The role of occupational therapy in the management of sport-related concussion for children and adolescents: A Scoping Review

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A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy

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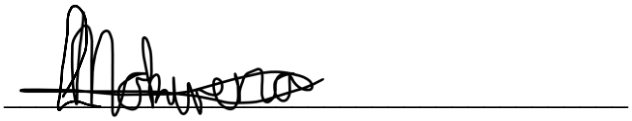
Declaration

I, Tebogo Lecticia Mokwena, declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Science in Occupational Therapy at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



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Dedication

I would like to dedicate this research to my late grandmother who got me through the undergraduate degree and inspired the courage to continue with the postgraduate programme, I miss you so much and hope you are proud in heaven! I would also like to dedicate this to both my parents and more especially my younger siblings who I hope are inspired to keep on keeping on with their academic endeavours, no matter how hard it may seem, if I can do it, so can you. I love you so much!

To Mrs Faye Jackson, we have finally made it! Thank you for your endearing support. There were days when I persevered just so that I don't let you down. Thank you for inspiring the endeavour in an interesting research topic and for your positive guidance throughout. I most certainly had fun learning about concussions and believe so much in the role of OT (to the extent of pursuing a career in it), and cannot wait to see what comes up in future. I hope you are immensely rewarded in all aspects of life, bless you!

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- To the authors whose contributions have been cited in this scoping review.

Abstract

Background

More children and adolescents are engaging in contact sport annually resulting in an increased incidence of sport-related concussions. Often, coaches, parents and athletes expect a transition back into an active lifestyle before symptom resolution which creates a dilemma in concussion management. Occupational therapists have a unique competency to facilitate the transition from injury to recovery however, a gap lies in understanding the role of occupational therapy in concussion management.

Methodology

The research design used was based on the scoping review framework by Arksey and O'Malley (2005) that was further expanded by Levac et al (2010). This scoping review collates findings from existing studies and describes the varying ways in which occupational therapists can assist in managing concussions. The electronic databases searched were PubMed, CINAHL, Scopus, OTSeeker and Cochrane Library. Hand-searching was done in the South African Journal of Occupational Therapy and Journal of Concussion. A search of grey literature was also conducted but no other articles were included from this search. The overall articles searched were from January 2010 until August 2022. A total of 12 articles were included.

Results and Discussion

Occupational therapists can play a role in the rehabilitation of concussions by implementing the three steps in the occupational therapy process. Evaluation of the concussion symptoms, occupational performance, background and concussion history through the use of standardised and non-standardised assessments. Intervention can be provided through energy conservation strategies during cognitive and physical rest, rehabilitation of concussion symptoms and occupational performance, facilitation of education and prevention programmes as well as referrals to other health care professionals. Lastly, the targeted outcomes are mainly the recovery of concussion symptoms as well as engagement in occupations.

Conclusion

These roles are mentioned in studies that have a global north bias and could present differently in South Africa depending on the financial implications and clinical reasoning of the treating

therapist. The role of occupational therapy has been proposed in the form of a Concussion Intervention Framework.

Keywords: children, concussion, sport-related, occupational therapy, management

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Nomenclature

Sport-related concussion: A traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities (Patricious et al.,2023p.6)

Pathophysiology: The functional changes that accompany a particular syndrome or disease (Merriam-Webster, n.d.). In concussion cases, these are ionic influx and glutamate release, altered cerebral blood flow, metabolism, synaptic function and diffuse axonal injury (Mwangi, 2019)

Biomechanics: The scientific study of the mechanics of biological and especially muscular activity (as in locomotion or exercise) (Merriam-Webster, n.d.)

Neurology: A branch of medicine concerned with the structure, function and diseases of the nervous system (Merriam-Webster, n.d.)

Neuropathology: The study of disorders of the nervous system (A Dictionary of Psychology (4 ed)., 2015)

Neuroimages: Any non-invasive means of generating images of a living brain. Images of the anatomical structure of the brain can be obtained using computerised axial tomography (CAT) or magnetic resonance imaging (MRI). These are used for the diagnosis of brain disease and injury (A Dictionary of Electronics and Electrical Engineering (5 ed)., 2018).

Mild traumatic brain injury (mTBI): A less severe form of Traumatic Brain Injury (TBI) which is an acquired brain injury that is caused by external forces such as a blow to the head that is sustained in a motor vehicle accident, fall or bullet entering through the skull (Merriam-Webster, n.d.)

Epidemiology: The branch of medicine which deals with the incidence, distribution, and possible control of diseases and other factors relating to health (Merriam-Webster, n.d.)

Myelination: The change or maturation of certain nerve cells whereby a layer of myelin sheath develops around motor neurons. Myelination improves the conduction speed of nerve impulses thus enabling fast reactions and skilled movements to occur (Kent., 2006)

Psychosocial: Pertaining the influence of social factors on an individual's mind or behaviour (i.e. psychological) (A Dictionary of Nursing., 2021).

Occupational therapy: Therapy that is based on engagement in meaningful activities of daily life (such as self-care skills, education, work, or social interaction) especially to enable or encourage participation in such activities despite impairments or limitations in physical or mental functioning (Merriam-Webster, n.d.)

Post-concussion syndrome: A combination of signs and symptoms that follow a concussion. These include headaches, irritability and mental fatigue. Athletes exhibiting post-concussive syndrome should not be allowed to return to participation in sports (especially contact or collision sports) until it has resolved completely because they are particularly susceptible to a serious injury at this time (Kent., 2006)

Attention-deficit hyperactivity disorder (ADHD): A developmental disorder that is marked especially by persistent symptoms of inattention (such as distractibility, forgetfulness or disorganisation) or by symptoms of hyperactivity and impulsivity (such as fidgeting, speaking out of turn, or restlessness) or by symptoms of all three and that is not caused by any serious underlying physical or mental disorder (Merriam-Webster, n.d.)

Learning Disability: Any of the various conditions (such as dyslexia or dysgraphia) that interfere with an individual's ability to learn and so result in impaired functioning in language, reasoning or academic skills (such as reading, writing and mathematics) and that are thought to be caused by difficulties in processing and integrating information (Merriam-Webster, n.d.)

Learner: A person who attends an ECD centre, school or ABET centre (Dictionary of Education Concepts and Terms., 2010)

Concussion Management: The implementation of laws and protocols that are associated with a reduction in recurrent concussion rates (such as mandatory removal from play following an actual or suspected concussion, requirements to receive clearance to return to play and other occupations from a health care professional and education of coaches, parents and athletes regarding concussion signs and symptoms) (Patricious JS, et al. p699., 2023)

List of Abbreviations

mTBI: Mild traumatic brain injury

OT: Occupational Therapy

USA: United States of America

SRC: Sport-Related Concussion

ADHD: Attention Deficit and Hyperactivity Disorder

VOMS: Vestibular/Ocular Motor Screening

PCSI: Post-Concussion Symptom Inventory

ACE: Acute Concussion Evaluation

HBI: Health Behaviour Inventory

PAQ-A: Physical Activity Questionnaire for Adolescents

CDI: Child Depression Index

PCERT: Pictorial Children's Effort Rating Table

BYI-II: Beck Youth Inventories

ADLs: Activities of Daily Living

IADLs: Instrumental Activities of Daily Living

CO-OP: Cognitive Orientation to Daily Occupational Performance

1. CHAPTER 1: INTRODUCTION, LITERATURE REVIEW AND METHODS

1.1. Introduction

This chapter aims to provide the reader with an overview of the study. It will discuss the background of the problem, the problem statement, the objectives and the justification of the study within the context. Additionally, a brief explanation of the chapters of this research report will be provided.

1.1.1. Introduction to the study

More school-going children and adolescents are engaging in contact sport annually resulting in a large number of learner-athletes who present to the emergency department for sport-related concussions[1]. Concussions are an outcome of underlying developmental factors that cause the youth to be more susceptible during sport participation such as decreased skull thickness, weaker neck muscles, immature physical and cognitive development, limited skill proficiency and fatigue during matches[1–9]. Paediatric and adolescent concussions pose a serious public health burden firstly, due to the large numbers of children participating in high school sport, in which nine per cent of injuries are concussions[4,10]. Additionally, by the time they turn ten, sixteen per cent would have had at least one head injury requiring medical attention, while those who are already concussed, have an increased risk of future concussive events[3,11]. Lastly, there is evidence associating repeat concussions with depression, mild cognitive impairment, impaired verbal fluency and electrophysiological abnormalities that are diagnosed in adulthood[12]. This implies that a concussed child can easily become a recurring healthcare user even in adulthood. Moreover, the combination of symptoms associated with sport-related concussion impacts performance in occupations such as school and sport, which further affects the health and well-being of young athletes[4,13–17]. Albeit inevitable, if concussions are properly managed, the resultant long-term challenges can be averted.

1.1.2. Problem Statement

Learner-athletes are often expected to transition back into an active lifestyle before concussion-related symptoms resolve. Conversely, should their daily activities be restricted to prioritise symptom resolution, they become at risk for developing secondary problems that are usually associated with social isolation such as anxiety, stress and mild depression[18,19]. This poses a challenge in the management of concussion where on one hand, the athlete needs to return to premorbid occupational functioning as soon as feasible, and on the other, this has to be done without exacerbating symptoms. Left to their own devices, learner-athletes prematurely return to occupations which worsens post-concussion symptoms and subsequently prolongs recovery[20,21]. The solution nonetheless, does not lie in halting activity participation until symptoms resolve, but rather in the proper management of return to activities while still symptomatic[22–24].

Occupational therapists have a unique competency to facilitate a return to activities post-concussion by either promoting participation in appropriate and meaningful activities or by prescribing environmental and activity adaptations[17,25,26]. However, a gap lies in understanding what specific roles occupational therapists can play in concussion management as well as the intervention strategies that facilitate return to meaningful activities without prolonging recovery and risking repeat concussions. Few sources of evidence describe a comprehensive approach to managing sport-related concussions for South African youth and even fewer guidelines specify the role of occupational therapy despite the reported difficulties with transitioning back to meaningful activities such as school and sport[11,26].

1.1.3. Purpose of the study

The purpose of the study was to understand the role that occupational therapists play in the management of sport-related concussions for children and adolescents. The study searched online databases for literature that demonstrates what occupational therapists around the world do to manage their concussed clients using a scoping review method. The results from the scoping review may assist in the formulation/development of a framework for South African occupational therapists to use in managing their clients. It may also assist in developing practice guidelines that can be applied contextually.

1.1.4. Research Question

What is known in the literature about the role of occupational therapy in the management of sport-related concussions for children and adolescents in South Africa?

1.1.5. Research Aims

This scoping review aimed to explore the role of occupational therapy in managing sport-related concussions for children and adolescents by identifying, analysing and synthesising relevant literature.

1.1.6. Research Objectives

The objectives are:

- To document the number and types of studies, intervention approaches, evidence of occupational therapy intervention and outcomes for children and adolescents and to identify gaps in the existing literature
- To describe the role occupational therapists play in sport-related concussions in the South African context.

1.1.7. Justification of the Study

Occupational therapists aim to promote health, well-being and engagement in occupations by analysing how clients interact with the environment while performing tasks[27,28]. Addressing the barriers that hinder optimal functioning for the individual diagnosed with sport-related concussion, allows the therapist to facilitate engagement in meaningful occupations while simultaneously monitoring client responses[17]. A balanced approach that carefully considers the transactional relationship between person, task, and environment adheres to the philosophy of occupational therapy, and looking at the challenges that manifest following a concussion as well as their impact on occupational functioning, one can safely affirm that occupational therapists are among the suitable practitioners for providing intervention[17,27,29]. The evidence supporting the role of occupational therapy, on the contrary, is sparse which warrants the need for a scoping review[17].

1.1.8. Layout of the Research Report

This research report consists of two subsequent chapters:

- **Chapter 2: Submissible Manuscript**
    - **Abstract:** Highlights the key points related to the journal article
    - **Introduction:** Introduces the reader and provides a background for the research conducted
    - **Literature Review:** Discusses the literature reviewed to contextualise the study
    - **Methodology:** Describes the study methodology which follows a scoping review framework
    - **Results:** Presents the findings of the scoping review undertaken and includes various tables that are organised thematically
    - **Discussion:** Discusses the findings within the context of the literature
    - **Conclusion:** Reflect on significant findings and the implications of the study, as well as recommendations for future research.
- **Chapter 3: Synthesis**
    - **Conclusion:** Reflect on significant findings and the implications of the study, as well as recommendations for future research.
    - **Limitations:** Discusses the limitations of the study
    - **Recommendations:** Discusses recommendations for future research as well as implications for the profession

Disclaimer: The Journal article follows the guidelines for publishing in the South African Journal of Occupational Therapy which permits a maximum of 60 references as stated in Appendix A. The bibliography exceeds this number for examination purposes.

1.2. Literature Review

1.2.1. Introduction to the literature review

This chapter aims to introduce the key terms and concepts relating to the study, mainly sport-related concussion, symptomology, epidemiology, the implication of concussion on occupational performance, the management of concussion and the role of occupational therapy. These concepts are explored to contextualise the role of occupational therapy in the management of sport-related concussions for children and adolescents. Additionally, concussion in South Africa is explored to justify the purpose of this study further. Often the term mild traumatic brain injury (mTBI) is used interchangeably with concussion[30], however, concussion will be used throughout the study.

1.2.2. Sport-Related Concussion

Sport-related concussion is a 'complex pathophysiological process' caused by trauma to the brain[2:598]. It manifests from biomechanical forces that impact either the head, face, or neck directly or cascade to the brain from elsewhere in the body[1–3,9,14,30,31]. The characteristic features used to diagnose a sport-related concussion are a) a rapid onset of neurologic impairments that cause a progression of signs and symptoms, from several minutes to hours before resolving spontaneously; b) neuropathological changes that reflect a disturbance in function rather than a structural injury and lastly; c) clinical signs and symptoms that develop sequentially and may involve loss of consciousness[2,4,5,9,14,30,31]. Concussions therefore result in impairments in brain function rather than structure, as structural neuroimages appear normal and the experienced signs and symptoms may directly affect communication, socialisation, academic performance, as well as participation in daily activities[2,4–6,11,13,15,17,17,18,26,27,30–32,32,33].

1.2.3. Symptomology

The most common symptoms experienced by patients diagnosed with a sport-related concussion are headache and dizziness[4–6,11,17–19,25,27,30–33]. Additional signs and symptoms vary within the physical (e.g. headache, dizziness, and vision problems), cognitive (e.g. concentration difficulties, impaired memory, fatigue and decreased processing speed), emotional (e.g. depression and anxiety), and occupational challenges (e.g. difficulties in daily activities such as sleep)[2,4–6,11,13,15,17,17,18,26,27,30–32,32,33].

The average child or adolescent experiences symptoms that can typically persist for up to four weeks[8,11,17,30,34], however, about ten to twenty per cent of concussions take longer than a month to heal [31,34], and may continue to do so even after a year[10,15,27,32]. Athletes are considered to be healed when they are symptom-free at rest, with exertion and without the need for medications, as well as when they can return to premorbid functioning in occupations such as school, work and sport[9,11,30,35–37].

1.2.4. Epidemiology

Internationally, it is estimated that American children aged eighteen years and younger suffer between 1.1 and 1.9 million reported concussions per year in the context of sport and recreation[9]. Moreover, about 1 in 220 paediatric patients seen in the emergency department are diagnosed with a concussion, in which 30 – 50% of the time is sport-related[4]. A Canadian emergency department study evaluating head injuries found that 53.4% of patients aged ten to fourteen years and 43% of patients aged fifteen to nineteen years had sport-related head injuries[8]. These estimations reflect the value of participation in sport, physical education and recreation as they provide an outlet for leisure and productive activities as well as a sense of routine, identity and social setting[38]. Concomitantly, these estimations also reflect the associated dangers.

In South Africa, there are currently no studies that monitor the number of sport-related concussions seen in emergency rooms or seeking treatment. However, research done on rugby unions indicates that concussion is more common among youth rugby players compared to adults, with incidences ranging from 0.2 to 6.9 concussions per thousand player hours[5,12]. Concussion in youth comprises 12% of all injuries, which is higher than the 4.5%–5% observed in adult games[9]. A narrative review done in 2017 cites the screening of three different population groups of rugby league players at a national tournament (that is under 13, under 16 and 18), and the findings concluded that the highest concussion rate occurred in players in the under-sixteen group[9]. Furthermore, in a large survey consisting of twenty-five South African high schools involving 3330 rugby union players, 15% of all reported injuries were concussions and 14.1% of players reported at least one prior concussion[12].

Paradoxically, the epidemiology of youth concussion is indeterminate as some injuries go unrecognised and patients sometimes do not seek medical care[3,4,9,31,39]. Thus, the available incidence reports may substantially underestimate the extent of the problem and for this reason,

sport-related concussion rates may be relatively higher, especially for athletes between the ages of nine and twenty-two years[3,4,9,12,31,39,40].

1.2.5. Implication on occupational performance

Occupations are the daily activities that people do either alone or in groups to create meaning and purpose in life[28]. Occupational performance is therefore the ability to accomplish engagement in an occupation through the dynamic transaction among the occupation, person and context[28]. Participation in occupations is considered important for recovery and the inability to do so, that is, poor occupational performance, is seen as more detrimental than experiencing symptoms alone[16]. Since concussions result in a constellation of symptoms that affect multiple categories of occupations, individuals who have sustained concussive injuries will likely have their occupational performance impacted negatively. This can interfere with optimal engagement as clients have reported a reluctance to engage in occupations due to symptoms such as headaches and fatigue[17]. Furthermore, symptoms that are not outwardly visible such as visual disturbances or dizziness have been found to compromise perceived quality of life. Thus, for individuals who experience prolonged recovery, the implication may be avoidance of meaningful activities for extended periods[17]. Avoidance of activity can then, in turn, impact the individual's psychological health and well-being[17]. Moreover, the importance of participation in premorbid routines following an injury appears to be related to psychological well-being[17]. Therefore, withdrawal from daily validating activities adversely affects the ability to cope with illness generally, which can result in psychological complications[17]. Thus, achieving health, well-being, and participation in life through engagement in occupation is the overarching statement that describes the domain and process of occupational therapy[28].

1.2.6. Sequelae

Evidence suggests that the risk for subsequent concussions after the initial injury is increased and that concussive injuries may accumulate even after a person has clinically recovered[31,41–43]. Additionally, the course of recovery might be prolonged after each successive injury[31,41–43]. Individuals who sustain repeat concussions may experience long-term and severe damage such as Second Impact Syndrome (SIS) and Chronic Traumatic Encephalopathy (CTE)[42].

Second Impact Syndrome occurs when a second concussion is sustained before symptom resolution of the first one, and there is debate as to whether it can also result from two separate

concussions that are indirectly related[2,3,12,27,31,44–47]. The population at most risk is the paediatric and adolescent group as all reported cases of SIS have occurred in athletes younger than twenty years[2,12,27,31,46].

Chronic Traumatic Encephalopathy results in longer-term structural injury to the brain[4,24,27,42]. Both CTE and SIS present with symptoms such as irritability, depression, impulsivity, concentration difficulties, impaired cognition and conversation challenges[4,27,34]. These conditions demonstrate longer symptom resolution time and increased time out of play, thus, increasing the chances of loss of consciousness, deterioration of neurological functioning, acquisition of a learning disability, or death[1,24,44,48,49].

Sport-related concussions predominantly affect the aspect of the brain that plays an important role in the cognitive, behavioural, and emotional domains of executive functions. Impairments in these areas have a devastating effect on an individual's daily activities including the ability to play sport, attend school, complete chores at home independently, or develop and maintain appropriate social relations[50]. Consequently, executive dysfunction has an adverse effect on the adolescent's quality of life and daily functioning in multiple domains; including academic functioning, independent living skills, and social interaction[50].

1.2.7. Management of concussion and the role of OT

The most comprehensive guidelines for the management of concussions for health practitioners are focused on adults despite increasing concern about concussion prevalence in children [14]. The current objectives of concussion management for all population groups, are to ensure quick recovery while avoiding activities that may hinder healing, exacerbate symptoms or cause a re-emergence of resolved symptoms as well as multiple concussions[2,31,33,51–53]. This includes understanding or recognising concussion symptoms through comprehensive assessments, instituting cognitive and physical rest through energy conservation principles, rehabilitation of adverse symptoms to ensure complete recovery, education of varying individuals involved in the person's life using a multidisciplinary approach, prevention strategies for risk reduction and finally, a safe return to prior occupational functioning[2,13–15,22,27,30,32–34,41,54,55].

Occupational therapy could assist the athlete in discovering ways to maximise participation in meaningful occupations while recovering from a concussion by using strategies to adapt activities and monitor internal responses to activities[16,17]. This can be achieved by implementing a client-centred, occupation-based approach that entails the use of meaningful

occupations as a therapeutic tool[17]. Not only is attaining health, well-being, and participation in life through engagement in meaningful occupations the main concern of practitioners, but also focusing on factors that disrupt or empower participation in health-promoting occupations[28]. By addressing barriers to optimal occupation, the therapist is better able to help the client return to full engagement, rather than participation alone[17].

Clinical practice in providing health-related services generally follows a three-step process which includes evaluation, intervention and targeted outcomes[28]. Occupational therapists also follow this process while focusing on the therapeutic use of occupations to promote health, well-being and participation in life[28]. For purposes of this study, concussion management in occupational therapy can therefore be summarised into; symptom recognition, energy conservation, rehabilitation, education, risk reduction and return to occupational function which includes return to school and sport. These concepts can be applied at any stage of concussion recovery and in any setting where occupational therapists are situated. They are further elaborated upon below.

Symptom Recognition and Assessment

Concussion management begins with the initial side-line evaluation which includes an inquiry into the athlete's symptoms, medical history, a neurologic examination, and evaluation of the athlete's balance and cognition using assessment tools[15,31,32,39,56]. Early recognition and diagnosis of concussion are associated with better health outcomes[15]. In all suspected cases of concussion, the best response is to remove the individual from the playing field and the athlete should not return to play on the day of injury[1,4,15,22,30,31,41,44–46,55,57–59]. Moreover, the athlete should continue to be monitored for several hours after the injury to evaluate for any deterioration[15,30,31,41].

A comprehensive occupational therapy assessment following a concussion would include a thorough client interview to ascertain the symptoms, affected areas of occupation, current and prior daily routine, factors that may be associated with the worsening of symptoms as well as the perceived quality of life [17]. Additional tools include symptom reporting questionnaires for gathering information about the level and types of symptoms as well as quality of life measures to help gather information about the impact of symptoms on the overall perceived quality of life[17]. This process allows the client and therapist to develop a comprehensive understanding of how both internal and external factors may contribute to the challenges faced in engaging in

desired occupations[17,27] and can facilitate the development of an individualized intervention plan that is occupation-based and client-centred[17].

Energy Conservation (Cognitive & Physical Rest)

Once a concussion diagnosis is confirmed, the first step in managing symptoms is the institution of both physical and cognitive rest[15,22,36,52,57,60–63]. Physical rest is recommended to avoid exacerbating and prolonging symptoms as well as to minimise the risk of a second head injury. This includes removing an athlete from practices, games and any other activity that may elevate the heart rate or place them at risk for reinjury until they are cleared for full return to play [31,41,46,57]. Cognitive rest refers to avoiding activities which require attention and concentration as well as potential cognitive stressors such as texting, video games, computer, television exposure, schoolwork, reading, listening to music on headphones and using the cell phone [1,20,31,33,41,44,46,52,57,58,60,63–67]. For most athletes, 24–48 hours of cognitive and physical rest is sufficient followed by a gradual introduction and increase in activity participation[3,9,11,15,17,22,23,30,51,55,68].

Research demonstrates a notable correlation between immediate rest from cognitive and physical activities, with a fast recovery rate, low risk of prolonged symptoms and positive neurocognitive outcomes [4,19,23,27,41,61]. Prescribing rest is understood to mitigate symptoms that manifest after a concussion, ease discomfort and promote recovery by minimising energy demands. Although the recommendation of rest may be clear to most, how it can be incorporated into daily function may not be as apparent[2,3,22,24,27,30,33,56]. Moreover, the optimal rest period and how one should rest is not well understood but there is a general agreement that strict rest is unrealistic and offers no added benefit over the usual care [4,8,11,19,22,23,30,36,52,58]. Occupational therapists can facilitate this by providing the athlete and family with energy conservation strategies that contribute to effective re-engagement in daily occupations[13,16].

Intervention Approaches and Rehabilitation

Approaches to intervention are the varying strategies that occupational therapists select to direct evaluation and intervention processes based on the context of service delivery. These guide the therapist in selecting appropriate practice models, frames of references and treatment theories and are namely; health promotion, remediation or restoration, maintenance, compensation or adaptation and disability prevention[28]. Rehabilitation being one of the

strategies recommended by the consensus guidelines for managing concussion can encompass any of the treatment approaches listed previously. Here, the therapist ought to focus on a balanced, gradual return to activities that can be facilitated through energy conservation, assistive technology, environmental modifications and activity adaptations[17]. In addition, building awareness of activities that exacerbate symptoms as well as recognising the need to implement rest breaks when symptoms resurface could also be the focus of intervention[17]. In children and adolescents, this would require educating the family as well in monitoring the signs and symptoms to avoid over-exertion.

Rehabilitation strategies in occupational therapy include improving visual, vestibular, cognitive, and other physical symptoms associated with a concussion but in the context of engaging in meaningful occupations[17]. Historically, rest followed by a graded exertion protocol was the treatment of choice in concussion management. However, a more active approach to rehabilitation such as vestibular rehabilitation which focuses on reducing dizziness, restoring balance and increasing physical activity has been recently purported as beneficial[19,22,24,30,34,55].

The role of the multidisciplinary team

Effective concussion management requires a multidisciplinary team-based approach in which the family, medical providers, and school personnel work together to maximise the recovery of the learner-athlete[22,33,44,69]. This may consist of sport medicine physicians, athletic trainers, physiotherapists, occupational therapists, sport chiropractors, neurologists, neurosurgeons, neuropsychologists, ophthalmologists, optometrists, psychologists and psychiatrists[70]. Referrals to specialised clinicians and a collaborative approach to treatment promote effective treatment of persisting symptoms such as migraines or headaches, cognitive and psychological difficulties, balance disturbances, vestibular signs and oculomotor challenges[70]. To reach the right balance at home and school, multidisciplinary teams should be well-versed in their roles and responsibilities in concussion management[33].

Education

The education of the child, family members and caregivers as well as school staff, is necessary to provide adjustments, accommodations, and long-term program modifications for learners[22]. A collaborative approach to education helps improve awareness, recognition, and management and should target all the key individuals involved, including athletes, parents, coaches, school

administrators, teachers, athletic trainers, physicians, and other healthcare providers[22,30,31,33,41,45,69,71]. Education can be provided in printed material, web-based resources, and educational videos combined with verbal review and can consist of; symptoms and expected outcomes, reassurance about expected positive recovery, a gradual return to activities, coping strategies, life roles, as well as techniques to manage stress[4,10,15,18,20,30,31,46,58,65,66].

Although it remains impossible to eliminate all concussions in sport, the number and severity of concussions can be reduced by means of prevention strategies such as protective gear modifications, rule changing, identification of athletes at risk, and continuous education of everyone involved with youth about the dangers of concussions[30,31,41,42,44,66,72,73]. Schools in general are ideal for implementing concussion prevention and awareness programmes as they encourage the sharing of information and the programmes can be implemented in the classroom and on the field[46].

1.2.8. Return to prior occupational functioning

Children need participation in routines and meaningful activities for a good quality of life[52]. Although the following guidelines are specific to a return to learning, school and sport, the therapist can also apply the recommendations to other areas of occupation, such as leisure and work[17].

Return to Sport: A Stepwise Graded Protocol

Returning to sport should occur only after obtaining medical clearance from a licensed healthcare provider who is trained in concussion-related protocols[22]. However, before starting the protocol, any medications used to reduce symptoms must be stopped and the athlete must remain symptom-free both at rest and with exertion[1,2,15,30,31,31,41,74]. Once symptoms have resolved, the individual can progress through a medically supervised stepwise exertion protocol that is designed to reintroduce the athlete to sport activities[22,41,58].

A series of physical exercises and sport-specific skills are used in six graduated steps that take a minimum of 24 hours to complete[1,9,13,15,17,22,25,31,37,41,44,57,58,72,75]. The athlete ought to remain asymptomatic before progressing to the next step however, should symptoms reoccur, progress

is halted and the athlete is returned to the previous level to engage in former exercise sets[4,15,22,31,46]. Recurrence of concussion-related symptoms during the graded protocol is used to prompt the discontinuation of activity and resumption of at least 24 hours of physical and cognitive rest until the patient is symptom-free again[14,15,30,31,37,44,46,47,51,57,58]. The youth athlete can only be cleared for a full return to sport when all six steps are completed without exacerbating symptoms[46].

Considering the environmental demands of the particular sport an athlete is returning to, occupational therapists can use these stepwise guidelines to develop individualised treatment plans that suit the specific needs of each athlete, particularly, the cognitive demands. In addition, occupational therapists can incorporate a gradual escalation of cognitive exertion while taking into account the complex interactions between person, task, and environment[13]

In some cases, the decision to retire an athlete may need to be made. This decision can be both difficult and complex as it does not affect the concussed athlete only[27,31]. Such a decision should weigh the risks of further injury against the risks of no longer participating in that sport[4,27]. Aspects that are considered during the decision-making process include, the number of concussions the athlete has sustained in the past as well as previous symptoms, symptom severity, recovery time, whether they returned to play with symptoms and the results from neurologic and neuropsychological examination as well as neuroimaging[4,27,31,41,46].

Returning to School and Learning

As young athletes advance through a graduated return to sport protocol, their return-to-school plan should operate in a parallel fashion[46]. The ability to tolerate a cognitive activity without symptom exacerbation or re-emergence serves as a reasonable indicator of when the learner is ready to attempt returning to school[33,51,58,65,69]. Returning to school ought to be highly prioritised and parents should be encouraged to do so as soon as possible[41,52,76]. Children and adolescents do not need to be symptom-free to do so however, they may return to school if rest breaks would resolve any symptoms that arise[33,41,58,65,76]. Returning to a modified school environment represents and promotes routine as well as supportive social environments[52]. Occupational therapists can develop return-to-school care plans while incorporating the unique needs of the client and addressing the specific functional deficits of the learner-athlete[13].

Once a learner is allowed to attend school, they can begin their return to learning programme as learning and academic success is important for full participation in school[52]. Though

somewhat ambiguous, return to learning is the process of transitioning back to the classroom without the need for academic accommodations[75]. Research reports children benefiting from a controlled and supervised gradual return-to-learn programme[3,11,17,20,27] that balances activity and rest[2,14,20,22,30,48,65]. A return-to-learn protocol involves incremental increases in cognitive activity while staying below the learner's symptom threshold, monitoring the learner for symptom exacerbation, and providing academic accommodations as needed[58]. Each learner progresses at their own pace based on symptomology, number of previous concussions, and comorbidities[58].

1.2.9. The South African context

Only one study has been found to describe concussion management for occupational therapists in South Africa through an integrative review[29]. The review describes that the practice guidelines for occupational therapy are published in developed countries such as America, Australia and Canada and yet may set unrealistic standards for South Africa mainly due to standardised tests that are not only expensive but are not being standardised on the South African population[29]. This poses a challenge in implementing evidence-based practice when the evidence is dearth.

In conclusion, the importance of a client-centred and occupation-based approach is necessary for concussion management and as a result, occupational therapists can offer a unique contribution to concussion rehabilitation[17]. However, despite the value that occupational therapy may offer, guidelines for clinical practice are limited[17]. Occupational therapists have the unique potential to help preserve cognitive functioning during recovery, facilitate reengagement in activity following a concussion and better overall functioning along with task and environmental modifications[13,16,17,25,26].

1.3. Methods

1.3.1. Introduction to Methodology

The purpose of this research study is to describe the role of occupational therapists in the management of sport-related concussions for children and adolescents. This research study was conducted through a scoping review to explore the role of occupational therapy in managing sport-related concussions for children and adolescents by identifying, analysing and synthesising relevant literature. This chapter outlines the research design, research procedure, data collection and analysis and the ethical considerations related to the study.

1.3.2. Scoping Review Research Design

The research design used is based on the scoping review framework by Arksey and O'Malley (2005) that was further expanded by Levac et al (2010)[77]. Scoping reviews map the literature of a particular research area by establishing important concepts, varying sources of evidence and identifying gaps in current research to inform practice and future research[78]. Due to the sparsity of practice guidelines in South Africa. A scoping review is thus necessary to investigate the existing occupational therapy approach in the management of concussions by looking at the available literature related to school-going children who are concussed. In collating the existing literature, one can describe the varying ways that occupational therapists are involved in the management of sport-related concussions with the hope that further research would inform practice in South Africa. The PRISMA-ScR checklist was used as a guideline in knowledge synthesis and reporting throughout this research report[79,80].

1.3.3. Research Procedure

The scoping review framework describes the following steps necessary to conduct the study: 1) Identifying the relevant studies, 2) Selecting the studies, 3) Charting the information and 4) Collating, and summarising the results[77–79,81–86]. The research procedure process was iterative in that stages such as identifying relevant studies were repeated several times as additional search terms were included or redefined to achieve comprehensiveness[78,79,86,87]. The following sections describe the details of how each step was conducted.

1.3.4. Identifying Relevant Studies

The objective was to be comprehensive in identifying published and grey literature to answer the aforementioned research question. The study search was conducted under the guidance of a librarian using the following steps:

Electronic Database Search

The electronic database search was conducted in PubMed, CINAHL, Scopus, OTseeker and Cochrane Library using the following keywords: *children, concussion, sport-related, occupational therapy, management* and their synonyms. Boolean operators, MeSH terms, truncation and parenthesis were also used of which further details can be found in Appendix B. The inclusion criteria which are detailed further in section 1.3.5 below include; papers needed to focus on the management or rehabilitation of children and adolescents who sustain a sport-related concussion, published between the period of 2010 and the date of search in August 2022, written in English, explicitly mention the management of sport-related concussions and more importantly, the role of occupational therapy. Papers were excluded if they did not fit into the conceptual framework of the study as well as looked at children and adolescents who had premorbid conditions that could exacerbate concussive symptoms such as attention-deficit hyperactivity disorder (ADHD), learning Disability and mood disorders[6,30,41,51,55,58]. The final search strategies for each database are found in Appendix B and the search results were exported to Zotero for deduplication.

Hand-Searching of the key Journals

Hand-searching the South African Journal of Occupational Therapy using the keyword search was done to identify articles that may have been missed in the database search. The articles searched were from 2010 till date, starting with articles in Volume 40 issue 3 and ending in Volume 52 issue 2. The number of articles found was five. The Journal of Concussion was also hand-searched using the keyword search. The articles that were available for searching ranged from 2017 to 2022. A total of 77 articles were found. This helped with identifying relevant articles that have been missed in the previous two search strategies resulting in a total of 82 articles being added to the search strategy.

Grey Literature Search

Finally, a search of grey literature, consisting of articles and documents that may not have been published but assisted with the research, was performed using the Grey Matters Checklist. Four documents were found using the search strategy resulting in a total number of 1 866 studies. The search history was recorded in an Excel spreadsheet to ensure transparency and reproducibility and can all be found in Appendix B.

Reference Lists

The bibliographies of studies accessed from the database searches, especially the systematic and literature reviews, were checked to see if studies were missed. This also included book chapters and other reviews. The more studies found the closer one came to reaching a saturation point in which no new studies are discovered. After checking 72 articles and finding 113 additional articles, it was at this point that the reference list search was deemed complete.

1.3.5. Study Selection

Based on the research question, the following inclusion and exclusion criteria were generated to cover the following (Table 1.1).

Inclusion Criteria:

Participants/Population: The study focused on children and adolescents as defined by McCrory et al. (2017) to be between the ages of 5 – 12 for children and 13 -18 for adolescents. Very often articles would either use the word 'youth' or separate the two population groups to be more specific. The scoping review search included all articles that catered for this population group provided that the ages fell within the children and adolescent range.

Intervention: The main intervention of interest was occupational therapy however, to broaden the search, literature that included rehabilitation or therapy was included provided that this was explicitly mentioned in either the title or the abstract.

Concepts: This scoping review focused on three concepts namely, concussion, sport and the management of injury by occupational therapists. Articles needed to focus on these three concepts to be included. Mild traumatic brain injuries were included as some articles used this term interchangeably with concussion. Various words related to sport such as athlete, game or competition were included as they fit within the conceptual framework.

Context: The literature generated needed to fall within the time frame of 2010 until August 2022 which was the date of the search.

Exclusion Criteria

Even though the scoping review was focused on children and adolescents who were concussed, research studies were excluded if the participants had premorbid conditions that could exacerbate symptoms or complicate the recovery process such as ADHD, learning disabilities and mood disorders[6,30,41,51,55,58]. Letters, texts and opinion pieces were also excluded as they were unable to meet the research objective that focused on collating evidence.

Table 1.1: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria:
Articles involving children and adolescents between the ages 5 - 18 years	Participants in the study should not have a premorbid condition that could exacerbate concussive symptoms such as ADHD, learning disability and mood disorders
A concussion that is sport-related	The following sources of evidence: Letters, texts and opinion pieces as they are unable to meet objective one
Information that is published in English	Intervention that involves aerobic exercise and gait-related activities on the premise that this is primarily done by physiotherapists
Articles that are explicit in mentioning the management of concussion in their abstract	Management that is based on preventive measures rather than rehabilitative or therapeutic
Articles published from the year 2010 until August 2022	Interventions that primarily focused on adults such as parents, educators and coaches
Articles that mention occupational therapy intervention related to concussion	Studies conducted on rats despite having recommendations for children and adolescents
	Conference proceedings, opinion pieces and protocols
	Titles and abstracts that reference other practitioners such as physiotherapy, speech therapy, nursing, chiropractic and office/emergency department physicians as the key clinicians to avoid ambiguity
	Articles that focused on TBI but encompassed mTBI were also excluded to avoid ambiguity.

	Full texts that were inaccessible or difficult to retrieve

Before any screening was conducted, 426 duplicates were removed. A pilot testing of 10% of the selected articles was thereafter done with a second reviewer using the Rayyan Software in which a percentage agreement of 80% and above needed to be met to ensure reliability. The exclusion criteria were loaded onto the software for ease of reference and each reviewer conducted a blind test in which they were unable to see each other's results. A total of 156 articles were reviewed and 96% agreement was reached, discrepancies were resolved by consensus.

All the studies that were identified underwent a title and abstract screening using the Rayyan Software™ to see if they met the inclusion criteria. 1 553 articles underwent the screening and a total of 1 158 articles were excluded while 395 articles underwent a full-text review. If the title and the abstract of the article could not be verified for relevance, the entire article was read to ensure that it was not excluded prematurely. The deadline for the study selection process was August 2022, and thus articles published after this date were automatically excluded. A total of 12 articles were included for charting the data and Figure 4.1 provides a representation of the study selection.

1.3.6. Charting the Data

'Charting' describes a technique for synthesising and interpreting data by sifting and sorting material according to key issues and themes and illustrating them in the form of a chart[86]. A data charting form was developed using the Microsft Excel spreadsheet (Appendix C) with the following headings: title, author(s), year of publication, study location, intervention type, comparator (if any), and important findings related to the role of occupational therapy[87–90]. These headings provided general information regarding the distribution of studies as well as additional information that was specific to the research objectives. This was an iterative process which was directed by the information obtained in the studies, with each new information obtained, the data charting form was updated[78,81,87,88].

1.3.7. Data Analysis

Data was stored online on the Rayyan Software™ which required a password to log in. In addition, access to the platform required the researcher to invite an external individual as well as authorise the role they would play which could be collaborator, translator, reviewer or viewer. This ensured that the data was securely protected, and no one could have access without the knowledge or permission of the researcher. Results were collated, summarised and reported in Table 2.3 by analysing the data extracted from each source of evidence and thereafter the broader themes related to the role of occupational therapy were identified. The end goal was to scope the available evidence on the role that occupational therapy plays in the management of concussions for children and adolescents.

1.3.8. Ethical Considerations

The researcher attended an internal ethics training before conducting the research. The research protocol was submitted for approval after undergoing assessment by the School of Therapeutic Sciences assessors committee (Appendix D). Due to the nature of the study being a scoping review, an ethical waiver for the study was received from the Wits Human Research Ethics Committee (W-CBP-201006-01).

2. CHAPTER 2: SUBMISSIBLE MANUSCRIPT

2.1. Manuscript Details

This chapter presents the manuscript prepared for submission to a journal. The manuscript will be submitted for review and publication in the *South African Journal of Occupational Therapy* and is presented according to the journal's format (Appendix A). This journal was chosen because it caters primarily for South African occupational therapists. The study aimed to illustrate the role of South African occupational therapists in managing sport-related concussions for children and adolescents and this journal allows for ease of access. The manuscript is titled, "*The Role of Occupational Therapy in the Management of Sport-related Concussion for Children and Adolescents: A Scoping Review."*

2.2. Details of Author Contribution

The primary researcher in this study is TL. Mokwena with F. Jackson and B. Baghoo as co-authors and supervisors. The authors' contributions to this manuscript are detailed in Table 2.1 according to the relevant aspects of the Contributor Role Taxonomy (CRediT)[91].

Table 2.1: Details of Author Contributions

CRediT Terms	**TL. Mokwena**	**F. Jackson**	**B. Baghoo**
Conceptualization	x	x	
Methodology	x	x	
Writing manuscript- draft	x		
Writing manuscript- reviewing and editing	x	x	x
Supervision		x	x

2.3. Abstract

2.3.1. Background

More children and adolescents are engaging in contact sport annually resulting in an increased incidence of sport-related concussions. Often, coaches, parents and athletes expect a transition back into an active lifestyle before symptom resolution which creates a dilemma in concussion management. Occupational therapists have a unique competency to facilitate the transition from injury to recovery however, a gap lies in understanding the role of occupational therapy in concussion management.

2.3.2. Methodology

The research design used was based on the scoping review framework by Arksey and O'Malley (2005) that was further expanded by Levac et al (2010). This scoping review collates findings from existing studies and describes the varying ways in which occupational therapists can assist in managing concussions. The electronic databases searched were PubMed, CINAHL, Scopus, OTSeeker and Cochrane Library. Hand-searching was done in the South African Journal of Occupational Therapy and Journal of Concussion. A search of grey literature was also conducted but no other articles were included from this search. The overall articles searched were from January 2010 until August 2022. A total of 12 articles were included.

2.3.3. Results and Discussion

Occupational therapists can play a role in the rehabilitation of concussions by implementing the three steps in the occupational therapy process. Evaluation of the concussion symptoms, occupational performance, background and concussion history through the use of standardised and non-standardised assessments. Intervention can be provided through energy conservation strategies during cognitive and physical rest, rehabilitation of concussion symptoms and occupational performance, facilitation of education and prevention programmes as well as referrals to other health care professionals. Lastly, the targeted outcomes are mainly the recovery of concussion symptoms as well as engagement in occupations.

2.3.4. Conclusion

These roles are mentioned in studies that have a global north bias and could present differently in South Africa depending on the financial implications and clinical reasoning of the treating

therapist. The role of occupational therapy has been proposed in the form of a Concussion Intervention Framework.

Keywords: children, concussion, sport-related, occupational therapy, management

2.4. Introduction

More school-going children and adolescents (aged between 5 – 18 years) are engaging in contact sport annually resulting in a large number of learner-athletes who present to the emergency department for sport-related concussions [1]. Paediatric and adolescent concussions pose a serious public health burden due to the underlying developmental factors that increase their susceptibility, such as; decreased skull thickness, weaker neck muscles, immature physical and cognitive development, limited skill proficiency and fatigue during matches[1–10]. The constellation of symptoms that follow sport-related concussions negatively influences occupational performance both on and off the playing field, which further impacts the health and well-being of young athletes[13,16,17].

Learner-athletes are often expected to transition back into an active lifestyle before symptom resolution, and should their daily activities be restricted for extended periods during recovery, they become at risk for secondary problems such as anxiety, stress, mild depression, and irritability[18,19]. This creates a dilemma in the management of concussions as the athlete needs to return to prior occupational functioning as soon as feasible, however, the exacerbation of symptoms and repeat concussions need to be precluded. Left to their own devices, learner-athletes often prematurely return to school and sport which worsens post-concussion symptoms and consequently prolongs recovery[20]. Concussions, albeit pervasive, can be properly managed and the resultant occupational challenges can be averted. The solution, conversely, does not lie in halting activity participation until symptoms resolve, but rather in the proper management of return to activities while still symptomatic[22–24].

Occupational therapists have a unique competency to facilitate return to activities post-concussion by either promoting participation in appropriate and meaningful activities or by prescribing adaptations to the environment[17,25,26]. However, a gap lies between understanding what role occupational therapists can play in concussion management for example the intervention strategies that facilitate return to meaningful activities without prolonging recovery and risking repeat concussions. Few sources of evidence describe a comprehensive approach to managing sport-related concussions for South African youth irrespective of the profession and fewer practice guidelines specify the role of occupational therapy in concussion management[11,26]. The current guidelines are based primarily on the Consensus Statement on Concussion in Sport (2023) which is developed internationally every four years by the Concussion in Sport Group. In addition, an integrative review was conducted in South Africa

to synthesise the role of occupational therapy in the treatment of sport-related concussions in schoolboys in 2020. This paucity of information warrants the need for a scoping review. Scoping reviews map the characteristics of literature to fulfil the review's objective, research question and inclusion criteria[89]. This is done to also establishing important concepts, varying sources of evidence and identifying gaps in current research to inform practice and future research[77–79,81,82,86–88]. This scoping review explored the role of occupational therapy in managing sport-related concussions for children and adolescents by identifying, analysing and synthesising relevant literature. In collating the existing sources of evidence, the varying ways in which occupational therapists can assist in the management of concussions are presented.

2.5. Literature Review

2.5.1. Introduction

Sport-related concussion is a 'complex pathophysiological process' caused by trauma to the brain[2:598]. It manifests from biomechanical forces that impact either the head, face, or neck directly or cascade to the brain from elsewhere in the body[1–3,9,14,30,31]. Concussions reflect impairments in brain function rather than structure, as structural neuroimages appear normal and the resultant symptoms directly impact communication, socialisation, academic performance, as well as participation in daily activities[2,4–6,11,13,15,17,18,26,27,30–33]. The most common symptoms experienced by concussed patients are headache and dizziness[4–6,11,17–19,25,27,30–33] while others vary within physical, emotional, cognitive and performance in occupations[2,4–6,11,13,15,17,18,26,27,30–33]. The average concussed child or adolescent experiences symptoms that can typically persist for up to four weeks[8,11,17,30,34], however, ten to twenty per cent of concussions take longer than a month to heal[31,34] and may continue to do so even after a year[10,15,27,32].

2.5.2. Epidemiology of Sport-Related Concussions

Internationally, it is estimated that American children aged eighteen years and younger suffer between 1.1 and 1.9 million reported concussions per year in the context of sport and recreation[9]. Moreover, about 1 in 220 paediatric patients seen in the emergency department are diagnosed with a concussion, in which 30 – 50% of the time is sport-related[4]. A Canadian emergency department study evaluating head injuries found that 53.4% of patients aged ten to fourteen years and 43% of patients aged fifteen to nineteen years had sport-related head

injuries[8]. These estimations reflect the value of participation in sport, physical education and recreation as they provide an outlet for leisure and productive activities as well as a sense of routine, identity and social setting[38]. Concomitantly, these estimations also reflect the associated dangers.

In South Africa, there are currently no known studies that monitor the sport-related concussions seen in emergency rooms, however, research done on rugby unions indicates that concussion is more common among youth rugby players than adults[5,9,12]. A narrative review done in 2017 cites the screening of three different population groups of rugby league players (that is under 13, 16 and 18) at a national tournament, and the findings concluded that the highest concussion rate occurred in players under sixteen[9]. Furthermore, in a large survey consisting of twenty-five South African high schools involving 3 330 rugby union players, 15% of all reported injuries were concussions and 14.1% of players reported at least one prior concussion[12]. The epidemiology of youth concussion is conversely indeterminate as some injuries go unrecognised and patients sometimes do not seek medical care[3,4,9,31,39]. Thus, the available incidence reports may substantially underestimate the extent of the problem. Therefore, concussion rates may be relatively higher, especially for athletes between the ages of nine and 22[3,4,9,12,31,39].

2.5.3. Concussion Management

According to a scoping review conducted by DeMatteo et al (2015), the most comprehensive practice guidelines on the management of concussions for health practitioners are focused on adults despite increasing concern about concussion prevalence in children[14]. The authors found that when it comes to children and adolescents, health practitioners are recommended to follow a more conservative approach when returning learners to activity as well as using a stepwise approach[14]. However, these recommendations would need further expounding for practical implementation.

The aim of concussion management is rapid recovery while avoiding situations that may hinder healing, exacerbate symptoms or cause a re-emergence of symptoms and multiple concussions[2,31,33,51,52]. This requires the managing team such as sport medicine physicians, athletic trainers, occupational therapists and neurosurgeons, to recognise concussion symptoms, institute early cognitive and physical rest, promote a return to premorbid functioning in school and sport, educate individuals involved in the learner's life and prevent

further injury[2,13–15,22,27,30,32–34,41,55]. These concepts are further explained below with the implicit aim of justifying the need for occupational therapy in each stage of concussion management.

Recognition of concussion symptoms through assessments

Symptom recognition begins with the initial side-line evaluation which includes an inquiry into the athlete's symptoms, medical history, a neurologic examination and the assessment of balance and cognition[15,31,32,39,56]. This is often conducted by the treating physician or athletic trainer immediately after the injury where the player is removed from the playing field and evaluated on the sidelines before proceeding to the emergency department[70]. Early recognition and diagnosis of concussion are associated with better health outcomes and in all suspected cases of concussion, the best response is to remove the individual from the playing field and not allow a return to play on the same day of injury[1,4,15,22,30,31,41,44–46,55,57–59]. Moreover, the athlete should continue to be monitored for several hours after the injury to evaluate for any functional deterioration[15,30,31,41]. Once a learner is diagnosed with a concussion and a referral has been made, occupational therapists could conduct comprehensive assessments to ascertain affected areas of occupation, current and prior daily routines, factors that are associated with symptom exacerbation as well as the perceived quality of life[17]. Comprehensive occupational therapy assessments allow the client and therapist to develop an understanding of how client factors and performance skills may make it difficult to engage in desired occupations. These assessments can also serve as a foundation for the development of an occupation-based, client-centred intervention plan[17,27].

Early physical and cognitive Rest

According to the most recent consensus statement on concussion in sport (2023), one of the most crucial intervention steps is the institution of 24–48 hours of physical and cognitive rest followed by a gradual introduction and increase in activity participation[70]. The prescribed rest is termed relative rest as it includes activities of daily living and reduced screen time rather than strict rest which is not beneficial[70]. Prescribing rest is understood to mitigate post-concussion symptoms, ease discomfort and promote recovery by minimising energy demands and although seemingly straightforward, integration into daily function may not be as apparent[2,3,22,24,27,30,33,56]. Occupational therapists can facilitate relative rest by providing the athlete and family with energy conservation strategies that contribute to effective re-

engagement in daily occupations[13,16]. In addition, building an awareness of activities that exacerbate symptoms as well as recognising the need to implement rest breaks when symptoms resurface could also be the focus of intervention[17]. Historically, strict rest was initially prescribed followed by a graded exertion protocol as the treatment of choice in concussion management, however, a more active approach to the rehabilitation of adverse symptoms which are visual, vestibular, cognitive, and physical has been recently purported as beneficial[19,22,24,30,34,55]. Once the relative rest period has passed, the occupational therapist can implement rehabilitation which focuses on a balanced, gradual return to activity that can be facilitated through energy conservation, assistive technology, environmental modifications and activity adaptations[17].

Return to School

The ability to tolerate a cognitive activity without symptom exacerbation serves as a reasonable indicator of when the learner is ready to attempt returning to school[33,51,58,65,69]. Returning to school ought to be a top priority and parents should be encouraged to do so as soon as possible as it promotes routine as well as a supportive social environment[41,52,76]. Children and adolescents need not be asymptomatic to return to school, however may only do so if rest breaks would resolve symptoms[33,41,58,65,76]. Once a learner is allowed to attend school, they can begin their return to learning programme which is important for full participation in school[52]. Return to learning is the process of transitioning back to the classroom without the need for academic accommodations[75]. Research reports children benefiting from a controlled and supervised gradual return-to-learn programme that balances activity and rest[2,3,11,14,17,20,20,22,25,27,30,65]. Occupational therapists can develop return-to-school care plans while incorporating the unique needs of the client and addressing the specific functional deficits of the learner-athlete[13].

Return to Sport

After successfully returning to school, athletes can undergo a return to sport programme provided that any medication used to reduce symptoms is stopped and the athlete remains symptom-free both at rest and with exertion[1,2,15,30,31,41,74]. The individual can progress through a medically supervised 6-step exertion protocol that uses a progression of physical exercise and sport-specific skills designed to reintroduce the athlete to sport[1,9,13,15,17,22,25,31,37,41,44,57,58,72,75]. The athlete ought to remain asymptomatic throughout each step and the recurrence of concussion-related symptoms is used to prompt the discontinuation of activity as well as the

resumption of the 24-hour physical and cognitive rest[14,15,30,31,37,44,46,47,51,57,58]. The young athlete can only be cleared for a full return to sport when all of these steps are completed without exacerbating symptoms[46]. However, in some cases, the decision to retire an athlete may need to be made which can be both difficult and complex due to its repercussions[27,31]. Such a decision should weigh the risks of further injury against the risks of no longer participating in sport[4,27]. Aspects that assist with the decision-making process include, the number of concussions the athlete has sustained in the past, previous symptoms and symptom severity, recovery time and results from the neurologic examination, neuropsychological testing and neuroimaging[4,27,31,41,46]. Such instances validate the need for a multi-disciplinary team in which the family, medical providers, and school personnel work together to maximise recovery and prevent sport retirement[22,33,44,69].

Prevention Programmes in school and Education of learners, caregivers and school staff

To reach the right balance in intervention implementation both at home and school, the education of all key individuals involved in dealing with children with sport related concussions (including athletes, parents, coaches, school administrators, teachers, athletic trainers, physicians, and other healthcare providers) is imperative[22,30,31,33,41,69]. Moreover, a collaborative approach to educating learners, coaches and school staff on sport-related concussion helps improve awareness, recognition, and management. Education about sport-related concussion should consist of information regarding concussion symptoms, expected outcomes, reassurance about positive recovery, a gradual return to activities, coping strategies, life roles and stress management techniques which can be provided in printed material, web-based resources, and educational videos[4,10,15,18,20,30,31,46,58,65].

Furthermore, another approach to educating the greater community involved with sport related concussion may be to consider prevention programmes and strategies. Even though it is impossible to eliminate all concussions in sport, prevention strategies can reduce the number and severity. These can include protective gear modifications, rule changing, identification of athletes at risk and continuous education about the dangers of concussions[30,31,41,44]. Schools in general are ideal for implementing concussion prevention and awareness programmes as they encourage the sharing of information and the programmes can be implemented in the classroom and on the field[46].

2.5.4. Implications of concussions on Occupational Performance

Participation in school and sport is important for children and adolescents due to the benefits it holds for their development and wellbeing (such as improved physical and psychosocial health)[13,52]. The loss of participation in these activities is considered to be the most detrimental part of concussion injuries in comparison to the symptoms, as concussed athletes often hesitate to return to certain occupations or feel a decreased sense of satisfaction in occupations[16,17]. Evidently, children need to establish routines and participate in meaningful activities in order to develop a good quality of life[52]. Occupational therapists have the unique potential to facilitate this during concussion recovery by helping athletes conserve cognitive resources, facilitate reengagement in activity and improve overall functioning along with task and environmental modifications[13,16,17,25,26]. By addressing barriers to optimal occupation, the therapist helps the client return to full engagement in occupations[17]. However, despite the valuable role that occupational therapy may offer, there are limited guidelines focusing on sport related concussion for clinical practice[17]. Only one study has been found to describe concussion management for occupational therapists in South Africa through an integrative review[29]. The review describes that the practice guidelines for occupational therapy are published in developed countries which may set unrealistic standards for South Africa[29]. This poses a challenge in implementing evidence-based practice when the evidence is dearth.

2.6. Methodology

The research design used is based on the scoping review framework by Arksey and O'Malley (2005) that was further expanded by Levac et al (2010)[77]. The Preferred Reporting Items for Systematic reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist was used as a guideline in knowledge synthesis and reporting throughout this research report [79,80].

2.6.1. Step 1: Identifying the research question

What is known in the literature about the role of occupational therapy in the management of sport-related concussions for children and adolescents in South Africa?

2.6.2. Step 2: Identifying Relevant Studies

The study search was conducted under the guidance of a librarian using the following steps; electronic database search, hand-searching of key journals and grey literature, and reference lists. The electronic database search was conducted in PubMed, CINAHL, Scopus, OTseeker and Cochrane Library using the following keywords: *children, concussion, sport-related, occupational therapy, management* and their synonyms. These were selected on the premise that they contain a series of medical research articles.

Boolean operators, MeSH terms, truncation and parenthesis were also used. An example of a search string that was used for the keyword children: ((Minor*[tiab] OR Inexperience*[tiab] OR Child*[tiab] OR Young*[tiab] OR Adolescen*[tiab] OR Immatur*[tiab] OR Junior[tiab] OR Juvenile[tiab] OR Girl*[tiab] OR Boy[tiab] OR Boys[tiab] OR Schoolboy*[tiab] OR Schoolgirl*[tiab] OR Youth*[tiab] OR Teen*[tiab] OR Pube*[tiab] OR Learner*[tiab] OR Student*[tiab]) OR (Child[Mesh])) OR (P?ediatric*[tiab] OR "School age*"[tiab])

Because the population that the research is aiming to reach are South African occupational therapists, hand-searching the South African Journal of Occupational Therapy using the keyword search was done to identify articles that may have been missed in the database search. The articles searched ranged from January 2010 as the upper date limiter and August 2022 as the lower date limiter, in addition, all articles were searched in English. The Journal of Concussion was also hand-searched however the articles that were available for searching ranged from 2017 to 2022. Furthermore, a search of grey literature was conducted using the Grey Matters Checklist that was designed in 2011 by the Canadian Agency for Drugs and Technology in Health [82]. Thereafter, the reference lists of systematic and other literature reviews were checked for additional potential sources. After searching the reference lists of 72 literature reviews and finding 113 additional articles, it was at this point that the reference list search was deemed complete.

2.6.3. Step 3: Study Selection

The inclusion and exclusion criteria used for the study selection are described in Table 2.2. A total of 1 979 publications were identified and before any screening was conducted, 426 duplicates were removed. A pilot testing of 10% of the selected articles was thereafter done with a second reviewer using the Rayyan Software in which a percentage agreement of 80%

and above needed to be met to ensure reliability[92]. The exclusion criteria were loaded onto the software for ease of reference and each reviewer conducted a blind review in which they were unable to see each other's results. A total of 156 articles were reviewed and 96% agreement was reached, discrepancies were resolved by consensus in a physical meeting. All the studies that were identified underwent a title and abstract screening by the primary researcher using the Rayyan Software to see if they met the inclusion criteria[92]. 1 553 articles underwent the screening and a total of 1 158 articles were excluded while 395 articles underwent a full-text review. A total of 12 articles were included for charting the data and Figure 2.1 provides a representation of the study selection.

Table 2.2: Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria:
Articles involving children and adolescents between the ages 5 - 18 years	Participants in the study should not have a premorbid condition that could exacerbate concussive symptoms such as ADHD, learning disability and mood disorders
A concussion that is sport-related	The following sources of evidence: Letters, texts and opinion pieces as they are unable to meet objective one
Information that is published in English	Intervention that involves aerobic exercise and gait-related activities on the premise that this is primarily done by physiotherapists
Articles that are explicit in mentioning the management of concussion in their abstract	Management that is based on preventive measures rather than rehabilitative or therapeutic
Articles published from the year 2010 until August 2022	Interventions that primarily focused on adults such as parents, educators and coaches
Articles that mention occupational therapy intervention related to concussion	Studies conducted on rats despite having recommendations for children and adolescents
	Conference proceedings, opinion pieces and protocols
	Titles and abstracts that reference other practitioners such as physiotherapy, speech therapy, nursing, chiropractic and office/emergency department physicians as the key clinicians to avoid ambiguity
	Articles that focused on TBI but encompassed mTBI were also excluded to avoid ambiguity.

	Full texts that were inaccessible or difficult to retrieve

2.6.4. Strep 4: Charting the data

'Charting' describes a technique for synthesizing and interpreting data by sifting and sorting material according to key issues and themes and illustrating them in the form of a chart[86]. A data charting form was developed using a Microsft Excel spreadsheet with the following headings: title, author(s), year of publication, study location, intervention type, comparator (if any), and important findings related to the role of occupational therapy[87–90]. These headings provided general information regarding the distribution of records as well as information that was specific to the research objectives. This was an iterative process which was directed by the information obtained in the records, with each new information obtained, the data charting form was updated[78,81,87,88].

2.6.5. Strep 5: Collating, Summarising and Reporting Results

Results were collated, summarised and reported in Table 2.3 by analysing the data extracted from each source of evidence and thereafter the broader themes related to the role of occupational therapy were identified. The end goal was to scope the available evidence on the role that occupational therapy plays in the management of concussions for children and adolescents.

2.6.6. Ethical Considerations

The researcher attended an internal ethics training before conducting the research. The research protocol was submitted for approval after undergoing assessment by the School of Therapeutic Sciences assessors committee. Due to the nature of the study being a scoping review, an ethical waiver for the study was received from the Wits Human Research Ethics Committee (W-CBP-201006-01).

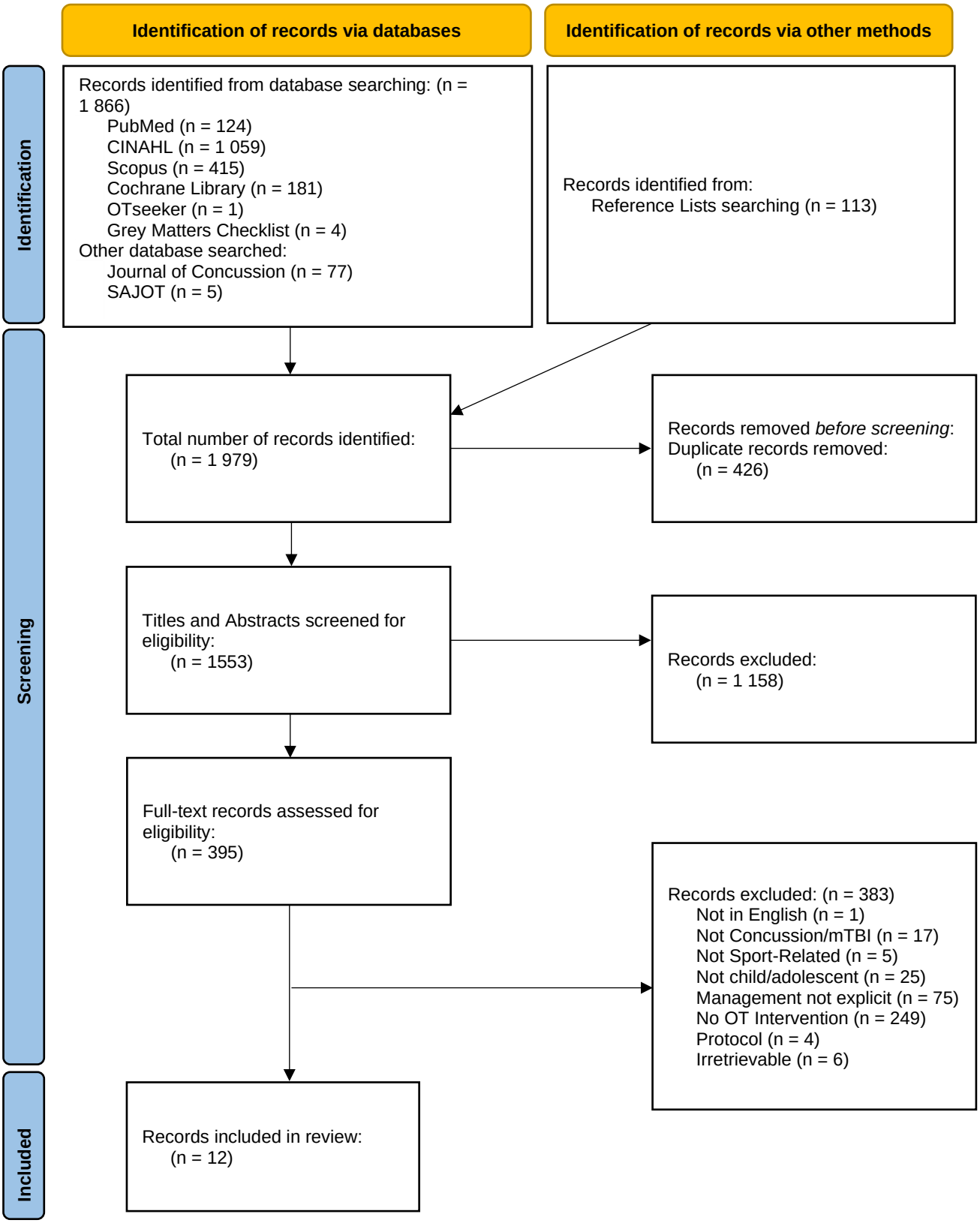

Figure 2.1 PRISMA Flow Diagram showing the record selection process

2.7. Results

The role of occupational therapy in managing sport-related concussions for children and adolescents will be discussed by analysing and synthesising selected literature.

2.7.1. Overview

An initial 1 553 records were screened by title and abstract, after which 1 158 records were excluded, 395 full-text records were screened, and 12 records were included in the final scoping review (Figure 2.1). The characteristics of the included records are described in Table 2.3 which focuses on the publication type, study location, type of study and intervention type. The quantity of available evidence superimposes this to illustrate the diversity of literature found.

Most records are situated in the Global North (n = 11) which may indicate a Global North bias or a lack of Global South publications. Nine of the records included were journal articles, two records were guidelines and one record was a book chapter. Both qualitative and quantitative designs were included, and study methods ranged from cross-sectional (n = 2), feasibility (n = 2), literature reviews (n = 2) interviews (n = 1), intervention development (n = 1) and practice guidelines (n = 4). Seven records were intervention design articles (n = 1), practice guidelines (n = 4) or literature reviews (n = 2). The intervention records fell into two groups: those that focused on structured occupational therapy programmes (n = 9) and those that included occupational therapy and other members of the multidisciplinary team (n = 3).

Table 2.3: A Summary of the characteristics of the included publications

Characteristic	Quantity (n = 12)	References (Author, Year)
Publication Type		
Journal Article	9	Boisgontier et al., 2020; Dobney and Gagnon, 2021; Hugentobler et al., 2019; Hunt et al., 2019, 2016; Moen et al., 2022; Reed, 2011; Shore et al., 2022; Sinnett and Franzsen, 2020
Book Chapter	1	Gagnon and Ptito, 2017
Document Guidelines	2	Canadian Association of Occupational Therapists, 2019; Ontario Neurotrauma Foundation (ONF), 2014
Publication Location		
Toronto, Canada	6	Dobney and Gagnon, 2021; Hunt et al., 2019, 2016; Ontario Neurotrauma Foundation (ONF), 2014; Reed, 2011; Shore et al., 2022
British Columbia, Canada	3	Boisgontier et al., 2020; Canadian Association of Occupational Therapists, 2019; Moen et al., 2022
Ohio, USA	1	Hugentobler et al., 2019
New York, USA	1	Gagnon and Ptito, 2017
JHB, South Africa	1	Sinnett and Franzsen, 2020
Type of publication method/design		
Cross-Sectional	2	Boisgontier et al., 2020; Dobney and Gagnon, 2021
Practice Guidelines	4	Ontario Neurotrauma Foundation (ONF), 2014; Canadian Association of Occupational Therapists, 2019; Gagnon and Ptito, 2017; Reed, 2011
Intervention Development	1	Shore et al., 2022
Qualitative Interviews	1	Moen et al., 2022
Feasibility	2	Hunt et al., 2019, 2016
Literature Review (Integrative & Narrative)	2	Hugentobler et al., 2019; Sinnett and Franzsen 2020
Intervention Type		
Specific: Occupational Therapy	9	Boisgontier et al., 2020; Canadian Association of Occupational Therapists, 2019; Gagnon and Ptito, 2017; Hunt et al., 2019, 2016; Moen et al., 2022; Reed, 2011; Shore et al., 2022; Sinnett and Franzsen, 2020
General: Allied Health Team	3	Dobney and Gagnon, 2021; Hugentobler et al., 2019; Ontario Neurotrauma Foundation (ONF), 2014

2.7.2. Intervention approaches

Some records (n = 4) had specific approaches to intervention that came with recommendations for clinical practice. One of the specific intervention programmes was "Concussion and You" which facilitated improved concussion knowledge for clients[93]. This programme used knowledge translation and exchange principles to make information accessible, simple and consistent, promoted the sharing of experiences and provided tangible tools and resources for participation[93]. Another specific intervention programme was the use of a tele-active rehabilitation approach which allowed the accessibility of occupational therapy in remote areas and early access that in turn encouraged proactivity and enabled a supervised early return to physical activities[94]. An important outcome of this study was that consistent communication with a healthcare provider, ongoing individualised education, lifestyle intervention, therapeutic support and feedback were key to promoting and retaining positive outcomes[94]. The Cognitive Orientation to Daily Occupational Performance (CO-OP) approach was another specific approach that focused on the use of Meta-Cognitive strategies to facilitate concussion recovery[95]. The authors reported that the strategies had positive implications for returning to school. Additionally, focusing on occupations, client-identified goals and providing intervention in the client's environment were the most meaningful forms of intervention that contributed to a positive experience for their clients[95]. The last approach was the occupation-based approach (promotion of safe re-engagement in daily physical occupations). An important finding was that client-centred goal setting was found to enhance the effectiveness of this treatment approach[38,96]. Overall, there is a consensus among the records on the importance of goal-setting, client-centred and occupation-based approaches as well as the use of education programmes and active physical activities when providing intervention. These are found to benefit the client by encouraging proactivity and promoting satisfaction during activity engagement.

Eight records had general approaches to intervention that could be applied irrespective of the programmes used. Two records recommended intervention types that need to be included when addressing the affected categories of occupation. These are health promotion, remediation/ restoration, maintenance, compensation/adaptation, and disability prevention[29,97]. Additionally, education, sleep recommendations, goal setting, energy and pain management and manual therapy were also intervention approaches recommended by several records[13,97–99]. The targeted outcomes of intervention that were recommended by records included client

factors and performance skills such as cognitive exertion, sensory challenges, emotive challenges such as anxiety and depression and functional vision. Furthermore, re-engagement in daily occupations such as leisure, social participation, activities of daily living, rest and sleep, return to school and productivity were also recommended targeted outcomes [13,29,97,99–101]. The consensus among these records is that recommendations would be effective if applied in a stepwise fashion with continuous reassurance of recovery to the learner-athletes and their caregivers. Moreover, a holistic, client-centred approach encourages children and youth to return to occupations both on and off the playing field which is imperative for recovery.

2.7.3. The role of occupational therapy in concussion management

Occupational therapists play a role in sports-related concussions when clients have an occupational dysfunction; through the assessment, intervention and outcome process which occurs within the rehabilitation phase of the consensus statement[70]. The second objective was to describe the role of occupational therapists in sport-related concussions as stated in the literature. The first role that was described fell within the evaluation process which is illustrated in Figure 2.2. This information was collated from eleven of the twelve records as one study did not speak to evaluation but rather focused on intervention and outcomes.

Evaluation

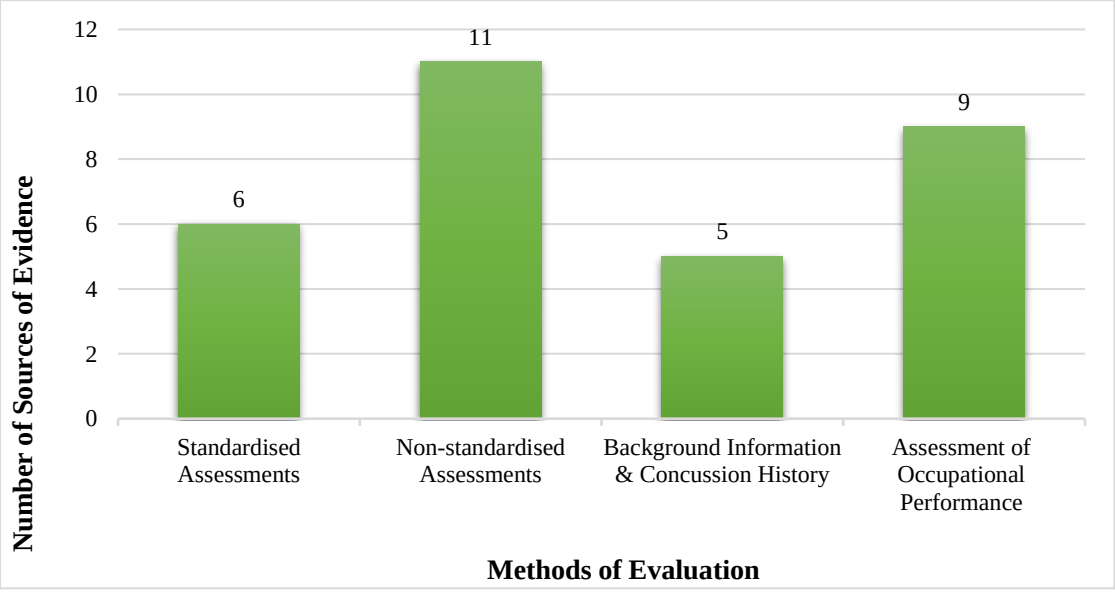

Figure 2.2: Evaluation

The four methods of evaluation mentioned from the highest to lowest number of records are; non-standardised assessments of post-concussion symptoms (n = 11), assessment of occupational performance (n = 9), standardised assessments of post-concussion symptoms (n = 6) and evaluation of the client's background and concussion history (n = 5). Within each of the evaluation methods, there are varying assessment tools and techniques that can be used by occupational therapists.

Under the non-standardised assessment method, several authors recommended using tools and techniques such as screening, observation and activity analysis of a cognitively demanding task as well as the assessments of post-concussion symptoms such fatigue, headache, behavioural changes, anger, anxiety and depression as well as impairments in cognitive, auditory, visual and vestibular functions[13,29,38,94–101]. When conducting the assessment of occupational performance, occupational therapists use tools and techniques that focus on activities of daily living, rest and sleep, education, social participation, physical and leisure activities as well as roles and routines[29,38,94,95,97–101]. Concerning the stan dardised assessment of post-concussion symptoms, occupational therapists can utilise the following tools and techniques, Vestibular/Ocular Motor Screening (VOMS), Post-Concussion Symptom Inventory (PSCI), Acute Concussion Evaluation (ACE), Health Behaviour Inventory (HBI), Physical Activity Questionnaire for Adolescents (PAQ-A), Child Depression Index (CDI), Movement ABC, Pictorial Children's Effort Rating Table (PCERT) and Beck Youth Inventories (BYI-II) some of which require training regarding administration[38,94–96,99,100]. Lastly, the recommended tools and techniques that can be used to attain background information and concussion history are the assessment of mental health status, perceived quality of life, potential modifiers that could delay recovery as well as the number of previous concussions. Such information could be obtained collaterally using the medical information recorded in referral forms as well as through interviews[94,96,99–101]. The results indicate that the assessment of post-concussion symptoms as well as the assessment of occupational performance are the highest recommended methods to implement when engaging in the process of evaluation.

General Intervention

Intervention is the second step in the occupational therapy process. Literature had general intervention and specific intervention approaches which are illustrated in in Figure 2.3 and Figure 2.5 respectively. The first intervention approach that will be addressed is the general intervention approach.

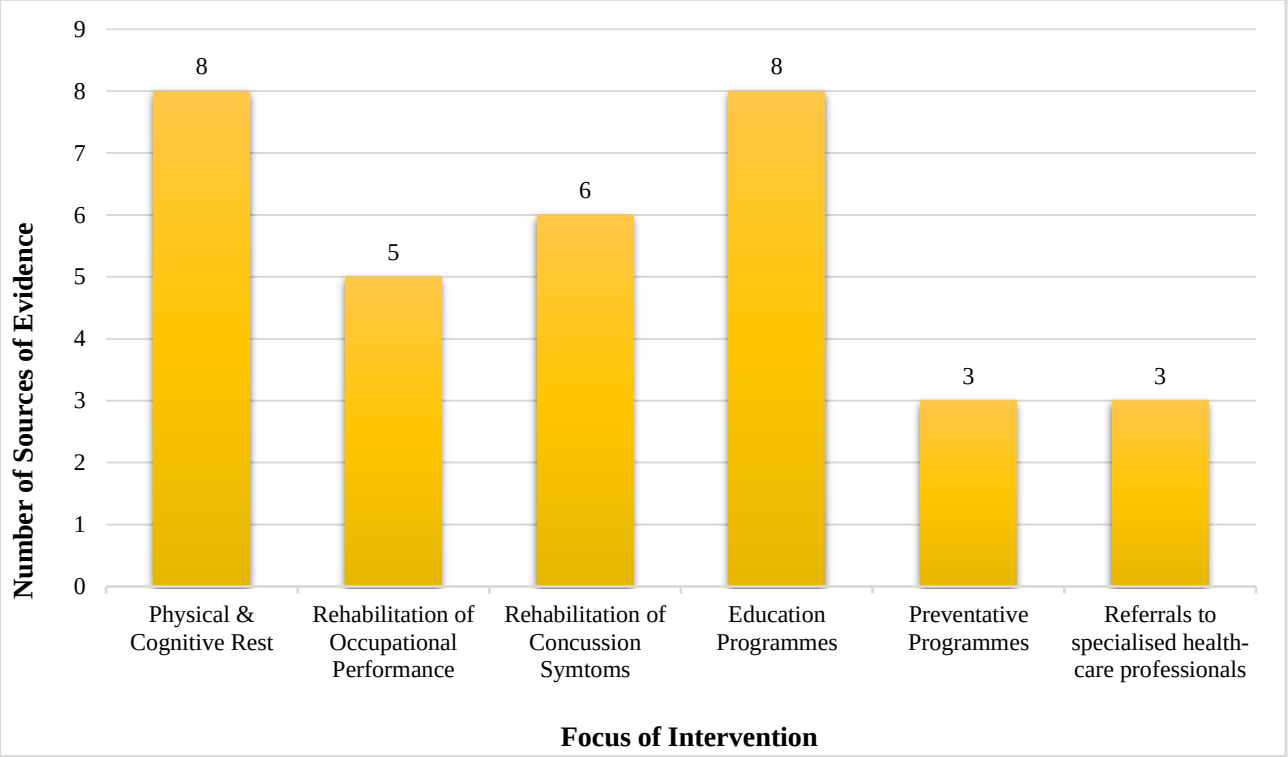

Figure 2.3: General Intervention

Occupational therapists direct their focus of intervention on physical and cognitive rest (n = 8), occupational performance (n = 5), concussion symptoms (n = 6), educating their clients (n = 8), designing preventive programmes (n = 3) as well as referring to specialised healthcare professionals (n = 3). Similar to the evaluation process, one source[95] did not speak to intervention but rather focused on evaluation and outcomes and thus information is collated from eleven sources of evidence. Each focus of intervention also has tools and techniques to assist the occupational therapist in the provision of intervention.

Looking at physical and cognitive rest which is one of the highest mentioned focuses of intervention (n = 8), occupational therapists use energy management or energy conservation strategies to facilitate this[13,29,93,94,96,98–100]. This correlates with literature that found strict rest as unrealistic and offers no added benefit over the usual care [4,8,11,19,22,23,30,36,52,58]. In providing rehabilitation for occupational performance, occupational therapists use fatigue management or relaxation strategies to ensure that their clients can cope with the activities they find meaningful which assists with the positive experiences during recovery[13,93,94,99,100]. When providing rehabilitation for concussion symptoms, occupational therapists focused on

cognitive rehabilitation strategies, vision rehabilitation, aerobic/active rehabilitation, vestibular rehabilitation as well as manual therapy[13,38,94,96,98,100]. Another one of the highest mentioned focus of intervention was the provision of education programmes (n = 8). Here, occupational therapists educated their clients on concussion-related information such as diagnosis, risks, symptoms, complications and recovery as well as provided strategies for sleep hygiene, self-management, stress management and return to activity guidelines[29,93,94,97–101].

Two referral systems were evident in the literature. One was focused on referrals to occupational therapy while the other focused on referrals to other professions by occupational therapists. Regarding referrals to occupational therapy, one source of evidence listed a series of conditions that warranted a referral namely, cognitive deficits, mental/physical fatigue, sleep difficulties, co-occurring orthopaedic injuries and persisting symptoms as well as when the learner-athlete is ready to be integrated into school activities[97]. Additionally, occupational therapists can refer to other professionals such as psychologists and osteopaths as well as specialists such as paediatric sleep specialists, functional vision specialists, paediatric mental health specialists, sport concussion specialists and cognitive behavioural specialists[97–99].

Specific Intervention

There are four specific intervention approaches identified in the literature namely, Cognitive Orientation to Daily Occupational Performance (CO-OP), Tele-Active Rehabilitation, Concussion and You as well as the occupation-based approach (promotion of safe re-engagement in daily physical occupations)[13,29,38,93–95,97,100,101]. The first three are referenced by only one source of evidence while the last one is the most common as it is referenced by six sources of evidence. Each of the intervention approaches had varying components (sub-sections) and intervention tools and techniques which are summarised in Figure 2.5.

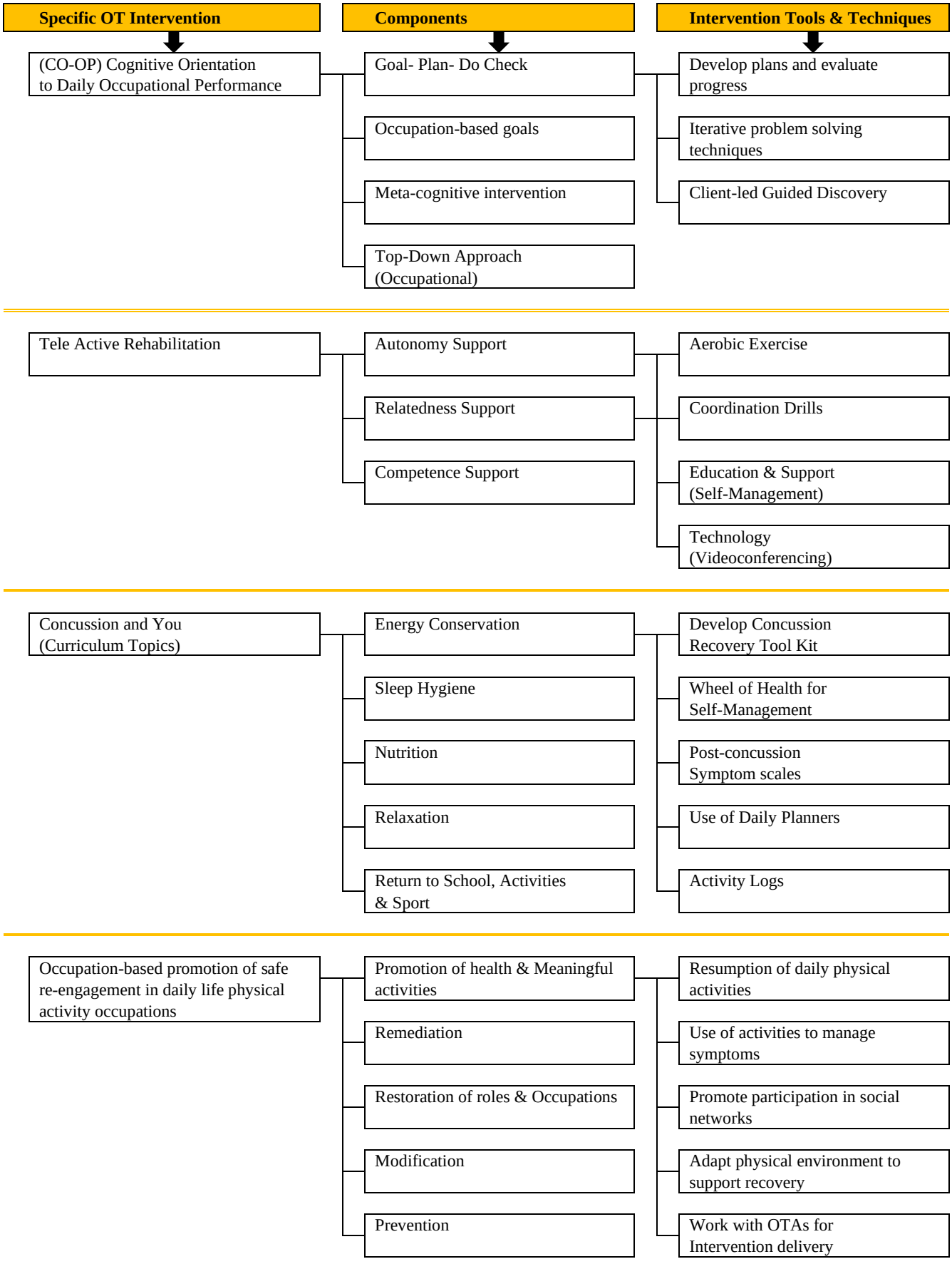

Figure 2.4: Specific OT Interventions

Targeted Outcomes

The final step in the occupational therapy process is targeted outcomes. These are the expected results that emerge from the intervention process and there are only two main targeted outcomes mentioned in the records namely engagement in meaningful occupations and recovery of concussion symptoms[13,29,38,93–95,97–101]. Engagement in meaningful occupations consisted of a large variety of expected outcomes which could be further grouped into structured and non-structured engagement. To differentiate between the two, the authors emphasised the use of a stepwise approach to facilitate the structured engagement while the non-structured engagement in meaningful occupations was based on the discretion of the occupational therapist and client through goal setting. The highest-mentioned target outcome is occupational engagement (n = 10), followed by symptom recovery (n = 6). Each of the targeted outcomes is further broken down into varying outcome measures as seen in Figure 2.5.

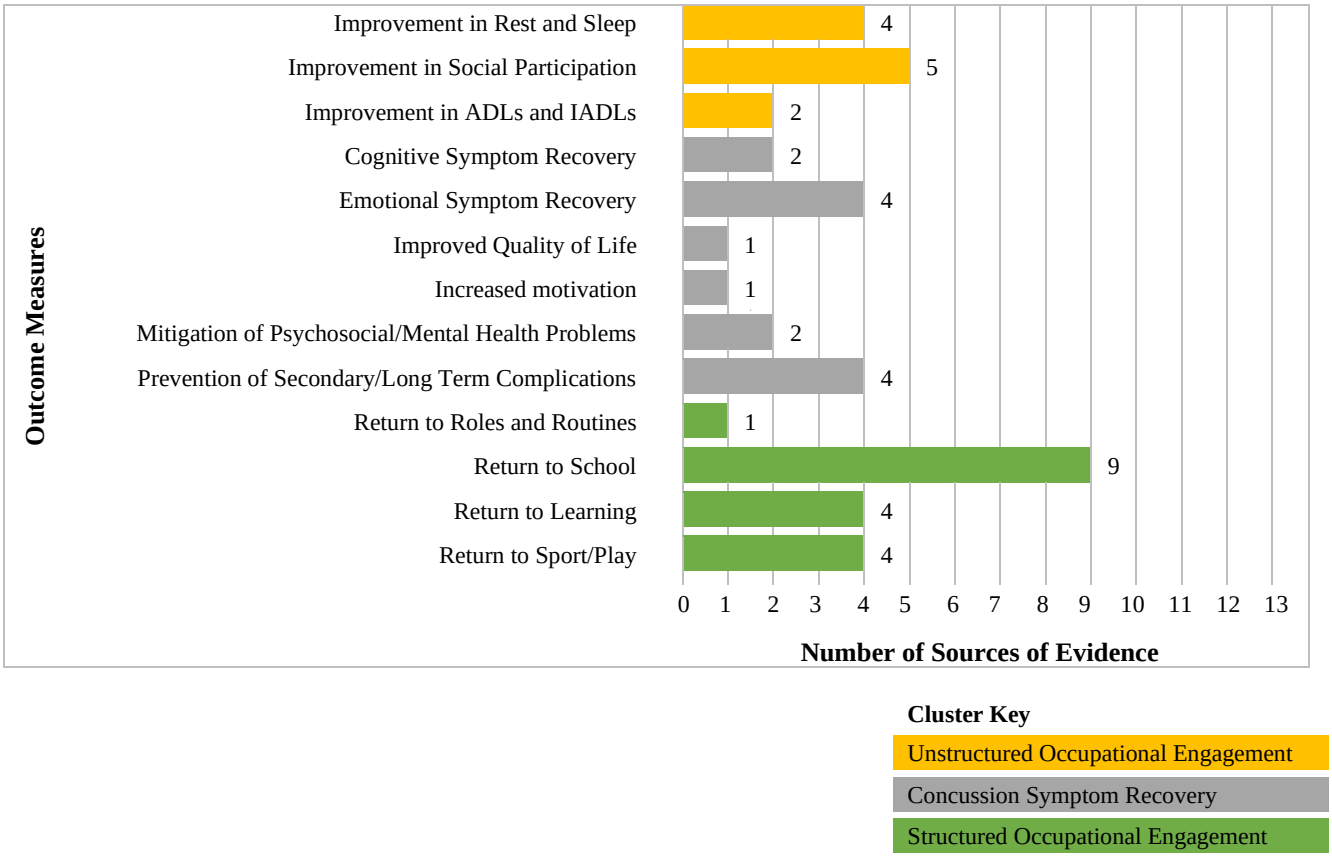

Figure 2.5: Outcomes Measures

In achieving occupational engagement through unstructured means, the occupational therapists focused on improving rest and sleep, social participation, activities of daily living and instrumental activities of daily living as well as roles and routines[13,29,38,93–95,98–101]. Looking at Figure 2.5, improved social participation had the most amount sources of evidence that mention it in their targeted outcomes (n = 5). This was mainly due to the social settings in which occupational performance takes place such as school and sporting teams. When focusing on the more structured means of achieving occupational engagement. Occupational therapists focused on the stepwise return to occupations such as school, learning and sport[13,29,38,94,95,97–101]. Return to School had the most amount of literature mentioning it (n = 9) and this corroborates the literature review which stated this as an important priority in concussion management[41,52,76]. Lastly, when occupational therapists targeted recovery in concussion symptoms, the following outcome measures were noted, cognitive symptom recovery, emotional symptom recovery, improved quality of life, increased motivation, mitigation of mental health problems as well as prevention of secondary/long-term complications[93–95,97–99].

One of the key findings expressed in the records was a positive correlation between the resolution of concussion symptoms and occupation-based intervention, daily physical activities as well as active rehabilitation programmes[38]. In addition, the occupation-based approach and client-centred goal setting were deemed effective for concussion management as they focused on meaningful engagement in occupations[38,98]. Furthermore, occupational therapy intervention supported clients in linking symptoms with functional recovery, adapted activities and environments in a manner that ensured participation without the exacerbation of symptoms and focused on finding an equilibrium between activities and symptoms[100]. Lastly, records (n = 2) found that early access to occupational therapy for education, screening, and assessment not only prevented individuals from being disengaged with their day-to-day activities but enabled an earlier resumption of supervised physical activity and quicker recovery[94,97]. Thus, healthcare costs can be saved as long-term functional impairments are mitigated against[97].

The above results highlight the contributions of occupational therapy in concussion management by focusing on the benefits of occupational therapy intervention as stated in the literature, intervention approaches and listing the roles that are embedded in the process of evaluation, intervention and targeted outcomes which are summarised in Table 2.4.

Table 2.4: Summary of sources of evidence that document the role of occupational therapy as illustrated in the OT process

OT Process		Tools and/or Techniques	Authors and Dates of Publication for the included records													Total
			Boisgontier et al., 2020	Dobney and Gagnon, 2021	Hunt et al., 2016	Shore et al., 2022;	Hunt et al., 2019	Moen et al., 2022	Hugentobler et al., 2019	ONF, 2014	Sinnett and Franzsen, 2020	Gagnon and Ptito, 2017	Reed, 2011	Canadian Association of Occupational Therapists, 2019		
Evaluation	Standardised Assessments Of Post-Concussion Symptoms	Vestibular/Ocular Motor Screening (VOMS)							✓							1
		Post-Concussion Symptom Inventory (PCSI)				✓	✓									2
		Acute Concussion Evaluation (ACE)								✓						1
		Health Behaviour Inventory (HBI)	✓													1
		Physical Activity Questionnaire for Adolescent (PAQ-A)	✓													1
		Pictorial Children's Effort Rating Table (PCERT)				✓										1
		Beck Youth Inventories (BYI-II)					✓									1
		Movement ABC										✓				1
		Child Depression Index (CDI)										✓				1
	Assessment of Occupational Performance	Activities of Daily Living (ADLs/IADLs)				✓	✓				✓	✓				4
		Rest and Sleep		✓		✓	✓			✓	✓	✓		✓		7
		Participation in Education				✓	✓	✓			✓	✓				5
		Social Participation & Support				✓	✓	✓			✓					4
		Physical & Leisure Activities	✓			✓	✓				✓	✓				5
		Roles and Routines	✓											✓		2
	Non-standardised Assessment of Post	Observation and Task analysis of cognitive demanding task									✓	✓	✓	✓		4
		Screening							✓	✓		✓		✓		4
		Persisting Symptoms (PCS)	✓	✓		✓	✓	✓		✓		✓		✓		8

	Concussion Symptoms	Cognitive Functioning		✓				✓		✓	✓	✓		✓	6
		Vestibular Functioning		✓		✓			✓	✓	✓			✓	6
		Auditory Functioning						✓				✓			2
		Anger, Anxiety & Depression		✓		✓	✓	✓		✓	✓	✓			7
		Vision & Light Sensitivity				✓		✓	✓	✓		✓		✓	6
		Behavioural changes				✓				✓	✓	✓			4
		Headache				✓		✓	✓	✓					4
		Fatigue & Activity Tolerance				✓			✓	✓		✓		✓	5
	Background and History	Mental Health				✓				✓					2
		Concussion History				✓		✓		✓					3
		Modifiers (Delay Recovery)				✓			✓	✓		✓			4
		Quality of life				✓									1
General Intervention	Rest	Energy Management / Energy Conservation Strategies		✓	✓	✓			✓	✓	✓	✓	✓		8
	Occupational Performance	Fatigue Management / Relaxation Strategies			✓	✓				✓		✓	✓		5
	Rehabilitation Of Concussion Symptoms	Cognitive Rehabilitation										✓	✓		2
		Vision Rehabilitation							✓						1
		Aerobic/ Active Rehabilitation	✓	✓		✓			✓						4
		Vestibular Rehabilitation							✓						1
		Cervical Spine Treatment/ Manual Therapy							✓						1
	Conditions that warrant referral to OT	Cognitive Deficits												✓	1
		Mental/Physical Fatigue												✓	1
		Sleep Difficulties												✓	1
		Co-occurring orthopaedic injuries												✓	1
		Integration to school/activities												✓	1
		Poor Prognosis/ Persisting Symptoms												✓	1

	Referral to other disciplines	Paediatric Sleep Specialist								✓					1
		Functional Vision Specialist								✓				✓	2
		Paediatric Mental Health Specialist								✓				✓	2
		Sports Concussion Specialist								✓					1
		Cognitive Behaviour Specialist								✓					1
		Other: Physician, Psychologist, Osteopath		✓											1
	Early Education	Concussion Recovery and Diagnosis		✓	✓	✓		✓		✓		✓		✓	7
		Sleep Hygiene Strategies		✓	✓	✓				✓		✓		✓	6
		Nutrition, Hydration, Headaches & Fatigue		✓	✓					✓		✓			4
		Risks, Complications, PCS and Re-Injury		✓	✓					✓					3
		Self-Management		✓								✓			2
		Return to activity guidelines		✓		✓				✓	✓	✓		✓	6
		Stress Management/ Coping Strategies								✓		✓		✓	3
	Risk Reduction	Prevention Strategies								✓		✓		✓	3
Specific OT intervention	CO-OP	Develop plans and evaluate progress					✓								1
		Iterative problem-solving techniques					✓								1
		Client-led guided discovery					✓								1
	Tele-Active Rehabilitation	Aerobic Exercise				✓									1
		Coordination Drills				✓									1
		Education and Support for self-management				✓									1
		Use of technology (videoconferencing)				✓									1
	Concussion & You	Curriculum-based intervention			✓										1
	Occupation-based re-engagement	Resumption of daily physical activities	✓					✓			✓	✓	✓	✓	6
		Use of activities to manage symptoms	✓					✓			✓	✓	✓	✓	6
		Promote participation in social networks	✓					✓			✓	✓	✓	✓	6
		Adapt physical environment to support recovery	✓					✓			✓	✓	✓	✓	6

Targeted	Non-structured	Improvement in Rest and Sleep		✓						✓	✓	✓			4
Outcome	Occupational	Improvement in Social Participation	✓		✓	✓				✓	✓				5
	Engagement	Improvement in ADLS and IADLs		✓							✓				2
	Symptom	Cognitive symptom recovery					✓			✓					2
	Recovery	Emotional symptom recovery		✓		✓	✓			✓					4
		Increased Motivation				✓									1
		Improved Quality of Life				✓									1
		Mitigation of Psychosocial/ Mental Health Problems								✓				✓	2
		Prevention of Secondary/Long Term Complications		✓	✓	✓				✓					4
	Structured	Roles & routines	✓												1
	Occupational	Return to School	✓	✓			✓	✓		✓	✓	✓	✓	✓	9
	Engagement	Return to Learning				✓				✓	✓	✓			4
		Return to occupations/activities	✓					✓			✓	✓	✓	✓	6
		Return to Sport/Play	✓							✓	✓		✓		4

Table 2.4 provides a detailed summary of the collated information described from sections 2.7.1 until section 2.7.3. The occupational therapy process which consists of evaluation, intervention (general and specific) and targeted outcomes is tabulated against each of the included records. In addition, the tools and/or techniques that are used by occupational therapists when implementing the therapy process are documented and tallied to provide a visual form of the number of records that describe specifically the role of occupational therapy in concussion management for children and adolescents. In the table, one can identify gaps in literature as there are hardly any sources of evidence that check all the steps in the occupational therapy process but instead, the records either focus on a particular step or focus on a series of tools and techniques within a step. This may indicate the novelty of the role of occupational therapy in concussion management.

2.8. Discussion

In this scoping review, twelve records addressing occupational therapy's role in concussion management for children and adolescents were identified. Findings indicate a paucity of research focusing specifically on occupational therapy. Only one article provided practice guidelines for South African occupational therapists while all other eleven records were internationally based which may indicate a Global North bias. Varying intervention approaches and benefits of occupational therapy were recommended by the records based on important findings and recommendations. Moreover, the role of occupational therapy in concussion management was described using the occupational therapy process as described by the Occupational Therapy Practice Framework[28]. The following sections discuss the findings of objectives one and two by describing the study characteristics and the role of occupational therapy in concussion management. A practice framework for South African occupational therapists will also be proposed.

2.8.1. Study Characteristics

A great majority of the records were qualitative with study designs ranging from literature reviews, practice guidelines, and intervention development while the quantitative records were feasibility records. This finding indicates that the role of occupational therapy is novel and still in the research stages with minimal evidence of implementation. Furthermore, only one book was found with clear guidelines for occupational therapists which corroborates Finn (2019)[25]

whose research findings indicated that 24.4% of occupational therapists covered concussion as a curriculum in their records. This shows that current knowledge is reliant on either existing research or clinical experiences with little information published in books for undergraduate therapists to access.

About 91.7% of the records are situated in the Global North region which may make it challenging for the therapists situated in the Global South region to relate. Similar to Sinnett and Franszen (2020), the implication is that some of the guidelines may be incompatible with the South African context due to the expenses incurred. Moreover, half of the records are situated in Toronto Canada which has a population demographic that might not be similar to the South African population accessing public health. In comparing the Human Development Index of South Africa against Canada and the United States of America, a discrepancy exists to show potential challenges that occupational therapists may face. The Human Development Index (HDI) is a measure of average achievement in key dimensions of human development namely, a long and healthy life, being knowledgeable and having a decent standard of living[102]. In this index, South Africa scored the least (0.717) in comparison to the United States (0.927) and Canada (0.935) which is indicative of differences in standards of living.

With regards to the type of study, there was a variation of records ranging from cross-sectional, feasibility and literature reviews. 41.7% of the records were either commentaries, book chapters, intervention designs or practice guidelines. These were reliant on experts who are experienced in the concussion field. However, the implication is that not enough research is being conducted to test the effectiveness of implementation as there were only 2 feasibility records. This demonstrates that the role of occupational therapy in concussion management is still in the conceptual stages and further research that focuses on implementation would need to be conducted. Lastly, the intervention type was another characteristic that was evaluated and over 75% of the records mentioned intervention that is unique to occupational therapy. A quarter of interventions provided general intervention approaches that apply to any allied professional. This means that only 9 records provided practice guidelines that are unique to the profession.

Lastly, several key findings justified the placement of occupational therapy within the rehabilitation phase of concussion management as records found a variety of benefits related to occupational therapy intervention. These validate the unique contributions of occupational therapy within the multidisciplinary team which is mainly the use of occupations in facilitating

recovery. This valuable contribution is corroborated by Silverberg and Iverson (2012) as cited in Gagnon et al (2016) who conducted a literature review on rest following a mild traumatic brain injury. Their findings recommended a gradual resumption of activities in the initial days and weeks following the injury, followed by active rehabilitation for athletes with prolonged recovery [11]. Thus the benefits of occupational therapy in concussion management are based on their capacity to provide this gradual resumption of activities during rest and recovery. These benefits are improved symptom recovery, quicker return to the varying categories of occupation, mitigation of long-term complications, decreased burden to the public health system and the prevention of disengagement during the early stages of recovery.

2.8.2. The role of occupational therapy

The role of occupational therapy in concussion management can be described using the three steps in the occupational therapy processes namely, evaluation, intervention and outcomes[28]. These roles are embedded in the multidisciplinary team and are enacted during the rehabilitation phase of concussion management[28,70]. As seen with the benefits of early occupational therapy, the rehabilitation stages need not take place later during recovery but can be initiated from the moment the client is seen in the examination room.

Evaluation

When a concussed client is referred to occupational therapy, evaluation becomes the initial step. Here the therapist uses a variety of assessments to obtain background information and concussion history, understand the concussion symptoms experienced through using standardised and non-standardised assessments as well as assess the categories of occupations that have been impaired[13,29,38,94–101]. The highest method of evaluation in literature is the use of non-standardised assessments for post-concussion symptoms followed by the assessment of occupational performance[29,38,94–101]. This follows a bottom-up approach where the evaluation of concussion symptoms precedes the evaluation of impaired categories of occupations.

Very often, background information can be obtained from the referral information or by giving the accompanying caregiver questionnaires to complete. In addition, interviews can be conducted for both the athlete and the parent[96,97,99,100]. Through this assessment, the therapist can gain an understanding of past concussions in terms of numbers, severity and length of recovery, current and previous mental health status and perceived quality of life. The

occupational therapist can decide whether to assess post-concussion symptoms related to cognition, emotive functions, fatigue and behavioural changes through the use of standardised assessments[94,95]. Depending on the variety of health practitioners involved in the multidisciplinary team, some standardised assessments would have already been completed by the assessing physician such as the VOMS (Vestibular/Ocular Motor Screening), PSCI (Post-Concussion Symptom Inventory) and ACE (Acute Concussion Evaluation)[94–96,99]. Other standardised assessments that may need to be administered are the Physical Activity Questionnaire for Adolescents (PAQ-A), the Pictorial Children's Effort Rating Table (PCERT), Beck Youth Inventories (BYI-II), Movement ABC and the Child Depression Index[38,94,95,100]. In some instances which will often be in the South African public health setting, the use of non-standardised assessments can be used to evaluate the post-concussion symptoms[38,94,95,97–101]. One of the non-standardised techniques that can implemented is the use of activity analysis during a cognitively demanding activity[13,29,97,100]. Such an observation can take place in the client's environment or using the available tools and materials within the setting. Valuable information regarding the underlying client factors and performance skills that are impacted by concussion can be observed. Other non-standardised tools and techniques may have been developed contextually to ascertain information related to cognitive, vestibular, visual and auditory functioning as well as behavioural changes, anger, anxiety, depression, fatigue and activity tolerances[29,94–101]. Occupational performance is usually impacted by concussion and this often has psychological implications linked to perceived health and quality of life status[17]. Thus, assessment of occupational performance in activities of daily living, rest and sleep, participation in education, social participation and support, physical and leisure activities as well as roles and routines will give the therapist a comprehensive understanding of the extent of injury[29,38,94,95,97–101]. The therapist would then start setting goals with the client to prepare for the intervention step[13,29,95,98–101].

General Intervention:

Usually, the client would have already been prescribed a minimum of 24 – 48 hours of cognitive and physical rest. During this time, the occupational therapist can recommend energy management and energy conservation strategies[13,29,93,94,96,98–100]. This will prevent the learner-athlete from disengaging in activities due to symptoms such as headache, dizziness and light sensitivity. It will also prevent the development of emotional distress caused by activity restriction, missing social interactions and falling behind academically [23,33,52,56,67,103]. A gradual

increase in occupational performance would thereafter be warranted provided that the occupational therapist gives the client relaxation techniques and fatigue management strategies[13,93,94,99,100]. It is at this stage that the recommended intervention approaches can be implemented according to the varying needs of the client. These are health promotion, remediation/ restoration, maintenance, compensation/ adaptation and disability prevention[29,97].

Similar to the evaluation step, the rehabilitation of concussion symptoms precedes the rehabilitation of occupational performance in terms of the number of sources of evidence that mention it. However, this is incongruent with the targeted outcomes in that, symptom recovery is the least mentioned outcome compared to engagement in occupations. Literature also follows a similar approach to outcomes by encouraging an early return to activities without full symptom resolution as learner-athletes may take longer to heal from concussion symptoms and without the return to activities, their symptoms could be exacerbated[14,17,18,30,36,61]. Given that in South Africa, occupational therapy intervention cannot be provided indefinitely and often the patients are discharged before symptom resolution and seen as outpatients with large gaps in between appointments. It would be impractical for the rehabilitation of symptoms to precede the rehabilitation of occupational performance. Moreover, the recovery rate of adolescents is significantly longer as they often recover within a month or longer [3–5,8,31,33,35,36,41,44,55,56,64,75]. Thus, it would be a waste of resources to focus on symptom resolution more than occupational performance.

Education is another focus of intervention that was mentioned by a large number of records (n = 8)[29,93,94,97–101]. Education can be implemented at any stage of occupational therapy. Some records started education during the initial assessment in which clients were given information regarding concussion diagnosis, symptoms, complications, risks and recovery[93,94,97–101]. Others incorporated education as part of the rehabilitation programme where clients were educated on sleep hygiene strategies, self-management strategies, stress management and coping strategies as well as return to activity guidelines[29,93,94,97–100]. Education about sport-related concussions is important as it helps improve the awareness, recognition and understanding of concussions as well as help with the management and should target all the key individuals involved, including athletes, parents, coaches, school administrators and teachers[22,31,41,71]. Education is found to benefit the clients by reducing the symptom severity and could increase concussion reporting while decreasing the number of athletes who choose to play while symptomatic[5,10,32].

One of the least mentioned interventions is the preventative programmes[97,99,100]. A possible reason for this observation is that the prevention programmes currently in the literature are implemented by sporting organisations and coaches. Examples of prevention strategies include modifying protective gear used in sport, changing rules to minimise contact, identifying athletes who are at risk for concussion injury, and continuing to educate everyone involved with youth about the dangers of concussions[30,31,41,42,44,72,73]. Moreover, this also reflects the stage in which an occupational therapist is involved, and that is usually after the injury has taken place. Thus, the role of an occupational therapist would be to educate the client on how to prevent re-injury. The second least-stated role is the rehabilitation of occupational performance[13,93,94,99,100]. This demonstrated that in a setting where there is no multi-disciplinary approach, occupational therapists would not be expected to rehabilitate occupational performance as the primary focus of intervention.

Finally, referrals are also a component of intervention. Only one source of evidence listed the conditions that warrant occupational therapy referral[97]. This validates the initial observation that the role of occupational therapy is still novel in concussion management. The implication would be to advocate for the involvement of occupational therapy in concussions. This could be done by demonstrating the benefits of interventions through quantitative records, incorporating the role within the academic curriculum, awareness programmes that are uniquely designed by occupational therapists such as the "Heads Up" initiative and involvement in the development of consensus statements that are formulated by the Sport Concussion Group[70]. Referrals from occupational therapy were also mentioned by a few sources (n = 2) which could also reflect the novelty of occupational therapy or illustrate the rarity of referrals as this is primarily done by a physician[97,99].

<u>Specific Intervention:</u>

Various specific interventions were mentioned in at least one record, the highest mentioned intervention was the occupation-based promotion of reengagement in daily physical activities as cited by six records[13,29,38,97,100,101]. This form of intervention focuses on the promotion, remediation, modification, prevention and restoration of roles and occupations[28,29]. The intervention tools and techniques used in this intervention are validated by the key findings of varying records that promoted the placement of occupational therapy. Thus, the role would be to use activities to manage symptoms, promote participation in social networks, adapt the physical environment to support recovery and resume daily physical activities[13,29,38,97,100,101].

Even though this intervention is considered specific, it does not necessarily have structured methods and approaches or specific equipment that need to be procured which makes it practical in the South African context. The only requirement for the occupational therapist is the use of clinical reasoning. One specific intervention that may not be practical in its implementation is the use of tele-active rehabilitation[94]. Although it permits remote access to occupational therapy as well as allows for early intervention, implementation could prove challenging for the average client. Given the current power cuts and expensive internet prices, not every client would be able to receive an intervention. The CO-OP programme would be another challenging approach as the outcome measures used in the study were the Canadian Occupational Performance Measure (COPM) as well as the Beck Youth Inventories for Children and Adolescents (BYI-II) which would be expensive to procure[95]. Lastly, the Concussion and You programme is another programme that an occupational therapist can practically implement provided that they use clinical reasoning and adaptations to suit the context of the client[93].

Outcomes:

Given what is currently known from the literature, that the objective of concussion management is to ensure quick recovery by avoiding activities and situations that may hinder healing while preventing secondary symptoms as well as multiple concussions from developing[2,31,33,52,53]. In addition, withdrawal from daily validating activities adversely affects one's ability to cope with ailments and can result in psychological complications[17]. Lastly, achieving health, well-being, and participation in life through engagement in occupation is the overarching statement that describes the domain and process of occupational therapy[28]. Targeting engagement in meaningful occupations becomes the primary outcome of occupational therapy intervention and there are two ways of reaching these outcomes, one using a structured protocol and the other using a non-structured protocol.

When using the structured protocol. Occupational therapists can use the stepwise gradual approach that is similar to the graded return to sport in that the exacerbation of symptoms warrants the discontinuation of any step that the learner is in. The following has been proposed for returning to school and learning[20,25,30].

Step 1: Daily activities at home that do not give the learner-athlete symptoms such as reading, texting, and screen time. At this stage, they are encouraged to refrain from school and can maintain low-level cognitive and physical activity for 15 to 20 minutes.

Step 2: Introduction of school activities such as homework, reading, or other cognitive activities outside of the classroom. At this stage, the learner returns to school on a partial day basis (that is, between 1-3 hours) provided that rest breaks can be incorporated.

Step 3: Return to school part-time with the gradual introduction of schoolwork. At this stage, accommodations can be provided as well as rest breaks that are not more than two.

Step 4: Return to school full-time with a gradual increase in the demands for academic activities a full day of school can be tolerated. At this stage, the learner can attend all classes with not more than one rest break. Additionally, they are expected to handle the majority of the physical and cognitive demands with maximal support. Specific accommodations may be required to avoid symptom exacerbation.

Step 5: Return to School for a full Day. At this stage, the learner can attend all classes for the expected duration but may continue to require no more than 2 cognitive rest breaks during the day. Given that concussion symptoms are reduced in severity and number, the learner can be introduced to tests and have the homework demands increased. Depending on how long the academic program has been modified, a schedule to allow for makeup classwork, homework, and tests will need to be devised. In addition, the return to play protocol can also begin provided that the learner is symptom-free and can attend without the need for accommodations.

Step 6: Return to full academic activities and playing catch up on missed work. At this stage, no form of support or rest breaks would be needed while the learner participates in a complete class schedule. The learner is expected to have no symptoms coming up during the full school day.

Returning to learning as well as returning to activities could follow a similar approach where accommodations, environmental adaptations and caregiver support can be incrementally

reduced over time while closely monitoring the symptoms. The unstructured approach could also be embedded in the stepwise protocols as the client would be expected to participate in other categories of occupations. For example, during the first of the protocol when the learner is not expected to be in school, they can engage in chores at home while engaging in rest breaks or have a friend visit to facilitate social participation. This will be guided by the goals that were initially set by the client and the occupational therapist as well as the clinical reasoning of the therapist. Goals such as improved participation in activities of daily living, social settings and rest and sleep.

Symptom recovery is another targeted outcome which can either be achieved indirectly through occupational performance or addressed directly when they are seemingly perversive. Occupational therapists could address the recovery of cognitive symptoms, emotional symptoms, increased motivation, improved quality of life and the mitigation of psychosocial problems as well as the prevention of secondary complications.

2.8.3. Proposed Concussion Intervention Framework:

The proposed Concussion Intervention Framework for occupational therapists is illustrated in Figure 2.6. The proposed framework is drafted to illustrate the role that occupational therapists can play in concussion management by following the three steps in the occupational therapy process. The framework is intended to provide therapists with a tool to assist in facilitating occupational therapy intervention for children and adolescents who are concussed. As observed in Table 2.4, each publication focused on limited aspects of the occupational therapy process and the framework attempts to aggregate the collated information for ease of reference. Embedded in each step are the intervention types that therapists can use depending on the client's needs, the varying approaches that can be implemented depending on the context as well as the proposed return to school protocol that can occur simultaneously with each step of intervention. The intention of the proposed framework is also for occupational therapists in South Africa to utilise the framework to develop evidence-based practice, for experienced therapists to expound on the ideas presented in the framework to contextualise therapy in South Africa, researchers to expand and test the feasibility of the framework and to initiate conversations regarding the advocacy of occupational therapy in concussion management within South Africa.

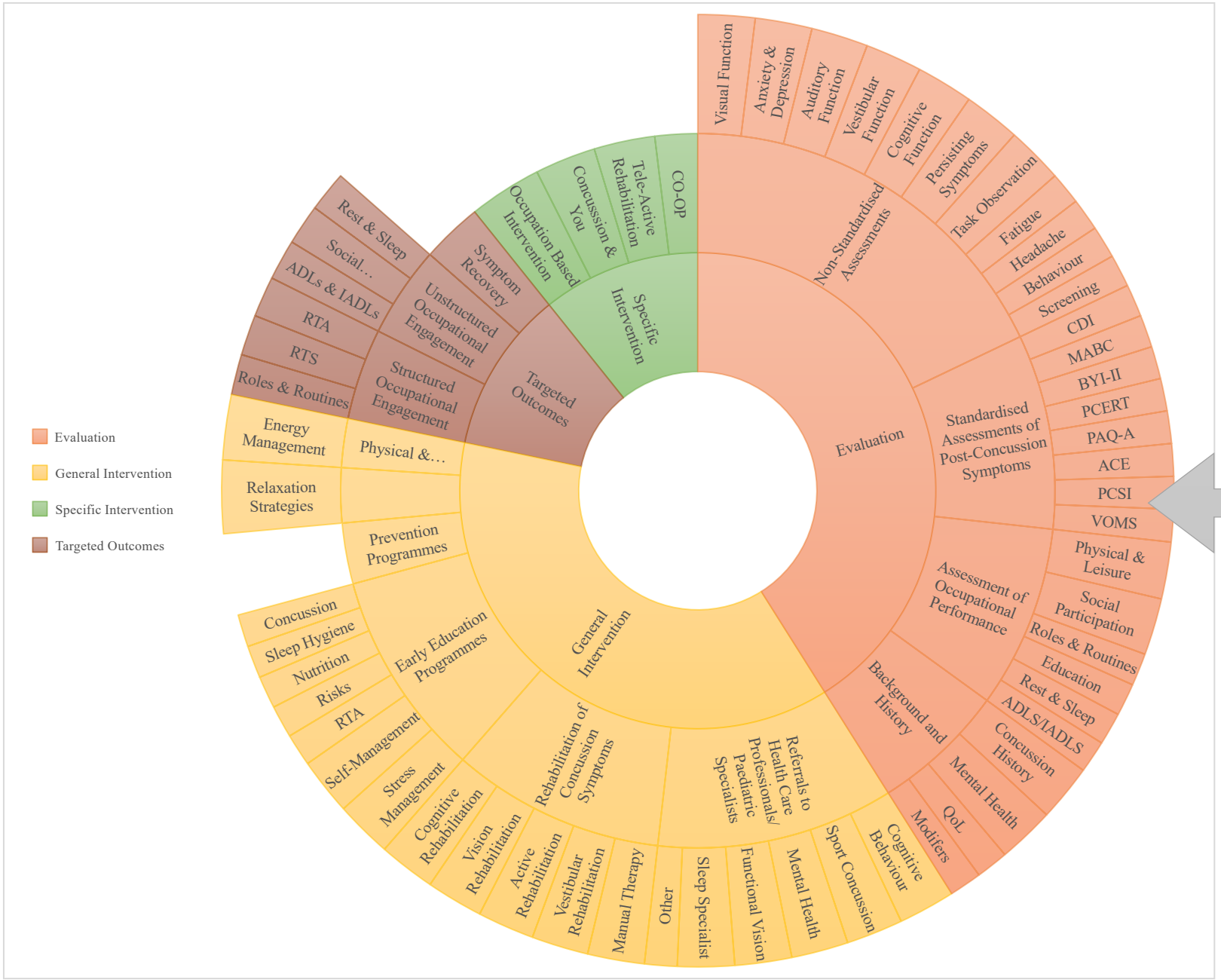

Figure 2.6: Proposed Concussion Intervention Framework

2.9. Limitations

The scoping review has some limitations. For starters, the included studies are from January 2010 and are only up to August 2022. This reduced the range of records, and any research published afterwards which could have updated information was excluded. Additionally, despite all the attempts to be as comprehensive as possible, not all possible literature related to concussion management was included. One of the reasons was consulting with the librarian only in the beginning of the search rather than being assisted with the search which yielded limited database searches. Several studies that discuss the role of occupational therapy in concussion management were excluded due to their inclusion of other methods of concussion injury outside of sport as well as the inclusion of adults in their intervention programme which could have implications for the current findings. Lastly, the interpretation of the included studies was subject to reviewer bias.

2.10. Conclusion

Occupational therapists have a significant role to play in the management of concussions due to the positive correlation between occupational engagement and symptom recovery as well as the use of activity analysis to facilitate the link between symptoms and occupational performance. This role can be grouped according to the rehabilitation intervention process which consists of three steps, namely evaluation, intervention and outcomes. The most mentioned roles that occupational therapists can play are the assessment of post-concussion symptoms and occupational performance using non-standardised assessments, facilitation of rest and sleep using energy conservation strategies, promotion of re-engagement in daily physical activities using the occupation-based approach and facilitation of engagement in meaningful occupations, more specifically, the return to school using structured protocols. These roles are mentioned in studies that have a global north bias and could present differently in South Africa however none of these roles come with overt financial implications that could significantly hinder implementation as they are client and context-dependent. Additionally, through occupational therapy training and clinical reasoning, these roles can all be adapted to the South African Setting. Finally, the proposed Concussion Intervention Framework illustrates the varying ways occupational therapists can provide intervention within concussion management to encourage future research and conversations for role advocacy and the development of practice guidelines.

2.11. Recommendations for future research

The following recommendations are made to inform future research. Implementation of feasibility studies that test out specific intervention approaches and protocols, development of practice guidelines including the return to school guidelines for the South African context, more research in South Africa or the Global South for evidence-based practice and contextual relevance as well as further development of the proposed framework, and finally more book publications to allow access to information for undergraduate studies. Pertaining clinical practice, the advocacy of occupational therapy in the early stages of concussion management is encouraged as well as the use of the proposed framework for guidance in the intervention of sport-related concussions.

2.12. Acknowledgements

The authors would like to thank the researchers and authors of the included studies for providing their wisdom and understanding of the role of occupational therapy in concussion management as well as for advocating for the inclusion of occupational therapy in concussion management.

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2.14. Data Management

Data was stored online on the Rayyan Software™ which required a password to log in. In addition, access to the platform required the researcher to invite an external individual as well as authorise the role they would play which could be collaborator, translator, reviewer or viewer. This ensured that the data was securely protected, and no one could have access without the knowledge or permission of the researcher. The online data is available upon request and there was no storage of paper-based data.

3. CHAPTER 3: SYNTHESIS

3.1. Limitations

The scoping review has some limitations.

Inclusion and exclusion criteria:

The included studies are from January 2010 and are only up to August 2022. This reduced the range of records, and any research published afterwards which could have updated information was excluded. Several studies incorporated the population demographic of youth athletes as well as sport-related concussions. However, these studies were excluded on the premise that they had large age groups which included adults as well as a variety of methods of injury such as motor vehicle accidents. These were seen to skew the results as well as influence the role of occupational therapy as consensus statements encourage the differentiation of treatment approaches for adults and youth.

Comprehensiveness:

Despite the attempts to be as comprehensive as possible, not all possible literature related to concussion management was included. One of the reasons was consulting with the librarian only in the beginning of the search rather than being assisted with the search which yielded limited database searches. Additionally, some articles were difficult to retrieve as they required an access fee while opinion pieces, letters and texts were also excluded as they could not provide the information needed to meet the first objective.

Global North Bias:

There was a limited number of articles from the Global South which have an implication on the inclusivity and applicability for the general population of South Africa.

Reviewer bias.

The interpretation of the included studies was subject to reviewer bias and the primary reviewer has limited experience in concussion management and the possibility of missed valuable information exists.

1.1. Conclusion

Occupational therapists have a significant role to play in the management of concussions due to the positive correlation between occupational engagement and symptom recovery as well as the use of activity analysis to facilitate the link between symptoms and occupational performance. This role can be grouped according to the rehabilitation intervention process which consists of three steps, namely evaluation, intervention and outcomes. The most mentioned roles that occupational therapists can play are the assessment of post-concussion symptoms and occupational performance using non-standardised assessments, facilitation of rest and sleep using energy conservation strategies, promotion of re-engagement in daily physical activities using the occupation-based approach and facilitation of engagement in meaningful occupations, more specifically, the return to school using structured protocols. These roles are mentioned in studies that have a global north bias and could present differently in South Africa however none of these roles come with overt financial implications that could significantly hinder implementation as they are client and context-dependent. Additionally, through occupational therapy training and clinical reasoning, these roles can all be adapted to the South African Setting. Finally, the proposed Concussion Intervention Framework illustrates the varying ways occupational therapists can provide intervention within concussion management to encourage future research and conversations for role advocacy and the development of practice guidelines.

1.1. Recommendations for future research

The following recommendations are made to inform future research and clinical practice.

Implementation of feasibility studies that test out specific intervention approaches and protocols. The proposed framework can be expanded through varying studies such as feasibility and framework development studies. Moreover, additional roles that can apply uniquely to the South African context can be recommended such as managing high caseloads when providing intervention. The return-to-school protocol can also be developed and tested against the school policies that exist in South African public and private schools.

The development of practice guidelines for the South African context is recommended through more research in South Africa or the Global South. This will strengthen the existing evidence, provide practicality during implementation and be contextually relevant to populations that

often cannot afford private occupational therapy and receive intervention from the public health sector at large intervals

It is advised that more books that state the role of occupational therapy in concussion management are written and published by occupational therapists who are experienced in this field. This way, information becomes easily accessible to the general public and allows access to information by undergraduate studies or inexperienced therapists.

Finally, occupational therapists are encouraged to advocate for their inclusion in the early stages of concussion management in acute hospital settings. The reason for this inclusion is that there are a variety of benefits to early occupational therapy intervention such as decreased burden of care, mitigation of disengagement in activities that are often caused by invisible symptoms such as headache, dizziness and light sensitivity, improved symptom recovery as well as early return to occupational engagement and physical activities.

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APPENDIX A: SAJOT GUIDELINES

Attached separately to the manuscript

APPENDIX B: BUILDING A SEARCH STRATEGY

Search Strategy for PubMed: 23/08/2022	
Concept 1:	Child
#1 Keywords:	Minor*[tiab] OR Inexperience*[tiab] OR Child*[tiab] OR Young*[tiab] OR Adolescen*[tiab] OR Immatur*[tiab] OR Junior[tiab] OR Juvenile[tiab] OR Girl*[tiab] OR Boy[tiab] OR Boys[tiab] OR Schoolboy*[tiab] OR Schoolgirl*[tiab] OR Youth*[tiab] OR Teen*[tiab] OR Pube*[tiab] OR Learner*[tiab] OR Student*[tiab]
#2 MeSH:	Child[Mesh]
#3 Title/Abstract	P?ediatric*[tiab] OR "School age*"[tiab]
#1 or #2 or #3 = #4	((Minor*[tiab] OR Inexperience*[tiab] OR Child*[tiab] OR Young*[tiab] OR Adolescen*[tiab] OR Immatur*[tiab] OR Junior[tiab] OR Juvenile[tiab] OR Girl*[tiab] OR Boy[tiab] OR Boys[tiab] OR Schoolboy*[tiab] OR Schoolgirl*[tiab] OR Youth*[tiab] OR Teen*[tiab] OR Pube*[tiab] OR Learner*[tiab] OR Student*[tiab]) OR (Child[Mesh])) OR (P?ediatric*[tiab] OR "School age*"[tiab])
Results Total:	**4 076 495**
Concept 2:	Concussion
#5 Keywords:	Concuss*[tiab] OR "Mild Traumatic Brain Injur*"[tiab] OR MTBI[tiab]
#6 MeSH:	"Brain Concussion"[Mesh] OR "Post-Concussion Syndrome"[Mesh]
#7 Title/Abstract	Concus*[tiab] OR "Post Concussion Symptom*"[tiab]
#5 or #6 or #7 = #8	((Concuss*[tiab] OR "Mild Traumatic Brain Injur*"[tiab] OR MTBI[tiab]) OR ("Brain Concussion"[Mesh] OR "Post-Concussion Syndrome"[Mesh])) OR (Concus*[tiab] OR "Post Concussion Symptom*"[tiab])
Results Total:	**18 644**
Concept 3:	Sport-Related
#9 Keywords:	"Sport-Related"[tiab] OR Athlet*[tiab] OR Competiti*[tiab] OR Exercise*[tiab] OR Game*[tiab]
#10 MeSH:	"Sports"[Mesh] OR "Return to Sport"[Mesh] OR "Youth Sports"[Mesh] OR "Sports Medicine"[Mesh] OR "Team Sports"[Mesh]
#11 Title/Abstract	Train*[tiab]
#9 or #10 or #11 = #12	(("Sport-Related"[tiab] OR Athlet*[tiab] OR Competiti*[tiab] OR Exercise*[tiab] OR Game*[tiab]) OR ("Sports"[Mesh] OR "Return to Sport"[Mesh] OR "Youth Sports"[Mesh] OR "Sports Medicine"[Mesh] OR "Team Sports"[Mesh])) OR (Train*[tiab])

Results Total:	**1 367 626**
Concept 4:	Occupational Therapy
#13 Keywords:	"Occupational Therap*"[tiab] OR Rehabilitation[tiab]
#14 MeSH:	"Occupational Therapy"[Mesh]
#15 Title/Abstract	"Occupation-based"[tiab] OR "Occupation-cent*"[tiab]
#13 or #14 or #15 = #16	(("Occupational Therap*"[tiab] OR Rehabilitation[tiab]) OR ("Occupational Therapy"[Mesh])) OR ("Occupation-based"[tiab] OR "Occupation-cent*"[tiab])
Results Total:	**213 738**
Concept 5:	Management[tiab]
#17 Keywords:	Manag*[tiab] OR Treat*[tiab] OR Therap*[tiab] OR Recover*[tiab] OR "Return to Activit*"[tiab] OR "Return to Learn*"[tiab] OR "Return to Sport*"[tiab] OR "Return to School*"[tiab] OR "Return to Play*"[tiab] OR Interven*[tiab] OR Program*[tiab]
#18 MeSH:	"Patient Care Management"[Mesh] OR "Conservative Treatment"[Mesh]
#19 Title/Abstract	Protocol*[tiab] OR Approach[tiab]
#17 or #18 or #19 = #20	(Treatment[tiab] OR Therapy[tiab] OR Recovery[tiab] OR "Return to Activity"[tiab] OR "Return to Learn*"[tiab] OR "Return to Sport"[tiab] OR "Return to School"[tiab] OR "Return to Play"[tiab] OR "Conservative Treatment"[Mesh] OR "therapy" [Subheading] OR Management[tiab])
Results Total:	**11 912 561**
#4 and #8 and #12 and #16 and #20	((((((Minor*[tiab] OR Inexperience*[tiab] OR Child*[tiab] OR Young*[tiab] OR Adolescen*[tiab] OR Immatur*[tiab] OR Junior[tiab] OR Juvenile[tiab] OR Girl*[tiab] OR Boy[tiab] OR Boys[tiab] OR Schoolboy*[tiab] OR Schoolgirl*[tiab] OR Youth*[tiab] OR Teen*[tiab] OR Pube*[tiab] OR Learner*[tiab] OR Student*[tiab]) OR (Child[Mesh])) OR (P?ediatric*[tiab] OR "School age*"[tiab])) AND (((Concuss*[tiab] OR "Mild Traumatic Brain Injur*"[tiab] OR MTBI[tiab]) OR ("Brain Concussion"[Mesh] OR "Post-Concussion Syndrome"[Mesh])) OR (Concus*[tiab] OR "Post Concussion Symptom*"[tiab]))) AND ((("Sport-Related"[tiab] OR Athlet*[tiab] OR Competiti*[tiab] OR Exercise*[tiab] OR Game*[tiab]) OR ("Sports"[Mesh] OR "Return to Sport"[Mesh] OR "Youth Sports"[Mesh] OR "Sports Medicine"[Mesh] OR "Team Sports"[Mesh])) OR (Train*[tiab]))) AND ((("Occupational Therap*"[tiab] OR Rehabilitation[tiab]) OR ("Occupational Therapy"[Mesh])) OR ("Occupation-based"[tiab] OR "Occupation-cent*"[tiab]))) AND (((Manag*[tiab] OR Treat*[tiab] OR Therap*[tiab] OR Recover*[tiab] OR "Return to Activit*"[tiab] OR "Return to Learn*"[tiab] OR "Return to Sport*"[tiab] OR "Return to School*"[tiab] OR "Return to Play*"[tiab] OR Interven*[tiab] OR Program*[tiab]) OR ("Patient Care Management"[Mesh] OR "Conservative Treatment"[Mesh])) OR (Protocol*[tiab] OR Approach[tiab]))
Results Total in PubMed:	**138 and English articles from 2010 = 124**

Search Strategy for CINAHL: 28/08/2022	
Concept 1:	Child
S1 Keywords:	TX Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pube* OR Learner* OR Student*
S2 Major Heading:	(MH "Child") OR (MH "Child, Hospitalized") OR (MH "Child Health") OR (MH "Child Care Providers") OR (MH "Child Health Services") OR (MH "P?ediatric Occupational Therapy")
S3 Title/Abstract	TX "Middle School" OR "High School" OR P?ediatric* OR Schoolchild*
S1 or S2 or S3 = S4	TX (Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pube* OR Learner* OR Student*) OR (MH "Child") OR (MH "Child, Hospitalized") OR (MH "Child Health") OR (MH "Child Care Providers") OR (MH "Child Health Services") OR (MH "P?ediatric Occupational Therapy") OR TX ("Middle School" OR "High School" OR P?ediatric* OR Schoolchild*)
Results Total:	**1 917 586**
Concept 2:	Concussion
S5 Keywords:	TX Concuss* OR "Mild Traumatic Brain Injur*" OR MTBI
S6 Major Heading:	(MH "Brain Concussion") OR (MH "Postconcussion Syndrome")
S7 Title/Abstract	TX "Post Concussion Symptom*"
S5 or S6 or S7 = S8	TX (Concuss* OR "Mild Traumatic Brain Injur*" OR MTBI) OR ((MH "Brain Concussion") OR (MH "Postconcussion Syndrome") OR TX ("Post Concussion Symptom*")
Results Total:	**14 117**
Concept 3:	Sport-Related
S9 Keywords:	TX "Sport-Related" OR Athlet* OR Competiti* OR Exercise* OR Game*
S10 Major Heading:	(MH "Sports Organizations") OR (MH "Sporting Events") OR (MH "Sport Specific Training") OR (MH "Team Sports") OR (MH "Professional Sports") OR (MH "Contact Sports") OR (MH "Occupational-Related Injuries") OR (MH "Rehabilitation, Athletic") OR (MH "Sports Participation") OR (MH "Sports") OR (MH "Athletic Injuries")
S11 Title/Abstract	TX Player* OR "Exercise-related" OR "Recreational Sport" OR Train*

S9 or S10 or S11 = S12	TX ("Sport-Related" OR Athlet* OR Competiti* OR Exercise* OR Game*) OR (MH "Sports Organizations") OR (MH "Sporting Events") OR (MH "Sport Specific Training") OR (MH "Team Sports") OR (MH "Professional Sports") OR (MH "Contact Sports") OR (MH "Occupational-Related Injuries") OR (MH "Rehabilitation, Athletic") OR (MH "Sports Participation") OR (MH "Sports") OR (MH "Athletic Injuries") OR TX (Player* OR "Exercise-related" OR "Recreational Sport" OR Train*)
Results Total:	**609 829**
Concept 4:	Occupational Therapy
S13 Keywords:	TX "Occupational Therap*" OR Rehabilita*
S14 Major Heading:	(MH "Occupational Therapy") OR (MH "Pediatric Occupational Therapy") OR (MH "Occupational Therapy Practice, Evidence-Based") OR (MH "Occupational Therapy Practice, Research-Based") OR (MH "Occupational Therapy Service")
S15 Title/Abstract	TX Therap* OR "Occupational Performance" OR "Rehabilitation Intervention*" OR "Occupation-Based" OR telerehabilitation
S13 or S14 or S15 = S16	TX ("Occupational Therap*" OR Rehabilita*) OR ((MH "Occupational Therapy") OR (MH "Pediatric Occupational Therapy") OR (MH "Occupational Therapy Practice, Evidence-Based") OR (MH "Occupational Therapy Practice, Research-Based") OR (MH "Occupational Therapy Service")) OR TX (Therap* OR "Occupational Performance" OR "Rehabilitation Intervention*" OR "Occupation-Based" OR telerehabilitation)
Results Total:	**2 613 735**
Concept 5:	Management
S17 Keywords:	TX Manag* OR Treat* OR Therap* OR Recover* OR "Return to Activit*" OR "Return to Learn*" OR "Return to Sport*" OR "Return to School*" OR "Return to Play*" OR Interven* or Program*
S18 Major Heading:	(MH "Treatment Outcomes") OR (MH "Conservative Treatment") OR (MH "Early Intervention")
S19 Title/Abstract	TX "Sports Re-entry" OR Protocol* OR "School Re-entry" OR "Treatment Outcome*" OR Manag* OR "Functional Outcome*" OR "Sports Participation" OR "Return to full training"
S17 or S18 or S19 = S20	TX (Manag* OR Treat* OR Therap* OR Recover* OR "Return to Activit*" OR "Return to Learn*" OR "Return to Sport*" OR "Return to School*" OR "Return to Play*" OR Interven* or Program*) OR (MH "Treatment Outcomes") OR (MH "Conservative Treatment") OR (MH "Early Intervention") OR TX ("Sports Re-entry" OR Protocol* OR "School Re-entry" OR "Treatment Outcome*" OR Manag* OR "Functional Outcome*" OR "Sports Participation" OR "Return to full training")
Results Total:	**4 100 091**

S4 and S8 and S12 and S16 and S20	(TX (Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pube* OR Learner* OR Student*) OR (MH "Child") OR (MH "Child, Hospitalized") OR (MH "Child Health") OR (MH "Child Care Providers") OR (MH "Child Health Services") OR (MH "P?ediatric Occupational Therapy") OR TX ("Middle School" OR "High School" OR P?ediatric* OR Schoolchild*)) AND (TX (Concuss* OR "Mild Traumatic Brain Injur*" OR MTBI) OR ((MH "Brain Concussion") OR (MH "Postconcussion Syndrome") OR TX ("Post Concussion Symptom*")) AND (TX ("Sport-Related" OR Athlet* OR Competiti* OR Exercise* OR Game*) OR (MH "Sports Organizations") OR (MH "Sporting Events") OR (MH "Sport Specific Training") OR (MH "Team Sports") OR (MH "Professional Sports") OR (MH "Contact Sports") OR (MH "Occupational-Related Injuries") OR (MH "Rehabilitation, Athletic") OR (MH "Sports Participation") OR (MH "Sports") OR (MH "Athletic Injuries") OR TX (Player* OR "Exercise-related" OR "Recreational Sport" OR Train*)) AND (TX ("Occupational Therap*" OR Rehabilita*) OR ((MH "Occupational Therapy") OR (MH "Pediatric Occupational Therapy") OR (MH "Occupational Therapy Practice, Evidence-Based") OR (MH "Occupational Therapy Practice, Research-Based") OR (MH "Occupational Therapy Service")) OR TX (Therap* OR "Occupational Performance" OR "Rehabilitation Intervention*" OR "Occupation-Based" OR telerehabilitation)) AND (TX (Manag* OR Treat* OR Therap* OR Recover* OR "Return to Activit*" OR "Return to Learn*" OR "Return to Sport*" OR "Return to School*" OR "Return to Play*" OR Interven* or Program*) OR (MH "Treatment Outcomes") OR (MH "Conservative Treatment") OR (MH "Early Intervention") OR TX ("Sports Re-entry" OR Protocol* OR "School Re-entry" OR "Treatment Outcome*" OR Manag* OR "Functional Outcome*" OR "Sports Participation" OR "Return to full training"))
Results Total in CINAHL:	**1 264 and English articles from 2010 = 1 059**

Search Strategy for Scopus: 22/08/2022	
Concept 1:	Child
#1 Keywords:	TITLE-ABS-KEY (inexperience* OR child* OR young* OR adolescen* OR immatur* OR junior OR girl* OR boy OR boys OR schoolboy* OR schoolgirl* OR youth* OR teen* OR pubescent)
#2 Title/Abstract	TITLE-ABS-KEY (student* OR learner* OR P?ediatric*)
#1 or #2 = #3	(TITLE-ABS-KEY (student* OR learner* OR p?ediatric*)) OR (TITLE-ABS-KEY (inexperience* OR child* OR young* OR adolescen* OR immatur* OR junior OR girl* OR boy OR boys OR schoolboy* OR schoolgirl* OR youth* OR teen* OR pubescent))
Results Total:	**7 691 717**
Concept 2:	Concussion
#4 Keywords:	TITLE-ABS-KEY (concussion* OR "mild traumatic brain injury" OR mtbi)
#5 Title/Abstract	TITLE-ABS-KEY ("post concussion symptom*" OR concuss* OR "repe* mild traumatic brain injury" OR "head trauma" OR "head injur*" concuss* OR "head impact*")
#4 or #5 = #6	(TITLE-ABS-KEY (concussion* OR "mild traumatic brain injury" OR mtbi)) OR (TITLE-ABS-KEY ("post concussion symptom*" OR concuss* OR "repe* mild traumatic brain injury" OR "head trauma" OR "head injur*" concuss* OR "head impact*"))
Results Total:	**23 488**
Concept 3:	Sport-Related
#7 Keywords:	TITLE-ABS-KEY ("sport-related" OR athlet* OR competiti* OR exercise OR game*)
#8 Title/Abstract	TITLE-ABS-KEY (train* OR player* OR "exercise-related")
#7 or #8 = #9	(TITLE-ABS-KEY (train* OR player* OR "exercise-related")) OR (TITLE-ABS-KEY ("sport-related" OR athlet* OR competiti* OR exercise OR game*))
Results Total:	**3 929 989**
Concept 4:	Occupational Therapy
#10 Keywords:	TITLE-ABS-KEY ("occupational therap*" OR rehabilita* OR occupation*)
#11 Title/Abstract	TITLE-ABS-KEY (therap* OR "rehabilitation program*" OR "rehabilitation intervention*")
#10 or #11 = #12	(TITLE-ABS-KEY ("occupational therap*" OR rehabilita* OR occupation*)) OR (TITLE-ABS-KEY (therap* OR "rehabilitation program*" OR "rehabilitation intervention*"))
Results Total:	**6 989 940**

Concept 5:	Management
#13 Keywords:	TITLE-ABS-KEY (treat* OR therap* OR recover* OR "return to activit*" OR "return to learn*" OR "return to sport*" OR "return to school*" OR "return to play*" OR interven* OR program* OR manage*)
#14 Title/Abstract	TITLE-ABS-KEY ("get going after concussion" OR "conservative manage*" OR "conservative treat*" OR "functional rehab*" OR "functional performance" OR "risk manage*")
#13 or #14 = #15	(TITLE-ABS-KEY ("get going after concussion" OR "conservative manage*" OR "conservative treat*" OR "functional rehab*" OR "functional performance" OR "risk manage*")) OR (TITLE-ABS-KEY (treat* OR therap* OR recover* OR "return to activit*" OR "return to learn*" OR "return to sport*" OR "return to school*" OR "return to play*" OR interven* OR program* OR manage*))
Results Total:	**22 435 193**
#3 and #6 and #9 and #12 and #15	((TITLE-ABS-KEY(Concussion* OR "Mild Traumatic Brain Injury" OR MTBI)) OR (TITLE-ABS-KEY("Post Concussion Symptom*" OR Concuss* OR "Repe* Mild Traumatic Brain Injury" OR "Head Trauma" OR "Head Injur*" Concuss* OR "Head Impact*"))) AND ((TITLE-ABS-KEY(student* OR learner* OR P?ediatric*)) OR (TITLE-ABS-KEY(Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pubescent))) AND ((TITLE-ABS-KEY(Train* OR Player* OR "Exercise-related")) OR (TITLE-ABS-KEY("Sport-Related" OR Athlet* OR Competiti* OR Exercise OR Game*))) AND ((TITLE-ABS-KEY("Occupational Therap*" OR Rehabilita* OR Occupation*)) OR (TITLE-ABS-KEY(Therap* OR "Rehabilitation Program*" OR "Rehabilitation Intervention*"))) AND ((TITLE-ABS-KEY("Get going After concussIoN" OR "Conservative Manage*" OR "Conservative Treat*" OR "Functional Rehab*" OR "Functional Performance" OR "Risk Manage*")) OR (TITLE-ABS-KEY(Treat* OR Therap* OR Recover* OR "Return to Activit*" OR "Return to Learn*" OR "Return to Sport*" OR "Return to School*" OR "Return to Play*" OR Interven* or Program* OR Manage*))) AND (LIMIT-TO (PUBYEAR,2022) OR LIMIT-TO (PUBYEAR,2021) OR LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR,2019) OR LIMIT-TO (PUBYEAR,2018) OR LIMIT-TO (PUBYEAR,2017) OR LIMIT-TO (PUBYEAR,2016) OR LIMIT-TO (PUBYEAR,2015) OR LIMIT-TO (PUBYEAR,2014) OR LIMIT-TO (PUBYEAR,2013) OR LIMIT-TO (PUBYEAR,2012) OR LIMIT-TO (PUBYEAR,2011) OR LIMIT-TO (PUBYEAR,2010)) AND (LIMIT-TO (LANGUAGE,"English"))
Results Total in Scopus:	**464 and English articles from 2010 = 415**

Search Strategy for Cochrane Library: 22/08/2022			
Concept 1:	Child		
#1 Keywords:	Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pubescent		
#2 MeSH:	(MeSH descriptor: [Child] explode all trees) OR (MeSH descriptor: [Adolescent] explode all trees)		
#3 Title/Abstract	Puberty OR "School Age" OR P?ediatric		
#1 or #2 or #3 = #4	Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pubescent in Title Abstract Keyword OR Child OR Adolescent in Title Abstract Keyword OR Puberty OR "School age" OR P?ediatric in Title Abstract Keyword - (Word variations have been searched)		
Results Total:	**Cochrane Reviews: 3 426**	**Cochrane Protocols: 231**	**Trials: 374 847**
	Editorials: 54	**Special Collections: 11**	**Clinical Answers: 312**
Concept 2:	Concussion		
#5 Keywords:	Concussi* OR "Mild Traumatic Brain Injur*"		
#6 MeSH:	N/A		
#7 Title/Abstract	"Acquired Brain Injur*" OR "Post Concussi* Syndrome*" OR "Post Concussi* Symptom*"		
#5 or #6 or #7 = #8	Concussion OR "Mild Traumatic Brain Injur*" in Title Abstract Keyword OR "Acquired Brain Injur*" OR "Post Concussion Syndrome*" OR "Post Concussion Symptom*" in Title Abstract Keyword - (Word variations have been searched)		
Results Total:	**Cochrane Reviews: 1**	**Cochrane Protocols: 1**	**Trials: 1 022**
	Editorials: 0	**Special Collections: 0**	**Clinical Answers: 0**
Concept 3:	Sport-Related		
#9 Keywords:	"Sport-Related" OR Athlet* OR Competition OR Exercise OR Game*		
#10 MeSH:	MeSH descriptor: [Sports] explode all trees		
#11 Title/Abstract	Sport* OR Train* OR Fitness		
#9 or #10 or #11 = #12	sport-related in Title Abstract Keyword OR "Sport-Related" OR Athlet* OR Competition OR Exercise OR Game* in Title Abstract Keyword OR sport* OR Train* OR Fitness in Title Abstract Keyword - (Word variations have been searched)		

Results Total:	**Cochrane Reviews: 1 415**	**Cochrane Protocols: 92**	**Trials: 229 199**
	Editorials: 53	**Special Collections: 1**	**Clinical Answers: 93**
Concept 4:	Occupational Therapy		
#13 Keywords:	"Occupational Therap*" OR Rehabilitat*		
#14 MeSH:	(MeSH descriptor: [Therapeutics] explode all trees) OR (MeSH descriptor: [Rehabilitation] explode all trees) OR (MeSH descriptor: [Occupational Therapy] explode all trees)		
#15 Title/Abstract	Telerehabilitation OR "Occupational Outcome*" OR Interven* OR Therap*		
#13 or #14 or #15 = #16	"Occupational Therap*" OR Rehabilitat* in Title Abstract Keyword AND Telerehabilitation OR "Occupational Outcome*" OR Interven* OR Therap* in Title Abstract Keyword - (Word variations have been searched)		
Results Total:	**Cochrane Reviews: 417**	**Cochrane Protocols: 16**	**Trials: 40 019**
	Editorials: 8	**Special Collections: 0**	**Clinical Answers: 3**
Concept 5:	Management		
#17 Keywords:	Treatment OR Therap* OR Recovery OR "Return to Activity" OR "Return to Learn*" OR "Return to Sport" OR "Return to School" OR "Return to Play"		
#18 MeSH:	MeSH descriptor: [Therapeutics] explode all trees		
#19 Title/Abstract	Interven* OR "Conservative Interven*" OR Treat* OR Manag*		
#17 or #18 or #19 = #20	Treatment OR Therapy OR Recovery OR "Return to Activity" OR "Return to Learn*" OR "Return to Sport" OR "Return to School" OR "Return to Play" in Title Abstract Keyword OR Therap* in Title Abstract Keyword OR Interven* OR "Conservative Interven*" OR Treat* OR Manag* in Title Abstract Keyword - (Word variations have been searched)		
Results Total:	**Cochrane Reviews: 8 577**	**Cochrane Protocols: 1 809**	**Trials: 1 386 114**
	Editorials: 135	**Special Collections: 16**	**Clinical Answers: 1 002**

#4 and #8 and #12 and #16 and #20	Minor* OR Inexperience* OR Child* OR Young* OR Adolescen* OR Immatur* OR Junior OR Juvenile OR Girl* OR Boy OR Boys OR Schoolboy* OR Schoolgirl* OR Youth* OR Teen* OR Pubescent OR Puberty OR "School Age" OR P?ediatric in Title Abstract Keyword AND Concussi* OR "Mild Traumatic Brain Injur*" OR "Acquired Brain Injur*" OR "Post Concussi* Syndrome*" OR "Post Concussi* Symptom*" in Title Abstract Keyword AND "Sport-Related" OR Athlet* OR Competition OR Exercise OR Game* OR Sport* OR Train* OR Fitness in Title Abstract Keyword AND "Occupational Therap*" OR Rehabilitat* OR Telerehabilitation OR "Occupational Outcome*" OR Interven* OR Therap* in Title Abstract Keyword AND Treatment OR Therap* OR Recovery OR "Return to Activity" OR "Return to Learn*" OR "Return to Sport" OR "Return to School" OR "Return to Play" OR Interven* OR "Conservative Interven*" OR Treat* OR Manag* in Title Abstract Keyword - (Word variations have been searched)		
Total in Cochrane Library From 2010	**Cochrane Reviews: 0**	**Cochrane Protocols: 0**	**Trials: 181**
	Editorials: 0	**Special Collections: 0**	**Clinical Answers: 0**

Search Strategy for OTseeker: 28/08/2022	
Concept 1:	Child
#1 Keywords:	[Title/Abstract] like 'inexperience* OR child* OR young* OR adolescen* OR immatur* OR junior OR girl* OR boy OR boys OR schoolboy* OR schoolgirl* OR youth* OR teen* OR pube*'
#2 Title/Abstract	[Title/Abstract] like 'school-age OR p?ediatric OR juvenile OR school-based'
#1 or #2 = #3	[Title/Abstract] like 'inexperience* OR child* OR young* OR adolescen* OR immatur* OR junior OR girl* OR boy OR boys OR schoolboy* OR schoolgirl* OR youth* OR teen* OR pube*' OR [Title/Abstract] like 'school-age OR p?ediatric OR juvenile OR school-based'
Results Total:	**1 554**
Concept 2:	Concussion
#4 Keywords:	[Title/Abstract] like 'concussion* OR "mild traumatic brain injury" OR mtbi'
#5 Title/Abstract	N/A
#4 or #5 = #6	[Title/Abstract] like 'concussion* OR "mild traumatic brain injury" OR mtbi'
Results Total:	**13**
Concept 3:	Sport-Related
#7 Keywords:	[Title/Abstract] like '"sport-related" OR athlet* OR competiti* OR exercise OR game*'
#8 Title/Abstract	[Title/Abstract] like 'train*'
#7 or #8 = #9	[Title/Abstract] like '"sport-related" OR athlet* OR competiti* OR exercise OR game*' OR [Title/Abstract] like 'train*'
Results Total:	**2 508**
Concept 4:	Occupational Therapy
#10 Keywords:	[Title/Abstract] like '"occupational therap*" OR rehabilita* OR occupation*'
#11 Title/Abstract	[Title/Abstract] like 'occupational performance'
#10 or #11 = #12	[Title/Abstract] like '"occupational therap*" OR rehabilita* OR occupation*' OR [Title/Abstract] like 'occupational performance'
Results Total:	**1 389**
Concept 5:	Management
#13 Keywords:	[Title/Abstract] like 'treat* OR therap* OR recover* OR "return to activit*" OR "return to learn*" OR "return to sport*" OR "return to school*" OR "return to play*" OR interven* OR program* OR manage*'

#14 Title/Abstract	Title/Abstract] like "'conservative manage*" OR "conservative treat*" OR prevent*'
#13 or #14 = #15	[Title/Abstract] like "'conservative manage*" OR "conservative treat*" OR prevent*' OR [Title/Abstract] like 'treat* OR therap* OR recover* OR "return to activit*" OR "return to learn*" OR "return to sport*" OR "return to school*" OR "return to play*" OR interven* OR program* OR manage*'
Results Total:	**7 492**
#3 and #6 and #9 and #12 and #15	[Any Field] like 'inexperience* OR child* OR young* OR adolescen* OR immatur* OR junior OR girl* OR boy OR boys OR schoolboy* OR schoolgirl* OR youth* OR teen* OR pube* OR school-age OR p?ediatric OR juvenile OR school-based' AND [Any Field] like 'concussion* OR "mild traumatic brain injury" OR mtbi' AND [Any Field] like "'sport-related" OR athlet* OR competiti* OR exercise OR game* OR train*' AND [Any Field] like "'occupational therap*" OR rehabilita* OR occupation* OR occupational performance' AND [Any Field] like 'conservative manage* OR "conservative treat*" OR prevent*' OR treat* OR therap* OR recover* OR "return to activit*" OR "return to learn*" OR "return to sport*" OR "return to school*" OR "return to play*" OR interven* OR program* OR manage*'
Results Total in OTseeker:	**1 and English articles from 2010 = 1 (Title & Abstract Search Yields no Results)**

Other Searches Conducted: 28/08/2022		
Source:	**Search Strategy:**	**No. of Aritcles Found:**
Grey Matters by Canada's Drug and Health Technology Agency (candth):	Searched: "Concussion"	4
Journal of Concussion:	Hand Searched Articles from 2017 - 2022	77
South African Journal of Occupational Therapy	Hand Searched Articles from 2010 (Vol 40 No.3 - Vol 52 No. 2)	5

APPENDIX C: DATA EXTRACTION FORM

Attached separately to the manuscript as PDF Form for ease of reading due to the size

APPENDIX D: ETHICAL CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

06/10/2020

Ref: W-CBP-201006-01

TO WHOM IT MAY CONCERN:

Waiver: This certifies that the following research does not require clearance from the Human Research Ethics Committee (Medical).

Investigator: Ms T Mokwena
Student No. (if appropriate): 542285
Staff No. (if appropriate):

Supervisor: Ms F Sinnett

School: Therapeutic Sciences
Department: Occupational Therapy
Medical School
University

Project title: *The role of occupational therapy in the management of sport-related concussion for children and adolescents: a scoping review*

Reason: Review of information in the public domain.
No human participants will be involved in the study.

Dr CB Penny
Co-Chairperson: Human Research Ethics Committee (Medical)

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