire model.

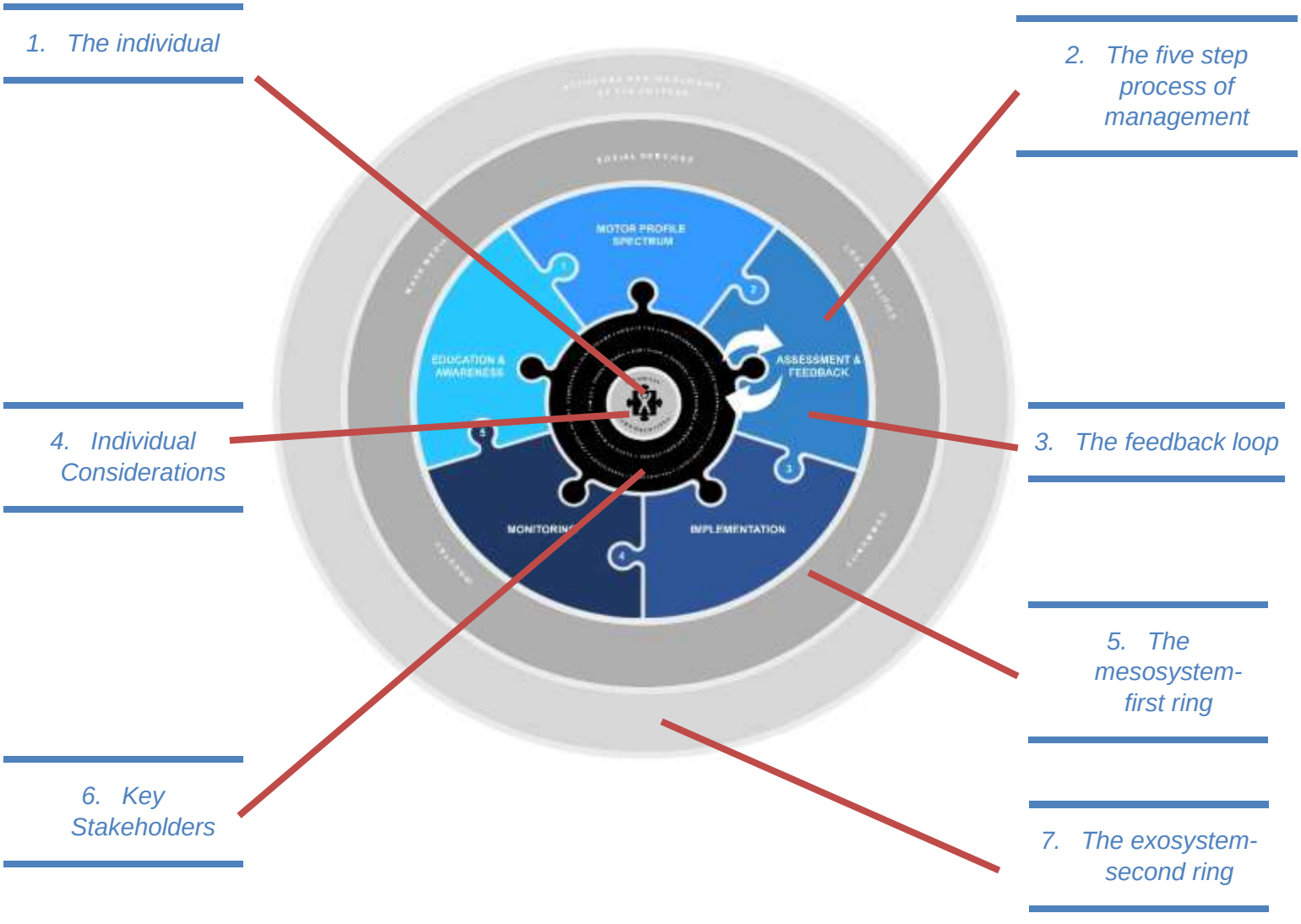
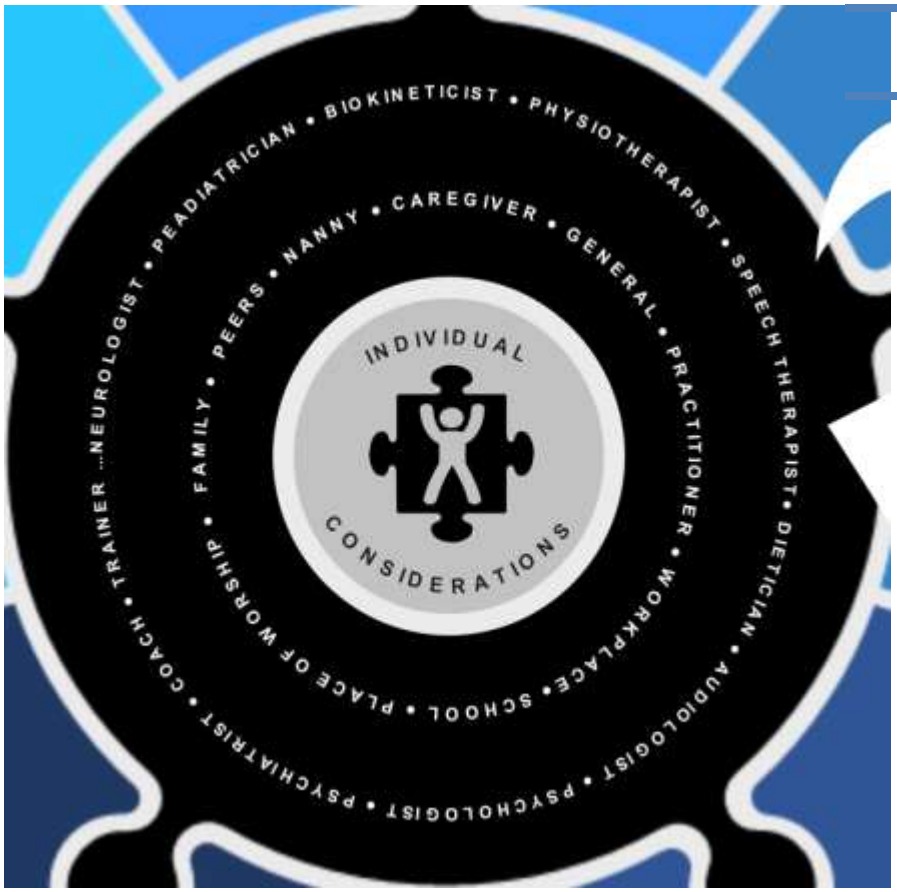


Figure 2: The components of the Model of care for children with ASD including motor proficiency levels and physical activity levels.



1. The individual

The individual is central to the model and should be considered at all times and during all steps of the management plan.

The individual is presented within a puzzle piece that reaches out to connect with key stakeholder that would be able to assist the individual along their journey of their management.

Specific individual considerations need to be considered in order to accommodate the varying needs of an individual on the spectrum. General considerations regarding physical activity intervention design also need to be considered to create a well thought out, and safe management plan.

2. Individual Considerations

Individual and general considerations may include but are not limited to:

Individual Considerations

- Consider medication and its effects on the individual
- Consider comorbid conditions-adapt and modify management accordingly.
- Consider safety: individuals must feel safe, in a stigma free environment, with optimal supervision, in a physical space that does trigger any sensory issues. Consider indoor versus outdoor spaces, and autism friendly spaces for example.
- Consider that individuals may have interoception issues. Interoception is a lesser-known sense that helps you understand and feel what's going on inside your body. Kids who struggle with the interoceptive sense may have trouble knowing when they feel hungry, full, hot, cold, or thirsty, or why their heart rate may increase when engaging with exercise for example.
- Consider trust, and the building of relationships between various professionals, parents and the individuals they engage with as this is important for the success of the management plan.
- Consider the individuals core and other deficits (social/ communication deficits, cognitive deficits, behavioural deficits, sensory deficits) and the individuals' level of function in all aspects of their management plan and modify activities where necessary. Specifically, consider differences between nonverbal and verbal children.
- Consider personal preferences and dislikes for physical activities

General Considerations

- Holistic, lifelong implementation is necessary
- Variability, variety and flexibility within exercise-based interventions. Allow individuals the opportunity to choose activities.
- Factors such as frequency, intensity, time, type/mode and preference of activities when designing the interventions need to be considered.
- Exercise-based programmes should be adaptable to each child's needs and should consider other factors like group versus lone activities, settings or environment (e.g. indoor versus outdoor), teaching styles of the instructors, and learning styles of the children, as well as socioeconomic factors.
- Consider that exercise based programmes may not need to be adapted in certain instances and individuals on the spectrum should be encouraged to meet neurotypical guidelines and standards wherever possible.
- Consider access to equipment and interventions as well as including animals as part of therapy.
- Consider making activities interesting and fun, making use of incentives and avoid having too many rules.
- Consider interdisciplinary collaboration to create comprehensive and cohesive intervention plans, consider the inclusion of parents in decision making processes for example.
- Those working with children on the spectrum needed to have a mindset change since children on the spectrum were very different to neurotypical children.
- Implementing activities as part of an individual's routine may be beneficial

3. Key Stakeholders

The model identifies key stakeholders that may involve in the individuals management plan. The key stakeholders are illustrated in the black ring surrounding the individual (and their individual considerations) in the model and are illustrated to reach out into the five step cyclical process to illustrate their involvement in management. These individuals should support the individual along their journey, and assist in facilitating and carrying out management. Multidisciplinary and holistic management is key, with all key stakeholders advocating for the inclusion of physical activity and motor skill improving as part of the individual's management plan. Key stakeholders identified include but are not limited to:

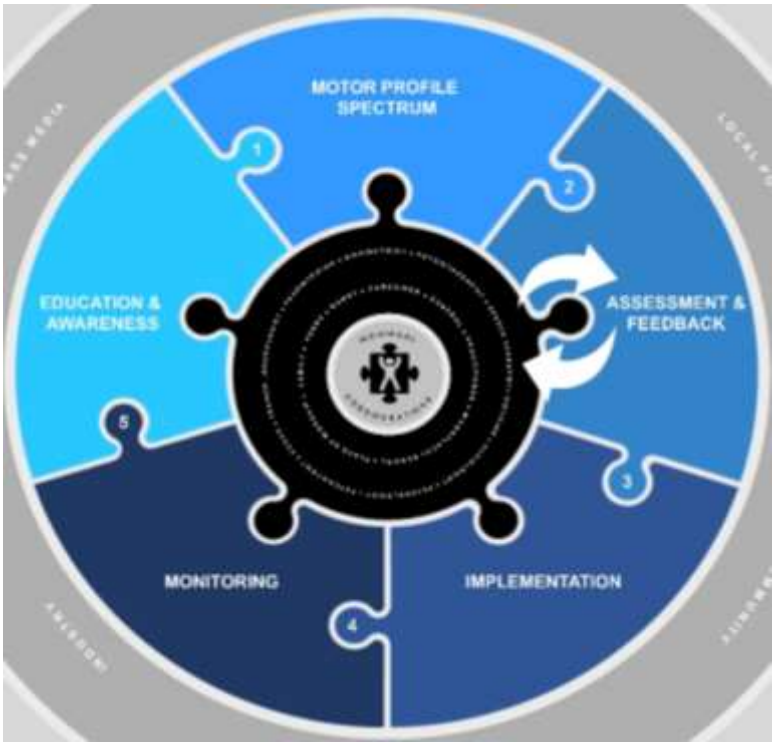
Individuals who may regularly engage with the individual: family, peers, nannies, caregivers, teachers or school based individuals, individuals in the workplace, and individuals in places of worship

Clinicians: general practitioners, pediatricians, neurologists, biokineticists, physiotherapists, speech therapists, dieticians/nutritionists, audiologists, psychologists, psychiatrists

Allied professionals: coaches and trainers

Key stakeholders, for example clinicians, should be approached to assist with specific deficits requiring expert support , while stakeholders the person on the spectrum may regularly engage with may be approached to assist with support in their personal field of expertise. Key stakeholders should ideally engage with one another wherever possible to create holistic mamangent plans that are tailored to the individual's needs.

4. The five step process of management



A five step cyclical process is illustrated in the model to guide ideal management for individuals on the spectrum focusing on improving physical activity levels and motor deficit skills. Ideally individuals being guided by this model should start at step one and follow the cycle. However, if the individual finds themselves within a different step as a starting point when using the model (for example they may already be engaging in an exercise-based intervention (i.e. they are in implementation phase phase), the model it designed in such a way that the individual may continue along the steps to complete the cycle.

STEP 1: EDUCATION AND AWARENESS

Education and awareness needs is the ideal starting point in the cycle central to the current model of care since improved education could elicit change. Under the education domain the following needs be considered: understanding ASD, the benefits of physical activity, and the importance of achieving good motor proficiency levels. In addition, improved education of key stakeholders, including parents, teachers, therapists, policymakers, and the broader community as well as improved training for those requiring ASD-specific skills to administer effective management may be included in this phase. Education regarding scope and roles of clinicians may be integrated into the educational component of the model. Examples of educational handouts to assist with improved education and awareness have been developed in accordance with this model and may be found at the end of this manual. Education and awareness is a continuous process and supplemental material will be created for specific areas of need on a continuous basis to accompany the model.

STEP 2: MOTOR PROFILE (SPECTRUM)

Following on from the education domain, an understanding the motor profile of individuals with ASD is necessary before targeted intervention could occur. Therefore the understanding the motor profile occurs second in the central cycle of the model. Motor profiles are highly varied from child to child and have been described as being on a spectrum, and thus it is important to understand which variables could be affected. Numerous specific motor variables to be considered, these include but are not limited to:

- Gross and fine motor skills
- Flexibility and mobility
- Balance and proprioception
- Gait and posture
- Muscle tone and strength
- Coordination
- Bilateral integration
- Midline crossing
- Body control
- Quality of movement
- Poor praxis and motor planning
- Ball skills and manual dexterity
- Visual motor skills
- Performing activities of daily life
- Reduced fitness

STEP 3: ASSESSMENT AND FEEDBACK

Following the understanding of what motor deficits could entail in individuals with ASD, assessment should then follow to measure and confirm impairments. Therefore, assessment makes up the third domain in the central cycle in the model. Under this domain the following should be considered: carrying out comprehensive assessments as effectively as possible using adapted standard tools to inform tailored interventions, developing assessment guidelines encompassing various motor variables and domains, conducting frequent assessments with appropriate feedback mechanisms, setting appropriate individualised goals from assessment finding and monitoring to track progress. Since no formal motor assessment tools exist at present for individuals with ASD, individual s may consider adapting tools such as the Brockport fitness test to assess fitness or make use of the MABC-2 (modifying where necessary) as these have successfully been used in individuals with ASD previously. Once formal motor and physical activity based assessment tools appropriate for individuals with ASD are established these may be used in this step of the process.

STEP 4: IMPLEMENTATION

The fourth domain presented in the central cycle of the model is implementation. This domain guides the implementation process of exercise and physical activity based intervention. The following considerations fall under this domain: approach of intervention (multidisciplinary and holistic being of priority), physical activity preferences, and socioeconomic factors, programme design (frequency, intensity, time and type of intervention). Other considerations include individual barriers and how to overcome them as well as other individual considerations and lifestyle factors. Overall consideration needs to be given on how to integrate physical activity and motor skill intervention into an individuals' routine or daily life to improve independence and everyday daily activities. Implementation of formal physical based intervention and motor skill interventions should be developed by experts in the field including Biokineticists, physiotherapists and occupational therapists with assistance from allied professionals such as coaches and trainers. Integration of physical activity and motor skill intervention programmes may also be carried out by parents, caregivers or other personnel who have knowledge on safety protocols and physical activity guidelines to ensure appropriate and safe training.

STEP 5: MONITORING

Once implementation occurs, monitoring must occur to determine if said intervention is effective and successful. Thus monitoring is next in the central cycle of the model. This domain includes the ideas that there should be regular monitoring and evaluation as well as the tracking of progress of the individual's performance. Furthermore, the efficacy of the intervention itself would need to be monitored, and where emerging issues are identified, adjustments be made to facilitate improved efficacy. In this process providing regular feedback to individuals with ASD and their families is be paramount. Effective monitoring can inform future implementation and assist in developing future standardised practices and protocols and promote consistency across different settings. Monitoring should be conducted by all key stakeholders involved in the management of the individual and feedback between all stakeholders could ensure effectiveness of the intervention.

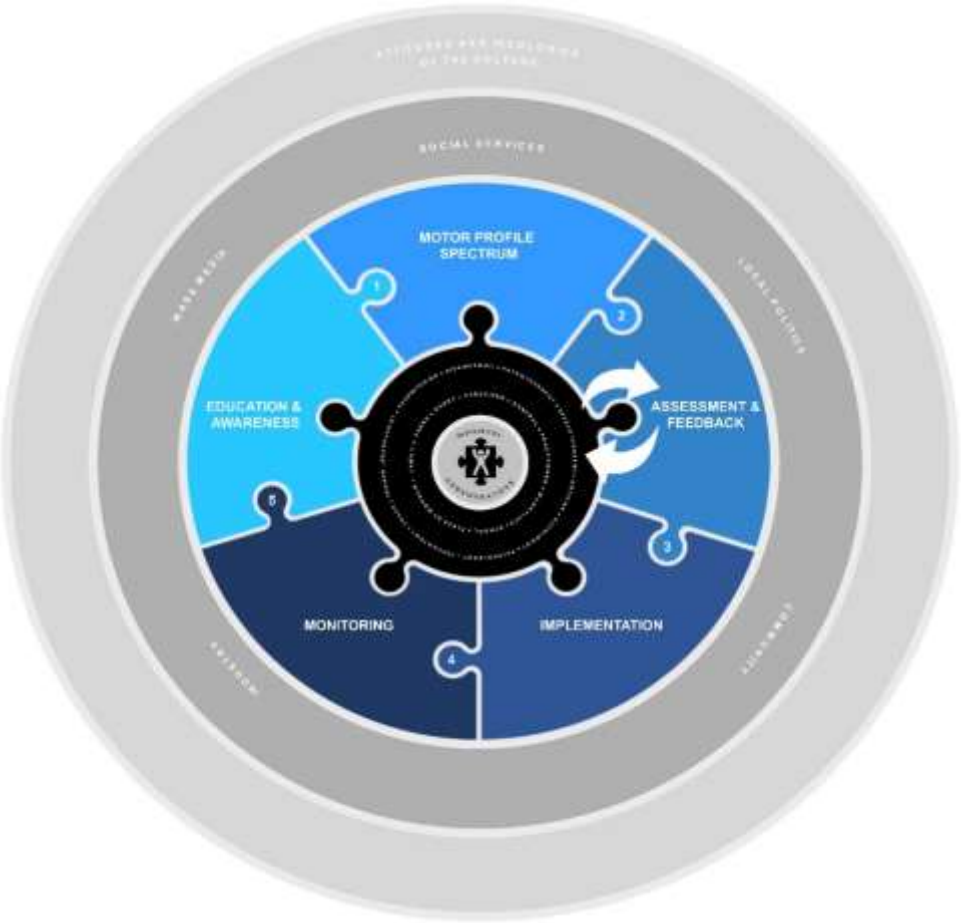
Following the completion of step five the individual may start the cycle again to further optimise their management. For example following intervention it may be found that further improvements are needed for certain motor skills, beginning the loop with a more focused education approach on that specific motor skill and what its relevance is and how it could be beneficial to improve it could be of value for the individual. This specific variable could then be re-assessed and a more targeted intervention could be developed to improve that specific variable. The more targeted intervention could then be monitored to see if it has been effective in assisting in the improving of that specific motor skill.



5. The feedback loop

The feedback loop is integral to optimal management of the individual. The model illustrates two white arrows that link the key stakeholders the cyclical process described above. Importantly feedback between key stakeholders and the individual should occur regularly. Feedback should not be limited to step three but should occur throughout all phases of the model. Feedback and musltidicuilicary interaction should be encouraged and facilitated by any means possible.

6. The mesosystem- first ring



The first ring of the model is termed the mesosystem and comprises of social services, mass media, industry, local politics, and other individuals who may interact with the child i.e. their community. The mesosystem includes the greater "web of associations and possibilities" that come about from the interactions between those in the individual's microsystem. The success of the Model of Care may rely on the collaboration and support of these cohorts and thus these have been identified to guide understanding of how and why an interplay with them should be considered.

7. The exosystem- second ring

The second and most outer ring depicted in light grey is termed the macro system and the term "attitudes and ideologies of the culture" are housed within this system. This outer ring encompasses the social attitudes and perceptions towards ASD, potential stigmas associated with the condition and how different cultures navigate the management of individuals on the spectrum (inclusion vs exclusion). All of which need to be considered when implementing any kind of intervention or management plan for the individual.

Importantly the mesosystem and exosystem may influence the cyclical components of the model as well as influence each other, which is something that needs to be considered when developing management strategies.

Things to Consider

This model of care may not be able to directly address all individual considerations nor address all the specific barriers individuals may experience regarding physical activity based interventions however it may create awareness around what the barriers may be and what may be needed to be considered when implementing a physical activity intervention. Some barriers to physical activity participation for children with ASD may include but is not limited to:

- **Reduced Motor Skills:** Limited motor abilities often lead to exclusion from physical activities and discourage further participation.
- **Low Self-Confidence**: Motor impairments and social challenges can lower confidence and reduce engagement.
- **Comorbidities:** Psychiatric conditions associated with ASD further hinder participation for example.
- **Socioeconomic Barriers:** Financial limitations restrict access to physical activity programmes, especially in low-income families.
- **Resource Limitations:** Lack of facilities, equipment, and trained personnel.
- **Safety Concerns:** Issues such as wandering off and misunderstanding social norms.
- **Sedentary Behaviours:** A preference for solitary, screen-based activities reduces physical activity.
- **Condition-Specific Challenges:** ASD-specific needs require tailored, adaptable programmes.
- **Behavioural Reactions:** Social difficulties may lead to adverse behaviours in group settings.
- **Cultural Factors:** Cultural expectations may limit physical activity opportunities.

Application of model Components

Once the different parts of the model are fully understood, they can be put into practice to effectively manage children with Autism Spectrum Disorder. The process starts with educating key stakeholders—parents, teachers, and clinicians as well as any other key stakeholders—about ASD, then moves on to assessing the child's specific motor abilities. This foundation helps ensure that interventions are tailored to each child’s needs. Regular monitoring ensures progress is tracked and adjustments are made as necessary, allowing the model to evolve and remain effective and appropriate to the child’s development over time.

Case Example

Case of Alex, an 8-year-old with ASD

Alexander is an 8-year-old boy diagnosed with Autism Spectrum Disorder (ASD), who struggles with motor coordination, especially balance and fine motor tasks.

Step 1: Education and Awareness

His caregivers and parents begin by attending workshops to better understand ASD and its impact on motor skills, working with his school to ensure teachers are trained in ASD-friendly teaching strategies.

Next, in **Step 2: Motor Profile**, and basic understanding of Alexander's motor profile is obtained following education and awareness. An understanding of Alexander's physical activity behaviours is realized.

Moving into **Step 3: Assessment and Feedback**, Alexander, undergoes a detailed motor skill assessment, which identifies poor balance and hand-eye coordination as his key challenges. Tools like the MABC-2 are used to measure these motor deficits, helping set specific improvement goals for him.

For **Step 4: Implementation**, a biokineticist creates a personalised physical activity plan for Alexander, incorporating balance games and fine motor tasks, which are also integrated into his daily school routine. This approach involves collaboration between Alexander's teachers, therapists, and parents to ensure consistency across all settings as well as a more holistic approach.

In **Step 5: Monitoring**, regular assessments track Alexander's progress. While his balance improves, his therapists notice ongoing difficulties with fine motor control, which gets them to adjust the intervention to include more targeted exercises. This ensures Alexander continues to progress as his needs change.

Support from his broader community and positive societal attitudes (the **exosystem**) play a crucial role in Alexander's experience. A local media campaign raises awareness about ASD, helping his peers better understand his condition and helps improve his interactions during group activities. Through the collaboration of stakeholders (the **mesosystem**) and supportive cultural attitudes, Alexanders motor skill intervention is regularly adapted and refined to address and he is supported on his journey which allows him make ongoing improvements over time.

Appendix U– Turn it in report



