

https://dspace.org/

The impact of adverse childhood experiences (ACEs) on health and well-being in young adulthood: a longitudinal analysis of data from the birth to twenty plus (Bt20+) cohort

Manyema, Mercy

2020

https://hdl.handle.net/10539/31812

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

The impact of adverse childhood experiences (ACEs) on health and well-being in young adulthood: a longitudinal analysis of data from the Birth to Twenty Plus (Bt20+) cohort

BY

Mercy Manyema

Student Number: 469168

SUPERVISORS

Prof Linda M Richter

Prof Shane A Norris

A THESIS

Submitted to the Faculty of Health Sciences, University of Witwatersrand, in fulfilment of the requirements for the degree of

Doctor of Philosophy

JOHANNESBURG, SOUTH AFRICA

2020

Declaration

I, Mercy Manyema, declare that this thesis is my own original, unaided work. It is being submitted for the degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at any other University or institution.

Signed  on the

6th day of October 20 20 in Johannesburg

Dedication

To the participants of the Bt20 Plus Study

To those who have lived and fought battles within and without

To those who have overcome and continue to conquer

To those who allowed us to see a part of their story

Acknowledgements

I am deeply honoured to have been supervised by two of the best researchers in the field of public health research. I am grateful to Prof Linda Richter for the invaluable opportunity to pursue my PhD studies under her supervision. I appreciate her vast knowledge and skills, guidance and input in the entire PhD process and putting together the whole thesis. She provided not only the platform, but also exposure to international expertise in my area of interest and facilitated many learning opportunities that enriched my PhD experience. Special thanks go to Prof Shane Norris for co-supervision of my work. His eye for fine detail in methodology and results presentation as well as insight in building a solid and cohesive story from the data was much appreciated. Prof Norris' vast technical knowledge on the dataset itself was priceless in ensuring that the data were handled appropriately and accurately.

Many thanks also go to the Wits School of Public Health Interdisciplinary PhD Program team for their continued guidance and administrative support. My fellow PhD students from the School of Public Health, DPHRU and the CoE in Human Development were a constant source of motivation along the way. The DST-NRF CoE in Human Development team did an excellent job of supporting its fellows and running alongside us all the way.

Thank you to my family for allowing me the time and space to spread my wings. Shaw Manyema, thank you for your unwavering support. You were there through the highs and lows of this journey, most of which only you saw. Heartfelt gratitude goes to my children Rachel and Nathan for always reminding me why I began this journey. I thank my many friends who cheered me on when motivation was dwindling and the end seemed so near yet so far.

Last but not least, I am grateful to Providence for giving me the opportunity to view my own story through a new lens.

Table of Contents

The impact of adverse childhood experiences (ACEs) on health and well-being in young adulthood: a longitudinal analysis of data from the Birth to Twenty Plus (Bt20+) cohort i

Declaration ii

Dedication iii

Acknowledgements iv

List of Tables xi

Table of Figures xii

List of Appendices xiii

List of Abbreviations xiv

Thesis Materials xvi

Peer-reviewed publications xvi

Student's contribution to publications xvi

Conference proceedings xvi

Other Publications xvii

A tough childhood has a long-term effect on health. Business Day 6 March 2019 (2). xvii

Funding and Awards xxi

Abstract xxii

Background xxii

Methods xxii

Results xxiii

Conclusions xxiii

Preface xxv

Thesis outline xxvii

SECTION 1: INTRODUCTION 1

Chapter 1 : Background and Literature Review 2

1.1 Background 3

1.1.1 Statement of the Problem 3

1.2 Literature Review 4

1.2.1 Early childhood: definition and importance 4

1.2.2 Early childhood development and the brain 5

1.2.3 Prevalence of ACEs worldwide 7

1.2.4 Epidemiology of ACES....9
1.2.5 ACEs and public health....10
1.2.6 Hypotheses of the link between ACEs and health....12
1.2.7 Measurement of ACEs....17
1.2.8 ACE Score....20
1.2.9 Summary of literature review and research gaps....20
1.3 Relevance and justification of study....20
1.4 Thesis framework....22
1.5 Aims and specific objectives....24
1.5.1 Research questions and hypotheses....25
Chapter 2 : Methods....27
Overview....28
2.1 Bt20 Plus Study....28
2.1.1 Study design....28
2.1.2 Study setting....28
2.1.3 Map of Soweto (93, 95)....29
2.1.4 Study recruitment and data collection....30
2.2 Ntshembo Study....31
2.2.1 Study design and setting....32
2.2.2 Study recruitment and data collection....33
2.3 Study Measures....33
2.4 Data Analysis Overview....33
2.5 Ethics....35
2.6 Candidate's role in the study....35
SECTION 2: Results and Empirical Chapters....36
Chapter 3 : Adverse childhood experiences: prevalence and associated factors among South African young adults....37
3.1 Introduction....38
3.2 Methods....40
3.2.1 Study design and context....40
3.2.2 Participants/Study population....40
3.2.3 Measures....40
3.2.4 Statistical analysis....43

3.2.5 Ethics 43
3.3 Results 44
3.3.1 Characteristics of the sample and prevalence of ACEs 44
3.3.2 Missing data 48
3.3.3 Maternal, household and community factors associated with experiencing single ACE exposures 50
3.3.4 Maternal, household and community factors associated with cumulative ACEs 55
3.4 Discussion 56
3.4.1 Prevalence of ACEs 57
3.4.2 Childhood factors 58
3.4.3 Inter-relation and co-occurrence of ACEs 59
3.4.4 Strengths and limitations of study 60
3.5 Conclusion 61
Chapter 4 : Identifying underlying adverse childhood experience typologies in the Birth to Twenty Plus Cohort: A latent class analysis 62
4.1 Introduction 63
4.2 Methods 64
4.2.1 Study design and context 64
4.2.2 Participants/Study population 64
4.2.3 Measures 65
4.2.4 Statistical analysis 65
4.3 Ethics 66
4.4 Results 66
4.4.1 Characteristics of the sample and prevalence of ACEs 66
4.4.2 Interrelation and co-occurrence of ACEs 69
4.4.3 Exploratory Factor analysis 71
4.4.4 Latent class analysis 73
4.5 Discussion 77
4.5.1 Strengths and limitations of study 79
4.6 Conclusion 80
Chapter 5 : Stress begets stress: The association of adverse childhood experiences with psychological distress in the presence of adult life stress 81
5.1 Background 82
5.2 Methods 84

5.2.1 Data and study population 84
5.2.2 Measures 84
5.2.3 Statistical analysis 86
5.2.4 Ethics 88
5.3 Results 88
5.3.1 Descriptive analysis 88
5.3.2 Missing data 91
5.3.3 Reporting of individual GHQ subscales 91
5.3.4 Regression analyses 93
5.3.5 Hierarchical logistic regression 100
5.4 Discussion 104
5.4.1 Strengths and limitations 107
5.5 Conclusion and future implications 108
Chapter 6 : The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa 109
6.1 Background 110
6.2 Methods 112
6.2.1 Study design and setting, and participants 112
6.2.2 Inclusion and exclusion criteria 113
6.2.3 Ethics approval 114
6.2.4 Variables 114
6.2.5 Statistical analysis 117
6.3 Results 119
6.3.1 Unadjusted regression analysis 120
6.3.2 Adjusted analysis 123
6.3.3 Structural Equation Model Analysis 126
6.4 Discussion 131
6.4.1 Study strengths and limitations 134
6.5 Conclusion 135
SECTION 3: GENERAL DISCUSSION 136
Chapter 7 : Discussion and Conclusion 137
7.1 Summary of key results 138
7.2 Emerging themes and their implications 142

7.2.1 ACE measurement tools may need to be modified 142
7.2.2 Clustering of ACEs and comorbidities 143
7.2.3 The household and community environment, ACEs and mental illness 144
7.3 Conceptual framework 145
7.4 Study strengths and limitations 147
7.5 Implications of research and next steps 148
7.5.1 Implications for research 148
7.5.2 Implications for policy and programs 149
7.6 Conclusion 151
REFERENCES 152
APPENDICES 166
Appendix 1: M. Manyema, S. A. Norris, R. Said-Mohamed, S. T. Tollman, R. Twine, K. Kahn, L. M. Richter. The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa. Health and Place. 2018; 51:97-106. 167
Appendix 2: M. Manyema, S. A. Norris, L. M. Richter. Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress. BMC Public Health. 2018; 18:35. 178
Appendix 3: Mercy Manyema, Linda M Richter. Adverse childhood experiences: prevalence and associated factors among South African young adults. Heliyon.2019; 5:12, e03003 191
Appendix 4: Declaration of Student's contribution to article and agreement of co-authors 202
Appendix 5: Original ACE Questionnaire 206
Appendix 6: Modified ACE Questionnaire 208
Appendix 7: Birth To Twenty Plus Young Adult Survey Core Questionnaire 210
Appendix 8: Childhood Factors Questionnaire Extracts 219
Appendix 9: Ethics Clearance Certificate 224

List of Tables

Table 1.1 Objectives, research questions and hypotheses 25
Table 2.1 Overview of the data analysis plan 34
Table 3.1 Prevalence of ACEs and demographic factors of participants surveyed in the 22-23 year wave of the Bt20+ survey, Soweto, South Africa, n=1636 45
Table 3.2 Comparison of demographic characteristics between YAS participants with ACE data and those with missing ACE data 49
Table 3.3 Adjusted childhood factors associated with individual abuse and neglect ACEs in the Bt20+ Study, Soweto, South Africa, n=1223 51
Table 3.4 Adjusted childhood factors associated with individual household dysfunction ACEs in the Bt20+ Study, Soweto, South Africa, n=1223 53
Table 3.5 Unadjusted and adjusted association of childhood factors with cumulative ACE score indices in the Bt20+ Study, Soweto, South Africa, n=1223. 55
Table 4.1 Descriptive statistics of the YAS sample, n=1636 67
Table 4.2 Factor loadings for the exploratory factor analysis of 13 individual ACEs in the Bt20+ Study 72
Table 4.3 Relative measures of fit class enumeration for latent class analyses 73
Table 4.4 Comparison of the latent classes with the ACE sum score 75
Table 4.5 Ordered logistic unadjusted and adjusted regression results of childhood factors associated with latent classes 76
Table 5.1 Prevalence of ACEs and demographic characteristics of the sample, n=1223 88
Table 5.2 Separate and cumulative effects of ACEs on adult life stress 93
Table 5.3 Separate effects of ACEs on PD 96
Table 5.4 Association between ACEs and the different PD subscales 98
Table 5.5 Hierarchical regression results: ACEs as binary exposure 101
Table 5.6 Hierarchical regression results: ACEs as a three-category exposure 102
Table 6.1 Questionnaire items used to measure exposure to violence and experience of adults stress events 115
Table 6.2 Distribution of individual, household and contextual factors by urban and rural status 119
Table 6.3 Unadjusted associations between the psychological distress (outcome) and contextual, household and individual exposure variables 121
Table 6.4 Unadjusted associations between contextual, household and demographic exposure variables 122
Table 6.5 Adjusted analysis 124
Table 6.6 Generalised structural equation model results for the final models by site. 129
Table 6.7 Model fit statistics 131
Table 7.1 Overview of key results 140

Table of Figures

Figure 1.1 A bio-developmental framework for understanding the origins of disparities in learning, behaviour, and health (adapted from Shonkoff et.al)(23) 13
Figure 1.2 The ACE pyramid (62)..... 14
Figure 1.3 The extended ACE pyramid: mechanisms by which adverse childhood experiences influence health and well-being throughout the lifespan (63)..... 15
Figure 1.4 Interacting layers of ACE and trauma exposure 17
Figure 1.5 Conceptual framework..... 23
Figure 2.1 Map of Soweto 29
Figure 2.2 Maps of Agincourt, Bushbuck Ridge, Mpumalanga, South Africa (1) 32
Figure 3.1 Flow chart describing the process for obtaining the analytic sample among participants in the 22-23 year wave of the Bt20+ survey, Soweto, South Africa. 44
Figure 3.2 Proportion of young adults experiencing a minimum number of ACEs..... 48
Figure 4.1 Proportion of young adults reporting additional ACEs given the presence of each of the ACEs in the abuse and neglect group 69
Figure 4.2 Proportion of young adults reporting additional ACEs given the presence of each ACE in the household dysfunction group. 70
Figure 4.3 Scree plot of Eigen values after performing iterated principal factor analysis. 71
Figure 4.4 Item response probabilities for the ACE exposures in the four class solution..... 74
Figure 5.1 Conceptual framework for the hierarchical regression 87
Figure 5.2 Number of participants reporting each of the GHQ subscales stratified by their experience of at least one ACE..... 92
Figure 6.1 Conceptual framework for the analysis..... 118
Figure 6.2 Rural GSEM model..... 126
Figure 6.3 Urban GSEM Model 127
Figure 6.4 Pooled GSEM model 128
Figure 7.1 Revised conceptual framework..... 146

List of Appendices

Appendix 1	M. Manyema, S. A. Norris, R. Said-Mohamed, S. T. Tollman, R. Twine, K. Kahn, L. M. Richter. The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa. Health and Place. 2018; 51:97-106.
Appendix 2	M. Manyema, S. A. Norris, L. M. Richter. Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress. BMC Public Health. 2018; 18:35.
Appendix 3	M. Manyema, L. M Richter. Adverse childhood experiences: prevalence and associated factors among South African young adults. Heliyon.2019; 5:12, e03003
Appendix 4	Declaration of student's contribution to article and agreement of co-authors
Appendix 5	Original ACE Questionnaire
Appendix 6	Modified ACE Questionnaire
Appendix 7	Birth to Twenty Plus Young Adult Survey Core Questionnaire
Appendix 8	Childhood Factors Questionnaire Extracts
Appendix 9	Ethics Clearance Certificate

List of Abbreviations

ACE	Adverse childhood experiences
CDC	Centres for Disease Control and Prevention
CA	California
SSA	Sub-Saharan Africa
LMIC	Low to middle income country
NCD	Non-communicable disease
ECD	Early childhood development
SDG	Sustainable development goals
Bt20+	Birth to Twenty Plus Study
BTT	Birth to Ten Study
EFA	Exploratory factor analysis
LCA	Latent class analysis
SASH Study	South African Stress and Health Study
GHQ-28	General Health Questionnaire 28
PD	Psychological distress
SES	Socioeconomic status
ANOVA	Analysis of variance
BMI	Body mass index
LCT	Life course theory
YAS	Young Adult Study
HDSS	Health and Demographic Surveillance System

HIV	Human Immunodeficiency Virus
GSEM	Generalized structural equation model
DALY	Disability-adjusted life years
PTSD	Post-traumatic stress disorder
WHO	World Health Organization
SEM	Structural equation modelling

Thesis Materials

In the process of completing this PhD thesis, the research was reported and published in several scientific publications in international, peer-reviewed journals, and presented on various platforms. Copies of the peer-reviewed publications are in Appendices one to three.

Peer-reviewed publications

1. M. Manyema, S. A. Norris, R. Said-Mohamed, S. T. Tollman, R. Twine, K. Kahn, L. M. Richter. The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa. *Health and Place.* 2018; 51:97-106.
2. M. Manyema, S. A. Norris, L. M. Richter. Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress. *BMC Public Health.* 2018; 18:35.
3. M.Manyema, L.M Richter. Adverse childhood experiences: prevalence and associated factors among South African young adults. *Heliyon.*2019; 5:12, e03003

Student's contribution to publications

The student was principally responsible for conducting the literature searches for all manuscripts, conceptualization of the papers, data management, statistical analyses and writing of the manuscripts. Guidance on the methods and data analysis was provided by the supervisors and co-authors, who also reviewed manuscript drafts. All co-authors other than the supervisors have agreed to the scientific papers being presented in the PhD thesis (Appendix 4).

Conference proceedings

1. M Manyema, S A Norris, L M Richter. Identifying underlying adverse childhood experience (ACE) typologies in the Birth to Twenty Plus Cohort**.** *Oral presentation:* **The African Regional Child Trauma Conference** August 2019, Cape Town, South Africa
2. M Manyema, S A Norris, L M Richter. What are the challenges and opportunities in creating a child-centered society based on the adverse childhood experiences (ACEs)

research done in South Africa? *Oral presentation and Panel Chair*: **11th Drama for Life Conference & Festival: Creating a Child-Centered Society** August 2019, Johannesburg, South Africa.

3. M Manyema, L M Richter. Monsters out of the closet: Reporting of adverse childhood experiences among South African young adults. *Oral Presentation***: University of the Witwatersrand School of Public Health Research Day** October 2018, Johannesburg, South Africa. (Awarded Best Student Oral Presentation).
4. M Manyema, S A Norris, L M Richter. Adverse childhood experiences research: A springboard of hope. *Oral presentation***: University of the Witwatersrand National Science Week** August 2017, Johannesburg, South Africa. (Semi-final round)
5. M Manyema, S A Norris, L M Richter. The association between adverse childhood experiences and psychological distress in young adults. *Oral presentation***: Public Health Association of South Africa Conference** September 2017, Johannesburg, South Africa.
6. Manyema M, Norris S A, Said-Mohamed R, Kahn K, Tollman S T, Richter L M. Violence and psychological distress among rural and urban adolescent girls: a structural equation modelling analysis. *Poster Presentation:* **University of the Witwatersrand Faculty of Health Science Research Day** September 2016, Johannesburg, South Africa. (Awarded Best Student Poster).

Other Publications

A tough childhood has a long-term effect on health. Business Day 6 March 2019 (2).
https://www.businesslive.co.za/bd/life/2019-03-06-a-tough-childhood-has-a-long-term-effect-on-health/

ACE study shows that physical and mental illnesses in adults can be linked to abuse suffered while young

US-based pediatrician Nadine Burke-Harris had a glut of attention deficit hyperactivity disorder (ADHD) cases at the clinic where she worked in Bayview, a poor area in San Francisco. She felt in her bones that these cases didn't come out of the blue, and were directly linked to high levels of toxic stress in the community.

Toxic stress, experienced through consistent exposure to violence, abuse and the consequences of poverty and inequality, has a lasting effect on the brain, notably in the way it perceives and processes stress. Burke-Harris asked herself whether the cause of the children's ADHD symptoms was not a mental disorder, but a biological process that worked on the brain to disrupt normal functioning.

"Twenty years of medical research has shown that childhood adversity literally gets under our skin, changing people in ways that can endure in their bodies for decades. It can tip a child's development trajectory and affect physiology. It can trigger chronic inflammation and hormonal changes that can last a lifetime. It can alter the way DNA is read and how cells replicate, and it can dramatically increase the risk for heart disease, stroke, cancer, diabetes — even Alzheimer's," she writes in her book *The Deepest Well: Healing the Long-Term effects of Childhood Adversity.*

Using the Adverse Childhood Experiences (ACE) test, Burke-Harris and her colleagues found a way to screen for toxic stress, and to quantify and interpret data. The test, which was formulated by Vincent Felitti, the head of Kaiser Permanente's department of preventative medicine in San Diego, asks 10 questions and for every yes, one point is given. Higher scores are often correlated with poorer health.

Felitti formulated the test to delve deeper into his anecdotal findings that obesity in adults was linked to experiences of childhood sexual abuse. His questionnaire was based on information provided by 17,377 participants and is seen as substantial enough to be applied across numerous settings. Questions include topics such as physical and emotional abuse, whether the individual's parents were separated or divorced, and whether a member of the household went to prison (see below for full questionnaire).

Community impact

Burke-Harris expanded the original questionnaire to include questions about community violence, homelessness, discrimination, foster care, bullying, repeated medical procedures or life-threatening illness, death of a caregiver, loss of a caregiver to deportation or migration, and, for youth, verbal or physical violence from a romantic partner and youth incarceration.

Zimbabwean researcher Mercy Manyema of the DST-NRF Centre of Excellence in Human Development, based at Wits School of Public Health, concurs with Burke-Harris that adversity

affects biological processes and is a plausible cause of illnesses that involve the cardiovascular, immune and endocrine systems.

“Higher levels of the stress hormone corticosterone affect the function of other hormones and body systems,” said Manyema. Manyema’s research, conducted with Linda Richter and Shane Norris in 2018, showed that a high proportion of the young adults studied were exposed to adverse childhood experiences.

Ninety percent said yes to one of the questions and 15% said yes to four questions. A score of four or more is associated with an increased risk of suicide attempts, lifetime depressive disorders and poor mental health. Alcohol misuse was also higher. Those who experienced six or more ACEs had nearly eight times greater odds of mental illness in adulthood. The average number of ACE scores in the SA study was three.

The study, which expands the original ACE questions from 10 to 13 to include chronic illness, unemployment and death of a caretaker (in light of SA’s HIV/Aids prevalence and high income inequality and poverty), revealed that the cohort have higher ACE scores than those studied in England and Wales (46% and 47% suffered at least one ACE and 8.3% and 14% experienced four or more) and Brazil (85% experienced at least one).

Manyema cites the work of Rachel Jewkes, who shows that just over half of women and men in rural areas experience emotional abuse. “ACEs pose a significant public-health threat, particularly in low- and middle-income countries,” says Manyema. She notes that the illnesses associated with higher ACE scores are entirely preventable. “The ACE scores are a fairly new tool, and so it isn’t a mandatory test in hospitals and child-care centres. We know, however, that the best time to intervene is in early childhood. Our research starts the conversation about the link between early adversity and poor health in adulthood, and informs policy across many sectors, including criminal justice, education, health and social development.”

A solid intervention, notes Manyema, is the building of resilience through strong social relationships. Resilience is evident when a person feels they have a degree of control over their circumstances and a strong ability to self-regulate. “Overwhelming research shows that at least one caring and supportive relationship between a child and a caregiver is critical. This insight can inform a number of interventions, she says.

The ACE study questionnaire

The original questions are:

1. Did a parent or other adult in the household often swear at you, insult you or put you down, or humiliate you or act in a way that made you afraid you might be physically hurt?
2. Did a parent or other adult in the household often push, grab, slap or throw something at you?
3. Did an adult or person at least five years older than you ever touch or fondle you or have you touch their body in a sexual way? Or attempt or actually have oral, anal or vaginal intercourse with you?
4. Did you often feel that no-one in your family loved you or thought you were important or special? Or that your family didn't look out for each other, feel close to each other, or support each other?
5. Did you often feel that you didn't have enough to eat, had to wear dirty clothes and had no-one to protect you? Or that your parents were too drunk or high to take care of you or take you to the doctor if you needed it?
6. Were your parents ever separated or divorced?
7. Was your mother or stepmother often pushed, grabbed, slapped, or had something thrown at her? Or sometimes kicked, bitten, hit with a fist or hit with something hard? Or repeatedly hit over at least a few minutes or threatened with a gun or knife?
8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?
9. Was a household member depressed or mentally ill, or did a household member attempt suicide?
10. Did a household member go to prison?

Funding and Awards

1. DST-NRF Centre of Excellence in Human Development Doctoral Bursary (2017, 2018 and 2019).
2. African Early Childhood Network (AfECN) Research Fellowship (2018 and 2019).

Abstract

Background

ACEs have gained increasing prominence in the public health arena with evidence emerging that they are highly prevalent, interrelated and associated with a range of adverse health and social outcomes. ACEs as a set of exposures was first defined by the ACE Study, a collaboration between the Centres for Disease Control and Prevention (CDC) and the Kaiser Permanente's Health Appraisal Centre, Department of Preventive Medicine in San Diego, California. Many adverse health outcomes have been strongly associated with ACE experience, though evidence is scarce in low-and-middle income countries due to unavailability of data. This study therefore set out to: (i) determine the prevalence of ACEs in a South African population and the childhood factors that may influence the experience of ACEs; (ii) investigate the presence and extent of interrelatedness and clustering of ACEs in the young adult population; (iii) determine the association between ACEs and psychological distress as an index of mental well-being; and finally (iv) explore the differences in the prevalence of psychological distress between a rural and urban population, and investigate the role of interpersonal violence, household stress and community danger in this relationship.

Methods

Data for this study came from a birth cohort in Soweto, Johannesburg in South Africa. The cohort has been followed up since 1990, in what is now the Birth to Twenty Plus Study (Bt20+). Adverse childhood experiences (ACEs) were measured retrospectively at 22 years of age using a modified ACE questionnaire. The prevalence of ACEs in the sample was determined, as well as childhood factors associated with experiencing ACEs. In the next step, the presence of underlying ACE typologies was investigated using latent class analysis. Thirdly the association between ACEs and psychological distress in the presence of contemporary stress was investigated using hierarchical regression methods. Finally, the experience of psychological distress in the urban Bt20+ cohort was compared to that of a rural population sampled from the MRC/Wits-Rural Public Health and Health Transitions Unit (Agincourt), a health and socio-demographic surveillance system based in Northeast South Africa, in the province of Mpumalanga. Only females were included in this last step of the study and data on violence and household stress were also included in the analyses. The impact of ACEs on psychological distress could not be assessed in the rural sample due to unavailability of data.

Results

Regarding the prevalence of experiencing at least one ACE in the Bt20+ cohort, 88% reported at least one ACE. Over one third of respondents reported experiencing four or more ACEs and 15% experienced 6 or more ACEs. Of the childhood factors investigated, higher household socio-economic status (SES) at 16 years of age and maternal marital status reduced the odds of ever experiencing ACEs as well as experiencing multiple ACEs. A high degree of co-occurrence was detected with many ACE exposures increasing the risk of experiencing others. Four distinct latent clusters of ACEs were identified: class one the "Low ACE" class, class two "Low abuse and neglect, medium household dysfunction", class three "High emotional abuse and neglect, low household dysfunction" and class four "High emotional abuse and neglect, high household dysfunction". Once again household socio-economic status at 16 years of age was an important factor influencing class membership. The proportion of participants in the Bt20+ cohort with psychological distress (PD) was 28%. Approximately 50% of those who had PD reported experiencing at least four ACEs, compared to 30% of those who had no PD, and 25% reported six or more ACEs, compared to 11% of those who did not have PD. Compared to those who experienced low levels of ACEs, participants who reported high ACE levels had nearly twelve times greater odds of experiencing high levels of adult stress. Interaction analyses showed that high levels of adult life stress increase the likelihood of PD by over 20 times compared to no stress, in the absence of ACEs. However, both low and high levels of ACEs had a significantly different effect in individuals with high adult stress compared to those with no adult stress. In the comparison analyses, the urban sample had higher levels of PD, interpersonal violence (IPV), household stress and community danger compared to the rural young women. A direct association between IPV and PD was observed in the urban young women independent of household stress, SES, community danger and demographic factors. Rural residents showed much greater sensitivity to the effect of household stress compared to the urban residents.

Conclusions

ACEs are highly prevalent and interrelated in this cohort of young adults. SES is an important factor in the experience of ACEs. The association between ACEs and PD is strong and the effect of ACEs needs to be considered in assessing mental well-being. The study of ACEs needs to account for the fact that they seldom occur alone. The interplay between ACEs and mental health

and contemporary stress means the management of psychological distress needs to extend beyond current events and stressors. Further research is needed to assess if there is a difference in ACE experience in rural and urban environments and if this differentially impacts mental well-being.

Preface

"Children's exposure to adverse childhood experiences is the greatest unaddressed public health threat of our time", **Robert W. Block**

After completing my Master's degree in Epidemiology at the University of the Witwatersrand in 2013, I was looking for opportunities to begin studying for a PhD. My research interests included non-communicable disease (NCD) and social determinants of health. After attending a presentation by Prof Shane Norris on the Birth to Twenty Plus Study (Bt20+), my interest was piqued by the availability of longitudinal data on NCD risk and prevalence, and the wealth of knowledge that could be gained from the Bt20+ cohort. In 2014 I met Prof Linda Richter who was part of the original investigator group of the Bt20+ Study, and whose work has a strong focus on early childhood development and the effects of adversity on children and families.

Three years, many discussions and copious amounts of literature later, my quest for a PhD research area culminated in the topic of adverse childhood experiences and their effect on adult health. I was excited by the great potential of longitudinal data available in the Bt20+ Study, the opportunity to gain further expertise in NCD, particularly mental illness, and how it is impacted by early life factors. It was also a privilege to work with two distinguished researchers whose expertise is recognised world-wide and I am grateful for the catharsis this PhD journey has proved to be.

Although we initially started with the aim to explore the impact of ACEs on several NCD outcomes, I eventually narrowed the outcomes down to mental well-being after extensive literature searches and seeing a largely untold story in that domain in South Africa. I developed my protocol, applied for ethics clearance and began the painstaking task of data cleaning and analysis. This body of work was put together through the publication route comprising three academic papers, and is presented here in the divided block format. I have also included analyses that have not been published yet.

The thesis comprises three broad sections: the introduction which has two chapters, gives the background to the study and the research gaps it seeks to address as well as the conceptual

framework informing the analyses. A description of the study methods, context and setting, and background to the Bt20+ Study is delineated. Section Two has four chapters that present the empirical results. Chapters 3, 5 and 6 have been published while Chapter 4 is not. Chapter 3 sets the scene by presenting a picture of the burden of ACEs in the Bt20+ cohort and providing an indication of child, maternal and household factors that may be associated with the experience of ACEs. In Chapter 4, the ACEs are further characterised, not by a-priori categories but by exploring latent unmeasured clusters in the population which may be useful in formulating context-specific interventions. Chapter 5 delves into the association of ACEs and mental health outcomes. Using psychological distress as an index of mental well-being, the relationship between ACEs and psychological distress and current household stress is explored using hierarchical regression. Possible interaction between the experience of ACES and contemporary stress is also investigated. The last chapter of Section Two, contrasts the prevalence of psychological distress between a rural and urban population and how this is impacted by violence and household stress.

The final section of the thesis is the discussion. This part of the thesis assesses whether the objectives of the study have been met and how adequately the research questions have been answered. Themes that have emerged in the study are explored and reflected upon in order to evaluate how the evidence generated added to the extant body of knowledge. The limitations of the study are discussed and further directions for future research are explored.

Thesis outline

SECTION 1: INTRODUCTION

Chapter 1 Background and literature review

Chapter 2 Methods

SECTION 2: RESULTS

Chapter 3 Adverse childhood experiences: prevalence and associated factors among South African young adults

Chapter 4 Identifying underlying adverse childhood experience typologies in the Birth to Twenty Plus Cohort: A latent class analysis

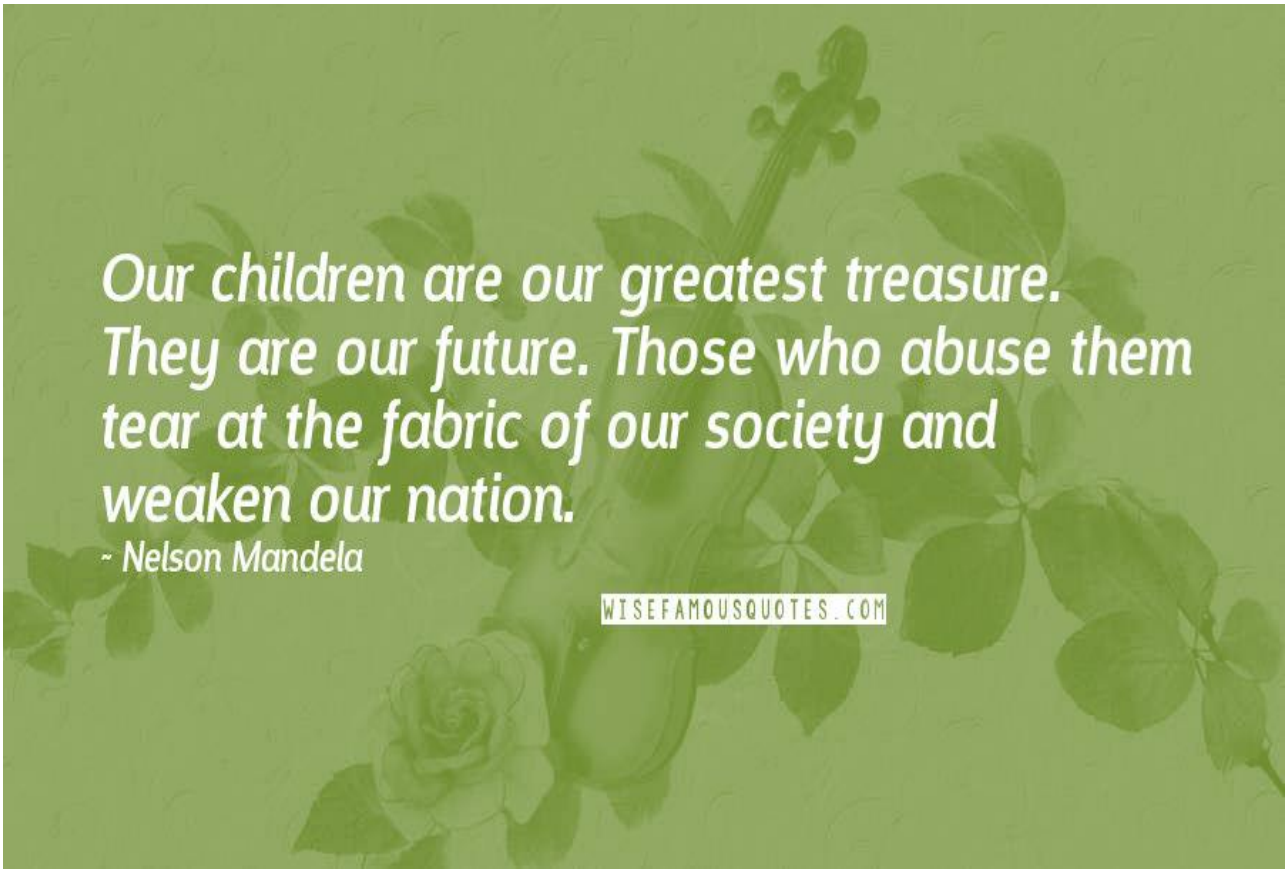
Chapter 5 Stress begets stress: The association of adverse childhood experiences with psychological distress in the presence of adult life stress

Chapter 6 The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa

SECTION 3: GENERAL DISCUSSION

Chapter 7 Discussion and conclusions

SECTION 1: INTRODUCTION



Chapter 1 : Background and Literature Review

1.1 Background

Adverse childhood experiences (ACEs) are incidents or exposures that happen in childhood within a child's household or social surroundings that can potentially cause damage or suffering and subsequently disrupt the child's neurological, physical or psychological development (3, 4). The idea of assessing child abuse and related experiences as a group of exposures instead of single isolated events is relatively new (3). ACEs as a set of exposures was defined by the ACE Study, a collaboration between the Centres for Disease Control and Prevention (CDC) and the Kaiser Permanente's Health Appraisal Centre, Department of Preventive Medicine in San Diego, CA (3). These include (but are not limited to) emotional, physical, sexual abuse, emotional, physical neglect and being raised in dysfunctional households, characterised by domestic violence in the household, alcohol and/or drug abuse in the household, members with mental illnesses or exhibit criminal behaviours, and where there is parental separation or divorce (3). This definition of ACEs will be used in this study, in reference to the period between birth and 18 years.

ACEs have gained increasing prominence in the public health arena with evidence emerging that they are both highly prevalent and interrelated (3, 5). A strong dose-response association has been found between ACEs and a myriad of health and social outcomes in adulthood including mental illness and perpetration of violence (6-8).

Data on the prevalence of ACEs and their effect on health are scarce in low-to-middle income countries (LMICs), including sub-Saharan Africa (SSA) (9). The bulk of evidence in extant literature is from high income countries. Not much is known about the interplay between ACEs, mental health and household and community stress and violence in South Africa. This study, therefore, aims to determine the prevalence of ACEs and their impact on mental health in a young adult South African population.

1.1.1 Statement of the Problem

ACEs are common and interrelated. In the original ACE study, 64% of the participants experienced at least one event and the probability of being exposed to any additional one was 86.5% (3). Other studies carried out in high –income countries have reported prevalence rates ranging between 23% - 75% (10-12). Data on the prevalence and impact of ACEs using the

ACE Study definition are scarce in South Africa, not to mention Africa as a whole with most of the evidence in South Africa on focusing single exposures of maltreatment or abuse (13, 14).

A strong, graded association has been shown between ACEs, non-communicable disease (NCD) risk factors and NCDs. The burden of NCDs is increasing in South Africa with NCDs being responsible for 37% of all-cause mortality in the year 2000 (15). Hypertension and excess body weight accounted for 9% and 7% of all deaths respectively (15). The impact of ACEs on these conditions and the influence of other childhood factors has not been explored in South Africa. The role of ACEs in the occurrence of interpersonal violence in South Africa needs further elucidation, in both the perpetrators and the victims. Indications from research suggest that interventions in childhood have the highest impact on adult health outcomes. With limited resources for intervention and treatment, it is important in LMICs to identify target areas of intervention that give the best value. A large proportion of children do not reach their full potential in LMICs and it is every child's right to get a chance to thrive.

1.2 Literature Review

1.2.1 Early childhood: definition and importance

Early child development (ECD) can be described as "the expansion of physical, cognitive, psychological, and socioemotional skills that lead to increased competence, autonomy, and independence" (16). Early childhood is the most rapid stage of development in the human life course, with the years between conception and 8 years of age being significant and essential to the healthy development of children (17). ECD forms the foundation of a full and fruitful and satisfying life and the economic and social progress of society. Research from the neurophysiology field shows that a person has 50% of their intelligence capacity by the of age four and therefore failure to invest in ECD can derail the development of children and inhibit them from reaching their full potential throughout their lives (17). Protecting, promoting and supporting ECD is key to ensuring that the tenets of the Sustainable Development Goals (SDGs) are realized (18).

1.2.2 Early childhood development and the brain

The development of the brain is a key component of ECD and is driven largely by the interaction of genes and the physical, social and biological environments to which the child is exposed (19, 20). The process of brain development begins in week three of gestation and extends through adolescence and possibly throughout the entire lifespan (21). Both the molecular processes of gene expression and environmental input (intrinsic and extrinsic factors) contribute to brain development, interacting to support the progressing events that define normal brain development (21, 22). While genes guide the creation of the specific proteins that are needed for the developmental process, the environment provides essential input that moulds and influences the direction of the developing neural systems (21). Stable early life experiences and environments promote healthy brain development while early adversity characterised by threat, uncertainty, neglect, or abuse may result in disruptions of developing brain circuitry and subsequently greater susceptibility to a multitude of chronic diseases, including mental ill-health (23).

A seminal paper by Black and Greenough explained how the environment can have differential effects on not only the final structure of the brain but also the trajectory of its development (22, 24). The terms “experience-expectant development” and “experience-dependent development” were coined in an attempt to show how both the quality and quantity of environmental stimuli can impact brain development (22). Experience-expectant development comprises “critical periods” when appropriate stimulation is required for normal development, and in which the stimuli have considerably greater impact than when experienced later in life (22). Experience-dependent development on the other hand involves “sensitive periods” of development in which stimuli, such as stress, drugs, toxins, infections and hypoxia, may interfere with development and produce a characteristic effect depending on the timing of the stimuli (22).

Based on the physiological expression of the stress response, stress has been categorised into positive stress (moderate and short-lived), tolerable stress (potentially harmful but buffered by stable social relationships) and toxic stress, characterised by strong and recurrent stimulation of the body’s stress responses (19). Toxic stress can arise not only from children experiencing abuse and neglect ,but also from being growing up in dysfunctional households

where children regularly witness domestic violence or are in close contact with individuals who abuse alcohol and other substances (25).

The distinguishing characteristics of toxic stress are its interference with brain architectural development, its adverse effects on other organs, and the disruption of stress management systems (23). When toxic stress is experienced in the sensitive periods of childhood, the stress-induced changes can possibly have long-lasting consequences on various important biological functions, such as stress regulation, the acquisition of new capabilities, and developing the ability to make healthy adjustments to future hardships (19, 26). Relatively lower stress thresholds are established that continue throughout life, thus increasing the possibility of stress-related disease in the adult years (23). Protecting children from violence, adversity and unsafe environments is essential for stimulating economic growth, enabling transformation and breaking intergenerational cycles of poverty (17).

1.2.2.1 Early childhood in the South African context

There were approximately 18 million children residing in South Africa in 2006 (27). Of these, nearly 12 million lived in households classified as income poor, and most of them in the rural provinces of Limpopo and Eastern Cape (27). The number of children increased to nearly 20 million in 2018 but the highest proportion of children still lived in the provinces with the largest rural proportions (28). Despite the implementations of various interventions since South Africa gained independence, the majority of South African children have insufficient access to key resources that are necessary for optimal early childhood development due to the unequally distributed burden of poverty (29). Research also strongly suggests that children growing up in South African townships are disproportionately affected by poverty and family dysfunction (30).

The poverty dynamics in a household, and in the community can influence the lives of children in the present as well as in the future. Poverty limits the resources available to parents to provide for their children because access to equitable healthcare, education and other opportunities is limited by the available income (31). Many women in South Africa are ate a higher risk of developing depression, which is exacerbated by poverty and living with a depressed parent is not only classified as an ACE, but is directly linked to mental illness in the child (32). Cash transfers as a way to improve household income have been shown to

mitigate the depression effects (32). Stresses involved in earning income to provide for the family make parents less available emotionally for their children (31). Poverty and socio-economic status have been linked with experiencing and witnessing violence by children in the home, the community and in society as a whole (33). Analysis of data from the Drakenstein Child Health Study showed that if the parents themselves, especially mothers, have experienced childhood adversity, this can also increase the risk of poverty and food insecurity in the home (34), creating a vicious cycle that can keep going if no intervention happens.

1.2.3 Prevalence of ACEs worldwide

ACEs have gained increasing prominence as a significant public health concern. Research from the United States of America (USA), Europe, Canada and some African countries show that ACEs are common, with between 50% to over 80% of respondents in various studies reporting at least one ACE before the age of 18 (9, 11-13). In the original ACE Study, 64% of respondents had experienced at least one ACE, with women more likely to report ACEs than men (35). More than 1 in 4 individuals had grown up with substance abuse in the home and at least 20% experienced five or more ACEs (3). In a similar study in Canada, nearly three out of four of the respondents (73%) had experienced one or more ACEs and 37% reported at least two ACEs (12).

In comparison, data from Wales and England show lower rates of ACE reporting. Bellis et.al report 46% of participants experiencing one or more ACEs and just eight percent experiencing four or more in England (36). In a Welsh study, 47% reported at least one ACE and 14% reported experiencing four or more ACEs (25). In the later, nine ACEs were included instead of the original ten.

Data on the prevalence of ACEs as a group of exposures in Sub-Saharan Africa (SSA) are scarce with the majority of evidence coming from single exposures (9). A study examining the impact on adverse childhood experiences on adolescent drunkenness in four African countries found that one out five of the respondents had lived with an alcohol abuser in the household and 18% had been physically abused (37). In Nigeria a study which used a set of adverse experiences primarily from the household dysfunction category such as parental

death, domestic violence and poverty, researchers found that over 40% of the participants had experienced at least one adverse event and 31.2% reported two or more adverse events (9).

In addition to being common, ACEs are also highly interrelated. Dong et.al reported that 81% to 98% of respondents who had experienced one ACE also reported at least one additional ACE in the original ACE study. The odds of having additional ACEs given the presence of one ACE were upwards of 17% (5). The co-occurrence of ACEs also point to their cumulative impact on health and well-being with participants who reported multiple exposures also at increased risk of multiple poor health outcomes (3). In their Nigerian study, Oladeji et.al reported the odds of experiencing an additional ACE of between 44 to 63% (9).

1.2.3.1 ACEs in South Africa

Several studies on childhood adversity have been conducted in South Africa, using a variety of tools to collect adversity data.

Jewkes et.al report, in a study done in rural South Africa, that over 15% of both young boys and girls reported often experiencing emotional neglect, just over 20% experienced emotional abuse and 15% of girls were often sexually abused before 18 years of age (13). In another South African study, 13% of the respondents reported severe physical abuse (7). Prevalence rates of frequent emotional abuse of 20.7% and 16.6% for physical abuse have also been reported (14). In all these studies the abuse and maltreatment exposures have been linked to adverse health outcomes such as suicide attempts, depression and drug and/or alcohol (7, 13, 14).

A recent analysis of South African college-age students by Mall et.al. showed a prevalence of experiencing at least one ACE of 79% (38). The most commonly reported events were bullying, parental mental illness and emotional abuse (38). An older population from the Agincourt subdistrict in Mpumalanga, South Africa reported experiencing parental unemployment (15%), domestic violence (25%), alcohol and substance abuse and mental illness (25%) and physical abuse (35%) (39). Kidman et.al. studied a sample of 250 HIV

perinatally infected adolescents from Soweto and reported nearly 50% of the sample experiencing eight or more adverse events, using the ACE International Questionnaire (40).

In general, 72% reported experiencing emotional abuse, 59% reported physical abuse, 34% experienced sexual abuse, 82% witnessed domestic violence, and 91% were exposed to vicarious community violence (40). The Children's Institute published a report in 2017 that concluded that 'children experience high levels of abuse and neglect in their homes, schools and communities" with many of these cases being unreported (41). These studies confirm that the South African population has fairly high prevalence of child maltreatment.

1.2.4 Epidemiology of ACES

Several factors have been found to contribute to the experience of ACEs. Growing up with economic hardship can undermine several aspects of livelihood including safety, care, resources and opportunities (19). Socio-economic conditions have been implicated as possible mediators or confounders of the link between ACEs and disease, with lower socio-economic status (SES) being associated with worse outcomes (14, 42). A change in SES between infancy and young adulthood has been demonstrated to be protective against high blood pressure in urban South African youths (43). The prevalence of ACEs was found to be higher in low income settings in Saudi Arabia but the strength of association with risky behaviour remained similar between low and high income settings (44).

Social disorganisation theory suggests that poor neighbourhoods with ethnic heterogeneity and residential instability do not have the resources to support community involvement and the transmission of pro-social values to children (45, 46). Community danger or the perception of it, which can be a sign or a cause of social disorganisation, has been linked to the experience of ACEs, the experience of violence in adulthood as well as mental health. It is one of the community-level factors that has been shown to mediate the relationship between ACEs and mental health. Neighbourhood crime was shown to moderate the association between child maltreatment and mental in a study by Lowe et.al. (47). Participants who had experienced maltreatment in childhood and lived in high crime neighbourhoods were at a higher risk of major depression and PTSD (47). Unsafe

neighbourhoods may also influence ACE and child maltreatment prevalence by eroding trust among members, and lack of shared responsibility and willingness to solve problems collectively (46). Research reveals that mothers' high community involvement and a positive perception of community social control significantly reduced the odds of physical and psychological assault, as well as the punishment of children (45). Perceptions of community danger have also been linked with the experience of other types of child abuse (48).

1.2.5 ACEs and public health

ACEs have been associated with a multitude of health and behavioural outcomes.

1.2.5.1 ACEs and health risk behaviour

Studies carried out in both LMICs and high-income countries show that people who reported adversity in childhood had a higher risk of being involved in risky health behaviour later on. In Saudi Arabia, adults who had experienced at least four ACEs had an 8-21 fold higher risk of engaging in smoking, alcohol and other substance abuse (44). Bellis et.al reported that compared to Welsh adults who had experienced no ACEs, those who experienced four or more ACEs had 15 times greater odds of committing interpersonal violence, 16 times more likely to have abused drugs and 20 times more likely to have been in jail at some point in their lives (25). In rural South Africa, emotional neglect increased the risk of suicide five-fold and risk of alcohol abuse two-fold among young women while in young men it increased the risk of drug abuse two-fold (13).

1.2.5.2 ACEs, non-communicable disease (NCD) risk factors and non-communicable diseases

The accumulation of ACEs increases the risk of chronic disease risk factors such as obesity and hypertension as well as the risk of NCDs like cancer and diabetes. Overall childhood adversity significantly predicts central obesity in adulthood though association with body mass index (BMI) varies (49, 50). Research has also shown that childhood maltreatment is associated with faster BMI growth in children, as well as significantly higher baseline and adolescent BMI levels (50). Blood pressure trajectories have been shown to rise faster in those who experienced early adversity compared to those who did not, pointing to the

longitudinal effect of ACEs on health (10). The risk of ischaemic heart disease increases by 1.3- to 1.7-fold and diabetes mellitus by 1.3 fold in those who experienced ACEs compared to those who did not (51, 52). In the Welsh ACE Study, 24.9% of individuals with four or more ACEs reported being diagnosed with one or more chronic diseases compared to 6.9% of those with no adverse experiences (53). The majority of these results are from high-income countries and adult populations.

1.2.5.3 ACEs and mental health

Extant literature suggests that ACEs increase the risk of poor mental health in adulthood. Associations have been observed between ACEs and perceived well-being, psychological distress, self-reported depression, anxiety and mood disorders. In American young adults the risk of psychological distress and depression more than doubled in those who reported childhood stress (42). Approximately four out of every ten Welsh adults who experienced four or more ACEs reported poor mental wellness, compared to 14% of those with no experience of ACEs (54). In the South African study by Jewkes et.al, the risk of depression doubled in young people who had experienced emotional neglect and sexual abuse in childhood (13). In another South African study, the rate of suicide attempts more than doubled from 1.9% among adolescents with no ACE to 6.3% among adolescents with more than five ACEs (7). The influence of ACEs on mental health observed in high-income countries may be similar or even less than that in low-income countries.

1.2.5.4 ACEs, violence and mental health in adulthood

The effect of ACEs on the experience as well as perpetration of violence, and their consequent effect on mental well-being has long been documented. Childhood abuse and adversity is associated with both mental ill health and violence and further abuse in adulthood (55-57). Multiple types of adverse experiences have been found to be associated with not only self-harm behaviours but also interpersonal violence-related acts such as criminal behaviors, intimidation and victimization, physical fighting, dating violence, and carrying weapons to school among an adolescent population (58). Machisa et.al have shown that males exposed to childhood maltreatment have a higher risk of perpetration of intimate partner violence (IPV), a relationship mediated by poor mental health in both the

perpetrators and the victims of the violence (57, 59). Evidence also suggests that male-perpetrated IPV may be predicted by both partners' experience of ACEs (55). The effect of ACEs on mental well-being is the focus of this study.

1.2.6 Hypotheses of the link between ACEs and health

The dominant hypothesis of the link between ACEs and later health holds that early life adversity disrupts brain development, leading to dysregulation of a number of biological systems that influence physiological functions such as stress regulation and immune response (23). Temporary adaptations in the functioning of systems such as the neuroendocrine, autonomic, immunologic, and neurophysiological systems that are meant to deal with immediate stress, become harmful when the stress is prolonged (19).

The term *biological embedding* describes the processes by which early life encounters "get under the skin" and biological systems and functions are altered by the environment in a long-term fashion (60, 61). Three co-existent processes have been classified through which early life events become biologically embedded, namely latent effects, pathway effects and cumulative effects (60, 61). Latency refers to exposures that occur between critical or sensitive periods in the developmental process that are related to certain outcomes irrespective of subsequent intervening exposures (60, 61). Pathway effects, also known as chains of risk, refer to exposures at one stage of development that increase the risk of experiencing other exposures later and are linked to health and developmental outcomes (61). Lastly, cumulative effects refer to the build-up of both favourable and unfavourable experiences throughout the life course whose effects come together to result in a range of either health-damaging or health-promoting outcomes depending on their duration, timing and intensity (60, 61).

Several frameworks and models have been put forward in an attempt to better understand how early childhood experiences impact later life outcomes. At the core of all these frameworks is the acknowledgement of the complex interaction between the burden of risk factors and the alleviating effects of protective factors that arise in the individual, family, community and societal spheres (23).

1.2.6.1 Biodevelopmental framework

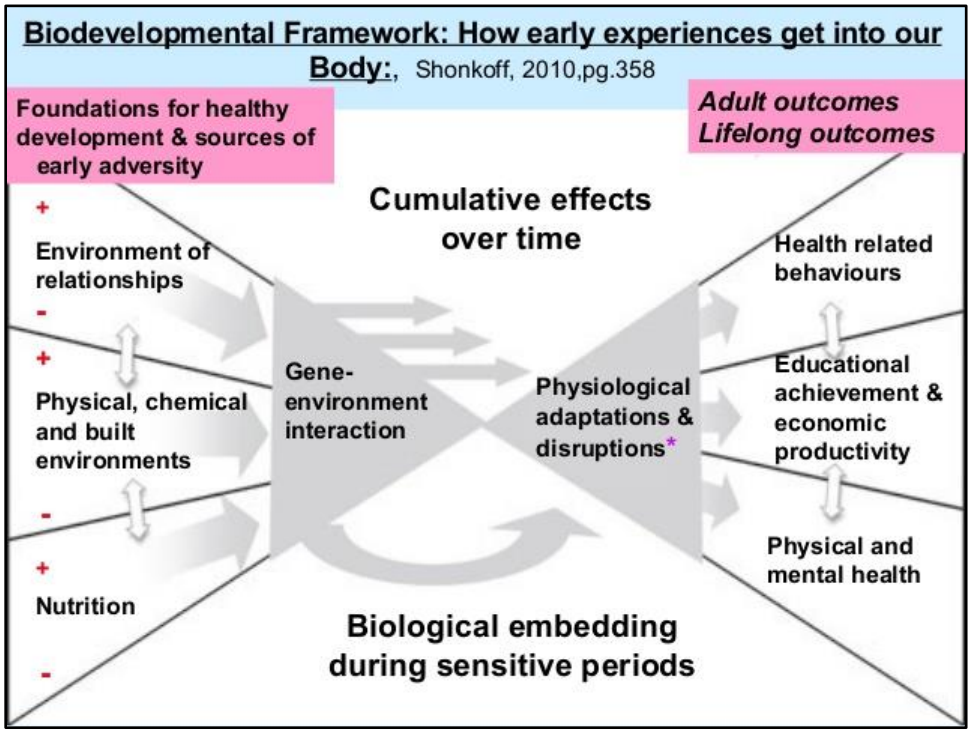


Figure 1.1 A bio-developmental framework for understanding the origins of disparities in learning, behaviour, and health (adapted from Shonkoff et.al)(23)

A rapidly growing body of evidence reveals the extent to which early life events are biologically entrenched in the development of the body's physiological systems, with enduring effects on many biological and psychological processes (23). Research continues to confirm that the underpinnings of healthy development and the establishment of many deficiencies can be traced back to "biological memories'' that are created through the interactions of gene with the environment in the early years of life (23). The bio-developmental framework attempts to conceptualise how early environments interact with the genetic make-up of an individual, leading to physiological adaptations as well as disruptions in various physiological processes and systems which ultimately culminate adult outcomes in health, learning and behaviour. This framework encompasses the entire spectrum of both early life experiences and outcomes, from negative to positive.

1.2.6.2 The ACE pyramid

The ACE pyramid (Figure 1.2 and 1.3) also attempts to conceptualise the processes of how adversity and early experience get under the skin. Rather than the broader view of the bio-developmental framework which looks at both desirable and undesirable effects and outcomes, the ACE pyramid focuses on adverse experiences.

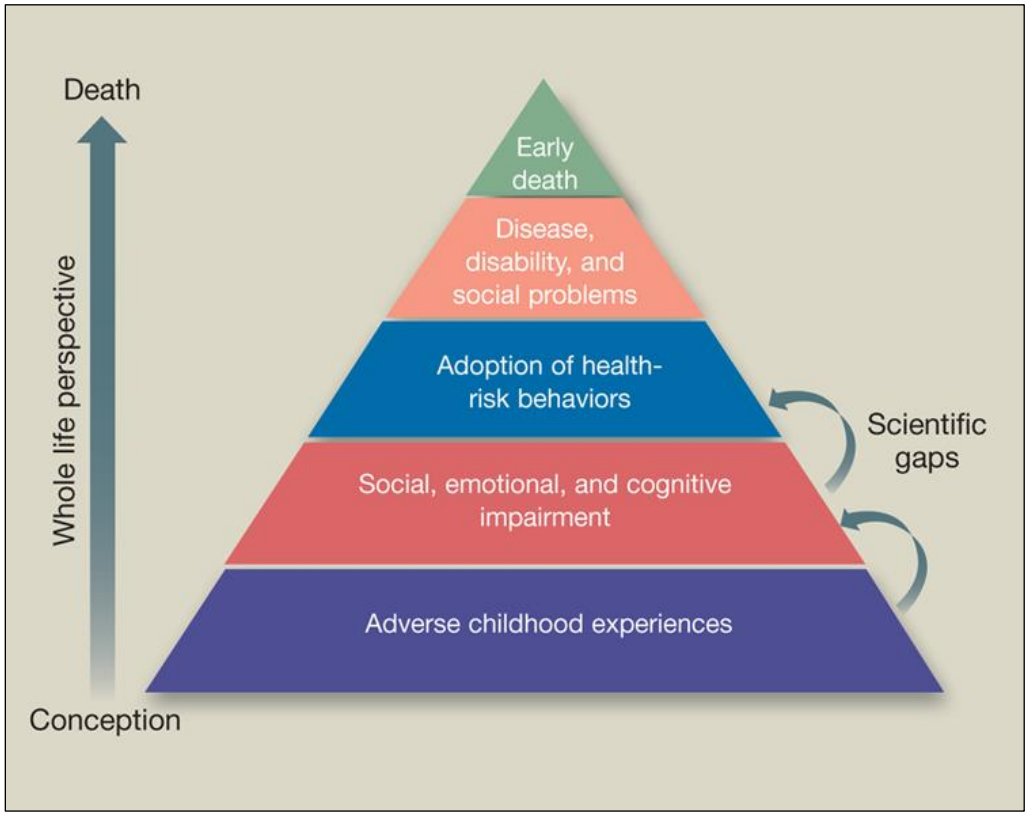


Figure 1.2 The ACE pyramid (62)

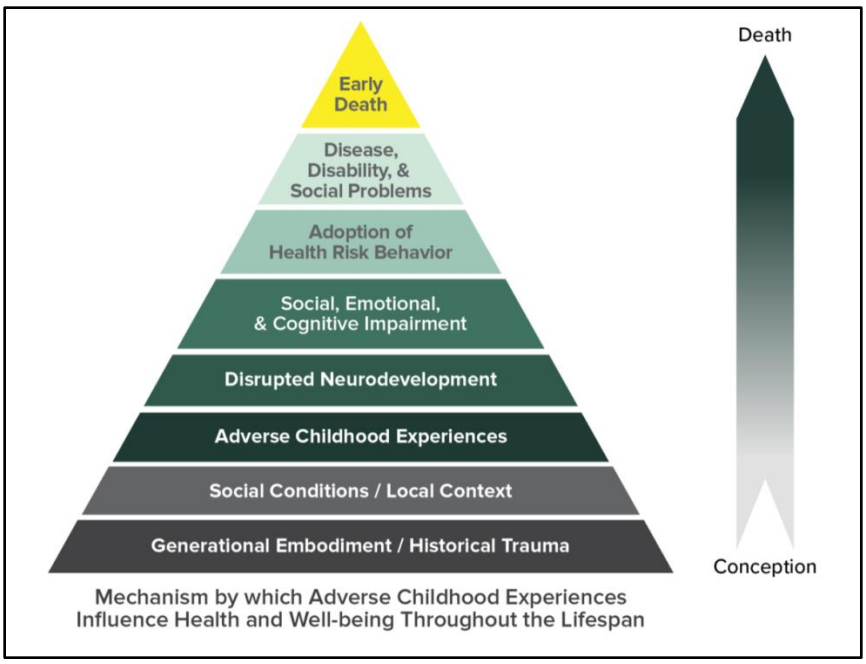


Figure 1.3 The extended ACE pyramid: mechanisms by which adverse childhood experiences influence health and well-being throughout the lifespan (63)

The basic principle of the ACEs pyramid is that toxic stress in childhood may weaken social, emotional and cognitive capabilities which in turn increases the risk of unhealthy behaviours, violence, disability and disease (3). However, subsequent research has shown that ACEs have to do with more than the experience of adversity by an individual. Extra layers have subsequently been added to the pyramid (Figure 1.3) to include the influence of historical trauma and social context, acknowledging the fact that ACEs do not occur in a vacuum (64). Many children are born into already established societal structures and conditions that limit the opportunities available to them and come with inherent inequalities (64).

Historical trauma has gained increasing prominence in the ACEs discourse and it includes issues such as mass displacement, enslavement and other forms of oppression and economic exploitation. It is based on the presupposition that an individual's experiences of life, including adversity, are influenced by dynamics within the community (65). Previously oppressed populations consistently show poorer health outcomes compared to the general population (66). The theory of historical trauma, defined as "collective trauma experienced

by one generation [that] can negatively impact the wellbeing of future generations" (67). This is of particular importance in South Africa because of the history of *Apartheid*. Historical events may result in epigenetic modifications that impact contemporary health outcomes through two possible biological pathways (66, 68). Firstly, because of oppressive historical events, the generation experiencing historical trauma, which I call Generation A, are at a higher risk of experiencing stressors that can induce epigenomic changes, including as low SES, discrimination, and a sense of cultural loss. These stressors can result in the development of poor health and an increase in disease burden. Secondly these changes of the epigenome can be transferred to generation B and subsequent generations (66). It is into this environment of intergenerational trauma that some children are born, and subsequently experience ACEs.

The social context into a which a child is born is essential in the discussion of ACEs because of the established link between biological, social and psychological factors with health and well-being. A study conducted by the RYSE Centre in the USA showed that although ACEs usually occur in the immediate environment, they are couched within the broader context of the community and historical events (Figure 1.4) (69). The lack of supportive adult relationships is the key factor that differentiates tolerable stress from toxic stress (19, 26). Social surroundings that are characterised by lack of safety and economic deprivation fail to provide primary caregivers with the support and scaffolding they need to raise their children, and they may fail to be emotionally available to their children. Emerging evidence is consistently showing that low community socio-economic status and economic disadvantage are associated with higher ACE prevalence (70, 71). Unsafe communities are also ill-equipped to provide adult support outside of the home, which has been shown to buffer against the effects of toxic stress (26). Safe and stable communities are important for strengthening the protective relationships that children need to develop well.

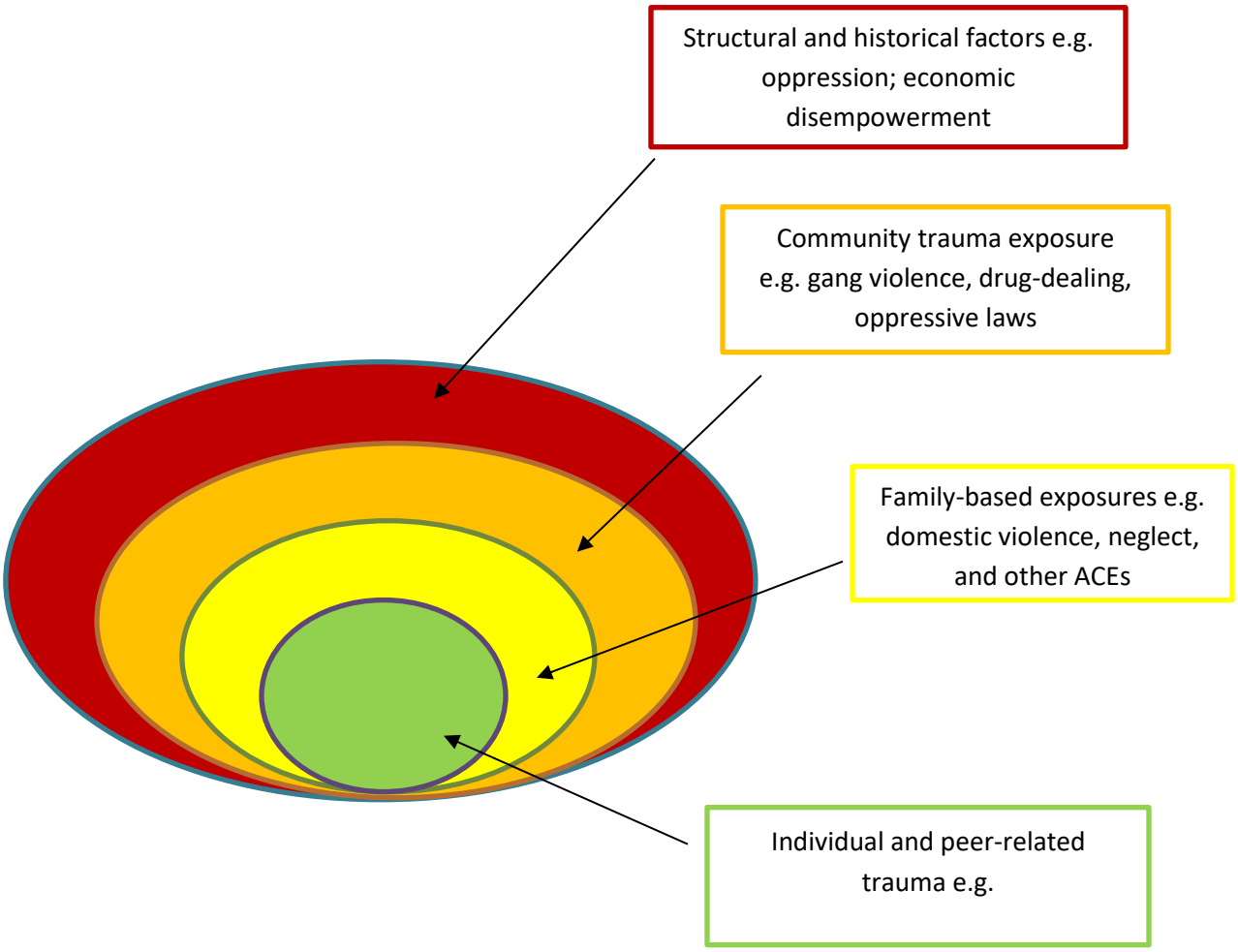


Figure 1.4 Interacting layers of ACE and trauma exposure

1.2.7 Measurement of ACEs

The current ACE scale, as used in the ACE Study, comprises ten exposures and has been shown to be associated with many adulthood outcomes (Appendix 5) (72). This scale however was used with an adult, predominantly Western, educated population. There is strong evidence that other types of adversity not included in this scale may lead to long-standing poor health outcomes (72). Although the original scale remains very important in the investigation of ACES even when many other adversities are considered, it has been

suggested that the ACE scale be expanded in order to capture more context-specific exposures to suit different environments (73).

Several studies have shown the value of not only adding other adversities to the ACE scale, but also removing some that may not be relevant to a particular community (72, 73). Experiences such as peer discrimination, segregation and peer rejection, witnessing or experiencing community violence, and low socioeconomic status have been demonstrated to be important predictors of physical and mental health outcomes (72). Other adversities such as racial discrimination, witnessing violence, living in a dangerous neighbourhood, experiencing intimidation and harassment, and having a history of living in foster care were shown to improve the predictive ability of the ACE scale, especially in a more socioeconomically and racially varied urban adult population (74).

The reliability of the ACE questionnaire, in respect to recall bias, has been questioned. Using the Bt20+ data, a comparison was made between three sources of ACE data: caregiver reports when participants were five to eleven years old, adolescent reports (11 to 18 years) and young adult reports (22 to 23 years), the latter being the data used in this study. The study found that adolescent Bt20+ participants tended to report higher prevalence of physical and sexual abuse compared to both caregiver and young adult reports (75). This may be due to entry into and travel to secondary school, which may expand possible encounters of abuse, or a heightened sense of awareness or egocentrism typical of adolescence (75). The prevalence of ACEs according to young adult reports was similar to that of caregiver reports, especially with regard to the household dysfunction category of ACEs (75). This demonstrated some congruence between prospective and retrospective reports, although the reports by the participants themselves show some differences. Other evidence has indicated that concurrent mental health issues may influence the reporting of retrospective ACEs with participants whose mental health is poor more likely to recall and report childhood adversity (76). Research suggests that minimisation or denial of maltreatment events is likely to occur across any retrospective instrument, and is not specific to the ACE questionnaire (77).

Recall bias may also be influenced by timing of adverse event. The results from Naicker et.al suggest that adverse household events that occurred at young ages are be recalled in young adulthood, but we do not have the same evidence from this data for abuse and neglect experienced at very young ages. However, evidence from the neurosciences tell us that even ACEs experienced at these ages can impact health because they can disrupt brain development in this critical phase (19, 23, 26). Some studies suggest that the younger the age at which ACEs are experienced, the greater the potential impact on health (78). Others have suggested that finding statistically significant associations between ACEs and health outcomes is in itself partial validation of the measure in that population (79).

The ACE questionnaire has been tested for validity and reliability in non-American populations, including a few LMICs. The WHO led a global piloting of the instrument in seven countries namely China, the Former Yugoslav Republic of Macedonia, Philippines, Thailand, Saudi Arabia, South Africa and Vietnam (80). The field-testing reports showed that overall, the questionnaire was acceptable, with simple wording that could be understood in different languages. Suggestions for changes were documented, notably for length of questionnaire (80). A psychometric test conducted in Malawi following this piloting further confirmed the suitability of the ACE questionnaire in LMICs and in an adolescent population. The same factor structure of household dysfunction, abuse and neglect was found in this population with significant correlation between the subdimensions (79). In addition, there was partial agreement between caregiver reports of ACEs and adolescent reports measured using the ACE International Questionnaire (79). Quinn et. al. qualitatively tested the ACE questionnaire for cultural validity in a South African population. Although among a small sample, the study showed the need for some adjustments to the questionnaire for clarity and relevance (81).

ACE studies subsequent to the original Kaiser Permanente Study (82) have used several variations of the ACE scale. Bellis et.al used an assessment tool with nine categories of ACE (36). Their questionnaire excluded emotional and physical neglect and used alcohol abuse and drug abuse as two different categories. The Welsh ACE study similarly used a tool with nine categories (54). Oladeji et.al reported six categories of ACEs (9). In this study we used

thirteen categories of ACE: all ten of the ACE exposures and three additional ones. The questionnaire was also piloted among a selection of the Bt20+ sample before study roll out. In addition, the WHO recommendation to place the questionnaire in between other measures in order to allow rapport with the interviewer before the ACE questions are asked, was followed (80).

1.2.8 ACE Score

To account for the snowballing impact of ACEs on health, an ACE score is calculated for each participant. Based on a ten-item tool, a participant with a score of 10 would have experienced all of the ACEs. Using this measure has shown that a high ACE score increases the risk of adverse outcomes and is also associated with multiple outcomes. Compared to those who experienced no ACEs, respondents who experienced four or more ACEs have consistently been shown to have increased risk of suicide, risky sexual behaviour, alcohol and drug abuse and a number of chronic conditions (3, 25, 36, 53, 54).

1.2.9 Summary of literature review and research gaps

From the literature review we see that safe and nurturing early childhood development is crucial for a happy, healthy and secure society. One of the problems that can disrupt early childhood development are ACEs, adverse events that happen in childhood that can disrupt brain development and consequently the development of other physiological systems.

Evidence from high income countries shows that ACEs are common and are related to poor health and behavioural outcomes. Studies in the neurophysiology field support the hypotheses that have been posited about how ACEs can lead to poor health outcomes in adulthood. Of particular focus is the association between ACEs and poor mental well-being and how violence and stress in adulthood interact with this association. These data are scarce in LMICs.

1.3 Relevance and justification of study

Over 250 million children under the age of 5 in LMICs are at risk of not reaching their full developmental potential because of exposure to adverse early experiences, with most affected children living in south Asia and sub-Saharan Africa (83). Preventing exposure to ACEs in

South Africa is therefore key to ensuring that children develop to their full potential. Research also shows that early intervention can greatly improve the health, cognitive and learning outcomes of children already exposed to ACEs (84). Early identification of children who are at risk of exposure, or who have been exposed to ACEs is therefore necessary and important.

This body of work aims to shed light on the longitudinal impact of ACEs on mental wellbeing and stress in adulthood, thus helping to identify stages at which potential interventions may have their maximum effect. The South African National Integrated Early Childhood Development Policy was approved by Cabinet in late 2015. Evidence from this study may potentially support this policy going into the future, adding to the body of knowledge on the impact of ACEs on early child development in South Africa. It will also add impetus and urgency to the need for South Africa to implement the Nurturing Care Framework, which seeks to provide a safe and conducive environment for children to fully develop their potential (85).

Studying the impact of ACEs on health requires a life course approach. Research on ACEs in LMICs has typically involved studying single exposures from a cross-sectional perspective with little prospective evidence on the longitudinal effect of ACEs on health outcomes (9, 13). The Birth to Twenty Plus (Bt20+) data provides an ideal platform for longitudinal analysis with data collected over the entire 18 years of childhood. The ACEs data from the Bt20+ was collected using the same tool as the original ACEs study enabling some comparisons between similar studies. In this study, I seek to extend knowledge on ACEs using data from a middle-income country and to assess their impact on health and wellbeing in a young adult population. The Bt20+ cohort comprises young adult men and women of mainly African ethnicity residing in an urban setting, which may limit the generalisability of the results to broader populations. However, they may be generalised to young adult urban populations in other middle-income countries and will inform the basis of further work on ACEs in non-Western countries.

Using the relevant statistical techniques, this study explores the potential pathways that link ACEs as a set of exposures to young adult disease, which to our knowledge has not previously been done in a non-Western setting. The study will investigate if ACEs cluster or co-occur in predictable ways in this young adult African population. This information is useful in practice where the presence of a particular exposure in a child should prompt a search for other related

exposures. Evidence of the clustering of ACEs further proves the importance of a multi-sectoral approach to ECD and child safety policy implementation.

It is also important to investigate the influence of community factors on mental wellbeing and the differences in these associations in rural and urban contexts. Apart from the evidence on the impact of neighbourhood context on health in general, several studies have also indicated that there are rural-urban differentials in the experience of ACEs and mental wellbeing. Orsi et.al. report lower prevalence of ACEs in an American rural populations where drug abuse was also less prevalent, compared to urban areas (86). In a study with a similar objectives, participants from major urban areas had greater odds of reporting any maltreatment, and urbanicity modified the association between race/ethnicity, welfare receipt, low parental educational attainment, and disability status and child maltreatment (87). Two pathways have been put forward to explain the association of urbanicity with child maltreatment incidence and prevalence. Firstly, it is possible that there are underlying and unmeasured characteristics that predispose some families to reside in disadvantaged urban communities which put them at risk of experiencing maltreatment (87). Secondly, socio-economic stress influences child maltreatment and it will vary depending on where a neighbourhood is located on the rural-urban continuum (87). Evidence of community comparisons in LMICs is scarce.

1.4 Thesis framework

Figure 1-3 shows the conceptual framework used in this study, based on the ACE pyramid constructed by Robert Anda (3) and the bio-developmental framework devised by Shonkoff et al (23). The key premise of the framework for this study is the life course theory (LCT) which holds that "non-communicable diseases (NCDs) are developed gradually over a lifetime given social, economic, and environmental patterns that are closely linked to community, neighbourhood, and household circumstances" (88). The current framework therefore postulates that ACEs may have an impact on mental wellbeing in young adulthood, a relationship which may be influenced by socio-economic and life stress factors in young adulthood and childhood factors such as socioeconomic status and family structure at birth. Demographic factors such as age and gender may confound this relationship and their role will

be considered in the analysis. The experience and witnessing of violence in young adulthood may also impact mental well-being, as well as the community context.

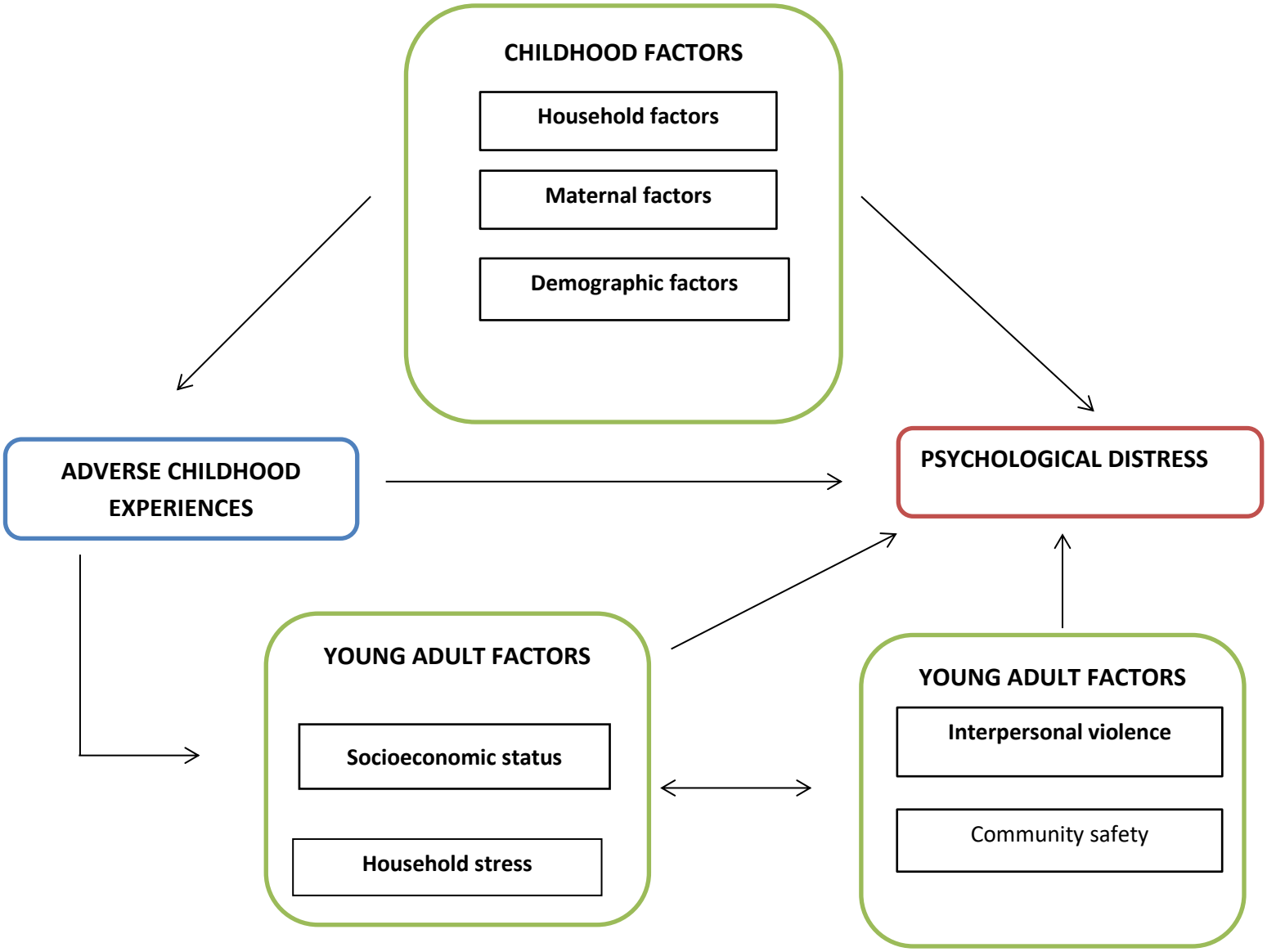


Figure 1.5 Conceptual framework

1.5 Aims and specific objectives

The primary aim of this study is to assess, from a life course perspective, the impact of adverse childhood experiences on health and wellbeing in young adulthood using data from a middle-income country. The study has several specific objectives as presented in Table 1.1.

1.5.1 Research questions and hypotheses

Table 1.1 Objectives, research questions and hypotheses

Objective	Research question	Hypothesis
1. **To determine the prevalence of ACEs in a middle income, predominantly black population and their associations with childhood factors**	a) What is the prevalence of ACEs in an LMIC and predominantly black population? b) What are the associations between childhood factors and ACEs?	a) H0: There are no ACEs in this population b) H0: There are no childhood factors associated with the experience of ACES
2. **To assess the level of co-occurrence and clustering between the ACEs**	Do ACEs co-occur in this population and is there any evidence of clustering in this population?	H0: There is no evidence of ACE clustering in this population
3. **To assess the association between retrospectively reported ACEs and the prevalence of psychological distress among young adults.**	Are ACEs associated with psychological distress in young adulthood?	H0: ACEs are not associated with psychological distress in adulthood
4. **a) Investigate the association of interpersonal violence and mental health among young women residing in rural and**	a) What are the associations between experiencing or witnessing violence and mental well-being in young women?	a) H0: There are no associations between the experience or witnessing of violence and mental well-being in young women

urban locations in South Africa **c) Explore the potential pathways of association between interpersonal violence and PD in urban and rural settings**	b) Are there specific pathways between interpersonal violence and mental health?	b) H0: There are no specific pathways between interpersonal violence and mental health

Chapter 2 : Methods

Overview

This study is a quantitative secondary data analysis of data from the Birth to Twenty Plus prospective cohort and the Ntshembo Study. This chapter describes the study settings and design of the main studies that provided the data, and how the data were managed for the present analyses.

2.1 Bt20 Plus Study

2.1.1 Study design

The Birth to Twenty Plus Study is the largest and longest running longitudinal birth cohort study in Africa (89). Initially called the Birth to Ten Study at its inception, the general aim of the study was to investigate the biological, environmental, economic and psychosocial factors associated with the lives of children living in an urban setting (90). The cohort has tracked the growth, health, cognitive development and educational progress of these children (now adults) for approximately three decades by 2019.

2.1.2 Study setting

The late 1980s was a period of great sociopolitical upheaval in South Africa characterized by the slow disintegration of the oppressive *Apartheid* state, and consequent rural-urban migration (91). The *Apartheid* system was founded on the legal separation and separate development of the races, with multiple laws being passed to enforce and further entrench these differences (92). Whites (of European origin) had the highest and best privileges and freedom followed by Indians (a collection of different people from the South East Asian region, mainly from India), Coloureds (people of mixed ancestry) and finally Black people (people of African descent) with the most severe restrictions (91).

It is with this background that the Bt20+ Study commenced in Soweto, South Africa, an urban settlement Southwest of Johannesburg that was created in an attempt to separate Black workers from White Johannesburg residential areas (93). At the time of the cohort enrolment, the Soweto-Johannesburg area had approximately 400 000 informal housing units and approximately 3.5 million people (89, 94). The population ranged from the super-rich to the desperately poor living in very diverse conditions (94).

2.1.3 Map of Soweto (93, 95)

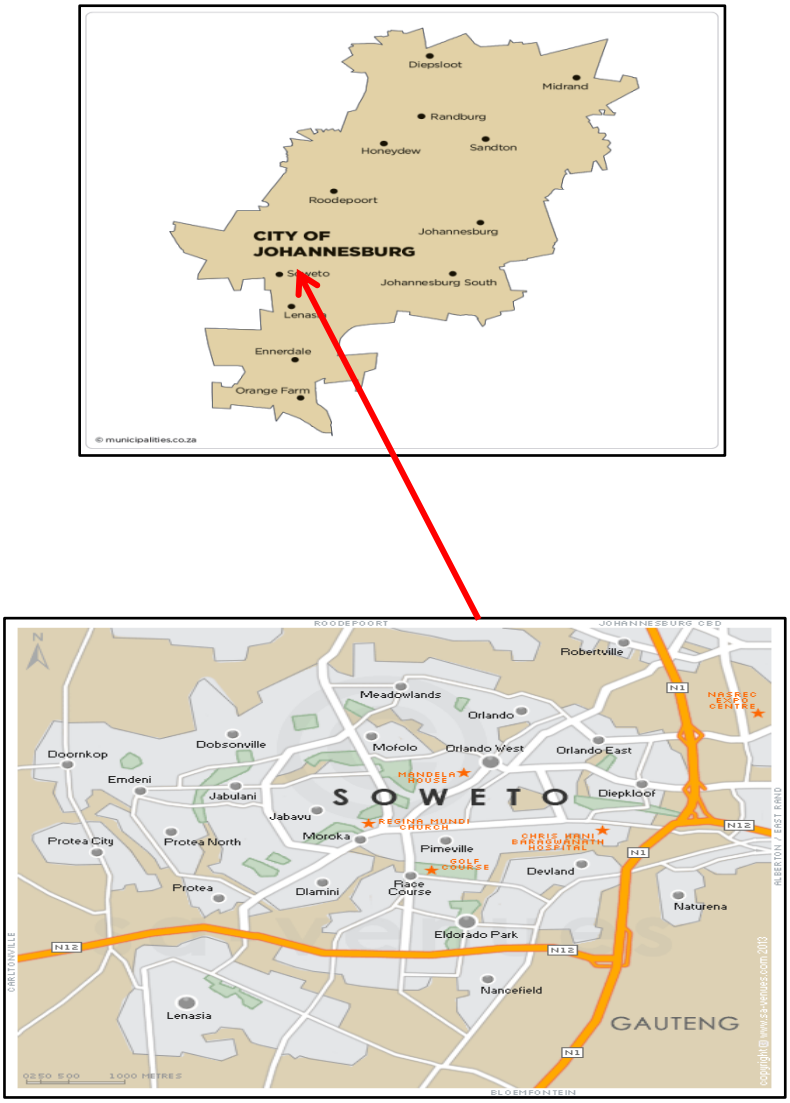


Figure 2.1 Map of Soweto

2.1.4 Study recruitment and data collection

Initially called the Birth to Ten Study (BTT) at its establishment, the Bt20+ cohort enrolled 3 273 singleton children out of the 5 449 born in Soweto, Johannesburg and surrounding areas, between 23 April and 8 June 1990 (89, 94). Pregnant women and mother- infant pairs residing in the Soweto-Johannesburg area at the time of delivery were recruited from public antenatal clinics, delivery centres and well-baby clinics (89). The mothers and babies also had to reside in Soweto for at least the first six months post-partum (89). All singleton births delivered in the designated area were eligible for selection, on condition of residing in the area for at least 6 months after the birth of the child (89). The cohort was designed to be static and new arrivals in the Soweto area with the applicable date of birth were excluded from the cohort (90). Because the cohort was born at the dawn of the new democratic dispensation in South Africa, the children became colloquially known as "Mandela's Children" (89).

Data were collected from childhood to early adulthood on the individual, the household and the community. Information collected on the individual included demographic, growth, physical activity, health and nutrition, mental development and schooling (91). Investigators also gathered social and psychological adjustment and physiological measures and involvement in health risk behaviour (91). In the households and the community, socioeconomic and household composition information was collected as well as community, neighbourhood and school environments (91). In 2012/2013 when the cohort was 22 to 23 years of age, a data collection wave was conducted that was called the Young Adult Study (YAS). In this survey participants also answered questions on stressful life events at various time points including at the age of 22-23 years, which data were used in this study. Adverse childhood experiences were retrospectively measured in this collection wave. Questionnaires used to collect these data are in Appendix 6 to 8.

For the current analyses, the sample comprises Bt20+ young adults with ACE-defined abuse, neglect and household dysfunction data as measured at age 22-23 years. Other measures were extracted from the relevant questionnaires that were administered prior to this time. This current study was situated in the Developmental Pathways for Health Research Unit

(DPHRU) at the University of the Witwatersrand, Chris Hani-Baragwanath Hospital, Johannesburg.

2.1.4.1 Attrition

As with most cohort studies, part of the cohort has been lost to follow up over the years. Approximately 70% of the children were followed up for more than 12 years (89). The population is highly mobile, a factor compounded by the rapidly changing urban residence laws at the fall of *Apartheid*. Three types of attrition were observed in this cohort. Firstly, absolute attrition due to the death of the child or the mother. Secondly, there was intermittent attrition due to circular migration between alternate rural and urban homes, and lastly attrition due to failure of the study to follow locate the participants (91). In the 2005-2006 collection wave, 64% of the cohort was surveyed and in the 2012-2013 wave, 50% of the cohort was surveyed.

Chapter-specific methodology details will be found in the individual results chapters.

2.2 Ntshembo Study

Data from the Project Ntshembo-Hope Cross-Sectional Survey (Ntshembo Study) were used in the comparative portion (Chapter 6) of this thesis. The broader project, which began in 2007, was called "Project Ntshembo – Health and well-being of female adolescents: limiting the intergenerational risk of metabolic disease" (96). Its primary aim was to develop an intervention to "improve the health and well-being of adolescent girls in order to limit the intergenerational transfer of risk of metabolic disease" (96). Data that were used in this study were collected during the formative stage during which the rural and urban adolescent female metabolic risk in rural Agincourt (MRC/Wits Rural Public Health and Heath Transitions Research Unit) and urban Soweto were extensively characterized (97).

2.2.1 Study design and setting

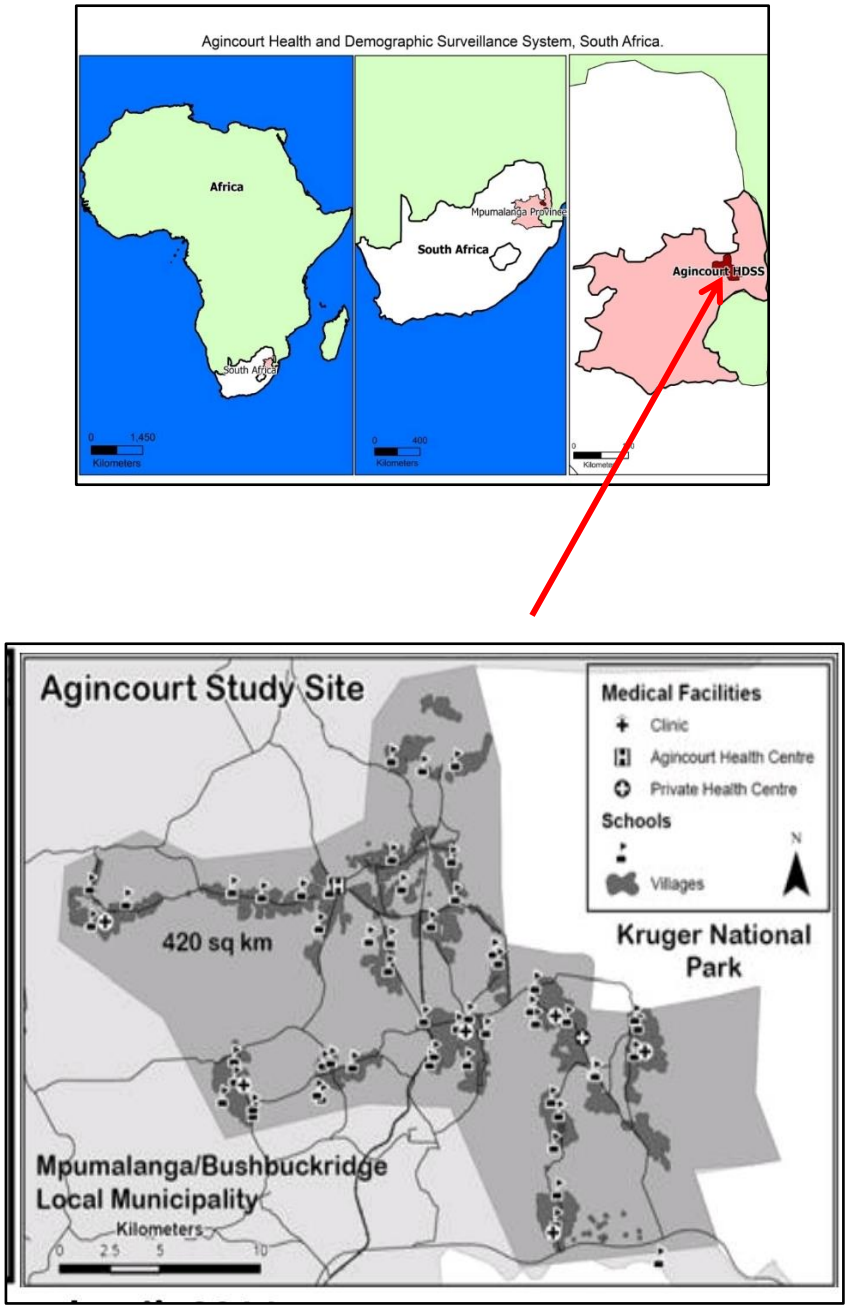


Figure 2.2 Maps of Agincourt, Bushbuck Ridge, Mpumalanga, South Africa (1)

The Ntshembo study was based at the MRC/Wits Rural Public Health and Transitions Research Unit (Agincourt), a Health and Demographic Surveillance System (HDSS) site in the rural Mpumalanga province of South Africa, established in 1992 (98). The HDSS area covers 420km^2 comprising a sub-district of Bushbuckridge with 27 villages and an approximate population density of 170 per km^2 (96, 98). As of 2012, infrastructural development has progressed but very slowly. Electricity remained unattainably expensive for many households and despite the construction of a dam nearby, there was no piped water to dwellings, and sanitation is rudimentary (98). The quality of education remains poor and unemployment is widespread (96, 98).

2.2.2 Study recruitment and data collection

Young women of ages between 13 to 19 years of age were enrolled for the Ntshembo Study. Questionnaires and interview procedures were synced and aligned with the Birth to Twenty Plus Study YAS study wave between 2012 and 2013. A subsample of 500 young women was selected from the Agincourt population for the current analyses.

2.3 Study Measures

Specific details of the measures used in the study will be presented in the relevant results sections.

2.4 Data Analysis Overview

Table 2.1 summarises the analysis steps that were used to address each objective of this study

Table 2.1 Overview of the data analysis plan

Objective	Data analysis steps
1. To determine the prevalence of ACEs in a lower middle-income Black population and associations with childhood factors	**Outcome measure:** Adverse childhood experiences **Exposure:** child, maternal and household childhood factors a. Prevalence presented in tables and graphs b. Logistic regression to determine association between childhood factors and ACEs
2. To assess the level of co-occurrence and clustering between the ACEs	**a.** Cross tabulation to determine co-occurrence of ACEs **b.** Exploratory factor analysis to explore evidence of clustering **c.** Latent class analysis to assess the presence of distinct clusters of ACE experiences in the population
3. To assess the association between retrospectively reported ACEs and the prevalence of psychological distress among young adults.	**Outcome measure: psychological distress** **Exposure:** ACEs, accounting for demographic factors and adult stress a. Hierarchical logistic regression to determine the association between ACEs and PD b. Interaction analysis to assess the role of adult stress in the relationship between ACEs and PD
4. a) To investigate the association of interpersonal violence and mental health among young women residing in rural and urban South Africa 2. To explore the potential pathways of association between interpersonal violence and PD in urban and rural settings	**Outcome measure:** Psychological distress (PD), as a binary variable (yes or no), adjusting for demographic factors, household stress and community safety **Primary exposure:** Interpersonal violence a. Determine the prevalence of interpersonal violence and PD in the sample, presented with histograms/tables b. Logistic regression to determine the association between interpersonal violence and PD c. Structural equation modelling to establish pathways between interpersonal violence and PD

2.5 Ethics

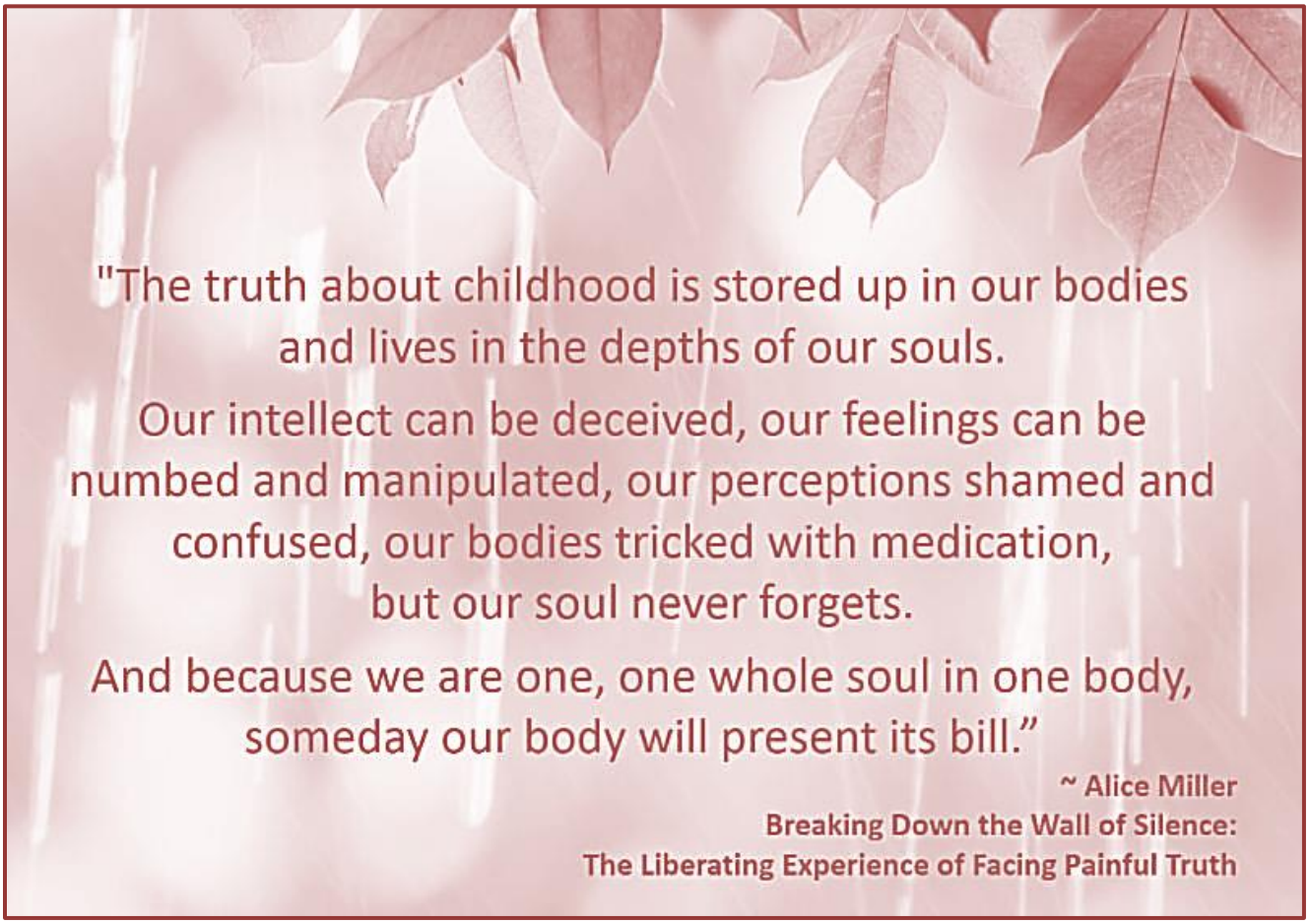
Ethical approval for this study was requested and granted from the Human Research and Ethics Committee (HREC) of the University of the Witwatersrand, Johannesburg, ethics clearance number: M160921 (Appendix 9). Approval was also obtained for the main studies from the HREC; clearance number M120138 for the Ntshembo-Hope Cross Sectional Survey and M111182 for the Bt20+ survey. Permission was granted by the Mpumalanga Department of Health Research as well. Informed consent was sought from parents and assent from participants when the participants were minors, and independent informed consent was obtained from adolescent and young adult participants at the beginning of each data collection round (Appendix 7).

2.6 Candidate's role in the study

PhD candidates are expected to be active members of the DPHRU team and take part in all meetings and activities related to the Bt20+ data, and to take on other additional responsibilities assigned to post-graduate students from time to time. The candidate led all activities related to this study, including data management:

- Literature review for each objective and analysis step
- Conceptualisation of the study, and the separate results sections
- Lodging requests for the data needed for this study
- Working with the data team to pull the data
- Cleaning the data for analyses
- Checking discrepant data with original questionnaires and lodging corrections with the data team
- Analysis of the data as per each objective and ensuring statistical rigour of all methods used for each objective
- Lodging all data sets with the data team after completion
- Questionnaire and data quality control

SECTION 2: Results and Empirical Chapters



Chapter 3 : Adverse childhood experiences: prevalence and associated factors among South African young adults

3.1 Introduction

Extensive research has been conducted globally on childhood abuse and maltreatment and their effects on health and well-being (4). However, the concept of adverse childhood experiences (ACEs) as a set of specified exposures was first described in the seminal "CDC-Kaiser Permanente Adverse Childhood Experiences (ACE) Study" (99). The ACE study described adverse experiences as "common, stressful and traumatic exposures affecting the (neuro) development of children" (3). The ACE hypothesis posits that adverse or stressful childhood experiences such as abuse and neglect, or growing up in a dysfunctional household, create common vulnerability to social, emotional and cognitive impairments that lead to increased risk of poor health behaviour, social adjustment and physical and mental illness (3). ACEs are more than child maltreatment and the neglect of a child's needs, and incorporate household and environmental influences as well (4).

The first wave of the study conducted in 1995/1996 included seven adverse events in the definition of ACEs, namely sexual, physical and emotional abuse, and household dysfunction (household substance abuse, household mental illness, domestic violence and household member with a history of imprisonment) (99). The second wave in 1997 updated the list to ten with the addition of emotional and physical neglect and parental divorce or separation (3, 5, 99). The latter study also became the basis for expert recommendations to expand the definition of ACEs to include exposures experienced in high income as well as low to middle income countries (LMICs), including the domains of socio-economic status, peer to peer and community violence (6).

Adverse childhood experiences are common, in both high income and LMICs. In the ACE study, approximately 60% of the sample experienced at least one ACE and more than 10 percent experienced 5 or more ACEs (3). A later survey in the USA also found a 60 percent prevalence of at least one ACE, and data from Wales showed a 47% prevalence (25, 100). Eighty-five percent of a Brazilian adolescent cohort reported experiencing at least one ACE, with females experiencing more adverse events (101). In Vietnam, 76% of a sample of university students reported experiencing at least one ACE (102). Though not using the ACE definition stated above, studies conducted in South Africa suggest high rates of individual exposures. For example, in a prospective survey of both rural and urban adolescents, 18.3%

and 19.5% reported frequent physical and emotional abuse, respectively (14). According to Jewkes et.al, 54.7% and 56.4% of rural South African women and men experienced emotional abuse respectively, 41.6% and 39.6%, respectively experienced emotional neglect and 39.1% and 16.7% experienced sexual abuse before the age of 18 (13).

ACEs have a cumulative impact on health and well-being (4). In order to measure this more accurately, Felitti et al. proposed computing an ACE score, which is the sum of the defined exposures, measured dichotomously, ranging from 0-10 (51, 70, 99). Strong dose-response relationships have been observed between the ACE score and adult health and social outcomes (7, 35, 36). Higher ACE scores are associated not only with increased health risk behaviours and risk of disease and poor social adjustment, but also with increased odds of reporting multiple adverse outcomes (25, 103). Examining the ACEs as a set of exposures and using the cumulative ACE score enables these relationships with health and wellbeing outcomes to be more precisely elucidated and quantified.

Scientific advances support the assertion that early life stress disrupts neurodevelopment, leaving lasting effects on brain structure and function (3). Early life adversity can produce biological memories that weaken multiple developing body systems such as the stress response, cardiovascular and immune systems, and metabolic regulatory controls (26, 104). Childhood maltreatment has been linked to reduced grey matter volumes in the hippocampus and the orbitofrontal cortex among other brain regions (105, 106). These effects can last well into adulthood and have been linked to poor health and behavioural outcomes (26, 104).

Several child, household and community factors have been linked to childhood maltreatment and abuse. Girls are reported to have a higher risk of being sexually abused than boys, as well as experiencing greater adversity in general (101, 107). Household factors such as HIV-related illness and poverty may increase the risk of child abuse (14). In Brazil, being of non-White race, low family income, low maternal schooling, absence of mother's partner, maternal smoking, and poor maternal mental health significantly increased the risk of a higher ACE score (101). Living in a poor neighbourhood is associated with a higher number of ACEs and conversely, neighbourhoods with large numbers of affluent families are associated with lower ACE scores (70). Child maltreatment is usually concentrated in poorer neighbourhoods and neighbourhood structural factors, particularly economic markers, are

consistently linked to abuse and neglect. Socio-economic context also potentially confounds the relationship between ACEs and outcomes in later life (70). Children who have previously been maltreated are also at an increased risk of being maltreated again (108).

There is evidence from high-income countries on the prevalence of ACEs, as defined by the ACE study, but such research is scarce in LMICs. Partly due to the paucity of data, the study of child adversity has tended to focus on single exposures such as sexual or physical abuse, despite emerging evidence that ACEs co-occur and are interrelated (5, 35). The objectives of this study are to determine the prevalence of ACEs, as defined in the ACE study, together with additional measures relevant to an LMIC, and to assess their association with childhood maternal, household and community factors in a long-term birth cohort study in South Africa.

3.2 Methods

3.2.1 Study design and context

A cross-sectional analysis of data from the Birth to Twenty Plus (Bt20+) study was conducted. Details of the Bt20+ Study are outlined in Chapter 2.

3.2.2 Participants/Study population

At the start, 3 273 singleton children born to women who resided in Soweto between April and June 1990 and resident in the area for at least six months post-partum were recruited into the study (91). Of these, 1 636 participants were surveyed at 22-23 years of age.

3.2.3 Measures

The main outcome measure was adverse childhood experiences (ACEs). Demographic factors of the participants in young adulthood were collected to describe the sample. Additional variables included maternal, household and community factors measured between birth and 18 years. All questionnaires were administered face-to-face, bar the ACE questionnaire which was completed by the participant.

3.2.3.1 Demographic factors at 22 years

Demographic information included marital status, socio-economic status, and graduation from high school. Marital status is a binary variable with the categories

single/widowed/divorced and married or living together. The latter were collapsed together because marriages is commonly delayed in South Africa, with the median age at first marriage 30 and 34 years for females and males respectively between 2009 and 2013 (109, 110). Socio-economic status was measured using a sum of household assets and analysed as a continuous variable. The young adults were asked whether they had graduated from secondary school or not, and this variable is also binary.

3.2.3.2 Adverse childhood experiences

ACEs were retrospectively measured at 22-23 years of age using a modified Adverse Childhood Experiences Study Questionnaire (5). A total of thirteen ACEs were assessed in this study. Data on chronic illness, unemployment and parental death were also collected in addition to the ten ACEs (5) used in the ACE study based on recommendations to include some experiences that may be prevalent in low-income settings (72, 74, 111). Five of the ACEs were the child's own experience of abuse or neglect and the remainder were household experiences namely witnessing domestic violence, parental divorce, parental death, substance abuse in the household, a household member being incarcerated and mental illness and other chronic illness of a household member and unemployment of a parent or caregiver. Appendix 2 shows the questions used to assess ACEs experienced. A point was allocated to each ACE exposure for which a participant answered yes to at least one of the questions, i.e. only one point could be allocated to each ACE.

ACEs were analysed as single variables and as an ACE score which was computed by summing the number of ACEs to which each person was exposed. Several categorical variables were created based on the ACE score:

1. Binary variables were created to indicate the proportion of participants who had experienced at least one, two, three, four, five or six ACEs in their lifetime.

2. A variable with five ACE score categories was created to indicate those who experienced no ACEs, one, two, three and four or more ACEs, to allow comparability with similar studies.

3.2.3.3 Child, maternal, household and community factors

These variables were collected between pregnancy and two years of age, at 16 years of age as well as at 18 years of age. Questionnaires were administered by trained research assistants to the caregivers or the participants themselves.

Participant's gender

The participant's gender was recorded at birth.

Mother's age at birth

The mother's age in years was collected during the antenatal visit.

Mother's education

Information on the mother's highest level of education was collected during the antenatal visit and updated during data collection in the first two years of the child's life. Education was divided into four categories: no formal education, Grades 1-7 (primary), Grades 8-12 (secondary) and post school training.

Mother's marital status

This variable was measured during the antenatal visit and updated during data collection in the first two years of the child's life, with two categories, namely single/divorced/widowed/separated and married/living together.

Father's presence

The presence of the participant's father in the household before the age of two was recorded and treated as a dichotomous variable in the analysis.

Socio-economic status

We assessed socio-economic status (SES) by creating a composite score based on responses to a questionnaire on assets in the household at birth as well as at 16 years of age. Assets include, for example, a refrigerator, motor car, television etc. The total score was used to create a dichotomous variable denoting relatively lower and higher SES. A variable to

determine change in SES between the two time-points was also created. In the absence of reliable income data in the Bt20+ Study, household assets have been demonstrated to be a stable proxy for income and purchasing power (112). Household assets have been widely used to measure SES level and wealth. They are used to indicate the household's ability to endure emergencies and economic shocks and are a measure of cumulative wealth over time (113-115). Unpublished work by the study team showed that the asset data, combined in several ways, remains stable (116). At 18 years of age the participants were asked questions regarding the SES of their community. For this analysis we created a community SES variable from two of these questions: "How do you describe your neighbourhood in terms of wealth?" and "Do you think people living outside of your neighbourhood see your neighbourhood as being: very poor, poor, average, wealthy or very wealthy?" The same response options were used for the first question as well. A dichotomous variable was created by summing the scores of the two questions and defining a score of five or less as lower community SES and a score above five as higher community SES. SES at 22 years was used as a continuous variable.

3.2.4 Statistical analysis

All analyses were carried out using STATA version 14.2 (117).

3.2.4.1 Descriptive statistics

The prevalence of each ACE exposure was determined and tabulated by gender, as well as demographic characteristics of the sample. The chi-square test and ANOVA were used to examine gender differences.

3.2.4.2 Association between childhood factors and ACEs

Univariate and multivariate logistic regression was used to test associations between childhood factors and ACEs: the binary ACE variable indicating the experience of any ACE, the cumulative ACE score index, and the individual ACEs. Variables significant at the 80% level in the univariate analysis were retained in the multivariate models.

3.2.5 Ethics

Ethics approval details are contained in Chapter 2.

3.3 Results

3.3.1 Characteristics of the sample and prevalence of ACEs

Figure 3.1 presents the sample flowchart displaying the number of participants in the present analysis. A final sample of 1 223 had complete ACE data

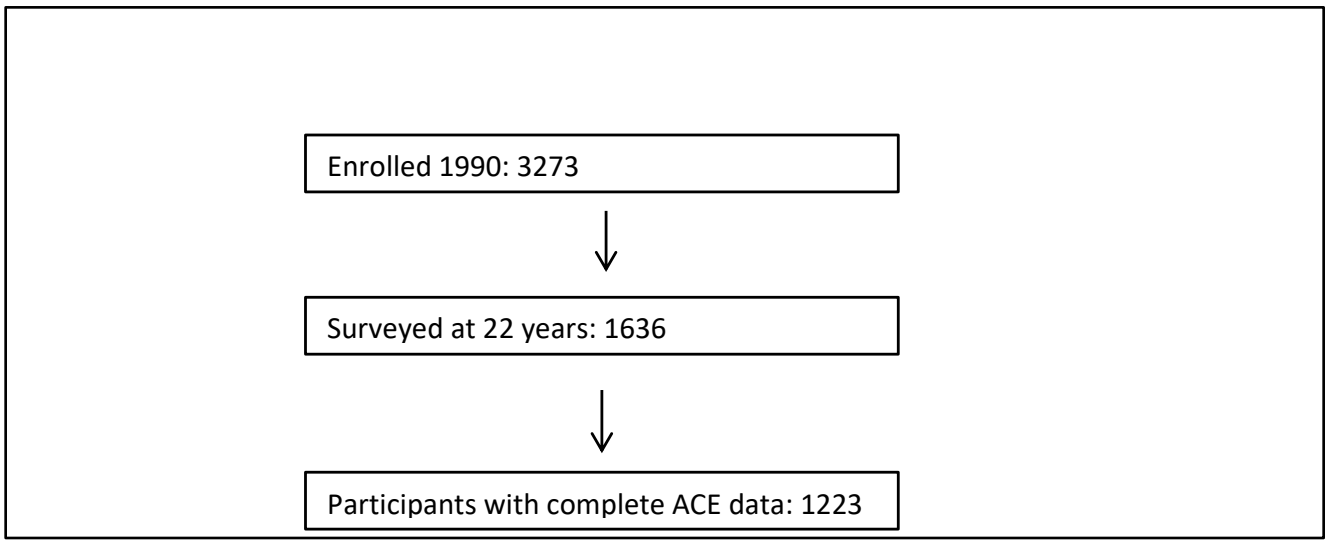


Figure 3.1 Flow chart describing the process for obtaining the analytic sample among participants in the 22-23 year wave of the Bt20+ survey, Soweto, South Africa.

Table 3.1 presents the descriptive statistics of the sample surveyed at 22 years of age. Forty-eight percent of the sample was male and 52% female. Sexual and physical abuse were the lowest reported ACEs (4% and 8% respectively), while unemployment of a parent or caregiver and parental divorce or separation had the highest prevalence at 43% and 45% respectively. The prevalence of the other two additional ACEs, parental death and chronic illness, were also among the highest reported, 28% and 26% respectively. Significant differences between males and females in education and marital status at 22 years of age were apparent, with a male disadvantage. There were also significant differences between males and females in the experience of sexual abuse, emotional and physical neglect, parental death, household substance abuse, mental illness and legal trouble or incarceration of a household member.

Table 3.1 Prevalence of ACEs and demographic factors of participants surveyed in the 22-23 year wave of the Bt20+ survey, Soweto, South Africa, n=1636

Variable	Male n (%)	Female n (%)	Total n (%)	Percent missing Data^	p-value (chi^2 and ANOVA)
Marital status					
Single	414 (55)	371 (45)	785 (50)		
Relationship	341 (45)	450 (55)	791 (50)	1.5	0.000
SES at 22 years	Median: 10 (Range 1-13)	Median: 10 (Range 1-13)		2.2	0.583
Completed secondary education					
No	356 (47)	263 (32)	619 (40)		
Yes	401 (53)	548 (68)	949 (60)	3.0	0.000
Any ACE*					
No	72 (12)	77 (12)	149 (12)		
Yes	521 (88)	550 (88)	1071 (88)	5.0	0.941
Cumulative ACEs_5*					
None	72 (12)	77 (12)	149 (12)		
1 ACE	106 (18)	135 (22)	241 (20)		
2 ACEs	106 (18)	108 (17)	214 (18)		
3 ACEs	94 (16)	92 (15)	186 (15)	23.0	0.600
4 or more	215 (36)	215 (34)	430 (35)		
Cumulative ACEs_3*					
None	72 (12)	77 (12)	149 (12)		
Low	435 (73)	453 (72)	888 (73)		

High	86 (15)	97 (16)	183 (15)	23.0	0.884
ACE score	Median: 3 (Range: 0-11)	Median: 3 (Range0-11)	Median: 3 (Range 0-11)	23.0	0.983
Emotional abuse					
No	519 (69)	572 (70)	1091 (70)		
Yes	232 (31)	240 (30)	472 (30)	1.7	0.566
Sexual abuse					
No	707 (97)	754 (95)	1461 (96)		
Yes	22 (3)	40 (5)	62 (4)	5.0	0.046
Physical abuse					
No	665 (91)	742 (93)	1407 (92)		
Yes	67 (9)	52 (7)	119 (8)	4.9	0.048
Emotional neglect					
No	555 (74)	562 (69)	1117 (71)		
Yes	198 (26)	252 (31)	450 (29)	1.4	0.041
Physical neglect					
No	648 (86)	734 (90)	1382 (88)		
Yes	103 (14)	78 (10)	181 (12)	1.7	0.011
Domestic violence					
No	657 (88)	700 (87)	1357 (87)		
Yes	93 (12)	108 (13)	201 (13)	2.0	0.570
Parental divorce/separation					
No	357 (56)	369 (54)	726 (55)		
Yes	281 (44)	311 (46)	592 (45)	17.0	0.537
Parental death					
No	521 (69)	602 (74)	1123 (72)		
Yes	231 (31)	212 (26)	443 (28)	1.5	0.040
Substance abuse					
No	521 (69)	613 (75)	1134 (72)		

Yes	233 (31)	204 (25)	437 (28)	1.2	0.009
Mental illness					
No	674 (90)	707 (87)	1381 (88)		
Yes	79 (10)	110 (13)	189 (12)	1.3	0.071
Incarceration					
No	552 (73)	652 (80)	1204 (77)		
Yes	202 (27)	163 (20)	365 (23)	1.3	0.001
Chronic illness					
No	562 (75)	591 (73)	1153 (74)		
Yes	191 (25)	222 (27)	413 (26)	1.5	0.384
Unemployment					
No	409 (54)	479 (59)	888 (57)		
Yes	345 (46)	338 (41)	683 (43)	1.2	0.080

*Totals for ACE score add up to 1 220 due to cross-tabulation with gender: five of those with full ACE data had missing gender data. ^ Based on sample of 1636

Of the 1 636 participants who were surveyed at 22 years of age, 1 223 had complete ACE data i.e. data on all the ACEs as reflected in the ACE score variables. Twelve percent of these (149) reported no ACEs and 1074 (88%) reported at least one ACE. The highest ACE score for this sample was 11 out of 13. Over one third of respondents reported experiencing four or more ACEs and 15% experienced 6 or more ACEs as indicated in Figure 3.2. Those who had full ACE data were used in the regression models.

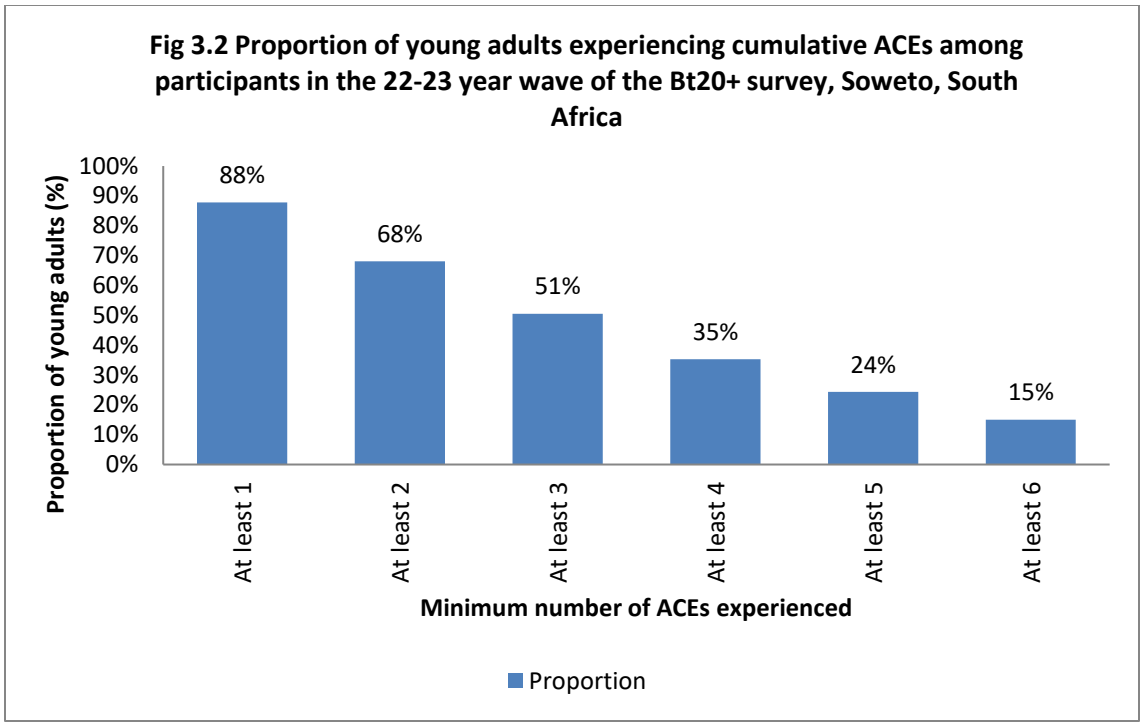


Figure 3.2 Proportion of young adults experiencing a minimum number of ACEs.

The bar chart illustrates the proportion of the sample that reported a minimum of one up to six ACEs.

3.3.2 Missing data

Included in Table 3.1 is a column illustrating the percentage of participants with missing data for each variable, based on the sample surveyed of 1 636 participants. All the variables except for parental divorce had less than 10% missing values. Out of the 1223 young adults that had complete ACE data, one percent had missing marital status data, and approximately two percent had missing education and SES data.

Table 3.2 Comparison of demographic characteristics between YAS participants with ACE data and those with missing ACE data

Variable	Sample with full ACE data n=1223 Frequency (%)	Sample with Missing ACE data n = 413 Frequency (%)	p-value (chi square)
Gender			
Male	592 (49)	171 (46)	
Female	626 (51)	201 (54)	0.373
Marital status			
Single	582 (48)	198 (56)	
Relationship	634 (52)	157 (44)	0.009
SES at 22 years	Median: 10, range: 1-13	Median:9, Range: 1-13	0.189
Completed matric			
No	453 (38)	159 (45)	
Yes	755 (62)	193 (55)	0.009

Table 3.2 displays how the demographic characteristics of participants who had full ACE data compared to those that had incomplete ACE data. Having incomplete ACE data was correlated to marital status and secondary school completion. We also compared the childhood factors of those surveyed at 22 years old and those not surveyed (results not presented). A significant difference was noted in SES at sixteen and eighteen years of age, with those who were surveyed more likely to be of a higher SES level.

3.3.3 Maternal, household and community factors associated with experiencing single ACE exposures

We explored the association of childhood factors with single ACE exposure, and the adjusted regressions are presented in Tables 3.3 and 3.4. Higher SES, both in the household (at birth and at 16 years of age) and in the community were significantly negatively associated with several ACE exposures such as physical neglect, sexual and emotional abuse and drug abuse. Community SES remained significantly associated with sexual and emotional abuse as well as physical and emotional neglect, with those residing in higher SES communities having more than 50% less odds of experiencing these ACEs. Participants who had older mothers at birth were less likely to witness domestic violence and live with a chronically ill household member compared to those who had younger mothers.

Table 3.3 Adjusted childhood factors associated with individual abuse and neglect ACEs in the Bt20+ Study, Soweto, South Africa, n=1223

Variable	Abuse: Adjusted OR (95% CI)			Neglect: Adjusted OR (95% CI)	
	Sexual	**Emotional**	**Physical**	**Physical**	**Emotional**
Gender					
Male	Ref	-	Ref	Ref	Ref
Female	1.67 (0.93-3.00)		0.70 (0.46-1.08)	**0.67 (0.45-0.99)**	1.18 (0.91-1.53)
Maternal age	-^	-	-	-	-
Maternal education					
No formal education	Ref	-	-	-	-
Standard 1-5	0.17 (0.02-1.85)				
Standard 6-10	0.34 (0.04 (2.86)				
Post school training	0.80 (0.09-7.38)				
Maternal marital status					
Single/widowed	-	Ref	-	Ref	-
Married/living together		0.82 (0.62-1.09)		0.75 (0.48-1.18)	
SES at birth					

Low	Ref	Ref	Ref	Ref	-
High	1.42 (0.80-2.53)	0.87 (0.67-1.14)	0.79 (0.50-1.24)	0.67 (0.40-1.14)	
SES at 16 years					
Low	-	Ref	Ref	Ref	Ref
High		0.98 (0.73-1.31)	0.93 (0.57-1.51)	**0.55 (0.34-0.88)**	0.83 (0.62-1.12)
Change in SES (birth to 16 years)	-	-	-		
None				Ref	Ref
Increase				0.94 (0.55-1.61)	1.23 (0.89-1.70)
Decrease				1.73 (0.96-3.11)	1.18 (0.80-1.73)
Community SES at 18					
Low	Ref	Ref	Ref	Ref	Ref
High	**0.55 (0.31-0.98)**	**0.70 (0.53-0.93)**	0.81 (0.50-1.29)	**0.54 (0.36-0.81)**	**0.66 (0.50-0.88)**
Father home					
No	-	-	-	Ref	-
Yes				0.67 (0.41-1.09)	

Bold: p<0.05; ^variables with no results were not entered into multivariate model for that outcome because they were not significant in the univariate model

Table 3.4 Adjusted childhood factors associated with individual household dysfunction ACEs in the Bt20+ Study, Soweto, South Africa, n=1223

Variable	Household dysfunction Adjusted OR (95% CI)							
	Domestic violence	**Parental divorce**	**Parental death**	**Substance abuse**	**Mental illness**	**Incarceration**	**Chronic illness**	**Unemployment**
Gender								
Male	-^	-	Ref	Ref	Ref	-	-	Ref
Female			0.79 (0.61-1.02)	**0.76 (0.59-0.99)**	**1.39 (1.00-1.92)**			**0.77 (0.61-0.98)**
Mother's age	**0.96 (0.93-0.99)**	0.98 (0.96-1.00)	-	-	-	0.99 (0.97-1.01)	**0.98 (0.95-0.99)**	0.98 (0.96-1.00)
Mother's education								
No formal education	-	-		-	-	-	-	-
Standard 1-5			Ref					
Standard 6-10			1.53 (0.31-7.42)					
Post school training			1.65 (0.35-7.75)					
			1.18 (0.23-6.02)					
Marital status								
Single/widowed	-	Ref	Ref	Ref	-	-	Ref	Ref
Married/living together		**0.69 (0.51-0.94)**	0.76 (0.57-1.02)	**1.33 (1.02-1.73)**			1.05 (0.77-1.44)	**0.72 (0.54-0.96)**

SES at birth Low High	-	Ref 0.94 (0.72-1.23)	Ref 0.86 (0.66-1.12)	Ref **0.68 (0.52-0.90)**	-	Ref 0.77 (0.58-1.03)	Ref 0.84 (0.65-1.09)	Ref **0.71 (0.55-0.91)**
SES at 16 years Low High	Ref 0.77 (0.54-1.10)	Ref **0.63 (0.47-0.86)**	-	Ref **0.74 (0.55-0.99)**	Ref 1.28 (0.88-1.86)	0.79 (0.58-1.07)	-	Ref **0.51 (0.39-0.68)**
Change in SES (birth to 16 years) None Increase Decrease	-	-	-	-	-	-	-	-
Community SES at 18 years Low High	-	-	-	Ref 0.79 (0.59-1.05)	-	-	Ref 0.88 (0.66-1.18)	-
Father home No Yes	Ref 1.50 (0.91-2.46)	Ref **0.65 (0.44-0.98)**	Ref **0.63 (0.45-0.88)**	-	-	-	Ref 0.98 (0.69-1.41)	Ref 0.93 (0.67-1.29)

Bold: p<0.05; ^variables with no results were not entered into the multivariate model for that outcome

3.3.4 Maternal, household and community factors associated with cumulative ACEs

The associations between childhood factors and cumulative ACEs are presented in Table 3.5. Only maternal marital status and SES at 16 years of age remained significantly associated with experiencing at least one ACE after adjusting for the other factors. The patterns of association and effect sizes were similar for the two ACE score indices. In adjusted analyses, higher household SES at 16 years of age and maternal marital status reduced the odds of ever experiencing ACEs as well as experiencing multiple ACE events. The effect of community SES and SES at birth remained protective but was not significant after adjusting for the other factors

Table 3.5 Unadjusted and adjusted association of childhood factors with cumulative ACE score indices in the Bt20+ Study, Soweto, South Africa, n=1223.

	Experiencing at least one ACE		ACE score categories (5)	
Variable	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)[1]**	**Unadjusted OR (95% CI)**	**Adjusted OR (95% CI)**
Gender		-		
Male	Ref		Ref	-
Female	0.99 (0.70-1.39)		0.99 (0.70; 1.39)	
Mother's age	0.98 (0.96-1.01)	-	0.98 (0.96; 1.01)	-
Mother's education				
No formal education	Ref	-	Ref	-
Standard 1-5	0.60 (0.07-4.92)		0.60 (0.07; 4.92)	
Standard 6-10	0.61 (0.08-4.75)		0.61 (0.08; 4.75)	
Post school training	0.49 (0.06-4.09)		0.49 (0.06; 4.09)	
Maternal marital status	Ref	Ref	Ref	Ref
Single/widowed				

Married/living together	0.54 (0.38-0.76)***	0.64 (0.42-0.98)**	0.54 (0.38-0.76)***	0.64 (0.42-0.98)**
SES at birth				
Low	Ref	Ref	Ref	Ref
High	0.78 (0.53-1.14)*	0.87 (0.52-1.46)	0.78 (0.53-1.14)*	0.87 (0.53-1.46)
SES at 16 years				
Low	Ref	Ref	Ref	Ref
High	0.42 (0.27-0.64)***	0.51 (0.26-0.99)**	0.37 (0.22-0.63)***	0.51 (0.26-0.99)**
Change in SES (birth to 16 years)				-
None	Ref	Ref	Ref	
Decrease	1.00(0.65-1.57)	1.00 (0.58-1.74)	1.00(0.65; 1.57)	
Increase	1.48 (0.81-2.69)*	1.22 (0.63-2.35)	1.48 (0.81; 2.69)	
Community SES at 18 years				
Low	Ref	Ref	Ref	Ref
High	0.57 (0.36-0.89)**	0.60 (0.35-1.01)	0.58 (0.36-0.89)**	0.60 (0.35-1.01)
Father home				
No	Ref	Ref	Ref	Ref
Yes	0.48 (0.23-1.00)**	0.56 (0.25-1.27)	0.48 (0.23; 1.00)*	0.56 (0.25; 1.27)

*p≤0.2; **p≤0.05; ***p≤0.001; [1]variables significant at 0.2 entered into the adjusted models

3.4 Discussion

Our results show that ACEs measured using a modified Kaiser Permanente ACE Study questionnaire, are highly prevalent in a middle-income young adult urban population, with 88% reporting at least one ACE during childhood and 35% experiencing at least four. Using only the original 10 ACE Study exposures, the prevalence of any ACE was 77%, while 21% of the sample reported four or more ACEs. Maternal marital status and age, household and

community SES were the most salient childhood factors associated with both single ACEs and the cumulative score. Most associations between childhood factors and single ACE exposures were attenuated by the addition of other factors in the models.

3.4.1 Prevalence of ACEs

We report prevalence rates higher than those reported in high-income countries, both using the 10-item score and our modified 13-item score (6, 25). The prevalence of sexual and physical abuse was, however, lower in this study compared to other studies, while most forms of household dysfunction were generally higher, including parental divorce/separation (3, 25, 100). Differences in the reporting of abuse have been attributed to the type of sample included in the study: random versus purposive or convenience samples, or samples taken from at-risk populations versus general population samples (118). The age of the victim when the abuse or maltreatment happened as well as the mode of questionnaire administration may also influence self-report rates (119). A systematic review of literature covering both high income and middle income countries found prevalence rates of experiencing four or more ACEs ranging between one and thirty-two percent, with the highest prevalence being from a middle income country (120). It seems that ACEs are more prevalent in poorer compared to richer countries, indicative of the urgency of preventing ACEs in these settings that face multiple public health burdens in the context of limited health and social resources.

Our three additional ACEs were fairly prevalent in this study group. These exposures should be taken into account when measuring ACEs in lower income communities. Independent of any association with health outcomes, they may be part of important pathways to illness. Markers of poverty have been linked to childhood sexual and psychological abuse and subsequently symptoms of depression among young South African men (121). Further analysis with path analysis methods would be beneficial to determine what role these exposures play in the occurrence of ACEs and their link with poor outcomes.

Data on the prevalence of cumulative ACEs are essential for reducing inequality in LMICs. Adverse early life experiences create inequalities by compromising children's development and later health and wellbeing trajectories. These inequalities, which exist within or between populations, originate prenatally and can become more firmly entrenched due to exposure to

cumulative adverse experiences (122). With more than 250 million children below the age of five years in LMICs at risk of not reaching their full potential due to developmental risks, ACE prevention becomes a matter of social justice. Early integrated interventions are of critical importance to protect the next generation and are a potentially cost-effective way to prevent age-related disease in adulthood (104, 122).

3.4.2 Childhood factors

The association between community SES and abuse is an important finding in this generally low SES population. Research shows that both neighbourhood disadvantage and affluence have an effect on the experience of ACEs; greater disadvantage increases the risk of higher ACE scores while affluence reduces the risk (70). Many studies have shown that neighbourhood factors correlate with maltreatment rates, the most consistent associations being with indicators of the economic status or resources of the neighbourhood (123). Possible explanations that have been put forward for these findings are that the differences are due to exposure to concentrated levels of inequality and disability that are characteristic of poor neighbourhoods together with characteristics of the youth living in these areas (70). Others have postulated that the link is through parental interaction with the environment, with parents who have positive perceptions of their neighbourhood context less likely to maltreat their children because of the potential protective capacity of neighbourhood supports (45).

Higher household SES was protective against experiencing any ACEs, as well as experiencing four or more ACEs, compared to no ACEs. These findings match those reported by Hatcher et.al with the interpretation that poverty is a key context for children experiencing abuse and maltreatment, and low SES may also compound deleterious effects of the abuse (121). Household poverty has been reported as a mediator between child maltreatment and chronic illness (14). Lower household SES may also increase parental stress and thus put children at risk of maltreatment (101). The association of household SES during childhood with unemployment in the household as an ACE could possibly be an indication of the vicious cycle that can occur in poor households that have limited access to education and other means of improving their status. Interventions to prevent ACEs, therefore, also need to address access to education and socio-economic empowerment for

households and communities. Our analysis did not find any significant associations between change in household SES and the experience of ACEs. However, adult household SES for people who have experienced ACEs has been found to mediate the relationships between ACEs and health outcomes (124), potentially creating an enabling environment for socio-economic change that may help to mitigate the effect of ACEs.

Family structure and the absence of the father in the home in childhood have a significant impact on the occurrence of ACEs. Our results show that single maternal marital status was significantly associated with children experiencing more ACEs compared to children whose mothers were married or had a live-in partner. Research on the effect of family structure on overall child well-being indicates that children from two-parent homes fare better, a relationship that is postulated to be mediated by economic resources, parental socialization, and lower family stress (125). This effect may be due to selection factors in that marriage may not necessarily help to make people feel happy, healthy, secure but that such individuals, who are more likely to be stable parents, are more likely to marry in the first place (125). In Canada maternal single marital status was also reported to be associated with allegations of child maltreatment (126). Further evidence from Sub-Saharan Africa suggests independent associations between paternal orphaning and parental absence and children experiencing sexual violence, with girls being at higher risk of sexual abuse (40). In South Africa, a study conducted in the Western Cape found that family satisfaction ranked lower among households with absent fathers, partly due to limited economic resources (127). It is also possible that in the present study the divorce and separation captured in the ACEs retrospective report occurred before two years of age and hence the association between divorce/separation as an ACE and absent fathers. Further exploration is needed in this cohort on the role of family structure on the occurrence of ACEs.

3.4.3 Inter-relation and co-occurrence of ACEs

The attenuation of associations between childhood factors and some of the ACEs in the adjusted models points to possible interrelationships between the ACEs, with some ACEs potentially acting as mediators. For example, household poverty has been found to mediate the association between chronic illness in the household and child maltreatment (14).

The cumulative risk hypothesis posits that additive risk factors increase the probability of adverse outcomes (12, 128). Use of the ACE score to capture the co-occurrence and cumulative impact of ACEs is coherent with this, as well as with evidence emerging from the neuroscientific field. Prolonged exposure to maltreatment early in life and attendant increases in stress hormones can influence the structural and functional plasticity of the brain, which in turn can affect patterns of emotional expression and regulation, stress reactivity, recovery, and coping, and perhaps even the rate of bodily aging (129). The investigation of childhood maltreatment needs to go beyond examination of single abuse exposures to investigating the household environment as well. The presence of one ACE should elicit a search for others, taking into account that the apparent effects of one ACE may not necessarily be attributable to that ACE alone.

3.4.4 Strengths and limitations of study

To our knowledge this is the first study to investigate the prevalence of ACEs in an African country using an extended definition to that of the Kaiser Permanente ACE study (5); as such, it adds to the still scant body of evidence from LMICs (120). We were able to use longitudinally collected childhood factors to investigate their impact on the reporting of ACEs experienced during the first 18 years of life. These results add to the body of knowledge on the prevalence of ACEs in LMICs and contribute to disentangling the intricate connections between them. The availability of robust local data from a long-running cohort study also means the findings are immediately relevant to the context (130).

Limitations of this study were firstly, as was done in the CDC-Kaiser Permanent Study, the experience of ACEs was retrospectively measured and open to recall bias. Contemporary individual characteristics such as chronic stress may influence the recall of some events (74). The participant may also have experienced adverse events very early in childhood that they may not recall. Secondly, due to the analysis being cross-sectional, temporality could not be stablished. There was no data available on the exact time of the experiences, how intense the abuse was and how long it lasted. Nonetheless, the use of an ACE score gives some indication of multiple, though not necessarily repeated or enduring, exposure. Some of the childhood factors may have changed between birth and 18 years of age and this was not accounted for. Face-to-face interviews for the demographic questionnaires may also have

resulted in reporting bias, for example reporting higher SES. The community SES variable was derived from questions that may be subjective, but no other measures of community wealth were available.

1636 participants from the original cohort were surveyed at 22 years of age, an attrition rate of 50%. In addition, only 1223 of those surveyed had complete ACE data and were used in the modelling analyses. Table 3 in Supplementary Information shows a comparison of demographic characteristics between participants surveyed at 22 with full ACE data and those surveyed but with missing ACE data. There were no differences in gender and SES. However, those who were not surveyed were less likely to be married and to have completed secondary schooling. Attrition may introduce selection bias where the distribution of unmeasured confounders depends on whether the participants remained in the study or not, threatening the internal validity of the study. It may also compromise external validity and reduce the generalizability of results (131). We do not claim that our results are generalizable to the entire population of South Africa. However, the cohort was large at the start in order to mitigate the effects of attrition on internal validity.

3.5 Conclusion

ACEs are highly prevalent in this cohort of young adults. SES is an important factor in the experience of ACEs. This finding is important because the impact of ACEs on behaviours, emotional and social well-being, and physical health has been shown to be cumulative (7, 13, 36, 107, 132). Parents, households and communities need help and support to create and maintain environments that are conducive for healthy child and adolescent development. A multi-setting, multi-sector approach is needed to coordinate service provision in areas that seem unrelated, such as employment and income protection, community safety, drug and alcohol rehabilitation, treatment of mental illness and rehabilitation of ex-convicts, all of which have a major impact on the home environment and hence child development.

Chapter 4 : Identifying underlying adverse childhood experience typologies in the Birth to Twenty Plus Cohort: A latent class analysis

4.1 Introduction

The study of child maltreatment has in the past tended to focus on single exposures such as sexual or physical abuse despite emerging evidence indicating that adverse childhood experiences (ACEs) co-occur and are highly interrelated (5, 35). From as far back as the 1980s, it was recognized that the long-term effects of child maltreatment may not necessarily be due to any single exposure but rather to negative experiences associated with the exposure such as psychological abuse, neglect and family dysfunction (133). ACEs as defined by the Kaiser Permanente Health Centre for Disease Control Study (ACE Study) comprise physical, sexual, and emotional abuse, physical and emotional neglect as well as several forms of household dysfunction (5). In addition to demonstrating that people who experience one type of adversity typically experience several others, research has also shown that multiple compared to single exposures are relatively more damaging from a developmental perspective (134).

The interrelatedness of ACEs has been demonstrated in several populations. The ACE Study data demonstrated that child sexual abuse and alcohol abuse in the household rarely occur as isolated events and can increase the likelihood of experiencing any of the other ACEs by as much as 18 times (35, 135). Similar results have been observed in paediatric samples with certain types of ACEs co-occurring more often than other types (136). The interrelatedness of ACEs is even more pronounced among high-risk populations. Exposure to one ACE increased the likelihood of having another by as much as 1 286 times among young juvenile offenders compared to youth who reported no ACEs, and by as much as 16 times among high-risk urban youth in the USA (136, 137). This evidence suggests that the presence of one ACE should elicit a search for others and that underlying common risk factors among specific adverse experiences should be investigated (136).

The ACE score has been used to capture the cumulative impact of childhood adversity. However, investigations of ACE interrelatedness must inevitably move beyond predefined categories to reveal context-specific typologies. This knowledge is important in crafting preventive strategies that are effective and targeted for specific populations. One of the main disadvantages of the ACE sum score is its inability to provide information on the different

constellations of ACE experiences and disaggregate the various permutations of risk that are unique to participants (134). This in turn hinders our understanding of the underlying mechanisms between co-occurring and interrelated adverse experiences. The technique of latent class analysis is increasingly being utilized to overcome this barrier by classifying ACEs into categories based on the observed data.

Latent class analysis (LCA) is a person-oriented approach that can identify distinct population subgroups of individuals with similar ACE risk profiles (134, 138). LCA allows researchers to characterize discrete latent unobserved variables based on the cross-classification of two or more observed categorical (ACE) variables (139). It makes possible the investigation of underlying typologies and the prediction of adverse outcomes based on these typologies.

The objectives of this study were to explore how ACEs are interrelated in the Bt20+ cohort, investigate the presence of distinct latent ACE typologies within the population and assess their association with childhood factors.

4.2 Methods

4.2.1 Study design and context

Data from the Birth to Twenty Plus (Bt20+) Study were utilized for this latent class analysis. Beginning in 1990, data has been collected from the cohort on childhood, household, community and socioeconomic factors among others (91). Further information on the data collection have been described elsewhere (91, 140). Data for this study were collected when the cohort was aged between 22 and 23 years.

4.2.2 Participants/Study population

Of the 3273 singleton children initially recruited into the study (91), 1636 were surveyed at 22-23 years of age.

4.2.3 Measures

4.2.3.1 Adverse childhood experiences

A modified, self-administered ACE Study questionnaire was used to collect ACE experience data. Information on chronic illness, unemployment and parental death were also collected in addition to the ten ACEs (5) used in the ACE study based on recommendations to expand the ACE definition based on different settings (72, 74, 111). The thirteen ACEs measured were sexual, physical and emotional abuse, emotional and physical neglect, parental death and divorce, witnessing domestic violence, substance abuse in the household, mental and chronic illness of a household member, unemployment of a caregiver and incarceration of a household member. One point was allocated to each ACE exposure, making a total possible score of 13.

4.2.3.2 Childhood factors

These were included in the analysis as covariates in the latent class regression model. We included mother's level of education and marital status at birth, father's presence at birth and household socio-economic status (SES) at birth. We also included community SES at 18 years of age.

4.2.4 Statistical analysis

Analyses were carried out using STATA version 16 (141).

4.2.4.1 Descriptive statistics

The prevalence of each ACE exposure was determined and tabulated by gender, as well as the childhood factors of the sample.

4.2.4.2 Co-occurrence

Cross –tabulations were carried out to show the individual ACEs most likely to co-occur with others and is presented in graphs.

4.2.4.3 Latent class analysis

We used exploratory factor analysis (EFA) as a preliminary assessment for the presence of latent factors. Because the ACE exposures are dichotomous, the variables were first converted into a correlation matrix before conducting the EFA. A scree plot was used to

determine the possible number of factors supported by the data. Oblique promax rotation was chosen because we assumed that the factors would be correlated and maximized factor loadings at the absolute value of 0.3. Cronbach's alpha test was carried out to test the strength of agreement between the variables loading onto each of the factors retained.

We then applied latent class analysis in Stata 16 (141) to identify distinct clusters of ACEs in this cohort. A latent class model has a categorical rather than continuous latent variable and the levels of this categorical latent variable represent unobserved groups in the population, referred to as classes (142). We fitted one, two, three, four and five class models and selected the best-fitting model based on the likelihood ratio test, Akaike's information criterion (AIC) and Schwarz's Bayesian information criterion (BIC). The association between gender and childhood SES and the latent classes was also investigated.

4.3 Ethics

Ethics approval particulars are detailed in Chapter 2.

4.4 Results

4.4.1 Characteristics of the sample and prevalence of ACEs

The sample characteristics are presented in Table 4.1. Forty-eight percent of the sample was male and 52% female. Sexual and physical abuse were the lowest reported ACEs (4% and 8% respectively), while unemployment of a parent or caregiver and parental divorce or separation had the highest prevalence at 43% and 45% respectively.

Table 4.1 Descriptive statistics of the YAS sample, n=1636

Variable	Male n (%)	Female n (%)	Total n (%)
Mother's education at birth			
None	6 (1)	9 (1)	15 (1)
Primary	92 (13)	87 (11)	179 (12)
Secondary	558 (79)	621 (80)	1179 (80)
Post school training	49 (7)	55 (7)	104 (7)
Mother's marital status at birth			
Single/widowed	478 (63)	547 (66)	1025 (65)
Married/living together	282 (37)	276 (34)	558 (35)
Father's presence at birth			
No	103 (15)	114 (15)	217 (15)
Yes	589 (85)	642 (85)	1231 (85)
Household SES at birth			
Low	338 (55)	351 (51)	689 (53)
High	279 (45)	339 (49)	618 (47)
Community SES at 18 years			
Low	188 (26)	224 (28)	412 (27)
High	526 (74)	573 (72)	1099 (73)
Emotional abuse			
No	519 (69)	572 (70)	1091 (70)
Yes	232 (31)	240 (30)	472 (30)
Sexual abuse			
No	707 (97)	754 (95)	1461 (96)
Yes	22 (3)	40 (5)	62 (4)
Physical abuse			
No	665 (91)	742 (93)	1407 (92)
Yes	67 (9)	52 (7)	119 (8)

Emotional neglect			
No	555 (74)	562 (69)	1117 (71)
Yes	198 (26)	252 (31)	450 (29)
Physical neglect			
No	648 (86)	734 (90)	1382 (88)
Yes	103 (14)	78 (10)	181 (12)
Domestic violence			
No	657 (88)	700 (87)	1357 (87)
Yes	93 (12)	108 (13)	201 (13)
Parental divorce/separation			
No	357 (56)	369 (54)	726 (55)
Yes	281 (44)	311 (46)	592 (45)
Parental death			
No	521 (69)	602 (74)	1123 (72)
Yes	231 (31)	212 (26)	443 (28)
Substance abuse			
No	521 (69)	613 (75)	1134 (72)
Yes	233 (31)	204 (25)	437 (28)
Mental illness			
No	674 (90)	707 (87)	1381 (88)
Yes	79 (10)	110 (13)	189 (12)
Incarceration			
No	552 (73)	652 (80)	1204 (77)
Yes	202 (27)	163 (20)	365 (23)
Chronic illness			
No	562 (75)	591 (73)	1153 (74)
Yes	191 (25)	222 (27)	413 (26)
Unemployment			
No	409 (54)	479 (59)	888 (57)
Yes	346 (46)	339 (41)	685 (44)

4.4.2 Interrelation and co-occurrence of ACEs

To show the interrelatedness and co-occurrence of individual ACE exposures, Figures 4.1 and 4.2, show that among participants experiencing emotional abuse, 21% reported experiencing four other ACEs and 16% experienced five other ACEs. 22% of those who experienced physical abuse experienced five other ACEs while 18% of those reporting emotional neglect also experienced four other ACEs.

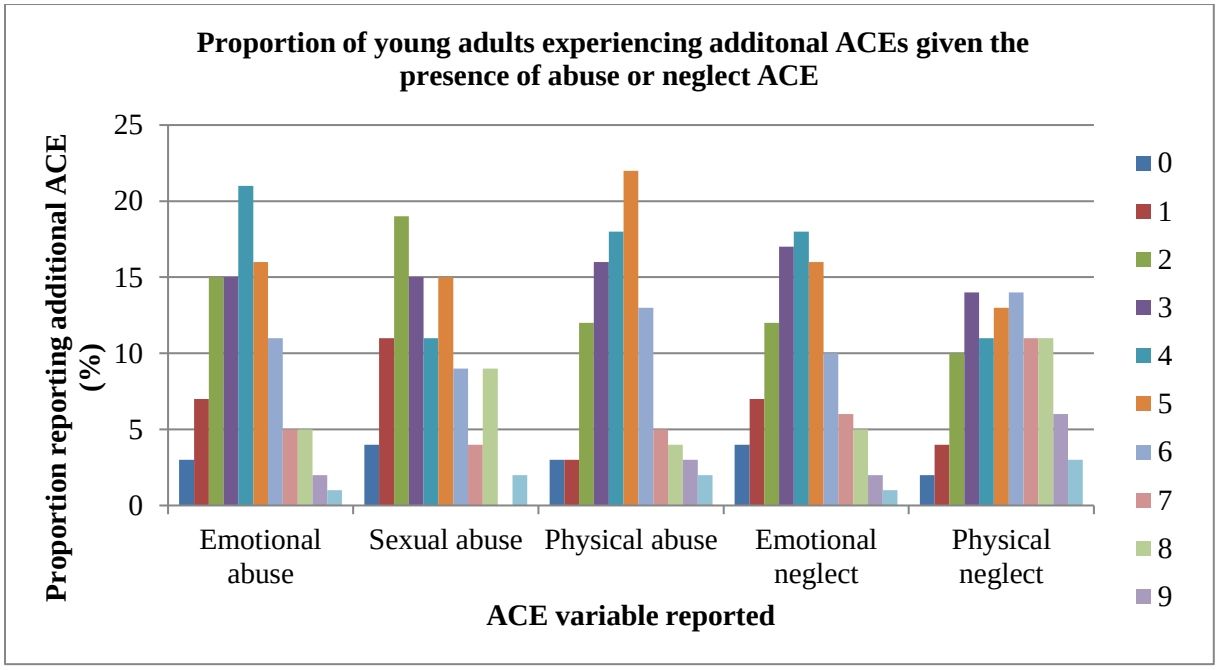


Figure 4.1 Proportion of young adults reporting additional ACEs given the presence of each of the ACEs in the abuse and neglect group

Legend: X-axis- labels represent the single ACEs experienced. Each bar under each single ACE represents the number of additional ACEs experienced besides the ACE on the label. **Y-axis –** the proportion of people experiencing that number of additional ACEs

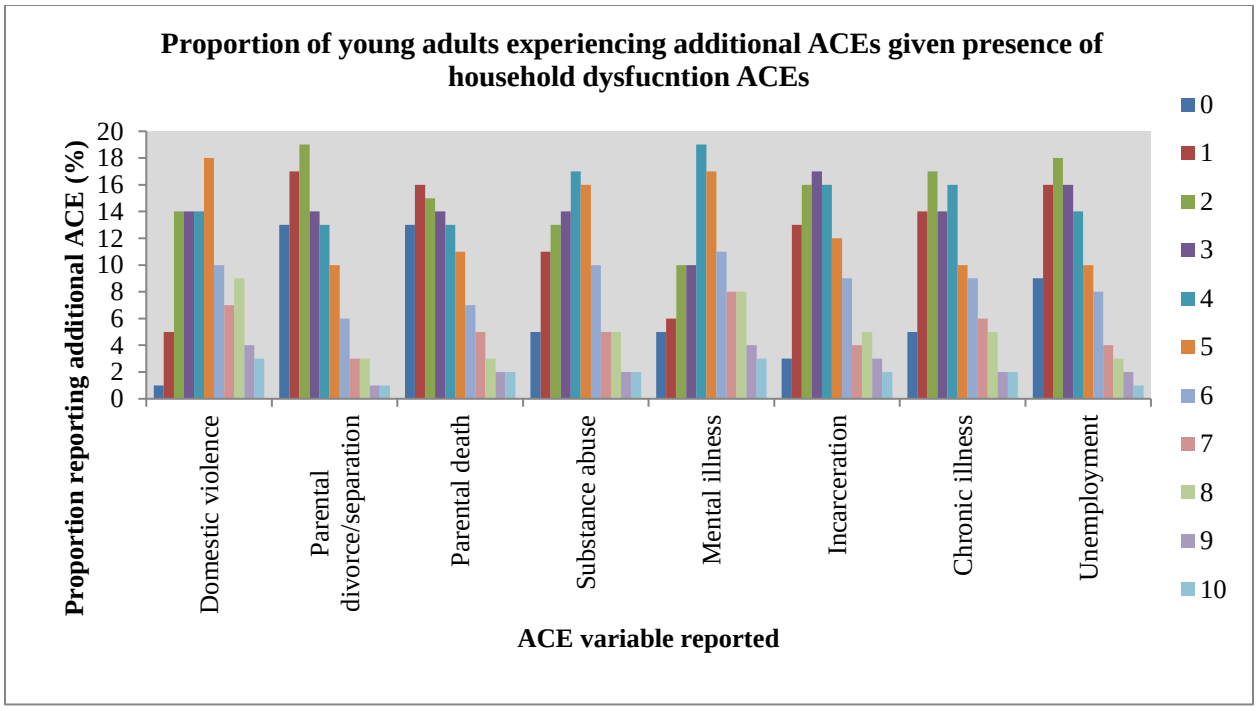


Figure 4.2 Proportion of young adults reporting additional ACEs given the presence of each ACE in the household dysfunction group.

Legend: X-axis- labels represent the single ACEs experienced. Each bar under each single ACE represents the number of additional ACEs experiences besides the ACE on the label. Y-axis – the proportion of people experiencing that number of additional ACEs

High proportions of participants who reported witnessing domestic violence, household substance abuse and mental illness also reported experiencing four or five other ACEs. The highest proportion of participants reporting ten or more other ACEs was among those who reported physical neglect, domestic violence and mental illness.

4.4.3 Exploratory Factor analysis

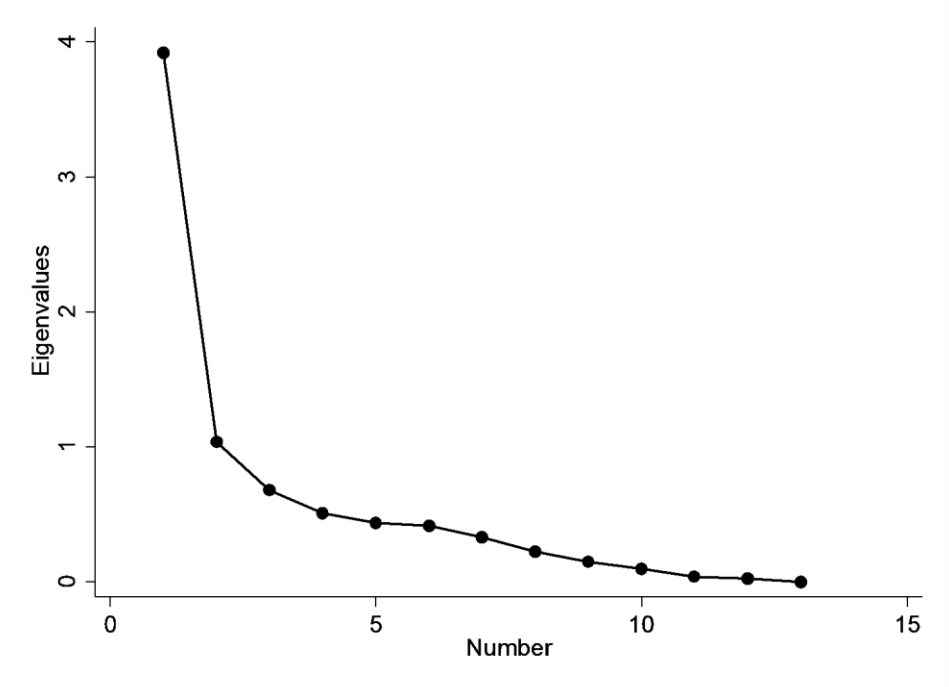


Figure 4.3 Scree plot of Eigen values after performing iterated principal factor analysis.

The plot shows the fraction of total variance explained by each factor obtained in the analysis, and displays the factors in decreasing proportion from left to right. Where the "elbow" is apparent on the plot is the point of separation between the most important and least important factors.

An EFA using iterated principal factor analysis was conducted using the 13 individual ACEs used in this study. Examination of the scree plot (Fig 4.3) showed that the eigenvalues begin to flatten between the third and fourth factors but only factors one and two have eigen values greater than 1 before rotation, therefore both a two-factor (Solution 1) and three-factor (Solution 2) structure were explored. The factor loadings for the two solutions are displayed in Table 4.2. In the two-factor solution domestic violence cross-loaded onto both factors, while physical abuse cross-loaded onto the first and third factors in the three-factor solution. The .05/0.2 rule states that an item can be

retained in the solution if its primary loading is greater than 0.5 and its secondary loading is less than 0.2 (143); based on this we should have discarded them from the solutions. However, we decided to keep them in because the EFA was a step in the process of determining the latent classes, and not the definitive stage.

Table 4.2 Factor loadings for the exploratory factor analysis of 13 individual ACEs in the Bt20+ Study

Two factor rotation				Three factor rotation		
Variable	**Factor 1 (41.3%)* Alpha: 0.5373**	**Factor 2 (36.8%) Alpha: 0.5007**		**Factor 1 (45.5%) Alpha: 0.6176**	**Factor 2 (36.6%) Alpha: 0.4744**	**Factor 3 (15.6%)**
Parental divorce						
Domestic violence	0.4336	0.3233		0.375		
Drug abuse		0.5935			0.6041	
Mental illness		0.4064			0.5282	
Incarceration		0.6882			0.8327	
Chronic illness					0.3418	
Unemployment		0.5311			0.3375	
Parental death						
Emotional abuse	0.7102			0.9058		
Emotional neglect	0.7809			0.9074		
Physical neglect		0.5681		0.6709		
Sexual abuse	0.5339					0.6604
Physical abuse	0.7808			0.4991		0.4902

*Proportion of variance accounted for by the factor

4.4.4 Latent class analysis

4.4.4.1 Class enumeration

We estimated an LCA to identify typical patterns of ACEs in this population and generate latent classes. Stata 16 fits the latent class models using the generalized structural equation model (GSEM) estimation. Based on the EFA results we fit two, three and four class models. We estimated the probabilities of class membership as well as the relationship between the latent classes and some childhood variables.

Table 4.3 Relative measures of fit class enumeration for latent class analyses

Number of classes	N	Log likelihood	AIC	BIC	LRT (p-value)
Two	1591	-9335.318	18724.636	18869.683	549.477 (1.00)
Three	1591	-9283.592	18649.184	18869.441	446.025 (1.00)
Four	1591	-9227.808	18565.616	18861.082	334.456 (1.00)

The four-class solution presented in Figure 4.4 was selected based on the general rule for the fit values that “the smaller, the better” (Table 4.3).

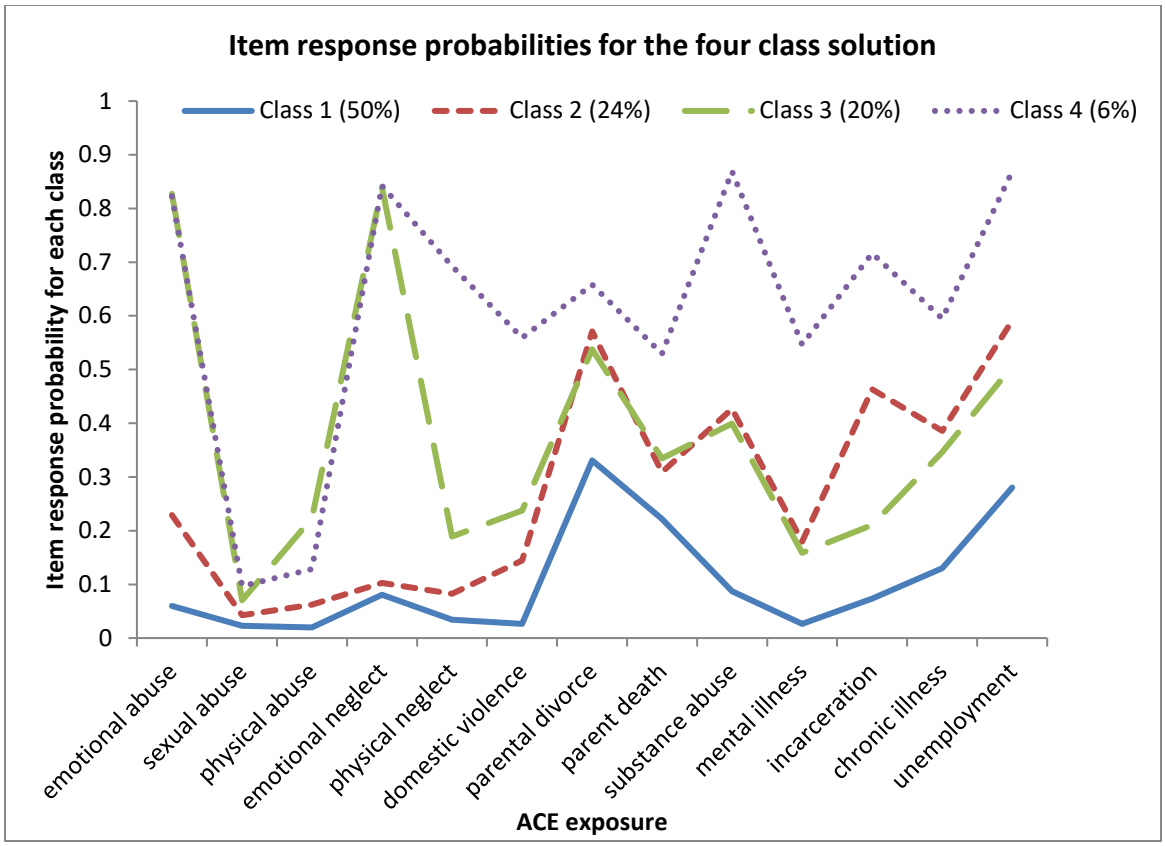


Figure 4.4 Item response probabilities for the ACE exposures in the four class solution

The proportion of the sample in class one was 50%, class two 24%, class three 20% and class four was six percent. We named class one the "Low ACE" class, class two "Low abuse and neglect, medium household dysfunction", class three "High emotional abuse and neglect, low household dysfunction" and class four "High emotional abuse and neglect, high household dysfunction".

Table 4.4 Comparison of the latent classes with the ACE sum score

ACE Score Categories	Class 1 Low ACE n (%)	Class 2 Low abuse and neglect, medium household dysfunction n (%)	Class 3 High emotional abuse and neglect, low household dysfunction n (%)	Class 4 High emotional abuse and neglect, high household dysfunction n (%)
None	149 (22)	0 (0)	0 (0)	0 (0)
1 ACE	242 (36)	0 (0)	0 (0)	0 (0)
2 ACEs	199 (30)	13 (5)	2 (1)	0 (0)
3 ACEs	76 (12)	80 (34)	30 (12)	0 (0)
4 or more ACEs	4 (1)	146 (61)	221 (87)	61 (100)

Table 4.4 demonstrates how the summative ACE score compares to our four-class latent class analysis. The first and last classes are more homogenous than classes 2 and 3, meaning individuals in classes 2 and 3 would be classified as experiencing at least 2 or more ACEs with no distinction on the level of abuse and neglect.

Table 4.5 Ordered logistic unadjusted and adjusted regression results of childhood factors associated with latent classes

Childhood variable	Unadjusted Coefficient (95% CI)	Adjusted Coefficient (95% CI)
Mother's education		
None	Ref	
Primary	0.27 (-0.72; 1.26)	-
Secondary	0.006 (-0.95; 0.97	
Post school training	-0.22 (-1.25; 0.80)	
Mother's age at birth	**-0.02 (-.04; -0.006)****	**-0.02 (-0.04; -0.002)**
Father present at birth		
No	Ref	-
Yes	-0.13 (-0.41; 0.14)	
Mother's marital status		
Single/widowed	Ref	Ref
Married/living together	**-0.17 (-0.37; 0.02)***	0.04 (-0.22; 0.31)
SES at birth		
Low	Ref	Ref
High	**-0.34 (-0.55; -0.13)****	-0.22 (-0.45; 0.01)
SES at 16 years		
Low	**Ref**	**Ref**
High	**-0.43 (-0.65; -0.22)*****	**-0.36 (-0.61; 0.12)**
Community SES at 18 years		
Low	Ref	Ref
High	**-0.32 (-0.53; -0.11)****	-0.23 (-0.48; 0.02)

*p<0.1; **p<0.05; ***p<0.001

In Table 4.5 we find that the age of the mother remained significant in the adjusted model. Before adjusting for other factors, all SES variables were significantly associated with latent class. However, only SES at 16 years of age remained significant in the adjusted model.

4.5 Discussion

The findings from this low to middle income young adult population indicate that ACEs are not only highly prevalent but also interrelated and co-occur in fairly distinct patterns. At least one out of five of respondents who experienced physical abuse, emotional abuse, domestic violence, drug and alcohol abuse or mental illness in the household reported four or more other ACEs. There is evidence of clustering with four distinct latent classes identified in this population, namely: low ACEs, low abuse/neglect and medium household dysfunction; high abuse and neglect and low household dysfunction; and high emotional abuse and neglect and high household dysfunction. Sexual and physical abuse reporting rates were too low to be included in any of the classes. SES appears to be an important childhood factor associated with the latent clusters, as well as the mother's age at the participant's birth.

The co-occurrence of ACEs has been documented in almost every instance that an analysis of ACEs has been done and analyses methods have evolved from simple cross-tabulations to more advanced latent class analysis. Dong et.al (5) report that between 81 to 98% percent of the ACE Study participants who had at least one ACE, reported one more ACE. The presence of one ACE increased the odds of having one other by two to 17 times (5). In a population of juvenile offenders, nearly a quarter of the participants who reported at least one ACE also reported six or more other exposures (137).

Evidence supports the link we found between domestic violence and abuse and neglect (144-146). The clustering together of domestic violence and abuse and neglect variables in our EFA further points to the possibility of the child not only suffering direct effects of domestic violence, but of other ACEs that are potentiated or exacerbated it. The link between exposure to mental illness in the household and reports of other forms of maltreatment, especially neglect, sexual and physical abuse has been found elsewhere (147). Though it is not possible in this study to infer causal links, a vicious cycle can be set off by mental illness and drug

abuse and possible associated imprisonment, which can lead to lower prospects of employment and therefore fewer resources or emotional presence to take good care of a child. Evidence of the mediating effects of mental illness and substance abuse on the link between parental maltreatment and subsequent offspring abuse and neglect has also been reported and is a subject for further study in this population (148, 149). The direction and pattern of the co-occurrence of these ACES needs to be studied further using longitudinal data.

With the advancement of analysis methods and software, it is increasingly evident that there may be distinct underlying groupings of ACE experience in various populations. Many of the populations investigated have in common a low ACE class where exposure is between no ACEs and up to four ACEs (134, 138, 150, 151). What remains to be investigated are firstly, the reasons for the low ACEs, secondly whether the low ACEs class significantly predicts poor health outcomes and lastly whether the same ACEs are consistently low across different populations. Latent classes appear distinct and well defined for their specific populations (138, 152, 153). However, more investigation is needed to ascertain whether the groups in this study are consistent across larger and different populations and whether results from one area can be generalised to another. The potential implications of this are that interventions based on ACE clusters in one population may not be beneficial in a different population. ACE clusters have been found to predict disease in some populations and this may change the way the cumulative impact of ACEs is assessed whether to use the score or the clusters. Using clusters would enable specific profiles of ACE exposure to be linked to specific outcomes and allow better targeting of interventions. In our analysis we found that the ACE score compared well with the low ACEs class and the high multiple ACEs class, with classes 2 and 3 being more heterogeneous.

The cumulative risk hypothesis posits that additive risk factors increase the probability of adverse outcomes (12, 128). Use of the ACE score and latent clusters to capture the co-occurrence and cumulative impact of ACEs is consistent with this, as well as with evidence emerging from the neuroscientific field. Prolonged exposure to maltreatment early in life and the attendant increase in stress hormones can influence the structural and functional plasticity of the brain, which in turn can affect patterns of emotional expression and regulation, stress

reactivity, recovery, and coping, and perhaps even the rate of bodily aging (129). The investigation of childhood maltreatment needs to go beyond examination of single abuse exposures to investigating the household environment as well. The presence of one ACE should elicit a search for others, considering that the apparent effects of one ACE may not necessarily be attributable to that ACE alone.

Our findings align with the ecobiodevelopmental framework for early childhood policies and programs proposed by Shonkoff et.al. (26). The framework for formulating ACEs interventions presupposes that ACEs occur to individuals in households, situated in in communities and in society. It is possible that the specific clustering of ACEs seen in different populations is driven by unique community factors because the majority of ACEs can be exacerbated or potentiated by community and cultural factors. With that in mind, Shonkoff et.al. posit that interventions that capacitate households and primary caregivers are important in reducing the occurrence of ACEs. Examples include legislative and administrative policies aimed at improving primary healthcare, housing and economic stability for parents (26). Any changes initiated at the individual level, for example drug rehabilitation of an addicted parent, need support at household, community societal levels for long term success.

4.5.1 Strengths and limitations of study

To our knowledge this is the first study to investigate the co-occurrence and clustering of ACEs in an African country using a comparable definition to that of the Kaiser Permanente ACE study; as such, it adds to the still scant body of evidence from middle-income countries. Similar research from low-income countries is still not available (120). We were able to use longitudinally collected childhood factors to investigate their impact on the clustering of ACEs during the first 18 years of life. The availability of robust local data from a long-running cohort study adds the benefit of the findings being immediately relevant to the context (3).

Limitations of this study were firstly, as was done in the Kaiser Permanent study, the experience of ACEs was retrospectively measured and are open to recall bias. Secondly, due

to attrition of the original cohort these results are not generalizable to the entire population. However, they do provide a window into how ACEs possibly associate in similar populations.

4.6 Conclusion

ACEs are highly prevalent and interrelated in this cohort of young adults, with evidence of distinct clusters. This finding is important because the impact of ACEs on behaviors, emotional and social well-being, and physical health has been shown to be cumulative (7, 13, 36, 107, 132). Service provision, programs and policy targeted at preventing and mitigating the effects of child maltreatment need to take this into account and include systems that, in the presence of one ACE, actively assess for the occurrence of other ACEs. The pervasiveness of some household dysfunction ACEs like domestic violence and mental illness points to the need for help and support for parents and households to help them to create and maintain environments that are conducive for healthy child and adolescent development. A multi-setting, multi-sector approach is needed to coordinate service provision in areas that seem unrelated, such as drug and alcohol rehabilitation, treatment of mental illness and rehabilitation of ex-convicts, all of which have a major impact on the home environment and hence child development.

Chapter 5 : Stress begets stress: The association of adverse childhood experiences with psychological distress in the presence of adult life stress

5.1 Background

Adverse childhood experiences (ACEs) have been linked to a myriad of poor behavioural and health outcomes. ACEs as defined by the Kaiser-Permanente Study, also known as the ACE Study, include child abuse and neglect and growing up in dysfunctional households characterized by domestic violence, mental illness and incarceration of a household member, parental divorce or separation and household drug or alcohol abuse (6). A high proportion of children from different settings are exposed to ACEs (6, 13, 36, 54, 101).

An increasing body of evidence points to a consistent link between ACEs and poor mental health in both children and adults. The ACE Study itself showed that the risk of suicide attempts increased two to five-fold with experiencing any ACE and an ACE score of four or more was associated with increased risk of attempted suicide, lifetime depressive disorders and poor mental health in general (82, 154, 155). Strong dose-response relationships between ACEs and depressive symptoms, drug abuse and antisocial behaviour as well as psychological distress (PD), perceived well-being and missed days of work have also been demonstrated (156, 157). A South African study, though not using the full description of ACEs, found a significant association between childhood emotional neglect and adult depression, alcohol problems and suicidality (13).

Mental, neurological and substance use disorders constitute a significant global disease burden, with 10% of global disability-adjusted life years (DALYs) attributed to these disorders in 2010 (158, 159). More than 1.1 billion people worldwide suffered from mental and substance use disorders in 2016 according to the Global Burden of Disease Study, constituting 18.6% of the total non-fatal disease burden (160). In the South African Stress and Health (SASH) Study conducted between 2002 and 2004, the lifetime prevalence of major depression was 9.7%, and 4.9% for the past year; 9.8% and 4.9% for mood disorders, and 15.8% and 8.1% for anxiety disorders respectively (161, 162). Mental health remains neglected in many countries with a large gap existing between the burden caused and resources available to address mental health problems (163). PD, which is defined as a "state of emotional suffering" characterized by depressive, anxiety as well as some somatic

symptoms, is widely used as a marker of population mental health (164). Evidence shows that it is positively associated with mental disorders and mental well-being (165).

The occurrence of stressful life events in adulthood increases the likelihood of experiencing psychological distress, as does race and availability of material resources, according to the SASH Study (166). A complex interplay exists between early life stress, socioeconomic status and later life adversity. The stress sensitization theory has been posited as a possible mechanism through which early adversity and stress in later life and poor health are connected. It suggests that repeated stress early in life dysregulates stress response systems and lowers the threshold for reactivity and adaptive responses to subsequent stress. This increases the risk of mental health disorders in later life (162, 167). In the same vein, Pearlin et.al put forward the theory of stress proliferation, a process through which stress begets stress, i.e. exposure to serious adversity in childhood increases the risk for later exposure to additional adversities (167, 168). Childhood adversity can result in secondary stressors that cause harmful health consequences either together with or in place of the initial event, with some secondary stressors possibly being other adverse events (168).

Several other factors have been identified as correlates of poor mental health. The prevalence of major depression and PD has been found to be higher among females than males, among people with lower levels of education and among those aged 40 to 49 years (161, 169). Increased risk of PD has been reported for unemployed and disabled persons as well as for those experiencing financial difficulties. (169-171). Some evidence suggests that household dysfunction ACEs are linked with the highest risk of mental disorders compared to abuse and neglect (172).

The relationship between ACEs and mental health is of marked public health importance. This association should however be examined in light of the several factors that may influence it, including adult stress and SES. Most of the literature on the epidemiology of ACEs and their impact on mental health comes from high-income countries. The objectives of this study were to: (1) describe the prevalence of ACEs and PD in a young adult South African sample, (2) examine the association between individual ACEs and PD and (3) assess the cumulative effect of ACEs on PD, while accounting for the effect of adult stress on this relationship.

5.2 Methods

5.2.1 Data and study population

Data for this cross-sectional study were drawn from the Birth to Twenty Plus (Bt20+) Study.

5.2.2 Measures

5.2.2.1 Psychological distress

The main outcome measure, psychological distress (PD), was assessed using the General Health Questionnaire 28 (GHQ-28), a screening tool developed to assess the risk of developing psychiatric disorders (173). It comprises 28 items arranged in four subscales: somatic symptoms; anxiety/insomnia; social dysfunction, and severe depression. Each item has four possible responses, namely Not at all, No more than usual, Rather more than usual, and Much more than usual, coded 0 to 3. The recall period for the GHQ-28 is six months. The total score for each participant was computed with a possible score of 21 for each subscale and a global total of 84. In line with literature, a total score of 24 was considered to be the threshold for PD, creating a binary variable for PD (173). The four subscales were also analysed separately as count variables. The internal validity of the GHQ-28 was tested using Cronbach's alpha analysis. An alpha coefficient of 0.9013 was obtained for correlation between all the 28 items and values of 0.7649, 0.8541, 0.7608 and 0.8802 were obtained for the somatic, anxiety, social dysfunction depression subscales respectively. All the questionnaire items were therefore retained in the analysis.

5.2.2.2 Adverse childhood experiences

Using a questionnaire adapted from the ACE Study Questionnaire (174), ACEs were retrospectively reported at 22-23 years of age. Data on chronic illness, unemployment and parental death were also collected in addition to the original ten ACEs used in the ACE study, based on recommendations to include some experiences that may be prevalent and relevant in low-income settings (72). Appendix 2 shows the questions used to assess ACEs. A point was allocated to each ACE exposure for which a participant answered yes to one or both questions, i.e. only one point could be allocated to each ACE.

ACEs were analysed as single variables, or grouped into abuse (emotional, physical and sexual abuse), neglect (emotional and physical neglect) and household dysfunction (parental

divorce, parental death, drug abuse in household, mentally ill household member, chronically ill household member, incarcerated household member, witnessing domestic violence and unemployment of caregiver) categories. An ACE score was computed by adding the number of ACEs to which each person was exposed. Three categorical variables were created based on the ACE score:

1. A binary variable to indicate the proportion of participants who had experienced at least one ACE before the age of 18 years.

2. A variable with five ACE score categories to indicate those who experienced no ACEs, one, two, three and four or more ACEs, to allow comparability with similar studies (6).

3. A variable was created to broadly divide the ACE score into three categories: no ACEs (score of 0), lower level of ACEs (score 1 to 5) and higher level of ACEs (score 6 to 13).

These three variations of the ACE score were created to gain a better understanding of the cumulative effect of ACEs on mental well-being, as well as to have results comparable to similar studies.

5.2.2.3 Stressful life events in adulthood

Data were collected on the participants' experience of stressful life events during the preceding six months. Participants at age 22-23 years completed a questionnaire asking if the following had happened: injury of a household member due to violence, family member was a victim of crime, witnessing a violent crime, illness of a close family member, death of a close family member, living with someone with a serious disability in the family, drug or alcohol abuse in the household, fighting with or alienation from a close family member or neighbour, and incarceration of a family member. With each item assigned one point, a score of stressful life events experienced was computed and a categorical variable created with three categories: no experience (0), low levels (score of 1 to 3) and high levels of adult stress (score of 4 or more).

5.2.2.4 Socioeconomic and demographic factors

Previous work using the Bt20+ data suggests that a wealth index is useful in adjusting regression models for SES (175). At 22-23 years of age, participants were asked questions

regarding ownership of thirteen household assets: television, car, washing machine, fridge, phone, radio, microwave, cell phone, DVD/ Video player, DSTV (satellite television), computer, internet and medical aid /medical insurance. We assessed SES using a summative wealth index based on this list of assets. SES was analysed as a continuous variable with scores ranging between 1 and 13. The scores were normally distributed with the mean very close in value to the median.

The questionnaire also collected data on gender, age, current marital status, graduation from high school or completing matric, and current employment status.

5.2.3 Statistical analysis

5.2.3.1 Descriptive statistics

Prevalence of ACEs and demographic characteristics were described by the presence or absence of PD, and chi-square and analysis of variance (ANOVA) tests used to test for significant differences between them. The Kruskal-Wallis test was used to assess the difference in the reporting of subscale symptoms among those reporting at least one ACE compared to those with no ACE. The distribution of the ACEs grouped into abuse, neglect and household dysfunction is also described.

5.2.3.2 Logistic regression: Effects of individual ACEs on PD

Logistic regression was used to determine the unadjusted and adjusted association between ACEs and PD as follows:

a) The association between each individual ACE and PD was tested in univariate analysis as well as adjusted for demographic, SES and adult stress factors

b) A model was created that included all individual ACE variables and the demographic factors to assess for overlapping effects between the ACES.

c) Negative binomial regression was used to test for associations between ACEs and the different GHQ subscales and adult life stress.

d) The association between ACEs and adult life stress were also tested in univariate and multivariate (ordered logistic regression) analysis

5.2.3.3 Hierarchical logistic regression

a) We used hierarchical regression to test the association between the cumulative ACE score variables and PD in order to assess the direct relationship, the potential multiple pathways linking them as well the cumulative effects of not only ACEs but also adult stressful life events. In step 1, we adjusted for demographic variables age, gender, and marital status. The second step added household SES, current employment, and completion of high school. The adult life stress variable was added in the third step of the hierarchical regression.

b) An interaction term between ACEs and adult life stress was also tested in separate models, the term being added to the model in the third step. Figure 5-1 shows the conceptual framework used in the hierarchical analysis.

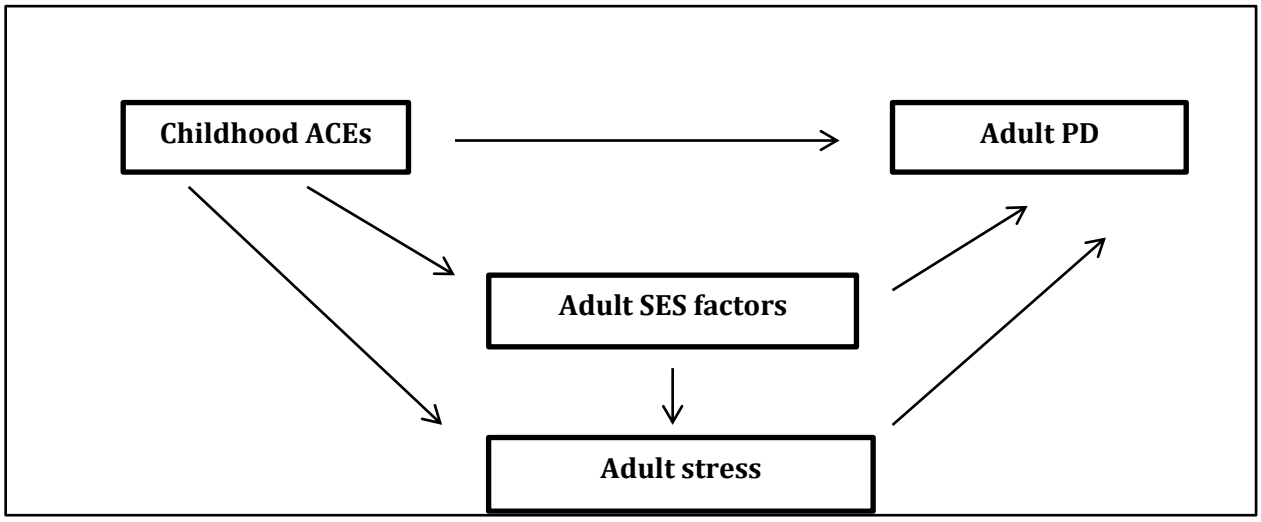


Figure 5.1 Conceptual framework for the hierarchical regression

ACEs – Adverse childhood experiences; PD-psychological distress; SES-socioeconomic status

The framework (Figure 5.1) hypothesizes a direct association between ACEs and PD independent of other factors. However, ACEs may act through SES and adult stress to impact mental well-being. SES factors themselves may also have an effect on adult stress. Demographic factors, not shown in the framework are potential confounders that may be associated with both ACEs and PD.

5.2.3.4 Missing data

We performed descriptive statistics on participants with missing ACE and PD data to check if there were any significant differences in demographic characteristics.

5.2.4 Ethics

Ethics approval details are outlined in Chapter 2 of this thesis.

5.3 Results

5.3.1 Descriptive analysis

Table 5.1 presents the demographic characteristics of the sample and the prevalence of ACEs and PD.

Table 5.1 Prevalence of ACEs and demographic characteristics of the sample, n=1223

Variable	PD No n (%)	PD Yes n (%)	Total N (%)	p-value
Cumulative ACE Variables				
Any ACE				
No	131 (15)	16 (5)	147 (13)	
Yes	735 (85)	308 (95)	1043 (87)	<0.001
ACE score categories				
None (0 ACEs)	131 (15)	16 (5)	147 (13)	
1 ACE	180 (21)	55 (17)	235 (20)	
2 ACEs	161 (19)	51 (16)	212 (18)	
3 ACEs	137 (16)	44 (14)	181 (15)	
4 or more ACEs	257 (30)	158 (49)	415 (35)	<0.001
Level of ACEs				
None (0 ACEs)	131 (15)	16 (5)	147 (12)	
Low (1 to 5)	640 (74)	228 (70)	868 (73)	
High (6 or more)	95 (11)	80 (25)	175 (15)	<0.001
Abuse				
No	731 (69)	220 (53)	951 (64)	

Yes	328 (31)	196 (47)	524 (36)	<0.001
Neglect				
No	812 (74)	217 (50)	1029 (67)	
Yes	282 (26)	214 (50)	496 (33)	<0.001
Household dysfunction				
No	169 (16)	29 (7)	198 (13)	
Yes	892 (84)	400 (93)	1292 (87)	<0.001
Individual ACE Variables				
Emotional abuse				
No	812 (74)	256 (59)	1068 (70)	
Yes	282 (26)	175 (41)	457 (30)	<0.001
Sexual abuse				
No	1032 (97)	385 (93)	1417 (96)	
Yes	31 (3)	27 (7)	58 (4)	0.001
Physical abuse				
No	997 (94)	369 (89)	1366 (92)	
Yes	68 (6)	44 (11)	112 (8)	0.005
Emotional neglect				
No	861 (78)	235 (54)	1096 (72)	
Yes	236 (22)	197 (46)	433 (28)	<0.001
Physical neglect				
No	992 (91)	355 (82)	1347 (88)	
Yes	101 (9)	77 (18)	178 (12)	<0.001
Domestic violence				
No	977 (90)	346 (80)	1323 (87)	
Yes	114 (10)	84 (20)	198 (13)	<0.001
Parental divorce/separation				
No	534 (57)	179 (51)	713 (55)	
Yes	401 (43)	174 (49)	575 (45)	0.039
Parental death				
No	794 (73)	305 (70)	1099 (72)	
Yes	301 (27)	128 (30)	429 (28)	0.417
Substance abuse				

No	836 (76)	278 (64)	1114 (73)	
Yes	264 (24)	155 (36)	419 (27)	<0.001
Mental illness				
No	1003 (91)	345 (80)	1348 (88)	
Yes	96 (9)	88 (20)	184 (12)	<0.001
Imprisonment				
No	852 (78)	325 (75)	1177 (77)	
Yes	246 (22)	108 (25)	354 (23)	0.289
Chronic illness				
No	837 (76)	292 (68)	1129 (74)	
Yes	259 (24)	140 (32)	399 (26)	<0.001
Unemployment				
No	644 (59)	222 (51)	866 (57)	
Yes	456 (41)	211 (49)	667 (43)	0.010
Age	23 (SD 0.6)	23 (SD 0.6)	23 (SD 0.6)	0.494
Marital status				
Single	538 (49)	228 (52)	766 (50)	
Marital relationship	567 (51)	207 (48)	774 (50)	0.188
Gender				
Male	594 (54)	150 (34)	744 (48)	
Female	516 (46)	288 (66)	804 (52)	<0.001
SES	9.4 (SD 2.3)	8.9 (SD 2.3)	9.3 (SD 2.2)	0.002
Secondary school graduation				
No	414 (38)	185 (43)	599 (39)	
Yes	680 (62)	247 (57)	927 (61)	0.073
Currently employed				
No	450 (47)	219 (57)	669 (50)	
Yes	503 (53)	166 (43)	669 (50)	0.001
Stressful life events (previous 6 months)				
No	352 (33)	85 (20)	437 (29)	
Low	619 (58)	254 (61)	873 (59)	
High	99 (9)	77 (19)	176 (12)	<0.001

The sample comprised 1223 participants with complete ACE data of whom 51% were women and 49% men. Nearly 90% of the sample reported experiencing at least one ACE, 35% experienced at least four and 15%experienced at least six ACEs. The most frequently reported ACEs were parental divorce or separation and parental unemployment (45% and 43% respectively), while the least frequently reported were sexual abuse (4%) and physical abuse (8%). Over a third of the participants reported experiencing some form of abuse, 33% reported experiencing physical or emotional neglect and over 90% reported household dysfunction. The proportion of participants with PD was 28%, with 66% of these being women. Approximately 50% of those who had PD reported experiencing at least four ACEs, compared to 30% of those who had no PD, and 25% reported six or more ACEs, compared to 11% of those who did not have PD. Of the demographic factors, there was no significant difference in education and marital status between those who reported PD and those who did not.

5.3.2 Missing data

Nearly two percent of males and 1.3 % of females did not have complete data for both ACEs and PD. Twenty-one percent of males and 23% of the females did not have complete ACE data, while 1.6% and 2.4% did not have complete PD data respectively and were thus (by default) not included in the regression models.

5.3.3 Reporting of individual GHQ subscales

Presented in Figure 5.2 are histograms that show the number of participants reporting each of the four different GHQ subscales in relation to their experience of at least one ACE. The median scores for the somatic, anxiety/insomnia, dysfunction and depression subscales were 4 (range 0-19), 4 (range 0-21), 6 (range 0-21) and 0 (range 0-21) respectively. The median scores for the subscales for participants experiencing at least one ACE compared to no ACEs were: 4 and 2 for somatic, 4 and 2 for anxiety/insomnia, 6 and 5.5 for dysfunction and 1 and 0 for depression respectively. The Kruskal-Wallis analysis showed that there was a significant difference in reporting somatic, anxiety/insomnia and depression symptoms between those who experienced at least one ACE and those who experienced no ACEs (p-value <0.05 for all three).

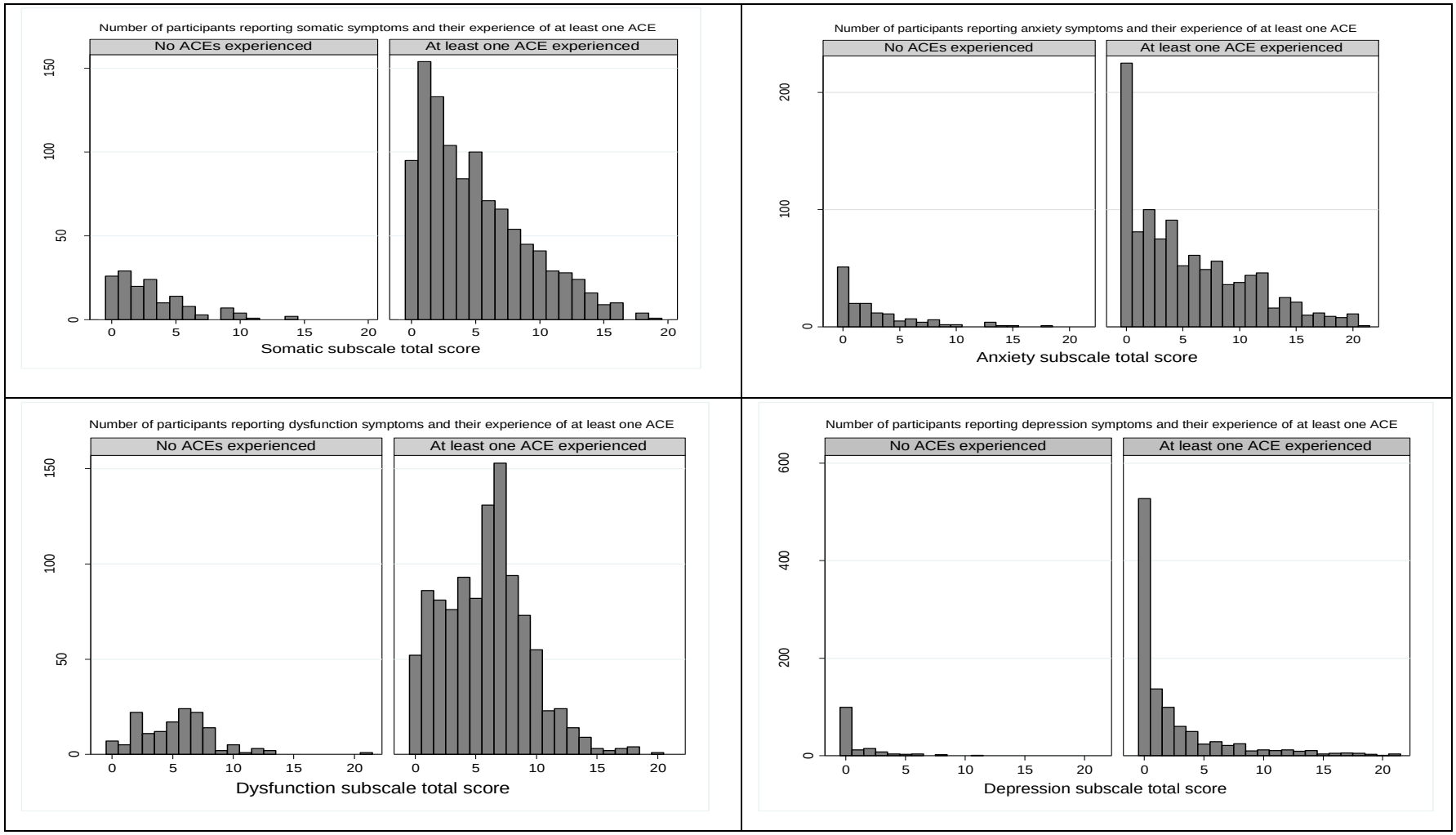


Figure 5.2 Number of participants reporting each of the GHQ subscales stratified by their experience of at least one ACE

The graphs present in each quadrant the participants who reported each of the four GHQ subscales, those who experienced no ACEs on the left of each quadrant and those who experienced at least one ACE on the right. In each quadrant are represented the participants who reported each of the four GHQ subscales, those who experienced no ACEs on the left of each quadrant and those who experienced at least one ACE on the right.

5.3.4 Regression analyses

5.3.4.1 Effects of ACEs on adult life stress

Table 5.3 shows the separate and cumulative effects of ACEs on adult life stress. Compared to those who experienced no ACEs and low levels of ACEs, participants who reported high ACE levels had nearly twelve times greater odds of experiencing higher levels of adult stress. None of the demographic factors were significantly associated with the experience of adult life stress. Parental death and sexual abuse were not significantly associated with adult life stress both in unadjusted and adjusted models.

Table 5.2 Separate and cumulative effects of ACEs on adult life stress

Variable	Crude OR (95% CI)	Adjusted OR (95% CI) Individual ACEs^
Any ACE		
No	Ref	Ref
Yes	**3.70 (2.63-5.22)**	**3.60 (2.55 – 5.08)**
Level of ACEs		
None	Ref	Ref
Low	**3.11 (2.20-4.40)**	**3.03 (2.14 – 4.30)**
High	**11.48 (7.28-18.11)**	**11.22 (7.08 – 17.75)**
Emotional abuse		
No	Ref	Ref
Yes	**2.97 (2.36 – 3.75)**	**2.93 (2.32 – 3.71)**
Sexual abuse		

No	Ref	Ref
Yes	1.26 (0.75 – 2.13)	1.21 (0.70 – 2.07)
Physical abuse		
No	Ref	Ref
Yes	**1.82 (1.25 – 2.67)**	**1.85 (1.26 – 2.70)**
Emotional neglect		
No	Ref	Ref
Yes	**2.90 (2.29 – 3.67)**	**2.82 (2.22 – 3.59)**
Physical neglect		
No	Ref	Ref
Yes	**2.48 (1.81 – 3.39)**	**2.20 (1.59 – 3.04)**
Domestic violence		
No	Ref	Ref
Yes	**1.79 (1.31 – 2.43)**	**1.76 (1.30 – 2.40)**
Parental divorce/separation		
No	Ref	Ref
Yes	**1.44 (1.15 – 1.79)**	**1.36 (1.08 – 1.70)**
Parental death		
No	Ref	Ref
Yes	1.12 (0.90 – 1.40)	1.08 (0.86 – 1.36)
Substance abuse		
No	Ref	Ref
Yes	**3.49 (2.74 – 4.45)**	**3.37 (2.63 – 4.32)**
Mental illness		
No	Ref	Ref
Yes	**3.78 (2.75 – 5.19)**	**3.63 (2.63 – 5.01)**
Incarceration		
No	Ref	Ref
Yes	**2.60 (1.62 – 2.60)**	**2.45 (1.90 – 3.16)**

Chronic illness		
No	Ref	Ref
Yes	**2.05 (1.62 – 2.60)**	**2.03 (1.60 – 2.57)**
Unemployment		
No	Ref	Ref
Yes	**1.86 (1.51 – 2.28)**	**1.73 (1.40 – 2.14)**

In unadjusted and adjusted analysis: **bold**=p<0.05; ^Each individual ACE entered as an exposure adjusted for demographic factors**;**

Separate effects of ACEs on PD

Table 5.3 Separate effects of ACEs on PD

Variable		Crude OR (95% CI)	Adjusted OR (95% CI) Individual ACEs[1]	Adjusted OR (95% CI) All individual ACEs in combined model[2]
Emotional abuse				
	No	Ref	Ref	Ref
	Yes	**1.96 (1.56-2.49)**	**1.93 (1.46-2.55)**	1.10 (0.75-1.63)
Sexual abuse				
	No	Ref	Ref	Ref
	Yes	**2.33 (1.38-3.96)**	**2.26 (1.20-4.25)**	1.78 (0.86-3.66)
Physical abuse				
	No	Ref	Ref	Ref
	Yes	**1.75 (1.17-2.60)**	**1.87 (1.20-2.93)**	1.14 (0.67-1.94)
Emotional neglect				
	No	Ref	Ref	Ref
	Yes	**3.05 (2.41-3.88)**	**2.79 (2.10-3.70)**	**1.99 (1.34-2.93)**
Physical neglect				
	No	Ref	Ref	Ref
	Yes	**2.13 (1.55-2.93)**	**2.24 (1.52-3.31)**	**1.64 (1.00-2.69)**
Domestic violence				
	No	Ref	Ref	Ref
	Yes	**2.08 (1.53-2.83)**	**1.91 (1.35-2.72)**	1.22 (0.78-1.90)
Parental divorce/separation		Ref	Ref	Ref
	No	**1.29 (1.01-1.65)**	1.13 (0.85-1.51)	0.96 (0.70-1.31)
	Yes			
Parental death				
	No	Ref	Ref	Ref
	Yes	1.11 (0.87-1.41)	1.26 (0.95-1.67)	1.15 (0.81-1.62)

Substance abuse			
No	Ref	Ref	Ref
Yes	**1.77 (1.39-2.25)**	**1.63 (1.22-2.17)**	1.24 (0.86-1.80)
Mental illness			
No	Ref	Ref	Ref
Yes	**2.66 (1.95-3.65)**	**2.72 (1.89-3.91)**	**2.25 (1.45-3.51)**
Incarceration			
No	Ref	Ref	Ref
Yes	1.15 (0.89-1.98)	1.12 (0.83-1.52)	0.79 (0.54-1.16)
Chronic illness			
No	Ref	Ref	Ref
Yes	**1.55 (1.21-1.98)**	**1.42 (1.07-1.89)**	1.07 (0.75-1.52)
Unemployment			
No	Ref	Ref	Ref
Yes	**1.34 (1.07-1.68)**	1.16 (0.89-1.51)	0.82 (0.59-1.15)
Marital status			
Single	Ref		Ref
Relationship	0.86 (0.69-1.08)		**0.64 (0.50-0.87)**
Gender			
Male	Ref		Ref
Female	**2.21 (1.76-2.78)**		**2.73 (1.98-3.77)**
SES	**0.91 (0.87-0.96)**		**0.90 (0.84-0.97)**
Completed matric			
No	Ref		Ref
Yes	**0.81 (0.65-1.02)**		0.84 (0.60-1.18)
Currently employed			
No	Ref		Ref
Yes	**0.68 (0.53-0.86)**		0.79 (0.58-1.08)
Stressful events			
No	Ref		Ref
Low	**1.70 (1.28-2.24)**		**1.67 (1.14-2.45)**
High	**3.22 (2.20-4.71)**		**1.80 (1.05-3.08)**

Legend: In unadjusted and adjusted analysis: **bold**=p<0.05; [1] Each individual ACE entered as an exposure adjusted for demographic factors; all demographic factors except completing high school were significant at p<0.05; [2]All individual ACEs placed in one multivariate model, also adjusted for demographic factors

The separate effects of ACEs on PD are presented in Table 5.3. Parental death and incarceration of household member were not associated with PD. After adjusting for demographic factors, parental divorce/separation and parental unemployment become statistically non-significant, pointing to possible confounding and/or mediation. In the model including all individual ACEs, the neglect ACEs and living with mental illness in the household remained statistically significantly, increasing the odds of PD, together with marital status, gender and adult life stress. Gender remained associated with PD in all adjusted models, women having greater odds of having PD and with no evidence of reduction of effect size.

5.3.4.2 Association between ACEs and the separate PD subscales

The associations between the individual subscales and PD are shown in Table 5.4 The social dysfunction subscale was not statistically significantly associated with any of the cumulative ACE scores, except experiencing at least six ACEs which was significant only in the univariate analysis. Of the demographic variables, household stress and gender significantly increased the relative risk of a high score on all four subscales. The depression subscale generally showed greater effect sizes compared to the other three subscales. A dose-response relationship is apparent in the three subscales that achieved statistical significance.

Table 5.4 Association between ACEs and the different PD subscales

Variable	Crude IRR	Adjusted IRR
	Somatic subscale	
Any ACE		
No	Ref	Ref
Yes	**1.60 (1.35-1.87)**	**1.46 (1.23-1.74)** **Gender, household stress**
ACE score categories		
None	Ref	Ref
1 ACE	**1.44 (1.19-1.73)**	**1.31 (1.07-1.60)** **Gender, household stress**

2 ACEs	**1.39 (1.15-1.69)**	**1.35 (1.10-1.66)**	
3 ACEs	**1.49 (1.23-1.81)**	**1.42 (1.15-1.76)**	
4 or more	**1.80 (1.52-2.13)**	**1.70 (1.40-2.06)**	
Level of ACEs			
None	Ref	Ref	
Low	**1.50 (1.28-1.76)**	**1.41 (1.18-1.68)**	**Gender, household stress**
High	**1.98 (1.64-2.40)**	**1.84 (1.48-2.28)**	
Anxiety/insomnia subscale			
Any ACE			
No	Ref	Ref	
Yes	**1.91 (1.55-2.34)**	**1.73 (1.38-2.16)**	**Household stress, gender, employment**
ACE score categories			
None	Ref	Ref	
1 ACE	**1.45 (1.14-1.84)**	**1.33 (1.03-1.71)**	**Household stress, gender, employment**
2 ACEs	**1.52 (1.19-1.93)**	**1.56 (1.20-2.02)**	
3 ACEs	**1.70 (1.32-2.18)**	**1.56 (1.19-2.05)**	
4 or more	**2.45 (1.97-3.04)**	**2.29 (1.80-2.91)**	
Level of ACEs			
None	Ref	Ref	
Low	**1.71 (1.40-2.10)**	**1.62 (1.29-2.02)**	**Household stress, gender, employment**
High	**2.86 (2.24-3.66)**	**2.53 (1.92-3.33)**	
Dysfunction subscale			
Any ACE			
No	Ref	Ref	
Yes	1.09 (0.98-1.22)	1.04 (0.92-1.17)	**gender, marital status, employment**
ACE score categories			
None	Ref	Ref	
1 ACE	1.11 (0.97-1.26)	1.03 (0.90-1.19)	**gender, marital status, employment**
2 ACEs	1.06 (0.93-1.21)	1.01 (0.88-1.17)	
3 ACEs	1.03 (0.90-1.19)	1.00 (0.86-1.17)	
4 or more	1.12 (1.00-1.26)	1.07 (0.94-1.23)	
Level of ACEs			
None	Ref	Ref	

Low	1.07 (0.96-1.20)	1.03 (0.91-1.16)	**gender, marital status, employment**
High	**1.16 (1.01-1.33)**	1.09 (0.93-1.28)	
Depression subscale			
Any ACE			
No	Ref	Ref	
Yes	**2.44 (1.74-3.42)**	**2.00 (1.36-2.97)**	**Household stress, gender, employment, matric, SES**
ACE score categories			
None	Ref	Ref	
1 ACE	1.45 (0.98-2.15)	1.26 (0.81-1.96)	**High household stress, gender, employment, matric**
2 ACEs	**1.76 (1.18-2.62)**	**1.63 (1.04-2.54)**	
3 ACEs	**2.28 (1.52-3.43)**	**2.30 (1.45-3.64)**	
4 or more	**3.39 (2.38-4.84)**	**2.75 (1.82-4.16)**	
Level of ACEs			
None	Ref	Ref	
Low	**2.09 (1.49-2.94)**	**1.87 (1.27-2.75)**	**High household stress, gender, employment, matric, SES**
High	**4.13 (2.75-6.20)**	**3.11 (1.94-4.99)**	

***Bold:** Likelihood ratio chi-square test significant at p<0.05; #**Bold OR:** significant at p<0.05;
^Interaction terms

5.3.5 Hierarchical logistic regression

Table 5.3 shows the adjusted hierarchical regression analyses for the relationship between ACEs and PD, with the ACE score variable depicting three levels of ACEs: no ACEs, low level of ACES (1 to 5) and high level of ACEs (6 or more). Table 5-5 presents the same analyses using the binary ACE score variable.

Table 5.5 Hierarchical regression results: ACEs as binary exposure

	Model 1	Model 2	Model 3	Model 4 (with interaction)
Chi² Δ	**77.6***	**88.3**	**101.4**	**112.8**
Any ACE				
No	Ref	Ref	Ref	Ref
Yes	**3.80 (2.17-6.62)**	**4.09 (2.14-7.82)**	**3.32 (1.72-6.40)**	**2.74 (1.03-7.36)**
^Adult stress#Any ACE				
No stress#No ACEs				Ref
Low stress#Any ACE				2.06 (0.49-8.71)
High stress#Any ACE				0.12 (0.01-1.21)
Age	1.08 (0.85-1.37)	1.09 (0.84-1.42)	1.09 (0.83-1.43)	1.09 (0.83-1.42)
Gender				
Male	Ref	Ref	Ref	Ref
Female	**2.56 (1.95-3.37)**	**2.67 (1.97-3.61)**	**2.74 (2.0-13.72)**	**2.78 (2.04-3.79)**
Marital status				
Single	Ref	Ref	Ref	Ref
Relationship	**0.74 (0.57-0.98)**	**0.72 (0.53-0.97)**	**0.71 (0.52-0.96)**	**0.70 (0.51-0.95)**
SES		**0.90 (0.84-0.97)**	**0.90 (0.84-0.97)**	**0.90 (0.83-0.97**
Completed matric				
No		Ref	Ref	Ref
Yes		0.77 (0.56-1.06)	0.79 (0.57-1.09)	0.79 (0.57-1.10)
Employment				
No		Ref	Ref	Ref
Yes		0.79 (0.59-1.07)	0.82 (0.60-1.10)	0.81 (0.60-1.09)
Adult stress				
None			Ref	Ref
Low			**1.96 (1.35-2.85)**	0.99 (0.25-3.98)
High			**2.77 (1.70-4.53)**	**21.92 (2.35-204.86)**

Table 5.6 Hierarchical regression results: ACEs as a three-category exposure

	Model 1	Model 2	Model 3	Model 4 (with interaction)
Chi^2 Δ	**103.3***	**110.0**	**123.3**	**129.6**
Level of ACEs				
None (0 ACEs)	Ref	Ref	Ref	Ref
Low (1 to 5)	**3.21 (1.83-5.63)**	**3.48 (1.81-6.67)**	**2.97 (1.53-5.72)**	2.49 (0.92-6.72)
High (6 or more)	**7.98 (4.28-14.91)**	**8.57 (4.19-17.53)**	**6.54 (3.14-13.63)**	**7.67 (1.90-30.94)**
Level of ACEs				
No stressful life events#No ACEs				Ref
Low stress#Low ACES				2.02 (0.47-8.59)
Low stress#High ACEs				1.33 (0.22-7.95)
High stress#Low ACEs				**0.10 (0.009-0.98)**
High stress#High ACEs				**0.08 (0.006-0.95)**
Age	1.10 (0.85-1.40)	1.09 (0.84-1.44)	1.09 (0.84-1.45)	1.09 (0.83-1.44)
Gender				
Male	Ref	Ref	Ref	Ref
Female	**2.61 (1.97-3.45)**	**2.67 (1.97-3.63)**	**2.71 (2.00-3.71)**	**2.77 (2.03-3.79)**
Marital status				
Single	Ref	Ref	Ref	Ref
Relationship	**0.70 (0.53-0.93)**	**0.68 (0.50-0.92)**	**0.67 (0.49-0.92)**	**0.66 (0.49-0.91)**
SES		**0.91 (0.85-0.98)**	**0.91 (0.84-0.98)**	**0.91 (0.84-0.98)**
Completed matric				
No		Ref	Ref	Ref
Yes		0.79 (0.57-1.09)	0.81 (0.58-1.12)	0.81 (0.58-1.13)
Employment				
No		Ref	Ref	Ref

Yes	0.79 (0.59-1.07)	0.80 (0.59-1.09)	0.80 (0.59-1.08)
Adult stress			
None		Ref	Ref
Low		**1.84 (1.26-2.68)**	0.99 (0.25-3.98)
High		**2.25 (1.35-3.74)**	**21.92 (2.35-204.86)**

***Bold:** Likelihood ratio chi-square test significant at p<0.05; #**Bold OR:** significant at p<0.05; ^Interaction terms.

The full regression models for the two ACE scores achieved significance. The likelihood ratio chi-square statistic showed statistically significant improvement between the null model and tested model after each step in the hierarchical modelling. The effect of ACEs remained statistically significant even after adjusting for demographic, SES and adult life events stress factors. A dose-response association is noted between the ACE score and PD. The addition of the demographic and SES factors increased the effect size of the ACE score to levels higher than the unadjusted values, but adult stress brought the ORs down in all the three full models to levels lower than or similar to the unadjusted models. Being married was not associated with PD in the unadjusted model but was significant when entered into the model with gender. The effect size of gender on PD increased at each subsequent level of the model.

In the models with the interaction terms, it is apparent that high levels of adult life stress increase the likelihood of PD by over 20 times compared to no stress, in the absence of ACEs, while low levels of stress have a statistically non-significant association. Having experienced at least one ACE was significantly associated with PD even in the absence of adult life event stress (AOR 2.74, 95% CI1.03-7.36). When the three category ACE scores was used as the main exposure in Table 3, high levels of ACEs in the absence of adult stress increased the odds of PD by nearly 8 times. A closer look at the interaction terms shows that there was no significant difference in the effect of the level of ACEs on PD in the presence of low stress, i.e. the impact of one to five ACEs as well as experiencing six or more ACEs on PD did not differ significantly between those with low stress compared to those with no adult stress. However, both low and high levels of ACEs had a significantly different effect in individuals with high adult stress compared to those with no adult stress.

5.4 Discussion

In this sample of young South African adults, 87% reported at least one ACE and 35% reported four or more ACEs. Nearly a third of the population reported signs of PD, of which 66% were women. Individual ACEs increased the odds of reporting PD by between 1.42 (chronic illness) and 2.79 (emotional neglect) times, after adjusting for demographic variables. Including all the ACEs in one model attenuated the effect of most ACEs except emotional and physical neglect and mental illness in the household. A significant direct association was observed between ACEs and PD, and a dose-response effect was apparent. A significant dose-response association was observed between ACE levels and adult stress levels, with participants who reported experiencing six or more ACEs being 11 times more likely to experience high levels of adult stress (AOR 11.22**;** 95% CI 7.1-17.8) compared to those who reported zero and one to five ACEs.

Our ACE prevalence levels are similar to those of the Kaiser-Permanente ACE study where over 60% of the population had experienced at least one ACE (6). However they are more consistent with a later study that used an expanded version of the ACE list and found that over 80% of the participants reported at least one ACE (176). Although the additional ACEs included in our analysis: parental death, parental unemployment and chronic illness in the household were among the most prevalent, their effect became non-significant in the model combining all individual ACEs. This may mean that their effect is manifest through other ACEs or that they act as moderating factors. As ACE research is widely used to advocate for the protection of and greater investment in the early childhood years, it is important for the ACE indices to be broadly focused in order to capture a diversity of experiences that may impact life-long health and wellbeing (72, 176).

The higher prevalence of PD among women compared to men is consistent with results from others studies (162, 177), although some studies have found no gender differentials in the prevalence of poor mental health (157). Compared to men, women who experienced at least one ACE were two and half times more likely to report PD, an effect that increased with the inclusion of SES and adult stress in the model. Greater odds of women having PD given the experience of ACEs compared to men have been reported in other studies, including in South Africa (7, 178).

The effect of most single ACEs on PD attenuated and became statistically not significant after accounting for other ACEs and demographic and SES factors. These results imply that the effect of some ACEs may only manifest through other exposures and that ACEs often co-occur and are highly interrelated. In this sample, physical and emotional neglect and mental illness in the household seem to be the most foreboding individual ACE exposures impacting mental well-being independently of other ACEs, adult stress, SES and demographic factors. A dose-response effect was observed between the ACE score and PD, even after accounting for adult stress, as well as demographic and SES factors. This shows an unmediated, direct effect of ACEs on PD, and that this effect increases with exposure to a greater number of ACEs. This finding is in line with a growing body of evidence that shows that early life adversity can disrupt not only brain structure and functioning, but also dysregulate other systems resulting in low stress thresholds that persist throughout life and increase the risk of stress-related disease or disorders (19, 23). This direct effect is however not the only effect of ACEs on PD. The hierarchical modelling showed increasing effects of ACEs with the addition of demographic and SES factors to the models. This may be due to exacerbating moderation effects of these factors on the association between ACEs and PD.

The magnitude of the dose-response association between ACEs and adult life stress did not decrease after adjusting for demographic factors signifying a significant direct relationship between the two. Adult stressors may possibly be mediators of the association between ACEs and PD, demonstrated by the reduction of the effect of ACEs on PD after the addition of adult stress to the model. This means that participants exposed to ACEs may be more likely to show greater distress in the presence of adult stressors compared to those not exposed to ACEs, and that comparatively lower levels of stress may trigger distress (162). The interaction analysis showed that among individuals that experienced high levels of adult stress, experiencing between 1 and 5 ACEs, and experiencing six ACEs or more had significantly different effects on PD compared to experiencing no ACEs. Additionally, low ACE levels did not have a significant association with PD in the absence of adult stress. High levels of adult stress therefore significantly increased the likelihood of those who had a history of ACEs, especially cumulatively high levels of ACEs, also reporting PD. Although the results also suggest that adult stress on its own has a greater impact on PD than do ACEs,

these two exposures possibly interact in several possible ways that have been suggested in previous research.

The interaction between ACEs and adult stressful events is clearly complex, with ACEs possibly exacerbating the effect of subsequent stress on PD, and adult stress likely mediating the relationship between ACEs and PD. These pathways are not fully elucidated, but our results are congruent with current knowledge. Evidence shows that exposure to ACEs can trigger neurophysiological sensitivity and erode stress reactive and adaptive thresholds leading to dysfunctional coping strategies (168, 179). Important psychosocial resources are undermined, resulting in lower levels of perceived social support and poorer perceptions of the self (179). These shortfalls have negative mediating influences on subsequent positive development and healthy physical, psychological, and social outcomes in adulthood (179). In addition to heightened sensitivity to stress, those who are exposed to ACEs may be at an increased risk of experiencing adult stress. The initial exposure to childhood stressors can lead to secondary effects through the inability to form and sustain healthy relationships, poor academic achievement and decisions that leave individuals vulnerable to subsequent stressors like those investigated in this study (167). Individuals exposed to childhood stress are hypothesized to have limited buffering of these secondary stressors compared to individuals without prior significant adversity exposure (167).

An important link between early life and adulthood stress, demonstrated in part through the hierarchical analysis, is through socio-economic status. Individuals exposed to ACEs are more likely to attain lower levels of education which can lead to financial insecurity that may increase the risk of personal and family conflict, homelessness and unemployment (156). Consequent to these adult adversities is the instability of social resources and reduced economic resources available to obtain professional help and maintain healthy habits (156, 180).

The Parental Acceptance–Rejection Theory (PARTheory) may explain the consistent link between neglect and PD in this sample. According to the theory, perceived parental acceptance or rejection affects psychological adjustment in childhood. In addition, when parental rejection that occurred in childhood is recollected later in life, it is likely to be associated with the same form of psychological maladjustment (181, 182). Parental

acceptance refers to warmth, affection, love, care, comfort, support and nurturance, while parental rejection refers to the absence or withdrawal of warmth, affection, or love by parents towards their children (183). An individual's emotional security is partly dependent on the amount of warmth he or she receives from parents as a child and how he or she perceives parents' warmth. Lack of experience of warmth may lead to low self-esteem, negative mental representations of self and others, anger, unresponsiveness, sadness, and emotional instability (184). Those who report being neglected are at increased direct risk of PD in adulthood, apart from the influence of other factors. It is also possible that other forms of adversity such as physical and sexual abuse are also perceived by the child as lack of love, comfort and warmth and have the same effect as neglect on the child's, and subsequently the adult's, psychological well-being.

The GHQ subscales are constructed to each represent common elements of symptomatology (185). Our analysis therefore sought to assess the association of ACEs with each set of reported symptoms. Three subscales showed results in the expected directions but the social dysfunction subscale was not significantly associated with any of the cumulative ACE variables except high level of ACEs (unadjusted OR 1.16 (95% CI: 1.01-1.33). The items in the social dysfunction scale may not all be appropriate for our sample, for example some of the items reflect opportunities to be socially functional. However, women were more likely to report social dysfunction compared to men, those who were married and those who had jobs were less likely to report dysfunction compared to those who were single and unemployed respectively. These socio-demographic factors may have modified the association of ACEs with this subscale.

5.4.1 Strengths and limitations

Our study utilized data from a long-running cohort with well-established data collection and management methods. Although a birth cohort is not a nationally representative sample two decades later, the data enable us to assess ACEs in a middle-income country and test their association with mental well-being in adulthood. The experience of ACEs was reported retrospectively at 22 years of age, which may be subject to recall bias. The role of social coping resources in the association between ACEs and PD has been alluded to previously but

we were not able to assess this here (186). The missing observations may potentially affect the estimations as well, but either as an under- or over- estimate.

5.5 Conclusion and future implications

The experience of ACEs in this population compares with that found in other populations and points to the need for a more holistic approach in dealing with childhood adversity that includes identifying other forms of maltreatment and neglect when one adversity is reported. Treatment of mental illness and promotion of mental well-being should not only focus on contemporaneous events but also on possible childhood neglect and adversity.

Of all animal species, human offspring are dependent on their parents for the relatively longest time. This means that efforts to support healthy early childhood growth and development should necessarily include parental support and education. Governments and communities need to work together to support healthy family relationships and support parents in their efforts to raise their children. Effective and collective interventions are necessary in cases of adversity, abuse and violence in the household. Our study shows that this will contribute to improved mental wellbeing and other evidence suggests that it may also prevent other diseases (36, 155).

Early childhood development (ECD) is the foundation for sustainable development. Building a strong beginning for healthy development in the early years of life is essential for individual well-being, economic productivity and harmonious societies around the world (19, 187). Every child, no matter where they live needs the best start in life in order for them to reach their full developmental potential. For the first time, ECD is a major part of the global development goals both directly in lifelong learning and embedded in several other goals. It is therefore time for governments, civil society, businesses, communities and individuals to work together to ensure that the importance of ECD takes centre stage and protecting children from adversity is a key action point. The current analysis is useful in showing the extent of the problem, albeit in part, and provides a more comprehensive view of early adversity than can be obtained by studying ACEs as single exposures.

Chapter 6 : The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa.

6.1 Background

Approximately 25% of the world's population is between 10-24 years of age, with nearly 90% residing in low-to-middle income countries (LMICs) (188). In South Africa, this age-group constitutes 27% of the population (189). The wellbeing of this age-group is central to the achievement of global health and development goals. Risk factors to which adolescents and young adults are exposed, such as violence and infectious diseases, and risk behaviours adopted during this stage of life like smoking and lack of exercise, can have a substantial effects in later life and potentially impact the health of future generations (190, 191). At least 70% of premature adult deaths reflect behaviours initiated or reinforced during adolescence (192). The rapid brain development, sexual maturation and dynamic behavioural and social change occurring in the second decade of life make it a time of great importance for later health, and therefore also a time of great potential for intervention (193).

Interpersonal violence, defined in this study as "violence between family members and intimates, and violence between acquaintances and strangers that is not intended to further the aims of any formally defined group or cause", imposes a significant public health and economic burden worldwide and locally (194-197). The World Health Organization divides interpersonal violence into two categories, namely family and intimate partner violence, and community violence, both of which are included in our definition for this study (195). Approximately 1.6 million people globally lose their lives to interpersonal, self-inflicted and collective violence with the majority of these deaths occurring in LMICs (195).

The experience of interpersonal violence peaks during the adolescent and young adulthood years with the highest rates of homicides and suicides in the world among males aged 15-29 years (195). In the South African Comparative Risk Assessment Study, interpersonal violence, defined as acts of family and community violence, was the second leading cause of healthy life-years lost (196). The average injury death rate of 157·8 per 100 000 population in South Africa is nearly twice the global average (162). Data from the South African National Youth Victimization study show that between September 2004 and September 2005, 42% of young people aged 12-22 years were victims of assault, sexual assault/rape, theft, robbery, housebreaking or car hijacking, translating to over 4 million people (198). Other data from South Africa reveal that at least 90% of adolescents aged 15-18 years

studied in Limpopo Province have been exposed to at least one act of violence in their lifetime (199).

The burden of mental health disorders in young people is similarly high and many such disorders may go unnoticed until later in life. At least 20-25% of young people in the general population globally will suffer from at least one mental disorder in any given year (194). Three quarters of lifetime mental health disorders may have their onset before the age of 25 (200). A systematic review of original studies from LMICs showed a prevalence of mental health problems of about 10–20% in most of the 16 surveys identified (201). The prevalence of mental disorders in South Africa is estimated at 15% (194).

A link between exposure to violence and mental health among young people has been widely demonstrated, with negative effects including post-traumatic stress disorder (PTSD), depression and psychological distress (PD) (199, 202, 203). The effects of exposure to violence in young women have also been especially studied because of the possibility of the transmission of intergenerational trauma through women's mental health.

In the United States of America (USA) and Spain, young women aged between 18-25 years who reported exposure to violence had increased risk of depressive symptoms, PTSD, general aggression and somatic complaints (204). Among young African-American mothers, violence exposure was found to increase aggression and depression, which in turn affected parenting behaviours and increased the risk of the use of harsh disciplining methods (204). South African evidence shows that interpersonal violence, including gender-based violence and criminal assault, is associated with increased incidence of HIV (205, 206) and an increased lifetime risk of PTSD in women (207). Women who experience or witness more violence are at an increased risk of more severe mental health and other symptoms (204, 208). Further research from South Africa also shows that young women are more likely to have a higher prevalence of depressive symptoms than men even with similar levels of exposure to violence (199).

The relationship between place of residence, risk factors for and prevalence of mental health disease appears quite complex. Evidence from high-income countries suggests that the epidemiology of mental health differs between rural and urban contexts. In Europe and

Canada, urbanicity has been linked to a higher risk and prevalence of mental health and depressive disorders (209, 210). On the other hand, data from the USA showed slightly but significantly higher prevalence of depression in rural compared to urban residents (211). The burden of mental disorders is often highest among the poor, women and rural communities among others, and these groups also have low access to the necessary services (212). This is further compounded by the fact that resources for mental health care are not only scarce, but are also inequitably distributed, with need and access usually inversely related (212). Data from the National Income Dynamics Study (NIDS) South Africa, a long-running national panel survey, confirms that poverty headcount ratios are higher among women compared to men, and among rural compared to urban dwellers (213). Disparities also persist in access to health care services and health-care service delivery between urban and rural South Africans (214). The role of the rural-urban divide in the association between exposure to violence and psychological distress therefore needs to be fully explored in South Africa.

The rapid development and pervasive social and behavioural changes occurring during adolescence and young adulthood make this period in the life course critical for later health and well-being (193). In South Africa, this age-group is exposed to high levels of violence which has been linked to poor mental health outcomes with greater risk among women. In addition to this, evidence shows that most mental health disorders that manifest in adulthood, usually have their first onset in childhood or adolescence (200). It is therefore essential to investigate the link between exposure to violence and psychological distress especially among young women to broaden our understanding of the factors that impact this association, with a view to develop appropriate and effective interventions. Therefore, the aims of this study were threefold: (i) to investigate comparatively the prevalence of interpersonal violence and PD among young women residing in rural and urban South Africa; (ii) assess the factors associated with interpersonal violence and PD; and (iii) explore the potential pathways between interpersonal violence and PD in urban and rural settings.

6.2 Methods

6.2.1 Study design and setting, and participants

We prospectively designed a study to examine rural-urban differences between young women drawing upon two research platforms. Firstly, data from the Project Ntshembo-Hope

Cross-Sectional Survey was utilised. This is a study set in the Agincourt Health and Socio-Demographic Surveillance System (Agincourt HDSS) research site whose main aim was to optimise the health of young women in South Africa and limit the intergenerational risk of metabolic disease (96, 201).

Secondly, 510 young women aged between 22 and 23 years were selected from the Young Adult Survey (YAS) of the Birth to Twenty Plus (Bt20+) cohort, Soweto (215, 216).The Bt20+ Study is the largest and longest-running birth cohort in Africa (91). At its inception, the cohort included 3 275 singleton babies born to women resident in Soweto during the enrolment period in 1990 (89, 91). Of these, over 1 600 returned for the YAS, which was the data collection wave conducted when the cohort was 22 to 23 years of age. Compared to the Agincourt HDSS sub-district, residents of Soweto have higher SES, higher education and employment levels, and better access to water, sanitation, electricity and health care facilities. These are the typical differentiating factors between urban and rural areas in South Africa, apart from population density and economic activity (189, 217, 218). The Agincourt HDSS and Bt20+ studies have been described elsewhere (91, 98). All the selected participants were black African young women.

A power analysis was carried out and we estimated that a sample size of 500 in each setting would provide sufficient power (90%) to examine differences and associations within and between the study samples. Both study samples were randomly selected from the respective site.

6.2.2 Inclusion and exclusion criteria

The study included female participants with no apparent mental or physical disability, who were not pregnant and who gave written consent. We selected young women given the sex differences in overweight and obesity prevalence in young women compared to men, with the former have a three-fold greater prevalence (96). Pregnancy was determined initially by self-report and later all consenting women were tested. Pregnant women were excluded due to hormonal changes that occur during pregnancy which may cause emotional states to fluctuate considerably.

6.2.3 Ethics approval

Ethical clearances were obtained from the relevant institutions as indicated in Chapter 2 of this thesis.

6.2.4 Variables

The questionnaires and survey procedures were standardized and synchronised for the two sites. Questionnaires were translated into Shangaan (the local language spoken in that part of Mpumalanga province) where needed but most were administered in English in both sites. Research assistants and fieldworkers for both sites were trained together and administered the questionnaires.

6.2.4.1 Main outcome: Psychological distress

The General Health Questionnaire-28 (GHQ-28), a tool developed to detect those at risk of developing psychiatric disorders, was used to collect data on PD (Appendix 7). This tool has been used as a screen in general medical settings (219, 220), in the general population (221), and in younger populations (222, 223). It consists of 28 items divided into four subscales: somatic symptoms; anxiety/insomnia; social dysfunction, and severe depression (173). Each item has four possible responses coded 0 to 3 (173). The recall period for the GHQ is six months. A score of 24 was considered the threshold for psychological distress as recommended by literature, creating a binary variable for psychological distress (173). We tested the internal validity of the GHQ-28 in the pooled, rural and urban populations using Cronbach's alpha analysis and obtained values of 0.7901, 0.8543 and 0.7820 respectively. All the questionnaire items were retained in the analysis.

6.2.4.2 *Exposure: Interpersonal violence*

The World Health Organization divides interpersonal violence into two categories, namely family and intimate partner violence and community violence, both of which are included in our definition for this study. The young women were asked three questions regarding their personal experience of or witnessing violence or violent crime in the past six months at home and/or at work. Participants could respond with a No or Yes, coded "0" and "1" respectively, giving a possible total score of 3. Based on this score, a binary variable was created, coded as "0" for no experience of violence at all, and "1" for at least one experience of violence for

those who answered at least one of the questions positively. This was done in order to assess the cumulative effect of exposure to violence on mental well-being (224). The questions used to assess exposure to violence are presented in Supplementary Information, Table 1.

6.2.4.3 Other factors:

Other exposures included demographic, household and community factors.

6.2.4.4 Demographic factors

Level of education, age and marital status were included in the analysis.

6.2.4.5 Household factors

Stressful household/life events

Data were collected on the young women's experience of stressful life events in the previous six months namely: illness of a close family member, death of a close family member, living with someone with a serious disability in the family, drug or alcohol abuse in the household, fighting with or alienation from a close family member or neighbour and incarceration of a family member, each with two possible responses "No" and "Yes", and each participant with a possible total score of 6. A composite variable was created from this score, and categorized into three: no experience with a score of zero, low levels with a score of 1 to 2 and high levels of household stress with a score of 3 to 6. A similar life stress score has been used by Seedat et.al using the SASH study data (162). The questionnaire items are listed in Table 6.1.

Please tick all appropriate events that have happened to you within the past 6 months

Table 6.1 Questionnaire items used to measure exposure to violence and experience of adults stress events

Questionnaire item	Variable
1. During the last 6 months, has any household member (including you) been injured as a result of violence in the areas where you live or work?	Exposure to interpersonal violence

2.	During the last 6 months, has any household member (including you) been a victim of a violent crime (e.g. murder, robbery, mugging, assault, rape)?	Exposure to interpersonal violence
3.	During the last 6 months, did you witness a violent crime (e.g. murder, robbery, mugging, assault, rape)?	Exposure to interpersonal violence
4.	During the last 6 months, have you or anyone in your close family been seriously ill?	Experience of stressful life events
5.	During the last 6 months, did any member of your close family pass away?	Experience of stressful life events
6.	Is there anyone in your close family (including you) that has a problem with drugs or alcohol?	Experience of stressful life events
7.	Is there anyone in your close family (including you) with a serious disability (for example, epilepsy, mental retardation, deafness, blindness, mental illness)?	Experience of stressful life events
8.	During the last 6 months, have you had any serious fight or alienation from members of your family or your close neighbours?	Experience of stressful life events
9.	During the last 6 months, have you or any member of your close family been arrested, had to go to court, or consulted a lawyer on a non-routine matter?	Experience of stressful life events

Socioeconomic status

Socioeconomic status (SES) was assessed using an asset score, based on household ownership of assets. A list of thirteen assets was used: television, car, washing machine, fridge, phone, radio, microwave, cell phone, DVD/ Video player, DSTV (satellite television), computer, internet and medical aid /medical insurance. SES was analysed as continuous variable with scores ranging between 1 and 13. The scores were normally distributed with the mean very close in value to the median. A summative asset-score based index has been successfully used before to differentiate SES levels, also in the Bt20 cohort (43, 175).

Community danger

The binary variable for community danger was derived from two questionnaire items, firstly "How safe do you feel walking around in your neighbourhood during the day and at night?" to which a participant could respond "very unsafe, unsafe, safe or very safe". Secondly, "In your opinion, how much crime is there in your neighbourhood?" with four possible responses: "a lot, some, not much or none". The responses for each question were coded 1 to 4, giving a possible total score of 8. The variable was categorized into low danger for a score of 6 or less and high danger for a score of 7 or 8. A variable with three categories was created at first but yielded low numbers in the middle category.

6.2.5 Statistical analysis

All analyses were carried out using STATA Release 14 (StataCorp 2015, College Station). Pooled analyses were conducted as well as stratified by rural/urban residence, guided by the conceptual framework shown in Figure 6.1. Chi-square and one-way analysis of variance (ANOVA) tests were used to conduct bivariate analyses. Logistic regression was employed to determine the association between experiencing personal violence and psychological distress. Variables with a p-value of <0.1 in the univariate analysis were entered into the multivariable model. The multivariable model was built in two stages. In model 1 we included all the demographic variables plus community variables with a p-value of <0.1. Model 2 included Model 1 variables plus the household variables. The likelihood ratio was used to test model fit.

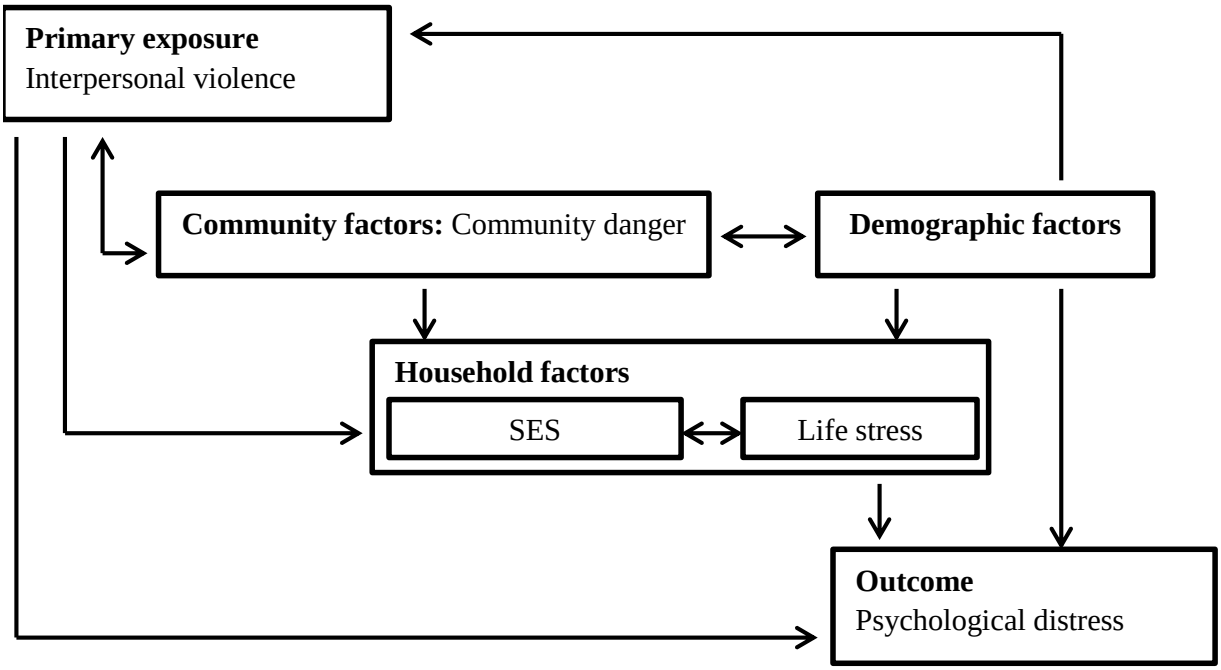


Figure 6.1 Conceptual framework for the analysis

A direct relationship between interpersonal violence (exposure) and psychological distress (outcome) is hypothesised. Both the exposure and outcome may also be influenced by demographic, household and community factors. In addition, these external factors may also have an impact on each other. Community danger is assumed to be the most distal factor in this framework and hence entered first in the model and may influence PD directly or through other more proximate factors such as household SES and life stress factors. Community danger and interpersonal violence may have a bi-directional association, as well as the former with demographic factors. The directions of the arrows indicate the postulated direction of the association.

6.2.5.1 Generalised structural equation modelling

To investigate pathways of association between experiencing interpersonal violence and PD, we built generalised structural equation models (GSEM). Variables significant at $p<0.1$ in the univariate regression analysis were included in the models. All demographic variables were included as potential confounders. Maximum likelihood method with observed information matrix standard errors was used to fit the models. All variables not significant at $p<0.05$ were

removed from the models. To assess model fit, the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) were computed before and after removing all non-significant variables.

6.3 Results

The analytical sample comprised 468 urban and 458 rural young women. Fifty-one participants were found to be pregnant on testing, 65% of whom were rural young women. An additional 44 had incomplete PD and or personal violence data, the larger proportion (57%) being the urban young women. Table 6.2 presents the characteristics of the young women by site. Differences were observed in the distribution of all the factors analysed between the two sites. Urban young women were indeed better off in terms of education and socioeconomic status, but were less likely to be married, and experienced greater stress, community danger, interpersonal violence and psychological distress.

Table 6.2 Distribution of individual, household and contextual factors by urban and rural status

Variable	Urban Mean/Median (SD/range) or N (%)	Rural Mean/Median (SD/range) or N (%)	P-value for rural-urban comparison (ANOVA or chi-square)
Primary outcome			
Psychological distress			
No	317 (66%)	377 (82%)	
Yes	161 (34%)	81 (18%)	<0.000
Primary exposure			
Personal violence			
Low	371 (77%)	412 (86%)	
High	112 (23%)	65 (14%)	<0.000
Demographic factors			

Age	22.8 (0.5)	21.3 (1.3)	<0.000
Education			
Primary/Secondary	159 (33%)	163 (44%)	
#Matric_NoTertiary	73 (15%)	132 (36%)	
Matric_Tertiary	248 (52%)	76 (20%)	<0.000
Marital status			
Single	248 (51%)	119 (25%)	
Married/Relationship	242 (49%)	356 (75%)	<0.000
Household factors			
Stressful events			
None	177 (38%)	261 (55%)	
Low	228 (49%)	196 (41%)	
High	60 (13%)	20 (4%)	<0.000
Socioeconomic status	8.8 (2.4)	5.6 (1.9)	<0.000
Contextual factors			
Community danger			
Low	363 (74%)	430 (90%)	
High	129 (26%)	46 (10%)	<0.000

#Matric =graduated from high school

6.3.1 Unadjusted regression analysis

Different patterns of univariate associations emerged by rural/urban status (Table 6.3). The association between interpersonal violence and PD was stronger in the urban compared to the rural residents, with the statistical significance in the latter being marginal. The association between community danger and psychological distress in the urban area was not significant, with a marginally significant association observed in the rural area. Rural adolescents who experienced high levels of stressful household events compared to those who experienced none had over five times greater odds of having PD, almost double the odds in the urban area.

We also tested univariate associations between the exposure variables themselves for the GSEM models, presented in Table 6.4. In both urban and rural adolescents, experiencing

stressful household events increased the odds of having PD. Being in a higher SES level was protective against stressful household events among urban adolescents.

Table 6.3 Unadjusted associations between the psychological distress (outcome) and contextual, household and individual exposure variables

Variable	Urban OR (95% CI)	Rural OR (95% CI)	Pooled
Effect of contextual, household and individual factors on psychological distress			
Primary exposure			
Personal violence			
Low	Reference	Reference	Reference
High	1.90 (1.22-2.95)***	1.73 (0.92-3.23)*	2.03 (1.42-2.89)***
Demographic factors			
Age	1.19 (0.79- 1.79)	0.97 (0.81-1.16)	1.25 (1.10-1.43)***
Education			
Primary /Secondary	Reference	Reference	Reference
#Matric_noTertiary	0.49 (0.28-0.93)**	0.71 (0.38-1.33)	0.54 (0.35-0.84)**
Matric_Tertiary	0.86 (0.56-1.30)	0.60 (0.28-1.30)	0.99 (0.70-1.41)
Marital status			
Single	Reference	Reference	Reference
Married/relationship	1.01 (0.69-1.48)	1.31 (0.73-2.34)	0.87 (0.61-1.17)
Household factors			
Stressful events			
None	Reference	Reference	Reference
Low	1.44 (0.93-2.22)*	2.55 (1.52-4.38)***	2.01 (1.45 – 2.79)***
High	2.30 (1.24-4.25)***	5.33 (2.01-14.20)***	3.78 (2.67 – 6.30)***
Socioeconomic status	0.92 (0.85 – 1.00)*	0.92 (0.81 – 1.05)	1.05 (0.99 - 1.10)
Contextual factors			
Community danger			

Low	Reference	Reference	Reference
High	1.13 (0.73-1.72)	1.88 (0.92-3.82)*	1.58 (1.10-2.26)**

*p-value =<0.1; **p-value=<0.05; ***p-value<0.01 #Matric=completed high school

Table 6.4 Unadjusted associations between contextual, household and demographic exposure variables

Variable	Urban Coefficient (95% CI)	Rural Co-efficient (95% CI)	Pooled Co-efficient (95% CI)
Effect of contextual factors on household factors (coefficients)			
SES and stressful events#			
None	Reference	Reference	Reference
Low	-0.52 (-1.00; -0.05)**	-0.09 (-0.46; 0.27)	0.12 (-0.25; 0.49)
High	-0.50 (-1.20; 0.20)	-0.13 (-1.01; 0.74)	0.79 (0.13; 1.44)**
SES and community danger#			
Low	Reference	Reference	Reference
High	-0.27 (-0.75; 0.20)	-0.22 (-0.80; 0.36)	0.66 (0.22; 1.10)
Stressful events and community danger#			
Low	Reference	Reference	Reference
High	0.13 (-0.26; 0.52)	0.36 (-0.23; 0.95)	0.40 (0.08; 0.72)**
Effect of household and contextual factors on primary exposure (coefficients)			
Personal violence and SES#	-0.02 (-0.11; 0.07)	0.04 (-0.10; 0.18)	0.07 (0.01; 0.13)**
Personal violence & stressful events#			
None	Reference	Reference	Reference
Low	1.15 (0.60; 1.72)***	0.91 (0.32; 1.49)***	1.09 (0.69; 1.50)***
High	1.64 (0.94; 2.35)***	1.81 (0.78; 2.84)***	1.79 (1.23; 2.35)***

Personal violence and community danger[#]			
Low	Reference	Reference	Reference
High	0.59 (0.14; 1.05)**	0.14 (-0.71; 0.99)	0.63 (0.25; 1.02)***

*p-value =0.05-0.1; **p-value=0.01-0.05; ***p-value<0.01 [#]**Bold:** entered as predictor in the model

6.3.2 Adjusted analysis

After adjusting for demographic, household and community factors the effect of interpersonal violence on PD in the urban adolescents was unchanged (Table 6.5). Among the rural young women however, the odds of PD decreased to 1.30 (95% CI 0.61-2.76) and was no longer statistically significant. In the pooled sample, rural residence was protective against PD. Although stressful household events remained significant in both rural and urban young women after adjusting for other variables, in the urban setting the statistical significance was borderline and only those experiencing high levels of household stress were more likely to have PD. In the rural area, only young women who experienced low levels of household stress had greater odds of having PD compared to those who had no household stress.

Table 6.5 Adjusted analysis

Variable	Urban		Rural		Pooled	
	Model 1[#]	Model 2[^]	Model 1	Model 2	Model 1	Model 2
Primary exposure						
Personal violence						
Low	Reference	Reference	Reference	Reference	Reference	Reference
High	2.06 (1.30-3.26)***	1.84 (1.13-3.00)**	1.62 (0.78-3.38)	1.30 (0.61-2.76)	1.85 (1.27-2.72)***	1.53 (1.03-2.29)**
Demographic factors						
Age	1.19 (0.75-1.90)	1.43 (0.84-2.46)	0.90 (0.72-1.13)	0.90 (0.71-1.14)	1.16 (0.98-1.37)*	1.15 (0.96-1.38)
Education						
Primary /Secondary	Reference	Reference	Reference	Reference	Reference	Reference
Matric-No Tertiary	0.49 (0.25-0.94)**	0.50 (0.25-1.01)*	0.70 (0.37-1.32)	0.68 (0.36-1.30)	0.59 (0.38-0.93)**	0.65 (0.41-1.04)*
Matric- With Tertiary	0.83 (0.54-1.29)	1.04 (0.63-1.73)	0.58 (0.27-1.27)	0.59 (0.27-1.30)	0.90 (0.63-1.30)	0.94 (0.62-1.41)
Marital status						
Single	Reference	Reference	Reference	Reference	Reference	Reference
Married/relationship	0.89 (0.59-1.34)	0.80 (0.52-1.24)	0.92 (0.48-1.77)	0.93 (0.48-1.82)	0.78 (0.56-1.09)	0.77 (0.55-1.09)
Residence						
Urban	-	-	-	-	Reference	Reference
Rural					0.43 (0.27-0.68)***	0.41 (0.24-0.69)***

Household factors						
Stressful events						
None	-	Reference	-	Reference	-	Reference
Low		1.24 (0.78-1.97)		2.71 (1.48-4.94)***		1.80 (1.25-2.58)***
High		1.93 (0.99-3.76)*		2.56 (0.74-8.87)		2.54 (1.45-4.47)***
Socioeconomic status		0.91 (0.83-1.00)*				0.98 (0.92-1.06)
Contextual factors						
Community danger						
Low	-	-	Reference	Reference	Reference	Reference
High			1.63 (0.69-3.84)	1.55 (0.64-3.75)	1.26 (0.85-1.87)	1.14 (0.75-1.72)

#Model 1 – demographic + contextual factors; ^Model 2 – Model 1 + household factors; *p-value =0.05-0.1; **p-value=0.01-0.05; ***p-value<0.01

6.3.3 Structural Equation Model Analysis

6.3.3.1 Rural model

As shown in Figure 6.2, no direct effect was observed between interpersonal violence and PD, and no indirect pathways were observed in the rural model. No variable except stressful household events and age had a positive direct effect on the outcome (PD) or exposure (interpersonal violence).

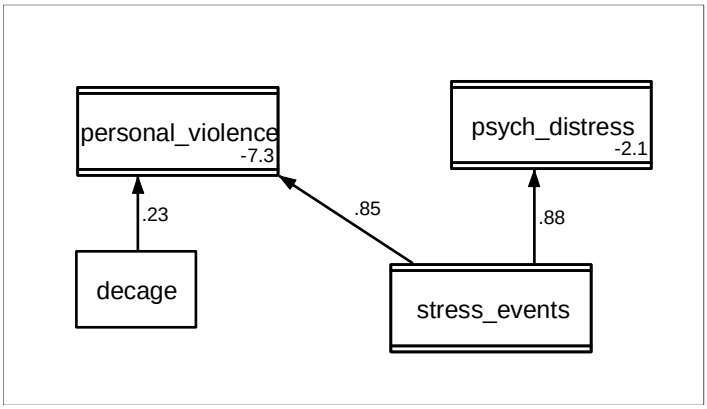


Figure 6.2 Rural GSEM model

Legend: personal_violence – interpersonal violence**; stress_events –** stressful household events**; psych_distress** – PD variable**; decage –** age of participant; **numbers next to the arrows =** beta coefficients for the path

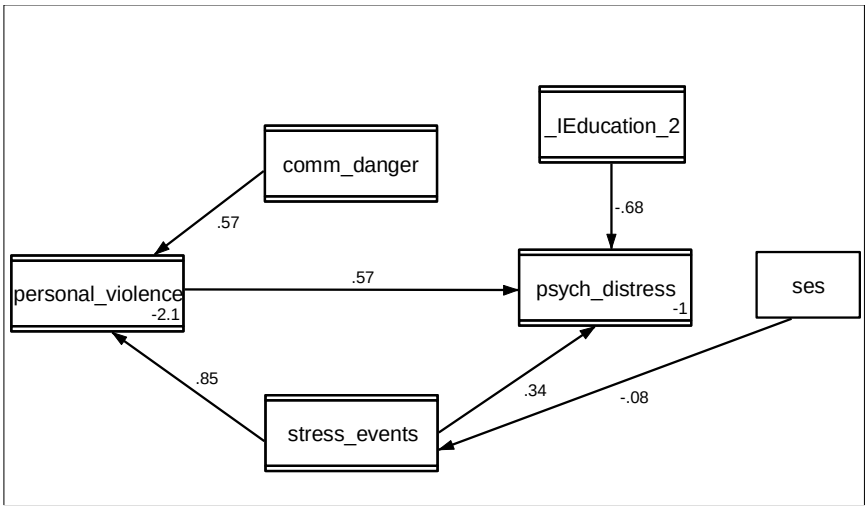


Figure 6.3 Urban GSEM Model

Legend: Personal_violence – interpersonal violence**; comm_danger –** community danger**; Education –** level of education attained**; psych_distress –** PD variable**; SES –** socioeconomic status**; stress_events –** stressful household events; **numbers next to the arrows –** beta coefficients for the path

Figure 6.3 is the GSEM model for the urban sample. Having graduated from high school, even without tertiary education, showed a direct protective association with PD. A higher SES was protective against stressful household events and was indirectly associated with PD. Stressful household events had both direct and indirect effects on PD. Community danger was indirectly associated with PD through its effect on interpersonal violence.

6.3.3.2 Pooled model

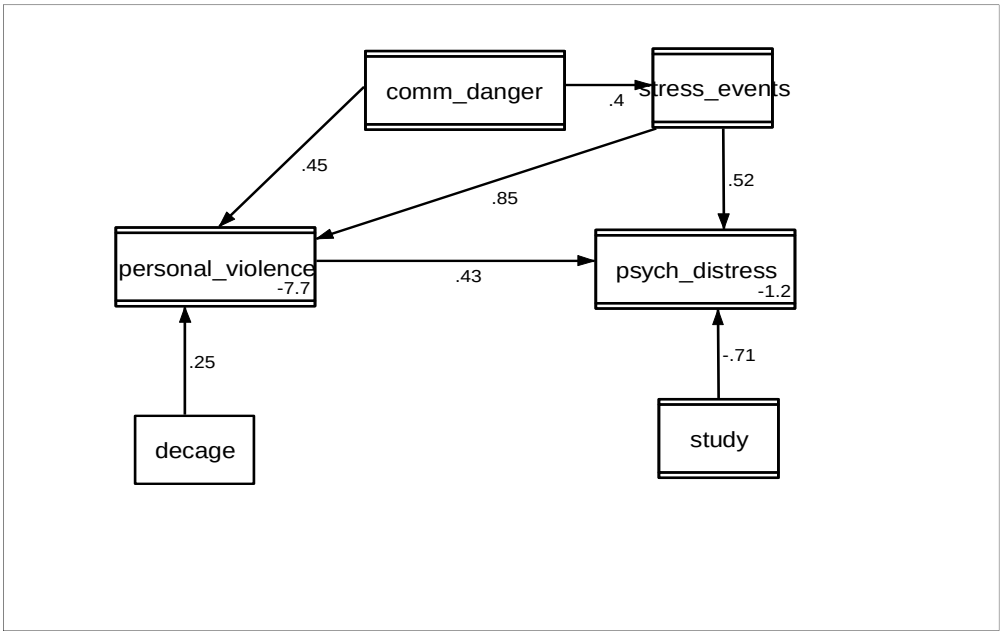


Figure 6.4 Pooled GSEM model

Legend: Personal_violence – interpersonal violence**; comm_danger –** community danger**; Education_2 –** graduated from high school but no tertiary education **; psych_distress –** PD variable**; SES –** socioeconomic status**; stress_events –** stressful household events**; decage –** age; **study –** rural or urban residence; **numbers next to the arrows** – beta coefficients for the path

The pooled GSEM model is shown in Figure 6.4. Stressful household events had a positive direct and indirect effect on PD, mediated by interpersonal violence. Community danger did not have a direct association with PD as was the case in the models by site, but had positive indirect associations through stressful household events as well as interpersonal violence. Table 6.6 presents the GSEM odds ratios for the different paths in each model.

Table 6.6 Generalised structural equation model results for the final models by site.

The arrow points to the dependent variable in the path. Only statistically significant variables retained in the final models

Variable pairs	Pooled model OR (95% CI) for the variable pairs	Urban model OR (95% CI) for the variable pairs	Rural model OR (95% CI) for the variable pairs
Personal violence -> psychological distress	1.53 (1.03-2.27)**	1.78 (1.10-2.88)**	-
Stressful events -> psychological distress	1.59 (1.23-2.06)***	1.37 (1.00-1.88)**	2.42 (1.62-3.62)***
Residence (rural) -> psychological distress	0.52 (0.37-0.75)***	-	-
Education (Matric_NoTertiary) -> psychological distress	-	0.50 (0.26-0.93)**	-
SES -> psychological distress	-	-	-
Stressful events -> personal violence	2.35 (1.81-3.06)***	2.34 (1.67-3.28)***	2.33 (1.51-3.62)***
Community danger -> personal violence	1.57 (1.04-2.36)**	1.76 (1.09-2.85)**	-
Age -> personal violence	1.28 (1.09-1.50)***	-	1.26 (1.02-1.57)**
Community danger -> stressful events	1.49 (1.08-2.05)**	-	-
SES -> stressful events	-	0.92 (0.86-0.99)**	-

**p<0.05; ***p<0.0

The association between interpersonal violence and PD in the rural model reduced slightly in the full GSEM model but remained significant. Young women residing in the rural area were less likely to report PD compared to the urban young women.

Table 6.7 Model fit statistics

Model	LR Chi^2 Test		Hosmer-Lemeshow Test			
	Chi^2 value	**p-value**	**Chi^2 value**	**p-value**		
Adjusted logistic regression models						
Pooled model 2	775.4	0.499	8.59	0.378		
Rural model 2	348.5	0.408	13.7	0.090		
Urban model 2	427.8	0.453	4.87	0.771		
SEM models						
	LR Chi^2 Test		**AIC**		**BIC**	
	Chi^2 value	**p-value**	**Full model**	**Restricted model**	**Full model**	**Restricted model**
Pooled model	4.45	0.2169	3565.3	3563.7	3633.16	3617.1
Rural model	2.70	0.2586	780.6	779.3	809.1	800.14
Urban model	2.84	0.0921	1936.2	1937.1	1981.8	1978.5

The models presented result in the best fit for the data.

6.4 Discussion

Our results show that compared to the rural young women, the urban sample had higher levels of PD, interpersonal violence, household stress and community danger. A greater proportion of rural young women was married and had not graduated from high school. Before adjusting for other factors there was a significant relationship between interpersonal violence and PD in both settings, with a weaker association in the rural setting. Rural young women experiencing high levels of household stress were more likely to report PD than those experiencing low stress. We further demonstrate that after adjusting for demographic,

household and community factors, the direct association between interpersonal violence and PD in rural South African young women becomes statistically insignificant. In urban South Africa, interpersonal violence is associated with PD after adjusting for household stress and SES. Community danger had no direct link with PD in any model. Residing in the rural area was significantly protective against symptoms of PD as compared to the urban area.

The prevalence of PD (26%) in our pooled sample is comparable to an Indian study of male and female adolescents among whom it was 23.3% (225). More urban young women showed signs of PD and reported higher levels of interpersonal violence, as well as greater odds of PD given experience of interpersonal violence. This is similar to an Australian study which showed that participants from remote areas were less likely to be diagnosed with a mental disorder compared to those residing in a metropolitan area (226). This pattern may be explained by greater social connectedness and support in rural areas which are known to moderate the impact of trauma and distress on mental well-being (227-229).

A direct association between interpersonal violence and PD was observed in the urban young women independent of household stress, SES, community danger and demographic factors. The strength of association did not change substantially between the unadjusted and adjusted urban models, possibly due to the absence of other relevant factors in the model. Despite attenuation of the direct association between interpersonal violence and PD in the multivariate and SEM models, no indirect pathways were observed in the rural subsample. It may be that other variables not explored in this study have a mediating effect on the relationship between interpersonal violence on PD, or that they have an effect on interpersonal violence and PD separately, examples being abuse and violence in childhood, drinking alcohol, smoking and availability of mental health care (96, 230). It may also be due to low variability in PD and interpersonal violence in the rural setting. This difference between the rural and urban populations indicates that household and community factors may operate differently in the two settings and therefore interventions need to be specifically tailored to each area (230).

Rural residents showed much greater sensitivity to the effect of household stress compared to the urban residents. A possible reason for this could be desensitisation theory, which asserts that chronic exposure to violence leads to emotional numbing in young people. Some

evidence partially supports the theory (231), while other studies have disputed it (232). Another possibility may be that the high levels of household stress remove the buffer of social connectedness thus making the young women more susceptible to PD. The differences in cultural context between rural and urban settings also may have led to the different responses. Culture defines and creates specific sources of distress and affects how symptoms are interpreted (96, 201). The GSEM models were in part able to disentangle the effects of context on the interpersonal violence-PD relationship and begin to shed light on the potential pathways of association.

The high levels of community danger observed in Soweto were expected given that the highest levels of contact crime occur mostly in urban areas (189). Rural young women reported low community danger compared to urban residents, but this was not associated with PD or interpersonal violence. In the urban SEM model, community danger increased the odds of experiencing interpersonal violence by about 60%. This relationship may be bi-directional with the experience of interpersonal violence itself leading to the perception of greater community danger.

Evidence is conflicting on the role of SES in the experience of interpersonal violence and its impact on mental health. Some studies show that recent and traumatic life events as well as PD are more common amongst participants with low SES (227), while other studies indicate that violence is not necessarily endemic to low SES areas but that the intensity and severity of events witnessed appear to affect low SES youth disproportionately (233). Other studies show that changes in SES have a greater impact on mental well-being than the actual levels of poverty (234). In this study, higher SES seemed to protect against PD in the urban residents but had no apparent effect in the rural residents. This may be explained by the low variability in SES levels in the rural population. Some studies have shown a strong association between SES and stressful household events which may then mediate the relationship between SES and PD. In this study, this association was observed in the urban and pooled populations.

Residing in the rural area was overall protective against PD in both the regression and SEM models for the pooled sample. Neighbour noise, feeling overcrowded in the home, dissatisfaction with green spaces, feeling unsafe to go out in the day and dissatisfaction with

community facilities are urban characteristics that have been found to increase the risk of poor mental well-being (235). Although these were not included in our analysis, they may partially explain the increased risk of PD in urban areas.

6.4.1 Study strengths and limitations

To our knowledge this is the first study to compare the impact of interpersonal violence among young rural and urban-residing South African women. The sample was derived from two long-standing surveys with established data collection and management procedures ensuring quality data. The data collection tools and procedures were synchronised to enable comparison between the two sites.

The cross-sectional nature of the data did not allow direction of some relationships such as community danger and exposure to violence to be discerned. The experience of interpersonal violence was self-reported, which may be subject to recall bias or a participant's perception of crime or injury. The interpersonal violence variable also included vicarious experience of violence or violence experienced by any household member. Therefore, a "yes" answer may not have been an indication of direct victimisation. However, we also know that stressful events happening to a household member can cause stress in other members of the household. The data did not include the types of interpersonal violence experienced which would have been useful in stratifying the analysis. The measure of community danger was based on the participant's perception, not specific cases of crime in the community, and it was not possible to determine whether the perception of the actual levels of crime influenced perception of safety or vice versa.

Despite all measures being taken to ensure uniformity, the response to questions may be affected by several issues such as the interview being face-to-face, culture differences and possibly language. Theses may lead to either under or overestimating the prevalence of factors such as interpersonal violence, community danger and stressful life events. The questionnaire items used to measure interpersonal violence did not specify the number of times each event had occurred in the past six months, or whether they had been experienced by only one household member or more. This could lead to an underestimation of the occurrence of interpersonal violence.

Although Agincourt HDSS and Soweto Johannesburg typify most rural and urban communities in South Africa in many ways, there are some factors that may differ from other populations that are considered rural or urban. Within the definitions of rural and urban in South Africa are several categories and our study samples do not represent them all (109, 236). This may limit the generalizability of our results.

6.5 Conclusion

Experiences of interpersonal violence are higher among urban than rural young women and seem not to be associated with PD in the latter. The pathways of association are different between the two settings and both need to be studied in their own contexts. Interventions for violence and mental health in the urban areas may therefore not necessarily translate into similar gains in rural areas and vice versa. Young adulthood is a critical stage for health intervention to maintain the benefits of early childhood and adolescent investments and maximize the potential of the adult years.

Further research is needed to explore other factors that influence the relationship between interpersonal violence and PD such as social capital and connectedness, and other behavioural factors such as alcohol abuse and childhood experiences of violence. Analysis tools such as multi-group structural equation modelling can also be employed to assess the similarities and differences between different populations, and to study measurement invariance. It would also enable the complex relationships between variables within each group to be explored (237).

SECTION 3: GENERAL DISCUSSION



"Ultimately, when you embrace the process of healing despite your adverse childhood experiences, you don't just become whom you might have been if you hadn't had so much childhood suffering in the first place. You gain something better: the hard-earned gift of life wisdom, which you bring forward into every arena of your life", **Donna Nakazawa Jackson(238)**

Chapter 7 : Discussion and Conclusion

7.1 Summary of key results

The results of four inter-related studies show that ACEs assessed using a modified Kaiser Permanente ACE Study questionnaire are highly prevalent in a young adult urban population in a middle-income country. At age 22, 88 percent reported at least one ACE during their first 18 years of life and 35% experienced at least four. Using only the 10-item score, the prevalence of any ACE remained high 77%, while 21% of the sample reported four or more ACEs. Marital status and age of the mother at the birth of the participant, and household and community SES were the most significant childhood factors linked with both single ACE exposures and the additive ACE score.

ACEs are not only highly prevalent but are interrelated and co-occur in fairly discrete patterns. Four distinct latent classes were identified in this population, namely: low ACEs; low abuse/neglect and medium household dysfunction; high abuse and neglect and low household dysfunction, and high emotional abuse and neglect and high household dysfunction. Sexual and physical abuse reporting rates were too low to be included in any of the classes. SES appeared to be an important childhood factor associated with the latent clusters, as well as the mother's age at the participant's birth.

Nearly thirty percent of the Bt20+ sample reported signs of psychological distress (PD), and 66% of these were women. Compared to the men, women who experienced at least one ACE had a two and half times greater risk of having PD. This effect increased when SES and adult stress were added to the model. A significant and unmediated association was detected between the cumulative ACE score and PD, after excluding the effect of adult stress, demographic and SES factors. A significant dose-response association was also observed between ACEs and adult stress levels, with young adults who reported at least six ACEs being 11 times more likely to experience high levels of adult stress compared to those who reported zero and five or less ACEs.

Comparing the PD and violence experience between rural and urban young women, the urban young women reported higher levels of PD, and exposure to interpersonal violence, household stress and community danger. Only the urban young women showed a significant association between interpersonal violence and PD. Experiencing high levels of household stress increased the risk of report PD among the rural young women. In the urban sample,

interpersonal violence was associated with PD after accounting for household stress and SES. There was no direct link between community danger and PD in any of the models. Rural young women reported significantly less symptoms of PD compared to urban young women.

Table 7.1 summarizes the key results of the thesis.

Table 7.1 Overview of key results

Objective	Chapter addressing objective	Key results
To determine the prevalence of ACEs in a middle income, predominantly black population and associations with childhood factors	Chapter 3, Chapter 4, Chapter 5	• Prevalence of at least one ACE was 88% • Prevalence of four or more ACEs was 35% • Maternal factors and SES were the most salient factors associated with ACEs
To assess the level of co-occurrence and clustering between ACEs	Chapter 4	• ACEs are highly interrelated • The experience of one ACE increases the risk of experiencing at least one other one • Distinct clustering was detected in this population
To assess the association between retrospectively reported ACEs and the prevalence of psychological distress among young adults	Chapter 5	• Experiencing ACEs increased the odds of reporting PD, an effect more apparent in women than men • An unmediated dose-response association between ACEs and PD was observed • ACEs were associated with adult stress • Low ACE levels in the presence of high adult stress were associated with PD

To investigate the association of interpersonal violence and mental health among young women residing in rural and urban South Africa To explore the potential pathways of association between interpersonal violence and PD in urban and rural settings	Chapter 6	• Urban young women showed higher levels of PD and a significant relationship between interpersonal violence and PD • Rural young women experiencing high levels of household stress were more likely to report PD than those experiencing low stress • Among urban young women, interpersonal violence was associated with PD after adjusting for household stress and SES.

7.2 Emerging themes and their implications

Several themes emerged from the results presented in this thesis.

7.2.1 ACE measurement tools may need to be modified

This study used a modified questionnaire to which three other ACEs were added because of their high prevalence in the South African population. Recommendations have been made to add exposures or exclude others based on the context (72, 73). The original ACE study was carried out in a high income country and among a middle class, predominantly White population (82). It may be necessary to adapt not only the questionnaire items and language, but also the ACE questions to suit different contexts. Events such as bullying and community violence have also been shown to have a lasting impact on health and may need to be considered in the measurement of ACEs.

The final tool used to collect the data used in this study was the culmination of an extensive iterative process. Several piloting studies were carried out to ensure that the language was understandable given the cultural context. Further explanatory text was added to the questionnaires for clarity. This is necessary especially in LMICs to ensure accuracy of results, and that the intent of the questions is understood by the participants. This in turn improves the comparability and generalisability of the result.

Sexual and physical abuse had low reporting rates in this population which may point to several issues including selective memory, or rationalising. It has been shown that the experience of adverse events in childhood, when remembered in adulthood, may appear less harmful. This might imply the usefulness of more prospective measurement tools. A study on the Bt20+cohort by Naicker et.al showed that sexual abuse reporting rates were much higher in the adolescent years than when retrospectively recalled at age 22 (75). Measuring exposure to ACEs at different stages of childhood may also help to determine the most vulnerable stages and the stages with the most lasting effects on health. Another possibility is to include questions on age or date at the time of exposure to a particular ACE, as well as duration, albeit these may be susceptible to recall bias.

7.2.2 Clustering of ACEs and comorbidities

It is evident that adverse childhood experiences are not only prevalent but also co-occur in fairly distinct ways in the Bt20+ cohort. Previous research has shown similar results in high income countries, as well as in more vulnerable communities like juvenile offenders (5, 137). Newer statistical techniques have enabled us to identify underlying patterns of co-occurrence that may otherwise not be measured empirically. We identified a class with low ACE experience where the prevalence of ACEs ranged from two percent to about 20%, save for parental death and unemployment which were generally high in all classes. The second class experienced relatively lower levels of abuse and neglect and higher household dysfunction. In the third latent class were participants who had notably high levels of emotional abuse and emotional neglect but relatively lower levels of household dysfunction. The last group, comprising six percent of the sample, class 4, experienced high levels of all ACEs bar sexual and physical abuse which generally had a low reporting rate.

The study and examination of ACEs should necessarily be conducted using combined versus single exposures. Evidence shows that specific clusters of ACEs may be associated with particular health and behavioural outcomes (138). Experiencing high levels of multiple ACEs increases the odds of reporting mental and substance use disorders (150). The study of ACEs has traditionally focused on single exposures and these results show that ACEs rarely occur in isolation and that their effect on health is exacerbated by multiple exposure. The presence of one ACE should elicit the search for others, for example when women report domestic abuse to the police or a child presents with evidence of physical abuse at a clinic.

Evidence from other studies shows us that ACEs are also strongly associated with the home or community environment. This is partly reflected in the tool through the household dysfunction questionnaire items. Factors such as adult life stress are associated with ACEs as well as mental wellbeing. Machisa et.al have shown that the experience of childhood adversity (though not defined as ACEs in their work) is linked to both the experience and perpetration of violence in adulthood (57, 59), as well as poor mental health. The comparison analyses in the experience of PD between urban and rural young

women showed a strong association between interpersonal violence and PD as well as household stress and PD. It was not possible in this study to explore the directionality of these associations. However, the SEM helped me to postulate possible pathways. These pathways are important to understand in order to determine the best intervention.

Due to the absence of ACEs data from the rural sample the link could not be investigated in this study. However, it is possible for this association to be present in both the rural and urban populations. This highlights the importance of not only a safe household environment, but of safe communities and workplaces too. It also demonstrates the far-reaching effects of childhood adversity in that events that occur at a household level can affect a community and society in the future. Preventing and managing the effects of ACEs is not just a public health priority, but also a matter of safety and social justice.

7.2.3 The household and community environment, ACEs and mental illness

ACEs are strongly associated with psychological distress in the results presented here and with other mental health disorders in other studies (3, 36, 150). This study has shown that not only do ACEs directly impact mental well-being, but they also increase the odds of experiencing high stress levels. The results also show that stressful events in the household and community in adulthood had a strong influence on mental health. Other studies have shown that ACEs are also linked to the experience of violence (59). It is therefore important to account not only for contemporaneous stress in the current environment, but also childhood stress when assessing and treating common mental health disorders.

ECD is the basic building block for a healthy individual and household, the benefits of which extend to the community and society. In addition to interventions that mitigate the effects of ACEs on mental health in adulthood, preventing ACEs ensures the development of healthy and resilient stress response systems to begin with. With the focus now placed on early childhood development by the Sustainable Development Goals (SDGs), the focus needs to be not only on adults already affected by ACEs but also on

preventing the experience of childhood adversity. Early life investments have been shown to yield great gains in the future (83).

Both household and community SES were associated with ACEs. Efforts to curb the prevalence of poor mental health need to focus not only on the individual but also on the community and household levels. Support and education at the household level may mitigate some of the effects of ACEs on mental well-being. Safety in the community as well as socioeconomic empowerment may go a long way in preventing mental health disorders, as well supporting those affected by them.

7.3 Conceptual framework

The conceptual framework for this study presented in Figure 1-1 hypothesised a relationship between ACEs and psychological distress. Childhood factors were assumed to have an effect on the experience of ACEs as well as PD. Simultaneously; factors in young adulthood such as household stress and socioeconomic status were considered in the relationship.

Based on the results of the study, maternal age and marital status at the birth of the child came out as childhood factors associated with ACEs as well as both household and community SES. Gender was an important factor associated with ACEs and PD. Community danger and area of residence (rural vs urban) emerged as factors associated with PD. The framework used at the start has thus been modified to reflect these changes, shown in Figure 7-1.

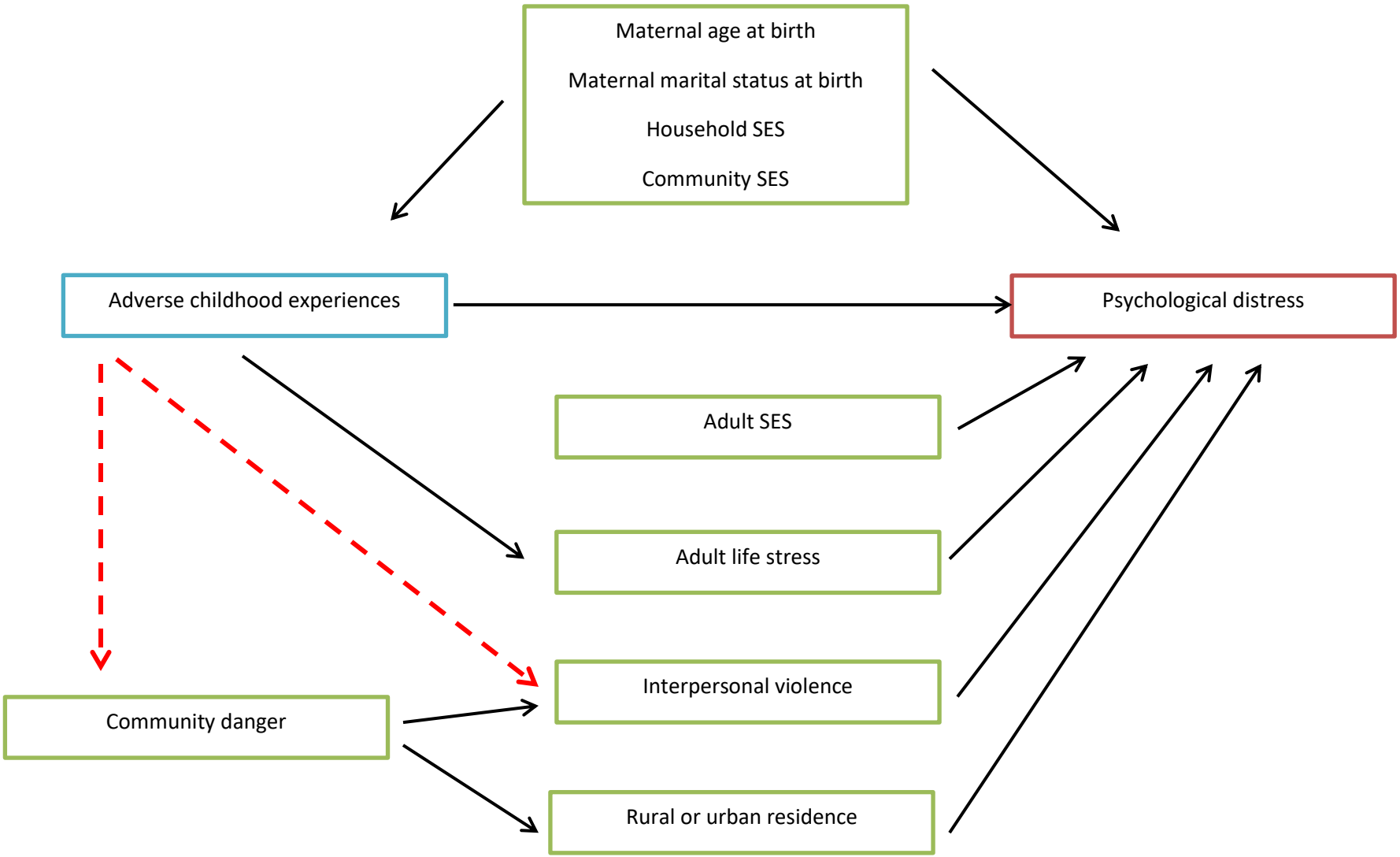


Figure 7.1 Revised conceptual framework

The red dashed arrows indicate possible pathways that were not explored in this study. In addition to the direct association between ACEs and PD, there are several household and community factors that also influence the relationship in this cohort.

7.4 Study strengths and limitations

To my knowledge this is the first study to explore adverse childhood experiences using a modified version of the Kaiser Permanente Study ACEs tool in Africa. This study adds evidence to the growing body of knowledge on adversity in childhood and its effect on mental well-being using data from a middle-income country. I was able to use longitudinal childhood data to assess the effect of child, maternal and household factors on ACE experience. Longitudinal data is not easily available and the Bt20+ cohort, the largest birth cohort in Africa, provided a unique opportunity to investigate these relationships. The study used statistical techniques such as interaction, latent class and structural equation modelling analyses to pry out some nuances that were otherwise not empirically measurable. I was able to characterize underlying clusters of ACE experiences and begin to identify pathways of mediation linked to psychological distress.

One of the major weaknesses of the study was that it used secondary analysis of data already collected. The result is that I was not able to include some important factors in the collection for example ACEs in the rural population. In addition to that, ACES were retrospectively measured which may have introduced recall bias. The results remain comparable to other studies however as the ACE questionnaire itself is designed to measure ACEs in retrospect. The retrospective nature of the ACEs data also means that information on the exact time, intensity and duration of ACEs was not available. This is something that can be added to questionnaires in future and evaluated for its usefulness in analysis. The self-report of some factors like SES and violence may also have been subject to bias.

Another limitation was the use of subjective measures for community variables such as SES and safety. In the absence of other measures however, these act as useful proxies that can shed some light on the role of the community environment. The Bt20+ study began with 3 723 participants and was down to 1 636 by year 22. This implies that the results may not be generalizable to the entire South African population. However, they show that ACEs are a public health concern in this population that need to be addressed and point to the need for more nationally representative samples to be studied. These results are the smoke that signals a fire which needs attention. Other research has shown similar rates of attrition (239). This lack of generalisability also applies to the Agincourt HDSS population used in the rural –urban comparison. The definitions of rural and urban in South Africa have several categories and the samples used in this study do not represent them all (109, 236).

7.5 Implications of research and next steps

7.5.1 Implications for research

Several questions have been raised by this thesis. Firstly, given the tentative evidence of the clustering of ACEs, one might ask if this is true for all populations in South Africa and other LMICs. Larger and more representative studies need to be conducted before interventions can be mapped out. The Bt20+ cohort does not fully represent the population of South Africa. The results of this study have however shown that ACEs and mental health are important public health issues. Many initiatives focused on early childhood development have been implemented already in South Africa and this evidence will enhance targeting and refining of programs. Further research is also needed to assess the association of ACE clusters and health and behavioural outcomes. This can be done with the current Bt20+ data but also extended to different populations and more representative samples

The ACE measurement tool needs to be further modified and expanded to suit LMIC contexts. Finkelhor et.al have also advocated for such modifications to ensure results are

relevant to each context (72, 73). In a study to examine whether additional items can improve the scale, they showed that the addition of measures of peer ill-treatment bullying, and witnessing and experiencing community violence improved the prediction of mental health symptoms (72). In the South African context, more health and behavioral outcomes need to be tested for their association with ACEs.

More investigation is needed on the prevalence of ACEs in rural communities and how ACEs interact with contemporaneous stress and violence in these contexts. A lot of evidence has been generated in urban communities and comparable data is needed for rural populations. Further study is also necessary in the South African context on the impact of community danger and the perception of it on ACEs and the relationship between ACEs and mental health. The type of interventions that work in urban settings may not be as effective in rural communities.

Support systems for ACE positive people are necessary to alleviate the consequences of their experiences on their health and behaviour. Social unity and socially supportive structures have been shown to prevent the occurrence of ACEs as well as reduce or even reverse their impact on mental health (240). The effect of social support on the link between ACEs and current stress and violence and mental well-being is a topic for further research. The type of and most useful social support resources can be investigated. This would assist in charting interventions to alleviate the effect of ACEs and violence on mental health and improve the prognosis of mental disorders.

7.5.2 Implications for policy and programs

South Africa has some of the most comprehensive early childhood and child protection laws and policies in the world. The Children's Act 38 of 2005, the National Constitution of South Africa, the Child Justice Act, 75 of 2008, Child Care Amendment Act (Act 96 of 1996), Sexual Offences and Related Matters Act of 2007 and the National Integrated Early Childhood Development Policy of 2015, all strive to protect children's right to a

safe and nurturing childhood, free from abuse and harm. They form the basis of many laws and programs aimed at improving access to early childhood services and preventing violence against children. The biggest barrier to realizing benefits from these policies has been their effective implementation. In light of the above, the evidence in this study highlights the urgent necessity to not only put more impetus on implementing existing policies, but take into account the role of ACEs in any future legislation. These results prove that the Safety and Security pillar of the Nurturing Care Framework is very important and a multi-sectoral approach is needed to ensuring a safe environment for children (85).

Funding and investment for further ACE research is necessary in South Africa and other LMICs. More nationally representative studies are needed that can be used as the basis for mapping out context specific interventions. Before widespread screening and rolling out of ACE testing can be implemented, frontline healthcare workers and caregivers need to be educated on the ACE evidence and how it affects their practice. Interventions that have been proven to work need to be readily available and accessible to everyone who may need them (241). All this needs funding to put in place.

Commitment and political will is necessary to implement policies and interventions that we already know, that address some of the issues raised in this study. In September 2019 the South African Constitutional Court effectively banned all forms of corporal punishment in the home (242). The banning of corporal punishment is supported by this study because of its direct harmful effects but also the point that no abuse exposure occurs in isolation. Hence the reduction in physical punishment in the home may also reduce attendant physical and emotional neglect. It is necessary to follow this development through in order to realize its positive gains.

Supportive legislation which has already been tabled in the draft Children's Third Amendment Bill (2018) is necessary to "take all reasonable steps to ensure that- (a) education and awareness-raising programs concerning the effect of subsections (1) and (2) are implemented across the Republic; and (b) programs promoting positive discipline at home and in alternative care are available across the Republic". My thesis shows that the household and community environment is important in the prevention of ACEs and

indeed mitigating their effects. The implementation and enforcement of such a Bill would ensure that the parents and caregivers as well as the community as a whole form a conducive environment to safe childhood growth and development.

Mental health care needs to be effective and readily accessible. Children growing up in households with mentally ill adults and caregivers are a risk of adverse outcomes as indicated in this study. Failure to provide holistic and effective mental health services is therefore a failure to support healthy child development. The issues of stigma and inaccessibility of care need to be addressed at community and national levels. Investment in more behavioural health practitioners in the public sector would help in this regard as many social workers and counsellors are often overwhelmed by the burden of cases.

7.6 Conclusion

In conclusion, this study demonstrates that ACEs and their impact on mental well-being are a notable public health concern that needs urgent consideration at the research and development as well as policy levels. Furthermore, it highlights the importance of supporting both the household and the community in providing a conducive environment for children to grow up in. The role of ACEs in the experience and witnessing of violence needs further investigation in the South African population.

REFERENCES

1. Twine W, Collinson M. Energy transitions in the Agincourt site in rural South Africa. South Africa: University of the Witwatersrand; 2019. https://ukdataservice.ac.uk/media/604438/datafirst_householdenergy_agincourthdss_28jan16.pdf. November 2019
2. Amato B. A tough childhood has a long-term effect on health. Business Day [Internet]. 2019.
3. Anda R. The health and social impact of growing up with adverse childhood experiences: The human and economic costs of the status quo. Centers for Disease Control and Prevention. 2007.
4. Kalmakis KA, Chandler GE. Adverse childhood experiences: towards a clear conceptual meaning. Journal of Advanced Nursing. 2014; 70(7): 1489-1501.
5. Dong M, Anda RF, Felitti VJ, Dube SR, Williamson DF, Thompson TJ, et al. The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. Child Abuse and Neglect. 2004; 28(7): 771-784.
6. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, et al. The enduring effects of abuse and related adverse experiences in childhood. European Archives of Psychiatry and Clinical Neuroscience 2006; 256(3): 174-186.
7. Cluver L, Orkin M, Boyes ME, Sherr L. Child and adolescent suicide attempts, suicidal behavior, and adverse childhood experiences in South Africa: a prospective study. Journal of Adolescent Health. 2015; 57(1): 52-59.
8. Anderson EL, Fraser A, Caleyachetty R, Hardy R, Lawlor DA, Howe LD. Associations of adversity in childhood and risk factors for cardiovascular disease in mid-adulthood. Child Abuse and Neglect. 2018; 76: 138-148.
9. Oladeji BD, Makanjuola VA, Gureje O. Family-related adverse childhood experiences as risk factors for psychiatric disorders in Nigeria. The British Journal of Psychiatry. 2010; 196(3): 186-191.
10. Su S, Wang X, Pollock JS, Treiber FA, Xu X, Snieder H, et al. Adverse Childhood Experiences and Blood Pressure Trajectories From Childhood to Young Adulthood The Georgia Stress and Heart Study. Circulation. 2015; 131(19): 1674-1681.
11. Bellis MA, Hughes K, Leckenby N, Jones L, Baban A, Kachaeva M, et al. Adverse childhood experiences and associations with health-harming behaviours in young adults: surveys in eight eastern European countries. Bulletin of the World Health Organization. 2014; 92(9): 641-655.
12. Chartier MJ, Walker JR, Naimark B. Separate and cumulative effects of adverse childhood experiences in predicting adult health and health care utilization. Child Abuse and Neglect. 2010; 34(6): 454-464.
13. Jewkes RK, Dunkle K, Nduna M, Jama PN, Puren A. Associations between childhood adversity and depression, substance abuse and HIV and HSV2 incident infections in rural South African youth. Child Abuse and Neglect. 2010; 34(11): 833-841.
14. Meinck F, Cluver LD, Boyes ME. Household illness, poverty and physical and emotional child abuse victimisation: findings from South Africa's first prospective cohort study. BMC Public Health. 2015; 15(1): 444.
15. Norman R BD, Schneider M, Joubert J, Groenewald P, Lewin S, et al. South African Comparative Risk Assessment, Group. C. A comparative risk assessment for South Africa in 2000: Towards promoting health and preventing disease. . South African Medical Journal. 2007; 97: 637-641.

16. Daelmans B, Black MM, Lombardi J, Lucas J, Richter L, Silver K, et al. Effective interventions and strategies for improving early child development. 2015.
17. UNICEF. Early childhood development: the key to a full and productive life. 2001.
18. Richter LM, Daelmans B, Lombardi J, Heymann J, Boo FL, Behrman JR, et al. Investing in the foundation of sustainable development: pathways to scale up for early childhood development. The Lancet. 2017; 389(10064): 103-118.
19. Shonkoff JP, Richter L, van der Gaag J, Bhutta ZA. An integrated scientific framework for child survival and early childhood development. Pediatrics. 2012; 129(2): e460-e472.
20. National Scientific Council on the Developing Child. The Science of Early Childhood Development: Closing the Gap Between What We Know and What We Do.: Centre on the developing child, Harvard University; 2007. Available: http://developingchild.harvard.edu/wp-content/uploads/2015/05/Science_Early_Childhood_Development.pdf. Accessed: 20 November 2015
21. Stiles J, Jernigan T. The Basics of Brain Development. Neuropsychology Review. 2010; 20(4): 327-348.
22. Andersen SL. Trajectories of brain development: point of vulnerability or window of opportunity? Neuroscience and Biobehavioral Reviews. 2003; 27: 3-18.
23. Shonkoff JP. Building a new biodevelopmental framework to guide the future of early childhood policy. Child Development. 2010; 81(1): 357-367.
24. Black J.E., W.T. Greenough. Learning and memory. Learning and memory. Second ed. New York: Academic Press; 1991.
25. Bellis MA, Kathryn Ashton, Karen Hughes, Katharine Ford, Julie Bishop and Shantini Paranjothy. Adverse Childhood Experiences and their impact on health-harming behaviours in the Welsh adult population. Wales: Public Health Wales

Centre for Public Health, Liverpool John Moores University; 2015. http://www.cph.org.uk/wp-content/uploads/2016/01/ACE-Report-FINAL-E.pdf. July 2017
26. Shonkoff JP, Garner AS, Siegel BS, Dobbins MI, Earls MF, Garner AS, et al. The Lifelong Effects of Early Childhood Adversity and Toxic Stress. Pediatrics. 2012; 129(1): e232.
27. Children's Institute. South African Child Gauge 2006. Cape Town: University of Cape Town Children's Institute; 2006. http://www.ci.uct.ac.za/ci/child-gauge/introduction.
28. Children's Institute. South African ChildGauge 2019. Child and adolescent health: Leave no one behind. Cape Town: Children's Institute; 2019.
29. Department of Social Development Republic of South Africa. NATIONAL INTEGRATED EARLY CHILDHOOD DEVELOPMENT POLICY. Pretoria, South Africa: Republic of South Africa; 2015. https://www.gov.za/sites/default/files/gcis_document/201610/national-integrated-ecd-policy-web-version-final-01-08-2016a.pdf. December 2019
30. Ward CL, Martin E, Theron C, Distiller GB. Factors Affecting Resilience in Children Exposed to Violence. South African Journal of Psychology. 2007; 37(1): 165-187.
31. Children's Institute. South African Child Gauge 2015. Cape Town: Children's Institute; 2015.
32. Eyal K, Burns J. Up or Down? Intergenerational Mental Health Transmission and Cash Transfers in South Africa. SALDRU Working Paper. 2014.
33. Children's Insititute. South African Child Gauge 2014: End the Cycle of Violence. Cape Town: Children's Institute; 2014.
34. Barnett W, Pellowski J, Kuo C, Koen N, Donald KA, Zar HJ, et al. Food-insecure pregnant women in South Africa: a cross-sectional exploration of maternal depression as a mediator of violence and trauma risk factors. BMJ Open. 2019; 9(3): e018277-e018277.

35. Dube SR, Felitti VJ, Dong M, Giles WH, Anda RF. The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. Preventive Medicine. 2003; 37(3): 268-277.
36. Bellis M, Hughes K, Leckenby N, Hardcastle K, Perkins C, Lowey H. Measuring mortality and the burden of adult disease associated with adverse childhood experiences in England: a national survey. Journal of Public Health. 2014: fdu065.
37. Kabiru CW, Beguy D, Crichton J, Ezeh AC. Self-reported drunkenness among adolescents in four sub-Saharan African countries: associations with adverse childhood experiences. Child and Adolescent Psychiatry and Mental Health. 2010; 4(1): 17.
38. Mall S, Mortier P, Taljaard L, Roos J, Stein DJ, Lochner C. The relationship between childhood adversity, recent stressors, and depression in college students attending a South African university. BMC Psychiatry. 2018; 18(1): 63.
39. Kobayashi LC, Farrell MT, Payne CF, Mall S, Montana L, Wagner RG, et al. Adverse childhood experiences and domain-specific cognitive function in a population-based study of older adults in rural South Africa. Psychology and Aging. 2020.
40. Kidman R, Palermo T. The relationship between parental presence and child sexual violence: evidence from thirteen countries in sub-Saharan Africa. Child Abuse and Neglect. 2016; 51: 172-180.
41. Children's Institute. Out of harm's way? Tracking child abuse cases through the child protection system at five selected sites in South Africa. Cape Town: Children's Institute; 2017.
42. Björkenstam E, Burström B, Brännström L, Vinnerljung B, Björkenstam C, Pebley AR. Cumulative exposure to childhood stressors and subsequent psychological distress. An analysis of US panel data. Social Science and Medicine. 2015; 142: 109-117.
43. Kagura J, Adair LS, Pisa PT, Griffiths PL, Pettifor JM, Norris SA. Association of socioeconomic status change between infancy and adolescence, and blood pressure, in South African young adults: Birth to Twenty Cohort. BMJ Open. 2016; 8: e008805.
44. Almuneef M, Qayad M, Aleissa M, Albuhairan F. Adverse childhood experiences, chronic diseases, and risky health behaviors in Saudi Arabian adults: A pilot study. Child Abuse and Neglect. 2014; 38(11): 1787-1793.
45. Kim B, Maguire-Jack K. Community interaction and child maltreatment. Child Abuse and Neglect. 2015; 41: 146-157.
46. Shaw CR, McKay HD. Juvenile delinquency and urban areas. 1942.
47. Lowe SR, Quinn JW, Richards CA, Pothen J, Rundle A, Galea S, et al. Childhood trauma and neighborhood-level crime interact in predicting adult posttraumatic stress and major depression symptoms. Child Abuse and Neglect. 2016; 51: 212-222.
48. Kotlaja MM, Fagan AA, Wright EM. Perceptions of danger, tolerance of delinquency, and economic disadvantage: Examining neighborhood influences on child physical abuse. Child Abuse and Neglect. 2020; 106: 104562.
49. Davis CR, Dearing E, Usher N, Trifiletti S, Zaichenko L, Ollen E, et al. Detailed assessments of childhood adversity enhance prediction of central obesity independent of gender, race, adult psychosocial risk and health behaviors. Metabolism. 2014; 63(2): 199-206.
50. Shin SH, Miller DP. A longitudinal examination of childhood maltreatment and adolescent obesity: results from the National Longitudinal Study of Adolescent Health (AddHealth) Study. Child Abuse and Neglect. 2012; 36(2): 84-94.
51. Dong M, Giles WH, Felitti VJ, Dube SR, Williams JE, Chapman DP, et al. Insights into causal pathways for ischemic heart disease adverse childhood experiences study. Circulation. 2004; 110(13): 1761-1766.
52. Huang H, Yan P, Shan Z, Chen S, Li M, Luo C, et al. Adverse childhood experiences and risk of type 2 diabetes: A systematic review and meta-analysis. Metabolism. 2015; 64(11): 1408-1418.

53. Ashton K, Bellis MA, Davies A, Hardcastle KA, Hughes K. Adverse childhood experiences and their association with chronic disease and health service use in the Welsh adult population: NHS Wales; 2016.
54. Ashton K, Bellis M, Hughes K. Adverse childhood experiences and their association with health-harming behaviours and mental wellbeing in the Welsh adult population: a national cross-sectional survey. The Lancet. 2016; 388: S21.
55. Cunradi CB, Todd M, Mair C, Remer L. Intimate Partner Violence among California Couples: Multilevel Analysis of Environmental and Partner Risk Factors. Partner Abuse. 2013; 4(4): 419-443.
56. Lu W, Mueser KT, Rosenberg SD, Jankowski MK. Correlates of adverse childhood experiences among adults with severe mood disorders. Psychiatric Services. 2008; 59(9): 1018-1026.
57. Machisa MT, Christofides N, Jewkes R. Mental ill health in structural pathways to women's experiences of intimate partner violence. PLoS ONE. 2017; 12(4): e0175240.
58. Duke NN, Pettingell SL, McMorris BJ, Borowsky IW. Adolescent violence perpetration: associations with multiple types of adverse childhood experiences. Pediatrics. 2010; 125(4): e778-786.
59. Machisa MT, Christofides N, Jewkes R. Structural Pathways between Child Abuse, Poor Mental Health Outcomes and Male-Perpetrated Intimate Partner Violence (IPV). PLoS ONE. 2016; 11(3): e0150986.
60. Hertzman C, Boyce T. How Experience Gets Under the Skin to Create Gradients in Developmental Health. Annual Review of Public Health. 2010; 31(1): 329-347.
61. Demetriou CA, van Veldhoven K, Relton C, Stringhini S, Kyriacou K, Vineis P. Biological embedding of early-life exposures and disease risk in humans: a role for DNA methylation. European Journal of Clinical Investigation. 2015; 45(3): 303-332.
62. Hinch BT. Adult Implications of Childhood Maltreatment USA: MJH Life Sciences; 2014 [[Available from: https://www.psychiatrictimes.com/special-reports/adult-implications-childhood-maltreatment/page/0/2.]
63. Centers for Disease Control and Prevention. About the CDC-Kaiser ACE Study USA: U.S. Department of Health & Human Services; 2020 [[Available from: https://www.cdc.gov/violenceprevention/aces/about.html#:~:text=The%20CDC%2DKaiser%20Permanente%20Adverse,two%20waves%20of%20data%20collection.]
64. Stevens J. ACEs Connection [Internet]. USA: ACEs Connection. 2015. [cited 2020]. Available from: https://www.acesconnection.com/blog/adding-layers-to-the-aces-pyramid-what-do-you-think.
65. Rides At The Door M, Trautman A. Considerations for implementing culturally grounded trauma-informed child welfare services: recommendations for working with American Indian/Alaska Native populations. Journal of Public Child Welfare. 2019; 13(3): 368-378.
66. Conching AKS, Thayer Z. Biological pathways for historical trauma to affect health: A conceptual model focusing on epigenetic modifications. Social Science & Medicine. 2019; 230: 74-82.
67. Walters KL, Mohammed SA, Evans-Campbell T, Beltrán RE, Chae DH, Duran B. BODIES DON'T JUST TELL STORIES, THEY TELL HISTORIES: Embodiment of Historical Trauma among American Indians and Alaska Natives. Du Bois review: Social Science Research on Race. 2011; 8(1): 179-189.
68. Boullier M, Blair M. Adverse childhood experiences. Paediatrics and Child Health. 2018; 28(3): 132-137.
69. Watson A, Dhaliwal K, Aceves K. THE RYSE CENTER'S LISTENING CAMPAIGN: Community-engaged inquiry of young people's experiences and articulations of trauma, violence, coping, and healing. Richmond: RYSE Centers; 2016.

https://static1.squarespace.com/static/58ece61644024383be911a95/t/593e57012e69cf4a3e12ec6d/1497257742081/RYSE+Listening+Report+2016.pdf.
70. Baglivio MT, Wolff KT, Epps N, Nelson R. Predicting adverse childhood experiences: The importance of neighborhood context in youth trauma among delinquent youth. Crime & Delinquency. 2017; 63(2): 166-188.
71. Wolff KT, Cuevas C, Intravia J, Baglivio MT, Epps N. The Effects of Neighborhood Context on Exposure to Adverse Childhood Experiences (ACE) Among Adolescents Involved in the Juvenile Justice System: Latent Classes and Contextual Effects. Journal of Youth and Adolescence. 2018; 47(11): 2279-2300.
72. Finkelhor D, Shattuck A, Turner H, Hamby S. A revised inventory of adverse childhood experiences. Child Abuse and Neglect. 2015; 48: 13-21.
73. Finkelhor D, Shattuck A, Turner H, Hamby S. Improving the adverse childhood experiences study scale. JAMA Pediatrics. 2013; 167(1): 70-75.
74. Cronholm PF, Forke CM, Wade R, Bair-Merritt MH, Davis M, Harkins-Schwarz M, et al. Adverse childhood experiences: expanding the concept of adversity. American Journal of Preventive Medicine. 2015; 49(3): 354-361.
75. Naicker SN, Norris SA, Mabaso M, Richter LM. An analysis of retrospective and repeat prospective reports of adverse childhood experiences from the South African Birth to Twenty Plus cohort. PLoS ONE. 2017; 12(7): e0181522.
76. Colman I, Kingsbury M, Garad Y, Zeng Y, Naicker K, Patten S, et al. Consistency in adult reporting of adverse childhood experiences. Psychological Medicine. 2015; 46(3): 543-549.
77. Schmidt MR, Narayan AJ, Atzl VM, Rivera LM, Lieberman AF. Childhood Maltreatment on the Adverse Childhood Experiences (ACEs) Scale versus the Childhood Trauma Questionnaire (CTQ) in a Perinatal Sample. Journal of Aggression, Maltreatment & Trauma. 2020; 29(1): 38-56.
78. Schroeder A, Slopen N, Mittal M. Accumulation, Timing, and Duration of Early Childhood Adversity and Behavior Problems at Age 9. Journal of Clinical Child & Adolescent Psychology. 2020; 49(1): 36-49.
79. Kidman R, Smith D, Piccolo LR, Kohler H-P. Psychometric evaluation of the Adverse Childhood Experience International Questionnaire (ACE-IQ) in Malawian adolescents. Child Abuse and Neglect. 2019; 92: 139-145.
80. World Health Organisation. Adverse Childhood Experiences International Questionnaire: Pilot study review and finalization meeting. Geneva: World Health Organisation; 2011. https://www.who.int/violence_injury_prevention/violence/activities/adverse_childhood_experiences/global_research_network_may_2011.pdf. 26 August 2020
81. Quinn M, Caldara G, Collins K, Owens H, Ozodiegwu I, Loudermilk E, et al. Methods for understanding childhood trauma: modifying the adverse childhood experiences international questionnaire for cultural competency. International Journal of Public Health. 2018; 63(1): 149-151.
82. Dube SR, Anda RF, Felitti VJ, Chapman DP, Williamson DF, Giles WH. Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span: findings from the Adverse Childhood Experiences Study. JAMA 2001; 286(24): 3089-3096.
83. Black MM, Walker SP, Fernald LC, Andersen CT, DiGirolamo AM, Lu C, et al. Early childhood development coming of age: science through the life course. The Lancet. 2017; 389(10064): 77-90.
84. Shonkoff JP, Richter L. The powerful reach of early childhood development: a science-based foundation for sound investment. Handbook of early childhood development research and its impact on global policy. Oxford: Oxford University Press; 2013. p. 24-34.
85. Britto PR, Lye SJ, Proulx K, Yousafzai AK, Matthews SG, Vaivada T, et al. Nurturing care: promoting early childhood development. The Lancet. 2017; 389(10064): 91-102.

86. Orsi R, Yuma-Guerrero P, Sergi K, Pena AA, Shillington AM. Drug overdose and child maltreatment across the United States' rural-urban continuum. Child Abuse and Neglect. 2018; 86: 358-367.
87. Beatriz ED, Salhi C, Griffith JL, Molnar BE. Urbanicity matters in self-reported child maltreatment prevalence: Findings from a nationally representative study. Child Abuse and Neglect. 2018; 79: 371-383.
88. Barnes MD, Heaton TL, Goates MC, Packer JM, editors. Intersystem Implications of the Developmental Origins of Health and Disease: Advancing Health Promotion in the 21st Century. Healthcare; 2016: Multidisciplinary Digital Publishing Institute.
89. Richter LM, Norris SA, De Wet T. Transition from Birth to Ten to Birth to Twenty: The South African Cohort Reaches 13 Years of Age. Paediatric and Perinatal Epidemiology. 2004; 18: 290 - 301.
90. Yach D, Cameron N, Padayachee N, Wagstaff L, Richter L, Fonn S. Birth to ten: child health in South Africa in the 1990s. Rationale and methods of a birth cohort study. Paediatric and Perinatal Epidemiology. 1991; 5(2): 211-233.
91. Richter L, Norris S, Pettifor J, Yach D, Cameron N. Cohort Profile: Mandela's Children: The 1990 Birth to Twenty Study in South Africa. International Journal of Epidemiology. 2007; 36: 504 - 511.
92. Richter LM, De Wet T. Growing Up in the New South Africa Birth to Ten: A Prospective Longitudinal Study from Birth to 10 Years of Age. Special Section of the Newsletter of the International Society for the Study of Behavioral Development. 1999; 36: 5 - 8.
93. South African History Online. Soweto Johannesburg, South Africa: SAHO; 2019 [[Available from: https://www.sahistory.org.za/place/soweto.]
94. Richter L, Yach D, Cameron N, Griesel R D, de Wet T. Enrolment into Birth to Ten (BTT): population and sample characteristics. Paediatric and Perinatal Epidemiology. 1995; 9: 109-120.
95. SA Venues. Map of Soweto, Gauteng Johannesburg, South Africa Johannesburg, South Africa2019 [[Available from: https://www.sa-venues.com/maps/gauteng/soweto.php.]
96. Draper CE, Micklesfield LK, Kahn K, Tollman SM, Pettifor JM, Dunger DB, et al. Application of Intervention Mapping to develop a community-based health promotion pre-pregnancy intervention for adolescent girls in rural South Africa: Project Ntshembo (Hope). BMC Public Health. 2014; 14(Suppl 2): S5-S5.
97. Non Communicable Disease Research Division. Project Ntshembo (Hope) Johannesburg: NCDRD; 2014 [[Available from: https://www.projecthope.org/what-we-do/noncommunicable-diseases-ncds/.]
98. Kahn K, Collinson MA, Gómez-Olivé FX, Mokoena O, Twine R, Mee P, et al. Profile: Agincourt health and socio-demographic surveillance system. International Journal of Epidemiology. 2012; 41(4): 988-1001.
99. Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: The Adverse Childhood Experiences (ACE) Study. American Journal of Preventive Medicine. 1998; 14(4): 245-258.
100. Centers for Disease Control and Prevention. Adverse Childhood Experiences Reported by Adults — Five States, 2009. Atlanta, GA, USA: Centers for Disease Control and Prevention; 2010 December 2010. https://www.cdc.gov/mmwr/pdf/wk/mm5949.pdf. June 2017
101. Soares ALG, Howe LD, Matijasevich A, Wehrmeister FC, Menezes AM, Gonçalves H. Adverse childhood experiences: Prevalence and related factors in adolescents of a Brazilian birth cohort. Child Abuse and Neglect. 2016; 51: 21-30.

102. Tran QA, Dunne MP, Vo TV, Luu NH. Adverse childhood experiences and the health of university students in eight provinces of Vietnam. Asia Pacific Journal of Public Health. 2015; 27(8_suppl): 26S-32S.
103. Helen Gonçalves, Soares ALG, Santos APGd, Ribeiro CG, Bierhals IO, Vieira LS, et al. Adverse childhood experiences and consumption of alcohol, tobacco and illicit drugs among adolescents of a Brazilian birth cohort. Cadernos de Saúde Pública [online]. 2016; 32(10).
104. Danese A, Moffitt TE, Harrington H, Milne BJ, Polanczyk G, Pariante CM, et al. Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation, and clustering of metabolic risk markers. Archives of Pediatrics & Adolescent Medicine. 2009; 163(12): 1135-1143.
105. Dannlowski U, Stuhrmann A, Beutelmann V, Zwanzger P, Lenzen T, Grotegerd D, et al. Limbic scars: long-term consequences of childhood maltreatment revealed by functional and structural magnetic resonance imaging. Biological Psychiatry. 2012; 71(4): 286-293.
106. Teicher MH, Anderson CM, Polcari A. Childhood maltreatment is associated with reduced volume in the hippocampal subfields CA3, dentate gyrus, and subiculum. Proceedings of the National Academy of Sciences of the United States of America. 2012; 109(9): E563-E572.
107. Gilbert R, Widom CS, Browne K, Fergusson D, Webb E, Janson S. Burden and consequences of child maltreatment in high-income countries. The Lancet. 2009; 373(9657): 68-81.
108. Hindley N, Ramchandani PG, Jones DPH. Risk factors for recurrence of maltreatment: a systematic review. Archives of Disease in Childhood. 2006; 91(9): 744-752.
109. Stats SA. Marriages and divorces. Pretoria, South Africa: Statistics South Africa; 2013. http://www.statssa.gov.za/publications/P0307/P03072013.pdf.
110. Senekal A. DOMESTIC PARTNERSHIPS Tyger Valley Greef Attorneys; 2017 [[Available from: https://greeffattorneys.co.za/2017/07/26/domestic-partnerships/.]
111. Anda RF, Butchart A, Felitti VJ, Brown DW. Building a framework for global surveillance of the public health implications of adverse childhood experiences. American Journal of Preventive Medicine. 2010; 39(1): 93-98.
112. Griffiths PL, Rousham EK, Norris SA, Pettifor JM, Cameron N. Socio-economic status and body composition outcomes in urban South African children. Archives of Disease in Childhood. 2008; 93(10): 862-867.
113. Basto-Abreu A, Barrientos-Gutiérrez T, Zepeda-Tello R, Camacho V, Gimeno Ruiz de Porras D, Hernández-Ávila M. The Relationship of Socioeconomic Status with Body Mass Index Depends on the Socioeconomic Measure Used. Obesity. 2018; 26(1): 176-184.
114. Galobardes B, Shaw M, Lawlor DA, Lynch JW, Davey Smith G. Indicators of socioeconomic position (part 1). Journal of Epidemiology & Community Health. 2006; 60(1): 7-12.
115. Saif-Ur-Rahman KM, Anwar I, Hasan M, Hossain S, Shafique S, Haseen F, et al. Use of indices to measure socio-economic status (SES) in South-Asian urban health studies: a scoping review. Systematic Reviews. 2018; 7(1): 196-196.
116. Desmond C. Measuring Socio-economic status in the Birth to Twenty cohort 2010.
117. StataCorp LP. Stata Statistics/Data Analysis. College Station, USA2014.
118. Stoltenborgh M, Van Ijzendoorn MH, Euser EM, Bakermans-Kranenburg MJ. A global perspective on child sexual abuse: Meta-analysis of prevalence around the world. Child Maltreatment. 2011; 16(2): 79-101.
119. Bottoms BL, Peter-Hagene LC, Epstein MA, Wiley TR, Reynolds CE, Rudnicki AG. Abuse characteristics and individual differences related to disclosing childhood sexual, physical, and emotional abuse and witnessed domestic violence. Journal of Interpersonal Violence. 2016; 31(7): 1308-1339.

120. Hughes K, Bellis MA, Hardcastle KA, Sethi D, Butchart A, Mikton C, et al. The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. The Lancet Public Health. 2017; 2(8): e356-e366.
121. Hatcher AM, Gibbs A, Jewkes R, McBride R-S, Peacock D, Christofides N. Effect of childhood poverty and trauma on adult depressive symptoms among young men in peri-urban South African settlements. Journal of Adolescent Health. 2019; 64(1): 79-85.
122. Walker SP, Wachs TD, Grantham-McGregor S, Black MM, Nelson CA, Huffman SL, et al. Inequality in early childhood: risk and protective factors for early child development. The Lancet. 2011; 378(9799): 1325-1338.
123. Coulton CJ, Crampton DS, Irwin M, Spilsbury JC, Korbin JE. How neighborhoods influence child maltreatment: A review of the literature and alternative pathways. Child Abuse and Neglect. 2007; 31(11–12): 1117-1142.
124. Font SA, Maguire-Jack K. Pathways from childhood abuse and other adversities to adult health risks: The role of adult socioeconomic conditions. Child Abuse and Neglect. 2016; 51: 390-399.
125. Brown SL. Marriage and Child Well-Being: Research and Policy Perspectives. Journal of Marriage and Family. 2010; 72(5): 1059-1077.
126. Parrish JW, Young MB, Perham-Hester KA, Gessner BD. Identifying risk factors for child maltreatment in Alaska. American Journal Of Preventive Medicine. 2011; 40(6): 666-673.
127. Roman NV, Isaacs SA, Davids C, Sui X-C. How well are families doing? A description of family well-being in South Africa. Family Medicine and Community Health. 2016; 4(3): 9-18.
128. Sameroff AJ. Developmental systems and psychopathology. Development and Psychopathology. 2000; 12(3): 297-312.
129. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. Annals of the New York Academy of Sciences. 2010; 1186(1): 190-222.
130. The Lancet. Adversity in childhood: how the past defines the future. The Lancet. 2016; 388(10058): 2324.
131. Kristman VL, Manno M, Cote P. Methods to account for attrition in longitudinal data: do they work? A simulation study. European Journal of Epidemiology. 2005; 20(8): 657-662.
132. Crouch E, Strompolis M, Bennett KJ, Morse M, Radcliff E. Assessing the interrelatedness of multiple types of adverse childhood experiences and odds for poor health in South Carolina adults. Child Abuse & Neglect. 2017; 65: 204-211.
133. Finkelhor D, Araji S. A Sourcebook on Child Sexual Abuse: Sage; 1986.
134. Barboza GE. Latent Classes and Cumulative Impacts of Adverse Childhood Experiences. Child Maltreatment. 2018; 23(2): 111-125.
135. Dube SR, Anda RF, Felitti VJ, Croft JB, Edwards VJ, Giles WH. Growing up with parental alcohol abuse: exposure to childhood abuse, neglect, and household dysfunction. Child Abuse and Neglect. 2001; 25(12): 1627-1640.
136. Scott BG, Burke NJ, Weems CF, Hellman JL, Carrión VG. The interrelation of adverse childhood experiences within an at-risk pediatric sample. Journal of Child & Adolescent Trauma. 2013; 6(3): 217-229.
137. Baglivio MT, Epps N. The interrelatedness of adverse childhood experiences among high-risk juvenile offenders. Youth Violence and Juvenile Justice. 2016; 14(3): 179-198.
138. Ballard ED, Van Eck K, Musci RJ, Hart SR, Storr CL, Breslau N, et al. Latent classes of childhood trauma exposure predict the development of behavioral health outcomes in adolescence and young adulthood. Psychological Medicine. 2015; 45(15): 3305-3316.

139. Schreiber JB. Latent class analysis: an example for reporting results. Research in Social and Administrative Pharmacy. 2017; 13(6): 1196-1201.
140. Manyema M, Norris SA, Richter LM. Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress. BMC Public Health. 2018; 18(1): 835.
141. StataCorp. Stata Statistical Software: Release 16. College Station, TX: StataCorp LLC.; 2019.
142. StataCorp. Stata 16 Base Reference Manual. . College Station, TX; 2019. . https://www.stata.com/manuals/semexample50g.pdf.
143. Matsunaga M. How to Factor-Analyze Your Data Right: Do's, Don'ts, and How-To's. International Journal of Psychological Research. 2010; 3(1).
144. Chan KL. Children exposed to child maltreatment and intimate partner violence: A study of co-occurrence among Hong Kong Chinese families. Child Abuse & Neglect. 2011; 35(7): 532-542.
145. McGuigan WM, Pratt CC. The predictive impact of domestic violence on three types of child maltreatment. Child Abuse and Neglect. 2001; 25(7): 869-883.
146. Hartley CC. Severe domestic violence and child maltreatment: Considering child physical abuse, neglect, and failure to protect. Children and Youth Services Review. 2004; 26(4): 373-392.
147. Kohl PL, Jonson-Reid M, Drake B. Maternal mental illness and the safety and stability of maltreated children. Child Abuse & Neglect. 2011; 35(5): 309-318.
148. Berlin LJ, Appleyard K, Dodge KA. Intergenerational Continuity in Child Maltreatment: Mediating Mechanisms and Implications for Prevention. Child Development. 2011; 82(1): 162-176.
149. Appleyard K, Berlin LJ, Rosanbalm KD, Dodge KA. Preventing Early Child Maltreatment: Implications from a Longitudinal Study of Maternal Abuse History, Substance Use Problems, and Offspring Victimization. Prevention Science. 2011; 12(2): 139-149.
150. Cavanaugh CE, Petras H, Martins SS. Gender-specific profiles of adverse childhood experiences, past year mental and substance use disorders, and their associations among a national sample of adults in the United States. Social Psychiatry and Psychiatric Epidemiology 2015; 50(8): 1257-1266.
151. Ross J, Waterhouse-Bradley B, Contractor AA, Armour C. Typologies of adverse childhood experiences and their relationship to incarceration in U.S. military veterans. Child Abuse and Neglect. 2018; 79: 74-84.
152. Elklit A, Christoffersen MN. A Latent Class Analysis of Childhood Maltreatment: Identifying Abuse Typologies AU - Armour, Cherie. Journal of Loss and Trauma. 2014; 19(1): 23-39.
153. Lew D, Xian H. Identifying Distinct Latent Classes of Adverse Childhood Experiences Among US Children and Their Relationship with Childhood Internalizing Disorders. Child Psychiatry & Human Development. 2019.
154. Chapman DP, Whitfield CL, Felitti VJ, Dube SR, Edwards VJ, Anda RF. Adverse childhood experiences and the risk of depressive disorders in adulthood. Journal of Affective Disorders. 2004; 82(2): 217-225.
155. Edwards VJ, Holden GW, Felitti VJ, Anda RF. Relationship between multiple forms of childhood maltreatment and adult mental health in community respondents: results from the adverse childhood experiences study. American Journal of Psychiatry. 2003; 160(8): 1453-1460.
156. Nurius PS, Green S, Logan-Greene P, Borja S. Life course pathways of adverse childhood experiences toward adult psychological well-being: A stress process analysis. Child Abuse and Neglect. 2015; 45: 143-153.
157. Schilling EA, Aseltine RH, Gore S. Adverse childhood experiences and mental health in young adults: a longitudinal survey. BMC Public Health. 2007; 7(1): 30.

158. Whiteford HA, Ferrari AJ, Degenhardt L, Feigin V, Vos T. The Global Burden of Mental, Neurological and Substance Use Disorders: An Analysis from the Global Burden of Disease Study 2010. PLoS ONE. 2015; 10(2): 1-14.
159. Ferrari AJ, Norman RE, Freedman G, Baxter AJ, Pirkis JE, Harris MG, et al. The burden attributable to mental and substance use disorders as risk factors for suicide: findings from the Global Burden of Disease Study 2010. PLoS ONE. 2014; 9(4): e91936.
160. Hay SI, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet. 2017; 390(10100): 1260-1344.
161. Tomlinson M, Grimsrud AT, Stein DJ, Williams DR, Myer L. The epidemiology of major depression in South Africa: results from the South African stress and health study. South African Medical Journal 2009; 99(5).
162. Seedat S, Stein DJ, Jackson PB, Heeringa SG, Williams DR, Myer L. Life stress and mental disorders in the South African stress and health study. South African Medical Journal. 2009; 99(5): 375-382.
163. WHO. Promoting Mental Health: Concepts , Emerging Evidence, Practice. Geneva, Switzerland: WHO; 2004. http://www.who.int/mental_health/evidence/en/promoting_mhh.pdf. Accessed 6 September 2017
164. Drapeau A, Marchand A, Beaulieu-Prévost D. Epidemiology of Psychological Distress. 2012 [cited 13 February 2018]. In: Mental Illnesses-Understanding, Prediction and Control

[Internet]. Rijeka, Croatia: InTech, [cited 13 February 2018]; [105-134]. Available from: https://www.intechopen.com/books/citations/mental-illnesses-understanding-prediction-and-control/epidemiology-of-psychological-distress.
165. Payton AR. Mental Health, Mental Illness, and Psychological Distress: Same Continuum or Distinct Phenomena? Journal of Health and Social Behavior 2009; 50(2): 213-227.
166. Jackson PB, Williams DR, Stein DJ, Herman A, Williams SL, Redmond DL. Race and psychological distress: The South African stress and health study. Journal of Health and Social Behavior. 2010; 51(4): 458-477.
167. Nurius PS, Uehara E, Zatzick DF. Intersection of stress, social disadvantage, and life course processes: reframing trauma and mental health. American Journal of Psychiatric Rehabilitation. 2013; 16(2): 91-114.
168. Pearlin LI, Schieman S, Fazio EM, Meersman SC. Stress, Health, and the Life Course: Some Conceptual Perspectives. Journal of Health and Social Behavior. 2005; 46(2): 205-219.
169. Peltzer K, Pengpid S, Skaal L. Prevalence of psychological distress and associated factors in urban hospital outpatients in South Africa. South African Journal of Psychiatry. 2012; 18(1): 10-15.
170. Erdem Ö, Van Lenthe FJ, Prins RG, Voorham TA, Burdorf A. Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighborhood social cohesion. PLoS ONE. 2016; 11(6): e0157119.
171. Pigeon-Gagné É, Hassan G, Yaogo M, Ridde V. An exploratory study assessing psychological distress of indigents in Burkina Faso: a step forward in understanding mental health needs in West Africa. International Journal for Equity in Health 2017; 16: 1-11.
172. Kessler RC, McLaughlin KA, Green JG, Gruber MJ, Sampson NA, Zaslavsky AM, et al. Childhood adversities and adult psychopathology in the WHO World Mental Health Surveys. British Journal of Psychiatry. 2010; 197(5): 378-385.
173. Sterling M. General Health Questionnaire–28 (GHQ-28). Journal of Physiotherapy. 2011; 57(4): 259.

174. Dube SR, Miller JW, Brown DW, Giles WH, Felitti VJ, Dong M, et al. Adverse childhood experiences and the association with ever using alcohol and initiating alcohol use during adolescence. Journal of Adolescent Health. 2006; 38(4): 444. e441-444. e410.
175. Sheppard ZA, Norris SA, Pettifor JM, Cameron N, Griffiths PL. Approaches for assessing the role of household socioeconomic status on child anthropometric measures in urban South Africa. American Journal of Human Biology. 2009; 21(1): 48-54.
176. Merrick MT, Ports KA, Ford DC, Afifi TO, Gershoff ET, Grogan-Kaylor A. Unpacking the impact of adverse childhood experiences on adult mental health. Child Abuse and Neglect. 2017; 69: 10-19.
177. Caron J, Fleury M-J, Perreault M, Crocker A, Tremblay J, Tousignant M, et al. Prevalence of psychological distress and mental disorders, and use of mental health services in the epidemiological catchment area of Montreal South-West. BMC Psychiatry. 2012; 12(1): 183.
178. Raposa EB, Hammen CL, Brennan PA, O'callaghan F, Najman JM. Early adversity and health outcomes in young adulthood: the role of ongoing stress. Health Psychology. 2014; 33(5): 410.
179. Nurius PS, Green S, Logan-Greene P, Longhi D, Song C. Stress pathways to health inequalities: Embedding ACEs within social and behavioral contexts. International Journal of Public Health. 2016; 8(2): 241.
180. Hobfoll SE. The Influence of Culture, Community, and the Nested-Self in the Stress Process: Advancing Conservation of Resources Theory. Applied Psychology. 2001; 50(3): 337-421.
181. Rohner RP, Khaleque A. Testing central postulates of parental acceptance-rejection theory (PARTheory): A meta-analysis of cross-cultural studies. Journal of Family Theory and Review. 2010; 2(1): 73-87.
182. Rohner RP, Khaleque A, Cournoyer DE. Parental Acceptance-Rejection: Theory, Methods, Cross-Cultural Evidence, and Implications. Ethos. 2005; 33(3): 299-334.
183. Khaleque A. Perceived Parental Warmth, and Children's Psychological Adjustment, and Personality Dispositions: A Meta-analysis. Journal of Child and Family Studies. 2013; 22(2): 297-306.
184. Sart ZH, Börkan B, Erkman F, Serbest S. Resilience as a Mediator Between Parental Acceptance–Rejection and Depressive Symptoms Among University Students in Turkey. Journal of Counseling & Development. 2016; 94(2): 195-209.
185. Molina J, Andrade-Rosa C, González-Parra S, Blasco-Fontecilla H, Real M, Pintor C. The factor structure of the General Health Questionnaire (GHQ): a scaled version for general practice in Spain. European Psychiatry. 2006; 21(7): 478-486.
186. Cheong EV, Sinnott C, Dahly D, Kearney PM. Adverse childhood experiences (ACEs) and later-life depression: perceived social support as a potential protective factor. BMJ Open. 2017; 7(9).
187. ARNEC: Asia Pacific Regional Network for Early Chldhood. ECD in the SDGs: Abriefing Note. Singapore: ARNEC; 2016. http://www.arnec.net/wp-content/uploads/2016/04/ECD-in-the-SDGs-20Mar2016_final-002.pdf. 18 January 2018
188. Sawyer SM, Afifi RA, Bearinger LH, Blakemore S-J, Dick B, Ezeh AC, et al. Adolescence: a foundation for future health. The Lancet. 2012; 379(9826): 1630-1640.
189. Africa SS. Mid-year population estimates 2016. Pretoria, South Africa; 2016. http://www.statssa.gov.za/publications/P0302/P03022016.pdf. 12 January 2016
190. Gore FM, Bloem PJ, Patton GC, Ferguson J, Joseph V, Coffey C, et al. Global burden of disease in young people aged 10–24 years: a systematic analysis. The Lancet. 2011; 377(9783): 2093-2102.
191. Patton GC, Coffey C, Cappa C, Currie D, Riley L, Gore F, et al. Health of the world's adolescents: a synthesis of internationally comparable data. The Lancet. 2012; 379(9826): 1665-1675.
192. Resnick MD, Richard F Catalano, Susan M Sawyer, Russell Viner, Patton GC. Seizing the opportunities of adolescent health. Lancet. 2012; 379: 1564-1566.

193. Viner RM, Ross D, Hardy R, Kuh D, Power C, Johnson A, et al. Life course epidemiology: recognising the importance of adolescence. Journal of Epidemiology and Community Health. 2015; 69(8): 719-720.
194. Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: a global public-health challenge. The Lancet. 2007; 369(9569): 1302-1313.
195. World Health Organisation. World report on violence and health. Geneva, Switzerland: World Health Oraganisation,; 2002. http://apps.who.int/iris/bitstream/10665/42495/1/9241545615_eng.pdf. 23 August 2016
196. Norman R, Schneider M, Bradshaw D, Jewkes R, Abrahams N, Matzopoulos R, et al. Interpersonal violence: an important risk factor for disease and injury in South Africa. Population Health Metrics. 2010; 8(1): 32.
197. Krug EG, Mercy JA, Dahlberg LL, Zwi AB. The world report on violence and health. The Lancet. 2002; 360(9339): 1083-1088.
198. Burton P. Results of the national youth victimisation study: easy prey. SA Crime Quarterly. 2006; 2006(16): 1-6.
199. Bach JM, Louw D. Depression and exposure to violence among Venda and Northern Sotho adolescents in South Africa : original article2010 13(1):[25-35 pp.]. Available from: http://reference.sabinet.co.za/webx/access/electronic_journals/medjda2/medjda2_v13_n1_a5.pdf.
200. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Archives of General Psychiatry. 2005; 62(6): 593-602.
201. Twine R, Kahn K, Scholtz A, Norris SA. Involvement of stakeholders in determining health priorities of adolescents in rural South Africa. Global Health Action. 2016; 9.
202. Rosenthal BS, Wilson WC. Adolescents' psychological response to the experience of community interpersonal violence: A cross-national and a cross-cultural comparison. Adolescence. 2006; 41(163): 417.
203. Visser MJ, Coetzee N, Claassen M. The expression of personality among adolescents exposed to community interpersonal violence. South African Journal of Psychology. 2015: 0081246315617136.
204. Mitchell SJ, Lewin A, Horn IB, Valentine D, Sanders-Phillips K, Joseph JG. How does violence exposure affect the psychological health and parenting of young African-American mothers? Social Science & Medicine. 2010; 70(4): 526-533.
205. Dunkle KL, Jewkes RK, Brown HC, Gray GE, McIntryre JA, Harlow SD. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. The Lancet. 2004; 363(9419): 1415-1421.
206. Jewkes RK, Dunkle K, Nduna M, Shai N. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. The Lancet. 2010; 376.
207. Kaminer D, Grimsrud A, Myer L, Stein DJ, Williams DR. Risk for post-traumatic stress disorder associated with different forms of interpersonal violence in South Africa. Social Science and Medicine. 2008; 67.
208. Sundermann JM, Chu AT, DePrince AP. Cumulative violence exposure, emotional nonacceptance, and mental health symptoms in a community sample of women. Journal of Trauma & Dissociation. 2013; 14(1): 69-83.
209. Kovess-Masféty V, Alonso J, de Graaf R, Demyttenaere K. A European approach to rural-urban differences in mental health: the ESEMeD 2000 comparative study. The Canadian Journal of Psychiatry. 2005; 50(14): 926.

210. Wang JL. Rural–urban differences in theprevalence of major depression and associatedimpairment. Social Psychiatry and Psychiatric Epidemiology. 39(1): 19-25.
211. Probst JC, Laditka SB, Moore CG, Harun N, Powell MP, Baxley EG. Rural-urban differences in depression prevalence: implications for family medicine. Family Medicine 2006; 38(9): 653.
212. Saxena S, Thornicroft G, Knapp M, Whiteford H. Resources for mental health: scarcity, inequity, and inefficiency. The Lancet. 2007; 370(9590): 878-889.
213. Jansen A, Moses M, Mujuta S, Yu D. Measurements and determinants of multifaceted poverty in South Africa. Development Southern Africa. 2015; 32(2): 151-169.
214. le R Booysen F. Urban–rural inequalities in health care delivery in South Africa. Development Southern Africa. 2003; 20(5): 659-673.
215. Micklesfield LK, Munthali RJ, Prioreschi A, Said-Mohamed R, van Heerden A, Tollman S, et al. Understanding the relationship between socio-economic status, physical activity and sedentary behaviour, and Adiposity in young adult South African women using structural equation modelling. International Journal of Environmental Research and Public Health. 2017; 14(10): 1271.
216. Prioreschi A, Wrottesley SV, Cohen E, Reddy A, Said-Mohamed R, Twine R, et al. Examining the relationships between body image, eating attitudes, BMI, and physical activity in rural and urban South African young adult females using structural equation modeling. PLoS ONE. 2017; 12(11): e0187508.
217. Maredza M, Bertram MY, Gómez-Olivé XF, Tollman SM. Burden of stroke attributable to selected lifestyle risk factors in rural South Africa. BMC Public Health. 2016; 16(1): 143.
218. Statistics South Africa. Census 2001: Investigation into appropriate definitions of urban and rural areas for South Africa. Pretoria, South Africa: Statistics South Africa; 2003. http://www.statssa.gov.za/census/census_2001/urban_rural/urbanrural.pdf. 2 February 2018
219. Benjamin S, Lennon S, Gardner G. The validity of the General Health Questionnaire for first-stage screening for mental illness in pain clinic patients. Pain. 1991; 47(2): 197-202.
220. Goldberg DP, Gater R, Sartorius N, Ustun TB, Piccinelli M, Gureje O, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. Psychological Medicine. 1997; 27(1): 191-197.
221. Jackson C. The general health questionnaire. Occupational Medicine. 2007; 57(1): 79-79.
222. Bray SR, Born HA. Transition to University and Vigorous Physical Activity: Implications for Health and Psychological Well-Being. Journal of American College Health. 2004; 52(4): 181-188.
223. Maltby J, Macaskill A, Day L. Failure to forgive self and others: a replication and extension of the relationship between forgiveness, personality, social desirability and general health. Personality and Individual Differences. 2001; 30(5): 881-885.
224. Zhang S, Anderson SG. Low-income single mothers' community violence exposure and aggressive parenting practices. Children and Youth Services Review. 2010; 32(6): 889-895.
225. Pillai A, Andrews T, Patel V. Violence, psychological distress and the risk of suicidal behaviour in young people in India. International Journal of Epidemiology. 2009; 38(2): 459-469.
226. Meuleners L, Lee AH, Hendrie D. Effects of demographic variables on mental illness admission for victims of interpersonal violence. Journal of Public Health. 2009; 31(1): 162-167.
227. Myer L, Stein DJ, Grimsrud A, Seedat S, Williams DR. Social determinants of psychological distress in a nationally-representative sample of South African adults. Social Science & Medicine. 2008; 66(8): 1828-1840.
228. De Silva MJ, Huttly SR, Harpham T, Kenward MG. Social capital and mental health: A comparative analysis of four low income countries. Social Science & Medicine. 2007; 64(1): 5-20.
229. Coker AL, Smith PH, Thompson MP, McKeown RE, Bethea L, Davis KE. Social Support Protects against the Negative Effects of Partner Violence on Mental Health. Journal of Women's Health & Gender-Based Medicine. 2002; 11(5): 465-476.

230. Peterson LE, Tsai AC, Petterson S, Litaker DG. Rural–urban comparison of contextual associations with self-reported mental health status. Health & Place. 2009; 15(1): 125-132.
231. Kennedy TM, Ceballo R. Emotionally numb: Desensitization to community violence exposure among urban youth. Developmental Psychology. 2016; 52(5): 778-789.
232. McCart MR, Smith DW, Saunders BE, Kilpatrick DG, Resnick H, Ruggiero KJ. Do urban adolescents become desensitized to community violence? Data from a national survey. American Journal of Orthopsychiatry. 2007; 77(3): 434-442.
233. Buka SL, Stichick TL, Birdthistle I, Earls FJ. Youth exposure to violence: Prevalence, risks, and consequences. American Journal of Orthopsychiatry. 2001; 71(3): 298-310.
234. Das J, Do Q-T, Friedman J, McKenzie D, Scott K. Mental health and poverty in developing countries: Revisiting the relationship. Social Science & Medicine. 2007; 65(3): 467-480.
235. Guite H, Clark C, Ackrill G. The impact of the physical and urban environment on mental well-being. Public health. 2006; 120(12): 1117-1126.
236. Republic of South Africa National Treasury. 2011 Local Government Budgets and Expenditure Review Pretoria, South Africa: National Treasury; 2011. http://www.treasury.gov.za/publications/igfr/2011/lg/02.%202011%20LGBER%20-%20Final%20-%2013%20Sept%202011%20(renumbered).pdf. February 2018
237. Ryu E. Multiple-group analysis approach to testing group difference in indirect effects. Behavior Research Methods. 2015; 47(2): 484-493.
238. Nakazawa DJ. Childhood Disrupted. How your biography becomes your biology, and how you can heal. New York, USA: Atria Paperback; 2015.
239. Mostafa T, Wiggins R. The impact of attrition and non-response in birth cohort studies: a need to incorporate missingness strategies. Longitudinal and Life Course Studies. 2015; 6(2): 131-146.
240. Machisa MT, Christofides N, Jewkes R. Social support factors associated with psychological resilience among women survivors of intimate partner violence in Gauteng, South Africa. Global Health Action. 2018; 11(sup3): 1491114.
241. Finkelhor D. Screening for adverse childhood experiences (ACEs): Cautions and suggestions. Child Abuse and Neglect. 2018; 85: 174-179.
242. Global Initiative to End All Corporal Punishment of children in South Africa. Corporal punishment of children in South Africa. United Kingdom: Global Initiative to End All Corporal Punishment of children in South Africa; 2019. https://endcorporalpunishment.org/wp-content/uploads/country-reports/SouthAfrica.pdf.

APPENDICES


Our children are our greatest treasure. They are our future. Those who abuse them tear at the fabric of our society and weaken our nation.
- Nelson Mandela
WISEFAMOUSQUOTES.COM

Appendix 1: M. Manyema, S. A. Norris, R. Said-Mohamed, S. T. Tollman, R. Twine, K. Kahn, L. M. Richter. The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa. Health and Place. 2018; 51:97-106.

Health & Place 51 (2018) 97–106

Contents lists available at ScienceDirect

Health & Place

journal homepage: www.elsevier.com/locate/healthplace

The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa

M. Manyema[a,b,*], S.A. Norris[a], R. Said-Mohamed[a], S.T. Tollman[c,d,e], R. Twine[c], K. Kahn[c,d,e], L.M. Richter[b]

[a] MRC/Wits Developmental Pathways of Health Research Unit, School of Clinical Medicine, University of the Witwatersrand, Johannesburg, South Africa
[b] DST-NRF Centre of Excellence in Human Development, University of the Witwatersrand, Johannesburg, South Africa
[c] MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences,University of the Witwatersrand, Johannesburg, South Africa
[d] INDEPTH Network, Accra, Ghana
[e] Epidemiology and Global Health Unit, Department of Public Health and Clinical Medicine, Umeå University, Umeå, Sweden

ARTICLE INFO

Keywords:
Interpersonal violence
Psychological distress
Rural
Urban
Adolescent
Young women

ABSTRACT

Background: Approximately 25% of the world's population consists of young people. The experience of violence peaks during adolescence and the early adult years. A link between personal experience of violence and mental health among young people has been demonstrated but rural-urban differences in these associations are less well known in low to middle income countries. The aim of this study was to investigate the associations between interpersonal violence and psychological distress among rural and urban young women.

Methods: Data on experiences of violence and psychological distress were collected from a total of 926 non-pregnant young women aged between 18 and 22 years of age in rural and urban sites in South Africa. The General Health Questionnaire-28 was used to assess psychological distress as an indicator of mental health. Generalised structural equation models were employed to assess potential pathways of association between interpersonal violence and psychological distress.

Results: Thirty-four percent of the urban young women (n = 161) reported psychological distress compared to 18% of rural young women (n = 81). In unadjusted analysis, exposure to interpersonal violence doubled the odds of psychological distress in the urban adolescents and increased the odds 1.6 times in the rural adolescents. In adjusted models, the relationship remained significant in the urban area only (OR 1.84, 95% CI 1.13–3.00). Rural residence seemed protective against psychological distress (OR 0.41, 95% CI 0.24–0.69). Structural equation modelling did not reveal any direct association between exposure to interpersonal violence and psychological distress among rural young women. Stressful household events were indirectly associated with psychological distress, mediated by violence among young women in the urban area.

Conclusion: The relationship between violence and psychological distress differs between urban and rural-residing young women in South Africa, and is influenced by individual, household and community (contextual) factors.

1. Background

Approximately 25% of the world's population is between 10 and 24 years of age, with nearly 90% residing in low-to-middle income countries (LMICs) (Sawyer et al., 2012). In South Africa, this age-group constitutes 27% of the population (Stats South Africa, 2016). The development of this age-group is central to the achievement of global health goals. Risk factors to which adolescents and young adults are exposed, such as violence and infectious diseases, and risk behaviors adopted during this stage of life like smoking and lack of exercise can have a substantial effect in later life and potentially impact the health of future generations (Gore et al., 2011; Patton et al., 2012). At least 70% of premature adult deaths reflect behaviors initiated or reinforced during adolescence (Resnick et al., 2012). The rapid brain development, sexual maturation and dynamic behavioral and social change occurring in the second decade of life make it a time of great importance for later health, and therefore also a time of great potential for intervention (Viner et al., 2015).

* Correspondence to: School of Public Health, University of the Witwatersrand, 27 St Andrews Road, Parktown 2193, Johannesburg, South Africa.
E-mail address: mercy.manyema@wits.ac.za (M. Manyema).

https://doi.org/10.1016/j.healthplace.2018.03.003
Received 25 May 2017; Received in revised form 26 February 2018; Accepted 13 March 2018
1353-8292/ © 2018 Elsevier Ltd. All rights reserved.

Interpersonal violence, defined in this study as "violence between family members and intimates, and violence between acquaintances and strangers that is not intended to further the aims of any formally defined group or cause", imposes a significant public health and economic burden worldwide and locally (Patel et al., 2007; World Health Organisation, 2002; Norman et al., 2010; Krug et al., 2002). The World Health Organisation divides interpersonal violence into two categories, namely family and intimate partner violence, and community violence, both of which are included in our definition for this study (World Health Organisation, 2002). Approximately 1.6 million people globally lose their lives to interpersonal, self-inflicted and collective violence with the majority of these deaths occurring in LMICs (World Health Organisation, 2002).

The experience of interpersonal violence peaks during the adolescent and young adulthood years with the highest rates of homicides and suicides in the world among males aged 15–29 years (World Health Organisation, 2002). In the South African Comparative Risk Assessment Study, interpersonal violence, defined as acts of family and community violence, was the second leading cause of healthy life-years lost (Norman et al., 2010). The average injury death rate of 157·8 per 100,000 population in South Africa is nearly twice the global average (Seedat et al., 2009). Data from the South African National Youth Victimization study show that between September 2004 and September 2005 42% of young people aged 12–22 years were victims of assault, sexual assault/rape, theft, robbery, housebreaking or car hijacking, translating to over 4 million people (Burton, 2006). Other data from South Africa reveal that at least 90% of adolescents aged 15–18 years studied in Limpopo Province have been exposed to at least one act of violence in their lifetime (Bach and Louw, 2010).

The burden of mental health disorders in young people is similarly high and many such disorders may go unnoticed until later in life. At least 20–25% of young people in the general population globally will suffer from at least one mental disorder in any given year (Patel et al., 2007). Three quarters of lifetime mental health disorders may have their onset before the age of 25 (Kessler et al., 2005). A systematic review of original studies from LMICs showed a prevalence of mental health problems of about 10–20% in most of the 16 surveys identified (Twine et al., 2016). The prevalence of mental disorders in South Africa is estimated at 15% (Patel et al., 2007).

A link between exposure to violence and mental health among young people has been widely demonstrated, with negative effects including post-traumatic stress disorder (PTSD), depression and psychological distress (PD) (Bach and Louw, 2010; Rosenthal and Wilson, 2006; Visser et al., 2015). The effects of exposure to violence in young women have also been especially studied because of the possibility of the transmission of intergenerational trauma through the women's mental health.

In the United States of America (USA) and Spain, young women aged between 18 and 25 years who reported exposure to violence had increased risk of depressive symptoms, PTSD, general aggression and somatic complaints (Mitchell et al., 2010). Among young African-American mothers, violence exposure was found to increase aggression and depression, which in turn affected parenting behaviors and increased the risk of the use of harsh disciplining methods (Mitchell et al., 2010). South African evidence shows that interpersonal violence, including gender-based violence and criminal assault, is associated with increased incidence of HIV (Dunkle et al., 2004; Jewkes et al., 2010) and an increased lifetime risk of PTSD in women (Kaminer et al., 2008). Women who experience or witness more violence are at an increased risk of more severe mental health and other symptoms (Mitchell et al., 2010; Sundermann et al., 2013). Further research from South Africa also shows that young women are more likely to have a higher prevalence of depressive symptoms than men even with similar levels of exposure to violence (Bach and Louw, 2010).

The relationship between place of residence, risk factors for and prevalence of mental health disease appears quite complex. Evidence from high-income countries suggests that the epidemiology of mental health differs between rural and urban contexts. In Europe and Canada, urbanicity has been linked to a higher risk and prevalence of mental health and depressive disorders. (Kovess-Masféty et al., 2005; Wang) On the other hand, data from the USA showed slightly but significantly higher prevalence of depression in rural compared to urban residents (Probst et al., 2006). The burden of mental disorders is often highest in the poor, in women and in rural communities among others, and yet these groups have low access to the necessary services (Saxena et al., 2007). This is further compounded by the fact that resources for mental health care are not only scarce, but are also inequitably distributed, with need and access usually inversely related (Saxena et al., 2007). Data from the National Income Dynamics Study (NIDS) South Africa, a long-running national panel survey, confirms that poverty headcount ratios are higher in women compared to men, and in rural compared to urban dwellers (Jansen et al., 2015). Disparities in access to health care services and health-care service delivery between urban and rural South Africans also persist (le and Booysen, 2003). The role of the rural-urban divide in the association between exposure to violence and psychological distress therefore needs to be fully explored in South Africa.

The rapid development and pervasive social and behavioral changes occurring during adolescence and young adulthood make this period in the life course critical for later health and well-being (Viner et al., 2015). In South Africa, this age-group is exposed to high levels of violence which has been linked to poor mental health outcomes with greater risk in women. In addition to this, evidence shows that most mental health disorders that manifest in adulthood, usually have their first onset in childhood or adolescence (Kessler et al., 2005). It is therefore essential to investigate the link between exposure to violence and psychological distress especially among young women to broaden our understanding of the factors that impact this association, with a view to develop appropriate and effective interventions. Therefore, the aims of this study were threefold: (i) to investigate the prevalence of interpersonal violence and PD among young women residing in rural and urban South Africa; (ii) assess the factors associated with interpersonal violence and PD; and (iii) explore the potential pathways between interpersonal violence and PD in urban and rural settings.

2. Methods

2.1. Study design and setting, and participants

We prospectively designed a study to examine rural-urban differences between young women drawing upon two research platforms. Firstly, the Project Ntshembo-Hope Cross-Sectional Survey, a study set in the Agincourt Health and Socio-Demographic Surveillance System (Agincourt HDSS) research site and whose main aim was to optimise the health of young women in South Africa and limit the intergenerational risk of metabolic disease (Twine et al., 2016; Draper et al., 2014) was utilised. Constituting the rural site, the Agincourt HDSS research site covers a sub-district of Mpumalanga Province in northeast South Africa covering 31 villages and a population of 115 000 living in a total area of 450 km^2 (Kahn et al., 2012). Living conditions are poor, with modest road infrastructure, poor access to piped water and electricity and low socio-economic status (SES) (Kahn et al., 2012; Maredza et al., 2016a). The Agincourt HDSS was established in 1992 to support district health systems development led by the Ministry of Health, and as of 2011 had 90,000 people under surveillance (Kahn et al., 2012). From the 2011 Agincourt HDSS database, 509 young women aged between 18 and 23 years of age were randomly selected out of a possible total of 2126 young women.

Secondly, 510 young women aged between 22 and 23 years were selected from the Young Adult Survey (YAS) of the Birth to Twenty Plus (Bt20+) cohort, Soweto (Micklesfield et al., 2017; Prioreschi et al., 2017). The Bt20+ Study is the largest and longest-running birth cohort

in Africa (Richter et al., 2007). At its inception, the cohort included 3275 singleton babies born to women resident in Soweto during the enrolment period in 1990 (Richter et al., 2007, 2004). Of these, over 1600 returned for the YAS, which was the data collection wave conducted when the cohort was 22–23 years of age. Soweto, is a densely populated suburb of Johannesburg situated in the Gauteng province with approximately 1.5 million inhabitants in 2017 living in a 200 km^2 area (Population of 2017, 2017). Compared to Agincourt HDSS sub-district, residents of Soweto have higher SES, higher education and employment levels, and better access to water, sanitation, electricity and health care facilities, which are the typical differentiating factors between urban and rural areas in South Africa apart from population density and economic activity (Mid-year, 2016; Maredza et al., 2016b; Stats South Africa, 2003). The Agincourt HDSS and Bt20+ studies have been described elsewhere (Kahn et al., 2012; Richter et al., 2007). All the selected participants were black African young women.

A power analysis was carried out and we estimated that a sample size of 500 in each setting would provide sufficient power (90%) to examine differences and associations within and between the study samples. Both study samples were randomly selected from the respective site.

2.2. Inclusion and exclusion criteria

The study included female participants with no apparent mental or physical disability, who were not pregnant and who gave written consent. We selected young women given the sex differences in overweight and obesity prevalence in young women compared to men, with the former have a three-fold greater prevalence (Draper et al., 2014). Pregnancy was determined initially by self-report and later all consenting women were tested. Pregnant women were excluded due to hormonal changes that occur during pregnancy which may cause emotional states to fluctuate considerably. Furthermore, we could not determine body composition on pregnant women using dual-energy X-ray absorptiometry (DXA).

2.3. Ethics approval

Ethical clearances were obtained from the Human Research Ethics Committee of the University of the Witwatersrand (M120138 for the Ntshembo-Hope Cross Sectional Survey and M111182 for the Bt20+ survey), and permission given by the Mpumalanga Department of Health Research Committee.

2.4. Variables

The questionnaires and survey procedures were standardised for the two sites. Questionnaires were translated into Shangaan (the local language spoken in that part of Mpumalanga province) where needed but most were administered in English in both sites. Research assistants and fieldworkers for both sites were trained together and administered the questionnaires.

2.4.1. Main outcome: Psychological distress

The General Health Questionnaire-28 (GHQ-28), a tool developed to detect those at risk of developing psychiatric disorders, was used to collect data on psychological distress. This tool has been used as a screen in general medical settings (Benjamin et al., 1991; Goldberg et al., 1997), in the general population (Jackson, 2007), and in younger populations (Bray and Born, 2004; Maltby et al., 2001). It consists of 28 items divided into four subscales: somatic symptoms; anxiety/insomnia; social dysfunction, and severe depression (Sterling, 2011). Each item has four possible responses coded 0–3 (Sterling, 2011). The recall period for the GHQ is six months. A score of 24 was considered the threshold for psychological distress as recommended by literature, creating a binary variable for psychological distress (Sterling, 2011). We tested the internal validity of the GHQ-28 in the pooled, rural and urban populations using Cronbach's alpha analysis and obtained values of 0.7901, 0.8543 and 0.7820 respectively. All the questionnaire items were retained in the analysis.

2.4.2. Exposure: Interpersonal violence

The World Health Organisation divides interpersonal violence into two categories, namely family and intimate partner violence and community violence, both of which are included in our definition for this study. The young women were asked three questions regarding their personal experience of or witnessing violence or violent crime in the past six months at home and/or at work. Participants could respond with a No or Yes, coded "0" and "1" respectively, giving a possible total score of 3. Based on this score, a binary variable was created, coded as "0" for no experience of violence at all, and "1" for at least one experience of violence for those who answered at least one of the questions positively. This was done in order to assess the cumulative effect of exposure to violence on mental well-being (Zhang and Anderson, 2010). The questions used to assess exposure to violence are presented in Supplementary Information, Table 1.

2.4.3. Other factors

Other exposures included demographic, household and community factors.

2.4.3.1. Demographic factors. Level of education, age and marital status were included in the analysis.

2.4.3.2. Household factors.

2.4.3.3. Stressful household/life events. Data were collected on the young women's experience of stressful life events in the previous six months namely: illness of a close family member, death of a close family member, living with someone with a serious disability in the family, drug or alcohol abuse in the household, fighting with or alienation from a close family member or neighbour and incarceration of a family member each with two possible responses "No" and "Yes", and each participant with a possible total score of 6. A composite variable was created from this score, and categorized into three: no experience with a score of zero, low levels with a score of 1–2 and high levels of household stress with a score of 3–6. A similar life stress score has been used by Seedat et.al using the SASH study data (Seedat et al., 2009). The questionnaire items are listed in Supplementary Information, Table 1.

2.4.3.4. Socioeconomic status. Socioeconomic status (SES) was assessed using an asset score, based on household ownership of assets. A list of thirteen assets was used: television, car, washing machine, fridge, phone, radio, microwave, cell phone, DVD/ Video player, DSTV (satellite television), computer, internet and medical aid /medical insurance. SES was analysed as continuous variable with scores ranging between 1 and 13. The scores were normally distributed with the mean very close in value to the median. A summative asset-score based index has been successfully used before to differentiate SES levels, especially so in the Bt20 cohort (Kagura et al., 2016; Sheppard et al., 2009).

2.4.4. Community danger

The binary variable for community danger was derived from two questionnaire items, firstly "How safe do you feel walking around in your neighbourhood during the day and at night?" to which a participant could

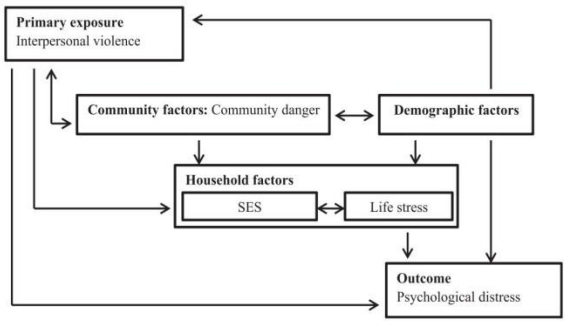


Fig. 1. Conceptual framework for the analysis.

respond "very unsafe, unsafe, safe or very safe". Secondly,"In your opinion, how much crime is there in your neighbourhood?" with four possible responses: "a lot, some, not much or none". The responses for each question were coded 1–4, giving a possible total score of 8. The variable was categorized into low danger for a score of 6 or less and high danger for a score of 7 or 8. A variable with three categories was created at first but yielded low numbers in the middle category.

2.5. Statistical analysis

All analyses were carried out using STATA Release 14. Pooled analyses were conducted as well as stratified by rural/urban residence, guided by the conceptual framework shown in Fig. 1. Chi-square and one-way analysis of variance (ANOVA) tests were used to conduct bivariate analyses. Logistic regression was employed to determine the association between experiencing personal violence and psychological distress. Variables with a p-value of < 0.1 in the univariate analysis were entered into the multivariable model. The multivariable model was built in two stages. In model 1 we included all the demographic variables plus community variables with a p-value of < 0.1. Model 2 included Model 1 variables plus the household variables. The likelihood ratio was used to test model fit.

A direct relationship between interpersonal violence (exposure) and psychological distress (outcome) is hypothesised. Both the exposure and outcome may also be influenced by demographic, household and community factors. In addition, these external factors may also have an impact on each other. Community danger is assumed to be the most distal factor in this framework and hence entered first in the model, which may influence PD directly or through other more proximate factors such as household SES and life stress factors. Community danger and interpersonal violence may have a bi-directional association, as well as the former with demographic factors. The directions of the arrows indicate the postulated direction of the association.

2.5.1. Generalised structural equation modelling

To investigate pathways of association between experiencing interpersonal violence and PD, we built generalised structural equation models (GSEM). Variables significant at $p < 0.1$ in the univariate regression analysis were included in the models. All demographic variables were included as potential confounders. Maximum likelihood method with observed information matrix standard errors was used to fit the models. All variables not significant at $p < 0.05$ were removed from the models. To assess model fit, the Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC) were computed before and after removing all non-significant variables.

3. Results

The analytical sample comprised 468 urban and 458 rural young women. Fifty-one participants were found to be pregnant on testing, 65% of whom rural young women. An additional 44 had incomplete PD and or personal violence data, the larger proportion being the urban young women at 57%. Table 1 presents the characteristics of the young women by site. Differences were observed in the distribution of all the factors analysed between the two sites. Urban young women were indeed better off in terms of education and socioeconomic status, but were less likely to be married, and experienced greater stress, community danger, interpersonal violence and psychological distress.

Table 1
Distribution of individual, household and contextual factors by urban and rural status.

Variable	Urban Mean/ Median (SD/range) or N (%)	Rural Mean/ Median (SD/range) or N (%)	P-value for rural-urban comparison (ANOVA or chi-square)
Primary outcome			
Psychological distress			
No	317 (66%)	377 (82%)	
Yes	161 (34%)	81 (18%)	< 0.000
Primary exposure			
Personal violence			
Low	371 (77%)	412 (86%)	
High	112 (23%)	65 (14%)	< 0.000
Demographic factors			
Age	22.8 (0.5)	21.3 (1.3)	< 0.000
Education			
Primary/Secondary	159 (33%)	163 (44%)	
[a]Matric_NoTertiary	73 (15%)	132 (36%)	
Matric_Tertiary	248 (52%)	76 (20%)	< 0.000
Marital status			
Single	248 (51%)	119 (25%)	
Married/Relationship	242 (49%)	356 (75%)	< 0.000
Household factors			
Stressful events			
None	177 (38%)	261 (55%)	
Low	228 (49%)	196 (41%)	
High	60 (13%)	20 (4%)	< 0.000
Socioeconomic status	8.8 (2.4)	5.6 (1.9)	< 0.000
Contextual factors			
Community danger			
Low	363 (74%)	430 (90%)	
High	129 (26%)	46 (10%)	< 0.000

[a] Matric =graduated from high school.

3.1. Unadjusted regression analysis

Different patterns of univariate associations emerged by rural/urban status (Table 2a). The association between interpersonal violence and PD was stronger in the urban compared to the rural residents, with the statistical significance in the latter being marginal. The association between community danger and psychological distress in the urban area was not significant, with a marginally significant association observed in the rural area. Rural adolescents who experienced high levels of stressful household events compared to those who experienced none had over five times greater odds of having PD, almost double the odds in the urban area.

We also tested univariate associations between the exposure variables themselves for the GSEM models, presented in Table 2b. In both urban and rural adolescents, experiencing stressful household events increased the odds of having PD. Being in a higher SES level was protective against stressful household events among urban adolescents.

3.2. Adjusted analysis

After adjusting for demographic, household and community factors the effect of interpersonal violence on PD in the urban adolescents was unchanged (Table 3). In the rural adolescents however, the odds of PD

Table 2a
Unadjusted associations between the psychological distress (outcome) and contextual, household and individual exposure variables.

Variable	Urban OR (95% CI)	Rural OR (95% CI)	Pooled
Effect of contextual, household and individual factors on psychological distress			
Primary exposure			
Personal violence			
Low	Reference	Reference	Reference
High	1.90 (1.22–2.95)***	1.73 (0.92–3.23)*	2.03 (1.42–2.89)***
Demographic factors			
Age	1.19 (0.79–1.79)	0.97 (0.81–1.16)	1.25 (1.10–1.43)***
Education			
Primary /Secondary	Reference	Reference	Reference
#Matric_noTertiary	0.49 (0.28–0.93)**	0.71 (0.38–1.33)	0.54 (0.35–0.84)**
Matric_Tertiary	0.86 (0.56–1.30)	0.60 (0.28–1.30)	0.99 (0.70–1.41)
Marital status			
Single	Reference	Reference	Reference
Married/relationship	1.01 (0.69–1.48)	1.31 (0.73–2.34)	0.87 (0.61–1.17)
Household factors			
Stressful events			
None	Reference	Reference	Reference
Low	1.44 (0.93–2.22)*	2.55 (1.52–4.38)***	2.01 (1.45–2.79)***
High	2.30 (1.24–4.25)***	5.33 (2.01–14.20)***	3.78 (2.67–6.30)***
Socioeconomic status	0.92 (0.85 – 1.00)*	0.92 (0.81 – 1.05)	1.05 (0.99–1.10)
Contextual factors			
Community danger			
Low	Reference	Reference	Reference
High	1.13 (0.73–1.72)	1.88 (0.92–3.82)*	1.58 (1.10–2.26)**

* p-value = < 0.1.
** p-value= < 0.05.
*** p-value < 0.01.
# Matric=completed high school.

decreased to 1.30 (95% CI 0.61–2.76) and was no longer statistically significant. In the pooled sample, rural residence was protective against PD. Although stressful household events remained significant in both rural and urban adolescents after adjusting for other variables, in the urban setting the statistical significance was borderline and only young women experiencing high levels of household stress were more likely to have PD. In the rural area, only adolescents who experienced low levels of household stress had greater odds of having PD compared to those who had no household stress.

3.3. Structural equation model analysis

3.3.1. Rural model

As shown in Fig. 2, no direct effect was observed between interpersonal violence and PD, and no indirect pathways were observed in the rural model. No variable except stressful household events and age had a positive direct effect on the outcome (PD) or exposure (interpersonal violence).

Fig. 3 presents the GSEM model for the urban sample. Having

Table 2b
Unadjusted associations between contextual, household and demographic exposure variables.

Variable	Urban Coefficient (95% CI)	Rural Co-efficient (95% CI)	Pooled Co-efficient (95% CI)
Effect of contextual factors on household factors (coefficients)			
SES and **stressful events**#			
None	Reference	Reference	Reference
Low	−0.52 (−1.00; −0.05)**	−0.09 (−0.46; 0.27)	0.12 (−0.25; 0.49)
High	−0.50 (−1.20; 0.20)	−0.13 (−1.01; 0.74)	0.79 (0.13; 1.44)**
SES and **community danger**#			
Low	Reference	Reference	Reference
High	−0.27 (−0.75; 0.20)	−0.22 (−0.80; 0.36)	0.66 (0.22; 1.10)
Stressful events and **community danger**#			
Low	Reference	Reference	Reference
High	0.13 (−0.26; 0.52)	0.36 (−0.23; 0.95)	0.40 (0.08; 0.72)**
Effect of household and contextual factors on primary exposure (coefficients)			
Personal violence and **SES**#	−0.02 (−0.11; 0.07)	0.04 (−0.10; 0.18)	0.07 (0.01; 0.13)**
Personal violence & **stressful events**#			
None	Reference	Reference	Reference
Low	1.15 (0.60; 1.72)***	0.91 (0.32; 1.49)***	1.09 (0.69; 1.50)***
High	1.64 (0.94; 2.35)***	1.81 (0.78; 2.84)***	1.79 (1.23; 2.35)***
Personal violence and **community danger**#			
Low	Reference	Reference	Reference
High	0.59 (0.14; 1.05)**	0.14 (−0.71; 0.99)	0.63 (0.25; 1.02)***

*p-value = 0.05–0.1.
** p-value= 0.01–0.05.
*** p-value < 0.01.
# **Bold:** entered as predictor in the model.

Table 3
Adjusted analysis.

Variable	Urban Model 1[#]	Model 2[^]	Rural Model 1	Model 2	Pooled Model 1	Model 2
Primary exposure						
Personal violence						
Low	Reference	Reference	Reference	Reference	Reference	Reference
High	2.06 (1.30–3.26)***	1.84 (1.13–3.00)**	1.62 (0.78–3.38)	1.30 (0.61–2.76)	1.85 (1.27–2.72)***	1.53 (1.03–2.29)**
Demographic factors						
Age	1.19 (0.75–1.90)	1.43 (0.84–2.46)	0.90 (0.72–1.13)	0.90 (0.71–1.14)	1.16 (0.98–1.37)*	1.15 (0.96–1.38)
Education						
Primary /Secondary	Reference	Reference	Reference	Reference	Reference	Reference
Matric-No Tertiary	0.49 (0.25–0.94)**	0.50 (0.25–1.01)*	0.70 (0.37–1.32)	0.68 (0.36–1.30)	0.59 (0.38–0.93)**	0.65 (0.41–1.04)*
Matric- With Tertiary	0.83 (0.54–1.29)	1.04 (0.63–1.73)	0.58 (0.27–1.27)	0.59 (0.27–1.30)	0.90 (0.63–1.30)	0.94 (0.62–1.41)
Marital status						
Single	Reference	Reference	Reference	Reference	Reference	Reference
Married/relationship	0.89 (0.59–1.34)	0.80 (0.52–1.24)	0.92 (0.48–1.77)	0.93 (0.48–1.82)	0.78 (0.56–1.09)	0.77 (0.55–1.09)
Residence						
Urban					Reference	Reference
Rural					0.43 (0.27–0.68)***	0.41 (0.24–0.69)***
Household factors						
Stressful events						
None		Reference		Reference		Reference
Low		1.24 (0.78–1.97)		2.71 (1.48–4.94)***		1.80 (1.25–2.58)***
High		1.93 (0.99–3.76)*		2.56 (0.74–8.87)		2.54 (1.45–4.47)***
Socioeconomic status		0.91 (0.83–1.00)*				0.98 (0.92–1.06)
Contextual factors						
Community danger						
Low			Reference	Reference	Reference	Reference
High			1.63 (0.69–3.84)	1.55 (0.64–3.75)	1.26 (0.85–1.87)	1.14 (0.75–1.72)

[#] Model 1 – demographic + contextual factors.
[^] Model 2 – Model 1 + household factors.
* p-value = 0.05–0.1.
** p-value= 0.01–0.05.
*** p-value < 0.01.

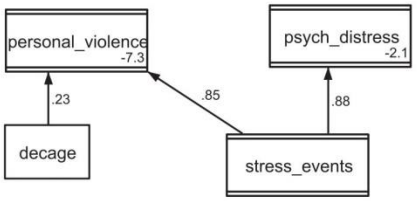


Fig. 2. Rural GSEM model Legend: personal_violence – interpersonal violence; stress_events – stressful household events; psych_distress – PD variable; decage – age of participant; **numbers next to the arrows** = beta coefficients for the path.

graduated from high school, even without tertiary education, showed a direct protective association with PD. A higher SES was protective against stressful household events and was indirectly associated with PD. Stressful household events had both direct and indirect effects on PD. Community danger was indirectly associated with PD through its effect on interpersonal violence.

3.3.2. Pooled model

The pooled GSEM model is shown in Fig. 4. Stressful household events had a positive direct and indirect effect on PD, mediated by interpersonal violence. Community danger did not have a direct association with PD as in the models by site, but had positive indirect associations through stressful household events as well as interperso-

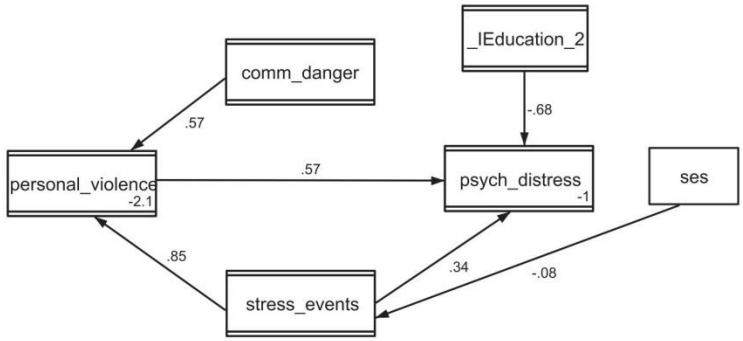


Fig. 3. Urban GSEM Model. **Legend: Personal_violence** – interpersonal violence**; comm_danger** – community danger**; Education_2** – graduated from high school but no tertiary education**; psych_distress** – PD variable**; SES** – socioeconomic status**; stress_events** – stressful household events; **numbers next to the arrows** – beta coefficients for the path.

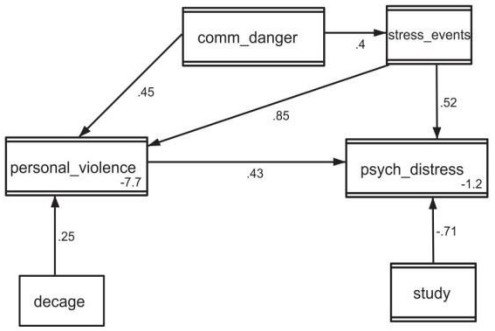


Fig. 4. Pooled GSEM model Legend: Personal_violence – interpersonal violence**; comm_danger** – community danger**; Education_2** – graduated from high school but no tertiary education**; psych_distress** – PD variable**; SES** – socioeconomic status**; stress_events** – stressful household events**; decage** – age; **study** – rural or urban residence; **numbers next to the arrows** – beta coefficients for the path.

nal violence. Table 4 presents the GSEM odds ratios for the different paths in each model.

The association between interpersonal violence and PD in the rural model reduced slightly in the full GSEM model but remained significant. Young women residing in the rural area were less likely to report PD compared to the urban young women. (Table 5)

4. Discussion

Our results show that compared to the rural young women, the urban sample had higher levels of PD, interpersonal violence, household stress and community danger. A greater proportion of rural young women was married and had not graduated from high school. Before adjusting for other factors there was a significant relationship between interpersonal violence and PD in both settings, rural having a weaker association. Rural adolescents experiencing high levels of household stress were more likely to have PD than those experiencing low stress. We further demonstrate that after adjusting for demographic, household and community factors, the direct association between interpersonal violence and PD in rural South African young women becomes statistically insignificant. In urban South Africa, interpersonal violence is associated with PD after adjusting for household stress and SES. Community danger had no direct link with PD in all models. Residing in the rural area was significantly protective against symptoms of PD as compared to urban young women.

The prevalence of PD (26%) in our pooled sample is comparable to an Indian study of male and female adolescents where the prevalence of PD was 23.3% (Pillai et al., 2009). More urban adolescents showed signs of PD and reported high levels of interpersonal violence, as well as greater odds of having PD given experience of interpersonal violence in our study. This is similar to an Australian study which showed that participants from remote areas were less likely to be diagnosed with a mental disorder compared to those residing in a metropolitan area (Meuleners et al., 2009). This pattern may be explained by greater social connectedness and support in the rural area which are known to moderate the impact of trauma and distress on mental well-being (Myer et al., 2008; De Silva et al., 2007; Coker et al., 2002).

A direct association between interpersonal violence and PD was observed in the urban young women independent of household stress, SES, community danger and demographic factors. The strength of association did not change substantially between the unadjusted and adjusted urban models, possibly due to the absence of other relevant factors in the model. Despite attenuation of the direct association between interpersonal violence and PD in the multivariate and SEM models, no indirect pathways were observed in the rural subsample. It may be concluded again that other variables not explored here have a mediating effect on the relationship between interpersonal violence on PD, or that they have an effect on interpersonal violence and PD separately, for example abuse and violence in childhood, drinking alcohol, smoking and availability of mental health care (Draper et al., 2014; Peterson et al., 2009). It may also be due to low variability in PD and interpersonal violence in the rural setting. This difference between the rural and urban populations indicates that household and community factors may operate differently in the two settings and therefore interventions need to be specifically tailored to each area (Peterson et al., 2009).

Rural residents showed much greater sensitivity to the effect of household stress compared to the urban residents. A possible reason for this could be desensitisation theory, which asserts that chronic exposure to violence leads to emotional numbing in young people. Some evidence partially supports the theory (Kennedy and Ceballo, 2016), while other studies have disputed it (McCart et al., 2007). Another possibility may be that the high levels of household stress remove the buffer of social connectedness thus making the young women more susceptible to PD. The differences in cultural context between rural and urban settings may have also led to the different responses. Culture defines and creates specific sources of distress and affects how symptoms are interpreted (Twine et al., 2016). The GSEM models were in part able to disentangle the effects of context on the interpersonal violence-PD relationship and begin to shed light on the potential pathways of association.

The high levels of community danger observed in Soweto were expected given that the highest levels of contact crime occur mostly in urban areas (SA CS, 2016). Rural adolescents reported low community danger compared to urban, but this was not associated with PD or

Table 4
Generalised structural equation model results for the final models by site. The arrow points to the dependent variable in the path. Only statistically significant variables retained in the final models.

Variable pairs	Pooled model OR (95% CI) for the variable pairs	Urban model OR (95% CI) for the variable pairs	Rural model OR (95% CI) for the variable pairs
Personal violence - > psychological distress	1.53 (1.03–2.27)**	1.78 (1.10–2.88)**	–
Stressful events - > psychological distress	1.59 (1.23–2.06)***	1.37 (1.00–1.88)**	2.42 (1.62–3.62)***
Residence (rural) - > psychological distress	0.52 (0.37–0.75)***	–	–
Education (Matric_NoTertiary) - > psychological distress	–	0.50 (0.26–0.93)**	–
SES - > psychological distress	–	–	–
Stressful events - > personal violence	2.35 (1.81–3.06)***	2.34 (1.67–3.28)***	2.33 (1.51–3.62)***
Community danger - > personal violence	1.57 (1.04–2.36)**	1.76 (1.09–2.85)**	–
Age - > personal violence	1.28 (1.09–1.50)***	–	1.26 (1.02–1.57)**
Community danger - > stressful events	1.49 (1.08–2.05)**	–	–
SES - > stressful events	–	0.92 (0.86–0.99)**	–

** $p < 0.05$.
*** $p < 0.0$.

Table 5
Model fit statistics.

Model	LR Chi^2 Test		Hosmer-Lemeshow Test			
	Chi^2 value	p-value	Chi^2 value	p-value		
Adjusted logistic regression models						
Pooled model 2	775.4	0.499	8.59	0.378		
Rural model 2	348.5	0.408	13.7	0.090		
Urban model 2	427.8	0.453	4.87	0.771		
SEM models	**LR Chi^2 Test**		**AIC**		**BIC**	
	Chi^2 value	**p-value**	**Full model**	**Restricted model**	**Full model**	**Restricted model**
Pooled model	4.45	0.2169	3565.3	3563.7	3633.16	3617.1
Rural model	2.70	0.2586	780.6	779.3	809.1	800.14
Urban model	2.84	0.0921	1936.2	1937.1	1981.8	1978.5

The models presented showed the best fit for the data.

interpersonal violence. In the urban SEM model, community danger increased the odds of experiencing interpersonal violence by about 60%. This relationship may be bi-directional with the experience of interpersonal violence itself leading to the perception of greater community danger.

Evidence is conflicting on the role of SES in the experience of interpersonal violence and its impact on mental health. Some evidence shows that recent and traumatic life events as well as PD are more common amongst participants with low SES (Myer et al., 2008) while other studies indicate that violence is not necessarily endemic to low SES areas but that the intensity and severity of events witnessed appear to affect low SES youth disproportionately (Buka et al., 2001). Other studies show that changes in SES have a greater impact on mental well-being than the actual levels of poverty (Das et al., 2007). In this study, higher SES seemed to protect against PD in the urban residents but had no apparent effect in the rural residents. This may be explained by the low variability in SES levels across the rural population. Some studies have shown a strong association between SES and stressful household events which may then mediate the relationship between SES and PD. In this study, this association was observed in the urban and pooled populations.

Residing in the rural area was overall protective against PD in both the regression and SEM models for the pooled sample. Neighbour noise, feeling overcrowded in the home, dissatisfaction with green spaces, feeling unsafe to go out in the day and dissatisfaction with community facilities are urban characteristics that have been found to increase the risk of poor mental well-being (Guite et al., 2006). Although these were not included in our analysis, they may partially explain the increased risk of PD in urban areas.

4.1. Study strengths and limitations

To our knowledge this is the first study to compare the impact of interpersonal violence in young rural and urban-residing South African women. The sample was derived from two long-standing surveys with established data collection and management procedures ensuring quality data. The data collection tools and procedures were synchronised to enable comparison between the two sites.

The cross-sectional nature of the data did not allow establishment of the direction of some relationships such as community danger and exposure to violence. The experience of interpersonal violence was self-reported, which may be subject to recall bias or a participant's perception of crime or injury. The data did not include the types of interpersonal violence experienced which would have been useful in stratifying the analysis. The measure of community danger was based on the participant's perception, not specific cases of crime in the community, and it was not possible to determine whether the perception of the actual levels of crime influenced perception of safety or vice versa.

Despite all measures being taken to ensure uniformity, the response to questions may be affected by several issues such as the interview being face to face, the culture and possibly language. This may lead to either under or overestimating the true prevalence of factors such as interpersonal violence, community danger and life stress events. The questionnaire items used to measure interpersonal violence did not specify the number of times each event had occurred in the past six months, or whether they had been experienced by only one household member or more. This would lead to an underestimation of the occurrence of interpersonal violence.

Although Agincourt HDSS and Soweto Johannesburg typify most rural and urban communities in South Africa in many ways, there are some factors that may differ from other populations that are considered rural or urban. Within the definitions of rural and urban in South Africa are several categories and our populations do not represent them all (Stats South Africa, 2003; Treasury, 2011). This may limit the generalisability of our results.

5. Conclusion

Experiences of interpersonal violence are higher in urban than in rural young women and they do not seem to be associated with PD in the latter. The pathways of association are different between the two settings and both need to be studied in their own contexts. Interventions for violence and mental health in the urban areas may therefore not necessarily translate into the same gains in rural areas. Adolescence is a critical stage for health intervention to maintain the benefits of early childhood investments and maximize the potential of the adult years.

Further research is needed to explore other factors that influence the relationship between interpersonal violence and PD such as social capital and connectedness, and other behavioral factors such as alcohol abuse and childhood experiences of violence. Analysis tools such as multi-group structural equation modelling can also be employed to assess the similarities and differences between different populations, and to study measurement invariance. It would also enable the complex relationships between variables within each group (Ryu, 2015).

Acknowledgements

None.

Competing interests

The authors declare no competing interests.

Funding

The UK MRC/DfID African Research Leader Scheme funded the data collected for this study in the Agincourt sub-district. The MRC/Wits-Agincourt Unit research centre is supported by the University of the Witwatersrand, the South African Medical Research Council, and the Wellcome Trust (grants 058893/Z/99/A; 069683/Z/02/Z;

085477/Z/08/Z; 085477/B/08/Z). The Birth to Twenty cohort data collection was funded by the Wellcome Trust and the South African Medical Research Council.

The support of the DST-NRF Centre of Excellence in Human Development at the University of the Witwatersrand, Johannesburg in the Republic of South Africa towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not to be attributed to the CoE in Human Development.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.healthplace.2018.03.003.

References

Population of 2017, 2017. Population of Soweto 2017 [cited 2018 18 January]. Available from: ⟨http://populationof2017.com/population-of-soweto-2017.html⟩.

Stats South Africa, 2003. Census 2001: Investigation into appropriate definitions of urban and rural areas for South Africa. Pretoria, South Africa: Statistics South Africa.

Stats South Africa. Mid-year population estimates 2016. Pretoria, South Africa: 2016 Contract No.: P0302.

Bach J.M., Louw D., 2010. Depression and exposure to violence among Venda and Northern Sotho adolescents in South Africa: original article; 13(1):[25-35 pp.]. Available from: ⟨http://reference.sabinet.co.za/webx/access/electronic_journals/medjda2/medjda2_v13_n1_a5.pdf⟩.

Benjamin, S., Lennon, S., Gardner, G., 1991. The validity of the general health Questionnaire for first-stage screening for mental illness in pain clinic patients. Pain 47 (2), 197–202, (11).

Bray, S.R., Born, H.A., 2004. Transition to university and vigorous physical activity: implications for health and psychological well-Being. J. Am. Coll. Health 52 (4), 181–188, (2004/01/01).

Buka, S.L., Stichick, T.L., Birdthistle, I., Earls, F.J., 2001. Youth exposure to violence: prevalence, risks, and consequences. Am. J. Orthopsychiatr. 71 (3), 298–310.

Burton, P., 2006. Results of the national youth victimisation study: easy prey. SA Crime Q. 2006 (16), 1–6.

Coker, A.L., Smith, P.H., Thompson, M.P., McKeown, R.E., Bethea, L., Davis, K.E., 2002. Social support protects against the negative Effects of Partner violence on mental health. J. Women's Health Gend.-Based Med. 11 (5), 465–476, (2002/06/01).

Das, J., Do, Q.-T., Friedman, J., McKenzie, D., Scott, K., 2007. Mental health and poverty in developing countries: Revisiting the relationship. Soc. Sci. Med. 65 (3), 467–480, (8).

De Silva, M.J., Huttly, S.R., Harpham, T., Kenward, M.G., 2007. Social capital and mental health: a comparative analysis of four low income countries. Soc. Sci. Med. 64 (1), 5–20, (1).

Draper, C.E., Micklesfield, L.K., Kahn, K., Tollman, S.M., Pettifor, J.M., Dunger, D.B., et al., 2014. Application of Intervention Mapping to develop a community-based health promotion pre-pregnancy Intervention for adolescent girls in rural South Africa: project Ntshembo (Hope). BMC Public Health 14 (2), S5.

Dunkle, K.L., Jewkes, R.K., Brown, H.C., Gray, G.E., McIntryre, J.A., Harlow, S.D., 2004. Gender-based violence, relationship power, and risk of HIV infection in women attending antenatal clinics in South Africa. Lancet 363 (9419), 1415–1421.

Goldberg, D.P., Gater, R., Sartorius, N., Ustun, T.B., Piccinelli, M., Gureje, O., et al., 1997. The validity of two versions of the GHQ in the who study of mental illness in general health care. Psychol. Med. 27 (1), 191–197, (Epub 01/01).

Gore, F.M., Bloem, P.J., Patton, G.C., Ferguson, J., Joseph, V., Coffey, C., et al., 2011. Global burden of disease in young people aged 10–24 years: a systematic analysis. Lancet 377 (9783), 2093–2102.

Guite, H., Clark, C., Ackrill, G., 2006. The impact of the physical and urban environment on mental well-being. Public Health 120 (12), 1117–1126.

Jackson, C., 2007. The general health Questionnaire. Occup. Med. 57 (1), (79-).

Jansen, A., Moses, M., Mujuta, S., Yu, D., 2015. Measurements and determinants of multifaceted poverty in South Africa. Dev. S. Afr. 32 (2), 151–169.

Jewkes, R.K., Dunkle, K., Nduna, M., Shai, N., 2010. Intimate partner violence, relationship power inequity, and incidence of HIV infection in young women in South Africa: a cohort study. Lancet, 376.

Kagura, J., Adair, L.S., Munthali, R.J., Pettifor, J.M., Norris, S.A., 2016. Association between early life growth and blood pressure trajectories in black South African children. Hypertension 116, 08046, (HYPERTENSIONAHA).

Kahn, K., Collinson, M.A., Gómez-Olivé, F.X., Mokoena, O., Twine, R., Mee, P., et al., 2012. Profile: Agincourt health and socio-demographic surveillance system. Int. J. Epidemiol. 41 (4), 988–1001.

Kaminer, D., Grimsrud, A., Myer, L., Stein, D.J., Williams, D.R., 2008. Risk for post-traumatic stress disorder associated with different forms of interpersonal violence in South Africa. Soc. Sci. Med., 67.

Kennedy, T.M., Ceballo, R., 2016. Emotionally numb: desensitization to community violence exposure among urban youth. Dev. Psychol. 52 (5), 778–789.

Kessler, R.C., Berglund, P., Demler, O., Jin, R., Merikangas, K.R., Walters, E.E., 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch. Gen. Psychiatry 62 (6), 593–602, (PubMed PMID: 15939837. Epub 2005/06/09. eng).

Kovess-Masféty, V., Alonso, J., de Graaf, R., Demyttenaere, K., 2005. A European approach to rural-urban differences in mental health: the ESEMeD 2000 comparative study. Can. J. Psychiatry 50 (14), 926.

Krug, E.G., Mercy, J.A., Dahlberg, L.L., Zwi, A.B., 2002. The world report on violence and health. Lancet 360 (9339), 1083–1088.

le, R., Booysen, F., 2003. Urban–rural inequalities in health care delivery in South Africa. Dev. S. Afr. 20 (5), 659–673.

Maltby, J., Macaskill, A., Day, L., 2001. Failure to forgive self and others: a replication and extension of the relationship between forgiveness, personality, social desirability and general health. Personal. Individ. Differ. 30 (5), 881–885, (2001/04/05/).

Maredza, M., Bertram, M.Y., Gómez-Olivé, X.F., Tollman, S.M., 2016a. Burden of stroke attributable to selected lifestyle risk factors in rural South Africa. BMC Public Health 16 (1), 1.

Maredza, M., Bertram, M.Y., Gómez-Olivé, X.F., Tollman, S.M., 2016b. Burden of stroke attributable to selected lifestyle risk factors in rural South Africa. BMC Public Health 16 (1), 143, (February 12).

McCart, M.R., Smith, D.W., Saunders, B.E., Kilpatrick, D.G., Resnick, H., Ruggiero, K.J., 2007. Do urban adolescents become desensitized to community violence? Data from a national survey. Am. J. Orthopsychiat. 77 (3), 434–442.

Meuleners, L., Lee, A.H., Hendrie, D., 2009. Effects of demographic variables on mental illness admission for victims of interpersonal violence. J. Public Health 31 (1), 162–167.

Micklesfield, L.K., Munthali, R.J., Prioreschi, A., Said-Mohamed, R., van Heerden, A., Tollman, S., et al., 2017. Understanding the relationship between socio-economic status, physical activity and sedentary behaviour, and Adiposity in young adult South African women using structural equation modelling. Int. J. Environ. Res. Public Health 14 (10), 1271.

Mid-year, S.A.S., 2016. population Estimates 2016. Stats SA, Pretoria, South Africa.

Mitchell, S.J., Lewin, A., Horn, I.B., Valentine, D., Sanders-Phillips, K., Joseph, J.G., 2010. How does violence exposure affect the psychological health and parenting of young African-American mothers? Soc. Sci. Med. 2 (4), 526–533, (70).

Myer, L., Stein, D.J., Grimsrud, A., Seedat, S., Williams, D.R., 2008. Social determinants of psychological distress in a nationally-representative sample of South African adults. Soc. Sci. Med. 66 (8), 1828–1840, (4).

Norman, R., Schneider, M., Bradshaw, D., Jewkes, R., Abrahams, N., Matzopoulos, R., et al., 2010. Interpersonal violence: an important risk factor for disease and injury in South Africa. Popul. Health Metr. 8 (1), 32.

Patel, V., Flisher, A.J., Hetrick, S., McGorry, P., 2007. Mental health of young people: a global public-health challenge. Lancet 369 (9569), 1302–1313.

Patton, G.C., Coffey, C., Cappa, C., Currie, D., Riley, L., Gore, F., et al., 2012. Health of the world's adolescents: a synthesis of internationally comparable data. Lancet 379 (9826), 1665–1675.

Peterson, L.E., Tsai, A.C., Petterson, S., Litaker, D.G., 2009. Rural–urban comparison of contextual associations with self-reported mental health status. Health Place 15 (1), 125–132.

Pillai, A., Andrews, T., Patel, V., 2009. Violence, psychological distress and the risk of suicidal behaviour in young people in India. (2009 April 1)Int. J. Epidemiol. 38 (2), 459–469.

Prioreschi, A., Wrottesley, S.V., Cohen, E., Reddy, A., Said-Mohamed, R., Twine, R., et al., 2017. Examining the relationships between body image, eating attitudes, BMI, and physical activity in rural and urban South African young adult females using structural equation modeling. PLoS One 12 (11), e0187508.

Probst, J.C., Laditka, S.B., Moore, C.G., Harun, N., Powell, M.P., Baxley, E.G., 2006. Rural-urban differences in depression prevalence: implications for family medicine. Fam. Med.-Kans. City 38 (9), 653.

Resnick, M.D., Richard, F. Catalano, Sawyer, Susan M., Viner, Russell, Patton, Seizing, G.C., 2012. the opportunities of adolescent health. Lancet 379, 1564–1566.

Richter, L., Norris, S., Pettifor, J., Yach, D., Cameron, N., 2007. Cohort Profile: Mandela's children: the 1990 birth to twenty study in South Africa. Int. J. Epidemiol. 36 (3), 504–511, (June 1, 2007).

Richter, L.M., Norris, S.A., De Wet, T., 2004. Transition from Birth to Ten to Birth to Twenty: the South African cohort reaches 13 years of age. Paediatr. Perinat. Epidemiol. 18 (4), 290–301.

Rosenthal, B.S., Wilson, W.C., 2006. Adolescents'psychological response to the experience of community interpersonal violence: a cross-national and a cross-cultural comparison. Adolescence 41 (163), 417.

Ryu, E., 2015. Multiple-group analysis approach to testing group difference in indirect effects. Behav. Res. Methods 47 (2), 484–493, (June 01).

SA CS, 2016. Crime Stats Simplified: Worst 10 precincts 2016 [27 October]. Available from: ⟨http://www.crimestatssa.com/index.php⟩.

Sawyer, S.M., Afifi, R.A., Bearinger, L.H., Blakemore, S.-J., Dick, B., Ezeh, A.C., et al., 2012. Adolescence: a foundation for future health. Lancet 379 (9826), 1630–1640.

Saxena, S., Thornicroft, G., Knapp, M., Whiteford, H., 2007. Resources for mental health: scarcity, inequity, and inefficiency. Lancet 370 (9590), 878–889, (2007/09/08).

Seedat, M., Van Niekerk, A., Jewkes, R., Suffla, S., Ratele, K., 2009. Violence and injuries in South Africa: prioritising an agenda for prevention. The Lancet 374 (9694), 1011–1022.

Seedat, S., Stein, D.J., Jackson, P.B., Heeringa, S.G., Williams, D.R., Myer, L., 2009. Life stress and mental disorders in the South African Stress and Health study: mental health. SAMJ 99 (5), 375–382 ⟨http://reference.sabinet.co.za/webx/access/electronic_journals/m_samj/m_samj_v99_n5_a20.pdf⟩.

Sheppard, Z.A., Norris, S.A., Pettifor, J.M., Cameron, N., Griffiths, P.L., 2009. Approaches for assessing the role of household socioeconomic status on child anthropometric measures in urban South Africa. Am. J. Hum. Biol. 21 (1), 48–54.

Sterling, M., 2011. General Health Questionnaire–28 (GHQ-28). J. Physiother. 57 (4), 259.
Sundermann, J.M., Chu, A.T., DePrince, A.P., 2013. Cumulative violence exposure, emotional nonacceptance, and mental health symptoms in a community sample of women. J. Trauma Dissociation 14 (1), 69–83.
Treasury, Ro.S.A.N., 2011. Local Government budgets and expenditure review Pretoria. South Afrcia: Natl. Treas., 2011.
Twine, R., Kahn, K., Scholtz, A., Norris, S.A., 2016. Involvement of stakeholders in determining health priorities of adolescents in rural South Africa. Glob. Health Action., 9.
Viner, R.M., Ross, D., Hardy, R., Kuh, D., Power, C., Johnson, A., et al., 2015. Life course epidemiology: recognising the importance of adolescence. J. Epidemiol. Community Health 69 (8), 719–720.
Visser, M.J., Coetzee, N., Claassen, M., 2015. The expression of personality among adolescents exposed to community interpersonal violence. S. Afr. J. Psychol., (0081246315617136).
Wang, J.L., 2004. Rural–urban differences in the prevalence of major depression and associated impairment. Soc. Psychiatry Psychiatric Epidemiol. 39 (1), 19–25.
World Health Organisation, 2002. World Report on Violence and Health. World Health Oraganisation, Geneva, Switzerland.
Zhang, S., Anderson, S.G., 2010. Low-income single mothers' community violence exposure and aggressive parenting practices. Child. Youth Serv. Rev. 32 (6), 889–895, (2010/06/01/).

Appendix 2: M. Manyema, S. A. Norris, L. M. Richter. Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress. BMC Public Health. 2018; 18:35.

Manyema et al. BMC Public Health (2018) 18:835
https://doi.org/10.1186/s12889-018-5767-0

BMC Public Health

RESEARCH ARTICLE Open Access

Stress begets stress: the association of adverse childhood experiences with psychological distress in the presence of adult life stress

Mercy Manyema[1,2*], Shane A. Norris[2] and Linda M. Richter[1]

Abstract

Background: Adverse childhood experiences (ACES) have been linked to poor health and well-being outcomes, including poor mental health such as psychological distress. Both ACEs and psychological distress pose a significant public health burden, particularly in low to middle income countries. Contemporaneous stress events in adulthood may also impact psychological distress. The aims of this study were to describe the prevalence of ACEs and psychological distress and to assess the separate and cumulative effect of ACEs on psychological distress, while accounting for the effect of adult stress.

Methods: In this cross-sectional study, we used retrospectively measured ACEs from a sample of 1223 young adults aged between 22 and 23 years (52% female) from the Birth to Twenty Plus Study. Psychological distress and adult life stress were measured with a six-month recall period. Hierarchical logistic regression was employed to assess the associations between the exposures and outcome.

Results: Nearly 90% of the sample reported at least one ACE and 28% reported psychological distress. The median number of ACEs reported was three (range 0–11). After accounting for demographic and socio-economic factors, all ACEs were individually associated with psychological distress except for parental divorce and unemployment. The individual ACEs increased the odds of PD by between 1.42 and 2.79 times. Compared to participants experiencing no ACEs, those experiencing one to five ACEs were three times more likely to report psychological distress (AOR 3.2 95% CI: 1.83–5.63), while participants who experienced six or more ACEs had nearly eight times greater odds of reporting psychological distress (AOR 7.98 95% CI: 4.28–14.91). Interaction analysis showed that in the absence of adult life stress, the effect of low ACEs compared to high ACEs on PD was not significantly different.

Discussion and conclusion: The prevalence of ACEs in this young adult population is high, similar to other studies in young adult populations. A significant direct association exists between ACEs and psychological distress. Adult life stress seems to be a mediator of this relationship. Interventions targeted at psychological distress should address both early life adversity and contemporary stress.

Keywords: Adverse childhood experiences, Psychological distress, Mental health, Stressful life events, Young adult, Birth to twenty plus

* Correspondence: mercy.manyema@gmail.com
[1]DST-NRF Center of Excellence in Human Development, University of the Witwatersrand, 1st Floor School of Public Health Building, Wits Education Campus, 7 York Road, Parktown, Johannesburg 2193, South Africa
[2]MRC/Wits Developmental Pathways for Health Research Unit, Corner College & Clinic Road, Chris Hani Baragwanath Academic Hospital, University of the Witwatersrand, Johannesburg, South Africa

© The Author(s). 2018 **Open Access** This article is distributed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (http://creativecommons.org/publicdomain/zero/1.0/) applies to the data made available in this article, unless otherwise stated.

Background

Adverse childhood experiences (ACEs) have been linked to a myriad of poor behavioral and health outcomes. ACEs as defined by the Kaiser-Permanente Study, also known as the ACE Study, include child abuse and neglect and growing up in dysfunctional households characterized by domestic violence, mental illness and incarceration of a household member, parental divorce or separation and household drug or alcohol abuse [1]. An increasing body of evidence points to a consistent link between ACEs and poor mental health in both children and adults. The ACE Study itself showed that the risk of suicide attempts increased two to five-fold with experiencing any ACE and an ACE score of four or more was associated with increased risk of attempted suicide, lifetime depressive disorders and poor mental health in general [2–4]. Strong dose-response relationships between ACEs and depressive symptoms, drug abuse and antisocial behavior as well as psychological distress (PD), perceived well-being and missed days of work have also been demonstrated [5, 6]. A South African study, though not using the full description of ACEs, found a significant association between childhood emotional neglect and adult depression, alcohol problems and suicidality [7].

A high proportion of children from different settings are exposed to ACEs. The ACE study reported a 60% prevalence of at least one ACE and 10% five or more ACEs [1, 8]. Nationally representative surveys conducted in England and Wales revealed that 46 and 47% of people, respectively, suffered at least one ACE and 8.3 and 14% respectively experienced four or more ACEs [9, 10]. In Brazil, 85% of an adolescent cohort reported experiencing at least one ACE in their lifetime [11]. According to Jewkes et al., 54.7 and 56.4% of rural South African women and men experience emotional abuse respectively, 41.6 and 39.6% experienced emotional neglect, and 39.1 and 16.7% experienced sexual abuse before the age of 18 [7].

Mental, neurological and substance use disorders constitute a significant global disease burden, with 10% of global disability-adjusted life years (DALYs) attributed to these disorders in 2010 [12, 13]. More than 1.1 billion people worldwide suffered from mental and substance use disorders in 2016 according to the Global Burden of Disease Study, constituting 18.6% of the total non-fatal disease burden [14]. In the South African Stress and Health (SASH) Study conducted between 2002 and 2004, the lifetime prevalence of major depression was 9.7, and 4.9% for the past year; 9.8 and 4.9% for mood disorders, and 15.8 and 8.1% for anxiety disorders respectively [15, 16]. Mental health remains neglected in many countries with a large gap existing between the burden caused and resources available to address mental health problems [17]. PD, which is defined as a "state of emotional suffering" characterized by depressive, anxiety as well as some somatic symptoms, is widely used as a marker of population mental health [18]. Evidence shows that it is positively associated with mental disorders and mental well-being [19].

The occurrence of stressful life events in adulthood increases the likelihood of experiencing psychological distress, as do race and availability of material resources, according to the SASH Study [20]. A complex interplay exists between early life stress, socioeconomic status and later life adversity. The stress sensitization theory has been posited as a possible mechanism through which early adversity and stress in later life and poor health are connected. It suggests that repeated stress early in life dysregulates stress response systems and lowers the threshold for reactivity and adaptive responses to subsequent stress. This increases the risk of mental health disorders in later life [16, 21]. In the same vein, Pearlin et al. put forward the theory of stress proliferation, a process through which stress begets stress, i.e. exposure to serious adversity in childhood increases the risk for later exposure to additional adversities [21, 22]. Childhood adversity can result in secondary stressors that cause harmful health consequences either together with or in place of the initial event, with some secondary stressors possibly being other adverse events [22].

Several other factors have been identified as correlates of poor mental health. The prevalence of major depression and PD has been found to be higher among females than males, among people with lower levels of education and among those aged 40 to 49 years [15, 23]. Increased risk of PD has been reported for unemployed and disabled persons as well as for those experiencing financial difficulties [23–25]. Some evidence suggests that household dysfunction ACEs are linked with the highest risk of mental disorders compared to abuse and neglect [26].

The relationship between ACEs and mental health is of marked public health importance. This association should however be examined in light of the several factors that may influence it, including adult stress and SES. The majority of literature on the epidemiology of ACEs and their impact on mental health come from high-income countries. The objectives of this study were: (1) to describe the prevalence of ACEs and PD in a young adult South African sample, (2) to examine the association between individual ACEs and PD and (3) to assess the cumulative effect of ACEs on PD, while accounting for the effect of adult stress on this relationship.

Methods

Data and study population

Data for this cross-sectional study were drawn from the Birth to Twenty Plus (Bt20+) Study. Named the Birth to Ten Study (Bt10) at its inception, the Bt20+ has been following up urban children and tracking their growth,

health, well-being and educational progress from 1990 to date [27]. The study is based in Soweto, a densely populated suburb in the Greater Johannesburg Metropolitan area in South Africa, with an estimated population of about 1.5 million in 2017 [27, 28]. In the period between 23 April and 8 June 1990, 3273 singleton children born to women resident in Soweto-Johannesburg during the designated 7-week enrolment period and for a further 6 months post-partum were recruited into the study [27, 29]. More recruitment details are described elsewhere [27]. Of the initial cohort, 1636 were interviewed between 2012 and 2013 when the cohort was aged between 22 and 23 years and data for this analysis were drawn from this data collection wave.

Measures

Psychological distress

The main outcome measure, psychological distress (PD), was assessed using the General Health Questionnaire 28 (GHQ-28), a screening tool developed to test the risk of developing psychiatric disorders [30]. It comprises 28 items arranged in four subscales: somatic symptoms; anxiety/insomnia; social dysfunction, and severe depression. Each item has four possible responses namely Not at all, No more than usual, Rather more than usual, and Much more than usual, coded 0 to 3. The recall period for the GHQ-28 is 6 months. The total score for each participant was computed with a possible score of 21 for each subscale and a global total of 84. In line with literature, a total score of 24 was considered to be the threshold for PD, creating a binary variable for PD [30]. The four subscales were also analysed separately as count variables. The internal validity of the GHQ-28 was tested using Cronbach's alpha analysis. An alpha coefficient of 0.9013 was obtained for correlation between all the 28 items and values of 0.7649, 0.8541, 0.7608 and 0.8802 were obtained for the somatic, anxiety, social dysfunction depression subscales respectively. All the questionnaire items were therefore retained in the analysis.

Adverse childhood experiences

Using a questionnaire adapted from the ACE Study Questionnaire [31], ACEs were retrospectively reported at 22–23 years of age. Data on chronic illness, unemployment and parental death were also collected in addition to the original ten ACEs used in the ACE study, based on recommendations to include some experiences that may be prevalent and relevant in low-income settings [32]. Additional File 1 shows the questions used to assess ACEs. A point was allocated to each ACE exposure for which a participant answered yes to one or both questions, i.e. only one point could be allocated to each ACE.

ACEs were analyzed as single variables, or grouped into abuse (emotional, physical and sexual abuse), neglect (emotional and physical neglect) and household dysfunction (parental divorce, parental death, drug abuse in household, mentally ill household member, chronically ill household member, incarcerated household member, witnessing domestic violence and unemployment of caregiver) categories. An ACE score was computed by adding the number of ACEs to which each person was exposed. Three categorical variables were created based on the ACE score:

1. A binary variable to indicate the proportion of participants who had experienced at least one ACE before the age of 18 years.
2. A variable with five ACE score categories to indicate those who experienced no ACEs, one, two, three and four or more ACEs, to allow comparability with similar studies [1].
3. A variable was created to broadly divide the ACE score into three categories: no ACEs (score of 0), lower level of ACEs (score 1 to 5) and higher level of ACEs (score 6 to 13).

These three variations of the ACE score were created to gain a better understanding of the cumulative effect of ACEs on mental well-being, as well as to have results comparable to similar studies.

Stressful life events in adulthood

Data were collected on the participants' experience of stressful life events during the preceding 6 months. Participants at age 22–23 years completed a questionnaire asking if the following had happened: injury of a household member due to violence, family member was a victim of crime, witnessing a violent crime, illness of a close family member, death of a close family member, living with someone with a serious disability in the family, drug or alcohol abuse in the household, fighting with or alienation from a close family member or neighbour, and incarceration of a family member. With each item assigned one point, a score of stressful life events experienced was computed and a categorical variable created with three categories: no experience (0), low levels (score of 1 to 3) and high levels of adult stress (score of 4 or more).

Socioeconomic and demographic factors

Previous work done on the Bt20+ data suggests that a wealth index is useful in adjusting regression models for SES [33]. At 22–23 years of age, participants were asked questions regarding ownership of thirteen household assets: television, car, washing machine, fridge, phone, radio, microwave, cell phone, DVD/

Video player, DSTV (satellite television), computer, internet and medical aid /medical insurance. We assessed SES using a summative wealth index based on this list of assets. SES was analysed as a continuous variable with scores ranging between 1 and 13. The scores were normally distributed with the mean very close in value to the median.

The questionnaire also collected data on gender, age, current marital status, graduation from high school or completing matric, and current employment status.

Statistical analysis

Descriptive statistics

Prevalence of ACEs and demographic characteristics were described by the presence or absence of PD, and chi-square and analysis of variance (ANOVA) tests used to test for significant differences between them. The Kruskal-Wallis test was used to assess the difference in the reporting of subscale symptoms among those reporting at least one ACE compared to those with no ACE. The distribution of the ACEs grouped into abuse, neglect and household dysfunction is also described.

Logistic regression: Effects of individual ACEs on PD

Logistic regression was used to determine the unadjusted and adjusted association between ACEs and PD as follows:

a) The association between each individual ACE and PD was tested in univariate analysis as well as adjusted for demographic, SES and adult stress factors
b) A model was created that included all individual ACE variables and the demographic factors to assess for overlapping effects between the ACES.
c) Negative binomial regression was used to test for associations between ACEs and the different GHQ subscales and adult life stress.
d) The association between ACEs and adult life stress were also tested in univariate and multivariate analysis

Hierarchical logistic regression

a) We used hierarchical regression to test the association between the cumulative ACE score variables and PD in order to assess the direct relationship, the potential multiple pathways linking them as well the cumulative effects of not only ACEs but also adult stressful life events. In step 1, we adjusted for demographic variables of age, gender and marital status. The second step added household SES, current employment and completion of high school. The adult life stress variable was added in the third step of the hierarchical regression.
b) An interaction term between ACEs and adult life stress was also tested in separate models, the term being added to the model in the third step. Figure 1 shows the conceptual framework used in the hierarchical analysis.

The framework hypothesizes a direct association between ACEs and PD independent of other factors. However, ACEs may act through SES and adult stress to impact mental well-being. SES factors themselves may also have an effect on adult stress. Demographic factors, not shown in the framework are potential confounders that may be associated with both ACEs and PD.

Missing data

We performed descriptive statistics on participants with missing ACE and PD data to check if there were any significant differences in demographic characteristics.

Results

Descriptive analysis

Table 1 presents the demographic characteristics of the sample and the prevalence of ACEs and PD.

The sample comprised 1223 participants with complete ACE data of whom 51% were women and 49% men. Nearly 90% of the sample reported experiencing at least

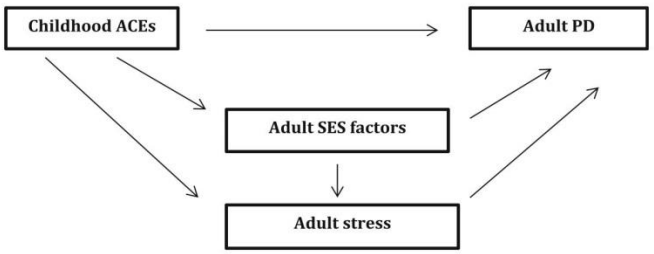


Fig. 1 Conceptual framework for the hierarchical regression. ACEs – Adverse childhood events; PD-psychological distress; SES-socioeconomic status

Table 1 Prevalence of ACEs and demographic characteristics of the sample

Variable	PD No n (%)	PD Yes n (%)	Total N (%)	*p*-value
Cumulative ACE Variables				
Any ACE				
No	131 (15)	16 (5)	147 (13)	
Yes	735 (85)	308 (95)	1043 (87)	< 0.001
ACE score categories				
None (0 ACEs)	131 (15)	16 (5)	147 (13)	
1 ACE	180 (21)	55 (17)	235 (20)	
2 ACEs	161 (19)	51 (16)	212 (18)	
3 ACEs	137 (16)	44 (14)	181 (15)	
4 or more ACEs	257 (30)	158 (49)	415 (35)	< 0.001
Level of ACEs				
None (0 ACEs)	131 (15)	16 (5)	147 (12)	
Low (1 to 5)	640 (74)	228 (70)	868 (73)	
High (6 or more)	95 (11)	80 (25)	175 (15)	< 0.001
Abuse				
No	731 (69)	220 (53)	951 (64)	
Yes	328 (31)	196 (47)	524 (36)	< 0.001
Neglect				
No	812 (74)	217 (50)	1029 (67)	
Yes	282 (26)	214 (50)	496 (33)	< 0.001
Household dysfunction				
No	169 (16)	29 (7)	198 (13)	
Yes	892 (84)	400 (93)	1292 (87)	< 0.001
Individual ACE Variables				
Emotional abuse				
No	812 (74)	256 (59)	1068 (70)	
Yes	282 (26)	175 (41)	457 (30)	< 0.001
Sexual abuse				
No	1032 (97)	385 (93)	1417 (96)	
Yes	31 (3)	27 (7)	58 (4)	0.001
Physical abuse				
No	997 (94)	369 (89)	1366 (92)	
Yes	68 (6)	44 (11)	112 (8)	0.005
Emotional neglect				
No	861 (78)	235 (54)	1096 (72)	
Yes	236 (22)	197 (46)	433 (28)	< 0.001
Physical neglect				
No	992 (91)	355 (82)	1347 (88)	
Yes	101 (9)	77 (18)	178 (12)	< 0.001
Domestic violence				
No	977 (90)	346 (80)	1323 (87)	
Yes	114 (10)	84 (20)	198 (13)	< 0.001
Parental divorce/separation				
No	534 (57)	179 (51)	713 (55)	
Yes	401 (43)	174 (49)	575 (45)	0.039
Parental death				
No	794 (73)	305 (70)	1099 (72)	
Yes	301 (27)	128 (30)	429 (28)	0.417
Substance abuse				
No	836 (76)	278 (64)	1114 (73)	
Yes	264 (24)	155 (36)	419 (27)	< 0.001
Mental illness				
No	1003 (91)	345 (80)	1348 (88)	
Yes	96 (9)	88 (20)	184 (12)	< 0.001
Imprisonment				
No	852 (78)	325 (75)	1177 (77)	
Yes	246 (22)	108 (25)	354 (23)	0.289
Chronic illness				
No	837 (76)	292 (68)	1129 (74)	
Yes	259 (24)	140 (32)	399 (26)	< 0.001
Unemployment				
No	644 (59)	222 (51)	866 (57)	
Yes	456 (41)	211 (49)	667 (43)	0.010
Age	23 (SD 0.6)	23 (SD 0.6)	23 (SD 0.6)	0.494
Marital status				
Single	538 (49)	228 (52)	766 (50)	
Marital relationship	567 (51)	207 (48)	774 (50)	0.188
Gender				
Male	594 (54)	150 (34)	744 (48)	
Female	516 (46)	288 (66)	804 (52)	< 0.001
SES	9.4 (SD 2.3)	8.9 (SD 2.3)	9.3 (SD 2.2)	0.002
Secondary school graduation				
No	414 (38)	185 (43)	599 (39)	
Yes	680 (62)	247 (57)	927 (61)	0.073
Currently employed				
No	450 (47)	219 (57)	669 (50)	
Yes	503 (53)	166 (43)	669 (50)	0.001
Stressful life events (previous 6 months)				
No	352 (33)	85 (20)	437 (29)	
Low	619 (58)	254 (61)	873 (59)	
High	99 (9)	77 (19)	176 (12)	< 0.001

one ACE, 35% experienced at least four and 15% experienced at least six ACEs. The most frequently reported ACEs were parental divorce or separation and parental unemployment (45 and 43% respectively), while the least frequently reported were sexual abuse (4%) and physical abuse (8%). Over a third of the participants reported experiencing some form of abuse, 33% reported experiencing physical or emotional neglect and over 90% reported

household dysfunction. The proportion of participants with PD was 28%, with 66% of these being women. Approximately 50% of those who had PD reported experiencing at least four ACEs, compared to 30% of those who had no PD, and 25% reported six or more ACEs, compared to 11% of those who did not have PD. Of the demographic factors, there was no significant difference in education and marital status between those who reported PD and those who did not.

Missing data

Nearly 2% of males and 1.3% of females did not have complete data for both ACEs and PD. Twenty-one percent of males and 23% of the females did not have complete ACE data, while 1.6 and 2.4% did not have complete PD data respectively and were thus (by default) not included in the regression models.

Reporting of individual GHQ subscales

Presented in Additional File 2 are histograms that show the number of participants reporting each of the four different GHQ subscales in relation to their experience of at least one ACE. The median scores for the somatic, anxiety/insomnia, dysfunction and depression subscales were 4 (range 0–19), 4 (range 0–21), 6 (range 0–21) and 0 (range 0–21) respectively. The median scores for the subscales for participants experiencing at least one ACE compared to no ACEs were: 4 and 2 for somatic, 4 and 2 for anxiety/insomnia, 6 and 5.5 for dysfunction and 1 and 0 for depression respectively. The Kruskal-Wallis analysis showed that there was a significant difference in reporting somatic, anxiety/insomnia and depression symptoms between those who experienced at least one ACE and those who experienced no ACEs (p-value < 0.05 for all three).

Regression analyses

Effects of ACEs on adult life stress

Additional File 3 shows the separate and cumulative effects of ACEs on adult life stress. Compared to those who experienced no ACEs and low levels of ACEs, participants who reported high ACE levels had nearly twelve times greater odds of experiencing high levels of adult stress. All the demographic factors were not significantly associated with the experience of adult life stress. Parental death and sexual abuse were not significantly associated with adult life stress both in unadjusted and adjusted models.

Separate effects of ACEs on PD

The separate effects of ACEs on PD are presented in Table 2. Parental death and incarceration of household member were not associated with PD. After adjusting for demographic factors, parental divorce/separation and parental unemployment become statistically non-significant, pointing to possible confounding and/or mediation. In the model including all individual ACEs, the neglect ACEs and living with mental illness in the household remained statistically significantly increased the odds of PD, together with marital status, gender and adult life stress. Gender remained associated with PD in all adjusted models, with no evidence of reduction of effect size.

Association between ACEs and the separate PD subscales

The associations between the individual subscales and PD are shown in Additional File 4. The social dysfunction subscale was not statistically significantly associated with any of the cumulative ACE score variables, except experiencing at least six ACEs which was significant only in the univariate analysis. Of the demographic variables, household stress and gender significantly increased the relative risk of a high score in all four subscales. The depression subscale generally showed greater effect sizes compared to the other three subscales. A dose-response relationship is apparent in the three subscales that achieved statistical significance.

Hierarchical logistic regression

Table 3 shows the adjusted hierarchical regression analyses for the relationship between ACEs and PD, with the ACE score variable depicting three levels of ACEs: no ACEs, low level of ACES (1 to 5) and high level of ACEs (6 or more). Additional File 5 presents the same analyses using the binary ACE score variable.

The full regression models for the two ACE score exposures achieved significance. The likelihood ratio chi-square statistic showed statistically significant improvement between the null model and tested model after each step in the hierarchical modelling. The effect of ACEs remained statistically significant even after adjusting for demographic, SES and adult life events stress factors. A dose-response association is noted between the ACE score and PD. The addition of the demographic and SES factors increased the effect size of the ACE score to levels higher than the unadjusted values, but adult stress brought the ORs down in all the three full models to levels lower than or similar to unadjusted. Being married was not associated with PD in the unadjusted model but was significant when entered into the model with gender. The effect size of gender on PD increased at each subsequent level of the model.

In the models with the interaction terms, it is apparent that high levels of adult life stress increase the likelihood of PD by over 20 times compared to no stress, in the absence of ACEs, while low levels of stress have a statistically non-significant association. Having experienced at least one ACE was significantly associated with PD even in the absence of adult life event stress (AOR 2.74, 95%

Table 2 Effects of individual ACEs on PD

Variable	Crude OR (95% CI)	Adjusted OR (95% CI) Individual ACEs[1]	Adjusted OR (95% CI) All individual ACEs in combined model[2]
Emotional abuse			
No	Ref	Ref	Ref
Yes	**1.96 (1.56–2.49)**	**1.93 (1.46–2.55)**	1.10 (0.75–1.63)
Sexual abuse			
No	Ref	Ref	Ref
Yes	**2.33 (1.38–3.96)**	**2.26 (1.20–4.25)**	1.78 (0.86–3.66)
Physical abuse			
No	Ref	Ref	Ref
Yes	**1.75 (1.17–2.60)**	**1.87 (1.20–2.93)**	1.14 (0.67–1.94)
Emotional neglect			
No	Ref	Ref	Ref
Yes	**3.05 (2.41–3.88)**	**2.79 (2.10–3.70)**	**1.99 (1.34–2.93)**
Physical neglect			
No	Ref	Ref	Ref
Yes	**2.13 (1.55–2.93)**	**2.24 (1.52–3.31)**	**1.64 (1.00–2.69)**
Domestic violence			
No	Ref	Ref	Ref
Yes	**2.08 (1.53–2.83)**	**1.91 (1.35–2.72)**	1.22 (0.78–1.90)
Parental divorce/separation			
No	Ref	Ref	Ref
Yes	**1.29 (1.01–1.65)**	1.13 (0.85–1.51)	0.96 (0.70–1.31)
Parental death			
No	Ref	Ref	Ref
Yes	1.11 (0.87–1.41)	1.26 (0.95–1.67)	1.15 (0.81–1.62)
Substance abuse			
No	Ref	Ref	Ref
Yes	**1.77 (1.39–2.25)**	**1.63 (1.22–2.17)**	1.24 (0.86–1.80)
Mental illness			
No	Ref	Ref	Ref
Yes	**2.66 (1.95–3.65)**	**2.72 (1.89–3.91)**	**2.25 (1.45–3.51)**
Incarceration			
No	Ref	Ref	Ref
Yes	1.15 (0.89–1.98)	1.12 (0.83–1.52)	0.79 (0.54–1.16)
Chronic illness			
No	Ref	Ref	Ref
Yes	1**.55 (1.21–1.98)**	**1.42 (1.07–1.89)**	1.07 (0.75–1.52)
Unemployment			
No	Ref	Ref	Ref
Yes	**1.34 (1.07–1.68)**	1.16 (0.89–1.51)	0.82 (0.59–1.15)
Marital status			
Single	Ref		Ref
Relationship	0.86 (0.69–1.08)		**0.64 (0.50–0.87)**
Gender			
Male	Ref		Ref

Table 2 Effects of individual ACEs on PD *(Continued)*

Variable	Crude OR (95% CI)	Adjusted OR (95% CI) Individual ACEs[1]	Adjusted OR (95% CI) All individual ACEs in combined model[2]
Female	**2.21 (1.76–2.78)**		**2.73 (1.98–3.77)**
SES	**0.91 (0.87–0.96)**		**0.90 (0.84–0.97)**
Completed matric			
No	Ref		Ref
Yes	**0.81 (0.65–1.02)**		0.84 (0.60–1.18)
Currently employed			
No	Ref		Ref
Yes	**0.68 (0.53–0.86)**		0.79 (0.58–1.08)
Stressful events			
No	Ref		Ref
Low	**1.70 (1.28–2.24)**		**1.67 (1.14–2.45)**
High	**3.22 (2.20–4.71)**		**1.80 (1.05–3.08)**

In unadjusted and adjusted analysis: **bold** = $p < 0.05$; [1] Each individual ACE entered as an exposure adjusted for demographic factors; all demographic factors except completing high school were significant at $p < 0.05$; [2]All individual ACEs placed in one multivariate model, also adjusted for demographic factors

CI 1.03–7.36). When the three category ACE score variable was used as the main exposure in Table 3, high levels of ACEs in the absence of adult stress increased the odds of PD by nearly 8 times. A closer look at the interaction terms shows that there was no significant difference in the effect of the level of ACEs on PD in the presence of low stress, i.e. the impact of one to five ACEs as well as experiencing six or more ACEs on PD did not differ significantly between those with low stress compared to those with no adult stress. However, both low and high levels of ACEs had a significantly different effect in individuals with high adult stress compared to those with no adult stress.

Discussion

In this sample of young South African adults, 87% reported at least one ACE and 35% reported four or more ACEs. Nearly a third of the population reported signs of PD, of which 66% were women. Individual ACEs increased the odds of reporting PD by between 1.42 (chronic illness) and 2.79 (emotional neglect) times, after adjusting for demographic variables. Including all the ACEs in one model attenuated the effect of most ACEs except emotional and physical neglect and mental illness in the household. A significant direct association was observed between ACEs and PD, and a dose-response effect was apparent. A significant dose-response association was observed between ACE levels and adult stress levels with participants who reported experiencing six or more ACEs being 11 times more likely to experience high levels of adult stress (AOR 11.22**;** 95% CI 7.1–17.8) compared to those who reported zero and one to five ACEs.

Our ACE prevalence levels are similar to those of the Kaiser-Permanente ACE study where over 60% of the population had experienced at least one ACE [1]. However they are more consistent with a later study that used an expanded version of the ACE list and found that over 80% of the participants reported at least one ACE [34]. Although the additional ACEs included in our analysis: parental death, parental unemployment and chronic illness in the household were among the most prevalent, their effect became non-significant in the model combining all individual ACEs. This may mean that their effect is manifest through other ACEs or that they act as moderating factors. As ACE research is widely used to advocate for the protection of and greater investment in the early childhood years, it is important for the ACE indices to be broadly focused in order to capture a diversity of experiences that may impact life-long health and wellbeing [32, 34].

The higher prevalence of PD among women compared to men is consistent with results from others studies [16, 35], although some studies have found no gender differentials in the prevalence of poor mental health [6]. Compared to men, women who experienced at least one ACE were two and half times more likely to report PD, an effect that increased with the inclusion of SES and adult stress in the model. Greater odds of women having PD given the experience of ACEs compared to men have been reported in other studies, including in South Africa [36, 37].

The effect of most single ACEs on PD attenuated and became statistically not significant after accounting for other ACEs and demographic and SES factors. These results imply that the effect of some ACEs may only manifest through other exposures and that ACEs often co-occur and are highly interrelated. In this sample, physical and emotional neglect and mental illness in the household seem to be the most foreboding individual ACE exposures impacting mental well-being independently of other ACEs, adult stress, SES and demographic factors. A dose-response effect was observed between the

Table 3 Hierarchical regression results: ACEs as a three-category exposure

	Model 1	Model 2	Model 3	Model 4 (with interaction)
Chi^2 Δ	**103.3**[a]	**110.0**	**123.3**	**129.6**
Level of ACEs				
None (0 ACEs)	Ref	Ref	Ref	Ref
Low (1 to 5)	**3.21 (1.83–5.63)**	**3.48 (1.81–6.67)**	**2.97 (1.53–5.72)**	2.49 (0.92–6.72)
High (6 or more)	**7.98 (4.28–14.91)**	**8.57 (4.19–17.53)**	**6.54 (3.14–13.63)**	**7.67 (1.90–30.94)**
Level of ACEs				
No stressful life events#No ACEs				Ref
Low stress#Low ACES				2.02 (0.47–8.59)
Low stress#High ACEs				1.33 (0.22–7.95)
High stress#Low ACEs				**0.10 (0.009–0.98)**
High stress#High ACEs				**0.08 (0.006–0.95)**
Age	1.10 (0.85–1.40)	1.09 (0.84–1.44)	1.09 (0.84–1.45)	1.09 (0.83–1.44)
Gender				
Male	Ref	Ref	Ref	Ref
Female	**2.61 (1.97–3.45)**	**2.67 (1.97–3.63)**	**2.71 (2.00–3.71)**	**2.77 (2.03–3.79)**
Marital status				
Single	Ref	Ref	Ref	Ref
Relationship	**0.70 (0.53–0.93)**	**0.68 (0.50–0.92)**	**0.67 (0.49–0.92)**	**0.66 (0.49–0.91)**
SES		**0.91 (0.85–0.98)**	**0.91 (0.84–0.98)**	**0.91 (0.84–0.98)**
Completed matric				
No		Ref	Ref	Ref
Yes		0.79 (0.57–1.09)	0.81 (0.58–1.12)	0.81 (0.58–1.13)
Employment				
No		Ref	Ref	Ref
Yes		0.79 (0.59–1.07)	0.80 (0.59–1.09)	0.80 (0.59–1.08)
Adult stress				
None			Ref	Ref
Low			**1.84 (1.26–2.68)**	0.99 (0.25–3.98)
High			**2.25 (1.35–3.74)**	**21.92 (2.35–204.86)**

[a]**Bold:** Likelihood ratio chi-square test significant at $p < 0.05$; [#]**Bold OR:** significant at $p < 0.05$; ^Interaction terms

ACE score and PD, even after accounting for adult stress, as well as demographic and SES factors. This shows an unmediated, direct effect of ACEs on PD, and that this effect increases with exposure to a greater number of ACEs. This finding is in line with a growing body of evidence that shows that early life adversity can disrupt not only brain structure and functioning, but also dysregulate other systems resulting in low stress thresholds that persist throughout life and increase the risk of stress-related disease or disorders [38, 39]. This direct effect is however not the only effect of ACEs on PD. The hierarchical modelling showed increasing effects of ACEs with the addition of demographic and SES factors to the models. This may be due to exacerbating moderation effects of these factors on the association between ACEs and PD.

The magnitude of the dose-response association between ACEs and adult life stress did not decrease after adjusting for demographic factors signifying a significant direct relationship between the two. Adult stressors may possibly be mediators of the association between ACEs and PD, demonstrated by the reduction of the effect of ACEs on PD after the addition of adult stress to the model. This means that participants exposed to ACEs may be more likely to show greater distress in the presence of adult stressors compared to those not exposed to ACEs, and that comparatively lower levels of stress may trigger distress [16]. The interaction analysis showed that in individuals that experienced high levels of adult stress, experiencing five ACEs or less, and experiencing six ACEs or more had significantly different effects on PD compared to experiencing no ACEs. Additionally, low ACE levels did

not have a significant association with PD in the absence of adult stress. High levels of adult stress therefore significantly increased the likelihood of those who had a history of ACEs, especially cumulatively high levels of ACEs, also reporting PD. Although the results also suggest that adult stress on its own has a greater impact on PD than do ACEs, these two exposures possibly interact in several possible ways that have been suggested in previous research.

The interaction between ACEs and adult stressful events is admittedly complex, with ACEs possibly exacerbating the effect of subsequent stress on PD, and adult stress possibly mediating the relationship between ACEs and PD. These pathways are not fully elucidated here but our results are congruent with current knowledge. Evidence shows that exposure to ACEs can trigger neurophysiological sensitivity and erode the stress reactive and adaptive threshold thus stimulating dysfunctional coping strategies [22, 40]. Important psychosocial resources are undermined, resulting in lower levels of perceived social support and poorer perceptions of the self [40]. These shortfalls have negative mediating influences on positive subsequent development and physical, psychological, and social health outcomes in adulthood [40]. In addition to this heightened sensitivity, those who are exposed to ACEs may be at an increased risk of experiencing adult stress. The initial exposure to childhood stressors can lead to secondary effects through the inability to form and sustain healthy relationships, poor academic achievement and making decisions that leave individuals vulnerable to subsequent stressors like those investigated in this study [21]. Individuals exposed to childhood stress are hypothesized to have limited buffering of these secondary stressors compared to individuals without prior significant adversity exposure [21].

An important link between early life and adulthood stress, demonstrated in part through the hierarchical analysis, is through socio-economic status. Individuals exposed to ACEs are more likely to attain lower levels of education which lead to financial insecurity that can increase the risk of personal and family conflict, homelessness and unemployment [5]. Consequent to these adult adversities is the instability of social resources and reduced economic resources available to obtain professional help and maintain healthy habits [5, 41].

The Parental Acceptance–Rejection Theory (PARTheory) may be applied to explain the consistent link between neglect and PD in this sample. According to the theory, perceived parental acceptance or rejection affects psychological adjustment in childhood. In addition, when parental rejection that occurred in childhood is recollected later in life, it is likely to be associated with the same form of psychological maladjustment in adulthood [42, 43]. Parental acceptance refers to warmth, affection, love, care, comfort, support and nurturance, while parental rejection refers to the absence or withdrawal of warmth, affection, or love by parents towards their children [44]. An individual's emotional security is partly dependent on the amount of warmth he or she receives from parents as a child and how he or she perceives parents' warmth. Lack of experience of warmth may lead to low self-esteem, negative mental representations of self and others, anger, unresponsiveness, sadness, and emotional instability [45]. Those who report being neglected would be at an increased direct risk of PD in adulthood, apart from the influence of other factors. It is also possible that other forms of adversity such as physical and sexual abuse are perceived by the child as lack of love, comfort and warmth and have the same effect as neglect on the child's and subsequently the adult's psychological well-being.

The GHQ subscales are constructed to each represent common elements of symptomatology [46]. Our analysis therefore sought to assess the association of ACEs with each set of reported symptoms. Three subscales showed results in the expected directions but the social dysfunction subscale was not significantly associated with any of the cumulative ACE variables except high level of ACEs (unadjusted OR 1.16 (95% CI: 1.01–1.33). The items in the social dysfunction scale may not all be appropriate for our sample. However, women were more likely to report social dysfunction compared to men, those who were married and those who had jobs were less likely to report dysfunction compared to those who were single and unemployed respectively. These socio-demographic factors may have modified the association of ACEs with this subscale.

Strengths and limitations

Our study utilized data from a long-running cohort with well-established data collection and management methods. Although a birth cohort is not a nationally representative sample two decades later, the data enable us to assess the presence of ACEs in a middle income population and test its association with poor mental well-being in adulthood. The experience of ACEs was reported retrospectively at 22 years of age, which may be subject to recall bias. The role of social coping resources in the association between ACEs and PD has been alluded to previously but we were not able to assess this here [47]. The missing observations may potentially affect the estimations as well but it may either be to under or over estimate.

Conclusion and future implications

The experience of ACEs in this population compares with that found in other populations and points to the need for a more holistic approach in dealing with childhood adversity that includes identifying other forms of maltreatment and neglect when one adversity is reported. Treatment of mental illness and promotion of mental well-being should not only focus on contemporaneous

events but also on possible childhood maltreatment and adversity.

Of all animal species, human offspring are dependent on their parents for the longest time. This means that any efforts to support healthy early childhood growth should necessarily include parental support and education. Governments and communities need to work together to support healthy family relationships and support parents in their efforts to raise their children. Effective and collective interventions are necessary in cases of adversity, abuse and violence in the household. Our study shows that this will contribute to improved mental wellbeing and other evidence suggests that it may also prevent other diseases [4, 10].

Early childhood development (ECD) is the foundation for sustainable development. Building a strong beginning for healthy development in the early years of life is essential for individual well-being, economic productivity and harmonious societies around the world [38, 48]. Every child, no matter where they live needs the best start in life in order for them to reach their full developmental potential. For the first time in the history of global development, ECD is a major part of the global development goals both directly in lifelong learning and embedded in several other goals. It is therefore time for governments, civil society, businesses, communities and individuals to work together to ensure that the importance of ECD takes center stage and protecting children from adversity is one of the key action points. The current analysis is useful in showing the extent of the problem, albeit in part, and provides a more comprehensive view than studying ACEs as single exposures.

Additional files

Additional file 1: Questionnaire items used to assess the experience of ACEs. The table presents the questionnaire items derived from the WHO ACE-IQ used to measure the exposure to ACEs. (DOCX 15 kb)

Additional file 2: Number of participants reporting each of the GHQ subscales stratified by their experience of at least one ACE. The graphs present in each quadrant the participants who reported each of the four GHQ subscales, those who experienced no ACEs on the left of each quadrant and those who experienced at least one ACE on the right. (PDF 177 kb)

Additional file 3: Separate and cumulative effects of ACEs on adult life stress. The table presents the regression results of ACEs on adult life stress. (DOCX 14 kb)

Additional file 4: Association between ACEs and the different PD subscales. This table presents the associations between ACEs and the four GHQ subscales, obtained using negative binomial regression. (DOCX 15 kb)

Additional file 5: Hierarchical regression results: ACEs as binary exposure. Presented here are the adjusted hierarchical regression results using ACE as a binary exposure, including the interaction analysis. (DOCX 14 kb)

Abbreviations

ACE: adverse childhood experiences; PD: psychological distress; SES: socioeconomic status; DALY: disability-adjusted life years; SASH: South African Stress and Health Study; YLD: years lived with disability; Bt20: Birth to Twenty Plus Study; Bt10: Birth to Ten Study; GHQ-28: General Health Questionnaire 28; DSTV: satellite television; ANOVA: analysis of variance; AOR: adjusted odds ratio; PARTheory: parental acceptance-rejection theory

Acknowledgements

The support of the DST-NRF Centre of Excellence in Human Development at the University of the Witwatersrand, Johannesburg in the Republic of South Africa towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the authors and are not to be attributed to the CoE in Human Development.

Funding

The Birth to Twenty Plus Study was funded by the SA Medical Research Council, Wellcome Trust (UK) and the University of the Witwatersrand, Johannesburg. MM, SAN and LMR are supported by the DST-NRD Centre of Excellence in Human Development at the University of the Witwatersrand, Johannesburg, South Africa. None of the funders had a role in the design of the study and collection, analysis and interpretation of data, and in writing the manuscript.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to them containing information that could compromise research participant privacy, but are available from Professor Shane Norris on reasonable request.

Authors' contributions

All the authors were involved in the conception and design of the study. SAN and LMR were responsible for data acquisition. MM was responsible for data analysis, interpretation of results and drafting the manuscript. All authors read and critically revised the manuscript for important intellectual content and gave their final approval of the version to be published, as well as taking responsibility of all aspects of the work to ensure that all questions related to the work are appropriately resolved.

Ethics approval and consent to participate

Ethical clearance for this study and the Bt20+ study were obtained from the Human Research Ethics Committee of the University of the Witwatersrand, clearance numbers M160921 and M111182 respectively. All participants were provided with information on the study and its procedures and signed consent forms at enrolment.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 21 February 2018 Accepted: 26 June 2018
Published online: 05 July 2018

References

1. Anda RF, Felitti VJ, Bremner JD, Walker JD, Whitfield C, Perry BD, et al. The enduring effects of abuse and related adverse experiences in childhood. Eur Arch Psychiatry Clin Neurosci. 2006;256(3):174–86.
2. Chapman DP, Whitfield CL, Felitti VJ, Dube SR, Edwards VJ, Anda RF. Adverse childhood experiences and the risk of depressive disorders in adulthood. J Affect Disord. 2004;82(2):217–25.
3. Dube SR, Anda RF, Felitti VJ, Chapman DP, Williamson DF, Giles WH. Childhood abuse, household dysfunction, and the risk of attempted suicide throughout the life span: findings from the adverse childhood experiences study. JAMA. 2001;286(24):3089–96.
4. Edwards VJ, Holden GW, Felitti VJ, Anda RF. Relationship between multiple forms of childhood maltreatment and adult mental health in community respondents: results from the adverse childhood experiences study. Am J Psychiatry. 2003;160(8):1453–60.

5. Nurius PS, Green S, Logan-Greene P, Borja S. Life course pathways of adverse childhood experiences toward adult psychological well-being: a stress process analysis. Child Abuse Negl. 2015;45:143–53.
6. Schilling EA, Aseltine RH, Gore S. Adverse childhood experiences and mental health in young adults: a longitudinal survey. BMC Public Health. 2007;7(1):30.
7. Jewkes RK, Dunkle K, Nduna M, Jama PN, Puren A. Associations between childhood adversity and depression, substance abuse and HIV and HSV2 incident infections in rural south African youth. Child Abuse Negl. 2010; 34(11):833–41.
8. Centers for Disease Control and Prevention. Adverse childhood experiences reported by adults — five states, 2009. Atlanta, GA, USA: Centers for Disease Control and Prevention; 2010. https://www.cdc.gov/mmwr/pdf/wk/mm5949.pdf. Accessed 15 June 2017
9. Kathryn Ashton MAB, Alisha R. Davies, Katie Hardcastle and Karen Hughes. Adverse Childhood Experiences and their association with chronic disease and health service use in the Welsh adult population. Cardiff, Wales: Public Health Wales NHS Trust Centre for Public Health, Liverpool John Moores University 2016. http://www.wales.nhs.uk/sitesplus/documents/888/ACE%20Chronic%20Disease%20report%20%289%29%20%282%29.pdf. Accessed July 2017.
10. Bellis M, Hughes K, Leckenby N, Hardcastle K, Perkins C, Lowey H. Measuring mortality and the burden of adult disease associated with adverse childhood experiences in England: a national survey. J Public Health. 2014;37(3):445–54.
11. Soares ALG, Howe LD, Matijasevich A, Wehrmeister FC, Menezes AM, Gonçalves H. Adverse childhood experiences: prevalence and related factors in adolescents of a Brazilian birth cohort. Child Abuse Negl. 2016;51:21–30.
12. Whiteford HA, Ferrari AJ, Degenhardt L, Feigin V, Vos T. The global burden of mental, neurological and substance use disorders: an analysis from the global burden of disease study 2010. PLoS One. 2015;10(2):1–14.
13. Ferrari AJ, Norman RE, Freedman G, Baxter AJ, Pirkis JE, Harris MG, et al. The burden attributable to mental and substance use disorders as risk factors for suicide: findings from the global burden of disease study 2010. PLoS One. 2014;9(4):e91936.
14. Hay SI, Abajobir AA, Abate KH, Abbafati C, Abbas KM, Abd-Allah F, et al. Global, regional, and national disability-adjusted life-years (DALYs) for 333 diseases and injuries and healthy life expectancy (HALE) for 195 countries and territories, 1990-2016: a systematic analysis for the global burden of disease study 2016. Lancet. 2017;390(10100):1260–344.
15. Tomlinson M, Grimsrud AT, Stein DJ, Williams DR, Myer L. The epidemiology of major depression in South Africa: results from the South African Stress Health study. SAMJ. 2009;99(5):367–73.
16. Seedat S, Stein DJ, Jackson PB, Heeringa SG, Williams DR, Myer L. Life stress and mental disorders in the south African stress and health study. SAMJ. 2009;99(5):375–82.
17. Promoting Mental WHO. Health: concepts, emerging evidence, practice. Geneva, Switzerland: WHO; 2004. http://www.who.int/mental_health/evidence/en/promoting_mhh.pdf. Accessed 6 Sept 2017
18. Drapeau A, Marchand A, Beaulieu-Prévost D. Epidemiology of psychological distress. In: L' Abate L, editor. Mental illnesses-understanding, prediction and control. Rijeka, Croatia: InTech; 2012. p. 105–34. https://www.intechopen.com/books/mental-illnesses-understanding-prediction-and-control/epidemiology-of-psychological-distress. Accessed 13 Feb 2018.
19. Payton AR. Mental health, mental illness, and psychological distress: same continuum or distinct phenomena? J Health Soc Behav. 2009;50(2):213–27.
20. Jackson PB, Williams DR, Stein DJ, Herman A, Williams SL, Redmond DL. Race and psychological distress: the south African stress and health study. J Health Soc Behav. 2010;51(4):458–77.
21. Nurius PS, Uehara E, Zatzick DF. Intersection of stress, social disadvantage, and life course processes: reframing trauma and mental health. Am J Psychiatr Rehabil. 2013;16(2):91–114.
22. Pearlin LI, Schieman S, Fazio EM, Meersman SC. Stress, health, and the life course: some conceptual perspectives. J Health Soc Behav. 2005;46(2):205–19.
23. Peltzer K, Pengpid S, Skaal L. Prevalence of psychological distress and associated factors in urban hospital outpatients in South Africa. S Afr J Psych. 2012;18(1):10–5.
24. Erdem Ö, Van Lenthe FJ, Prins RG, Voorham TA, Burdorf A. Socioeconomic inequalities in psychological distress among urban adults: the moderating role of neighborhood social cohesion. PLoS One. 2016;11(6):e0157119.
25. Pigeon-Gagné É, Hassan G, Yaogo M, Ridde V. An exploratory study assessing psychological distress of indigents in Burkina Faso: a step forward in understanding mental health needs in West Africa. Int J Equity Health. 2017;16:1–11.
26. Kessler RC, McLaughlin KA, Green JG, Gruber MJ, Sampson NA, Zaslavsky AM, et al. Childhood adversities and adult psychopathology in the WHO world mental health surveys. Br J Psychiatry. 2010;197(5):378–85.
27. Richter L, Norris S, Pettifor J, Yach D, Cameron N. Cohort Profile: Mandela's children: The 1990 birth to twenty study in South Africa. Int J Epidemiol. 2007;36(3):504–11.
28. Population of 2017. POPULATION OF SOWETO 2017. 2017. http://populationof2017.com/population-of-soweto-2017.html. Accessed 18 Jan 2018.
29. Kagura J, Adair LS, Musa MG, Pettifor JM, Norris SA. Blood pressure tracking in urban black south African children: birth to twenty cohort. BMC Pediatr. 2015;15(1):1.
30. Sterling M. General health questionnaire–28 (GHQ-28). J Physiother. 2011; 57(4):259.
31. Dube SR, Felitti VJ, Dong M, Giles WH, Anda RF. The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. Prev Med. 2003;37(3):268–77.
32. Finkelhor D, Shattuck A, Turner H, Hamby S. A revised inventory of adverse childhood experiences. Child Abuse Negl. 2015;48:13–21.
33. Sheppard ZA, Norris SA, Pettifor JM, Cameron N, Griffiths PL. Approaches for assessing the role of household socioeconomic status on child anthropometric measures in urban South Africa. Am J Hum Biol. 2009;21(1):48–54.
34. Merrick MT, Ports KA, Ford DC, Afifi TO, Gershoff ET, Grogan-Kaylor A. Unpacking the impact of adverse childhood experiences on adult mental health. Child Abuse Negl. 2017;69:10–9.
35. Caron J, Fleury M-J, Perreault M, Crocker A, Tremblay J, Tousignant M, et al. Prevalence of psychological distress and mental disorders, and use of mental health services in the epidemiological catchment area of Montreal south-west. BMC Psychiatry. 2012;12(1):183.
36. Cluver L, Orkin M, Boyes ME, Sherr L. Child and adolescent suicide attempts, suicidal behavior, and adverse childhood experiences in South Africa: a prospective study. J Adolesc Health. 2015;57(1):52–9.
37. Raposa EB, Hammen CL, Brennan PA, O'callaghan F, Najman JM. Early adversity and health outcomes in young adulthood: the role of ongoing stress. Health Psychol. 2014;33(5):410.
38. Shonkoff JP, Richter L, van der Gaag J, Bhutta ZA. An integrated scientific framework for child survival and early childhood development. Pediatrics. 2012;129(2):e460–e72.
39. Shonkoff JP. Building a new biodevelopmental framework to guide the future of early childhood policy. Child Dev. 2010;81(1):357–67.
40. Nurius PS, Green S, Logan-Greene P, Longhi D, Song C. Stress pathways to health inequalities: embedding ACEs within social and behavioral contexts. Int J Public Health. 2016;8(2):241.
41. Hobfoll SE. The influence of culture, community, and the nested-self in the stress process: advancing conservation of resources theory. Appl Psychol. 2001;50(3):337–421.
42. Rohner RP, Khaleque A. Testing central postulates of parental acceptance-rejection theory (PARTheory): a meta-analysis of cross-cultural studies. J Fam Theory Rev. 2010;2(1):73–87.
43. Rohner RP, Khaleque A, Cournoyer DE. Parental acceptance-rejection: theory, methods, cross-cultural evidence, and implications. Ethos. 2005;33(3):299–334.
44. Khaleque A. Perceived parental warmth, and Children's psychological adjustment, and personality dispositions: a meta-analysis. J Child Fam Stud. 2013;22(2):297–306.
45. Sart ZH, Börkan B, Erkman F, Serbest S. Resilience as a mediator between parental acceptance–rejection and depressive symptoms among university students in Turkey. J Couns Dev. 2016;94(2):195–209.
46. Molina J, Andrade-Rosa C, González-Parra S, Blasco-Fontecilla H, Real M, Pintor C. The factor structure of the general health questionnaire (GHQ): a scaled version for general practice in Spain. Eur Psychiatry. 2006;21(7):478–86.
47. Cheong EV, Sinnott C, Dahly D, Kearney PM. Adverse childhood experiences (ACEs) and later-life depression: perceived social support as a potential protective factor. BMJ Open. 2017;7(9):e013228.
48. ARNEC. Asia Pacific Regional Network for Early Chldhood. ECD in the SDGs: Abriefing Note. Singapore: ARNEC; 2016. http://www.itacec.org/ece/document/learning_resources/2017/ECD-in-the-SDGs-20Mar2016_final-002.pdf. 18 Jan 2018.

Appendix 3: Mercy Manyema, Linda M Richter. Adverse childhood experiences: prevalence and associated factors among South African young adults. Heliyon.2019; 5:12, e03003

Heliyon 5 (2019) e03003

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Adverse childhood experiences: prevalence and associated factors among South African young adults

Mercy Manyema [a,b,*], Linda M. Richter [a]

[a] DST-NRF Centre of Excellence in Human Development, University of the Witwatersrand School of Public Health Building, Wits Education Campus, 7 York Road, Parktown, Johannesburg, South Africa

[b] MRC/Wits Developmental Pathways for Health Research Unit, Second Floor School of Public Health Building, University of the Witwatersrand (Education Campus), 7 York Road, Parktown, South Africa

ARTICLE INFO

Keywords:
Developmental biology
Epidemiology
Public health
Quality of life
Interrelated
Abuse
Clustering
Household dysfunction
ACE score
Adverse childhood experiences
Neglect
Adversity
Early childhood development

ABSTRACT

While adverse childhood experiences (ACEs), as described by the CDC-Kaiser Permanente Study, are reportedly common in both high and low-income settings, evidence on the epidemiology of ACEs in low-income settings is scarce. This study aimed to determine the prevalence of ACEs reported in young adulthood and assess their association with childhood maternal, household and community factors. We used data from the 22–23 year wave of the Birth to Twenty Plus (Bt20+) study in South Africa, the largest and longest running birth cohort in Africa. With ACEs as the main outcome measure, their association with childhood factors was assessed using regression models. As demonstrated in high-income settings, ACEs are highly prevalent in this young adult population in a middle income country. Both household and community socio-economic status in childhood was associated with the experience of ACEs and the likelihood of experiencing multiple ACEs. The attenuation of significance in adjusted models suggested that individual ACEs are correlated and may exert their effects through other ACEs. Interventions for the prevention of ACEs need to be directed not only at individuals but households as well as communities.

1. Introduction

Extensive research has been conducted globally on childhood abuse and maltreatment and their effect on health and well-being [1]. However, the concept of adverse childhood experiences (ACEs) as a set of specified exposures was first described in the seminal "CDC-Kaiser Permanente Adverse Childhood Experiences (ACE) Study" [2]. The ACE study described adverse experiences as "common, stressful and traumatic exposures affecting the (neuro) development of children" [3]. The ACE hypothesis posits that adverse or stressful childhood experiences such as abuse and neglect, or growing up in a dysfunctional household, create common vulnerability to social, emotional and cognitive impairments that lead to increased risk of poor health behavior, social adjustment and physical and mental illness [3]. ACEs are more than child maltreatment and the neglect of a child's needs, and incorporate household and environmental influences as well [1].

The first wave of the study conducted in 1995/1996 included seven adverse events in the definition of ACEs, namely sexual, physical and emotional abuse, and household dysfunction (household substance abuse, household mental illness, domestic violence and household member with a history of imprisonment) [2]. The second wave in 1997 updated the list to ten with the addition of emotional and physical neglect and parental divorce or separation [2, 3, 4]. The latter study also became the basis for expert recommendations to expand the definition of ACEs to include exposures experienced in high income as well as low to middle income countries (LMICs), including the domains of socio-economic status, peer to peer and community violence [5].

Adverse childhood experiences are common, in both high income and LMICs. In the ACE study, approximately 60% of the sample experienced at least one ACE and more than 10 percent experienced 5 or more ACEs [3]. A later survey in the USA also found a 60 percent prevalence of at least one ACE, and data from Wales showed a 47% prevalence [6, 7]. Eighty-five percent of a Brazilian adolescent cohort reported experiencing at least one ACE, with females experiencing more adverse events [8]. In Vietnam, 76% of a sample of university students reported experiencing at least one ACE [9]. Though not using the ACE definition stated

* Corresponding author.
E-mail address: mercy.manyema@gmail.com (M. Manyema).

https://doi.org/10.1016/j.heliyon.2019.e03003
Received 27 July 2018; Received in revised form 17 April 2019; Accepted 4 December 2019
2405-8440/© 2019 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

above, studies conducted in South Africa suggest high rates of individual exposures. For example, in a prospective survey of both rural and urban adolescents, 18.3% and 19.5% reported frequent physical and emotional abuse, respectively [10]. According to Jewkes et.al, 54.7% and 56.4% of rural South African women and men experienced emotional abuse respectively, 41.6% and 39.6%, respectively experienced emotional neglect and 39.1% and 16.7% experienced sexual abuse before the age of 18 [11].

ACEs have a cumulative impact on health and well-being [1]. In order to measure this more accurately, Felitti et al. proposed computing an ACE score, which is the sum of the defined exposures, measured dichotomously, ranging from 0-10 [2,4,12]. Strong dose-response relationships have been observed between the ACE score and adult health outcomes [13, 14, 15]. Higher ACE scores are not only associated with increased health risk behaviours and risk of disease and poor social adjustment, but also with increased odds of reporting multiple adverse outcomes [7, 16]. Examining the ACEs as a set of exposures and using the cumulative ACE score enables these relationships with health and wellbeing outcomes to be more precisely elucidated and quantified.

Scientific advances support the assertion that early life stress disrupts neurodevelopment, leaving lasting effects on brain structure and function [17]. Early life adversity can produce biological memories that weaken multiple developing body systems such as the stress response, cardiovascular and immune systems, and metabolic regulatory controls [18, 19]. Childhood maltreatment has been linked to reduced grey matter volumes in the hippocampus and the orbitofrontal cortex among other brain regions [20, 21]. These effects can last well into adulthood and have been linked to poor health and behavioral outcomes [18, 19].

Several child, household and community factors have been linked to childhood maltreatment and abuse. Girls are reported to have a higher risk of being sexually abused than boys, as well as experiencing greater adversity in general [8, 22]. Household factors such as HIV-related illness and poverty may increase the risk of child abuse [10]. In Brazil, being of non-White race, low family income, low maternal schooling, absence of mother's partner, maternal smoking, and poor maternal mental health significantly increased the risk of a higher ACE score [8]. Living in a poor neighborhood is associated with a higher number of ACEs and conversely, neighborhoods with large numbers of affluent families are associated with lower ACE scores [12]. Child maltreatment is usually concentrated in poorer neighborhoods and neighborhood structural factors, particularly economic markers, are consistently linked to abuse and neglect. Socio-economic context also potentially confounds the relationship between ACEs and outcomes in later life [12]. Children who have previously been maltreated are also at an increased risk of being maltreated again [23].

There is evidence from high-income countries on the prevalence of ACEs, as defined by the ACE study, but such research is scarce in LMICs. Partly due to the paucity of data, the study of child adversity has tended to focus on single exposures such as sexual or physical abuse, despite emerging evidence that ACEs co-occur and are interrelated [4, 14]. The objectives of this study are to determine the prevalence of ACEs, as defined in the ACE study, together with additional measures relevant to an LMIC, and to assess their association with childhood maternal, household and community factors in a long-term birth cohort study in South Africa.

2. Methods

2.1. Study design and context

A cross-sectional analysis of data from the Birth to Twenty Plus (Bt20+) study was conducted. Bt20+ is the longest running birth cohort in Africa, following up urban children and tracking their growth, health, well-being and educational progress [24]. Based in Soweto, Johannesburg, a densely populated suburb in the Greater Johannesburg Metropolitan area, the study began at the dawn of freedom from the *Apartheid* regime in South Africa, a time characterized by increased freedom of movement and rapid unplanned urbanization [24]. The *Apartheid* regime created a system of so-called race classification which legally differentiated between Whites of European origin, Indians (a collection of different people from the South East Asian region, mainly from India), Coloreds (people of mixed ancestry) and Black people (of African descent). Participation in society was differentiated in freedom and quality on a continuum from Whites to Indians to Coloreds to Black people. The terminology is retained because it carries the legacy of decades of oppression and discrimination, the effects of which are still evident [24]. Data for this study come from data collected when the cohort was aged between 22 and 23 years and measured, among other things, education and employment, general health, ACEs, as well as general life events.

2.2. Participants/study population

At the start, 3 273 singleton children born to women who resided in Soweto between April and June 1990 and resident in the area for at least six months post-partum were recruited into the study [24]. Of these, 1 636 participants were surveyed at 22–23 years of age.

2.3. Measures

The main outcome measure is adverse childhood experiences (ACEs). Demographic factors of the participants in young adulthood were collected to describe the sample. Additional measures included maternal, household and community factors measured between birth and 18 years. All questionnaires were administered face-to-face, bar the ACE questionnaire which was completed by the participant.

2.3.1. Demographic factors at 22 years

Demographic information included marital status, socio-economic status and graduation from high school. Marital status is a binary variable with the categories single/widowed/divorced and married or living together. The latter were collapsed together because cohabitation is common at that age in South Africa, with the median age at first marriage 30 and 34 years for females and males respectively between 2009 and 2013 [25,26]. Socio-economic status was measured using a sum of household assets and analyzed as a continuous variable. The young adults were asked whether they had graduated from secondary school or not, and this variable is also binary.

2.3.2. Adverse childhood experiences

ACEs were retrospectively measured at 22–23 years of age using a modified Adverse Childhood Experiences Study Questionnaire [4]. The questionnaire was self-administered. A total of thirteen ACEs were assessed in this study. Data on chronic illness, unemployment and parental death were also collected in addition to the ten ACEs [4] used in the ACE study based on recommendations to include some experiences that may be prevalent in low-income settings [5, 27, 28]. Five of the ACEs were the child's own experience of abuse or neglect and the remainder were household experiences namely witnessing domestic violence, parental divorce, parental death, substance abuse in the household, a household member being incarcerated and mental illness and other chronic illness of a household member and unemployment of a parent or caregiver. Table 1 in Supplementary Information shows the questions used to assess ACEs experienced. A point was allocated to each ACE exposure for which a participant answered yes to at least one of the questions, i.e. only one point could be allocated to each ACE.

ACEs were analyzed as single variables and as an ACE score which was computed by summing the number of ACEs to which each person was exposed. Several categorical variables were created based on the ACE score:

Table 1. Prevalence of ACEs and demographic factors of participants surveyed in the 22–23 year wave of the Bt20 + survey, Soweto, South Africa, n = 1636.

Variable	Male n (%)	Female n (%)	Total n (%)	Percent missing data (based on sample of 1636)	p-value (chi^2 and ANOVA)
Marital status					
Single	414 (55)	371 (45)	785 (50)		
Relationship	341 (45)	450 (55)	791 (50)	1.5	0.000
SES at 22 years	Median: 10 (Range 1–13)	Median: 10 (Range 1–13)		2.2	0.583
Completed secondary education					
No	356 (47)	263 (32)	619 (40)		
Yes	401 (53)	548 (68)	949 (60)	3.0	0.000
Any ACE[a]					
No	72 (12)	77 (12)	149 (12)		
Yes	520 (88)	549 (88)	1069 (88)	5.0	0.941
Cumulative ACEs_5[a]					
None	72 (12)	77 (12)	149 (12)		
1 ACE	106 (18)	135 (22)	241 (20)		
2 ACEs	106 (18)	108 (17)	214 (18)		
3 ACEs	93 (16)	91 (15)	184 (15)		
4 or more	215 (36)	215 (34)	430 (35)	23.0	0.600
Cumulative ACEs_3[a]					
None	72 (12)	77 (12)	149 (12)		
Low	434 (73)	452 (72)	886 (73)		
High	86 (15)	97 (16)	183 (15)	23.0	0.884
ACE score	Median: 3 (Range: 0–11)	Median: 3 (Range0-11)	Median: 3 (Range 0–11)	23.0	0.983
Emotional abuse					
No	519 (69)	572 (70)	1091 (70)		
Yes	232 (31)	240 (30)	472 (30)	1.7	0.566
Sexual abuse					
No	707 (97)	754 (95)	1461 (96)		
Yes	22 (3)	40 (5)	62 (4)	5.0	0.046
Physical abuse					
No	665 (91)	742 (93)	1407 (92)		
Yes	67 (9)	52 (7)	119 (8)	4.9	0.048
Emotional neglect					
No	555 (74)	562 (69)	1117 (71)		
Yes	198 (26)	252 (31)	450 (29)	1.4	0.041
Physical neglect					
No	648 (86)	734 (90)	1382 (88)		
Yes	103 (14)	78 (10)	181 (12)	1.7	0.011
Domestic violence					
No	657 (88)	700 (87)	1357 (87)		
Yes	93 (12)	108 (13)	201 (13)	2.0	0.570
Parental divorce/ separation					
No	357 (56)	369 (54)	726 (55)		
Yes	281 (44)	311 (46)	592 (45)	17.0	0.537
Parental death					
No	521 (69)	602 (74)	1123 (72)		
Yes	231 (31)	212 (26)	443 (28)	1.5	0.040
Substance abuse					
No	521 (69)	613 (75)	1134 (72)		
Yes	233 (31)	204 (25)	437 (28)	1.2	0.009
Mental illness					
No	674 (90)	707 (87)	1381 (88)		
Yes	79 (10)	110 (13)	189 (12)	1.3	0.071
Incarceration					
No	552 (73)	652 (80)	1204 (77)		
Yes	202 (27)	163 (20)	365 (23)	1.3	0.001
Chronic illness					
No	562 (75)	591 (73)	1153 (74)		
Yes	191 (25)	222 (27)	413 (26)	1.5	0.384
Unemployment					
No	409 (54)	479 (59)	888 (57)		
Yes	345 (46)	338 (41)	683 (43)	1.2	0.080

[a] Totals add up to 1218 due to cross-tabulation with gender: five of those with full ACE data had missing gender data.

1. Binary variables were created to indicate the proportion of participants who had experienced at least one, two, three, four, five or six ACEs in their lifetime.
2. A variable with five ACE score categories was created to indicate those who experienced no ACEs, one, two, three and four or more ACEs, to allow comparability with similar studies.

2.3.3. Child, maternal, household and community factors

These variables were collected between pregnancy and two years of age, at 16 years of age as well as at 18 years of age. Questionnaires were administered by trained research assistants to the caregivers or the participants themselves.

2.4. Participant's gender

The participant's gender was recorded at birth.

2.5. Mother's age at birth

The mother's age in years was collected during the antenatal visit.

2.6. Mother's education

Information on the mother's highest level of education was collected during the antenatal visit and updated during data collection in the first two years of the child's life. Education was divided into four categories: no formal education, Grades 1–7 (primary), Grades 8–12 (secondary) and post school training.

2.7. Mother's marital status

This variable was measured during the antenatal visit and updated during data collection in the first two years of the child's life, with two categories, namely single/divorced/widowed/separated and married/living together.

2.8. Father's presence

The presence of the participant's father in the household before the age of two was recorded and treated as a dichotomous variable in the analysis.

2.9. Socio-economic status

We assessed socio-economic status (SES) by creating a composite score based on responses to a questionnaire on assets in the household at

birth as well as at 16 years of age. Assets include, for example, a refrigerator, motor car, television etc. The total score was used to create a dichotomous variable denoting relatively lower and higher SES. A variable to determine change in SES between the two time-points was also created. In the absence of reliable income data in the Bt20 + Study, household assets have been demonstrated to be a stable proxy for income and purchasing power [29]. Household assets have been widely used to measure SES level and wealth. They are used to indicate the household's ability to endure emergencies and economic shocks and are a measure of cumulative wealth over time [30, 31, 32]. Unpublished work by the study team showed that the asset data, combined in several ways, remains stable [33]. At 18 years of age the participants were asked questions regarding the SES of their community. For this analysis we created a community SES variable from two of these questions: "How do you describe your neighborhood in terms of wealth?" and "Do you think people living outside of your neighborhood see your neighborhood as being: very poor, poor, average, wealthy or very wealthy?" The same response options were used for the first question as well. A dichotomous variable was created by summing the scores of the two questions and defining a score of five or less as lower community SES and a score above five as higher community SES. SES at 22 years was used as a continuous variable.

2.10. Statistical analysis

All analyses were carried out using STATA version 14.2 [34].

2.10.1. Descriptive statistics

The prevalence of each ACE exposure was determined and tabulated by gender, as well as demographic characteristics of the sample. The chi-square test and ANOVA were used to examine gender differences.

2.10.2. Association between childhood factors and ACEs

Univariate and multivariate logistic regression was used to test associations between childhood factors and ACEs: the binary ACE variable indicating the experience of any ACE, the cumulative ACE score index, and the individual ACEs. Variables significant at the 80% level in the univariate analysis were retained in the multivariate models.

2.11. Ethics

Ethics approval for the Bt20 + study was obtained from the Human Research Ethics Committee of the University of the Witwatersrand Clearance Certificate Number: M111182. Approval for this analysis was sought from the same: Clearance Number: M160921. All participants and/or their caregivers gave informed written consent for the data reported.

3. Results

3.1. Characteristics of the sample and prevalence of ACEs

Figure 1 presents the sample flowchart displaying the number of participants in the present analysis. Table 1 presents the descriptive statistics of the sample surveyed at 22 years of age. Forty-eight percent of the sample was male and 52% female. Sexual and physical abuse were the lowest reported ACEs (4% and 8% respectively), while unemployment of a parent or caregiver and parental divorce or separation had the highest prevalence at 43% and 45% respectively. The prevalence of the other two additional ACEs, parental death and chronic illness, were also among the highest reported, 28% and 26% respectively. Significant differences between males and females in education and marital status at 22 years of age were apparent. There were also significant differences between males and females in the experience of sexual abuse, emotional and physical neglect, parental death, household substance abuse, mental illness and legal trouble or incarceration of a household member.

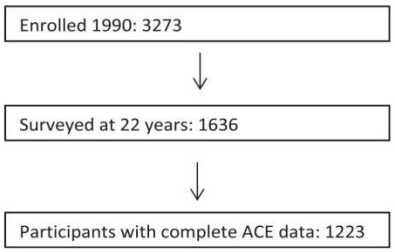


Figure 1. Bt20 + sample flow chart Flow diagram showing how the analytical sample was derived.

Of the 1636 participants who were surveyed at 22 years of age, 1223 had complete ACE data i.e. data on all the ACEs as reflected in the ACE score variables. Twelve percent of these (149) reported no ACEs and 1074 (88%) reported at least one ACE. The highest ACE score for this sample was 11 out of 13. Over one third of respondents reported experiencing four or more ACEs and 15% experienced 6 or more ACEs as indicated in Figure 2. Those who had full ACE data were used in the regression models.

3.2. Missing data

Included in Table 1 is a column illustrating the percentage of participants with missing data for each variable, based on the sample surveyed of 1636 participants. All the variables except for parental divorce had less than 10% missing values. Out of the 1223 young adults that had complete ACE data, one percent had missing marital status data, and approximately two percent had missing education and SES data. Table 2 in Supplementary Information displays how the demographic characteristics of participants who had full ACE data compared those that had incomplete ACE data. Having incomplete ACE data was correlated to marital status and secondary school completion. We also compared the childhood factors of those surveyed at 22 years old and those not surveyed (results not presented). A significant difference was noted in SES at sixteen and eighteen years of age, with those who were surveyed more likely to be of a higher SES level.

3.3. Maternal, household and community factors associated with experiencing single ACE exposures

We explored the association of childhood factors with single ACE exposure, and the adjusted regressions are presented in Tables 2 and 3. Higher SES, both in the household (at birth and at 16 years of age) and in the community were significantly negatively associated with several ACE exposures such as physical neglect, sexual and emotional abuse and drug abuse. Community SES remained significantly associated with sexual and emotional abuse as well as physical and emotional neglect, with those residing in higher SES communities having more than 50% fewer odds of experiencing these ACEs. Participants who had older mothers at birth were less likely to witness domestic violence and live with a chronically ill household member compared to those who had younger mothers.

3.4. Maternal, household and community factors associated with cumulative ACEs

The associations between childhood factors and cumulative ACEs are presented in Table 4. Only maternal marital status and SES at 16 years of age remained significantly associated with experiencing at least one ACE after adjusting for the other factors. The patterns of association and effect sizes were similar for the two ACE score indices. In adjusted analyses, higher household SES at 16 years of age and maternal marital status reduced the odds of ever experiencing ACEs as well as experiencing

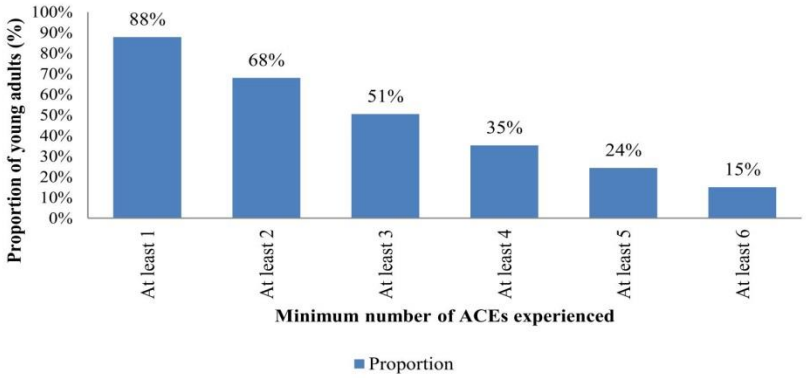


Figure 2. Proportion of young adults experiencing a minimum number of ACEs. The bar chart illustrates the proportion of the sample that reported a minimum of one up to six ACEs.

Table 2. Adjusted childhood factors associated with individual abuse and neglect ACEs in the Bt20 + Study, Soweto, South Africa, n = 1223.

Variable	Abuse: Adjusted OR (95% CI)			Neglect: Adjusted OR (95% CI)	
	Sexual	Emotional	Physical	Physical	Emotional
Gender					
Male	Ref	-	Ref	Ref	Ref
Female	1.67 (0.93–3.00)		0.70 (0.46–1.08)	**0.67 (0.45–0.99)**	1.18 (0.91–1.53)
Maternal age	-	-	-	-	-
Maternal education					
No formal education	Ref	-	-	-	-
Standard 1-5	0.17 (0.02–1.85)				
Standard 6-10	0.34 (0.04 (2.86)				
Post school training	0.80 (0.09–7.38)				
Maternal marital status					
Single/widowed	-	Ref	-	Ref	-
Married/living together		0.82 (0.62–1.09)		0.75 (0.48–1.18)	
SES at birth					
Low	Ref	Ref	Ref	Ref	-
High	1.42 (0.80–2.53)	0.87 (0.67–1.14)	0.79 (0.50–1.24)	0.67 (0.40–1.14)	
SES at 16 years					
Low	-	Ref	Ref	Ref	Ref
High		0.98 (0.73–1.31)	0.93 (0.57–1.51)	**0.55 (0.34–0.88)**	0.83 (0.62–1.12)
Change in SES (birth to 16 years)					
None	-	-	-	Ref	Ref
Increase				0.94 (0.55–1.61)	1.23 (0.89–1.70)
Decrease				1.73 (0.96–3.11)	1.18 (0.80–1.73)
Community SES at 18					
Low	Ref	Ref	Ref	Ref	Ref
High	**0.55 (0.31–0.98)**	**0.70 (0.53–0.93)**	0.81 (0.50–1.29)	**0.54 (0.36–0.81)**	**0.66 (0.50–0.88)**
Father home					
No	-	-	-	Ref	-
Yes				0.67 (0.41–1.09)	

Bold: $p < 0.05$; variables with no results were not entered into multivariate model for that outcome.

multiple ACE events. The effect of community SES and SES at birth remained protective but was insignificant after adjusting for the other ACEs.

4. Discussion

Our results show that ACEs measured using a modified Kaiser Permanente ACE Study questionnaire, are highly prevalent in a middle-income young adult urban population, with 88% reporting at least one ACE during childhood and 35% experiencing at least four. Using only the original 10 ACE Study exposures, the prevalence of any ACE was 77%, while 21% of the sample reported four or more ACEs. Maternal marital status and age, household and community SES were the most salient childhood factors associated with both single ACEs and the cumulative score. Most associations between childhood factors and single ACE exposures were attenuated by the addition of other factors in the models.

Table 3. Adjusted childhood factors associated with individual household dysfunction ACEs in the Bt20 + Study, Soweto, South Africa, n = 1223.

Variable	Household dysfunction Adjusted OR (95% CI)							
	Domestic violence	Parental divorce	Parental death	Substance abuse	Mental illness	Incarceration	Chronic illness	Unemployment
Gender								
Male	-	-	Ref	Ref	Ref	-	-	Ref
Female			0.79 (0.61–1.02)	**0.76 (0.59–0.99)**	**1.39 (1.00–1.92)**			**0.77 (0.61–0.98)**
Mother's age	**0.96 (0.93–0.99)**	0.98 (0.96–1.00)	-	-	-	0.99 (0.97–1.01)	**0.98 (0.95–0.99)**	0.98 (0.96–1.00)
Mother's education								
No formal education	-	-	Ref	-	-	-	-	-
Standard 1-5			1.53 (0.31–7.42)					
Standard 6-10			1.65 (0.35–7.75)					
Post school training			1.18 (0.23–6.02)					
Marital status								
Single/widowed	-	Ref	Ref	Ref	-	-	Ref	Ref
Married/living together		**0.69 (0.51–0.94)**	0.76 (0.57–1.02)	**1.33 (1.02–1.73)**			1.05 (0.77–1.44)	**0.72 (0.54–0.96)**
SES at birth								
Low	-	Ref	Ref	Ref	-	Ref	Ref	Ref
High		0.94 (0.72–1.23)	0.86 (0.66–1.12)	**0.68 (0.52–0.90)**		0.77 (0.58–1.03)	0.84 (0.65–1.09)	**0.71 (0.55–0.91)**
SES at 16 years								
Low	Ref	Ref	-	Ref	Ref		-	Ref
High	0.77 (0.54–1.10)	**0.63 (0.47–0.86)**		**0.74 (0.55–0.99)**	1.28 (0.88–1.86)	0.79 (0.58–1.07)		**0.51 (0.39–0.68)**
Change in SES (birth to 16 years)								
None								
Increase								
Decrease	-	-	-	-	-	-	-	-
Community SES at 18 years								
Low				Ref			Ref	
High	-	-	-	0.79 (0.59–1.05)	-	-	0.88 (0.66–1.18)	-
Father home								
No	Ref	Ref	Ref	-	-	-	Ref	Ref
Yes	1.50 (0.91–2.46)	**0.65 (0.44–0.98)**	**0.63 (0.45–0.88)**				0.98 (0.69–1.41)	0.93 (0.67–1.29)

Bold: $p < 0.05$; variables with no results were not entered into multivariate model for that outcom.

Table 4. Unadjusted and adjusted association of childhood factors with cumulative ACE score indices in the Bt20 + Study, Soweto, South Africa, n = 1223.

Variable	Experiencing at least one ACE		ACE score categories [5]	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)[a]	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Gender				
Male	Ref	-	Ref	-
Female	0.99 (0.70–1.39)		0.99 (0.70; 1.39)	
Mother's age	0.98 (0.96–1.01)	-	0.98 (0.96; 1.01)	-
Mother's education				
No formal education	Ref	-	Ref	-
Standard 1-5	0.60 (0.07–4.92)		0.60 (0.07; 4.92)	
Standard 6-10	0.61 (0.08–4.75)		0.61 (0.08; 4.75)	
Post school training	0.49 (0.06–4.09)		0.49 (0.06; 4.09)	
Maternal marital status				
Single/widowed	Ref	Ref	Ref	Ref
Married/living together	0.54 (0.38–0.76)***	0.64 (0.42–0.98)**	0.54 (0.38–0.76)***	0.64 (0.42–0.98)**
SES at birth				
Low	Ref	Ref	Ref	Ref
High	0.78 (0.53–1.14)*	0.87 (0.52–1.46)	0.78 (0.53–1.14)*	0.87 (0.53–1.46)
SES at 16 years				
Low	Ref	Ref	Ref	Ref
High	0.42 (0.27–0.64)***	0.51 (0.26–0.99)**	0.37 (0.22–0.63)***	0.51 (0.26–0.99)**
Change in SES (birth to 16 years)				
None	Ref	Ref	Ref	-
Decrease	1.00 (0.65–1.57)	1.00 (0.58–1.74)	1.00 (0.65; 1.57)	
Increase	1.48 (0.81–2.69)*	1.22 (0.63–2.35)	1.48 (0.81; 2.69)	
Community SES at 18 years				
Low	Ref	Ref	Ref	Ref
High	0.57 (0.36–0.89)**	0.60 (0.35–1.01)	0.58 (0.36–0.89)**	0.60 (0.35–1.01)
Father home				
No	Ref	Ref	Ref	Ref
Yes	0.48 (0.23–1.00)**	0.56 (0.25–1.27)	0.48 (0.23; 1.00)*	0.56 (0.25; 1.27)

*p ≤ 0.2; **p ≤ 0.05; ***p ≤ 0.001.
[a] Variables significant at 0.2 entered into the adjusted models.

4.1. Prevalence of ACEs

We report prevalence rates higher than those reported in high-income countries, both using the 10-item score and our modified 13-item score [7, 17]. The prevalence of sexual and physical abuse was, however, lower in this study compared to other studies, while most forms of household dysfunction were generally higher, including parental divorce/separation [6, 7, 17]. Differences in the reporting of abuse have been attributed to the type of sample included in the study: random versus purposive or convenience samples, or samples taken from at-risk populations versus general population samples [35]. The age of the victim when the abuse or maltreatment happened as well as the mode of questionnaire administration may also influence self-report rates [36]. A systematic review of literature covering both high income and middle income countries found prevalence rates of experiencing four or more ACEs ranging between one and thirty-two percent, with the highest prevalence being from a middle income country [37]. It seems that ACEs are more prevalent in poorer compared to richer countries, indicative of the urgency of preventing ACEs in these settings that face multiple public health burdens in the context of limited health and social resources.

Our three additional ACEs were fairly prevalent in this study group. These exposures should be taken into account when measuring ACEs in lower income communities. Independent of any association with health outcomes, they may be part of important pathways to illness. Markers of poverty have been linked to childhood sexual and psychological abuse and subsequently symptoms of depression among young South African men [38]. Further analysis with path analysis methods would be beneficial to determine what role these exposures play in the occurrence of ACEs and their link with poor outcomes.

Data on the prevalence of cumulative ACEs are essential for reducing inequality in LMICs. Adverse early life experiences create inequalities by compromising children's development and later health and wellbeing trajectories. These inequalities, which exist within or between populations, originate prenatally and can become more firmly entrenched due to exposure to cumulative adverse experiences [39]. With more than 250 million children below the age of five years in LMICs not reaching their full potential due to developmental risks, ACE prevention becomes a matter of social justice. Early integrated interventions are of critical importance to protect the next generation and are a potentially cost-effective way to prevent age-related disease in adulthood [19, 39].

4.2. Childhood factors

The association between community SES and abuse is an important finding in this generally low SES population. Research shows that both neighborhood disadvantage and affluence have an effect on the experience of ACEs: greater disadvantage increases the risk of high ACE scores while affluence reduces the risk [12]. Many studies have shown that neighborhood factors correlate with maltreatment rates, the most consistent associations being with indicators of the economic status or resources of the neighborhood [40]. Possible explanations that have been put forward for these findings are that the differences are due to exposure to concentrated levels of inequality and disability that are characteristic of poor neighborhoods together with characteristics of the youth living in

these areas [12]. Others have postulated that the link is through parental interaction with the environment, with parents who have positive perceptions of their neighborhood context less likely to maltreat their children because of the potential protective capacity of neighborhood supports [41].

Higher household SES was protective against experiencing any ACEs, as well as experiencing four or more ACEs, compared to no ACEs. These findings match those reported by Hatcher et.al with the interpretation that poverty is a key context for children experiencing abuse and maltreatment, and low SES may also compound deleterious effects of the abuse [38]. Household poverty has been reported as a mediator between child maltreatment and chronic illness [10]. Lower household SES may also increase parental stress and thus put children at risk of maltreatment [8]. The association of household SES during childhood with unemployment in the household as an ACE could possibly be an indication of the vicious cycle that can occur in poor households that have limited access to education and other means of improving their status. Interventions to prevent ACEs, therefore, also need to address access to education and socio-economic empowerment for households and communities. Our analysis did not find any significant associations between change in household SES and the experience of ACEs. However, adult household SES for people who have experienced ACEs has been found to mediate the relationships between ACEs and health outcomes [42], potentially creating an enabling environment for socio-economic change that may help to mitigate the effect of ACEs.

Family structure and the absence of the father in the home in childhood have a significant impact on the occurrence of ACEs. Our results show that single maternal marital status was significantly associated with children experiencing more ACEs compared to children whose mothers were married or had a live-in partner. Research on the effect of family structure on overall child well-being indicates that children from two-parent homes fare better, a relationship that is postulated to be mediated by economic resources, parental socialization, and lower family stress [43]. This effect may be due to selection factors in that marriage may not necessarily help to make people feel happy, healthy, secure but that such individuals, who are more likely to be stable parents, are more likely to marry in the first place [43]. In Canada maternal single marital status was also reported to be associated with allegations of child maltreatment [44]. Further evidence from Sub-Saharan Africa suggests independent associations between paternal orphaning and parental absence and children experiencing sexual violence, with girls being at higher risk of sexual abuse [45]. In South Africa, a study conducted in the Western Cape found that family satisfaction ranked lower among households with absent fathers, partly due to limited economic resources [46]. It is also possible that in the present study the divorce and separation captured in the ACEs retrospective report occurred before two years of age and hence the association between divorce/separation as an ACE and absent fathers. Further exploration is needed in this cohort on the role of family structure on the occurrence of ACEs.

4.3. Inter-relation and co-occurrence of ACEs

The attenuation of associations between childhood factors and some of the ACEs in the adjusted models points to possible interrelationships between the ACEs, with some ACEs potentially acting as mediators. For example, household poverty has been found to mediate the association between chronic illness in the household and child maltreatment [10].

The cumulative risk hypothesis posits that additive risk factors increase the probability of adverse outcomes [47, 48]. Use of the ACE score to capture the co-occurrence and cumulative impact of ACEs is coherent with this, as well as with evidence emerging from the neuroscientific field. Prolonged exposure to maltreatment early in life and attendant increases in stress hormones can influence the structural and functional plasticity of the brain, which in turn can affect patterns of emotional expression and regulation, stress reactivity, recovery, and coping, and perhaps even the rate of bodily aging [49]. The investigation of childhood maltreatment needs to go beyond examination of single abuse exposures to investigating the household environment as well. The presence of one ACE should elicit a search for others, taking into account that the apparent effects of one ACE may not necessarily be attributable to that ACE alone.

4.4. Strengths and limitations of study

To our knowledge this is the first study to investigate the prevalence of ACEs in an African country using an extended definition to that of the Kaiser Permanente ACE study [4]; as such, it adds to the still scant body of evidence from LMICs [37]. We were able to use longitudinally collected childhood factors to investigate their impact on the reporting of ACEs experienced during the first 18 years of life. These results add to the body of knowledge on the prevalence of ACEs in LMICs and contribute to disentangling the intricate connections between them. The availability of robust local data from a long-running cohort study also means the findings are immediately relevant to the context [50].

Limitations of this study were firstly, as was done in the CDC-Kaiser Permanent Study; the experience of ACEs was retrospectively measured and open to recall bias. Contemporary individual characteristics such as chronic stress may influence the recall of some events [28]. The participant may also have experienced adverse events very early in childhood that they may not recall. Secondly, due to the analysis being cross-sectional, temporality could not be stablished. There was no data available on the exact time of the experiences, how intense the abuse was and how long it lasted. Nonetheless, the use of an ACE score gives some indication of multiple, though not necessarily repeated or enduring, exposure. Some of the childhood factors may have changed between birth and 18 years of age and this was not accounted for. Face-to-face interviews for the demographic questionnaires may also have caused reporting bias, for example over-reporting of SES. The community SES variable was derived from questions that may be subjective, but no other measures of community wealth were available.

1636 participants from the original cohort were surveyed at 22 years of age, an attrition rate of 50%. In addition, only 1223 of those surveyed had complete ACE data and were used in the modelling analyses. Table 3 in Supplementary Information shows a comparison of demographic characteristics between participants surveyed at 22 with full ACE data and those surveyed but with missing ACE data. There were no differences in gender and SES. However those who were not surveyed were less likely to be married and to have completed secondary schooling. Attrition may introduce selection bias where the distribution of unmeasured confounders depends on whether the participants remained in the study or not, threatening the internal validity of the study. It may also compromise external validity and reduce the generalizability of results [51]. We do not claim that our results are generalizable to the entire population of South Africa. However, the cohort was large at the start in order to mitigate the effects of attrition on internal validity.

5. Conclusion

ACEs are highly prevalent in this cohort of young adults. SES is an important factor in the experience of ACEs. This finding is important because the impact of ACEs on behaviors, emotional and social well-being, and physical health has been shown to be cumulative [11, 13, 15, 22, 52]. Parents, households and communities need help and support to create and maintain environments that are conducive for healthy child and adolescent development. A multi-setting, multi-sector approach is needed to coordinate service provision in areas that seem unrelated, such as employment and income protection, community safety, drug and alcohol rehabilitation, treatment of mental illness and rehabilitation of ex-convicts, all of which have a major impact on the home environment and hence child development.

Declarations

Author contribution statement

Mercy Manyema: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

Linda Richter: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Competing interest statement

The authors declare no conflict of interest.

Funding statement

The Birth to Twenty Plus Study was funded by the SA Medical Research Council, the Wellcome Trust (UK), the Human Sciences Research Council and the University of the Witwatersrand, Johannesburg. MM and LMR are supported by the DST-NRF Centre of Excellence (CoE) in Human Development at the University of the Witwatersrand, Johannesburg, South Africa. None of the funders had a role in the design of the study and collection, analysis and interpretation of data, and in writing the manuscript. The support of the DST-NRF Centre of Excellence in Human Development at the University of the Witwatersrand, Johannesburg, South Africa towards this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the authors and are not to be attributed to the CoE in Human Development.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2019.e03003.

References

[1] K.A. Kalmakis, G.E. Chandler, Adverse childhood experiences: towards a clear conceptual meaning, J. Adv. Nurs. 70 (7) (2014) 1489–1501.
[2] V.J. Felitti, R.F. Anda, D. Nordenberg, D.F. Williamson, A.M. Spitz, V. Edwards, et al., Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults: the Adverse Childhood Experiences (ACE) Study, Am. J. Prev. Med. 14 (4) (1998) 245–258.
[3] The health and social impact of growing up with adverse childhood experiences: the human and economic costs of the status quo, in: R. Anda (Ed.), Conference in Anacortes, WA on June, 2007.
[4] M. Dong, R.F. Anda, V.J. Felitti, S.R. Dube, D.F. Williamson, T.J. Thompson, et al., The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction, Child Abuse Neglect 28 (7) (2004) 771–784.
[5] R.F. Anda, A. Butchart, V.J. Felitti, D.W. Brown, Building a framework for global surveillance of the public health implications of adverse childhood experiences, Am. J. Prev. Med. 39 (1) (2010) 93–98.
[6] Centers for Disease Control and Prevention, Adverse Childhood Experiences Reported by Adults — Five States, Centers for Disease Control and Prevention, Atlanta, GA, USA, 2009, 2010 December 2010. Report No.
[7] M.A. Bellis, Kathryn Ashton, Karen Hughes, Katharine Ford, Julie Bishop, Shantini Paranjothy, Adverse Childhood Experiences and Their Impact on Health-Harming Behaviours in the Welsh Adult Population, Public Health Wales Centre for Public Health, Liverpool John Moores University, Wales, 2015.
[8] A.L.G. Soares, L.D. Howe, A. Matijasevich, F.C. Wehrmeister, A.M. Menezes, H. Gonçalves, Adverse childhood experiences: prevalence and related factors in adolescents of a Brazilian birth cohort, Child Abuse Neglect 51 (2016) 21–30.
[9] Q.A. Tran, M.P. Dunne, T.V. Vo, N.H. Luu, Adverse childhood experiences and the health of university students in eight provinces of Vietnam, Asia Pac. J. Public Health 27 (8_suppl) (2015) 26S–32S.
[10] F. Meinck, L.D. Cluver, M.E. Boyes, Household illness, poverty and physical and emotional child abuse victimisation: findings from South Africa's first prospective cohort study, BMC Public Health 15 (1) (2015) 444.
[11] R.K. Jewkes, K. Dunkle, M. Nduna, P.N. Jama, A. Puren, Associations between childhood adversity and depression, substance abuse and HIV and HSV2 incident infections in rural South African youth, Child Abuse Negl. 34 (11) (2010) 833–841.
[12] M.T. Baglivio, K.T. Wolff, N. Epps, R. Nelson, Predicting adverse childhood experiences: the importance of neighborhood context in youth trauma among delinquent youth, Crime Delinq. 63 (2) (2017) 166–188.
[13] M.A. Bellis, K. Hughes, N. Leckenby, K. Hardcastle, C. Perkins, H. Lowey, Measuring mortality and the burden of adult disease associated with adverse childhood experiences in England: a national survey, J. Public Health 37 (3) (2014) 445–454.
[14] S.R. Dube, V.J. Felitti, M. Dong, W.H. Giles, R.F. Anda, The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900, Prev. Med. 37 (3) (2003) 268–277.
[15] L. Cluver, M. Orkin, M.E. Boyes, L. Sherr, Child and adolescent suicide attempts, suicidal behavior, and adverse childhood experiences in South Africa: a prospective study, J. Adolesc. Health 57 (1) (2015) 52–59.
[16] Helen Gonçalves, A.L.G. Soares, APGd Santos, C.G. Ribeiro, I.O. Bierhals, L.S. Vieira, et al., Adverse childhood experiences and consumption of alcohol, tobacco and illicit drugs among adolescents of a Brazilian birth cohort, Cadernos de Saúde Pública [online] 32 (10) (2016).
[17] R.F. Anda, V.J. Felitti, J.D. Bremner, J.D. Walker, C. Whitfield, B.D. Perry, et al., The enduring effects of abuse and related adverse experiences in childhood, Eur. Arch. Psychiatry Clin. Neurosci. 256 (3) (2006) 174–186.
[18] J.P. Shonkoff, A.S. Garner, B.S. Siegel, M.I. Dobbins, M.F. Earls, A.S. Garner, et al., The lifelong effects of early childhood adversity and toxic stress, Pediatrics 129 (1) (2012) e232.
[19] A. Danese, T.E. Moffitt, H. Harrington, B.J. Milne, G. Polanczyk, C.M. Pariante, et al., Adverse childhood experiences and adult risk factors for age-related disease: depression, inflammation, and clustering of metabolic risk markers, Arch. Pediatr. Adolesc. Med. 163 (12) (2009) 1135–1143.
[20] U. Dannlowski, A. Stuhrmann, V. Beutelmann, P. Zwanzger, T. Lenzen, D. Grotegerd, et al., Limbic scars: long-term consequences of childhood maltreatment revealed by functional and structural magnetic resonance imaging, Biol. Psychiatry 71 (4) (2012 Feb 15) 286–293. PubMed PMID: 22112927. Epub 2011/11/25. eng.
[21] M.H. Teicher, C.M. Anderson, A. Polcari, Childhood maltreatment is associated with reduced volume in the hippocampal subfields CA3, dentate gyrus, and subiculum, Proc. Natl. Acad. Sci. U. S. A 109 (9) (2012) E563–E572. PubMed PMID: 22331913. Epub 02/13. eng.
[22] R. Gilbert, C.S. Widom, K. Browne, D. Fergusson, E. Webb, S. Janson, Burden and consequences of child maltreatment in high-income countries, The Lancet 373 (9657) (2009) 68–81.
[23] N. Hindley, P.G. Ramchandani, D.P.H. Jones, Risk factors for recurrence of maltreatment: a systematic review, Arch. Dis. Child. 91 (9) (2006 07/13 05/24/ accepted) 744–752. PubMed PMID: PMC2082913.
[24] L. Richter, S. Norris, J. Pettifor, D. Yach, N. Cameron, Cohort Profile: mandela's children: the 1990 birth to twenty study in South Africa, Int. J. Epidemiol. 36 (3) (2007 June 1) 504–511, 2007.
[25] S. SA, Marriages and Divorces, Statistics South Africa, Pretoria, South Africa, 2013.
[26] A. Senekal, Domestic Partnerships, Greeff Attorneys, Tyger Valley, 2017 [cited 2019 4 March]. Available from: https://greeffattorneys.co.za/2017/07/26/domestic-partnerships/.
[27] D. Finkelhor, A. Shattuck, H. Turner, S. Hamby, A revised inventory of adverse childhood experiences, Child Abuse Neglect 48 (2015) 13–21.
[28] P.F. Cronholm, C.M. Forke, R. Wade, M.H. Bair-Merritt, M. Davis, M. Harkins-Schwarz, et al., Adverse childhood experiences: expanding the concept of adversity, Am. J. Prev. Med. 49 (3) (2015) 354–361.
[29] P.L. Griffiths, E.K. Rousham, S.A. Norris, J.M. Pettifor, N. Cameron, Socio-economic status and body composition outcomes in urban South African children, Arch. Dis. Child. 93 (10) (2008) 862–867.
[30] A. Basto-Abreu, T. Barrientos-Gutiérrez, R. Zepeda-Tello, V. Camacho, D. Gimeno Ruiz de Porras, M. Hernández-Ávila, The relationship of socioeconomic status with body mass index depends on the socioeconomic measure used, Obesity 26 (1) (2018) 176–184.
[31] B. Galobardes, M. Shaw, D.A. Lawlor, J.W. Lynch, G. Davey Smith, Indicators of socioeconomic position (part 1), J. Epidemiol. Community Health 60 (1) (2006 Jan) 7–12. PubMed PMID: 16361448. Pubmed Central PMCID: PMC2465546. Epub 2005/12/20. eng.
[32] K.M. Saif-Ur-Rahman, I. Anwar, M. Hasan, S. Hossain, S. Shafique, F. Haseen, et al., Use of indices to measure socio-economic status (SES) in South-Asian urban health studies: a scoping review, Syst. Rev. 7 (1) (2018) 196. PubMed PMID: 30447696. eng.
[33] C. Desmond, Measuring Socio-Economic Status in the Birth to Twenty Cohort, 2010.
[34] L.P. StataCorp, Stata Statistics/Data Analysis, 2014. College Station, USA.
[35] M. Stoltenborgh, M.H. Van Ijzendoorn, E.M. Euser, M.J. Bakermans-Kranenburg, A global perspective on child sexual abuse: meta-analysis of prevalence around the world, Child. Maltreat. 16 (2) (2011) 79–101.
[36] B.L. Bottoms, L.C. Peter-Hagene, M.A. Epstein, T.R. Wiley, C.E. Reynolds, A.G. Rudnicki, Abuse characteristics and individual differences related to disclosing childhood sexual, physical, and emotional abuse and witnessed domestic violence, J. Interpers Violence 31 (7) (2016) 1308–1339.
[37] K. Hughes, M.A. Bellis, K.A. Hardcastle, D. Sethi, A. Butchart, C. Mikton, et al., The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis, The Lancet Public Health 2 (8) (2017) e356–e366.
[38] A.M. Hatcher, A. Gibbs, R. Jewkes, R.-S. McBride, D. Peacock, N. Christofides, Effect of childhood poverty and trauma on adult depressive symptoms among young men in peri-urban South African settlements, J. Adolesc. Health 64 (1) (2019) 79–85.
[39] S.P. Walker, T.D. Wachs, S. Grantham-McGregor, M.M. Black, C.A. Nelson, S.L. Huffman, et al., Inequality in early childhood: risk and protective factors for early child development, Lancet 378 (9799) (2011) 1325–1338.
[40] C.J. Coulton, D.S. Crampton, M. Irwin, J.C. Spilsbury, J.E. Korbin, How neighborhoods influence child maltreatment: a review of the literature and alternative pathways, Child Abuse Neglect 31 (11–12) (2007) 1117–1142.

[41] B. Kim, K. Maguire-Jack, Community interaction and child maltreatment, Child Abuse Neglect 41 (2015) 146–157.
[42] S.A. Font, K. Maguire-Jack, Pathways from childhood abuse and other adversities to adult health risks: the role of adult socioeconomic conditions, Child Abuse Neglect 51 (2016) 390–399.
[43] S.L. Brown, Marriage and child well-being: research and policy perspectives, J. Marriage Fam. 72 (5) (2010) 1059–1077.
[44] J.W. Parrish, M.B. Young, K.A. Perham-Hester, B.D. Gessner, Identifying risk factors for child maltreatment in Alaska, Am. J. Prev. Med. 40 (6) (2011) 666–673, 2011/06/01/.
[45] R. Kidman, T. Palermo, The relationship between parental presence and child sexual violence: evidence from thirteen countries in sub-Saharan Africa, Child Abuse Neglect 51 (2016) 172–180.
[46] N.V. Roman, S.A. Isaacs, C. Davids, X.-C. Sui, How well are families doing? A description of family well-being in South Africa, Family Medicine and Community Health 4 (3) (2016) 9–18.
[47] M.J. Chartier, J.R. Walker, B. Naimark, Separate and cumulative effects of adverse childhood experiences in predicting adult health and health care utilization, Child Abuse Neglect 34 (6) (2010) 454–464.
[48] A.J. Sameroff, Developmental systems and psychopathology, Dev. Psychopathol. 12 (3) (2000) 297–312. Epub 09/01.
[49] B.S. McEwen, P.J. Gianaros, Central role of the brain in stress and adaptation: links to socioeconomic status, health, and disease, Ann. N. Y. Acad. Sci. 1186 (1) (2010) 190–222.
[50] The Lancet, Adversity in childhood: how the past defines the future, The Lancet 388 (10058) (2016) 2324.
[51] V.L. Kristman, M. Manno, P. Cote, Methods to account for attrition in longitudinal data: do they work? A simulation study, Eur. J. Epidemiol. 20 (8) (2005) 657–662. PubMed PMID: 16151878. Epub 2005/09/10. eng.
[52] E. Crouch, M. Strompolis, K.J. Bennett, M. Morse, E. Radcliff, Assessing the interrelatedness of multiple types of adverse childhood experiences and odds for poor health in South Carolina adults, Child Abuse Neglect 65 (2017) 204–211.

Appendix 4: Declaration of Student's contribution to article and agreement of co-authors

21

I, **Mercy Manyema**, student number **469168**, declare that this Thesis is my own work and that I contributed adequately towards research findings published in the article stated below which is included in my Thesis.

Signature of Student ..... **Date** 22/01/2020

Name of Primary Supervisor.....Linda M Richter.....

Signature of Primary Supervisor ..... **Date** 21 January 2020

Agrrement by co-authors: By signing this declaration, the co-authors listed below agree to the use of the article by the student as part of her Thesis. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitled to use the paper for her degree purposes.

Article 1: Title: The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa
Journal name, year, volume and page numbers: Health and Place, 2018:51(97-106)

Authors	Name	Signature	Date
1st author	Mercy Manyema		22/01/2020
2nd author	Shane A Norris		
3rd author	Rihlat Said-Mohamed		
4th author	Steven T Tollman		
5th author	Rhian Twine		
6th author	Kathleen Kahn		
7th author	Linda M Richter		21 Jan 2020

Comments by primary supervisor: I agree to the use of the article by the student as part of her Thesis.

Declaration: Student's contribution to article(s) and agreement of co-author(s)

I, **Mercy Manyema**, student number **469168**, declare that this Thesis is my own work and that I contributed adequately towards research findings published in the article stated below which is included in my Thesis.

Signature of Student ..... **Date** 22/01/2020

Name of Primary Supervisor.....Linda M Richter.....

Signature of Primary Supervisor .....**Date**.....

Agreement by co-authors: By signing this declaration, the co-authors listed below agree to the use of the article by the student as part of her Thesis. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitled to use the paper for her degree purposes.

Article 1: Title: The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa
Journal name, year, volume and page numbers: Health and Place, 2018:51(97-106)

Authors	Name	Signature	Date
1st author	Mercy Manyema		22/01/2020
2nd author	Shane A Norris		21/01/2020
3rd author	Rihlat Said-Mohamed		
4th author	Stephen Tollman		21/01/2020
5th author	Rhian Twine		
6th author	Kathleen Kahn		21/01/2020
7th author	Linda M Richter		

Comments by primary supervisor:

.....

.....

Declaration: Student's contribution to article(s) and agreement of co-author(s)

I, **Mercy Manyema**, student number **469168**, declare that this Thesis is my own work and that I contributed adequately towards research findings published in the article stated below which is included in my Thesis.

Signature of Student ..... **Date** 22/01/2020

Name of Primary Supervisor.....Linda M Richter.....

Signature of Primary Supervisor .....**Date**.....

Agreement by co-authors: By signing this declaration, the co-authors listed below agree to the use of the article by the student as part of her Thesis. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitled to use the paper for her degree purposes.

Article 1: Title: The associations between interpersonal violence and psychological distress among rural and urban young women in South Africa
Journal name, year, volume and page numbers: Health and Place, 2018:51(97-106)

Authors	Name	Signature	Date
1st author	Mercy Manyema		22/01/2020
2nd author	Shane A Norris		
3rd author	Rihlat Said-Mohamed		21/01/2020
4th author	Steven T Tollman		
5th author	Rhian Twine	Rhian	22/01/2020
6th author	Kathleen Kahn		
7th author	Linda M Richter		

Comments by primary supervisor:

.....

.....

Appendix 5: Original ACE Questionnaire

While you were growing up, during your first 18 years of life:

1. Did a parent or other adult in the household **often** …

Swear at you, insult you, put you down, or humiliate you?

or

Act in a way that made you afraid that you might be physically hurt?

Yes No If yes enter 1 _____

2. Did a parent or other adult in the household **often** …

Push, grab, slap, or throw something at you?

or

Ever hit you so hard that you had marks or were injured?

Yes No If yes enter 1 _____

3. Did an adult or person at least 5 years older than you **ever**…

Touch or fondle you or have you touch their body in a sexual way?

or

Try to or actually have oral, anal, or vaginal sex with you?

Yes No If yes enter 1 _____

4. Did you **often** feel that …

No one in your family loved you or thought you were important or special?

or

Your family didn't look out for each other, feel close to each other, or support each other?

Yes No If yes enter 1 _____

5. Did you **often** feel that …

You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you?

or

Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?

Yes No If yes enter 1 _____

6. Were your parents **ever** separated or divorced?

Yes No If yes enter 1 _____

7. Was your mother or stepmother:

Often pushed, grabbed, slapped, or had something thrown at her?

or

Sometimes or often kicked, bitten, hit with a fist, or hit with something hard?

or

Ever repeatedly hit over at least a few minutes or threatened with a gun or knife?

Yes No If yes enter 1 _____

8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?

Yes No If yes enter 1 _____

9. Was a household member depressed or mentally ill or did a household member attempt suicide?

Yes No If yes enter 1 _____

10. Did a household member go to prison?

Yes No If yes enter 1 _____

Now add up your "Yes" answers: _____ This is your ACE Score

Appendix 6: Modified ACE Questionnaire

These questions refer to when you were growing up (before 18 years of age).

ACE	Question	Yes	No
Physical abuse	Did a parent or other adult in the household **often or very often**… Push, grab, slap, or throw something at you? **OR** **Ever** hit you so hard that you had marks or were injured?		
Sexual abuse	Did an adult or person at least 5 years older than you **ever**… Touch or fondle you or have you touch their body in a sexual way? **OR** Attempt or actually have oral, anal, or vaginal intercourse with you?		
Emotional abuse	Did a parent or other adult in the household **often or very often**… Swear at you, insult you, put you down, or humiliate you? **OR** Act in a way that made you afraid that you might be physically hurt?		
Emotional neglect	Did you **often or very often** feel that … No one in your family loved you or thought you were important or special? **OR** Your family didn't look out for each other, feel close to each other, or support each other?		
Physical neglect	Did you **often or very often** feel that … You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you? **OR** Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?		
Parental divorce	Were your parents **ever** separated or divorced?		

	(If the young adult's parents' were never together, please write "NOT APPLICABLE")
Witnessing domestic violence	Was your mother or stepmother: **Often or very often** pushed, grabbed, slapped, or had something thrown at her? **OR** **Sometimes, often, or very often** kicked, bitten, hit with a fist, or hit with something hard? **OR** **Ever** repeatedly hit at least a few minutes or threatened with a gun or knife?
Alcohol and/or drug abuse in the household	Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?
Mental illness in the household	Was a household member depressed or mentally ill, or did a household member attempt suicide?
Legal trouble in the household	Did a household member go to prison?
Chronic illness (other than mental illness) in the household	Was there anyone in your household who was chronically ill when you were a child?
Unemployment of parent/caregiver	Was one or more of your parents/caregivers mostly unemployed during your childhood because they could not get a job?
Death of parent/caregiver	Did either of your parents/caregivers pass away before you turned 18?

Appendix 7: Birth To Twenty Plus Young Adult Survey Core Questionnaire

University of the Witwatersrand, Johannesburg

Developmental Pathways for Health Research Unit

Department of Paediatrics and Child Health

BIRTH TO TWENTY PLUS YAS CORE QUESTIONNAIRE

DATE: **Day** **Month** **Year**

BTT ID NUMBER:

Contact details of a relative or a friend who will **always** know where you live (different to information on contact sheet):

Name: _____ Relationship: _____

Landline number: _____ Cell number: _____

Work number: _____ Other: _____

Address: _____

PARTICIPATION IN BIRTH TO TWENTY PLUS CONSENT

I agree to myself being a participant in Birth to Twenty Plus study

The goals and methods of the study are clear to me.

I understand that the study will involve interviews. All the details and purposes of this study have been explained to me. I understand that I have the right to refuse to participate in the study.

I agree to participation in Birth to Twenty Plus study on condition that:

1. I can withdraw from the study at any time voluntarily and that no adverse consequences will follow on withdrawal from the study.

2. I have the right not to answer any or all questions posed in the interviews and not to participate in any or all of the procedures / assessments.

3. The University of the Witwatersrand Human Ethics committee has approved the study protocol and procedures.

4. All results will be treated with the strictest confidentiality.

5. Only group results, and not my individual results, will be published in scientific journals and in the media.

6. The study scientific team are committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.

7. I will receive a referral note to a health service if any result is out of the normal range or a problem is detected in the course of the study.

PARTICIPANT:

Printed Name	**Signature / Mark or Thumbprint**	**Date and Time**

RESEARCH ASSISTANT:

Printed Name	**Signature**	**Date and Time**

SURVEY CONSENT

I agree to myself being a participant in the study

The goals and methods of the study are clear to me.

I understand that the study will involve interviews. All the details and purposes of this study have been explained to me. I understand that I have the right to refuse to participate in the study.

I agree to participation in the study on the condition that:

1. I can withdraw from the study at any time voluntarily and that no adverse consequences will follow on withdrawal from the study.

2. I have the right not to answer any or all questions posed in the interviews and not to participate in any or all of the procedures / assessments.

3. The University of the Witwatersrand Human Ethics committee has approved the study protocol and procedures.

4. All results will be treated with the strictest confidentiality.

5. Only group results, and not my individual results, will be published in scientific journals and in the media.

6. The study scientific team are committed to treating participants with respect and privacy through interviews conducted in private and follow-up counselling available on request.

7. I will receive a referral note to a health service if any result is out of the normal range or a problem is detected in the course of the study.

PARTICIPANT

Printed Name	**Signature / Mark or Thumbprint**	**Date and Time**

RESEARCH ASSISTANT:

Printed Name	**Signature**	**Date and Time**

SECTION 1: Education, Employment and Job Search

Education

The first few questions ask about your experiences with schooling and education.

1. Have you successfully completed grade 12 (passed matric, obtained matric certificate?

Yes (Skip to Q4)	No

2. If no, what is your highest grade successfully completed? (tick one)

Grade 5 or lower	Grade 6	Grade 7	Grade 8	Grade 9	Grade 10	Grade 11

3. Are you **currently** doing any studies, or registered with any educational institution (including training through employment or correspondence)?

Yes, full time (Skip to Q6)	Yes, part time (Skip to Q6)	No

4. If no, please tell us the main reason that you are not **currently** registered? (**Do NOT read out options;** tick **one** only)

Reason	**Tick one**	**Code**
Financial constraints		1
Family responsibilities (i.e. Pregnant or Looking after children/family/relatives)		2
Completed educational goals		3
Employed		4
Taking a planned break from my studies		5
Results not good enough		6

Other (specify)		7

Occupation/ Employment/ Income

1. Have you **ever** had a job? By job we mean any work done to earn money or to gain skills. This includes casual/informal work & volunteer work.

Yes	No (Skip to Q3)

2. Do you currently have a job? By job we mean any work done to earn money or to gain skills. This includes casual/informal work & volunteer work.

Yes (Skip to Q5)	No

3. Are you currently looking for a job?

Yes (Skip to Q5)	No

4. If no, what is the main reason? (tick **one**)

Reason	**Tick one**	**Code**
I am at school / studying		1
I am too busy or don't have time		2
Family responsibilities (i.e. Pregnant or Looking after children/family/relatives)		3
I don't need money		4
I am not skilled or experienced enough/ my level of education is not high enough		5
It's too expensive to look		6
I am sick / disabled		7

Other (specify)		8

Yes	**No**

5. Have you been unemployed and seeking work for a month or more during the past 6 months?

6. Have you had any job during the past 6 months?

Yes	No

1. What is your current marital status? (tick one)

Marital Status	**Tick one**	**Code**
Single		1
Not married and not living together but in a committed relationship/partnership		2
Not married but living together		3
Married (including traditional or customary)		4
Divorced or separated		5
Widow/widower		6

6. How would you describe your access to the following facilities?

(Please tick only the box for the best available access for each facility)

Water Facility	**Tick One**	**Code**
Indoor water (sole use for your household only)		1
Indoor water (shared between multiple households)		2
Outdoor water (sole use for your household only)		3
Outdoor water (shared between multiple households)		4

Toilet Facility	**Tick One**	**Code**
Indoor toilet (sole use for your household only)		1
Indoor toilet (shared between multiple households)		2
Outdoor toilet (sole use for your household only)		3
Outdoor toilet (shared between multiple households)		4

7. Which of the following do you have in your current home (place where you spent most nights in the past three months)? It does not matter who owns/pays for these things. (answer all questions)

	Item	**In current home**	
		Yes	**No**

a.	Electricity		
b.	Motor vehicle		
c.	Fridge		
d.	Microwave		
e.	Washing machine		
f.	Landline telephone		
g.	Cell phone		
h.	Television		
i.	Radio		
j.	Video machine/DVD player		
k.	MNet/DSTV/Satellite		
l.	Computer/laptop		
m.	Internet access		

SECTION 2: Life Events

A. General Events

Please tick all appropriate events that have happened to you within the <u>past 6 months</u>

a. During the last 6 months, has any household member (including you) been injured as a result of violence in the areas where you live or work?

Yes=1	No=0

b. During the last 6 months, has any household member (including you) been a victim of a violent crime (e.g. murder, robbery, mugging, assault, rape)?

Yes=1	No=0

c. During the last 6 months, did you witness a violent crime (e.g. murder, robbery, mugging, assault, rape)?

Yes=1	No=0

d. During the last 6 months, have you or anyone in your close family been seriously ill?

Yes=1	No=0

e. During the last 6 months, did any member of your close family pass away?

Yes=1	No=0

f. Is there anyone in your close family (including you) with a serious disability (for example, epilepsy, mental retardation, deafness, blindness, mental illness)?

Yes=1	No=0

g. Is there anyone in your close family (including you) that has a problem with drugs or alcohol?

Yes=1	No=0

h. During the last 6 months, have you had any serious fight or alienation from members of your family or your close neighbours?

Yes=1	No=0

i. During the last 6 months, have you or any member of your close family been arrested, had to go to court, or consulted a lawyer on a non-routine matter?

Yes=1	No=0

B General Health

I am now going to ask you the General Health Questionnaire (GHQ 28)

We would like to know if you have had any medical complaints and how your health has been in general, over the past few weeks. Please answer ALL the questions on the following pages simply by ticking the answer which you think most nearly applies to you. Remember that we want to know about present and recent complaints, not those that you had in the past.

Have you recently,

A1	Been feeling perfectly well and in good health?	Better than usual	Same as usual	Worse than usual	Much worse than usual

A2	Been feeling in need of a good tonic?	Not at all	No more than usual	Rather more than usual	Much more than usual
A3	Been feeling run down and out of sorts?	Not at all	No more than usual	Rather more than usual	Much more than usual
A4	Felt that you are ill?	Not at all	No more than usual	Rather more than usual	Much more than usual
A5	Been getting any pains in your head?	Not at all	No more than usual	Rather more than usual	Much more than usual
A6	Been getting a feeling of tightness or pressure in your head?	Not at all	No more than usual	Rather more than usual	Much more than usual
A7	Been having hot or cold spells?	Not at all	No more than usual	Rather more than usual	Much more than usual

Have you recently,

B1	Lost much sleep over worry?	Not at all	No more than usual	Rather more than usual	Much more than usual
B2	Had difficulty in staying asleep once you fall off "to sleep"?	Not at all	No more than usual	Rather more than usual	Much more than usual
B3	Felt constantly under strain?	Not at all	No more than usual	Rather more than usual	Much more than usual
B4	Been getting edgy and bad tempered?	Not at all	No more than usual	Rather more than usual	Much more than usual
B5	Been getting scared or panicky for no good reason?	Not at all	No more than usual	Rather more than usual	Much more than usual
B6	Found everything getting on top of you?	Not at all	No more than usual	Rather more than usual	Much more than usual
B7	Been feeling nervous and strung-out all the time?	Not at all	No more than usual	Rather more than usual	Much more than usual

Have you recently,

C1	Been managing to keep yourself busy and occupied?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C2	Been taking longer to do the things you do?	Quicker than usual	Same as usual	Longer than usual	Much longer than usual
C3	Felt on the whole you were doing things well?	Better than usual	About the same as usual	Less well than usual	Much less well than usual
C4	Been satisfied with the way you've carried out your tasks?	More satisfied than usual	About the same as usual	Less satisfied than usual	Much less than usual
C5	Felt that you are playing a useful part in things?	More so than usual	Same as usual	Less so than usual	Much less than usual
C6	Felt capable of making decisions about things?	More so than usual	Same as usual	Rather less than usual	Much less than usual
C7	Been able to enjoy your normal day-to-day activities?	More so than usual	Same as usual	Rather less than usual	Much less than usual

Have you recently,

D1	Been thinking of yourself as a worthless person?	Not at all	No more than usual	Rather more than usual	Much more than usual
D2	Felt that life is entirely hopeless?	Not at all	No more than usual	Rather more than usual	Much more than usual
D3	Felt that life isn't worth living?	Not at all	No more than usual	Rather more than usual	Much more than usual

D4	Thought of the possibility that you might "make away" with yourself?	Definitely not	I don't think so	Has crossed my mind	Definitely have
D5	Found at times you couldn't do anything because your nerves were too bad?	Not at all	No more than usual	Rather more than usual	Much more than usual
D6	Found yourself wishing you were dead and away from it all?	Not at all	No more than usual	Rather more than usual	Much more than usual
D7	Found that the idea of taking your own life kept coming into your mind?	Definitely not	I don't think so	Has crossed my mind	Definitely have

SECTION 3: MEASUREMENTS

ANTHROPOMETRY

- STANDING HEIGHT: (mm)
- SITTING HEIGHT: (mm)
- WEIGHT: (kg)

Date: h

COLLECTION OF SPECIMENS

- ROUTINE BLOOD SAMPLE (Fasting) Y N

Research Nurse: **Date:**

Appendix 8: Childhood Factors Questionnaire Extracts

ANTENATAL QUESTIONNAIRE: HOME SITUATION

We would like to know a little about your home situation.

1. Are you

1 = a housewife	2 = earning money	3 = a student	4 = unemployed

2. Could you please tell me what you marital status is

1 = single	2 = divorced	3 = civil marriage	3 = common law marriage	3 = traditional marriage	4 = widow

LIVING CONDITIONS

The type of facilities that are provided for the area where a person lives can influence health. We are interested in what facilities are available to you. I am going to ask you some questions about your home.

1. How would you describe where you live – as a

1 = shack	2 = flat	3 = house	4 = hostel	5 – shared house with another family	6 = other

2. Is your home

1 = owned	2 = rented from another person	3 = rented from	4 = provided by

WATER AND SANITATION SUPPLY

1. I would like to know about facilities that are provided to you. Does your household have sole use of, share with another household or not have any of the following?

WATER	Sole use = 1	Shared = 2	No access = 3
Indoor running hot & cold water			
Indoor running cold water only			
Tap outside house only			
Water from other source only			

If **OTHER**, specify _____

TOILET	Sole use = 1	Shared = 2	No access = 3
Flush toilet in the household			
Flush toilet outside household			
Bucket system			
Other toilet			

2. Which of the following do you have in your home?

	Yes = 1	No = 2
Electricity		
Television		
Radio		
Motor vehicle		
Fridge		
Washing machine		
Telephone		
Children's toys		

EDUCATION

For various reasons people have more or less opportunity to attend school as well as getting other training or qualifications. I would like to know what schooling you and your partner had.

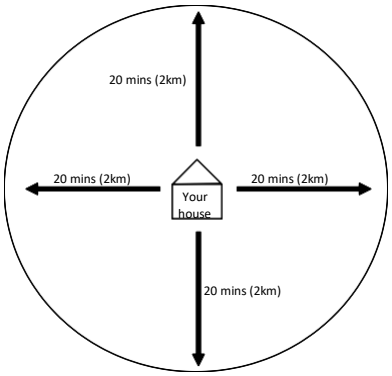
1. What is the highest standard you passed at school?

1 = no formal schooling	6 = grade 8
2 = grade 1 / grade 2	7 = grade 9
3 = grade 3 – 5	8 = grade 10
4 = grade 6	9 = grade 11
5 = grade 7	10 = Matric

2. Do you have any post-school training?

Yes = 1	No = 2

The following questions refer to the **neighbourhood** where you live which we consider to be the **area where you could potentially walk to in about 20 minutes from your house, that is, approximately 2km in any direction from your house.**



If you live in more than one house because for example you stay with your mother/father/partner, as they do not live in the same house, please answer the questions based on the neighborhood where you spend **most** of your time. There are no right or wrong answers to the questions we are asking you as we are only interested in your **perceptions** of the neighborhood where you live.

Section A: Economic aspects of your neighborhood

The first few questions ask about the level of wealth in your neighborhood. Remember we are interested in the area where you could potentially walk to in about 20 minutes from your house, that is, approximately 2km from your house.

1. How do you describe your neighborhood in terms of wealth?

Response	**Code**	**Please tick one box only**
Very poor	1	
Poor	2	
Average	3	
Wealthy	4	
Very wealthy	5	

2. Do you think people living **outside** of your neighborhood see **your** neighborhood as being:

Response	**Code**	**Please tick one box only**
Very poor	1	
Poor	2	
Average	3	
Wealthy	4	
Very wealthy	5	

Section B: Social aspects of your neighborhood

The first few questions in this section refer to safety and crime in your neighborhood. Remember we are interested in the area 20 minutes/2km from your house.

3. How safe do you feel in your neighborhood?

Response	**Code**	**Please tick one box only**
Very unsafe	1	
Unsafe	2	
Average	3	
Safe	4	
Very safe	5	

4. In your opinion, how much crime is there in your neighborhood?

Response	**Code**	**Please tick one box only**
A lot	1	
Some	2	
Average	3	
Not much	4	
None	5	

Appendix 9: Ethics Clearance Certificate

R14/49 Ms Mercy Manyema et al

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160921

NAME: (Principal Investigator)	Ms Mercy Manyema et al
DEPARTMENT:	Public Health MRC/Wits Developmental Pathways for Health Research Unit
PROJECT TITLE:	The Impact of Adverse Childhood Experiences (ACEs) on Health and Well-Being in Young Adulthood: A Longitudinal Analysis of Data from the Birth to Twenty Plus (Bt20+) Cohort
DATE CONSIDERED:	30/09/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Shane Norris
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	05/10/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004, 10th floor, Senate House/3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in September and will therefore be due in the month of September each year.

Principal Investigator Signature _____ Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES