Exploring the mental health of adolescent parent families affected by HIV within the Eastern Cape province of South Africa: Addressing a critical evidence gap

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Declaration of freedom from plagiarism

I, Kathryn J. Steventon Roberts, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

Kathryn J. Steventon Roberts

Date: 15/12/2022

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The works within this thesis would not have been possible without the thousands of adolescents in South Africa who have given their time to work with our teams with the hope of improving the lives of future adolescents.

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Data from this thesis is drawn from two linked studies, 1) the ***Adolescent HIV study*** – Mzantsi Wakho, and 2) the Helping Empower Youth Brought up in Adversity with their Babies and Young children (***HEY BABY***) study. These studies were funded by: the International AIDS Society through the CIPHER grant (155-Hod and 625-TOS); Claude Leon Foundation [F08 559/C]; Evidence for HIV Prevention in Southern Africa (EHPSA), a UK aid programme managed by Mott MacDonald; the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 771468); University of Oxford's ESRC Impact Acceleration Account (IAA) [K1311-KEA-004]; Research England [0005218]; Janssen Pharmaceutica N.V., part of the Janssen Pharmaceutical Companies of Johnson & Johnson; the Nuffield Foundation, but the views expressed are those of the authors and not necessarily the Foundation; Oak Foundation/GCRF "Accelerating Violence Prevention in Africa" [OFIL-20-057]; Oxford University Clarendon-Green Templeton College Scholarship; the Regional Inter-Agency Task Team for Children Affected by AIDS - Eastern and Southern Africa (RIATT-ESA); the Philip Leverhulme Trust [PLP-2014-095]; UNICEF Eastern and Southern Africa Office (UNICEF-ESARO); UKRI GCRF Accelerating Achievement for Africa's Adolescents (Accelerate) Hub (Grant Ref: ES/S008101/1); the Fogarty International Center, National Institute on Mental Health, National Institutes of Health [under Award Number K43TW011434]; the John Fell Fund [161/033].

Abstract

Adolescent (10-19 years) pregnancy and poor adolescent mental health remain prominent global health issues. Sub-Saharan Africa has the highest rates of adolescent pregnancy globally and is the epicentre of the global HIV epidemic – both phenomena are associated with poor mental health. This thesis explores the potential synergistic impacts when adolescent pregnancy and HIV co-occur by examining i) prevalence and correlates of likely common mental disorder (CMD) among adolescent mothers, ii) the association between likely maternal CMD, HIV, and child cognitive development, iii) likely paternal CMD among the fathers of children born to adolescent mothers, and iv) whether fatherhood characteristics differ according to core maternal characteristics (e.g., HIV and mental health status).

Cross-sectional data were drawn from two linked studies: the ***Adolescent HIV study*** (n=1059 adolescents living with HIV and a comparison group [n=467]), and the ***HEY BABY study*** (n=1046 young mothers and their child(ren)), undertaken between 2015-2019. Participants completed validated and study specific questionnaires including items on sociodemographic information, health and wellbeing, and parenting experience (within the ***HEY BABY study***). Child development was assessed utilising the Mullen Scales of Early Learning (***HEY BABY study***). Likely CMD was measured utilising a battery of validated symptomology scales (depression, anxiety, posttraumatic stress, suicidality). Quantitative methodologies including regression modelling are utilised to explore data.

Prevalence of likely CMD among adolescent mothers was 18.8% (***Adolescent HIV***) and 12.6% (***HEY BABY***). Compared to adolescent mothers not living with HIV, adolescent mothers living with HIV were more likely to report probable CMD (***HEY BABY***: 16.2% vs. 11.2%, X^2=4.41, *p*=0.04). Identified risk factors (correlates) for likely CMD among adolescent mothers included violence exposure (verbal, physical or sexual abuse; OR=2.54 [95%CI:1.20-5.40], *p*=0.01]), exposure to community violence; (OR=2.09 [95%CI:1.33-3.27], *p*=0.001), and perceived lack of social support (OR=4.09 [95%CI:2.48-6.74], *p*=<0.0001). There was limited evidence of interactions,

suggesting that the risk factors for likely CMD are similar among adolescent mothers living with and without HIV. When considering child cognitive development, maternal HIV was found to be associated with reduced child gross motor scores (*B*=-2.90 [95%CI:-5.35,-0.44], *p*=0.02), however, no associations were identified with either maternal likely CMD, nor maternal HIV status (inclusive of interaction terms). Prevalence of likely CMD among adolescent fathers was 12.5% (***Adolescent HIV***: n=8). Father involvement was low (***HEY BABY***: 19.5% were involved with their child at least once every two weeks). Adolescent mothers reporting probable CMD were less likely to be in a relationship with the father of their child (41.8% vs. 54.1%, X^2=7.32, *p*=0.03), more likely to experience domestic violence perpetrated by the father of their child (8.2% vs. 3.3%, X^2=6.07, *p*=0.01), and more likely to engage in arguments about finances with the father of their child (30.0% vs. 17.0%, X^2=10.8, *p*=0.001).

Findings highlight the commonality of mental health burden within the context of adolescent pregnancy and HIV, and the urgent need for effective evidence-based programming for adolescent parent families living with and affected by HIV within South Africa.

Impact statement

Africa's adolescent population are the fastest growing the in world. Consequently, the health of adolescents, of which mental health is a fundamental component, is becoming increasingly important to promote individual potential, and ensure the prosperity of the region, and future generations. Poor mental health within adolescence has broad negative implications for individuals and wider society. Yet, the mental health of children and adolescents remains an overlooked global health priority. Both experiencing adolescent pregnancy and living with HIV have been found to be associated with poor mental health. However, there is a dearth of literature exploring mental health when both phenomena co-occur. Adolescents and their children living with and affected by HIV are a core population in both the future prosperity of the region and the HIV response. However, adolescent parent families living with and affected by HIV remain understudied, and thus underserved with regard to intervention and prevention.

The works within this thesis respond to a critical evidence gap in relation to adolescent parental mental health in the context of HIV in sub-Saharan Africa, providing an initial exploration of parental mental health (focusing on both adolescent mothers and the fathers of children born to adolescent mothers), and the potential impacts of adolescent parental mental health on child cognitive development outcomes. Findings provide the first insight to a sparse evidence base focusing on the syndemic experience of adolescent pregnancy and living with HIV, highlight the potential needs of children born to adolescent mothers, and emphasise that fathers should not be forgotten in this context. The COVID-19 pandemic has exacerbated the issues outlined in this thesis (e.g., an increase in mental ill-health, and adolescent pregnancies), and consequently, the findings from this thesis may be even more pertinent to future research, policy, and programming efforts. These explorations provide important insights into the needs of this group and a foundation for future scholarship which the candidate is engaging with as part of her postdoctoral activities.

Dissemination has been a core priority since the undertaking of this thesis. Dissemination efforts have been driven by the absence of existing data, the resulting need to build awareness of the needs of adolescent parent families within the context of HIV, and the wellbeing of adolescent mothers and their children being adopted as a topic of interest by advocacy groups and polygonal organisations (e.g., the *World Health Organization [WHO]*). These works have been disseminated across international fora including peer-reviewed-journals, conferences, webinars, blogs, and policy advocacy briefs in response to need and requests from organisations. For example, the candidate has had six first-authored peer-reviewed manuscripts accepted for publication, a further two manuscripts submitted/being prepared for peer-review, and additional manuscripts submitted as part of the wider study team. Two of these publications are referenced in a technical brief focusing on young mothers living with HIV developed by the *WHO* and *UNICEF*, and the candidate has additionally had an invited commentary focusing on promoting mental health among pregnant adolescents living with HIV published in the *Lancet Child and Adolescent Health* journal.

Publications, presentations & scholarships arising from the works in this thesis

Given the novelty of the research undertaken within thesis, a core priority throughout the development of the works within thesis has been to ensure that findings are made available as soon as possible to policymakers, programmers, and stakeholders working within the development of services for adolescent parent families. The candidate has been proactive with dissemination efforts and has been responsive to the requests and requirements of polygonal organisations working within the field of interest. A full list of dissemination activities undertaken by the candidate and scholarships awarded is outlined below.

Invited commentary

1. **Steventon Roberts, K. J.** (2022). Promoting mental health among pregnant adolescents living with HIV. The Lancet Child & Adolescents Health. DOI: https://doi.org/10.1016/S2352-4642(22)00186-9

Peer-reviewed publications

Accepted

The works within and those produced in the development of this thesis have resulted in the following peer-reviewed publications:

2. **Steventon Roberts, K.J.**, Smith, C., Cluver, L., Toska, E., Jochim, J., Marlow, M. & Sherr, L. (2022). Adolescent mothers and their children affected by HIV – an exploration of maternal mental health, and child cognitive development. PLOS One, 17(10), e0275805. DOI: https://doi.org/10.1371/journal.pone.0275805

3. **Steventon Roberts, K.J.,** Smith, C., Toska, E., Cluver, L., Haag, K., Wittesaele, C., Langwenya, N., Jochim, J. Saal, W., Shenderovich, Y. & Sherr, L. (2022).

Risk factors for mental health among adolescent mothers affected by HIV in South Africa. Psychology, Health & Medicine, 1-18. DOI: https://doi.org/10.1080/13548506.2022.2124295

4. **Steventon Roberts, K. J.,** Sherr, L., Haag, K., Smith, C., Jochim, J., Toska, E., ... & Cluver, L. (2022). Adolescent parenthood and HIV-infection in South Africa—Associations with child cognitive development. PLOS Global Public Health, 2(5), e0000238. DOI: https://doi.org/10.1371/journal.pgph.0000238

5. Sherr, L., Haag, K., **Steventon Roberts, K.J.**, Cluver, L., Wittesaele, C., Saliwe, B., Tolmay, J., Langwenya, N., Jochim, J., Saal, W., Zhou, S., Chen, J., & Toska, E. (2022) The development of children born to young mothers with no, first- or second-generation HIV acquisition in the Eastern Cape province, South Africa: a cross-sectional study. BMJ open, 12(10), e058340. DOI: http://dx.doi.org/10.1136/bmjopen-2021-058340

6. Toska, E.*, Saal, W., Chen-Charles, J., Wittesaele, C., Langwenya, N., Jochim, J., **Steventon Roberts, K.J.,** Anquandah, J., Sherr, L. & Cluver, L.* (2021). Achieving the Sustainable Development Goals among adolescent mothers and their children in South Africa: findings from a community-based mixed HIV-status cohort. PLOS One, 17(12): e0278163. DOI: https://doi.org/10.1371/journal.pone.0278163
**Authors contributed equally to the writing of this manuscript*

7. **Roberts, K.J.**, Smith, C., Cluver, L., Toska, E., Zhou, S., Boyes, M., & Sherr, L. (2021). Adolescent Motherhood and HIV in South Africa: Examining Prevalence of Common Mental Disorder. AIDS and Behavior, 26:1197–1210. DOI: https://doi.org/10.1007/s10461-021-03474-8

8. **Roberts, K. J.**, Smith, C., Cluver, L., Toska, E. & Sherr, L. (2021). Understanding Mental Health in the Context of Adolescent Pregnancy and HIV in Sub-Saharan Africa: A Systematic Review Identifying a Critical

Evidence Gap. AIDS and Behavior, 25:2094–2107. DOI: https://doi.org/10.1007/s10461-020-03138-z

9. Toska, E.,* Laurenzi, C.A.,* **Roberts, K.J.**,* Cluver, L. & Sherr, L. (2020). Adolescent mothers affected by HIV and their children: A scoping review of evidence and experiences from sub-Saharan Africa. Global Public Health, 15(11), 1655-1673. DOI: https://doi.org/10.1080/17441692.2020.1775867
**Authors contributed equally to the writing of this manuscript*

10. **Steventon Roberts, K.J.**, Smith, C., Toska, E., Cluver, L., Wittesaele, C., Langwenya, N., Shenderovich, Y., Saal, W., Jochim, J., Chen-Charles, J. & Sherr, L. Exploring the cognitive development of children born to adolescent mothers in South Africa. Infant and Child Development, e2408.

Under peer-review/In preparation

The following manuscript, which has arisen from the works within and in the development of this thesis, is currently being prepared:

10. **Steventon Roberts, K.J.** et al. Who are the fathers of children born to adolescent mothers in South Africa? In preparation.

Reports/Policy engagement activities

Policy engagement for the Coalition for Children Affected by AIDS. Undertaking a scoping review and consultation exercise regarding the current evidence relating to adolescent mothers affected by HIV and their children in sub-Saharan Africa. Awarded to **K.J. Roberts**, E. Toska, C. Laurenzi, L. Cluver, L. Sherr.

Resulting report: Toska, E.,* **Roberts, K.J.**,* Laurenzi, C.A.,* Cluver, L. & Sherr., L (2019). Adolescent mothers affected by HIV and their children – understanding and

meeting their needs in our HIV response and global commitments. Prepared for the Coalition for Children Affected by AIDS, Canada. Access via: https://childrenandhiv.org/wp-content/uploads/2019/11/Background-Paper-on-Teen-Mothers-and-Children-Toska-Roberts-and-Laurenzi-2019-Final.pdf **Authors contributed equally to the writing of this report*

Presentations

The works within and those produced in the development or as a result of this thesis have resulted both oral and poster presentations presented at international fora:

1. **Steventon Roberts, K.J.** et al. 2022: HIV & Pediatrics Workshop: Paper: The cognitive development of children born to adolescent mothers living with HIV in South Africa according to child HIV status. Montreal, Canada, July (poster presentation).
   ***This presentation was awarded the best abstract prize for the conference**
2. **Steventon Roberts, K.J.** et al. 2022: AIDS 2022: Paper: Adolescent mothers living with HIV in South Africa – how are their children faring? Montreal, Canada, July (oral presentation).
3. **Steventon Roberts, K.J.** et al. 2022: AIDS 2022: Paper: The cognitive development of children born to adolescent mothers – does child HIV status matter? Montreal, Canada, July (poster presentation).
4. **Steventon Roberts, K.J.** et al. 2022: AIDS 2022: Paper: Does HIV compound maternal mental health challenges among adolescent mothers in South Africa? Montreal, Canada, July (poster presentation).
5. **Steventon Roberts, K.J.** et al. 2022: HIV & Women Workshop: Paper: Exploring Maternal Mental Health and Child Cognitive Development among Adolescent Mothers and Their Children Affected by HIV in South Africa. Remote, April (poster presentation).
6. **Steventon Roberts, K.J.** et al. 2022: HIV & Women Workshop: Paper: Adolescent Mothers Affected by HIV in South Africa: An Exploration of Risk

and Protective Factors for Maternal Mental Health. Remote, April (guided poster presentation).

7. **Roberts, K.J.** et al. 2021: REPSSI Psychosocial Forum South Africa: Paper: Mental health, adolescent parenthood, and HIV in South Africa. Remote, October (oral presentation).
8. **Roberts, K.J.** et al. 2021: ICASA (International Conference on AIDS and STIs in Africa): Paper: An exploration of maternal mental health and child cognitive development among HIV-affected adolescent mothers. Remote, September (poster presentation).
9. **Roberts, K.J.** et al. 2021: HIV and Adolescence Workshop: Paper: Adolescent parenting in the presence of HIV - insights into mental health and child development in South Africa. Remote, September (poster presentation).
10. **Roberts, K.J.** et al. 2020: International Marce Society Perinatal Mental Health Conference: Paper: Perinatal mental health and implications for the development of children born to adolescent mothers in South Africa. Remote, October (oral presentation).
11. **Roberts, K.J.** et al. 2020: International Marce Society Perinatal Mental Health Conference: Paper: Pregnancy and mental health burden amongst adolescents in South Africa. Remote, October (oral presentation).
12. **Roberts, K.J.** et al. 2019: AIDS Impact 14th International Conference: Paper: Adolescent pregnancy & psychological wellbeing in South Africa – exploring issues for HIV+ve and HIV-ve adolescents. London, UK. July (poster presentation).
13. Wittesaele, C., Toska, E., Cluver, L., Sherr, L., **Roberts, K.J.**, Jochim, J., Hodes, R. & Langwenya, N. 2019: ICASA 2019 Conference: 'Adolescent mothers living with HIV and their children' Kingali, Rwanda. December (oral presentation).
14. Sherr, L., Toska, E., Cluver, L., **Roberts, K.J.** & Laurenzi, C. 2019: The Coalition of Children Affected by AIDS/WHO meeting: 'HIV and adolescent pregnancy – research considerations' Geneva, Switzerland. December (oral presentation).

Workshops/Invited talks

1. **Steventon Roberts, K.J.** 2022: Men Matter Webinar hosted by the International AIDS Society. Invited talk: Sizing up male involvement –Does it matter? May 2022.
2. **Roberts, K.J.** 2021: International Symposium on Health Development of Vulnerable Populations. Invited talk: Mental health, adolescent parenthood, and HIV in South Africa. Remote, September.
3. **Roberts, K.J.** 2020: The COVID-19 experience- a lens to inform the frontline webinar hosted by the Accelerate Hub: Paper: Adolescent fatherhood - Insights from existing data and potential impacts of COVID-19. Remote, December.
4. **Roberts, K.J.** 2020: PHACS Women's Health Working Group: Paper: Youth pregnancy and mental health. Remote, February.

Scholarships

In addition to the Economic Social Research Council funding grant awarded to undertake the works in this thesis, the following scholarships were awarded to the candidate:

Conference attendance

- International AIDS Society, AIDS 2022, Montreal, Canada. July.
- HIV & Pediatrics 2022, Montreal, Canada. July.
- HIV & Women 2022 (remote). April.
- ICASA (International Conference on AIDS and STIs in Africa) 2021 (remote). September.
- International AIDS Society, IAS 2021 (Remote). July.

Funding award

- Chadwick Trust Fellowship, University College London (for works on adolescent fatherhood)

Additional peer-reviewed publications co-authored by the candidate

The works within this thesis focus on topics including adolescent pregnancy, mental health, child development, and fatherhood. These topics permeate across other topic areas within the broader studies form which data within this thesis is drawn. As part of the study team, the candidate has additionally been a co-author on peer-reviewed publications linked to the works in this thesis:

Accepted

1. Jochim, J., Meinck, F., **Steventon Roberts, K. J.**, Wittesaele, C., Langwenya, N., Toska, E., & Cluver, L. (2022). Which factors affect postpartum educational enrollment of adolescent mothers in South Africa? A latent class analysis. Psychology, Health & Medicine, 1-17. DOI: https://doi.org/10.1080/13548506.2022.2108085

2. Jochim, J., Meinck, F., Toska, E., **Roberts, K.**, Wittesaele, C., Langwenya, N., & Cluver, L. (2022). Who goes back to school after birth? Factors associated with postpartum school return among adolescent mothers in the Eastern Cape, South Africa. Global public health, 1-15. DOI: https://doi.org/10.1080/17441692.2022.2049846

3. Shenderovich, Y., Boyes, M., Esposti, M. D., Casale, M., Toska, E., **Roberts, K. J.**, & Cluver, L. (2021). Relationships with caregivers and mental health outcomes among adolescents living with HIV: a prospective cohort study in South Africa. BMC Public Health, 21(1), 1-11. DOI: https://doi.org/10.1186/s12889-020-10147-z

Under peer-review

1. Cluver, L., Jochim, J., Mapukata, Y., Wittesaele, C., Shenderovich, Y., Mafuya, S., **Steventon Roberts, K.J.**, Banougnin, B., Sherr, L., Toska, E. (2022) Associations of formal childcare use with health and human capital

development for adolescent mothers and their children in South Africa. *Journal of Epidemiology & Community Health (under review).*

2. Laurenzi, C.A., Toska, E., Tallarico, R., Cluver, L., Sherr, L., **Steventon Roberts, K.J.**, Hansen, M., Tolmay, J., Jochim, J., Armstrong, A., Ameyan, W., Yates, R. (2022) Key normative, legal, and policy considerations for supporting pregnant and postpartum adolescents in HIV-endemic regions. *Sexual and Reproductive Health Matters (under review).*

See **Appendix** for a list of additional allied works (broadly linked to the topics of interest but not directly linked to the works within this thesis) undertaken by the candidate during her PhD period.

Contents

Key terms, concepts, acronyms & abbreviations

This section provides a summary of key terminology and concepts used throughout this thesis.

Key terms & concepts

Adolescents and/or adolescence, based on the World Health Organization definition, include young people 10-19 years old

Adolescent parenthood, childrearing resulting from pregnancy among young people aged 10-19 years

Adolescent pregnancy, pregnancy among young people aged 10-19 years

Antiretroviral therapy (ART), the treatment of people living with HIV using medication. Commonly, treatment consists of a combination of drugs that suppress the replication of HIV. ART can prevent the transmission of HIV, improve quality of life, as well as reduce morbidity and mortality

Comorbid, refers to medical conditions that are concurrently present in an individual

Global North, a concept used to refer to a grouping of countries based on geography but also political and socio-economic characteristics including areas and countries such as North America, Europe, Russia, Japan, New Zealand, Australia, Singapore, South Korea, and Taiwan

HIV, (Human Immunodeficiency Virus) is a virus that damages the immune system and may lead to a reduced ability of the immune system to respond to opportunistic infection. Prominent modes of acquisition include contact with blood products, sexual intercourse, and mother-to-child transmission

HIV-affected, living with HIV, being HIV-exposed uninfected or living in a high HIV endemic community

isiXhosa, the most prominent language spoken in the Eastern Cape province of South Africa (from which the data within this thesis was drawn), and one of the 11 official languages of South Africa

Likely common mental disorder, for the purpose of this thesis likely common mental disorder was defined as scoring above the validated cut-off on any of the

four mental health symptomology measures (depression, anxiety, posttraumatic stress, suicidality) utilised in studies from which the data in this thesis was obtained

Mental health comorbidities, for the purpose of this thesis mental health comorbidities was defined as scoring above the validated cut-off on two or more of the four mental health symptomology measures (depression, anxiety, posttraumatic stress, suicidality) utilised in studies from which the data in this thesis was obtained

Vertical HIV acquisition, HIV acquired in utero, during birth or breastfeeding

Horizontal HIV acquisition, HIV acquired after the birth or breastfeeding period. Among the population of interest in this thesis, HIV is predominantly acquired through sexual transmission (heterosexual)

Quartile, four equal groups in which a population can be divided

Retrovirus, a type of virus that uses in RNA as part of its genetic material to integrate its viral DNA into the DNA of the host cell, changing the genome of that cell and allowing the retrovirus to replicate

Social protection, policies and programmes designed to reduce, prevent, or eliminate social and economic vulnerabilities (e.g., cash grants)

Syndemic, the presence of multiple phenomena which may have implications for the assessment, treatment, and experience of disorder (e.g., for the purpose of this thesis, poor mental health)

Acronyms & abbreviations

AIDS - Acquired immune deficiency syndrome

ALHIV - Adolescents living with HIV

AOR – Adjusted Odds Ratio

ART - Antiretroviral therapy

CDI – Child Depression Inventory

CDI-S – Child Depression Inventory – Short Form

CI - Confidence interval

CMD – Common mental disorder

ECD - Early child development

HEU - HIV exposed uninfected

HIV - Human immunodeficiency virus

HU - HIV unexposed

IQR - Interquartile range

LMIC - Low- and middle-income countries

MINI-Kid - Mini-International Neuropsychiatric Interview for Children and Adolescents

MHC - Mental health comorbidities

MTCT - Mother to child transmission

OR - Odds Ratio

PHQ-9 - Patient Health Questionnaire-9

PMTCT - Prevention of mother to child transmission

PTSD - Posttraumatic stress disorder

RCMAS - Revised Child Manifest Anxiety Scale

SD - Standard deviation

SDG - Sustainable Development Goal

SSA - Sub-Saharan Africa

STI - Sexually transmitted infection

UK - United Kingdom

UN - United Nations

UNAIDS - Joint United Nations Programme on HIV/AIDS

UNICEF - United Nations Children's Fund

USA - United States of America

USAID - United States Agency for International Development

USD - United States Dollars

WHO - World Health Organization

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Chapter 1 Introduction

This thesis responds to a critical evidence gap relating to the mental health of adolescent parent families affected by HIV in South Africa. As detailed within the subsequent chapters, adolescent mothers affected by HIV within sub-Sahara Africa remain an underserved group in relation to research and programming. Consequently, the children born to adolescent mothers, and the fathers of children born to adolescent mothers are also neglected from research and policy agendas. There is a dearth of literature regarding the mental health of adolescent mothers (and fathers) living with HIV in sub-Saharan Africa. Mental health experiences may have implications for both the individual and their children, as well as broader socio-economic consequences. Findings from this thesis contribute to an absence of existing literature exploring this population, provide insight for policy and programming, and offer an initial foundation to future scholarship. The subsequent thesis links four core topics: adolescent mental health, adolescent pregnancy and parenthood, child cognitive development, and fatherhood roles in relation to adolescent pregnancy – all within the context of HIV in sub-Saharan Africa. This introductory chapter provides a brief summary of the existing literature and evidence relating to the core topics of interest within this thesis (above) to provide a rationale for the overarching research question guiding the proceeding works.

The works undertaken in the development of this chapter have resulted in the following peer-reviewed publication:

Toska, E.,* Laurenzi, C.A.,* **Roberts, K.J.**,* Cluver, L. & Sherr, L. (2020). Adolescent mothers affected by HIV and their children: A scoping review of evidence and experiences from sub-Saharan Africa. Global Public Health, 15(11), 1655-1673. DOI: https://doi.org/10.1080/17441692.2020.1775867 **Authors contributed equally to the writing of this manuscript*.

1.1 Research questions guiding the works within this thesis

The research within this thesis is guided by a single underlying research question:

What is the mental health experience of adolescent mothers within the context of HIV in South Africa?

Through the initial exploration of this question (by undertaking a systematic review: see **Chapter 2**), further research questions arose:

1. What is the prevalence of likely common mental disorder among adolescent mothers in South Africa, comparing adolescent mothers living with and not living with HIV?
2. What are the risk factors for (correlates of) likely common mental disorder among adolescent mothers in South Africa, and do these risk factors (correlates) differ according to maternal HIV status?
3. How are the children of adolescent mothers in South Africa faring with respect to child cognitive development?
4. What is the relationship between likely common mental disorder among adolescent mothers and the cognitive development of their children, and does this differ according to maternal or child HIV status?
5. What is the prevalence of likely common mental disorder among adolescent fathers?
6. What are the characteristics of the fathers of children born to adolescent mothers (both adolescent and older fathers), and do these differ according to adolescent maternal HIV status or maternal mental health status?

These research questions are explored within the analyses undertaken within the proceeding chapters of this thesis.

1.2 Adolescents in sub-Saharan Africa – an opportunity for promoting potential

Adolescents are defined as individuals within the age group 10-19 years.[1] Adolescence is a period marked by rapid and substantial physical, neurodevelopmental, psychological and social change which brings about specific health and developmental needs for individuals as they transition from childhood to adulthood.[1] Globally, adolescents make up approximately 16% of the population, numbering approximately 1.2 billion.[2] In the sub-Saharan African region, adolescents form the highest proportion of the population, with almost a quarter (23%) of the population being aged between 10 and 19 years.[2] Approximately 224 million adolescents (10-19 years) reside within sub-Saharan Africa.[3] In 2016, adolescents made up approximately one fifth (18.5%) of the population in South Africa (10.2 million).[4] The adolescent population in sub-Saharan Africa is projected to reach 435 million by 2050,[5-7] making Africa home to the fastest growing adolescent population (10-19 years) in the world. [5-7] The number of adolescents in sub-Saharan Africa is predicted to increase over the next century, despite the number of adolescents in other regions (e.g., Asia, Europe, and the Americas) being expected to decrease.[5-7] The emergence of such a large youth population brings challenges and opportunities for the region of sub-Saharan Africa, and the wellbeing and development of adolescents has implications for the individual, countries, globally and for future generations.[8]

Projections relating to the adolescent population are illustrated within **Figure 1-1** and **Figure 1-2**. These figures show adolescent population size data extracted from the 2019 United Nations World Population Prospects according to region.[6,7] Through normalising the data (using min-max scaling to account for overall regional population), the rate of increase in the size of the adolescent population within the African region (driven by the sub-Saharan African region) is clearly demonstrated (see **Figure 1-1** and **Figure 1-2** developed by the candidate).[6,7] This recent and continued projected growth of the adolescent population within the African region is likely due to improved infant and child survival.[8,9] The promotion of adolescent potential is

critical to the success and prosperity for not only individuals themselves, but also the region, and as such, the wider global population.[8] The growth of Africa's adolescent population offers opportunity for promoting individual potential and by consequence the opportunity for social development and economic growth.[8] As such, the health of adolescents, of which mental health is a fundamental aspect, will become increasingly important over the coming years and decades. An increased understanding of mental health is necessary to inform impactful policy, intervention, and resource allocation relating to the assessment, treatment, and experience of mental health for adolescents.[10]

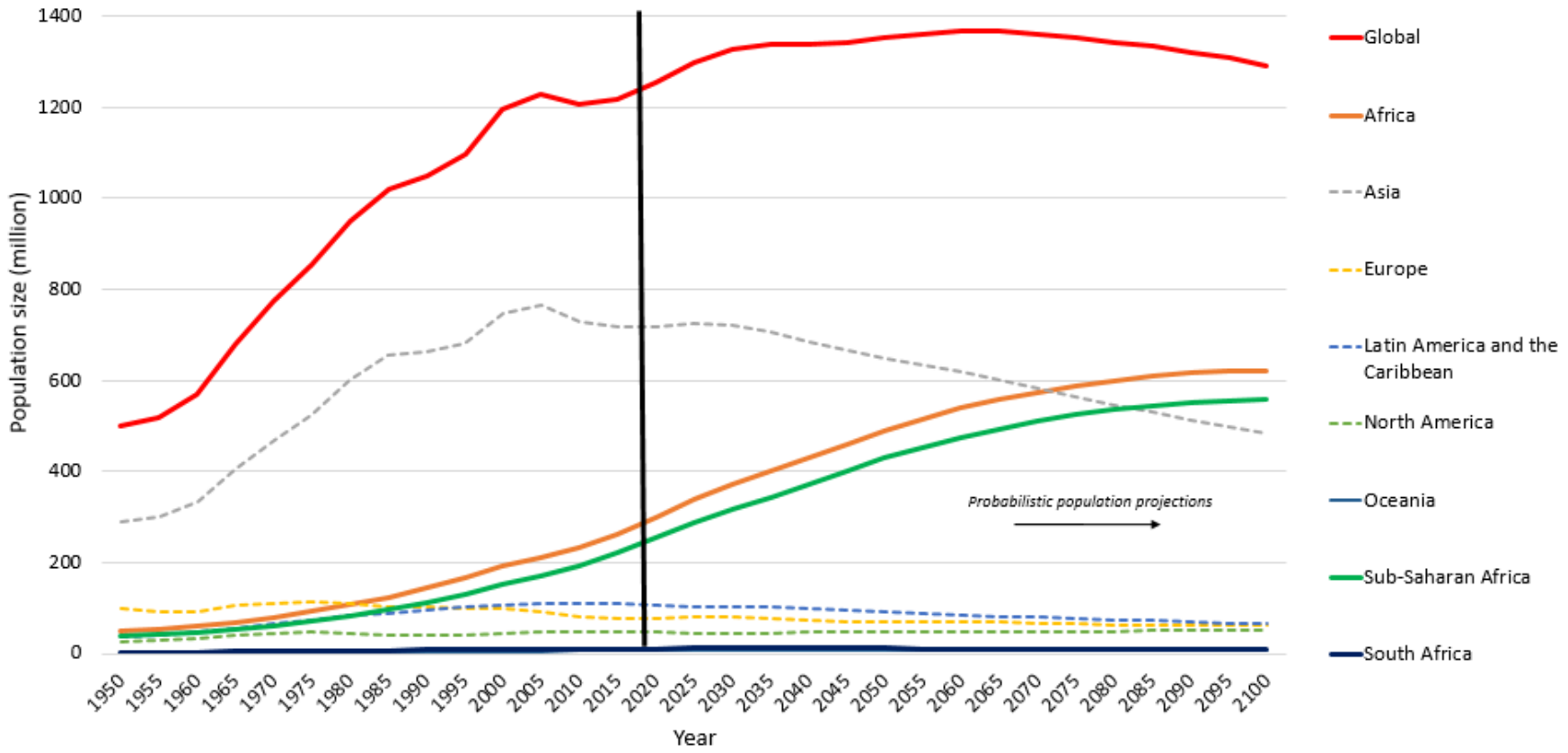


Figure 1-1 Total adolescent population (10-19 years; both sexes) estimates including probabilistic population projections 1950-2100 according to region (data drawn from United Nations World Population Prospects 2019; graphic developed by the candidate)[6,7]

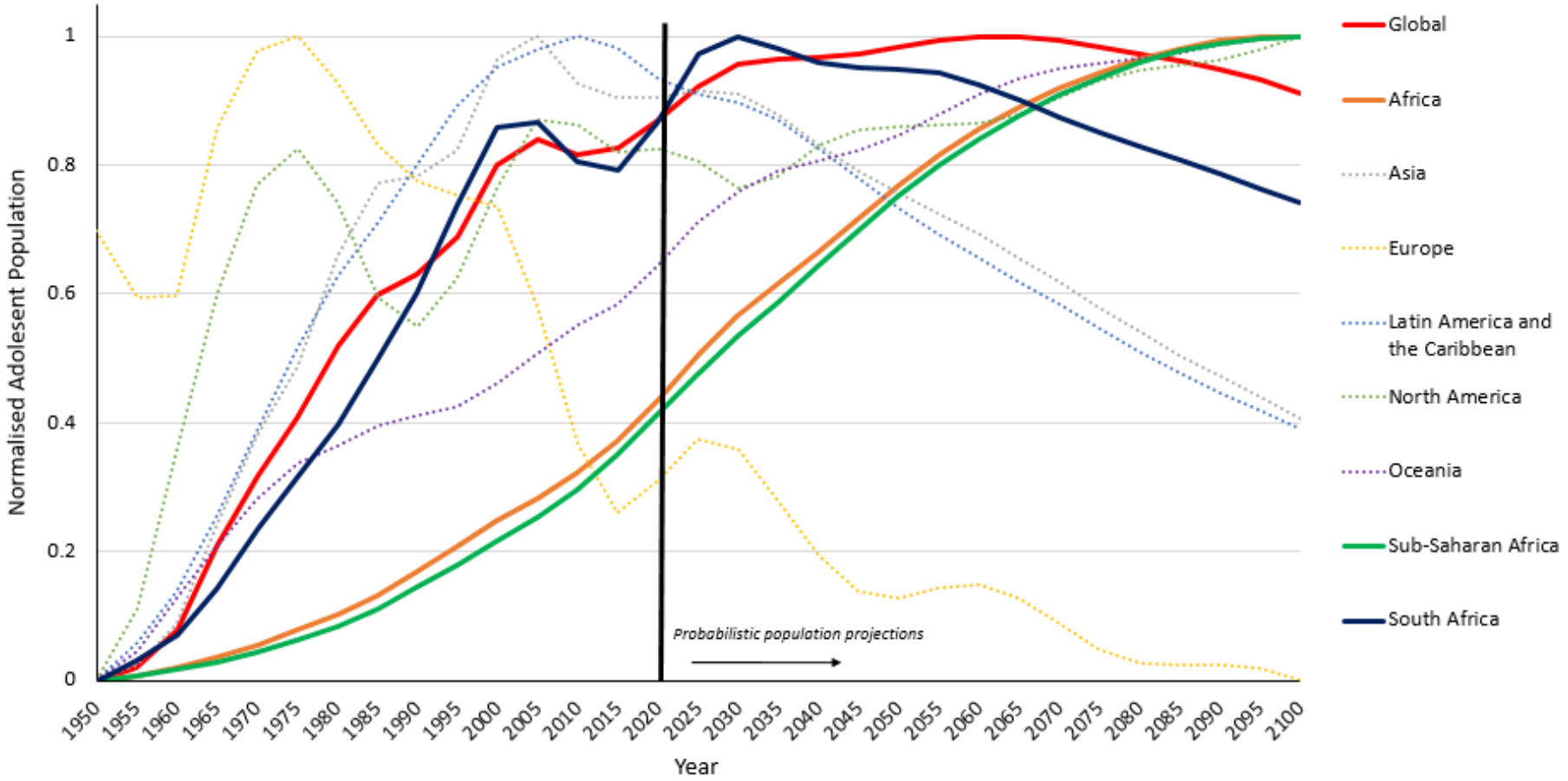


Figure 1-2 Normalised total adolescent population (10-19 years; both sexes) estimates including probabilistic population projections 1950-2100 according to region (data drawn from United Nations World Population Prospects 2019; graphic developed by the candidate)[6,7]

1.3 Adolescent mental health

Adolescent mental health remains an overlooked global health issue.[11-14] Fifty percent of mental health disorders are established by 14 years of age, and 75% before 24 years of age.[15] Poor mental health within adolescence has implications across the life course; affecting both physical and mental morbidity.[14-20] At a societal level, poor mental health has widespread socioeconomic impacts both within the short and long term; having implications for workforce participation, healthcare systems, and economic growth.[8,21,22]

Mental health disorders are a leading cause of disability, affecting an estimated 10-20% of children and adolescents globally.[11,23] However, estimates may not be wholly representative as the coverage of prevalence data for mental disorders among children and adolescents remains limited, particularly within low- and middle-income countries; potentially skewing global estimates.[24-27] Few studies relating to the treatment and prevention of mental health have targeted children and adolescents, and those that do often focus on developmental disability rather than broader mental disorder.[27] Globally, depression and anxiety are leading causes of illness and disability among adolescents.[23,28] Yet, as above, explorations of disorders are often skewed towards data from the Global North. Such disorders have profound impacts; affecting daily life and, at their worse have implications for mortality (e.g., depression may lead to suicide).[29,30] Within the context of high poverty, violence, communicable disease (e.g., HIV) and adolescent childbirth, such as within sub-Saharan Africa, trauma may also present challenges for adolescents,[31-34] which may lead to experiences of posttraumatic stress disorder.

The works within this thesis focus on exploring symptoms of depression, anxiety, posttraumatic stress, and suicidality (see below for an overview of each phenomenon). Given the substantial impacts of poor mental health for individuals and broader society (see above) experience of any likely mental disorder, and comorbid mental disorders (based on validated cut-offs on symptomology scales [see section **1.3.5** and **3.4**]) are also explored. While it is important not to pathologise

adolescents through the labelling of disorder, it remains essential that needs relating to poor mental health are identified so that support can be provided if required.

1.3.1 Depression

Depression is classified as a mood disorder characterised by specific symptoms, behaviours, and impairments including enduring low mood, loss of pleasure or interest in activities, fatigue, low self-worth, poor concentration, sleep disturbance, changes in appetite or eating behaviour, unreasonable feelings of self-criticism[35] and suicidal thoughts or suicidal acts.[35,36] Individuals must experience a range of the above symptoms to have a clinical diagnosis of depression.[35,36] Depression is a leading cause of disability globally,[37] with an estimated 5% of adults experiencing clinical depression.[38] Within South Africa, an estimated 9.8% of adults experience depression.[39] The experience of depression has major public health consequences, is often associated with numerous comorbid conditions (often bi-directionally, e.g., HIV), and has been found to increase mortality. In general, prevalence of depression is higher among females than males.[40]

Among children (<10 years of age), experience of depression is uncommon (>1%).[41] The prevalence of depression has been identified as rising during adolescence,[41] with prevalence estimated to be 3% globally[23] (although prevalence estimates range between 1.1% and 14.6%[42] – however, it should be noted that this estimate is likely skewed [see above]). Experience of depression during the adolescent period has been linked to an increased risk of suicidal thoughts and behaviours, increased risk behaviour (e.g., substance abuse,[43] risky sexual behaviour[44]), and has been found to have negative implications for social functioning (leading to an increase in social withdrawal), poor school attendance, poor educational achievement, and quality of life.[23] Experiencing depression during adolescence has also been associated with experiencing depression (often of a greater severity) within adulthood.[45]

1.3.2 Anxiety

Like depression, anxiety is classified as a mood disorder characterised by symptoms including excessive worry, difficulty controlling worry, restlessness, fatigue, difficulty concentrating, irritability, sleep disturbance, muscle tension, sympathetic autonomic overactivity (e.g., palpitations, sweating, shaking, dry mouth, gastrointestinal issues).[35,36] Individuals are required to experience a range of symptoms to be classified as experiencing anxiety and often acute symptoms lead to substantial impacts for functioning and major distress.[35,36,46] After depression, anxiety disorders are the second leading mental health related cause of disability globally.[47] Approximately 4% of the worldwide population experience an anxiety disorder (~301 million people, including ~58 million children and adolescents).[46,48] Similar to depression, prevalence of anxiety disorders is often higher among females than males.[40]

Among adolescents, anxiety disorders are the most prevalent mental disorders. Globally, approximately 5% of adolescents experience anxiety disorders. There is a dearth of prevalence estimates relating to anxiety disorders among adolescents in South Africa. A nationally representative 2018 study identified prevalence of anxiety disorders among 5631 adolescents to be 3.4%[49] (yet it should be noted that this study focused on sexual violence which may have skewed estimates).[50] Like depression, the experience of anxiety disorders among adolescents has been found to be associated with numerous adverse outcomes including social withdrawal, poor school attendance, educational attainment, and quality of life.[23,51] Anxiety disorders are often comorbid with depression among adolescents, often leading to a compounding negative impact on mental health prognosis, and additional impairments.[52]

1.3.3 Posttraumatic stress disorder

Posttraumatic stress disorder (PTSD) is characterised as an anxiety disorder, and thus a mood disorder, that may arise as a result of a traumatic event. PTSD symptoms include flashbacks to the traumatic event, nightmares, sympathetic autonomic overactivity (e.g., palpitations, sweating, shaking, dry mouth, gastrointestinal issues),

avoidance of stimuli that remind the individual of the event, irritability, insomnia, and difficulty concentrating.[35] PTSD symptoms are clustered into categories including re-experience (recurring, distressing, and intrusive memories of the traumatic event), avoidance (of stimuli that remind the individual of the event), and hyperarousal (anxiety symptoms that were not present before the traumatic event).[53] An additional category of symptoms - dysphoria[54] (general distress, persistent negative thoughts, distorted blame, feelings of isolation, alienation) is also well supported in the existing literature,[55-58] inclusive of children and adolescents in South Africa.[54] Like depression and anxiety, PTSD is more common among females than males.[59,60] There is a body of evidence suggesting a cumulative effect of exposure to traumatic events and PTSD symptomology.[61-63] PTSD is often comorbid with depression, anxiety, and substance use disorders.

Within South Africa, adolescents are living in communities with a high prevalence of community violence, interpersonal violence, and parental bereavement (often attributed to HIV). Within South Africa, traumatic events among children and adolescents have been found to range between 82% and 100%, and prevalence of PTSD has been found to range from 1% to 22%.[62,64-66]

1.3.4 Suicidality

Suicidality refers to the idea or thoughts of ending one's life. Suicidality is not a diagnosis of a disorder but often a symptom of other mental disorders (e.g., depression can lead to suicide). Suicidality -suicidal ideation or suicidal thoughts- may lead to suicide. Suicidality is often presented as a spectrum as suicidal ideation and/or thoughts may be active (e.g., include a plan) or passive (e.g., include thoughts of death without a plan). Suicidality may lead to suicidal behaviours such as a suicide attempt (self-injurious behaviour undertaken with an intent of death), and possible death by suicide.[67,68] It is well-established that suicide and suicidality are associated with mental disorder and that many suicides are the result of an impulsive decision during crises. Annually, ~700,000 people die by suicide (approximately 1% of all deaths globally),[69] and many more have suicide attempts or experience suicidality.[68] Approximately 80% of suicides occur in low- and middle-income countries.[68] In 2016,

~11,000 people died by suicide in southern sub-Saharan Africa resulting in the third highest regional suicide mortality rate (16.3 per 100,000 people).[69] However, this is likely an underestimate given that reporting of mortality data (particularly national level suicide data) is low across the sub-Saharan African region.[70] Like depression and anxiety, prevalence of suicide attempts are generally higher among females when compared to males. However, prevalence rates of suicide are approximately three times higher among males compared to females.[71]

Globally, suicide is the fourth leading cause of death among adolescents (15-19 years of age).[72] Yet, it should be noted that the worldwide availability and quality of data relating to suicidality and suicide is often poor. There is often stigma relating to suicide which may result underreporting.[68] The data that is available is skewed by findings from the Global North, and there is a dearth of literature on suicide and suicidality among adolescents (10-19 years) from sub-Saharan Africa.[73] As such, there is a global absence of reliable data relating to suicide and suicidality for adolescents, including adolescents in South Africa.[67]

1.3.5 Considerations within the measurement of adolescent mental health within low- and middle-income countries

There is a large disease burden relating to poor mental health that is concentrated in low- and middle-income countries - approximately 10-15% of all diseases are mental health related.[46,74] Yet, only a minority of individuals experiencing poor mental health within low- and middle-income countries (as low as 10%) will access treatment.[75-78] This treatment gap is due to numerous factors including a lack of mental health professionals, a lack of funding, discrimination, stigma relating to mental health, and a need for health policies relating to mental health.[67,75,79] A resulting effect of this treatment gap is a lack of routine screening and diagnosis of mental disorder and thus a dearth of literature and prevalence data from settings such as sub-Saharan Africa. Clinical diagnosis of mental disorder is the best for "gold standard" classification but brief validated screening instruments, focusing on symptomology, are more practical and are therefore utilised in large scale studies (such as those from which the data are drawn within this thesis).[80] Such screening measures are vital to gain reliable

estimates of mental disorder and the need for referral across and within populations.[80] Given this, the works within this thesis focus on poor mental health symptomology rather than clinical diagnosis. The use of such screening measures should however be interpreted in the context of some limitations. The use of cut-offs on symptomology scales does not necessarily represent a clinical diagnosis of a mental health disorder. Furthermore, while the use of symptomology scales and resulting classifications (obtained from validated cut-offs) hold clinical utility,[76,81] individuals who may be experiencing some dimension of poor mental health but do not reach the clinical threshold may be missed within investigations. However, symptomology scales do offer an indication of mental health need and the possible requirement for referral (and, thus, programming).[82]

The exploration of the above mental disorders may be criticised by those who argue that distress among populations in low- and middle-income countries in response to environmental impacts (e.g., high levels of communicable disease) should not be amalgamated with the presence of mental disorder, and those who question the applicability of definitions of mental disorder beyond the Global North.[83] However, there is a growing acceptance that mental disorders (with definitions developed in the Global North and measured by relevant accompanying instruments often developed in the Global North – such as symptomology scales) are associated with significant impairment among individuals within low- and middle-income countries and broader society.[84,85] Nevertheless, the important impacts of cultural context on the experience of mental disorder should not be diminished.[82] For example, the clinical, conceptual or linguistic interpretation of disorders such as depression, anxiety, posttraumatic stress disorder, or suicidality may not be understood or reflected within the experiences described by adolescents within such settings.[86,87] Similarly, terminology relating to mental health disorders (i.e., anxiety) does not necessarily have direct linguistic translation within many languages used across sub-Saharan Africa potentially restricting interpretation of measures and scales. However, recent research has identified that individual items within mental health screening tools have been found to be relevant and understood among adolescents (including those experiencing pregnancy) within sub-Saharan Africa.[88] Developing

culturally appropriate screening measures relevant to the population of interest in which local idioms of distress are incorporated should be prioritised, however, such efforts may limit between country comparisons.[82] In the absence of such locally developed mental health screening measures, locally validated measures, such as those used within subsequent analyses offer an accepted practical alternative.

While the diagnosis of mental disorder holds valuable clinical utility, in recent years there have been calls to shift away from binary classifications of mental health towards a continuum approach. Still, this is yet to be broadly implemented. This continuum may better reflect the diversity and complexity of mental health experience.[76,81] However, understanding prevalence of disorder (and likewise symptoms) is important to adequately inform policy, programming and for the allocation of resources. Due to the treatment gap in mental disorders for adolescents within low- and middle-income countries, transdiagnostic approaches to interventions for mental health (responding multiple disorders subsumed under the category of poor mental health) for adolescents are beginning to emerge. For example, PRemIum for aDoLEscents (PRIDE) is an effective transformative approach to provision in which a stepped series of evidence-based mental health interventions were implemented by lay counsellors in low-income schools in India.[89] In consideration of these factors, the candidate chose to explore poor mental health symptoms within this thesis using broader measures of poor mental health (any likely common mental disorder, and any mental health comorbidities). Where possible individual mental health symptom scales (i.e., depression, anxiety, posttraumatic stress, and suicidality) were also explored with the aim of responding to the absence of data relating to adolescent mental health emerging from sub-Saharan Africa.

1.4 Adolescents living with HIV within sub-Saharan Africa

Human immunodeficiency virus (HIV) is a retrovirus impacting the immune system resulting in immune suppression through the depletion of t-cells which increases the risk of opportunistic infection, disease, and death if untreated. If untreated the damage to the immune system from HIV infection can result in acquired immune

deficiency syndrome (AIDS): late-stage HIV infection defined by a drop in t-cells (>200 CD4 cell) and often signalled by the presence of opportunistic infection. Three predominant routes of HIV transmission have been identified: contact with blood products (horizontal acquisition), sexual transmission (horizontal acquisition), and transmission from mother to child (vertical acquisition). HIV/AIDS as a pandemic was first recognised in the 1980s as a terminal illness without effective treatment.[90-93] In the 1990s, effective treatment in the form of antiretroviral therapy (ART) was identified altering the prognosis of HIV. Now, with access to effective treatment, the life expectancy of individuals with HIV is improving to a level that is similar to the general population.[94] Such tremendous advances have led to HIV now being considered as a life-long chronic illness which can be managed with regular care and medication. Recent advances in HIV prevention and treatment (e.g., pre-exposure prophylaxis)[95] have also led to ambitious hopes of ending the HIV epidemic.[96-98] However, these hopes will not be achieved without addressing some of the remaining challenges experienced by populations living with HIV or those vulnerable to HIV acquisition including high levels of mental health burden.[99]

Sub-Saharan Africa is home to almost 35 million people living with HIV, accounting for 71% of the global disease burden of HIV, despite only 12% of the global population residing within the region.[100] South Africa has the largest HIV epidemic in the world, with over one fifth of the population living with HIV.[100,101] In sub-Saharan Africa, HIV/AIDS remains the leading cause of morbidity and mortality.[102,103]

Globally, more than 2 million adolescents are living with HIV - a figure that has increased by 30% within the last decade.[104] Sub-Saharan Africa is home to 85% of the global population of adolescents living with HIV.[105-107] Three in four new HIV infections amongst adolescents (15-19 years) are within sub-Saharan Africa, and female adolescents (10-19 years) remain disproportionately affected with seven female adolescents living with HIV for every five male adolescents.[104] South Africa has the largest population of adolescents living with HIV in the world - approximately 370000.[108] Despite global responses and investment to prevent HIV among adolescents, the number of adolescents living with HIV in the both the sub-Saharan

African region and South Africa is projected to rise. As such, adolescents remain a key population within the global HIV response.[109] The increase in the number of adolescents living with HIV is, in part, due to population increases but also due to the increased health and survival of children from childhood into adolescence (including those who vertically acquired HIV). Improved access to ART in recent decades has led to large numbers of children who have vertically acquired HIV surviving into adolescence, and rates of horizontal HIV acquisition (largely due to sexual transmission) remain high among adolescent populations.[107]

Increases in the number of adolescents living with HIV bring about novel considerations regarding the health and wellbeing of adolescents living with HIV including developmental changes (e.g., puberty, sexual debut, initiation of risk-taking behaviour) as well as broader psychosocial considerations such as mental health, and environmental stressors.[110] Biologically, the neurological impacts of HIV may pose challenges. For those adolescents who vertically acquired HIV, HIV may have implications for cognitive development which may persist into the adolescent period.[111,112] Exposure to ART (among adolescents with both vertically and horizontally acquired HIV) may also pose challenges for cognition (e.g., ART related neurotoxicity).[113] Stigma, discrimination, and disclosure may pose issues, with many adolescents learning that they are living with HIV during this period of development.[114,115] Sexual debut may also bring about challenges regarding the disclosure that adolescents are living with HIV to their sexual partners.[116] Adolescents living with HIV may also have to cope with caregiver ill health, death, grief, bereavement, and possibly experiencing orphanhood - with adolescents often navigating their own and loved one's mortality.[114,117] Adolescents may also be increasingly expected to manage their own medication and adherence to such medication during this developmental period.[112] Within sub-Saharan Africa, environmental challenges such as poverty also often poses challenges for adolescent living with HIV.[118,119] For example, food insecurity[120,121] and a lack of access to ART[122] have previously been identified as challenges to the wellbeing of adolescents living with HIV.

Adolescents with chronic illnesses, in the general population, have previously been found to be at an increased risk of emotional and behavioural issues.[123,124] Not all adolescents living with HIV experience mental health challenges,[125,126] however, poor mental health has been found to be prevalent among adolescents living with HIV,[124,127] having implications for overall health, adherence to medication and care,[128-130] and, as such, onwards HIV transmission and mortality. There is likely a bidirectional relationship between poor mental health and HIV among adolescents.[124,127,131-133] For example, poor mental health may increase the risk of HIV acquisition among adolescents (e.g., adolescents with poor mental health may be more likely to engage in risk behaviours [i.e., condomless sex] which may increase their risk of HIV acquisition or onwards HIV transmission). Similarly, living with HIV (and the possible ramifications of their diagnosis; see above for examples) may increase the risk of poor mental health among adolescents.[134] However, despite such knowledge regarding the mental health of adolescents living with HIV, there remains limited evidence-based programming for adolescent mental health within low- and -middle income countries.[124,134,135] An increased understanding of mental health for this group is critical, both to inform effective policy and programming to promote adolescent potential, and within the advancement of the HIV response. This increased understanding is particularly important when HIV is compounded by other comorbid or syndemic conditions - such as adolescent pregnancy.[136]

1.5 Adolescent pregnancy & parenthood

Adolescent pregnancy, defined within this thesis as pregnancy between the ages of 10-19 years, is a prominent global and public health issue.[137] Globally, approximately 14.5% of girls give birth before the age of 18 (years). In low- and middle-income countries, ~21 million adolescents (15-19 years of age) become pregnant each year and approximately, 50% of these pregnancies are unintended. Of the ~21 million pregnant adolescents in low- and middle-income countries, ~12 million give birth every year. Similarly, ~800,000 births annually are to females under 15 years of age in developing countries (e.g., South Africa).[137] Sub-Saharan Africa has the highest rates of adolescent pregnancy in the world (one in four [26.3%] females give birth

during adolescence) - rates much higher than other regions (e.g., one in ten [10.8%] females in South Asia give birth during adolescence).[7] This high rate of adolescent pregnancy in sub-Saharan Africa has continued to rise within recent years, despite other regions experiencing a decline (see **Figure 1-3**). Over the coming decade, sub-Saharan Africa will become home to over 16 million adolescent mothers (10-19 years) and, thus, home to more children born to adolescent mothers.[138] Within South Africa, the birth rate among adolescents (the number of births to 15–19-year-old females per 1000 females within that age group) is 68 births per 1000. This figure is much higher than the global rate of 44 births per 1000 15–19-year-old females.[7,139] Recent estimates suggest that 19% (95% confidence intervals: 16%-22%) of female adolescents in South Africa have experienced pregnancy.[140]

Globally, several factors contribute to high rates of adolescent pregnancy including child marriage, a lack of access to contraception, a lack of educational or employment prospects, and sexual abuse.[137] Within low and middle income countries, risk factors associated with adolescent pregnancy include lower educational attainment and lower economic status.[141] In addition to navigating the developmental period of adolescence (characterised by physical and emotional changes), parenting adolescents are also navigating pregnancy, childbirth, and childrearing. These experiences have widespread negative consequences for female adolescents and their children, such as impacts for health (including mental health and child development), social experiences, education, as well as future opportunities, livelihood, and contributions to the global economy. Health complications resulting from pregnancy and childbirth are leading causes of morbidity and mortality among adolescents.[137] Adolescent mothers are at a greater risk of complications during childbirth, such as preeclampsia, postpartum haemorrhage, and infection, compared to older mothers.[137,142] Similarly, compared to adult mothers, children born to adolescent mothers are at a greater risk of adverse neonatal outcomes, such as preterm delivery and low birth weight.[137,142,143] Psychosocial factors associated with adolescent pregnancy include exposure to stigma and discrimination[137,144,145] which may lead to social difficulties, and a greater exposure to violence.[141,146] Poor retention in education, and thus lower educational attainment, is a challenge for

adolescent mothers, which may in turn lead to reduced economic and employment opportunities. Pregnancy during adolescence is often associated with female adolescents dropping out of school, and not returning to school postpartum.[141,147,148] Yet, this relationship may be bidirectional as those adolescents who drop out of school may be more likely to become pregnant. The majority of parenting adolescents reside within low- and middle-income countries and therefore face an addition challenge of possibly raising children within contexts of adversity inclusive of poverty, food insecurity, poor sanitation, high levels of violence, and a lack of learning and stimulation opportunities.[149] The promotion of child development is critical to the long-term success and potential of low- and middle-income countries.[150,151] As such, supporting adolescent parents and their children is critical to unlocking the potential of future generations. See section **1.7** for a summary of the literature relating to the development of children born to adolescent mothers.

Like adolescents living with HIV (see section **1.4**), poor mental health has been found to be prevalent among adolescents experiencing pregnancy.[152,153] There may be a bidirectional relationship between adolescent pregnancy and poor mental health. For example, poor mental health may lead to increased risk behaviour, such as sexual intercourse without contraception use, which in turn may lead to adolescent pregnancy (and likewise possible HIV infection). Similarly, adolescent pregnancy and parenting may contribute to mental health challenges. As detailed in section **1.3,** adolescent mental health experiences have been found to have adverse outcomes across the life course.[14-20] Evidence, from the Global North, identifies poor mental health among pregnant and parenting adolescents as having adverse impacts for both parent and child (e.g., bonding, child development).[153] Most existing research, policy, and advocacy efforts relating to adolescent pregnancy focus on prevention (e.g., promoting contraception and delaying sexual debut). This focus has resulted in a lack of insight into the experience of adolescent parents and their children. As a result of this, there is a limited understanding of mental health within the context of adolescent pregnancy and parenting, particularly in low- and middle-income countries (where there is already a dearth of evidence regarding adolescent mental health [see section **1.3**]).

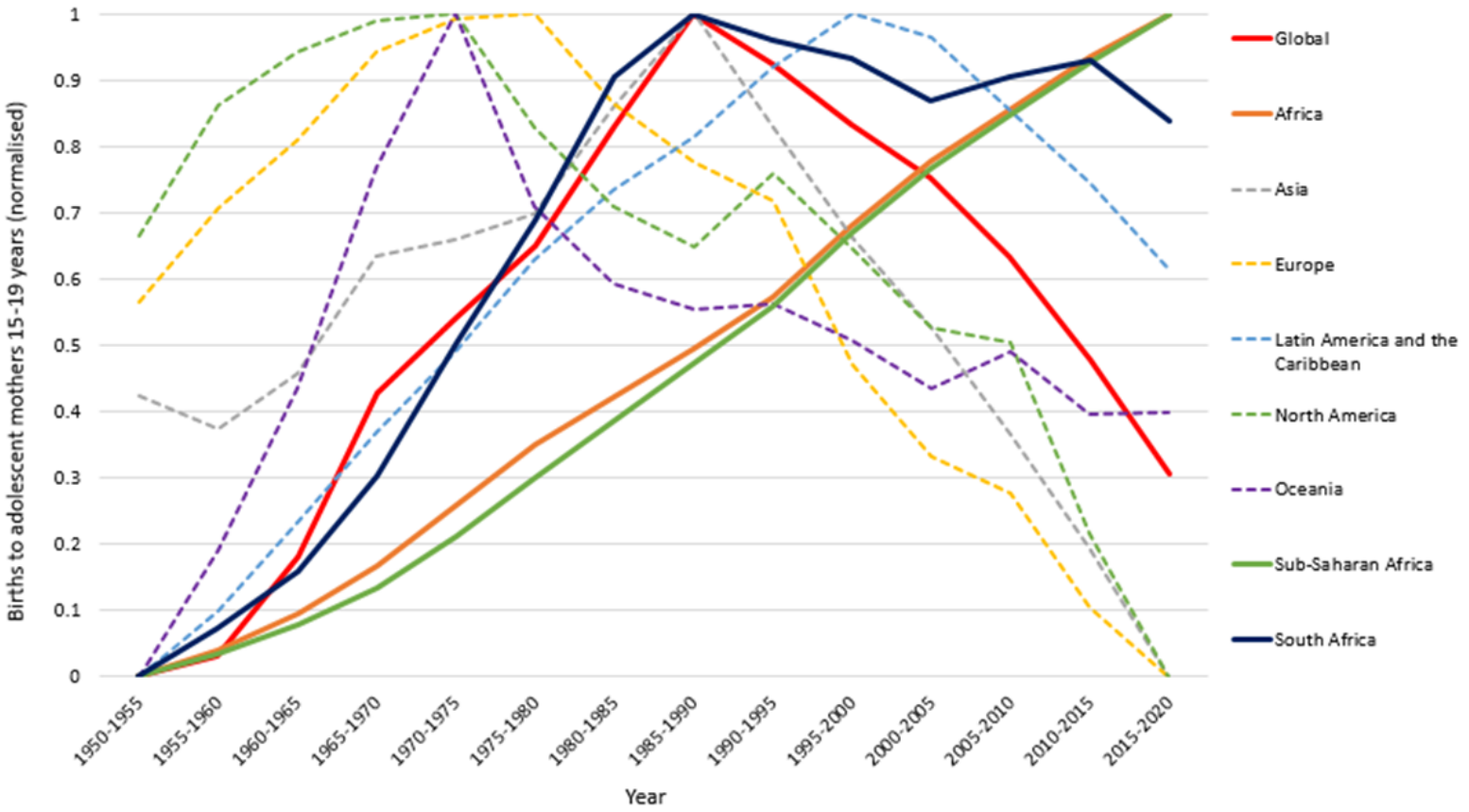


Figure 1-3 Normalised number of estimated births to adolescent mothers (10-19 years; 1950-2020) according to region (developed using min-max scaling; data drawn from United Nations World Population Prospects 2019; graphic developed by the candidate)[7]

1.6 Adolescents living with HIV experiencing pregnancy – a syndemic of risks?

Sub-groups of the adolescent population living with HIV may have specific needs - for instance, when adolescents experience a syndemic of health conditions (e.g., two or more interrelated factors that cause an increased health burden, such as adolescent pregnancy and HIV). The high rates of adolescent pregnancy in sub-Saharan Africa (see section **1.5**) occur within the epicentre of the global HIV epidemic (as detailed in section **1.4**). Pregnancy during adolescence has been found to be associated with an increased risk of incident and postpartum HIV acquisition.[154-156] Adolescents living with HIV experiencing pregnancy are a core population within the HIV response and the global efforts to eliminate HIV (e.g., through engagement with PMTCT).[136,157,158] Likewise, promoting the mental health of this population is critical to promoting their health and wellbeing, engagement with services (e.g., PMTCT services), and ensuring the wellbeing of their children, and, thus, our future generations.[159]

As detailed above, globally, within separate explorations, both living with HIV[124,127] and experiencing pregnancy during adolescence[152,153,160] have been found to be associated with poor mental health. Given the broad biological and psychosocial ramifications of living with HIV (see section **1.4**) and pregnancy (see section **1.5**) for adolescence, experiencing the dual impact of such phenomena may compound experiences of poor mental health. Previous studies, including those from South Africa, have identified substantial rates of poor mental health among adult populations living with HIV within pregnancy and the postpartum period[161] - however, explorations of mental health among adolescent populations are yet to be undertaken.[136] Sections **1.4** and **1.5** highlight that mental health may have a bidirectional relationship with the experience of pregnancy and, also, living with HIV for adolescents.[131,152,162] The ramifications of poor mental health for adolescent living with HIV, and those experiencing pregnancy discussed above (sections **1.4** and **1.5**), highlight considerations for adolescents who are living with HIV and have experienced pregnancy. For example, among adolescents living with HIV, poor mental health has been found to have negative implications for service engagement,

medication adherence and risk behaviours.[110] Hence, for pregnant and parenting adolescents living with HIV, additional issues may arise; as poor mental health may have impacts on service engagement (e.g., HIV care, sexual and reproductive health service, antenatal care) and onwards HIV transmission (e.g., engagement with PMTCT services) - concerns critical to both adolescent and child wellbeing.[136] However, without explicit explorations of mental health among this population the nuances of their experiences remain unknown. As a result, there is a lack of evidence-based policy, programming, and intervention for this group.

Due to the prevalence of both HIV and adolescent pregnancy within the sub-Saharan African region, a large sub-group are living with HIV, and have experienced pregnancy. Considering the current global estimates of mental disorder among children and adolescents (see section **1.3**), a large proportion of this population may be experiencing poor mental health. Yet, the literature regarding mental disorder within groups experiencing both phenomena is yet to be summarised. **Chapter 2** provides a summary of the existing literature exploring the mental health of adolescents living with HIV who have experienced pregnancy and provides a rationale for the proceeding analyses within this thesis.

1.7 Children born to adolescent mothers living with HIV – multiple vulnerabilities?

While there has been a growth of attention given to adolescents within the global HIV response in recent years, adolescent mothers, and particularly their children remain mostly disregarded within existing literature, funding, and programmatic responses.[136] As noted above, the wellbeing and developmental trajectory of adolescent mothers and their children is critical not only to individuals and the efforts towards the elimination of HIV,[136,157,158] but also to the success of the sub-Saharan African region as a whole.[136,138] Promoting child development, particularly within low- and middle-income countries, remains a core priority of the Sustainable Development Goals[163] and as such, a core priority for global health research. The existing literature related to adolescent pregnancy and the literature on living with

HIV (both maternal and child) identify both phenomena as being associated with adverse health and development outcomes among children.[111,164-170] For children born to adolescents who are living with HIV, the possible adverse implications for development may be compounded due to the broad array of biological, environmental, and psychosocial consequences associated with both living with HIV and adolescent pregnancy (see sections **1.4** and **1.5**) – inclusive of the impacts of adolescent maternal mental health.

1.7.1 Child cognitive development

Development within children is maturational. As such, the attainment of skills and prospects throughout the life course is constructed on foundational capacities formed in early childhood.[150] Early childhood, from birth up to 8 years, is a significant period of growth and development representing the continuous evolution of developmental domains (i.e., motor, sensory, emotional, social and language skills).[171,172] The development of such skills is influenced by a multitude of factors inclusive of genetics as well as child interactions and experiences with their environment.[173,174] Development in early childhood provides a basis for longer term health and wellbeing among children and has lifelong consequences.[171,172]

Cognitive development is an area of child development which encapsulates how children perceive and understand the world around them. Skills and areas relating to child cognitive development include reasoning, the development of language, motor skills, memory, and information processing. Children begin to develop such skills from birth through the processing of information from their environment.[171,172,175] The successful development of these skills are fundamental to an individual's future success and prosperity.

Child cognition has lasting implications for both the individual child themselves as they move through childhood, adolescence, and adulthood, and additionally has implications for broader communities and societies. Child cognitive development is impacted by numerous factors, not limited to biological factors (e.g., birth weight, nutrition, health conditions - such as HIV[176]), environmental factors (e.g., home

environment, socio-economic resources [income, educational attainment]), and psychosocial factors (e.g., parental health, parent-child interaction, learning and development opportunities).[173,174,177] Within sub-Saharan Africa, children are often exposed to multiple forms of deprivation.[178-181] Given this, over two thirds of children under 5 years of age do not reach their cognitive potential.[182] This places children living within sub-Saharan Africa at the highest risk of poor child development, globally.[182] Not reaching developmental potential may be associated with poor economic implications (i.e., children who do not reach their developmental potential are anticipated to only receive three quarters of the average annual income in adulthood compared to their peers who did reach their developmental potential).[10] Consequently, developmental delay may preserve cycles of poverty within future generations, which in turn may have widespread effects for regional and national growth, gross domestic product, and, country contributions to the global economy.[150,183] It follows that it remains critical to identify need, and those groups who may be particularly vulnerable. Factors such as adolescent motherhood, poor maternal mental health, and HIV may contribute to vulnerability among children.

1.7.1.1 Measurement of child cognitive development

Given that domains of development are theoretical constructs, the assessment of developmental domains requires inference based on a child's performance in relation to different tasks (i.e., can a child complete an activity that is reflective of the level of development expected at a given age?).[184] Numerous validated tools for assessing the cognitive development of children exist. These tools are often used to determine whether a child is at risk of experiencing developmental challenges. The majority of tools require the child to complete a series of tasks while being observed by a trained administrator. Examples of assessments of child cognitive development that have been utilised in sub-Saharan Africa and South Africa include the Mullen Scales of Early Learning,[185] the Malawi Development Assessment Tool,[186] the Bayley Scales of Development,[187] and the Peabody Picture Vocabulary Test.[188]

These cognitive assessments have numerous strengths and limitations which should be considered in relation to their use and the interpretation of data. A major strength

of these tools are that they are standardised assessments of child cognitive development which ensures consistency of assessment across settings and allows for comparison. Secondly, these tools predominantly cover multiple domains of development (e.g., motor, language, reasoning) and therefore provide a comprehensive and concise overview of child development, indicating risk of developmental problems. Third, these assessments rely on them being completed by trained researchers, and as such, they provide an independent assessment of development, rather than relying on caregiver self-report (which may be susceptible to bias).[189] Limitations include the cultural relevance of such measures.[149] With the exception of the Malawi Development Assessment Tool,[186] all other assessments for child cognitive development outlined above were developed in the Global North with reference populations from the Global North.[185,187,188] This raises issues relating to the relevance and appropriateness of these tools for the sub-Saharan African context (e.g., children's understanding of items and activities within the tools). Tools often require translation to local languages and adaptation to the local culture[186] (e.g., changing reference objects to those understood by children within the local context). This highlights the issue of validity with regards to such assessments. However, it should be noted that validity is somewhat difficult to evaluate within low- and middle-income countries, as often only a limited number of existing assessment tools have been used each context. Thus, the number of validation tools is somewhat restricted. Locally developed assessment tools that include culturally sensitive content should be a priority within the development of future measures. However, such measures require considerable resources to develop.[190] In the absence of such measures, locally validated tools and those tools previously used within the sub-Saharan African region provide a practical alternative. However, this should not detract from the need for locally derived measures or the role of cultural context within the understanding of child development.[190] A second limitation is the issue of access to screening tools. The majority of the measures detailed above (except the Malawi Development Assessment Tool) are not open access and therefore charges are incurred for use. This often limits the use of such tools and thus limits our understanding of child development within the sub-Saharan African context. The number of open access measures (e.g., measuring early learning quality and

outcomes [MELQO] developed by UNICEF[191]) is increasing in response to this issue, however, many of these measures utilise caregiver report rather than direct assessment, and many of these measures are yet to be locally validated or used extensively at the time of writing this thesis.[190] Third, while the above assessment tools capture multiple domains of child development, domains assessed vary between tools and not all aspects of child development are captured (e.g., the Mullen Scales of Early Learning do not measure attention). Similarly, the validated age range varies between measures. Thus, a complete understanding of child development within such settings remains absent from the literature.

The analyses in this thesis which focus on child cognitive development utilise the Mullen Scales of Early Learning.[185] The Mullen Scales of Early learning assesses a broad series of developmental abilities including motor skills, language development, and visual reception across five domains. The Mullen Scales of Early Learning were developed in the Global North using a reference population from the USA.[185] Thus, normative data, to which collected data is compared, is derived form a population in the USA.[185] Given this, the cultural relevance of the Mullen Scales of early learning remains a limitation. However, the Mullen Scales of Early Learning have previously been utilised within sub-Saharan Africa including within the extensive assessment of children affected by HIV (i.e., children living with HIV, children exposed to HIV, children living in high HIV endemic communities – the population of interest within this thesis).[192-200] The Mullen Scales of Early Learning have also been previously used within South Africa.[201] An additional advantage of the Mullen Scales of Early Learning is that they assess child cognitive development between 0-68 months, which allowed for the assessment of the majority of children eligible for the study in which data from this thesis were drawn and allows for the planned long-term follow-up of these children. Further detail relating to the use of the Mullen Scales of Early Learning within this thesis (e.g., the scoring of scales) can be found in **Chapter 6**.

1.7.2 Adolescent pregnancy, HIV & child development

Both adolescent pregnancy and HIV have been associated with adverse child health and development outcomes. Existing literature highlights that children born to

adolescent mothers are at an increased risk of adversity,[164] including poorer neonatal, cognitive, behavioural, and educational outcomes compared to children born to adult mothers.[165,166] Likewise, there is large body of evidence documenting the negative impacts of HIV (both for children living with HIV and those who are exposed to HIV in-utero and are uninfected [HEU]) on child development outcomes inclusive of physical growth and cognitive development.[111,167-170,202]

As discussed in section **1.4** (with a focus on adolescents), risk of developmental delay among children (and adolescents) living with and affected by HIV (i.e., those who are HEU), may be due to the biological effects of HIV on the brain and central nervous system, exposure to ART, or the associated psychosocial ramifications.[111,112,169] For instance, children living with HIV or those who are HEU are more likely to experience poverty, food insecurity, stigma and discrimination, caregiver ill-health, bereavement, and possible orphanhood.[114,117-119,203] In the context of adolescent mothers who may be affected by HIV, such factors may pose challenges for both the adolescent mothers and their child(ren) (who may either be living with HIV or be HEU). Additionally, existing literature has identified adult mothers living with HIV as being at risk of poor mental health.[161,204] There is also extensive global literature identifying poor maternal mental health as being associated with adverse child development outcomes,[153,194,205-209] potentially adding to the burden of risk among this group see section **1.7.3** below).

Given the rise in programming focusing on the prevention of mother to child transmission of HIV in recent years, fewer children are now living with HIV and there is a growing group of children who are HEU.[210] Children living with HIV are at a greater risk of developmental adversity compared to children who are HEU.[169,211-213] However, despite somewhat mixed literature, developmental challenges seemingly remain for children who are HEU when compared to children who are HIV unexposed.[168,170,211,214]

Inferring from the above literature children born to adolescent mothers living with HIV may be at risk of developmental challenges (whether living with HIV or HEU).

However, explicit examinations relating to the development of such children are seemingly yet to be undertaken. It is important to develop an understanding of the development of children born to adolescent mothers living with HIV (i.e., cognitive) to ascertain whether there is a risk of developmental challenges, and if so, whether such risk is similar to that of children born to adult mothers living with HIV, or children born to adolescent mothers, to allow for targeted policy and programmatic responses if required.

1.7.3 Maternal mental health & child development

Parental mental health (both maternal and paternal) has been found to negatively impact development outcomes for children born to adult mothers,[153,205,207-209] and have lasting implications for children.[206,215-217] Poor maternal mental health has been found to been linked to poor birth outcomes (e.g., low birth weight, extended labour),[218-220] and physical outcomes for children (e.g., stunted growth),[206,216,221,222] which in turn may lead to long-term development challenges among children. Likewise, poor maternal mental health has been linked to worse cognitive skills and socio-emotional development among children.[205,206,217,223,224] Poor mental health has also been found to adversely impact children having previously been found to be associated with poor attachment, harsher parenting, and reduced child cognitive development.[194,206] As detailed above (section **1.7.2**), poor mental health has been found to be prevalent among mothers living with HIV.[161,204] Among adult mothers living with HIV, poor mental health has been found to be associated with lower cognitive development scores among children.[194] It is important to understand whether parental mental health in the presence of adolescent pregnancy and HIV is similarly problematic, or potentially even more problematic.

Despite the vast global literature (inclusive of works from sub-Saharan Africa) on the impacts of maternal mental health on child development, the literature focusing on the impacts of adolescent maternal mental health and overall child development is scant. Available literature from the Global North (USA) identifies adolescent maternal mental health (depression) to be associated with worse child behaviour and reduced child warmth towards their mother,[225] factors which may have implications for child

development. Yet, there is a dearth of explicit investigations (with both the Global North and Global South) regarding the impacts of adolescent maternal mental health on the cognitive development of their children. Given this, the impacts of maternal mental health, inclusive of implications for the development of children born to adolescent mothers, remain unknown.

1.8 Fatherhood in the context of adolescent pregnancy & HIV

Due to the monumental consequences of pregnancy, childbirth, and childrearing for female adolescents, this group dominate the literature. Yet, the experience of adolescent parents is not confined to females. Despite this, the existing literature focusing on adolescent fathers and the fathers of children born to adolescent mothers is sparse – particularly in relation to HIV and mental health.[159]

1.8.1 Fathers – do they matter?

Fathers are key to the well-being of children and their families. Recent decades have brought about a global change within the role, involvement and understanding of fathers in the context of families.[226-228] Within many countries, the promotion of gender equality and the consequential shift in gender rights and roles has led to socio-economic changes such as an increase in women's engagement in the workforce, and an increase in educational attainment. Subsequently, this has led to an alteration in the functioning and formation of families.[229] This shift in gender roles has led to a reformation of father's roles and responsibilities within families – with an emphasis on caregiving and involvement of fathers in the lives of their children.[229,230] Within the existing literature it is well established that active positive father involvement has broad beneficial impacts for both maternal (e.g., mental health)[231-234] and child outcomes (e.g., development, feeding).[235-241] Furthermore, the early involvement of fathers within the lives of their children often establishes lifelong engagement and may enhance development outcomes among children in later life.[242] However, much of the existing research on fatherhood and male partner involvement is from the Global North.[238,243] As such, there remains a biased view of fatherhood as existing literature does not explore the involvement of fathers within

different socio-economic, and cultural contexts. Consequently, there remains a limited understanding of fatherhood within sub-Saharan Africa.[238] Given the variation in cultures globally, there may be differences in how fatherhood is experienced among different groups.[244] Given the diversity of sub-Saharan Africa's cultural composition, it is essential to develop contextually relevant understandings of fatherhood experiences to better inform policy to promote family wellbeing within the region.

1.8.2 Fatherhood in the sub-Saharan African context

A patriarchal head of the family is the traditional dominant view within most sub-Saharan African cultures. In this, fathers are traditionally seen to be providers for families and hold overall responsibility in the family. As a result, childcare is often the responsibility of females and in some contexts the exclusive contribution of fathers is to provide financial support.[245-248] In juxtaposition to this traditional view, recent research has indicated an increasing involvement of fathers within childcare within sub-Saharan African communities.[238,246,248] This may be due to changing contexts, shifts in gender roles (i.e., women entering the workforce), and exposure to different communities and belief systems.[238,249,250] Despite the emergence of increased father involvement, there remains a dearth of literature focusing on the experience of fatherhood and the impacts of involvement. Much of the evidence drawn from sub-Saharan Africa on fatherhood (most of which is concentrated in South Africa), focuses on father absence, rather than father involvement, with existing research showing father absence having no difference on familial outcomes or detrimental impacts for both mothers, and children.[238] While there is a noted desire among sub-Saharan African fathers to be involved in caregiving,[251,252] father involvement is often met with barriers including exclusion from services (i.e., healthcare or child education services), socioeconomic factors possibly leading to migrant working, and gender roles and dynamics.[238] As a result of such barriers, father involvement is often low.[238] Based on what is known, largely from high income countries, father involvement within families and the lives of their children has promising benefits.[233,236,253,254] However, disparities within existing research (e.g.,

how father involvement/absence is measured – does this include caregiving activities, physical presence, or socioeconomic contributions to the family?) limit broad understanding and applicability. Future research is required to develop understandings of fatherhood beyond the focus on father absence, and address gaps in the existing literature to harmonise existing research efforts to ensure that the evidence base can effectively inform policy and programming efforts.

1.8.3 Fatherhood in the context of HIV

Within the context of HIV, there are again limited data relating to fatherhood,[255,256] but father involvement is seemingly important. Among men who are living with HIV there is a reported desire for fatherhood.[255] Within families affected by HIV, existing evidence has highlighted the benefits of father involvement including in relation to onwards HIV transmission (i.e., prevention of mother to child transmission efforts). For example, father involvement has been found to increase adherence to ART and feeding recommendations for children, and as a result reduce HIV infection rates among children.[257] Likewise, father presence in the lives of their children has been also found to have lasting implications related to future HIV acquisition among their children. For example, within South Africa, father absence/presence has been found to be linked to sexual risk behaviour, alcohol consumption, and incident HIV among adolescents.[258] Yet, among adult populations, compared to mothers not living with HIV, families of mothers living with HIV were more likely to experience paternal absence and disengagement.[259] Previous investigations of fatherhood in the context of HIV have often focused on fathers residing with their children and their financial contributions to the family. Consequently, there is absence of investigation into broader activities undertaken by fathers within the lives of mothers and their children affected by HIV,[256] and the impact of fathers on maternal and child outcomes. There is also a near absence of data relating to fathers in the context of child HIV status (i.e., children who are living with HIV, children who are HEU).

Within the context of HIV, fathers may have needs requiring specific support. For example, fathers of children living with HIV reported elevated psychological distress and parenting stress.[260] However, given the dearth of literature on such needs,

further investigations are required to adequately inform future policy and programming efforts. In relation to the specific content within this thesis, there is an absence of explicit explorations of adolescent fatherhood and the fathers of children born to adolescent mothers in the context of HIV.

1.8.4 Adolescent fatherhood in South Africa

In the context of adolescent pregnancy, motherhood, and HIV, fatherhood remains a neglected topic. Like adolescent mothers, adolescent fathers are also navigating the developmental period of adolescence, and the possible challenges of parenting. In 2011, approximately 1% of all fathers in South Africa were adolescent fathers.[261] Yet, accurate country estimates of adolescent fatherhood are difficult to ascertain, possibly due to unknown or a reluctance to share paternity status.[262] In contrast to this, in some communities within South Africa, fathering a child signifies masculinity and adolescents may seek out fatherhood to affirm a masculine status.[263] Both wanting to demonstrate masculinity and engaging in sexual risk-taking behaviours have been identified as factors contributing to adolescent fatherhood in South Africa.[263] Challenges for adolescent fatherhood include financial dependency and caring responsibilities for children.[263] Possible solutions to navigating such challenges vary within the literature – adolescent fathers may rely on financial support for themselves and their children from their caregivers,[264] or adolescent fathers may actively renegotiate their identity to take responsibility for their child(ren), restructuring goals and relationships to provide emotional and financial support for their child(ren).[265,266] Drawing on the literature in the section above, father involvement may be a critical form of support for adolescent mothers and their children. Father presence may also interrupt intergenerational cycles of adolescent pregnancy and parenting, as father absenteeism within South Africa has previously been linked to early sexual debut and adolescent pregnancy.[267] The current understanding of adolescent fatherhood (including the needs of adolescent fathers) remains restricted as much of the existing literature was published before 2000.[268] As such, further research is required regarding how best to support adolescent fathers, and their families.

The impacts of father involvement may differ based on father characteristics.[241] Much of the existing literature on fatherhood focuses on adult fathers. Within the context of adolescent pregnancy, there is a particular focus within the literature on age disparate relationships with little focus on broader characteristics exploring who the fathers of children born to adolescent mothers are. The focus on age disparate relationship raises issues of concern including abuse, transactional sex, and child marriage.[269,270] Hence, policy, programming and research efforts often bring attention to adolescent pregnancy within the context of age disparate relationships. Given this focus, adolescent fathers are often excluded from research and policy agendas. There is an urgent need to develop the evidence base relating to adolescent fathers (particularly within the context of HIV; see above). Likewise, within the context of adolescent pregnancy it is important to develop an understanding of who the fathers of children born to adolescent mothers are (regardless of age) inclusive of their role in the lives of adolescent mothers and their children, and within the context of HIV.

1.8.5 Paternal mental health

Gender and biological sex are critical determinants in mental health, with females more likely to experience/report mental ill-health compared to males (see section **1.3**).[271,272] There is a growing research interest in paternal (or parental, as separate from maternal) mental health,[273,274] and to a lesser extent a growing interest within policy and practice. Poor paternal mental health has been linked to both maternal and child outcomes (e.g., poor paternal mental health has been found to impact fathers' interactions with their children, maternal interactions with children, and behavioural outcomes among children).[275] There is a paucity of literature exploring paternal mental health in sub-Saharan Africa, and the existing global research on paternal mental health mostly focuses on adult populations. Explorations of mental health among adolescent fathers have identified elevated poor mental health symptomology among adolescent fathers compared to adult fathers.[276] Yet, there is a dearth of literature exploring adolescent paternal mental health in relation to maternal and child outcomes.

1.9 Developing a framework for the works in this thesis

Given the broad array of concepts explored within this thesis, these works are informed and inspired by numerous concepts, theories, and frameworks. This section gives an overview of some of the concepts, theories, and frameworks informing these exploratory works.

As will be set out in **Chapter 2**, there is an absence of existing literature focusing on the mental health of adolescents living with HIV who have experienced pregnancy. Given this, there is an absence of evidence relating to the mental health needs of adolescents living with HIV who have experienced pregnancy, and, as such, a lack of evidence to guide the development of policy, intervention, and the allocation of resources. To be effective, the development of interventions should be grounded in existing literature. Effective theories of change for the development of interventions require a robust program theory including prevalence rates, as well as risk and protective factors for the outcome of interest.[277] The works within this thesis provide an initial exploration of mental health among adolescents living with HIV who have experienced pregnancy in South Africa, and, as such, aim to contribute to building a problem theory to inform future intervention, policy, and resources allocation.

Through the undertaking of the works in this thesis, it quickly became apparent that existing evidence focusing on adolescent pregnancy predominantly focuses on female adolescents with little consideration or acknowledgement of males. This prompted the candidate to incorporate a gender focus (inclusive of biological sex) within the thesis to ensure that the experiences of both female and males in relation to the core topics of interest in this thesis (adolescent pregnancy and parenthood, HIV, and mental health) were reflected. **Chapter 7** focuses specifically on the experiences of adolescent fathers and the fathers of children born to adolescent mothers. Through incorporating a gender focus, these works aim to highlight the exclusion of males within the current literature and allows for insight into the potential differing experience of female and male adolescents, as well as the possible

role of fathers within the experiences of adolescent mothers (both living with and not living with HIV).

The socio-ecological model states that health (or more specifically, mental health for the purpose of this thesis) is impacted by characteristics of the individual, the community, and the environment, as well as the interactions between characteristics within each of these levels.[278,279] The socio-ecological model provides a framework for understanding human behaviour and development in which the individual is influenced by numerous systems (often illustrated by the individual surrounded by nesting circles representative of various systems). The microsystem is the system closest to the individual comprising of individual and family level factors. The mesosystem focuses on factors at a community level. The exosystem does not have a direct impact on the individual but impacts at a family or community level (e.g., economic, social, political, and structural elements). The macrosystem incorporates societal and cultural influences.[278] This model, first conceptualised by Bronfenbrenner[278] has previously been utilised, and been effective, within investigations of mental health,[280,281] and is often adapted within health and wellbeing promotion efforts globally (e.g., Centres for Disease Control and Prevention violence prevention strategy,[282] UK health promotion strategy[283]). Given that adolescence is a core period within human development, utilising a socio-ecological model to understand adolescent mental health is particularly relevant.[284]

However, the use of the socioecological model should be considered in the context of some limitations. For instance, the application of the model to potential attributable outcomes (i.e., improved mental health within health promotion efforts) are difficult to examine empirically. Similarly, it is difficult to empirically examine the mechanisms through which the numerous systems influencing behaviour (i.e., mental health) interact. At a theoretical level, the interactions between systems are not clearly understood,[285] and often the application of the socio-ecological model to health promotion efforts (e.g., UK health promotion strategy[283]) does not account for or attempt to examine the interaction between systems. Nevertheless, the application of the socio-ecological model as a framework has particular strengths. It

offers a comprehensive view of development, accounting for both individual and environmental influences on behaviour (in this instance mental health).[278,279] Additionally, unlike the majority of theoretical frameworks within the social sciences, the socioecological model has been used to develop and design policy which has been implemented in practice (see above). Thus, the model provides a framework which can translate to policy and programming. The works within this thesis aim to develop an understanding of the mental health experiences of adolescent parent families within the context of HIV with the intention of being able to build the evidence-base to better inform policy and programming for this group. Thus, being informed by a framework with practical applications was deemed to be of benefit.

The works in this thesis utilise secondary data and thus data had been collected before the commencement of this thesis. Given this, it was not possible to explore factors that may impact on the mental health of adolescents (both living with and not living with HIV) who have experienced pregnancy within all hypothesised systems in the model nor interactions between systems. However, to acknowledge the broader social context and the lived realities of adolescents' lives, the socio-ecological model was used to guide the selection of hypothesised risk factors (correlates) that might impact on the mental health of adolescents (living with and not living with HIV) who have experienced pregnancy at an individual, interpersonal and, community level in **Chapter 5**. The use of the socio-ecological model in this way is also aligned with a life course and social determinants of mental health perspective that stresses that mental health is not shaped exclusively by individual level factors but also to a large extent by the social, physical, and economic environments which individuals are exposed to within their lives.[272]

1.10 Thesis aim & objectives

Data from two prospective cohort studies (the ***Adolescent HIV study,*** and the ***HEY BABY study*** see section **3.1**) undertaken within the Eastern Cape province, South Africa are utilised to explore the research questions outlined in section **1.1**.

The analyses within the proceeding chapters aim to develop an understanding of likely common mental disorder symptomology (depressive, anxiety, posttraumatic stress, and suicidality) among adolescents experiencing parenthood in the context of HIV within South Africa. Specific objectives of this thesis are to:

Objective 1: Review and summarise the existing literature on likely common mental disorder among adolescents living with HIV and experiencing pregnancy in sub-Saharan Africa (**Chapter 2**)

Objective 2: Investigate the prevalence of likely common mental disorder among adolescents experiencing parenthood in the context of HIV (adolescent mothers; **Chapter 4**, adolescent fathers; **Chapter 7**)

Objective 3: Explore risk factors (correlates) for likely common mental disorder among adolescent mothers both living with and not living with HIV (**Chapter 5**)

Objective 4: Explore child cognitive development in the context of adolescent motherhood, adolescent maternal mental health, as well as maternal and child HIV status (**Chapter 6**)

Objective 5: Explore the characteristics of fathers of children born to adolescent mothers in the context of likely maternal common mental disorder and maternal HIV (**Chapter 7**)

The final chapter of this thesis (**Chapter 8**) provides a summary of findings from the preceding chapters, contextualises these findings, provides an overview of limitations and strengths of these works, and discusses recommendations for future research, policy, and programming.

1.11 Chapter summary

High rates of both adolescent pregnancy and HIV within sub-Saharan Africa may increase the vulnerability among adolescents and their children, inclusive of

challenges relating to mental health, and child cognitive development. Adolescent mothers and their children are a core population within both the HIV response and the development of the sub-Saharan Africa region. It is therefore critical to build an understanding of the experiences of, and challenges for, this intergenerational population to inform targeted, evidence-based, policy and programming which recognises the complexities of the lived realities of this population as required. This thesis focuses on developing an understanding of likely common mental disorder among adolescent parent families in the context of HIV in South Africa. This chapter summarises the core topic areas relevant to the works within this thesis - adolescent mental health, adolescent pregnancy and parenthood, child cognitive development, and fatherhood in the context of adolescent pregnancy – and provides a rationale for the works undertaken in the proceeding chapters in which these topics intersect.

Chapter 2 Understanding common mental disorder in the context of adolescent pregnancy & HIV in sub-Saharan Africa: A systematic review identifying a critical evidence gap

This chapter details the first systematic review undertaken to explore, 1) the prevalence/occurrence of poor mental health (defined as likely common mental disorder) among adolescents living with HIV who have experienced pregnancy in sub-Saharan Africa, 2) risk and protective factors for likely common mental disorder among adolescents living with HIV who have experienced pregnancy in sub-Saharan Africa, and 3) interventions (including both prevention/treatment interventions) for likely common mental disorder for adolescents living with HIV who have experienced pregnancy in sub-Saharan Africa. See **Table 2-1** for an overview of the population included within this review.

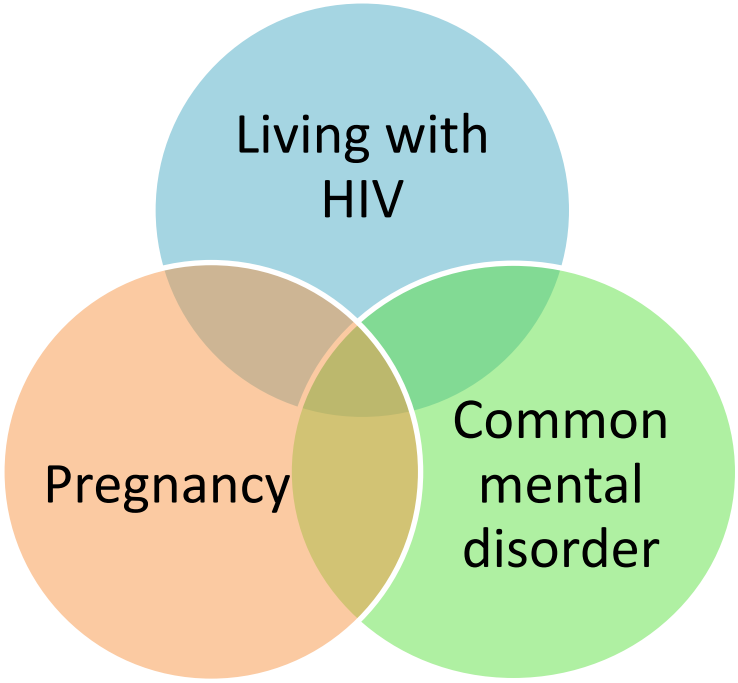
The works within this chapter have resulted in the following peer-reviewed publication:

Roberts, K. J., Smith, C., Cluver, L., Toska, E. & Sherr, L. (2021). Understanding Mental Health in the Context of Adolescent Pregnancy and HIV in Sub-Saharan Africa: A Systematic Review Identifying a Critical Evidence Gap. AIDS and Behavior, 25:2094–2107. DOI: https://doi.org/10.1007/s10461-020-03138-z

2.1 Background

As detailed within the background of this thesis (**Chapter 1**), poor mental health within adolescent pregnancy and parenthood may have implications for both parent and child.[152,153,205,207-209] Sub-Saharan Africa has the highest prevalence of adolescent pregnancy in the world (approximately one in five female adolescents will experience pregnancy),[286] yet most of the existing literature relating to adolescent pregnancy and parenthood originates from outside of sub-Saharan Africa. Adolescents within

sub-Saharan Africa face specific challenges i.e., living in high HIV endemic communities (an estimated 2 million adolescents are living with HIV in sub-Saharan Africa).[104,106] Poor mental health has been found to be prevalent among adolescents living with HIV[124,127] and, likewise, those experiencing adolescent pregnancy and parenthood[152,153] within separate explorations. The dual impact of such phenomena may compound poor mental health experiences. As stated in section **1.6**, mental health may have a bidirectional relationship with the experience of adolescent pregnancy and HIV.[131,152,162] Parental mental health has previously been found to have implications for child development,[153,205,208,209] which may have both short- and long-term social and economic implications for individuals, communities, and broader society. It is therefore important to understand whether parental mental health disorder within the context of HIV and adolescent pregnancy is comparably (or potentially more) problematic. However, prior to this systematic review, the literature focusing on mental health among adolescents within the context of HIV (i.e., those adolescents living with HIV and experiencing pregnancy) with sub-Saharan Africa is yet to be summarised. As stated in **Chapter 1**, there is a high prevalence of adolescents living with HIV in sub-Saharan Africa, likewise there is a high prevalence of adolescent pregnancy. Given the global estimates relating to mental disorder among children and adolescents (10-20% of children and adolescents are affected by poor mental health globally),[11,30] a large proportion of adolescents living with HIV and experiencing pregnancy may be experiencing poor mental health - yet, such estimates are unknown. See **Figure 2-1**.



Note. For illustrative purposes only

Figure 2-1 Venn diagram illustrating the syndemic experience of living with HIV, experiencing pregnancy, and experiencing likely common mental disorder among adolescents

2.1.1 Defining common mental disorder

As detailed in section **1.3**, commonly emerging mental health challenges within adolescence comprise emotional disorders including depression and anxiety. Globally, depression and anxiety are leading causes of illness and disability among adolescents.[28,30] Such disorders have profound impacts; affecting daily life and, at their worse have implications for mortality (e.g., depression may lead to suicide).[29,30] Within contexts of high-poverty, -violence, -communicable disease (i.e., HIV) and -levels of adolescent pregnancy, such as within sub-Saharan Africa, trauma may also present challenges for adolescents.[31-34] Due to the potentially commonality of such mental health challenges among adolescents (including the population of interest), and the emergence of transdiagnostic approaches (see section **1.3**) to interventions for mental health among adolescents within low and middle income countries,[89] for the purpose of this thesis' measures of depression, anxiety, posttraumatic stress and

suicidality symptomology are subsumed under the rubric of likely ***common mental disorder.***[287] Where possible, individual disorders will additionally be explored separately. The concept of common mental disorder has been used extensively within the global mental health field.[14,81,287-289] In recent years, there has been a call to shift away from binary classifications of mental disorder towards a continuum approach to mental health to better reflect the diversity and complexity of mental health experience within the global mental health field.[76,81] However, this is yet to be implemented at scale (see section **1.3**).[76] Due to the potential paucity of quantitative research focusing on adolescent mental health experience within sub-Saharan Africa, the use of existing classification systems seemingly will provide the most substantial evidence in relation to mental health experience at this time. While it is important not to pathologise or reduce the contextual understanding of the mental health experience of adolescents through such labelling, it is critical that need in relation to mental health experience and elevated poor mental health symptomology is identified to ensure that adequate and effective support can be provided. While a clinical diagnosis of mental disorder is the "gold standard" classification, validated scales and questionnaires are common practice within research studies undertaken within low and middle income countries and provide a more practical estimates of poor mental health across and within population.[80] Given this, measures of poor mental health symptomology and, where possible, clinical diagnosis will be included within this review. In addition, to ensure comprehensiveness and broaden the contextual understanding of mental health beyond quantitative investigation, qualitative studies exploring mental health experience of adolescents living with HIV who have experienced pregnancy are also included within the forthcoming review.

2.1.2 Rationale for systematic review

Summarising existing data is imperative to assessing the scale of likely common mental disorder among adolescents who have experienced pregnancy (inclusive of adolescent fathers) and are living with HIV, as well as enhancing the fields understanding of mechanisms of effect for likely common mental disorder and interventions that may be effective for these adolescents should they be required.

Such an overview is critical to establishing need, where gaps in the existing evidence base remain, and future research directives.

2.1.3 Aim and objectives

This chapter aims to summarise the existing evidence relating to mental health among adolescents living with HIV who have experienced pregnancy (those who are currently pregnant or have experienced pregnancy during adolescence and already given birth. Adolescent males who report fatherhood are also included. The systematic review is focused on sub-Saharan Africa (due to the high prevalence of adolescent pregnancy with this the region[7]) with three specific objectives:

Objective 1: To identify the prevalence/occurrence of likely common mental disorder among adolescents (10–19 years old) living with HIV experiencing pregnancy (including fatherhood) in sub-Saharan Africa.

Objective 2: To identify risk and protective factors for likely common mental disorder among adolescents (10–19 years old) living with HIV experiencing pregnancy (including fatherhood) in sub-Saharan Africa.

Objective 3: To identify which psychosocial interventions have aimed to reduce likely common mental disorder among adolescents (10–19 years old) living with HIV experiencing pregnancy (including fatherhood) in sub-Saharan Africa, and the effectiveness of such interventions.

2.2 Methodology

This systematic review adheres to the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines.[290] Prior to initiation, the systematic review protocol was registered via the PROSPERO database (protocol number: CRD42019133585). To provide a comprehensive overview of mental health with the context of adolescent pregnancy and HIV, both quantitative and qualitative studies were included within this review.

2.2.1 Inclusion and exclusion criteria

Only those studies meeting the pre-specified inclusion criteria and none of the exclusion criteria (see **Table 2-1**) were included in the review findings. Studies were included if the outcomes of interest (likely common mental disorder [for quantitative studies]/mental health experience [for qualitative studies]) were clearly identifiable for the population of interest (adolescents living with HIV who had experienced pregnancy i.e., currently pregnant adolescents, or individuals who experienced pregnancy during adolescence [inclusive of adolescent fathers]). Quantitative studies utilising outcome measures relating to likely common mental disorder (as defined by this review; see **Table 2-1**) were identified for inclusion. Common mental disorder is often used as an overarching term within the field of mental health and encompasses an array of mental health burdens.[14,81,287-289] Many validated measures relating mental health are often labelled with reference to common mental disorder i.e., the Shona Symptom Questionnaire (a measure of common mental disorder).[291] However, the concept of common mental disorder is much broader,[14,81,287-289] and therefore search terms were extended to map additional concepts including depression, anxiety, posttraumatic stress, and suicidality to identify studies utilising such measures from which we could glean data relating to prevalence, predictors, and interventions for mental health among the group of interest. Within the identification of qualitative studies, the outcome measures of interest were expanded to include any discussion of experience relating to mental health among the population of

interest to glean the most information relating to the mental health experience of the population of interest.

2.2.2 Search strategy and selection criteria

Using a pre-determined search strategy, studies considered for inclusion within this review were identified through a systematic search of electronic bibliographic databases. Databases searched included: PsycINFO (1806-present), PsycExtra (1900-present), PsycARTICLES, Embase, PubMed (including MEDLINE, 1966-present), Global Health Archive (1910-1972), Web of Science (1900-present), and the Cochrane database of systematic reviews. Campbell Collaboration Records and PROSPERO register for systematic reviews were also hand searched using multiple variations of the search terms used within this review (see **Figure 2-2** for a list of search terms used within the review). The bibliography of manuscripts selected for full-text review were also scrutinised to identify works for inclusion within this systematic review. Database searches were undertaken in September 2020.

Table 2-1 Inclusion and exclusion criteria for studies within this systematic review

	Inclusion criteria		Exclusion criteria
	Quantitative studies	***Qualitative studies***	
Population	Individuals reported to be living with HIV who are currently or have previously experienced any pregnancy during adolescence (10-19 years; inclusive of adolescent fathers)		
Outcome measure	- Validated measures of likely common mental disorder including depression, anxiety, posttraumatic stress, suicidality and/or self-harm	- Any exploration of mental health experience as defined by the study	
Geographical location	-Sub-Saharan Africa[1]		-Studies undertaken wholly outside of sub-Saharan Africa
Study design	- Randomised control trials - Cluster randomised control trials - Quasi-experimental studied with an identified control group - Controlled before and after studies - Longitudinal cohort studies - Cross-sectional studies (relating to aim one [prevalence] only)	- Qualitative studies	
Publication type	- Peer reviewed manuscripts - Grey literature including dissertations and theses - Conference abstracts and presentations with sufficient information		- Books
Language	- English, French		- All other languages
Intervention (for relevant studies only)	Psychosocial; psychological (e.g., psychological therapies), psychosocial (e.g., care, playgroups, social support, school-based interventions), physical (e.g., medical interventions), economic (e.g., economic assistance, material assistance).		

*To be included within the review data should disaggregate by HIV and pregnancy status

[11] Sub-Sharan African countries eligible for inclusion in this review: Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Democratic Republic of the Congo, Republic of the Congo, Ivory Coast (Côte d'Ivoire), Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Réunion, Rwanda, São Tomé and Príncipe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Tanzania, Togo, Uganda, Western Sahara, Zambia, Zimbabwe

The following search strategy was used to search PsycINFO (1806-present) and was adapted (as required) for other databases.

1. child*.mp.
2. adolescen*.mp.
3. youth.mp.
4. young adult*.mp.
5. young person*.mp.
6. young people*.mp.
7. young maternal*.mp.
8. young paternal.mp.
9. teen*.mp.
10. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9

11. Human immunodeficiency virus.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
12. HIV*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
13. HIV*AIDS*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
14. Acquired immune deficiency syndrome.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
15. PHIV*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
16. HEU*.mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh]
17. 11 or 12 or 13 or 14 or 15 or 16

18. 10 and 17

19. pregnan*.mp.
20. parent*.mp.
21. mother*.mp.
22. father*.mp.
23. exp Pregnancy/ or exp Pregnancy Outcomes/ or gestation*.mp.
24. matern*.mp.
25. antenatal.mp.
26. prenatal.mp.
27. perinatal.mp.
28. childbearing*.mp.
29. birth.mp. or exp BIRTH/
30. childbirth.mp. or exp Birth/
31. delivery.mp.
32. deliveries.mp.
33. exp FERTILITY/ or fertility.mp.
34. reproductive health.mp. or exp Reproductive Health/
35. postpartum.mp.
36. postnatal.mp.
37. puerperal.mp.
38. exp Breast Feeding/ or exp Lactation/ or breastfeeding.mp.
39. trimester.mp.
40. peripartum.mp.
41. 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40

42. CMD*.mp.
43. exp Mental Health/ or mental health*.mp.
44. exp Mental Disorders/ or common mental disorder*.mp.
45. Mental disorder.mp. or exp Mental Disorders/
46. mental illness.mp.
47. mental ill health.mp.
48. psychiatric.mp.
49. psychiatric disorder*.mp.
50. exp Psychiatric Symptoms/ or psychiatric symptom*.mp.
51. exp Affective Disorders/ or affective disorder*.mp.
52. exp Affective Disorders/ or Mood disorder*.mp.
53. exp Anxiety Disorders/ or Anxiety disorder*.mp.
54. depression.mp.
55. depressive.mp.
56. depress*.mp.
57. depressing*.mp.
58. exp Major Depression/ or depressive disorder.mp.
59. exp Postpartum Depression/ or Depression postpartum.mp.
60. Anxiety.mp. or exp ANXIETY/
61. exp Anxiety Disorders/ or Anxiety disorder*.mp.
62. social anxiety.mp. or exp Social Anxiety/
63. anxious*.mp.
64. exp Generalized Anxiety Disorder/ or generalised anxiety disorder.mp.
65. posttraumatic stress disorder.mp. or exp Posttraumatic Stress Disorder/
66. post-traumatic stress disorder*.mp.
67. post-traumatic*.mp.
68. exp POSTTRAUMATIC STRESS DISORDER/ or posttraumatic*.mp.
69. stress disorder*.mp.
70. suicidality.mp.
71. exp Suicide/ or suicid*.mp.
72. exp Self-Inflicted Wounds/ or self harm.mp.
73. suicidal behav*.mp.
74. exp DRUG OVERDOSES/ or overdose.mp.
75. self injurious behav*.mp.
76. self destructive behav*.mp.
77. exp Self-Inflicted Wounds/ or self inflicted wounds.mp.
78. exp Self-Mutilation/ or self mutilation.mp. or exp Self-Injurious Behavior/
79. suicidal ideation.mp. or exp Suicidal Ideation/
80. attempted suicide.mp. or exp Attempted Suicide/
81. auto mutilation.mp.
82. 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60 or 61 or 62 or 63 or 64 or 65 or 66 or 67 or 68 or 69 or 70 or 71 or 72 or 73 or 74 or 75 or 76 or 77 or 78 or 79 or 80 or 81

83. Africa.mp.
84. sub-sahara*.mp.
85. Sahara*.mp.
86. Angola.mp.
87. Benin.mp.
88. Botswana.mp.
89. Burkina Faso.mp.
90. Burundi.mp.
91. Cameroon.mp.
92. Cape Verde.mp.
93. Central African Republic.mp.
94. Chad.mp.
95. Comoros.mp.
96. Congo.mp.
97. Brazzaville.mp.
98. Democratic Republic of Congo.mp.
99. Cote d'Ivoire.mp.
100. Djibouti.mp.
101. Equatorial Guinea.mp.
102. Eritrea.mp.
103. Eswatini.mp.
104. Ethiopia.mp.
105. Gabon.mp.
106. The Gambia.mp.
107. Ghana.mp.
108. Guinea.mp.
109. Guinea Bissau.mp.
110. Kenya.mp.
111. Lesotho.mp.
112. Liberia.mp.
113. Madagascar.mp.
114. Malawi.mp.
115. Mali.mp.
116. Mauritania.mp.
117. Mauritius.mp.
118. Mozambique.mp.
119. Namibia.mp.
120. Niger.mp.
121. Nigeria.mp.
122. Reunion.mp.
123. Rwanda.mp.
124. Sao Tome*.mp.
125. Senegal.mp.
126. Seychelles.mp.
127. Sierra Leone.mp.
128. Somalia.mp.
129. South Africa.mp.
130. South Sudan.mp.
131. Sudan.mp.
132. Swaziland.mp.
133. Tanzania.mp.
134. Togo.mp.
135. Uganda.mp.
136. Western Sahara.mp.
137. Zambia.mp.
138. Zimbabwe.mp.
139. 83 or 84 or 85 or 86 or 87 or 88 or 89 or 90 or 91 or 92 or 93 or 94 or 95 or 96 or 97 or 98 or 99 or 100 or 101 or 102 or 103 or 104 or 105 or 106 or 107 or 108 or 109 or 110 or 111 or 112 or 113 or 114 or 115 or 116 or 117 or 118 or 119 or 120 or 121 or 122 or 123 or 124 or 125 or 126 or 127 or 128 or 129 or 130 or 131 or 132 or 133 or 134 or 135 or 136 or 137 or 138

140. 18 and 41 and 82 and 139

Figure 2-2 Search strategy for systematic review

2.2.3 Study selection and data extraction

All titles and abstracts identified through electronic database searching and hand searching were examined for relevance. Full manuscripts of any potentially relevant studies were obtained and assessed for inclusion. Where any uncertainty arose within the examination process of titles and abstracts, full manuscripts were acquired for further scrutiny. For validation, an independent researcher, reviewed a subsection of identified titles and abstracts (10%) – no discrepancies arose between the candidate and the independent researcher. Data from studies that met the inclusion criteria were extracted using a standardised extraction form which included publication detail, study methodology, geographical location, sample details, details of measures and relevant findings. Data extraction was carried out by the candidate and, in keeping with good research practice and publication guidelines, was scrutinised by co-authors of the published manuscript. No cases of dispute occurred.

2.2.4 Assessment of quality and risk of bias of included studies

Based on the recommended practice of the *Cochrane Collaboration*, as only non-randomised quantitative studies were included within this review, the Newcastle-Ottawa scale was used to assess risk of bias.[292,293] The Newcastle-Ottawa scale assesses the quality of the evidence within this review based on selection methods of the study i.e., representativeness, the comparability of groups of interest and the quality of the outcome measure. The scale ranges from 0-9, with scores ≥6 indicative of high methodological quality.[293] To maximise the validity of the assessment, both the candidate and an independent researcher completed the assessment for included studies. No disagreement arose between the two reviewers.

2.2.5 Synthesis of data

Based on the type and number of studies that met the inclusion criteria for this systematic review, a narrative synthesis providing a descriptive summary of studies is presented.

2.3 Results

Following the removal of duplicate records, 2287 citations were identified from electronic databases and hand searching: 2059 quantitative studies, and 228 qualitative studies. After completing title and abstract screens of all 2287 citations, inclusive of full-text screens of 38 quantitative records and seven qualitative records, **one quantitative manuscript was eligible for inclusion** based on the first objective of this review. No qualitative records were identified which met the inclusion criteria for the review (see **Figure 2-3**).

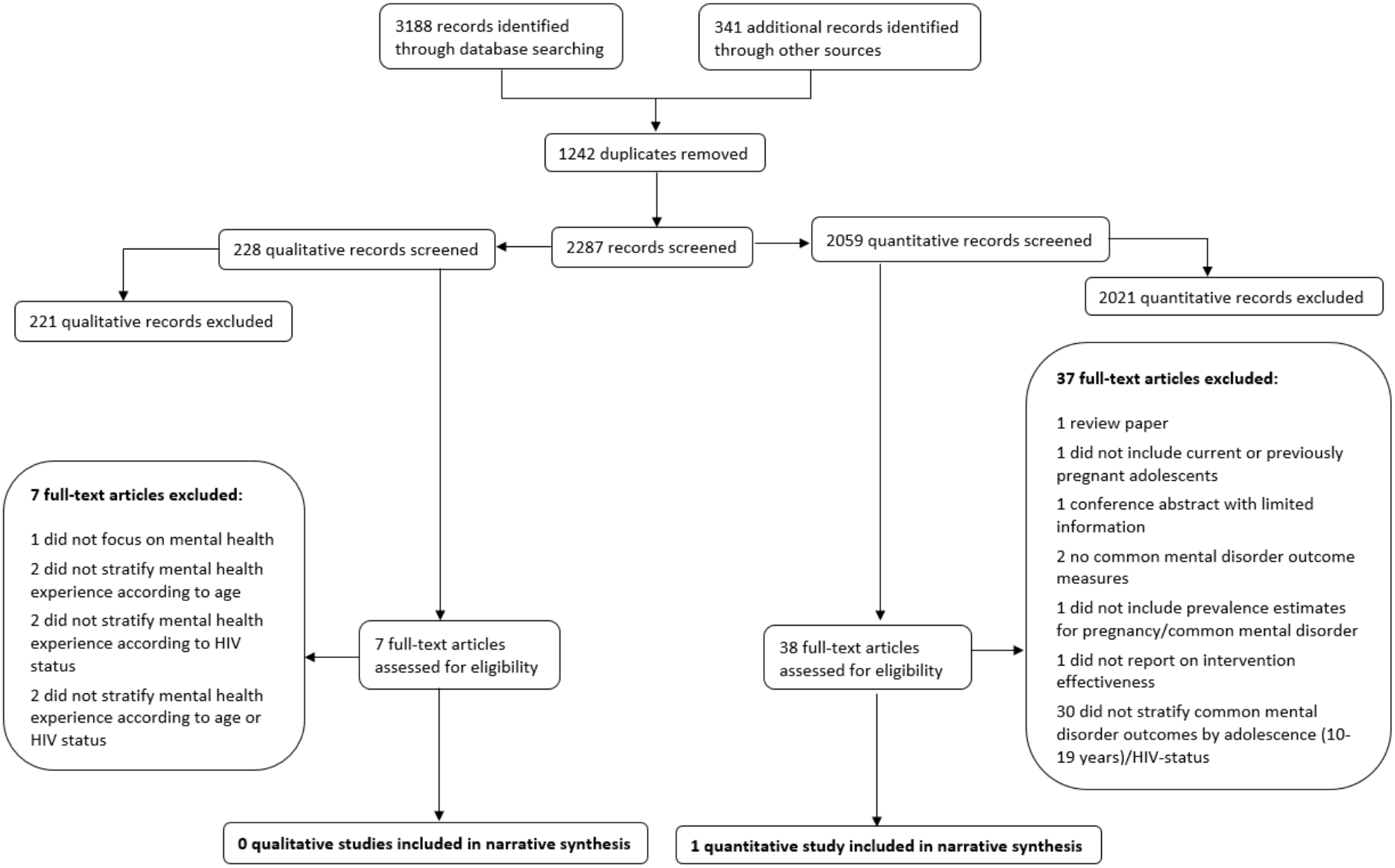


Figure 2-3 Study flow diagram for systematic review

This single study, undertaken in Kenya, focuses on a study sample of pregnant female adolescents and stratifies data relating to a positive depression screen according to HIV status as part of sub-analyses (see **Table 2-2**). Fourteen pregnant adolescents living with HIV were included within the study. Amongst those 14, 13 (92.9%) screened positive for symptomology consistent with likely depression whereas, 27.8% (45/162) of those not living with HIV in the sample screened positive for symptomology consistent with likely depression. Pregnant adolescents living with HIV in the sample also reported higher mean depressive symptomology scores comparative to pregnant adolescents not living with HIV (17.4 vs. 10.6, respectively; PHQ-9 scored 0-27). While an exploration of risk factors for common mental disorder was undertaken relating to the overall sample within this study, such findings were not stratified accord to HIV status and were therefore not included within this review.[294]

No manuscripts were identified which met the criteria for inclusion for objective two (identifying risk and protective factors for likely common mental disorder) or objective three (interventions for likely common mental disorder) of this review.

Table 2-2 Studies identified for inclusion within the review

Author & year	Country	Study design	Measure of CMD	Total sample (n)	Adolescents living with HIV (n)	Age	Female (%)	Male (%)	Study population	Prevalence of poor mental health symptoms
Osok et al. (2018)[294]	Kenya	Cross-sectional survey	Depressive symptoms; Patient Health Questionnaire-9	176	14 (8.0% total sample)	15-18 years	100%	n/a	Currently pregnant female adolescents recruited from an antenatal care clinic	Prevalence of depressive symptoms amongst adolescents living with HIV was found to be 92.9%

Table 2-3 Quality assessment of studies included within this review (Osok et al. 2018)[294]

Newcastle-Ottawa Scale (NOS) of methodological quality									
Selection				Comparability	Outcome			NOS total score (0-9)	Overall methodological quality
Representativeness of cohort	Selection of non-exposed cohort	Ascertainment of exposure	Presence of outcome of interest at study initiation	Comparability of cohort	Assessment of outcome	Length of follow-up	Adequacy of follow-up		
0	1	0	0	1	0	N/A	N/A	2	Poor

2.3.1 Quality and risk of bias of included studies

Table 2-3 provides a summary of the methodological quality of the single study identified by this review.[294] Overall, the study was given a score of 2 (scored 0-9), indicative of poor methodological quality due to multiple sources of bias (including: the representativeness of the sample, the ascertainment of pregnancy and combined HIV status within the sample, an inability to demonstrate that depressive symptomology was not present prior to pregnancy and combined HIV status, the use of self-reported outcome measures to ascertain depressive symptomology, and limitations directly linked to the use of cross-sectional data inclusive of a lack of follow-up data). It should be noted however that prevalence data (relating to objective one of this review) is by definition cross-sectional, and thus is not necessarily applicable to this assessment of quality and risk of bias.

2.4 Discussion

This systematic review identified only a single quantitative study that commented on the prevalence of likely common mental disorder amongst pregnant adolescents living with HIV in sub-Saharan Africa (objective 1). Within the identified study, the prevalence of likely depressive symptoms among pregnant adolescents living with HIV (a sub-sample of the whole sample included within the study; n=14) was 92.9%.[294] No studies were identified reporting on risk and protective factors for likely common mental disorder (objective 2), and no studies were found identifying specific interventions to improve mental health for this group (objective 3). The study included within this systematic review should be commended for the inclusion of disaggregated data relating to adolescents living with HIV who have experienced pregnancy. However, any inferences drawn from this data are limited, given the identified study did not meet the high methodological quality requirements utilised for the purpose of this systematic review.

While only one of the identified studies met the inclusion criteria for this review, numerous quantitative studies were identified within the search as partially relevant to the review. These studies did not meet the inclusion criteria as they did not stratify likely common mental disorder outcomes by age (adolescence; 10-19 years) or HIV status. These studies focusing on pregnancy and parenthood, (possibly including adolescents living with HIV based on the sampling strategy), may contribute insight into the mental health experience of pregnant (currently or previous) adolescents living with HIV. One study documenting the experience of adolescents living with HIV (male and female) reported the unadjusted association between ever being pregnant and current mental health status and identified no difference in mental health scores relating to experience of pregnancy.[295] This study was not included within the review, as it did not report on the number of participants within the study who reported pregnancy. Therefore, prevalence of likely common mental disorder for this specific sub-group could not be ascertained.[295]

In relation to prevalence of common mental disorder, 15 studies reporting on likely common mental disorder (as defined above) considered for inclusion within this systematic review did include pregnant or previously pregnant adolescents within their samples.[296-310] However, 11 of these studies did not stratify likely common mental disorder outcomes according to age, so prevalence rates within the adolescent group could not be identified.[296-298,300,301,303-306,309,310] Four studies did stratify likely common mental disorder outcomes according to adolescence, yet did not stratify by HIV status.[299,302,307,308] Within these studies, rates of likely common mental disorder amongst pregnant adolescents (two studies focused on pregnancy,[302,307] one the postpartum period [0-36 months][308] and, one on both pregnancy and the postpartum period[299]) ranged from 8.8% to 21.6% (total number of pregnant/previously pregnant adolescents ≥14 years included within the studies = 517).[299,302,307,308]

Four additional studies that included adolescents within the larger study sample (but did not stratify according to age or HIV status) reported on factors associated with likely common mental disorder. Post-partum depression was found to be associated

with impaired child growth.[299] Psychological morbidity during pregnancy was not associated with age, employment status[302] nor HIV.[302,307] Psychological morbidity among mothers was associated with having an older spouse in one study in Zimbabwe,[307] and, experiencing verbal/physical abuse, having a partner who did not help with childcare, being in a polygamous relationship, having a partner with lower levels of education and, having a partner who smoked tobacco in a study in Tanzania.[308] Furthermore, a study undertaken in Kenya, identified younger age, experience of a stressful life event and living with HIV as being associated with increased depressive symptomology during pregnancy, and social support as being a protective factor for depression within this period. While this study was included within the review in relation to prevalence, the examination of factors associated with depressive symptoms did not stratify by adolescents living with HIV.[294]

A further five studies were identified which were likely to have included adolescents within their sample based on the reported ages of the sample (presented as an average, alongside a measure of variability) reported on factors associated within likely common mental disorder. Within these five studies, likely common mental disorder was found to be associated with economic difficulties,[311,312] relationship difficulties,[312] HIV infection,[312] infant health issues,[312,313] food insecurity,[314] and experience of intimate partner violence.[311]

Six studies included populations aged ≥18 years.[315-320] As such, some older adolescents (18-19 years) may have been included within the sample. Within these studies, antenatal depression was found to be associated with unintended pregnancy[319] and younger age[315] (amongst pregnant women living with HIV), intimate partner violence,[316,320] and previous history of depression.[320]

Populations of ever-pregnant adolescents (not stratified by the adolescent period) were included in two studies (population age: 18+ years[318] and 14-46 years[303]), which stratified mental health outcomes by HIV status. These studies report mixed results. One study identified HIV as being associated with depressive symptoms,[303] and one reported depressive symptoms to be more prevalent amongst those participants who

were known to be HIV-negative in the sample when compared to those who were living with HIV.[318]

Likewise, six studies (which included, or may have included adolescents living with HIV within their sample [due to a lack of specific information regarding age and/or HIV status within the sample]) focusing on the associations between likely common mental disorder amongst mothers, and child outcomes report mixed results. Three studies identified no difference in child outcomes according to common mental disorder status.[297,300,311] However, three studies identified common mental disorder as having a negative effect on child behaviour,[304] child growth,[299,317] child emotional development and peer problems.[317] In a longitudinal sample of 70 mothers living with HIV, aged 16-64 years, the presence of likely common mental disorder was found to be associated with worse child behaviour outcomes.[304]

In relation to interventions, a study undertaken in Uganda reported on the development of a community-based intervention aimed at improving the wellbeing of adolescent mothers. However, it was not clear if adolescent mothers were living with HIV, and no results relating to intervention effects were reported.[321] Two intervention studies in which participants either received visitation from community health workers or standard care were undertaken within South Africa were identified. The samples for these studies likely included a small number of adolescents living with HIV who had experienced pregnancy; however, results were not disaggregated accordingly. The interventions provided mixed results. When undertaken in a peri-urban area in which participants received visits from community health workers, the intervention was found to reduce maternal depression at 6-month follow-up when compared standard available care.[322] However, a similar intervention, undertaken in a rural area, found no statistically significant differences regarding maternal depression scores between groups in the first two years postpartum.[323]

Within the search, a single study identified the rate of adolescent fatherhood to be 11.1% in South Africa. This study included data on likely common mental disorder as

well as data on adolescent pregnancy and adolescent fatherhood. However, data regarding likely common mental disorder was not stratified by parenthood status and, data regarding HIV status was not reported.[309]

Despite no qualitative studies being identified relating to mental health within the population of interest, several studies were identified which gave a partial view of the mental health experience of this group. While adolescents living with HIV who had experienced pregnancy (10-19 years) were included within two studies (total n=12; two articles were drawn from the same dataset) undertaken in South Africa,[324-326] findings relating to mental health were not disaggregated by age (adolescence; 10-19 years at time of pregnancy)[325,326] or HIV status.[324] While it was not possible to identify prevalence of common mental disorder from qualitative studies, descriptive experience of, and themes/experiences linked to poor mental health/emotionality were identified. Studies described "*despair*" and "*sadness*" related to pregnancy discovery,[325] "*anger*", "*embarrassment*" and "*suicidal ideation*" related to pregnancy, "*guilt*" related HIV discovery and, a "*fear*" of transmitting HIV to their unborn child.[326] "*Stress*" and "*anxiety*" were found to be linked to pregnancy disclosure rather than HIV disclosure, a withdrawal from schooling and, unstable family and partner relationships following pregnancy discovery. Adolescents also described "*sadness*" related to HIV discovery, a lack of partner support postpartum and, feeling that the baby had become a burden to their family.[324] Much of the data related to the pregnancy period and pregnancy discovery, with little mention of the postpartum or parenting period.[324-326] Themes related to poor mental health (as described by participants) within this context were feelings of unpreparedness relating to imminent motherhood and limited financial and emotional support.[325,326] These studies identified the female adolescents' families, particularly the maternal grandmother of the child, as critical in providing financial, emotional, psychological and physical support. Such support was identified as a key feature of "*coping*".[324-326] It should be noted that mental health experience does not remain static and as such may change over time. As such, these studies are limited by their focus on the period relating to pregnancy discovery as broader experiences relating to pregnancy, post-partum and parenting periods may be better placed to inform policy.

Adolescents living with HIV who had experienced pregnancy were or were likely to be included within a further three qualitative manuscripts based on information relating to the study sample however, results and emerging themes were again not disaggregated by age or HIV status.[86,327,328] These studies focused on experiences of "*depression*", "*suicidal ideation*[86,327,328] and "*anxiety*";[328]some of which mapped on to clinical common mental disorder symptomology.[328] Potential themes identified as being linked to poor mental health experiences were intimate partner violence,[327] lack of social support, [86,327,328] social isolation and stigmatisation related to both HIV and pregnancy,[327,328] poverty and a lack of material support,[86,327,328] and child illness.[328] Within secondary analyses, one study highlighted the interconnected and often bidirectional relationship between early (adolescent) pregnancy, HIV, and mental health, and the emerging importance of mental health within their original study focusing on HIV-affected female adolescents.[86]

A single qualitative study focused on a peer mentoring intervention for adolescents living with HIV who had experienced pregnancy relating to PMTCT. While mental health was not a focus of the intervention, the authors identified loneliness as being linked to anxiety among the study population and a desire for receiving psychosocial support from adolescent peer mentors, highlighting an example of an active intervention that may be a vehicle for psychosocial support for this population.[329] None of the qualitative studies identified which offered a partial view of the mental health experience of adolescents living with HIV who experienced pregnancy focused on adolescent fathers.

2.4.1 Adolescent pregnancy, HIV, and common mental disorder: A critical evidence gap

Disregarding attempts within this discussion to supplement the field's understanding of the mental health experience of pregnant adolescents living with HIV with partially relevant studies, this systematic review identified a single study focusing on likely common mental disorder among pregnant adolescents living with HIV (n=14) in Kenya. As such, mental health need among this group remains underexplored, and

there remains an absence of data from the sub-Saharan African region. Within this review, and among most studies identified deemed relevant to this review, the measures of likely common mental disorder relate to probable depressive symptomology, with few also commenting on measures of overall likely common mental disorder. Hence, there remains a limited understanding of other likely common mental disorder symptoms (i.e., anxiety, posttraumatic stress, suicidality) and the impacts of such experiences for both adolescents and their child(ren).

While a single prevalence estimate of depressive symptomology was identified, no exploration of risk and protective factors for common mental health nor, interventions to prevent or treat likely common mental disorder were identified for this group – despite evidence that pregnant adolescents (potentially living with HIV) are seemingly accessing some support.[321] As such, the effectiveness of any interventions currently in place is unknown. This finding supports previous research highlighting a lack of prevention interventions targeting mental health among adolescent parents within low and middle income countries.[330] Furthermore, no studies exploring the mental health experience and needs of adolescent fathers living with HIV were identified. As detailed in the introduction of this thesis (**Chapter 1**), adolescent mental health experiences have been found to have adverse outcomes across the life course.[14-20] For pregnant adolescents (current or previously), poor mental health has been found to have adverse impacts for both parent and child (i.e., bonding, child development).[153] For adolescents living with HIV, poor mental health has been found to have negative implications for service engagement, medication adherence and risk behaviours.[110] Hence, for pregnant adolescents living with HIV, additional considerations may arise; poor mental health may have impacts on service engagement (HIV, sexual and reproductive health, antenatal) and onwards HIV transmission (i.e., PMTCT engagement) - concerns critical to both adolescent and child wellbeing.[136] Adolescents living with HIV (both mothers and fathers) and their children may have specific needs, and therefore, further investigations into the mental health needs of this group are required to strengthen positive outcomes for this group.

There is seemingly a focus within the available literature on the pregnancy period with less attention given to the post-partum period and beyond. An exploration of outcomes for children born to adolescents living within HIV in relation to adolescent mental health also remains absent. Data for adult populations who may have experienced adolescent pregnancy may exist. However, a lack of stratification results in the mental health experience of adolescents living with HIV as they progress into adulthood and the subsequent impacts for their children, again, being absent from literature. Common mental disorder is not a static phenomenon, therefore mapping mental health experience over the life course is critical to assess how mental health need may change, and at which stage and/or under which circumstances intervention should be targeted.

The period of adolescence bridges childhood and adulthood and as such, data regarding this critical developmental stage is not consistently presented within the literature and may be missed within the presentation of data. Focused data on the adolescent period (10-19 years) is urgently required. Seemingly, (as detailed above in this discussion) data may be available regarding adolescent pregnancy and parenthood within the context of HIV within existing studies and databases. Many researchers only include individuals over 18 years of age due to ethical concerns, more stringent ethical review processes, and the challenges of engaging children and adolescents under 18 years old (i.e., logistical challenges, the requirement for specifically trained researchers and/or data collectors and the need for age-appropriate measures and study materials). However, not reporting the needs of adolescents - a potentially vulnerable group - also raises ethical concerns, as a lack of evidence may result in inadequate policy, programming, and resource allocation.

There is a dearth of knowledge regarding likely common mental disorder among currently or previously pregnant adolescents (inclusive of adolescent fathers) living with HIV in sub-Saharan Africa. This data gap is seemingly not simply that data regarding this group is not collected – data exists relating to likely common mental disorder within adolescent pregnancy and, likewise adolescents living with HIV – but partially because data is not disaggregated by age, HIV status, pregnancy/parenthood

status. As such, this data becomes lost within the findings relating to broader groups. Clustering data regarding adolescents with young adults (i.e., 15-24 years) remains a common feature within international data collection strategy.[331,332] Experiences may not be similar across this broad age range. Additionally, often adolescents are described as adult women within data and research following the birth of a child (possibly due to the legal emancipation of adolescent mothers within some countries, such as Kenya).[333] Such practices distort our understanding of the experience of adolescents living with HIV who have experienced pregnancy. This group should not be forgotten within research and policy agendas. This review echoes and extends calls for more granular data regarding adolescents living with HIV,[334] and high quality data regarding interventions for the prevention and treatment of mental health in adolescents living with HIV.[134] Expanding the scope of inquiry to include more explicit and scrupulous examination of the mental health needs of pregnant adolescent living with HIV is essential to ensuring that this adolescent group and their children are able to reach their potential. In the interim, disaggregation of available data would be a prompt and valuable exercise for research to better our understanding of this group, and to inform policy and programming. However, methodologies should also remain a consideration within future investigations relating to this group to ensure robust data to better inform policy where possible, including collecting data regarding pregnancy/parenthood, the use of longitudinal data, and greater access and analyses of available clinical data. The mental health of pregnant adolescents has socioeconomic implications for individuals, communities, and wider society (see section **1.1**). Ensuring adolescent mental health -inclusive of this potentially vulnerable group- remains at the core of development agendas is critical to providing the building blocks of prosperity for future generations and societies. Yet, to do this, an evidence base is required. Currently, this evidence base is lacking. The proceeding chapters of this thesis attempt to provide a foundation from which to build this evidence base.

2.4.2 Limitations of the review

The findings from this review should be interpreted in the context of certain limitations. Firstly, while extensive efforts were made to include a wide range of databases, only available databases were included. Likewise, grey (unpublished) literature was not included within this review. As such, some relevant studies may have been overlooked within the identification stage of this review. Secondly, some studies which may have included samples aged 18 years+ (older adolescents) focusing on common mental disorder, pregnancy, and HIV may not have been included within the identification process of this review, as the search terms within this review did not focus on adult populations. Thirdly, due to resource constraints, only manuscripts written in the English or French language (due to the high prevalence of French speakers within sub-Saharan Africa) were included within the review. Fourthly, it should be noted that the use of terminology within this review i.e., likely *common mental disorder* and the dependence on validated screening tools within the inclusion criteria for quantitative studies may limit investigation into broader experience of mental health for adolescents living with HIV who have experienced pregnancy within sub-Saharan Africa. While the use of such measures and classifications hold clinical utility,[76,81] individuals who may be experiencing some dimension of poor mental health but do not reach the clinical threshold may be missed within investigations. Additionally, the use of symptomology scales does not necessarily represent a clinical diagnosis of a mental health disorder. While there is movement within the field of global mental health towards broader classifications of mental health experience,[76,81] such detail is often not included within current clinical, research, or policy practice within sub-Saharan Africa.[76] Hence, the utilised classifications (predominantly based on symptomology scores) were deemed the most relevant in relation to the current state of the evidence, the most appropriate for summarising the experience of the population of interest in a timely manner, and the most accessible to policymakers. In an attempt to incorporate broader mental health experiences, qualitative studies relating to mental health focusing on the population of interest were additionally included as part of this review however, no manuscripts were identified focusing on the population of interest. The contextual,

conceptual, and linguistic relevance of such measures to adolescents within sub-Saharan Africa should also be noted.[86] The clinical interpretation of disorders such as depression, anxiety, posttraumatic stress, or suicidality may not be captured within adolescents' articulation of such experiences.[86,87] Likewise, often these disorders do not have direct linguistic translation within many languages used across sub-Saharan Africa potentially restricting the interpretation of diagnostic terminology. However, while recent research has identified some confusion among adolescents within sub-Saharan Africa over terminology definitions relating to mental health i.e., *anxiety*, items within clinical measures of mental health screening tools have been found to be relevant and understood among adolescents experiencing pregnancy within sub-Saharan Africa.[88] Finally, it was beyond the scope of this review to explore likely common mental disorder among pregnant (currently or previous) adolescents not living with HIV. Pregnant adolescents have been found to be at a greater risk of horizontal HIV infection,[154-156] which may in turn have implications for mental health. Therefore, this group should not be forgotten within research or programming responses.

2.5 Chapter summary & conclusions

Good mental health is critical to allow adolescents and their child(ren) to reach their full potential and thus, in turn, the success of the individuals, and at a societal level within the sub-Saharan African region. Yet, the mental health of pregnant adolescents (currently or previously) living with HIV (including both mothers and fathers) within sub-Saharan Africa has been neglected within the literature. This systematic review identified only a single quantitative study that commented on the prevalence of likely common mental disorder amongst pregnant adolescents living with HIV in sub-Saharan Africa. However, the inferences that can be drawn from this study are limited as it does not meet the high methodological requirement of this review. As such, there is an absence of knowledge regarding the prevalence of common mental disorder amongst this group, risk and protective factors for common mental disorder and the effectiveness of interventions – limiting evidence-based policy and programming for this group. This systematic review identifies a need for

rigorous evidence regarding the mental health of pregnant adolescents living with HIV and calls for granular interrogation of existing data to further our understanding of the needs of this group. There remains a pressing need to explore the mental health experience of pregnant adolescents living with HIV (inclusive of antenatal experience, post-partum, and fatherhood), and to assess the effectiveness of existing interventions being implemented for common mental disorder among pregnant (currently or previously) adolescents living with HIV.

Findings from this review inform and provide a rationale for the proceeding results chapters within this thesis. The prevalence of likely common mental disorder among adolescents living with HIV who have experienced pregnancy is explored utilising data from the ***Adolescent HIV study*** in **Chapter 3** and, the ***Helping Empower Youth Brought up in Adversity and their Young children (HEY BABY) study*** in **Chapter 5** (**Chapter 5** extends explorations of prevalence beyond the pregnancy period to parenting adolescents). **Chapter 5** additionally utilises data from the ***HEY BABY study*** to explore risk factors for adolescent maternal mental health. The impact of maternal mental health on child cognitive development will be explored utilising data from the ***HEY BABY study*** in **Chapter 6**, and **Chapter 7** begins to build a narrative relating to the fathers of children born to adolescent mothers (including paternal mental health) utilising data from both the ***Adolescent HIV study*** and the ***HEY BABY study***. Findings from these analyses, their context, and the implications for policy and programme development will be discussed in the concluding chapter of this thesis (**Chapter 8**).

Chapter 3 Data & methodological overview

Each results chapter of this thesis provides detail on the specific sample, measures, and methodology used within the respective analyses. This chapter gives an overview of data sources and methodology used within the results chapters of this thesis and provides a summary of the candidate's role within the study team. The methodology for the systematic review undertaken as part of this thesis is presented separately, within **Chapter 2** (see section **2.2**).

3.1 Data sources

This thesis uses data from two linked studies undertaken within a peri-urban and rural health district (Buffalo City Municipality) of the Eastern Cape province, South Africa (see Error! Reference source not found.):

1) the Adolescent HIV (***Adolescent HIV***) study - Mzantsi Wakho
2) the Helping Empower Youth Brought up in Adversity with their Babies and Young children (***HEY BABY)*** study

Figure 3-1 Map of the Adolescent HIV and HEY BABY study site centred around the Buffalo City Municipality within Eastern Cape province, South Africa

3.1.1 Study context: South Africa

The Republic of South Africa (South Africa) is the southernmost country in Africa and has a population of approximately 60 million people.[335] South Africa has three Capital cities: Pretoria (executive), Cape Town (legislative), and Bloemfontein (judicial). Nine provinces make up the country: Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, Mpumalanga, Limpopo. South Africa has 11 official languages: English, Zulu, Swazi, Afrikaans, Sepedi, Sesotho, Setswana, Xitsonga, isiXhosa, Tshivenda, Ndebele. Most of the population identify as Black South African (~81%), and communities of European, Asian, and Multi-ethnic ancestry make up the remainder of the population.[336] South Africa is a developing country in the Global South and is classified as an upper-middle income country by the World Bank.[337] Yet, South Africa remains burdened by inequality, having some of the highest levels of inequality globally as well as high levels of crime, poverty, and communicable disease (e.g., HIV and TB).[337-340]

3.1.2 Adolescent HIV study - Mzantsi Wakho

The ***Adolescent HIV study*** is a large prospective cohort study (n=1526) following adolescents living with HIV, and a comparison group of adolescents not living with HIV who co-resided with eligible participants or lived within the same communities. Analyses presented in **Chapter 4**, and **Chapter 7**, section 1 (**7.1**) utilise data the **Adolescent HIV *study***. The sample comprised 1059 adolescents living with HIV, and a comparison group of 467 adolescents drawn from the same geographical environment not living with HIV. The 1059 adolescents living with HIV were recruited from the records of 53 public health facilities and were followed up using community-tracing methods. All public health facilities in the region were included for recruitment purposes if they provided antiretroviral therapy to adolescents. All adolescents (10-19 years) who had initiated antiretroviral therapy were identified through either electronic or paper-based records and were followed-up to complete interviews in the form of questionnaires either in clinic, or at their homes to ensure those adolescents disengaged from clinic care were also included within the study.[122,341] At baseline, 90.1% of the eligible sample undertook interviews. Of the

9.9% of the sample that did not participate in the study: 0.9% were deemed unable to have capacity to give informed consent due to cognitive disability, 4.1% refused to participate in the study, 1.2% did not undertake interviews as it was deemed unsafe to do so, and 3.7% were unable to be successfully traced.

A comparison group of 467 adolescents, who co-resided with eligible participants or who lived within the same communities as participants, who had no recorded health condition and had not initiated antiretroviral therapy (and where therefore assumed to not be living with HIV), were also interviewed with a version of the questionnaire. The comparison group questionnaire omitted questions relating to HIV or adherence to HIV medication. The inclusion of this group allowed for comparison data and ensured that potential stigmatisation that may be associated with being involved with HIV research was averted. The study was presented to all participants as an investigation into the overall needs of adolescents, and an evaluation of engagement with health and social care. All data collection tools were piloted with adolescents living with HIV (n=25). Baseline data collection took place between February 2014 through to September 2015 and follow-up data collection (wave 2) proceeded between November 2015 to February 2017. The study had a 95.3% retention rate at wave 2 follow-up (n=1050 adolescents living with HIV, and n=404 adolescents not living with HIV). Adolescents were re-traced for further follow-up interviews in 2018 (wave 3) with a 93.6% retention rate (based on the baseline n; n=1010 adolescents living with HIV, and n=419 adolescents not living with HIV).

All adolescents and caregivers (if adolescents were <18 years of age) provided informed consent. To protect participant's confidentiality interviews were conducted in a private space chosen by the participant and electronic tablets (administered by trained data collectors) were used to collate participant responses. All participants completed a detailed study questionnaire consisting of validated scales and study specific questions focused on sociodemographic characteristics, health (inclusive of mental health screening measures), relationships, communities, schooling, and management of HIV (if appropriate). Questionnaires consisted of 12 sections and took approximately 90-100 minutes to complete. Study questionnaires were

developed in conjunction with adolescents, as well as local, national, regional, and global organisations. Questionnaires were pre-piloted with an adolescent advisory group local to South Africa prior to data collection and amendments to the questionnaire were made based on recommendations and suggestions from this advisory group. Participants completed questionnaires in their language of choice (isiXhosa or English), and data was translated and back translated if appropriate. Questionnaires can be accessed via http://www.youngcarers.org.za/youthpulse. Health data was cross-checked with clinical records during data cleaning. Any discrepancies in data were addressed utilising a series of solutions including further follow-up with participants.

The main aim of the ***Adolescent HIV study*** is to explore risk and resilience promoting factors for adherence to antiretroviral medication, the utilization of sexual and reproductive health services, and health outcomes of adolescents accessing HIV care. Given the aim of the ***Adolescent HIV study,*** data regarding adolescent pregnancy/fatherhood and mental health outcomes were recorded – however, this was not the core focus of the study. The detailed study questionnaire also collates data regarding demographic information, sexual and reproductive health, medication, HIV disclosure, stigma (HIV related), physical and mental health, risk behaviour, caregiver status and the home environment, education experiences, relationships with peers, poverty, and support. Sample characteristics at baseline are presented in

Table 3-1, below.

Table 3-1 Baseline sample characteristics for the Adolescent HIV study (n=1526)

Sample characteristics	**Total sample (n=1526)** **Mean (SD)/Median [IQR] /N (%)**
Age (years)	M=14 [IQR: 11-17] Range 10-20
Biological sex (female) Biological sex (male)	864 (56.6%) 662 (43.4%)
Living in a rural area	403 (26.4%)
Living with HIV Not living with HIV	1059 (69.4%) 467 (30.6%)
Reported ever been or made somebody pregnant*	142 (9.3%)
Ever been pregnant (female)	140 (98.6%)
Ever made somebody pregnant (male)	2 (1.4%)

*Available data: Ever been or made somebody pregnant (n=142)

3.1.3 HEY BABY study

The ***HEY BABY study***, a sister study of the ***Adolescent HIV study*** undertaken within the same setting, supplemented the ***Adolescent HIV study*** cohort with young mothers (10-24 years) and their child(ren) (both living with and not living with HIV). The ***HEY BABY study*** is an expansion of the ***Adolescent HIV study,*** with a new focus on maternal and child wellbeing, undertaken in parallel with its third round of data collection. **Chapter 5**, **Chapter 6**, and **Chapter 7**, section 2 (**7.2**) use data from a sample of adolescent mothers and their children in the Eastern Cape province, South Africa. The main aim of the ***HEY BABY study*** is to understand the experience of

adolescent parent families within South Africa and identify factors that can promote resilience to mitigate against adversity. In total, 1712 female youth (from both the ***Adolescent HIV study*** and the ***HEY BABY study***) were interviewed between March 2018 and July 2019. All female participants in the ***Adolescent HIV study*** who had at least one living child (both those living and not living with HIV) were eligible for the ***HEY BABY study*** (n=208; n=159 were included in the final ***HEY BABY study*** sample). This included both adolescent mothers (10-19 years) and young adult mothers (19-24 years). The study was then extended to recruit additional adolescent mothers (resulting in the total ***HEY BABY study*** sample). Seven parallel sampling strategies were employed to reach participants (including those living with HIV) who were both engaged, and not engaged with services. Sampling strategies were developed with an advisory group of adolescent mothers and regional experts. See

Table 3-2 for an overview of sampling strategies.

Table 3-2 Recruitment strategies utilised within the HEY BABY study

	Category	Detail
1	Participants recruited from the ***Adolescent HIV study***	All female adolescents who initiated antiretroviral therapy within the Adolescent HIV study in all district health services providing HIV services (n=53) between March 2014-Septemebr 2015. Adolescents were re-traced for interview in 2018 and those adolescents who reported ever being pregnant were invited to participate within the HEY BABY study.
2	Maternity obstetric units & HIV services	Case files from all maternity obstetric units within the local health district (n=9) were used to identify adolescent mothers. Case files from HIV services (above) were also used to identify adolescent mothers.
3	Demographic matching (door-to-door)	Neighbouring female adolescents of those identified by clinic files to reduced unintended stigmatisation and to provide demographically matched control group.
4	Schools	Local secondary schools (n=43) were randomly selected from a publicly available list of secondary schools (www.schoolsweb.co.za). Schools were stratified by municipality, and identified adolescent mothers were invited to participate within the study.
5	Community	Referrals from social workers and non-government organisations were used to identify those adolescent mothers who may be particularly vulnerable.
6	Peer	Community referrals from adolescent mothers already enrolled within the study were used to identify their peers who were adolescent mothers, who may not be accessing services.
7	Other	An adolescent mother advisory group developed a recruitment strategy for engaging particularly hard to reach adolescent mother within the study (e.g., family engagement, shopping malls).

All participants completed the full study questionnaire utilised within the ***Adolescent HIV study*** (described in section **0**). For those mothers with at least one living child, a further three aspects of data were collected in relation to each of the mothers' child(ren) (aged 2 months to 9 years). First, an adolescent parent questionnaire was completed, collecting data regarding health (maternal and child), care services (i.e., antenatal care/postnatal care), support (childcare, financial assistance), education, child development, nutrition, experiences of parenthood, violence, and information regarding the father of the child. This questionnaire was piloted with adolescent mothers within South Africa (including those living with HIV). Amendments to the questionnaire were made based on participant suggestions and recommendations. Second, child cognitive assessments were completed using the Mullen Scales of Early Learning, and third, Road to Health Cards were captured; detailing information from child medical records (i.e., postnatal care/child HIV status). All questionnaires were administered using electronic tablets by trained data collectors. Participants completed all components of data collection in their language of choice (isiXhosa or English) and data was translated as appropriate. Questionnaires (including the adolescent health and wellbeing questionnaire utilised in the ***Adolescent HIV study***) can be accessed via https://www.heybaby.org.za/. The study team affectionately referred to the four aspects of data collected within the study as a "BABY Bundle" (see **Figure 3-2** for an overview of the data components included within both the ***Adolescent HIV study*** and the ***HEY BABY study***). Data for children was acquired from both adolescent maternal report and cognitive assessment. Participants were eligible for inclusion within the ***HEY BABY study*** if all four aspects of data were collected. All data collection tools were piloted with adolescent mothers (n=9) and adolescents living with HIV (n=25). 1194 participants were identified as eligible for participation in the ***HEY BABY study*** (of whom 208 were eligible from the ***Adolescent HIV study***). Of these, 1151 (96.4%) of eligible participants consented to being included in ***HEY BABY study***, 1077 (90.2%) completed the ***Adolescent HIV study*** questionnaire (wave 3), and 1046 (87.6%) had a completed "BABY Bundle" and were therefore included within the ***HEY BABY study*** data. In total, BABY bundles were obtained for 1046 young mothers (10-24 years) and their children (n=1125). See Error! Reference source not

found. for a flow chart of participants included within the study from each sampling method.

			Data components			
			Adolescent Health & Wellbeing Questionnaire	Adolescent Parent Questionnaire	Child Cognitive Assessment (Mullen Scales of Early Learning)	Health records - Road to Health Booklet
Adolescent HIV study – Mzantsi Wakho	Wave 1	2014-2015				
	Wave 2	2016-2017				
	Wave 3	2017-2018				
HEY BABY study	Baseline	2017-2019				

Included in the study

Not included in the study

Figure 3-2 An overview of data sources collected within both the Adolescent HIV study and the HEY BABY study

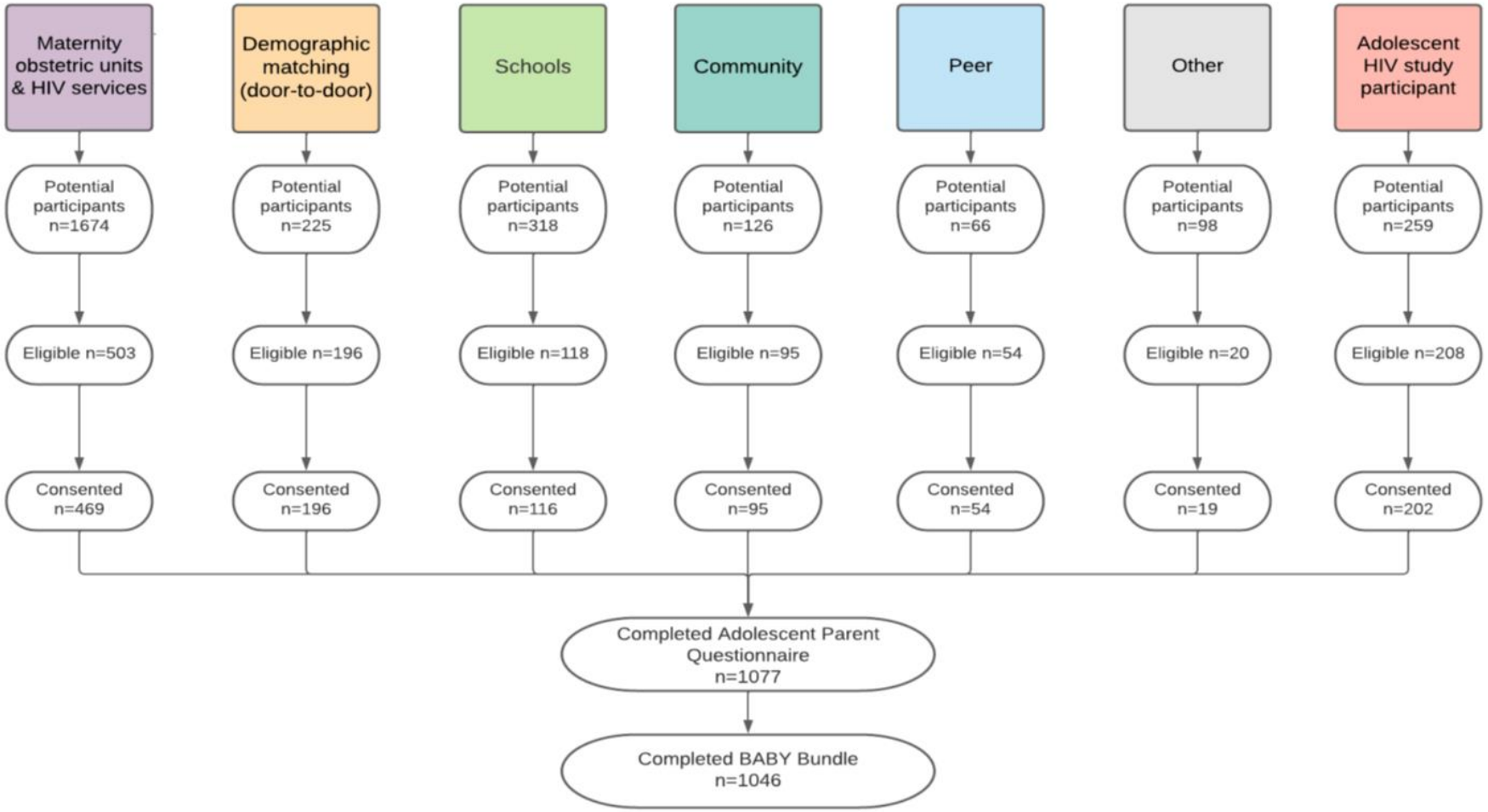


Figure 3-3 Flow chart detailing participants included within the HEY BABY study

All mothers (and their caregivers; if participants were <18 years of age) provided informed voluntary consent. Additional consent was obtained from the child's primary caregiver if the adolescent/young mother identified that they were not the main caregiver for their child. The majority, 84.9% (887/1045) of adolescent mothers in the included sample, reported that they were the main caregiver of their child. However, other main caregivers identified included the child's father (0.5%; 5/1045), the maternal grandmother (8.2%; 86/1045), partner - not the child's father (0.5%; 5/1045), someone else in the family (5.6%; 58/1045) or someone in the community (0.4%; 4/1045). Baseline sample characteristics for the ***HEY BABY study*** sample (stratified by whether mothers were drawn from the ***Adolescent HIV study***) are presented in **Table 3-3**.

Table 3-3 Baseline sample characteristics for the HEY BABY study (n=1046)

Sample characteristics	Total sample (n=1046)	Sample drawn from the Adolescent HIV study (n=159)	Newly recruited participants (n=887)	X^2/ t- test, p-value
	Median [IQR]/N (%)			
Adolescent mother characteristics				
Age at birth of oldest child (years)	M=17 [IQR: 16-18] Range:11-23	M=17 [IQR: 16-19] Range:13-23	M=17 [IQR: 16-18] Range:11-23	**6.24, <0.0001**
Age at time of interview	M=18 [IQR: 17-19] Range:12-25	M=20 [IQR: 16-23] Range:16-24	M=18 [IQR: 17-19] Range:12-25	**14.9, <0.0001**
Living with HIV **Not living with HIV**	311 (29.7%) 735 (70.3%)	97 (61.0%) 62 (39.0%)	214 (24.1%) 673 (75.9%)	**87.8, <0.0001**
Living in a rural area	299 (28.6%)	52 (32.7%)	247 (27.9%)	1.56, 0.21
Living with caregiver **Not living with caregiver**	953 (91.1%) 93 (8.9%)	136 (85.5%) 23 (14.5%)	817 (92.1%) 70 (7.9%)	**1.19, 0.007**
Number of children				**40.3, <0.0001**
1 child	94 (9.0%)	34 (21.4%)	60 (6.7%)	
2 or more children	4 (0.4%)	2 (1.3%)	2 (0.2%)	
Primary caregiver of the child(ren)*				**13.0, 0.04**
Yes	887 (84.9%)	122 (77.2%)	765 (86.3%)	
No	158 (15.1%)	36 (22.8%)	122 (13.7%)	
Unplanned & unwanted pregnancy (first pregnancy) **Planned & wanted pregnancy (first pregnancy)**	917 (87.7%) 129 (12.3%)	135 (84.9%) 24 (15.1%)	782 (88.2%) 105 (11.8%)	1.32, 0.25
Age of oldest child's father at time of birth (years)*	M=20 [IQR: 18-23] Range:13-40	M=21 [IQR: 19-24] Range: 15-38	M=20 [IQR: 18-23] Range: 13-40	-0.58, 0.56

In a relationship with the child's father*				**16.1, <0.0001**
Yes	521 (49.9%)	56 (35.4%)	465 (52.4%)	
No	524 (50.1%)	102 (64.6%)	422 (47.6%)	
Living with the child's father*				**20.3, <0.0001**
Yes	50 (4.8%)	6 (3.8%)	44 (5.0%)	
No	995 (95.2%)	152 (96.2%)	843 (95.0%)	
Child characteristics (first-born child)				
Child age (months)	M=15 [IQR: 6-29] Range:2-110	M=34 [IQR: 23-47] Range: 4-110	M=13 [IQR: 5-25] Rang: 2-98	**14.4, <0.0001**
Child biological sex -female	507 (48.5%)	84 (53.2%)	423 (47.7%)	1.61, 0.21
Child biological sex -male	539 (51.2%)	75 (46.8%)	464 (52.3%)	
Child living with HIV^	13 (1.27%)	5 (3.4%)	8 (0.9%)	**12.7, 0.005**
Child not living with HIV	1013 (98.7%)	143 (96.6%)	870 (99.1%)	

*Available data: (Not) primary caregiver of the child(ren) (n=1045); Age of oldest child's father at the time of birth (n=955); In a relationship with child's father (n=1045); Living with child's father (n=1045); Child HIV status (n=1026). ^Note: Child HIV status will not be finalised until breastfeeding has ceased. The data presented includes the full sample, some of which may still be breastfeeding, as such this data is indicative of child HIV status.

3.1.4 Dataset usage within this thesis

Table 3-4 presents an overview of dataset usage in relation to each chapter within this thesis. Samples were selected for analyses based on the objectives within each section of this thesis.

Table 3-4 Dataset usage within the thesis chapters

Thesis chapter	Results chapter title	Section title	Dataset	Participants included
Chapter 4	Examining the prevalence of common mental disorder in the context of adolescent motherhood and HIV in South Africa	-	***Adolescent HIV study*** (wave 2) – cross-sectional	723 female adolescents (10-19 years) reporting a live birth (n=110) or never pregnant (n=613)
Chapter 5	Correlates of common mental disorder among adolescent mothers in the context of HIV in South Africa	-	***HEY BABY study*** - cross-sectional	1002 adolescent mothers (who had given birth between the ages of 10-19 years) with at least one living child
Chapter 6	Maternal mental health and the cognitive development of children born to adolescent mothers within the context of HIV in South Africa	Exploring the cognitive development of children born to adolescent mothers in South Africa – how are the children of adolescent mothers in South Africa faring?	***HEY BABY study*** - cross-sectional	954 adolescent mothers (who had given birth between the ages of 10-19 years) & their first-born child (0-68 months)
		Exploring the cognitive development of children born to adolescent mothers in South Africa according to maternal HIV and mental health status		
		Exploring the cognitive development of children born to adolescent mothers in South Africa in the context of HIV		920 adolescent mothers (who had given birth between the

				ages of 10-19 years) & their first-born child (0-68 months)
Chapter 7	Adolescent fatherhood and paternal mental health in South Africa	Adolescent fatherhood and paternal mental health in South Africa	***Adolescent HIV study*** (wave 3) – cross-sectional	566 male adolescents (10-19 years) – both fathers (n=8) and non-fathers (n=558)
		Men matter: The forgotten fathers of children born to adolescent mothers in South Africa	***HEY BABY study*** – cross-sectional. Adolescent mother report on the fathers of their first-born child	894 adolescent mothers (who had given birth between the ages of 10-19 years) & their first-born child (0-68 months)

3.1.5 Dataset limitations & strengths

This section presents an overview of some of the core limitations and strengths of the ***Adolescent HIV study*** and the ***HEY BABY study*** datasets which should be considered within the interpretation of all the analyses undertaken within subsequent chapters. Specific limitations relating to each series of analyses are presented within the respective chapters.

3.1.5.1 Limitations

First, data presented in this thesis is cross-sectional. As such, causality and the direction of any associations identified within analyses cannot be established, as temporality cannot be determined. While the findings within this thesis allow for the development of hypotheses, to fully explore the relationship between variables, further longitudinal studies are required to eliminate the possibility of reverse causality when potential associations between variables have been identified. Longitudinal data would also allow for the exploration of changes in mental health symptomology over time. All data have been interpreted considering this limitation. However, further research is required to validate findings and improve the generalisability of findings from the subsequent research.

Second, data utilised within this thesis, are only drawn from the Eastern Cape province of South Africa. Despite efforts within recruitment to make the sample as representative as possible (within the study setting), findings from analyses within this thesis may be limited within their generalisability beyond the region to broader populations in both South Africa and sub-Saharan African. While a high percentage (>87%) of eligible participants were included within the studies utilised in this thesis (the ***Adolescent HIV***, and the ***HEY BABY study***), it is possible that that those most at risk of likely common mental disorder may not have participated within the study. Nevertheless, the data utilised in this thesis are obtained from the largest study of adolescents living with HIV (the ***Adolescent HIV study***), and the largest study of adolescent mothers affected by HIV and their children globally (the ***HEY BABY study***).

Third, most measures utilised within data collection for this thesis are self-report. As such, there is a risk of bias relating to recall and social desirability. To mitigate against this, electronic tablets were utilised for data collection with the aim of improving data quality, bias, and minimising missing data. Likewise, within the ***Adolescent HIV study***, adolescents living with HIV in the sample, were recruited utilising medical records to identify those who had been enrolled in antiretroviral therapy however, for the comparison group (those not living with HIV) self-report data was obtained. Hence, there is a possibility that some of the comparison group could have been living with HIV and not enrolled in services. Self-report data was also used in relation to mental health scales. This remains common practice within the field of global mental health and was deemed the best available data given the setting of data collection and the scarcity of mental health/clinical services within the locality.

Fourth, the works within this thesis highlight mental health symptoms above validated cut-offs on screening measures of mental health. These cut-offs are not diagnostic but give a clear indication of potential referral need and disorder. These data do not examine the variability within the mental health experience (i.e., variation in screening scores). In recent years, there has been a call to shift away from binary classifications of mental disorder towards a continuum approach to mental health to better reflect the diversity and complexity of mental health experience.[76,81] However, this is yet to be implemented within the global mental health field at scale.[76] Thus, to be able to establish need in relation to mental health in these early investigations among the population of interest a binary classification system was utilised within analyses. While it is important not to detract from the contextual understanding of mental health experience or pathologise adolescents through such labelling, it is essential that poor mental health symptomology is identified to ensure that support can be provided to those in need. The classifications utilised within analyses were inclusive, both within the definition of common mental disorder utilised and the cut-offs used, to ensure that potential need was identified in this sample. Some of the measures utilised in analyses give detail of the experience of poor mental health symptomology within the past two weeks/month (e.g., depressive symptoms, suicidality symptoms). As such, prevalence estimates provide

a snapshot of current mental health symptoms, and do not include previous experience of poor mental health symptoms or an indication of how mental health symptoms might vary over time. While all measures have previously been used in populations in South Africa, further research is still required to confirm psychometric properties in relation shortened versions of some of the scales e.g., the CDI-S[342,343] and Child PTSD checklist.[54,344] It should also be noted that while the data within this thesis are drawn from large studies, both of which are pioneering in the field, the sample size for some comparisons within analyses are small (e.g., probable mental health comorbidities) and likely underpowered. This therefore highlights the need for further, well-funded, research focusing on adolescent mental health to ensure sufficient statistical power to address the important issues raised in this thesis.

Fifth, data from the ***Adolescent HIV study*** is drawn from a sample of adolescents predominantly living with HIV (69.4%), which is not representative of national HIV prevalence estimates within South Africa.[345] Hence, this may have implications for the interpretation of results utilising this data, as those living with HIV are over represented, thus limiting the generalisability of findings.

Sixth, a small number of adolescents declined to participate in the **Adolescent HIV study** and the **HEY BABY study**. This additionally may have implications for the interpretation of results, inclusive of introducing bias. For instance, those adolescents struggling with their mental health may be less likely to engage with the studies which may result in this group being underrepresented. However, it should be noted that only a small proportion of those eligible for the studies declined to participate.

3.1.5.2 Strengths

Data utilised within this thesis, from both the ***Adolescent HIV*** and the ***HEY BABY study***, were drawn from large cohort studies representative of adolescents and their children affected by HIV in the Eastern Cape province of South Africa. These studies are the world's largest studies of adolescent affected by HIV, and adolescent mothers and their children affected by HIV. Both studies utilised a range of recruitment strategies (e.g., within the ***HEY BABY study***, community tracing methods were used

to identify adolescent mothers and their children both engaged and not engaged in care). Subsequently, the generalisability of results is enhanced compared to previous studies of adolescent mothers who are recruited only from clinical care facilities (e.g., Osok et al. 2018;[294] see **Chapter 2**).

Overall, study refusal and exclusion rates were low, and there was minimal missing data relating to exposures and outcomes of interest within the thesis (see individual chapters detail relating to variables of interest with missing data). Similarly, any attrition between data collection waves (for the ***Adolescent HIV study***) was low. Therefore, any bias resulting from such missing data is deemed to be minimal. All study questionnaires were piloted and developed with groups representative of the target sample (i.e., adolescents [including those living with HIV], and adolescent mothers). Furthermore, measures utilised had either previously been used in or were validated for the sub-Saharan African/South African setting. The use of previously utilised and/or validated measures enhances the validity of the findings within this study (e.g., those relating to likely common mental disorder), and allows for comparability with data utilising the same data collection tools, thus building on existing literature in the field.

The questionnaires within the studies from which data for this thesis was drawn were broad in scope. As such a rich array of data was collected including measures relating to mental health, health, social circumstances, parenting, and child development. This extensive range of data has allowed for the development of novel research questions relating to adolescent parent families affected by HIV in South Africa. It has also allowed for investigations of mental health symptoms to expand beyond a single disorder within subsequent analyses.

3.2 Ethical approvals

Ethical approvals for the ***Adolescent HIV study*** were obtained from the Universities of Oxford (SSD/CUREC2/12-21) and Cape Town (CSSR2013/14). Additional local permissions were obtained from the Provincial Departments (Eastern Cape) of

Health, and Education, Buffalo City Municipality (Department for Health), and participating clinics.

Ethical approvals for the ***HEY BABY study*** were obtained from the Universities of Oxford (R48876/RE002) and Cape Town (HREC 226/2017). Additional local approvals and permissions were obtained from the Provincial Departments (Eastern Cape, South Africa) of Health, Education, and Social Development.

Additional approvals for the analyses of secondary data from both the ***Adolescent HIV study*** and ***the HEY BABY study*** within this thesis (and associated publications) were obtained from University College London (14795/001).

3.3 The candidate's role within data sources

Both the ***Adolescent HIV study*** and the ***HEY BABY study*** were planned prior to the commencement of this thesis. The candidate was not involved in the design, recruitment, or data collection of the respective studies in relation to the data used within this thesis. However, following the commencement of this thesis (October 2018), the candidate has been an active member of the ***HEY BABY study*** team. Her role is multifaceted, undertaking responsibility for data cleaning and management, taking full responsibility for the planning, and undertaking of all analyses included within this thesis, contributing to analysis plans and the statistical analyses for works not included within this thesis, participating in the dissemination of study findings, and contributing to preparations for the follow-up round of data collection for the ***HEY BABY study***. The candidate holds specific responsibility for the mental health and child development measures in the study (core measures within this thesis) including cleaning the measures, coding, and advising team members on their usage. The ***HEY BABY study*** team is directly linked with the ***Adolescent HIV study*** team, and both teams regularly collaborate in data cleaning efforts, data management efforts, the planning and undertaking of analyses, and data dissemination. As part of the ***HEY BABY*** team, the candidate takes part in weekly study management team calls to discuss progress on data cleaning, management, the development and use of data

codebooks, planned data analyses, brainstorming future projects, and plans for future data collection. The candidate also contributes to monthly calls with the study's principal investigators and wider team to discuss proposed analyses plans, study findings, and policy engagement. Until COVID-19 restrictions were implemented within the UK, the candidate also had monthly, face-to-face meetings with the study teams based at the University of Oxford to discuss data management and proposed data analyses. Both studies (the ***Adolescent HIV study***, and the ***HEY BABY study***) also form part of the UKRI GCRF Accelerating Achievement for Africa's Adolescents (Accelerate) Hub, which aims to generate evidence regarding *developmental accelerators* which can support adolescents to reach multiple Sustainable Development Goals (full information regarding the UKRI GCRF Accelerate Hub *(Hub)* can be found at https://www.acceleratehub.org/). As a doctoral candidate working with data that contributes to the *Hub*, the candidate is actively involved in *Hub* activities. Such activities include attending regular seminars, training, and meetings to discuss research studies within the *Hub*, and how best to utilise the available data within the *Hub* to inform *Hub* objectives. The candidate has also taken an active role in capacity building within the *Hub,* supporting other early career researchers with training relating to statistical analyses, and dissemination (including the development of manuscripts for peer review and conference presentations). The candidate has also had the opportunity to engage in dissemination activities, presenting some of the works within thesis to the wider *Hub* team and at international fora, publishing peer-reviewed manuscripts and invited commentaries focusing on the core topics of interest in this thesis. The works within this thesis and the resulting peer-review publications have been documented as part of the *Hub* outcomes.

3.3.1 Data cleaning and management

The candidate has actively been involved within the data cleaning and management process of the ***HEY BABY study*** data since commencement of data cleaning activities in October 2018. As part of the data cleaning team, the candidate took responsibility and led the cleaning of two of the four aspects of data collected (the adolescent

health and wellbeing questionnaire, and the Mullen Scales of Early Learning[185]; both of which feature prominently within the works in this thesis). This involved merging raw data files, writing, checking, and cleaning syntax (to be used within current and future rounds of data collection), performing consistency checks within the data, identifying issues, responding to field queries, and creating derived variables for use within analyses. The candidate was also responsible for quality checks regarding the data cleaning of the child health records (*Road to Health Cards:* a third aspect of the data collected) and aided in the development of the child health records dataset. Finally, the candidate was responsible for merging individual datasets (e.g., the adolescent health and wellbeing questionnaire data, and the Mullen Scales of Early Learning) to create a comprehensive dataset for both the ***HEY BABY study*** and for use alongside the ***Adolescent HIV study***. Different users of the data undertook data cleaning for the differing aspects of the ***HEY BABY study*** concurrently, the candidate held weekly calls with the wider study team to share data cleaning syntax and to make team-level decisions regarding data inclusion and variable interpretation to ensure the final dataset was consistent and is as meaningful as possible. Data presented within this thesis was finalised for inclusion in May 2020.

3.4 Measurement of likely common mental disorder

Adolescent mental health is predominantly explored within this thesis utilising a composite measure of overall mental health - any likely **common mental disorder (CMD)**. Participants were classified as experiencing any likely common mental disorder if they scored above the cut-off on any of the four validated mental health symptomology measures available within the studies (see below). A second composite measure of overall mental health was also utilised - any **mental health comorbidities (MHCs)**. Participants were classified as experiencing any mental health comorbidities (concurrently experiencing different domains of poor mental health symptomology[346] [i.e., experiencing depressive symptomology concurrently with anxiety symptomology]) if they scored above the cut-off on two or more of the four mental health symptomology measures available (see below).

Four symptomology measures (depression, anxiety, posttraumatic stress, and suicidality) were included within both the ***Adolescent HIV study***, and the ***HEY BABY study*** (Adolescent Health and Wellbeing Questionnaire; see **Figure 3-2**). These measures are combined to create a composite measure of overall mental health and are also used as individual symptom domains to explore adolescent mental health throughout this thesis. Cut-off values are used to ascertain prevalence estimates, and where appropriate individual mental health scale (e.g., depressive symptom) scores are reported. There is no missing data relating to the measures of interest regarding mental health. All participants completed all mental health symptomology scales (within both the ***Adolescent HIV study***, and the ***HEY BABY study***) – a major strength of the available data. An overview of the four mental health symptomology measures used throughout this thesis is provided below.

Depressive symptomology was measured using the 10-item Child Depression Inventory short form (CDI-S).[342,343] Items consisted of a series of statements (e.g., 'I like myself', 'I don't like myself' 'I hate myself') for which adolescents had to choose the statement that reflected how they felt in the previous two weeks. Each item was scored 0-1 (0=absent symptoms, 1=mild symptoms/definitive symptoms), thus giving scores a value in the range of 0 to 10.[342,343] Scores of ≥3 (based on mild/definitive symptoms due to the small number of participants reporting definitive symptoms)[347] were used to indicate symptomology consistent with a positive screen for probable depression (binary; yes/no). A cut-off ≥3 on the CDI-S has been previously been used in high income contexts.[348] The CDI-S has been previously found to be highly correlated (r=0.89) with the broader 27-item CDI scale. Given this, scores were prorated based on the suggested inclusive cut-off within the full scale.[343,349,350] The CDI (from which the CDI-S is derived) has generally been found to have strong psychometric properties and is well validated in the sub-Saharan African region.[351-354] The CDI-S has previously been used with adolescent populations in South Africa.[350,355-358] The CDI-S has an alpha of 0.73 in the ***Adolescent HIV study*** (baseline), and an alpha of 0.71 in the ***HEY BABY study***, representing acceptable internal consistency.[359]

Anxiety symptomology was measured using an abbreviated version (14 items) of the Children's Manifest Anxiety Scale -Revised (RCMAS).[360,361] Adolescents identified if statements (i.e. "I worry a lot of the time") were true for them, in the past two weeks. The 14 items were scored as "yes" (1) or "no" (0); indicative of experience consistent with anxiety symptomology and not, respectively. Scores of ≥10 were used to indicate symptomology consistent with a positive screen for anxiety.[360,361] The RCMAS has been validated within sub-Saharan Africa and shows good internal consistency among HIV-affected children and adolescents.[362] The RCMAS has an alpha of 0.81 in the ***Adolescent HIV study*** (baseline), and an alpha of 0.86 in the ***HEY BABY study***, representing good internal consistency.[359]

Posttraumatic stress symptomology was measured using a 19-item version of the Child PTSD checklist in the ***Adolescent HIV study*** (baseline/wave 2; see **Chapter 4**).[54,344] Adolescents were asked to think about something upsetting or frightening that has happened in their lives (based on lifetime experience)and identify how often they felt a series of items (i.e., "*Do you get upset when you think about what happened?*"). Items were scored 0-3 (0 "*not at all*", 1 "*some of the time*", 2 "*most of the time*", 3 "*all of the time*"). Items within the checklist represent four domains relating to posttraumatic stress disorder (re-experience, avoidance, hyperarousal and, dysphoria), based on a four factor model proposed by Boyes et al. (2012) for South African Adolescents.[344] Participants were classified as experiencing symptomology consistent with a probable positive screen for posttraumatic stress disorder if they scored on items across all four domains with affirmative responses (i.e. "most of the time"/"all of the time") in the following frequencies: re-experience >=1, avoidance >=1, hyperarousal >=2, dysphoria >=2.[54] Classifications were used to determine the presence of posttraumatic stress based on the DSM-5 criteria and were prorated based on the full 28-item Child PTSD scale.[36,344,363] The Child PTSD checklist showed good internal consistency[359] within the ***Adolescent HIV study*** sample (baseline; α=0.90). The 19-item scale has been widely used among adolescents and youth with South Africa,[64,65] and has been validated within the South African context.[54]

A shortened 12-item version of the child PTSD checklist (developed using factor loading[364]) was utilised in wave 3 of the ***Adolescent HIV study***, and the ***HEY BABY study***. In analyses using this data (**Chapter 5**, **Chapter 6**, **Chapter 7**), participants were classified as experiencing symptomology consistent with a partial positive screen for posttraumatic stress disorder if they scored on items across all four domains in the following frequencies: re-experience >=1, avoidance >=1, hyperarousal >=1, dysphoria >=1. The Child PTSD checklist showed good internal consistency[359] within both the ***Adolescent HIV study*** sample (wave 3; α=0.84), and the ***HEY BABY study*** sample (α=0.86).

Suicidality symptoms were measured using the five-item Mini International Neuropsychiatric Interview (MINI-Kid; scored 0-5).[365] The MINI-Kid used the following questions to identify suicidal symptoms: "*In the past month did you: wish you were dead?*" "*Want to hurt yourself?*" "*Think about killing yourself?*" "*Think of a way to kill yourself?*" "*Attempt suicide?*" Participants responded "*yes*" (1) or "*no*" (0). Participants were classified as reporting suicidal symptoms if they scored on any item on the MINI-Kid.[365] Globally, the MINI-Kid has been extensively validated, demonstrates good internal consistency[359] in both the ***Adolescent HIV study*** (α=0.87), and the ***HEY BABY study*** (α=0.92), and good test-retest reliability.[365-367] A log of deaths was kept during both the ***Adolescent HV study*** and the ***HEY BABY study*** and no suicide completions occurred.

3.5 Missing data

The proportion of missing data varied by variable. Overall, due to the diligent efforts of the data collection and data entry team, the proportion of missing data was very low within both the ***Adolescent HIV study***, and the ***HEY BABY study***. Each chapter details the proportion of missing data for relevant variables, if appropriate, this was accounted for within the statistical models utilised within the analyses undertaken within this thesis. Primarily, a missing indicator method was used in which variables with missing data were recoded to include an "unknown" category for use within analyses.

3.6 Statistical analyses

Specific statistical methods used within each series of analyses are presented in the methods section of each chapter. This section provides an overview of the common statistical methods used within analyses in this thesis. All statistical methods undertaken are two-sided. Probability (p) values of <0.05 were highlighted in text to indicate those associations where there was some evidence of a difference between groups. Where appropriate, explorations of patterns within the data, trends, magnitudes of association, and the distribution of confidence intervals were additionally used throughout this thesis to guide the interpretation of results. All analyses within this thesis were conducted utilising Stata v.15.[368]

3.6.1 Summary statistics

Data were explored using summary statistics. Throughout this thesis (N) denotes the number of participants within the population under study, and percentages (%) for categories of interest are reported. Within the exploration of continuous variables, the mean (M) and standard deviation (SD) are presented as an average and measure of distribution for normally distributed data. Where data are not normally distributed, the median and interquartile range (IQR) are presented.

3.6.2 Univariable analyses

Pearson's chi-squared (X^2) test is used to assess the differences between categorical variables. In instances when the expected numbers within the chi-squared test were too small (i.e., <5), Fisher's exact test was used instead. T-tests were used to assess the differences between means among two groups for continuous dependent variables, and analysis of variance (ANOVA) explorations (including Tukey's HSD post hoc testing) were undertaken when exploring differences between means among three or more groups. Where data were deemed to be non-normally distributed, alternative non-parametric statistical methods were used as appropriate for example, the use of Kruskal Wallis tests for exploring differences in distribution between three or more groups of data.

3.6.3 Multivariable analyses

Logistic regression models were undertaken to assess the association between variables of interest in instances where the outcome of interest was presented within a binary format (e.g., the presence or absence of *common mental disorder*). Models were subsequently adjusted for relevant demographic factors present within the sample of interest if they were identified as being relevant factors within the literature of interest (according to the research question/objective of the analyses) or found to be associated (p=<0.2)[369,370] with either, or both, the predictor and outcome variables. Odds ratios were used to identify core findings within analyses. Confidence intervals (95%) and probability values (p-values) are also presented to guide the interpretation of results.

Linear regression models were undertaken to assess the association between variables of interest in instances where the outcome of interest was presented in a continuous format (e.g., child cognitive development scores). As with logistic regression models (above), models were adjusted for relevant demographic factors within the sample of interest. Beta coefficients were used to identify core findings within analyses. Confidence intervals (95%) and probability values (p-values) are also presented to guide the interpretation of results.

3.6.4 Accounting for multiple testing

Where the impact of multiple testing may pose a potential issue for the interpretation of results within regression models, the Benjamini Hochberg procedure was undertaken (employing false discovery rate of 10%[371]). The Benjamini Hochberg procedure aims to decrease the false discovery rate (i.e., type I error [incorrectly rejecting the null hypothesis]) by sorting p-values in ascending order, assigning rank values to the p-values, and calculating Benjamini Hochberg critical values for each p-value. Original p-values are then compared to the Benjamini Hochberg critical values to identify p-values that are smaller than the critical values.[372,373] Benajmini-Hochberg critical values are calculated utilising the following formula:

$$\frac{\boldsymbol{p - value\ assigned\ rank}}{\boldsymbol{total\ number\ of\ tests}} \times \boldsymbol{false\ discovery\ rate}\ [\mathbf{10}\%]$$

3.7 Chapter summary

Data used within this thesis are drawn from two data sources. The ***Adolescent HIV study*** is a large mixed methods prospective cohort study (n=1526) following adolescents living with HIV, and a comparison group of adolescents not living with HIV. The ***HEY BABY study***, a sister study of the ***Adolescent HIV study*** undertaken within the same setting, supplemented the study cohort with young mothers (10-24 years) and their child(ren) both living with and not living with HIV, resulting in cross-sectional data from 1046 young mothers and 1125 children. The ***HEY BABY study*** was undertaken in parallel with the third round of data collection of the ***Adolescent HIV study***. This chapter has provided an overview of these two datasets including their strengths and limitations, the ethical approvals obtained for these works, and the candidates role within the data sources. It has also provided an overview of how likely common mental disorder is measured within this thesis (including how composite measures of poor mental health [likely common mental disorder and likely mental health comorbidities] were derived) as well as how individual mental health symptomology scales are scored). Finally, a brief outline of the core statistical methods used throughout this thesis are summarised. These include summary statistics, univariable statistics (e.g., chi-square tests, t-tests, ANOVA), and multivariable statistics including logistic and linear regression models.

Chapter 4 Examining the prevalence of common mental disorder in the context of adolescent motherhood & HIV in South Africa

4.1 Background

As detailed within the systematic review undertaken in **Chapter 2**, the mental health of adolescents living with HIV who have experienced pregnancy/parenthood (inclusive of both mothers and fathers) within sub-Saharan Africa is a neglected topic - only a single prevalence study (from Kenya) relating to a sub-sample (n=14) of adolescents living with HIV who were currently pregnant was identified.[294] Given the small sample size, the sole focus on depressive symptomology and the focus on the pregnancy period within the identified study, an understanding of likely common mental disorder among adolescents living with HIV who are or have experienced pregnancy remains absent from the literature. Explicit examinations of the mental health experience of adolescents living with HIV who have experienced pregnancy/parenthood are (at the time of writing this thesis) yet to be undertaken. These adolescents have seemingly been side-lined from mental health agendas - as there exists no evidence-based policy or programming available for this group. To build an evidence base, the first step is to establish an understanding of mental health need, and how this need relates to adolescent pregnancy and/or HIV status.

Given that both pregnancy and living with HIV have been found to be independently associated with poor mental health among adolescents,[131,152,162] experiencing the syndemic of both adolescent pregnancy and living with HIV may compound poor mental health experience. Such experiences may also have a bidirectional relationship with poor mental health.[131,152,162] Poor mental health has previously been found to be prevalent among adult populations living with HIV within pregnancy and the postpartum period[161] - however, explorations among adolescent populations are yet to be undertaken. For those adolescents living with HIV experiencing pregnancy/parenthood, there remain additional considerations such as health,

stigma, medication adherence and, both horizontal and vertical HIV transmission – all of which may be impacted by mental health experience. Thus, it is important to develop an understanding of mental health within the context of adolescent parenthood and HIV to establish the impacts for both adolescents and their children.

Utilising data from the ***Adolescent HIV study*** (see section **0**), the analyses in this chapter aim to directly respond to this gap within the literature to determine the prevalence of likely common mental disorder among adolescents, and specifically among those who have experienced motherhood and are living with HIV within South Africa. In line with the definition of likely common mental disorder utilised within the systematic review (**Chapter 2**), and section **3.4**, likely experience of common mental disorder was defined as depressive and anxiety, posttraumatic stress, and suicidality symptomology. Globally, depression and anxiety are prominent causes of illness and disability among adolescents.[28,30] Given the commonality of trauma experience among South African adolescents,[33] the severity of suicidality symptomology (i.e. mortality),[29] and the potential comorbidity of posttraumatic stress and suicidality with depression and general anxiety, a broad definition of likely common mental disorder (depressive, anxiety, posttraumatic stress, and suicidality symptomology) was used within analyses to identify need and where support for adolescents may be required.

The works within this chapter have resulted in the following peer-reviewed publication:

Roberts, K.J., Smith, C., Cluver, L., Toska, E., Zhou, S., Boyes, M., & Sherr, L. (2021). Adolescent Motherhood and HIV in South Africa: Examining Prevalence of Common Mental Disorder. AIDS and Behavior, 26:1197–1210. DOI: https://doi.org/10.1007/s10461-021-03474-8

4.1.1 Aim and objectives

The analyses in this chapter provide an overview of and identify the prevalence of likely common mental disorder for female adolescents living with and without HIV

who experienced pregnancy/motherhood during adolescence (10-19 years) utilising cross-sectional data from the ***Adolescent HIV study*** (see section **0**). Specific objectives of these analyses were to:

Objective 1: Identify the prevalence of adolescent motherhood within the sample

Objective 2: Identify prevalence of likely common mental disorder stratified by adolescent HIV status, motherhood, and combined HIV and motherhood status

Objective 3: Explore the association between adolescent motherhood and HIV status, and likely common mental disorder

4.2 Methods

4.2.1 Participants and procedure

Data used within these analyses are drawn from the ***Adolescent HIV study*** (n=1526; see section **0** for detail regarding participants and procedure) and utilise both baseline and follow-up (wave 2) data. Analyses present data relating to adolescent motherhood (previous pregnancy between 10-19 years of age). Only data for female adolescents ≤20 years of age were included within these analyses. Females who were 20 years of age were retained in the sample if they were within 40 weeks (average length of a full-term pregnancy) of their twentieth birthday to ensure that any reporting of pregnancy was between 10-19 years of age. Dates of birth and dates of interview were used to ascertain eligibility. Adolescent motherhood status was ascertained from participant self-report. Given the potentially differing mental health profiles of current adolescent mothers and adolescents who had experienced elective abortion (n=8), miscarriage or still birth (n=7), adolescents who reported a pregnancy but did not report a live birth were excluded from these analyses. Likewise, adolescents who were currently pregnant (n=8), and those who reported pregnancy, but the outcome was unclear (n=5) were also excluded from analyses. In total, 723 adolescents were included within analyses (see **Figure 4-1**).

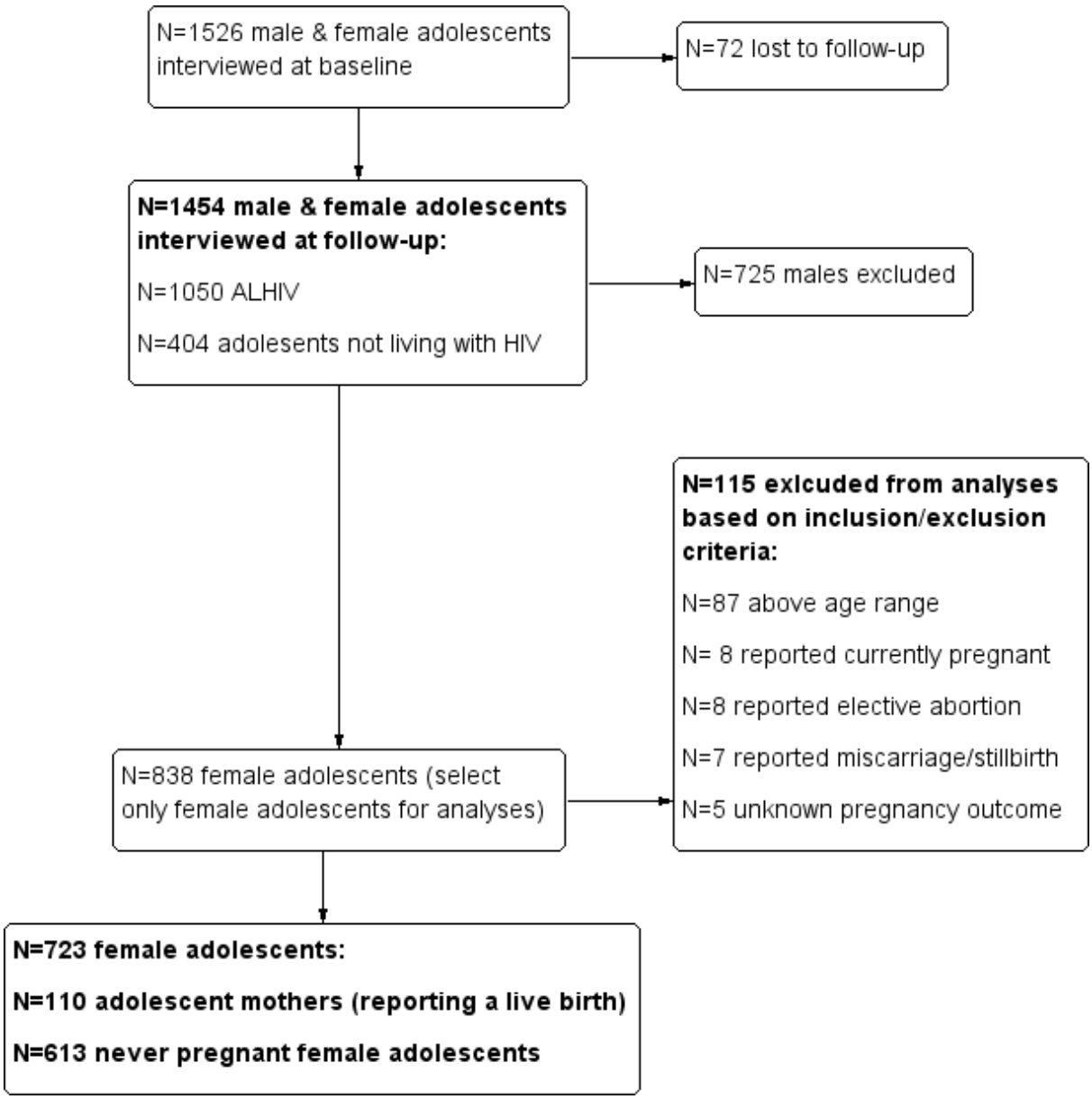


Figure 4-1 Participant selection for analyses exploring likely common mental disorder according to adolescent motherhood and HIV status

4.2.2 Measures

These analyses utilise cross-sectional data. Both baseline and follow-up (wave 2) data were used to corroborate reported adolescent pregnancy within the sample, all other measures were obtained from the follow-up (wave 2) round of data collection questionnaire (2015-2017; total sample n=1454; See **Figure 4-1**).

Sociodemographic characteristics were routinely gathered, including age of adolescent at time of questionnaire and pregnancy (years), biological sex, dwelling location (urban vs. rural), housing (informal vs. formal), orphanhood status (no parents have died vs. one or both parents have died), school enrolment status (enrolled vs. not enrolled), and cash grant receipt (cash grant received vs. no cash grant received) via participant self-report.

Motherhood status: Adolescent motherhood (previous pregnancy and live birth between 10-19 years) was identified using two self-report measures (having had a previous pregnancy resulting in a live birth and having one or more biological child(ren)). Adolescents were classified as experiencing motherhood if they met any of the criteria to define motherhood (above). Whether the pregnancy was **planned** and/or **wanted, age at start of last pregnancy (years), the number of previous pregnancies** and the **number of children** were obtained from participant self-report.

Sexual behaviour (see **Appendix**): participants were classified as being **sexually active** if they responded positively (i.e., gave an age or responded "yes") to questions relating to the age of sexual debut, previous condom use, and/or previous pregnancy. **Age of sexual debut** was ascertained through participant self-report.

HIV status was ascertained through clinical notes and corroborated by participant or caregiver self-report on a case-by-case basis.

Combined motherhood and HIV status was obtained through a composite measure of both **Adolescent motherhood** and **HIV status (both detailed above).** Four groups of interest were created: 1) those adolescents not living with HIV who had never had a pregnancy (No HIV & never pregnant), 2) those adolescents not living with HIV who were mothers (No HIV & mothers), 3) ALHIV who had never had a pregnancy (HIV & never pregnant), and 4) adolescent mothers who were living with HIV (HIV & mothers).

Mental health status: For a detailed overview of the mental health symptomology measures used within analyses see Section **3.4**. All participants within the current sample responded to all items of the four validated mental health symptomology measures used within these analyses (see below). Cut-off scores were used to ascertain prevalence estimates. Symptomology scores for individual scales are explored for illustrative purposes in **Appendix 2**. Participants were classified as experiencing any likely **common mental disorder (CMD)** if a participant scored above the cut-off on any of the mental health measures explored within the study (depressive symptoms [Child Depression Inventory Short Form ≥3/10 items[342,343]], anxiety symptoms [Revised Children's Manifest Anxiety Scale ≥10/14 items[360,361]], posttraumatic stress symptoms [Child PTSD checklist-12 items over four domains of posttraumatic stress disorder , scoring ≥1 on each of the four domains of the scale: re-experience, voidance, hyperarousal and dysphoria[54,344,363]], and suicidality [any; Mini International Psychiatric Interview for Children and Adolescents ≥1/5 items[365]]). Participants were classified as experiencing any likely **mental health comorbidities** (MHCs; concurrently experiencing different domains of poor mental health symptomology[346] [i.e., experiencing depressive symptomology concurrently with anxiety symptomology]) if a participant scored above the cut-off on two or more of the mental health measures within the study (see above).

4.2.3 Statistical analyses

Chi-square tests (Fisher's exact test, where appropriate) and Kruskal Wallis tests were used to explore sample characteristics (inclusive of mental health status) according to motherhood status. For exploratory purposes, more detailed characteristics of pregnancy and motherhood are explored further according to HIV status in **Appendix 2, Table 9-1**. Prevalence and associations of likely common mental disorder with adolescent motherhood, HIV status (including the two factors combined) were described descriptively and assessed using chi-square tests. Finally, a series of logistic regression models were used to explore the cross-sectional associations between motherhood and HIV status (including interaction effects) and likely common mental disorder. Interaction effects of motherhood and maternal HIV status were assessed

by introducing interaction terms into the multivariable models. Within multivariable analyses, models were adjusted for covariates identified apriori as relevant in the literature relating to mental health, adolescent pregnancy and living with HIV. Factors included geographic location (rural vs. urban), poverty (informal housing), and orphanhood status.[374-377] Covariates were also included within multivariable models if factors were found to be associated with predictor or outcome variables in univariable analyses (school enrolment status, household cash grant receipt). Adjusted odds ratios from the models including interaction terms were used to develop forest plots as a visual representation of the odds of experiencing likely common mental disorder among adolescent mothers who are living with HIV.

4.3 Results

4.3.1 Sociodemographic characteristics

Table 4-1 presents sample characteristics stratified according to motherhood status. The prevalence of adolescent motherhood in the sample was 15.2% (95% CI: 12.8%-18.0%). The median age of the sample was 15 years (IQR: 13-18 years). Adolescent mothers within the sample were older compared to never pregnant adolescents (19 [IQR:18-20] vs. 15 [IQR: 13-17] years, X^2=166.9, *p*=0.0001). Over a quarter (27.1%) resided in a rural area and 15.4% lived in informal (shack) housing. Adolescent mothers were more likely to be living in informal housing comparative to never pregnant adolescents (23.5% vs. 14.1%, X^2=5.73, *p*=0.02). Over half of participants were orphans (52.7%). On average, the highest (current) school grade passed was grade 9 [IQR: 7-11] and, 6.4% were not in receipt of social protection in the form of cash grants. The majority of the sample were living with HIV (70.5%). Adolescent mothers were less likely to be living with HIV compared to never pregnant adolescents within the sample (55.5% vs. 73.3%, X^2=14.21, *p*=<0.0001). See **Table 4-1**.

Table 4-1 Sample characteristics according to motherhood status (female adolescents [10-19 years], n=723)

Sociodemographic characteristics	N(%)/Median(IQR)			X^2, *p*-value
	Total sample (n=723)	Adolescent mother (n=110)	Never pregnant adolescent (n=613)	
Current age (years)	15 (13-18)	19 (18-20)	15 (13-17)	**166.86, 0.0001**
Dwelling location*				**2.86, 0.09**
Rural	195 (27.1%)	37 (33.6%)	158 (25.9%)	
Urban	526 (72.9%)	73 (66.4%)	453 (74.1%)	
Housing*				**5.73, 0.02**
Informal	109 (15.4%)	23 (23.5%)	86 (14.1%)	
Formal	600 (84.6%)	75 (76.5%)	525 (85.9%)	
Orphanhood status				1.53, 0.22
One or both parents have died	381 (52.7%)	52 (47.3%)	329 (53.7%)	
Non-orphan	342 (47.3%)	58 (52.7%)	284 (46.3%)	
Enrolled in school				**132.44, 0.0001**
Yes	628 (86.9%)	58 (52.7%)	570 (93.0%)	
No	95 (13.1%)	52 (47.3%)	43 (7.0%)	
Cash grant receipt				0.00, 1.00
Yes	677 (93.6%)	103 (93.6%)	574 (93.6%)	
No	46 (6.4%)	7 (6.4%)	39 (6.4%)	
HIV status	510 (70.5%)	61 (55.5%)	449 (73.3%)	**14.21, <0.0001**
Living with HIV	213 (29.5%)	49 (44.5%)	164 (26.7%)	

Not living with HIV				

*Available data (total n included in analyses): Dwelling location (n=721) | Housing (n=709)

4.3.2 Prevalence of common mental disorder

Table 4-2 presents the prevalence of likely common mental disorder for the total sample and according to the experience of adolescent motherhood. Seventy-nine participants (10.9%) scored above the predetermined cut-off on at least one screening measure for mental health (depression, anxiety, posttraumatic stress, suicidality) and were classified as experiencing a probable common mental disorder. Prevalence of probable mental health comorbidities (scoring above the predetermined two or more measures for different mental health) was 2.8% in the sample. Within individual scales, 6.9% of the sample were classified as experiencing depressive symptomology, 1.4% were classified as experiencing anxiety symptomology, 0.6% reported posttraumatic stress symptomology and, 6.1% reported suicidality symptomology. Adolescent mothers reported a greater prevalence of probable common mental disorder (18.2% vs. 9.6%, X^2=7.02, *p*=0.008) and probable mental health comorbidities (scoring above the cut-off on ≥2 mental health measures; 8.2% vs. 1.8%, X^2=14.15, *p*=<0.0001) compared to adolescents who had never been pregnant. Within individual scales, adolescent mothers reported a greater prevalence of depressive, anxiety, and suicidality symptoms (see **Table 4-2**) than adolescents who had not experienced a pregnancy. For exploratory purposes **Appendix 2**, **Table 9-2** details mental health symptomology scores stratified according to motherhood status.

Table 4-2 Mental health symptoms stratified according to adolescent motherhood status (female adolescents [10-19 years], n=723)

Mental health symptoms	N (%)			X^2, *p*-value
	Total sample (n=723)	Adolescent mother (n=110)	Never pregnant adolescent (n=613)	
Any common mental disorder	79 (10.9%)	20 (18.2%)	59 (9.6%)	**7.02, 0.008**
Any mental health comorbidities	20 (2.8%)	9 (8.2%)	11 (1.8%)	**14.15, <0.0001**
Any depressive symptoms	50 (6.9%)	14 (12.7%)	36 (5.9%)	**6.80, 0.009**
Any anxiety symptoms	10 (1.4%)	4 (3.6%)	6 (1.0%)	4.83, 0.05
Any posttraumatic stress symptoms	4 (0.6%)	0 (0.0%)	4 (0.7%)	0.72, 1.00
Any suicidality symptoms	44 (6.1%)	14 (12.7%)	30 (4.9%)	**10.0, 0.002**

Note. Sample includes adolescents both living with and without HIV | Common mental disorder (scoring above the cut-off on one or more screening measure for mental health)| Mental health comorbidities (experiencing two or more common mental disorders concurrently defined for the purpose of this thesis as scoring above the cut-off on two or more mental health screening measures) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

4.3.3 Prevalence of common mental disorder according to the syndemic of adolescent motherhood and HIV

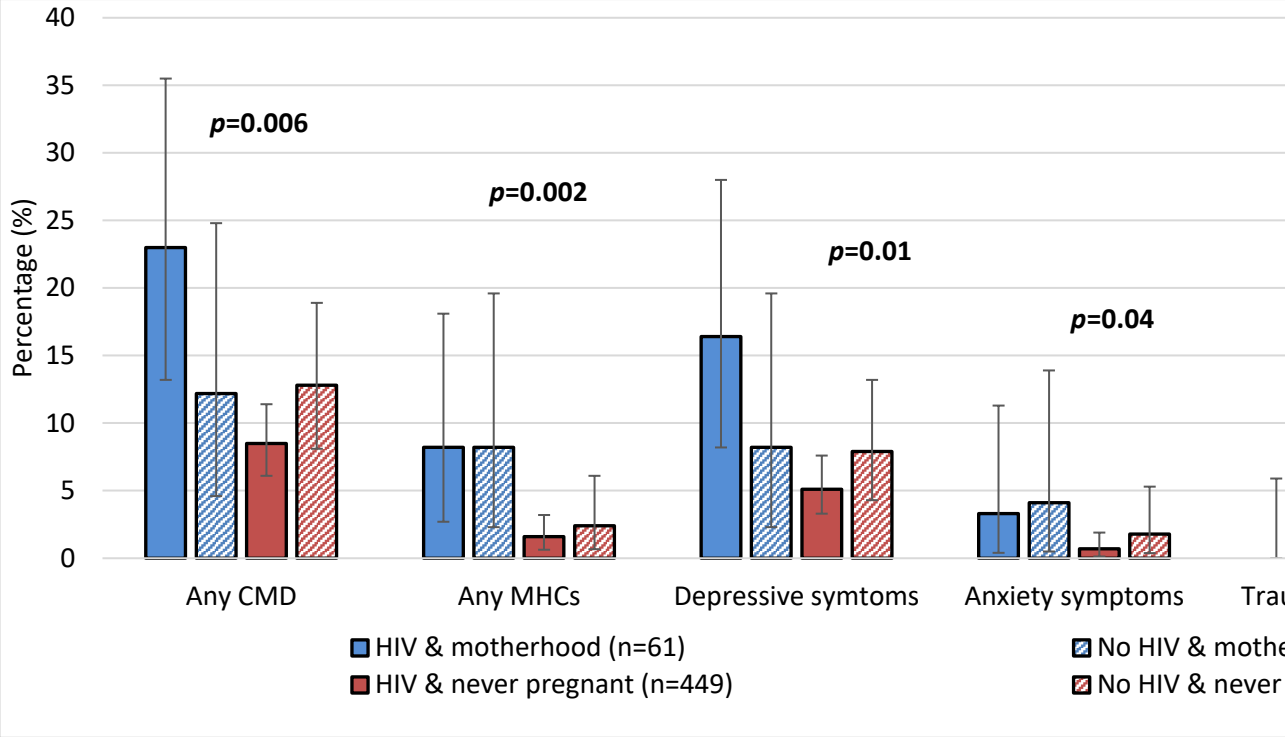


Figure 4-2 (and **Appendix 2**,

	N (%) / M(SD)			
	Total sample (n=723)	**No HIV & never pregnant (n=164)**	**No HIV & motherhood (n=49)**	**HIV & pregnant**
Mental health symptoms (prevalence)				
Any common mental disorder	79 (10.9%)	21 (12.8%)	6 (12.2%)	38 (8.
Any mental health comorbidities	20 (2.8%)	4 (2.4%)	4 (8.2%)	7 (1.
Any depressive symptoms	50 (6.9%)	13 (7.9%)	4 (8.2%)	23 (5.
Any anxiety symptoms	10 (1.4%)	3 (1.8%)	2 (4.1%)	3 (0.
Any posttraumatic symptoms	4 (0.6%)	3 (1.8%)	0 (0.0%)	1 (0.
Any suicidality symptoms	44 (6.1%)	10 (6.1%)	5 (10.2%)	20 (4.

Mental health symptoms scores				
Depressive symptoms scores (0-10)	0.65 (1.21	0.71 (1.33)	0.63 (1.45)	0.58 (
Anxiety symptoms scores (0-14)	1.15 (2.20)	1.43 (2.52)	1.45 (2.84)	0.93 (
Posttraumatic stress symptoms scores (0-19)	0.89 (1.97)	1.15 (2.64)	0.45 (0.98)	0.83 (
Suicidality symptoms scores (0-5)	0.16 (0.73)	0.12 (0.57)	0.27 (0.95)	0.12 (

Table 9-3) presents the prevalence of probable common mental disorder disaggregated across four groups according to motherhood and HIV status. Prevalence of likely common mental disorder was found to be highest amongst adolescent mothers living with HIV (23.0% [95% CI: 14.1%-35.15%]). Likewise, prevalence of depressive symptomology was found to be highest among adolescent mothers living with HIV (16.4%). Of note, the prevalence of probable mental health comorbidities was higher amongst mothers regardless of HIV status (adolescents living with HIV: 8.2%, Adolescents not living with HIV: 8.2%). Similar patterns were identified relating to anxiety and suicidality symptoms (see

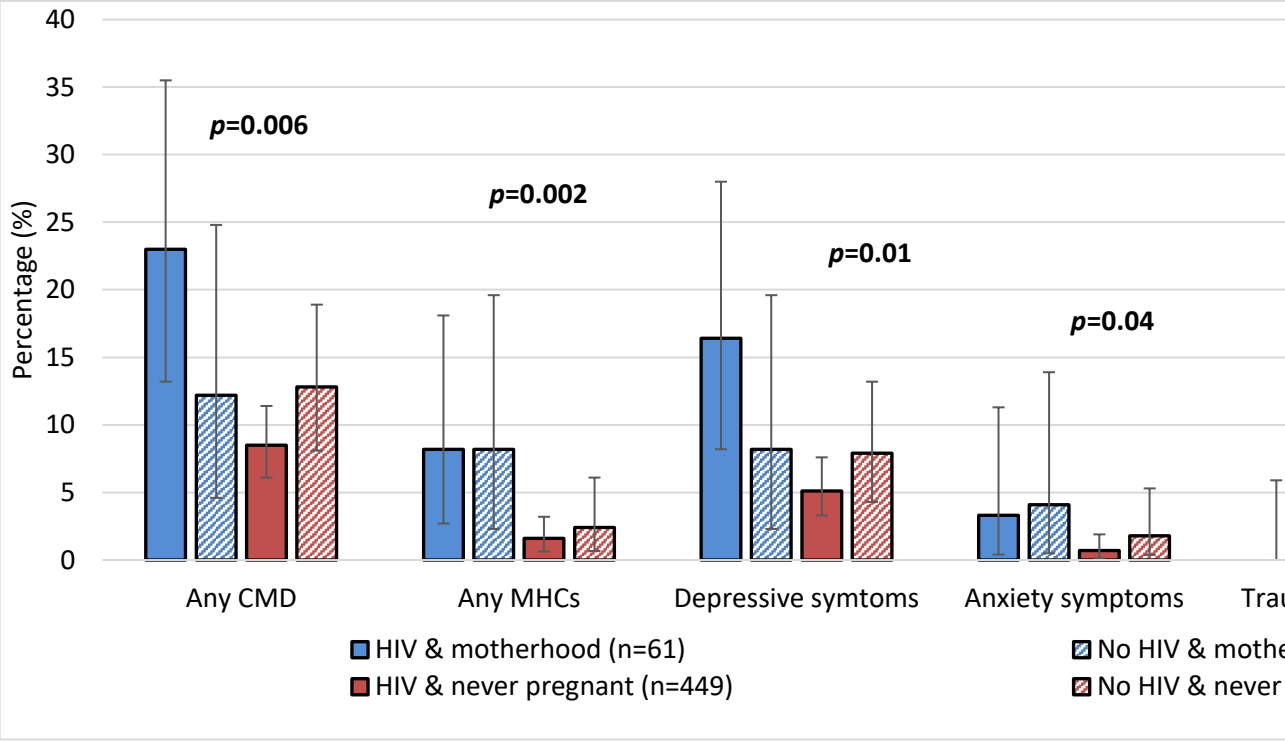


Figure 4-2). For exploratory purposes **Appendix 2**, **Table 9-3** details mental health symptomology scores stratified according to combined motherhood and HIV status.

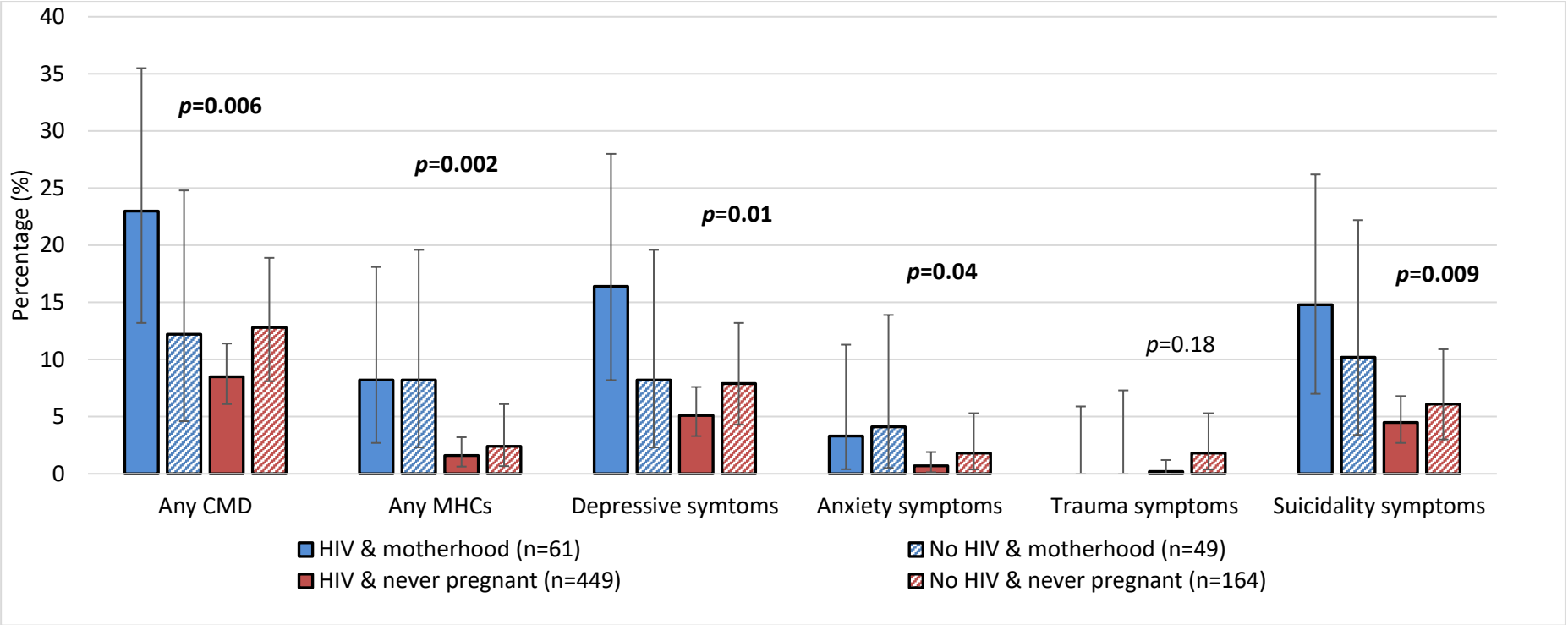


Figure 4-2 Mental health symptoms stratified accordingly to combined motherhood and HIV status

Note. Common mental disorder (scoring above the cut-off on one or more screening measure for mental health)|Mental health comorbidities (experiencing two or more common mental disorders concurrently defined for the purpose of this thesis as scoring above the cut-off on two or more mental health screening measures). Confidence intervals calculated at 95%. *one-sided 97.5% confidence interval. Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

4.3.4 Associations between combined motherhood and HIV status and common mental disorder

Table 4-3 presents a series of logistic regression models exploring the cross-sectional associations between motherhood and HIV status and, likely common mental disorder (including mental health comorbidities and the presence of individual mental health symptomology). **Figure 4-3** illustrates the adjusted odds ratios (with 95% confidence intervals) for likely common mental disorder and mental health comorbidities according to combined motherhood and HIV status. Within the multivariable models (model 1), the odds of experiencing probable mental health comorbidities were found to be elevated among those experiencing motherhood (regardless of HIV status), however, this did not reach statistical significance (AOR: 2.64, *p*=0.08; likely due to the small sample size experiencing mental health comorbidities). The association between motherhood and likely common mental disorder in the sample did not reach statistical significance and the magnitude of the association was considerably attenuated compared to that for presence of co-morbidities (AOR: 1.30, *p*=0.44). Adjusted odds ratios suggest living with HIV was protective of likely common mental disorder/mental health comorbidities, however these associations did not reach statistical significance (model 1). Within the interaction models (model 2), a trend was identified for an exacerbating interaction effect between experiencing motherhood and living with HIV, predicting an increased likelihood of likely common mental disorder when both adolescent motherhood and HIV occur (AOR: 2.67, *p*=0.13). A similar trend was identified for reported depressive symptomology (AOR:3.23, *p*=0.12), identifying depressive symptomology as a likely driver of reported likely common mental disorder within these analyses. No other associations were identified within these models.

Table 4-3 Multivariable logistic regression models exploring the association between motherhood and HIV status and, prevalence of common mental disorder

	Any common mental disorder		Any mental health comorbidity		Any depressive symptoms		Any anxiety symptoms		Any posttraumatic stress symptoms		Any suicidality symptoms	
	OR (95% CI)	***p***	**OR (95% CI)**	***p***	**OR (95% CI)**	***p***	**OR (95% CI)**	***p***	**OR (95% CI)**	***p***	**OR (95% CI)**	***p***
Model 1*												
Motherhood (n=110)	1.30 (0.67-2.55)	0.44	2.64 (0.89-7.90)	0.08	1.66 (0.75-3.68)	0.21	1.79 (0.41-7.81)	0.44	1	-	1.59 (0.71-3.57)	0.26
Living with HIV (n=510)	0.76 (0.45-1.29)	0.31	0.67 (0.25-1.80)	0.43	0.74 (0.39-1.42)	0.37	0.49 (0.13-1.85)	0.29	0.14 (0.009-2.09)	0.16	0.84 (0.42-1.68)	0.63
Living in a rural area	0.90 (0.53-1.55)	0.71	1.47 (0.58-3.74)	0.42	1.29 (0.70-2.40)	0.42	1.82 (0.51-6.51)	0.36	1	-	0.68 (0.32-1.44)	0.31
Living in informal housing	1.52 (0.84-2.75)	0.17	1.03 (0.30-3.61)	0.96	1.49 (0.72-3.10)	0.28	2.40 (0.61-9.42)	0.21	1.84 (0.19-17.88)	0.60	1.50 (0.70-3.22)	0.30
Orphanhood	1.29 (0.80-2.06)	0.30	1.10 (0.45-2.69)	0.83	1.51 (0.83-2.71)	0.18	0.90 (0.26-3.12)	0.86	0.90 (0.13-6.40)	0.91	1.08 (0.59-2.00)	0.80
No school enrolment	2.79 (1.60-4.86)	<0.001	4.72 (1.88-11.87)	0.001	1.98 (0.98-4.01)	0.06	6.92 (1.97-24.38)	0.003	1	-	4.34 (2.25-8.38)	**<0.001**
No household cash grant receipt	0.36 (0.17-0.73)	0.005	0.60 (0.14-2.67)	0.50	0.58 (0.22-1.55)	0.28	0.26 (0.05-1.28)	0.10	0.20 (0.02-1.97)	0.17	0.32 (0.13-0.77)	**0.01**

Model 2*												
Motherhood (n=110)	0.74 (0.27-2.07)	0.57	2.50 (0.55-11.50)	0.24	0.85 (0.25-2.89)	0.80	1.27 (0.18-9.05)	0.81	1	-	1.36 (0.41-4.54)	0.62
Living with HIV (n=510)	0.60 (0.33-1.09)	0.10	0.64 (0.18-2.32)	0.50	0.55 (0.27-1.14)	0.11	0.36 (0.07-2.00)	0.24	0.14 (0.009-2.09)	0.16	0.78 (0.34-1.78)	0.55
Motherhood*Living with HIV (n=61)	2.67 (0.75-9.44)	0.13	1.11 (0.15-8.14)	0.92	3.23 (0.72-14.40)	0.12	2.09 (0.14-30.98)	0.59	1	-	1.31 (0.29-5.93)	0.73
Living in a rural area	0.88 (0.50-1.55)	0.66	1.41 (0.52-3.83)	0.51	1.27 0.67-2.44)	0.46	1.93 (0.49-7.51)	0.35	1	-	0.66 (0.30-1.44)	0.30
Living in informal housing	1.37 0.73-2.57)	0.32	0.78 (0.21-2.89)	0.71	1.47 (0.69-3.14)	0.31	1.90 (0.44-8.22)	0.39	1.19 (0.08-17.71)	0.89	1.13 (0.50-2.57)	0.77
Orphanhood	1.46 (0.88-2.42)	0.14	1.38 (0.52-3.66)	0.51	1.73 (0.93-3.25)	0.09	1.13 (0.30-4.24)	0.86	1.29 (0.12-13.79)	0.83	1.24 (0.64-2.40)	0.52
No school enrolment	2.68 (1.39-5.17)	0.003	3.61 (1.21-10.80)	0.02	1.58 (0.69-3.61)	0.28	4.92 (1.18-20.52)	0.03	1	-	4.20 (1.92-9.20)	**<0.001**
No household cash grant receipt	0.36 (0.17-0.76)	0.007	0.51 0.11-2.40)	0.40	0.57 (0.21-1.55)	0.27	0.24 (0.04-1.31)	0.10	1.03 (0.06-18.99)	0.98	0.32 (0.13-0.80)	**0.01**

Note. Common mental disorder (scoring above the cut-off on one or more screening measure for mental health)| Mental health comorbidities (experiencing two or more common mental disorders concurrently defined for the purpose of this thesis as scoring above the cut-off on two or more mental health screening measures) *Model 1/Model 2: Multivariable logistic regression models adjusted for sample characteristics (living in a rural area [yes], living in informal housing [yes], orphanhood status [at least one parent has died], enrolled in school [no], household in receipt of cash grant [no]). Any mental health symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

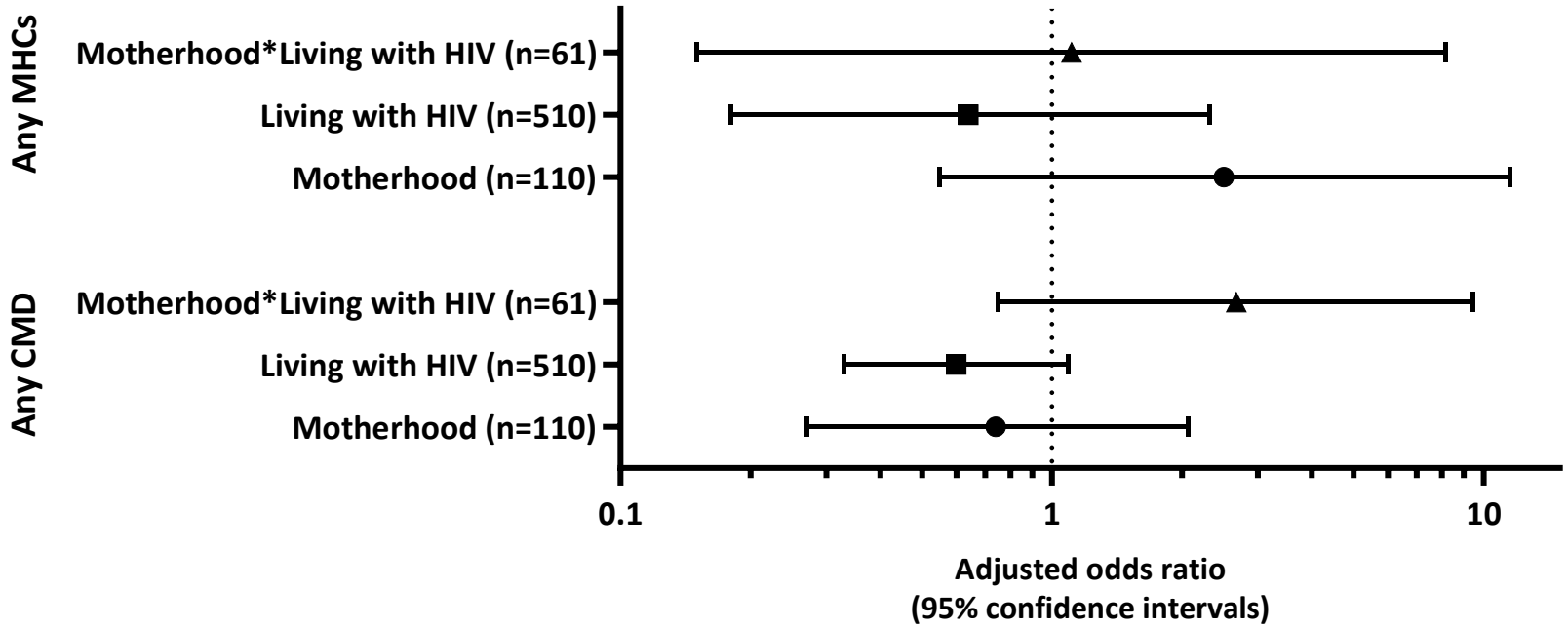


Figure 4-3 Forest plot detailing adjusted odds ratios (with 95% confidence intervals) for likely common mental disorder and mental health comorbidities according to combined motherhood and HIV status

Note. CMD; Common mental disorder (scoring above the cut-off on one or more screening measure for mental health)| MCHs; Mental health comorbidities (experiencing two or more common mental disorders concurrently defined for the purpose of this thesis as scoring above the cut-off on two or more mental health screening measures). Multivariable logistic regression models adjusted for sample characteristics (living in a rural area [yes], and living in informal housing [yes], orphanhood status [at least one parent has died], Enrolled in school [no], Household in receipt of cash grant [no]). Any mental health symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**

4.4 Discussion

This is the first known explicit exploration of mental health among adolescent mothers within sub-Saharan Africa with a focus on HIV status. These analyses explore the current prevalence of likely common mental disorder according to experience of adolescent motherhood and the syndemic of adolescent motherhood and HIV. The prevalence of adolescent motherhood was 15.2% (a figure in line with current national South African estimates),[140] and over a tenth (10.9%) were classified as reporting likely common mental disorder (either depression, anxiety, posttraumatic stress disorder, or suicidality symptomology; see section **3.4**). These prevalence data indicate a need for attention to adolescent mental health, particularly within the context of adolescent motherhood. The detailed exploration of associations in these analyses reveals three core findings. First, poor mental health was higher among mothers compared to adolescents who had never experienced pregnancy. Secondly, within univariable analyses, prevalence of likely common mental disorder was found to be highest among adolescent mothers living with HIV (23.0%) compared to those experiencing motherhood who were not living with HIV, and non-mothers. Thirdly, prevalence of likely mental health comorbidities within unadjusted analyses (scoring above the cut-off on two or more measures of mental health symptomology; see section **3.4**) was found to be higher among adolescent mothers, regardless of HIV status, indicating that experience of pregnancy/motherhood may drive more complex mental health burden. This finding was supported within adjusted models, as a trend for adolescent mothers to be marginally more likely to report probable mental health comorbidities was identified. These findings highlight the commonality and potential complexity of mental health burden within the context of adolescent motherhood and HIV within South Africa, and the urgent need for further research and effective support for this group.

These findings extend literature identifying elevated prevalence of mental health burden among adolescent mothers,[152,153] and highlight increased mental health burden (likely driven by probable depressive symptoms) among adolescents

experiencing the dual impact of motherhood and living with HIV. As such, findings address the critical evidence gap highlighted by the systematic review undertaken as part this thesis (see **Chapter 2**) which identified no existing studies reporting the prevalence of likely common mental disorder among adolescent mothers living with HIV. Adjusted models within analyses also highlight the potential complexity of likely common mental disorder among adolescent mothers within the context of HIV. While results suggest that adolescent motherhood may be associated with elevated poor mental health, adjusted models also indicate that living with HIV was potentially protective of mental health for this sample - a finding in contrast to previous literature.[124,127,131-133] It should be noted that these associations did not reach statistical significance. Despite this, these findings, warrant further study to explore potential factors contributing to this pattern of results i.e., mode of HIV infection, time since HIV diagnosis, engagement with HIV services, resilience or access to social support may have implications for mental health within this population. Findings also highlight the experience of mental health comorbidities within adolescent motherhood, broadening previous investigations exploring singular mental health disorders.[209] The evidence base on mental health and pregnancy/motherhood is often limited to depressive symptomology with a reduced focus on anxiety, posttraumatic stress, and suicidal behaviours. In addition to highlighting elevated depressive symptomology among adolescents who have experienced motherhood in the sample, these data identify both anxiety, and worryingly, suicidality symptomology as prevalent among adolescent mothers. These data extend emerging literature identifying the commonality of suicidal ideation within pregnancy among HIV-affected populations in South Africa,[378] providing evidence relating to adolescents. Furthermore, these data highlight the potential complexity of mental health experience (demonstrated through the presence of probable mental health comorbidities) for this group. While the findings from these analyses focus on exploring likely common mental disorder and poor mental health status within this sample, it would be amiss not to highlight the absence of poor mental health within most of the sample - particularly given the burdens of HIV, adolescent pregnancy, and sociodemographic challenges among this population. As above, such findings warrant further exploration to examine possible contributors to resilience, coping,

and positive mental health among this population to appropriately inform future programming with the aim of bolstering wellbeing for this group.

For adolescent mothers living with HIV, elevated likely common mental disorder is of particular concern as poor mental health has been found to negatively impact HIV treatment uptake and adherence[379,380], including prevention of mother to child transmission efforts[381] - potentially having negative health consequences for both the adolescent and their child(ren). Mental health challenges have previously been found to be associated with parenting challenges i.e., harsh parenting practices[152] and sub-optimal child development outcomes,[153,205,207-209] bringing to light the importance of supporting adolescent maternal mental health for both the individual and their child(ren). A recent systematic review exploring psychosocial interventions for pregnant and parenting adolescents identified seventeen interventions studies with small to moderate effects on positive mental health however, no studies were identified within low and middle income countries[330] - highlighting the need for tailored intervention among this group. There is a robust literature on effective interventions for maternal common mental disorder (mostly focused on depression),[382] including interventions for populations living with HIV within South Africa e.g. psycho-educational interventions.[161,383,384] Adapting such interventions for adolescents living with HIV may be of benefit. Future research may also be well placed to explore modifiable factors that contribute to common mental disorder among adolescent mothers living with HIV to better inform future programming. Within the above multivariable analyses, not being enrolled in school and receiving a cash grant were found to be associated with likely common mental disorder in this sample, suggesting that adolescent mothers not in school (i.e., those adolescent mothers who have dropped out of school or are older) or those experiencing poverty are more likely to report poor mental health symptomology. However, it was beyond the scope of this chapter to fully explore such associations, and further research is required examine these relationships further. Additional possible factors driving elevated common mental disorder among this group may include stigma (related to both adolescent pregnancy/motherhood and HIV), a lack of social support, poverty, parenting stress, knowledge, and timing of HIV diagnosis and, child HIV

status.[136,161,324,385] For the majority, contact with health services likely increases for these adolescents during the pregnancy and post-partum period. Inherently, this contact with antenatal and postnatal care services (as well as HIV care services for adolescents living with HIV), provides an opportunity to amalgamate differing branches of health service through providing screening, monitoring, and referral for likely common mental disorder.

4.4.1 Limitations of analyses

These analyses should be interpreted within the context of study limitations. First, given the distribution of participants within groups established from combined motherhood and HIV status, some of the regression models undertaken as part of these analyses may have been underpowered to detect associations. Nevertheless, trends within the models were identified and, the prevalence data within these analyses contribute to a critical gap within the evidence base relating to adolescent mothers living with HIV. Second, these analyses focus solely on female adolescents. It was beyond the scope of this study to explore the mental health experience of adolescent fathers. As such, there remains an absence of literature regarding the experience of adolescents who have fathered a child.[386] Third, it was beyond the scope of these analyses to explore pregnancy loss, parenting of multiple children and, some of the intricacies relating to the experience of mental health burden, adolescent motherhood, and HIV (i.e., how risk and protective factors contribute to such experiences, the impact of mode of maternal HIV infection and, the timing of common mental disorder symptomology [e.g., the post-partum period]). However, the contribution of such factors should not be excluded from the discussion regarding these experiences. Future studies should be encouraged to further examine the experience of mental health for this group to allow for a greater understanding of modifiable mechanisms of effect for common mental disorder to better inform effective interventions among this group. The strengths and limitations of these data and analyses are discussed further in sections **3.1.5** and **8.3** of this thesis.

4.4.2 Chapter summary & conclusions

Mental health research, policy, and provision is beginning to be given attention by international funding bodies and polygonal organisations however, resources, programming, and research capacity within the field remains low, limiting the production of evidence relevant to programming for adolescents within low- and middle-income countries. For policy change to occur in relation to mental health, a core step is raising awareness of the burden of mental health challenges among the population, and identifying particularly vulnerable sub-groups to allow for targeted responses.[134] This chapter explored the prevalence of likely common mental disorder among adolescent mothers within the context of HIV and explored associations between motherhood and HIV status, and mental health status. These analyses identified a high prevalence of likely common mental disorder among a particularly vulnerable group and provides a foundation for further exploration regarding the needs of adolescent mothers within the context of HIV. This is the first explicit exploration of likely common mental disorder prevalence among adolescent mothers living with HIV within South Africa. Three core findings emerge: 1) results highlight elevated likely common mental disorder among adolescent mothers, 2) prevalence of likely common mental disorder was found to be greatest among those adolescents experiencing the syndemic of adolescent motherhood and HIV and, 3) likely mental health comorbidities were found to be prevalent among adolescent mothers regardless of HIV status. These data focus on syndemic conditions (adolescent pregnancy/parenthood and HIV status) and highlight the potential need for integrated responses for adolescent mothers within South Africa (i.e., the amalgamation of antenatal, postnatal, and HIV care, with mental health screening).

Chapter 5 Correlates of common mental disorder among adolescent mothers in the context of HIV in South Africa

5.1 Chapter overview

Chapter 4 of this thesis utilised data from the ***Adolescent HIV study*** to explore prevalence of likely common mental disorder according to motherhood and HIV status. This proceeding chapter further extends these works to explore prevalence of likely common mental disorder beyond the pregnancy period in a broader sample of mothers who have previously been pregnant during adolescence. Unlike the previous chapter, the ***HEY BABY study*** focuses solely on adolescent mothers, both living with and not living with HIV [see section **3.1.3** for an overview]). As well as exploring prevalence of likely common mental disorder, this chapter additionally explores correlates (framed as risk factors) for likely common mental disorder among adolescent mothers (both living with and not living with HIV) to address the absence of evidence relating to this population.

The works within this chapter have resulted in the following peer-review publication:

Steventon Roberts, K.J., Smith, C., Toska, E., Cluver, L., Haag, K., Wittesaele, C., ... & Sherr, L. (2022). Risk factors for poor mental health among adolescent mothers in South Africa. Psychology, Health & Medicine, 1-18. https://doi.org/10.1080/13548506.2022.2124295

5.2 Background

Adolescent pregnancy has previously been found to be associated with poor mental health, [152,153] and this previous evidence is supported by the findings from **Chapter 4** of this thesis. Within South Africa, adolescents are additionally exposed to numerous risk factors for poor mental health including poverty, violence exposure, and high levels of communicable disease (e.g., HIV). Risk of poor mental health may therefore

be further compounded by the experience of adolescent pregnancy within such settings. As detailed in section **1.4**, HIV has been found to be associated with poor mental health among adolescents. A recent systematic review identified a high prevalence of mental health problems among adolescents living with HIV, with 24–27% of adolescents identified as experiencing psychiatric disorder and 30–50% showing behavioural or emotional difficulties.[132] For adolescents living with HIV, poor mental health has implications for treatment adherence[387,388] which in turn has implications for health outcomes and onward HIV transmission.

Both pregnancy and living with HIV have been found to be independently associated with poor mental health among adolescents.[131,152,162] Similarly, the findings from **Chapter 4** identify the prevalence of likely common mental disorder to be higher among adolescent mothers living with HIV compared to adolescent mothers not living with HIV and non-mothers. This evidence suggests that the experiencing the syndemic of both adolescent pregnancy and living with HIV seemingly may compound poor mental health experience. Established literature highlights that poor mental health has widespread impacts for the individual and their social networks.[8,14,15,17,19,21,22] Within the context of adolescent mothers, poor mental health may additionally have implications for the health, development, and wellbeing of their children.[153,205,389,390] Despite the possible impacts for both adolescent mothers and their children, there is limited research exploring factors associated with poor mental health among adolescent mothers, and there is an absence of literature exploring risk and protective factors for adolescent mothers living with HIV (see **Chapter 2**). As such, there exists no evidence-based programming to support the mental health of adolescent mothers living with HIV (see **Chapter 2**). Given this, the next challenge is to explore factors associated with poor mental health among adolescent mothers (including those living with HIV), to identify risk and protective factors for mental health among this group.

Existing research exploring risk factors for poor mental health among populations which may have included adolescent mothers (but did not stratify according to age; such research is outlined in section **2.4** of this thesis) identify factors that may be

associated with a heightened likelihood of probable common mental disorder. Previously identified factors include having an older spouse,[307] abuse exposure,[294,308,311,316,320] relationship difficulties,[308,312] younger maternal age,[294,315] living with HIV,[294,312] economic difficulties,[311] food insecurity,[314] unintended pregnancy,[319] and previous history of poor mental health.[320] Furthermore, within some of these previous explorations, social support has been identified as protective of mental health.[86,294,328] Further insight into risk and protective factors for mental health in this specific age group remains critical to better understand the mental health experience of adolescent mothers generally and those living with HIV, specifically, within sub-Saharan Africa, and how best to support this population. Such insights are also critical to ensure the development of impactful policy and programming to promote adolescent wellbeing and enhance adolescent potential. This study set out to test if the above established risk factors (for which there are available measures) are correlated with likely common mental disorder specifically among adolescent mothers affected by HIV.

5.2.1 Aim and objectives

The exploratory analyses within this chapter builds the evidence base relating to potential correlates for likely common mental disorders among adolescent mothers (including those living with HIV and not living with HIV) in South Africa. Specific objectives of these analyses are to:

Objective 1: Identify prevalence of likely common mental disorder among adolescent mothers, including explorations according to adolescent HIV status

Objective 2: Explore the associations between hypothesised correlates (framed as risk factors) and likely common mental disorder (informed by concepts drawn from Bronfenbrenner's ecological model[278] as a framework)

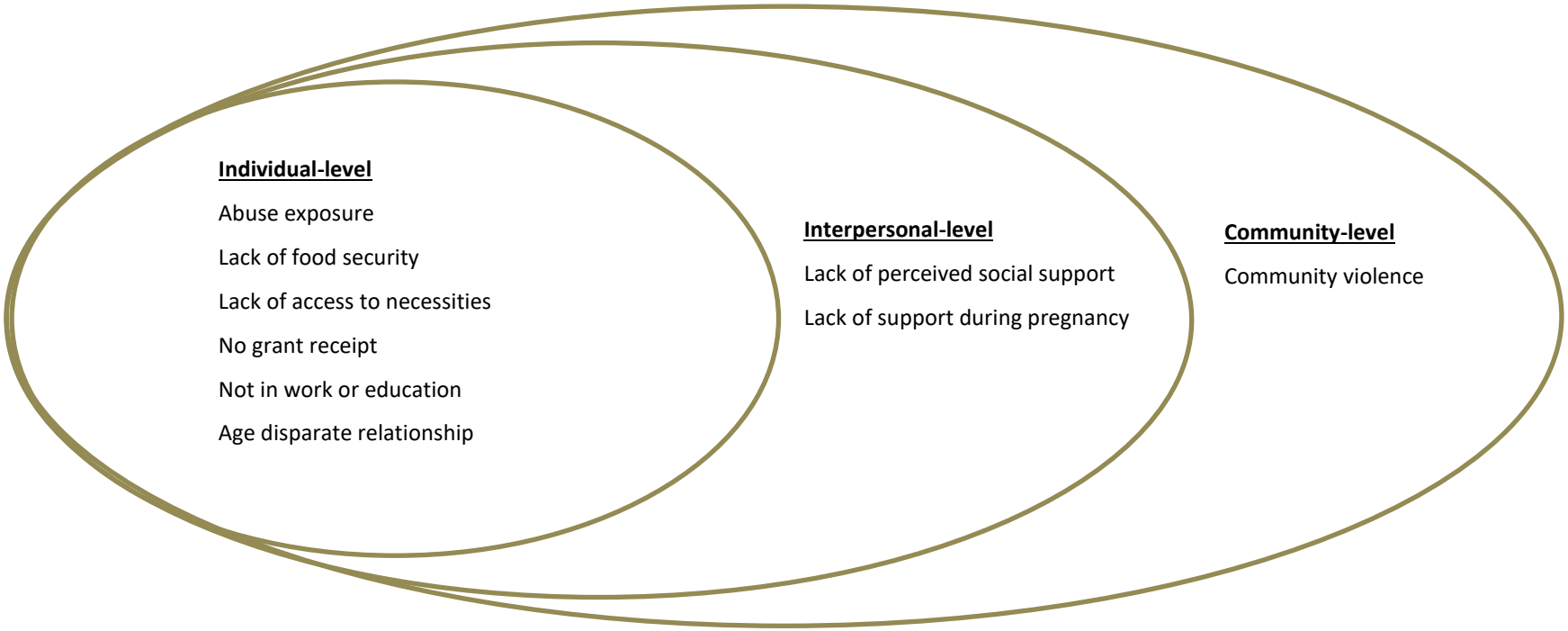
5.2.2 Hypothesised correlates

Hypothesised correlates were drawn from the limited existing literature (obtained from studies identified in the systematic review undertaken as part of this thesis but did not fully meet the criteria for inclusion; see section **2.4**) and, for practicality, were selected based on the availability of measures in the ***HEY BABY study***. To acknowledge the broader social context and the lived realities of adolescents' lives, these analyses utilise concepts from Bronfenbrenner's socio-ecological model[278] as a framework to explore hypothesised correlates at an individual, interpersonal and, community level. See section **1.9** for an overview of Bronfenbrenner's ecological model and its application to the works in this thesis.

The socio-ecological perspective allows for both individual and contextual factors to be accounted for within the exploration of common mental disorder. A core concept from Bronfenbrenner's ecological model was that at least two ecological systems are included within analyses to allow for the understanding of a particular phenomenon,[278] in this instance the reporting of likely common mental disorder. Use of this concept also highlights the role of the social and physical environment in mental health experience and broadens investigations beyond individual based factors. Hypothesised correlates were clustered into three levels (individual, interpersonal and community); see **Figure 5-1**.

At an individual level hypothesised correlates include ***previous experience of abuse***, ***access to social protection*** (operationalised for the purpose of these analyses as food security, access to necessities, access to cash grants), ***access to work and education***, and ***experience of age disparate relationships***. In addition to the literature outlined above (which may have included adolescent mothers and those living with HIV) which highlights these factors as potentially being associated with poor mental health among adolescent mothers,[294,308,311,316,320] previous research has identified exposure to abuse (physical or sexual) as being associated with both poor mental health and adolescent pregnancy.[86,391,392] Likewise, while food insecurity[314] and economic difficulties have been associated with poor mental health among pregnant women (including adolescents)[311], access to social protection[393,394] (e.g., food security, access

to necessities, cash grant receipts) has previously been identified as being associated with improved mental health among adolescent populations within sub-Saharan Africa. To explore the concept of economic difficulties further within this sample, being in work or education was also added to the model as a possible correlate of poor mental health among adolescent mothers. Age disparate sexual relationships have previously been found to be associated with adolescent pregnancy within South Africa,[395] and having an older partner has previously been identified as being associated with poor mental health in a sample which may have included adolescent mothers and those living with HIV.[307] At an interpersonal level, the concept of ***support*** is explored as a hypothesised correlate, as previous research has identified social support as protective of mental health[86,294,328] within pregnancy (inclusive of populations including adolescents and those living with HIV). Finally, at a community level, ***exposure to community violence*** is explored as there is a strong body of evidence which shows that exposure to violence within the community is associated with a higher likelihood of mental disorders among adolescents in South Africa (see **Figure 5-1**).[396-399]



Note. Hypothesised correlates drawn from existing literature

Figure 5-1 Hypothesised correlates for likely common mental disorder among adolescent mothers affected by HIV clustered according to a socio-ecological framework

5.3 Methods

5.3.1 Participants and procedure

Cross-sectional data utilised within these analyses is drawn from the ***HEY BABY study*** (see section **3.1.3** for full details relating to participants and procedure), undertaken between March 2018 and July 2019. Data included in these analyses exploring the associations are derived from the group of adolescent mothers (those who had given birth between the ages of 10-19 years who had at least one living child; n=1002).

5.3.2 Measures

Maternal mental health status. For a detailed overview of the mental health symptomology measures utilised within analyses see section **3.4**. All participants within the current sample responded to all items of the four validated mental health symptomology measures used within these analyses (see below). Cut-off scores were utilised to ascertain prevalence estimates. Symptomology scores for individual mental health symptom scales are explored for illustrative purposes in **Appendix 3**. Participants were classified as experiencing likely **common mental disorder**[386] if they scored above the cut-off on any of the four mental health symptomology measures utilised within the study (depressive symptoms [Child Depression Inventory Short Form ≥3/10 items[342,343]], anxiety symptoms [Revised Children's Manifest Anxiety Scale ≥10/14 items[360,361]], posttraumatic stress symptoms [Child PTSD checklist-12 items over four domains of posttraumatic stress disorder , scoring ≥1 on each of the four domains of the scale: re-experience, voidance, hyperarousal and dysphoria[54,344,363]], and suicidality [any; Mini International Psychiatric Interview for Children and Adolescents ≥1/5 items[365]]). Participants were classified as experiencing any likely **mental health comorbidities (MHCs)** if a participant scored above the cut-off on two or more of the mental health measures within the study (see above).

Sociodemographic characteristics were routinely gathered by maternal report and corroborated with health records on a case-by-case basis. Characteristics included maternal age at time of birth, maternal HIV status (living with HIV vs. not living with

HIV), number of children given birth to, relationship status (in a relationship vs. not in a relationship), housing type (formal vs. informal) and, dwelling location (rural vs. urban). Child characteristics (child age [months] and biological sex) were collected from adolescent mother/caregiver report and cross-checked with child health records.

Hypothesised correlates were clustered according to a socio-ecological model (see **Figure 5-1**) based on concepts from Bronfenbrenner's theoretical framework[278] (see section **5.2.2** above). **Individual-level factors** were obtained via maternal self-report. Mothers reported on whether they had experienced any previous abuse (emotional, physical [weekly/monthly] or sexual abuse [ever]).[400] Socioeconomic circumstances were captured utilising a series of measures relating to food security (participant had food for the last week and can afford three meals a day),[401] access to necessities (from a list of eight basic necessities recognised by over 80% of the population in the nationally representative South African Social Attitudes Survey),[402] government cash grant receipt and, being in paid work or education. Whether adolescent mothers were in an age disparate relationship was calculated utilising maternal age and maternal reporting of partner/father of child age. Relationships were classified as age disparate if the fathers of the children born to adolescent mothers were 5+years older than the mother.[395,403,404] **Interpersonal-level factors** focused on support and were based on adolescent self-report. Perceived social support was measured using 8-items from the Medical Outcomes Study (MOS) Social Support Survey.[405] Participants were classified as receiving a lack of social support if they did not score positively on all survey items. Support during pregnancy was measured utilising a single self-report item. **Community-level factors** included adolescent report of exposure to community violence, assessed as a binary item (yes/no) obtained from the Child Exposure to Community Violence (CECV) checklist.[406]

5.3.3 Statistical analyses

Analyses examined cross-sectional associations between hypothesised correlates and likely common mental disorder. Sample characteristics (including prevalence of likely common mental disorder) were described and explored according to maternal

HIV status using Chi-square tests, t-tests and, Kruskal Wallis tests, as appropriate. For exploratory purposes, individual mental health scales are explored further, inclusive of stratification according to HIV status in **Appendix 3**. Logistic regression analyses were used to explore associations between hypothesised correlates and likely common mental disorder independently (univariable models; model 1), and within multivariable models (models 2-5). Within multivariable models, factors were clustered based on a hypothesised socio-ecological framework (i.e., sociodemographic characteristics, individual-level, interpersonal-level, community-level; see **Figure 5-1**) and entered into the models within a stepwise sequential approach to identify independent factors (i.e., sociodemographic factors were added, followed by individual- level factors, interpersonal- level factors, and community-level factors). To explore potential differences according to maternal HIV status, interactions with maternal HIV status were additionally explored using logistic regression models. The Benjamini Hochberg procedure was undertaken to account for multiple testing within regression models (false discovery rate of 10%[371]).

5.4 Results

5.4.1 Sociodemographic characteristics

The median age of adolescent mothers at the birth of their first child in the total sample was 17 years (IQR: 16-18 years). See **Figure 5-2/Appendix 3, Table 9-4** for a breakdown of the study sample according to maternal age at the birth of their first child. Almost a third (27.2%; 272/1002) of the sample were living with HIV. Adolescent mothers living with HIV were older compared to adolescent mothers not living with HIV at the birth of their first child (17 vs. 16 years, t= 59.64, p=0.0001). Eight percent of adolescent mothers had more than one child and adolescent mothers living with HIV were more likely to report having more than one child (19.9% vs. 4.7%, X^2=57.11, p=<0.0001). Almost of a third (28.9%) of adolescent mothers lived in a rural area, and 22.3% in informal housing. Two thirds of adolescent mothers were in a relationship at the time of the study (659/1002; 66.4%), adolescent mothers living with HIV were more likely to report being in a relationship compared to adolescent mothers not living with HIV (71.9% vs. 64.3%; X^2=5.03, p=0.03). The

median age of children born to adolescent mothers in the sample was 15 months (IQR: 6-29 months), and 48.7% of children were female. Children of adolescent mothers living with HIV were older compared to those of adolescent mothers not living with HIV (25 vs .13 months: *t*=51.334, *p*=0.0001; see

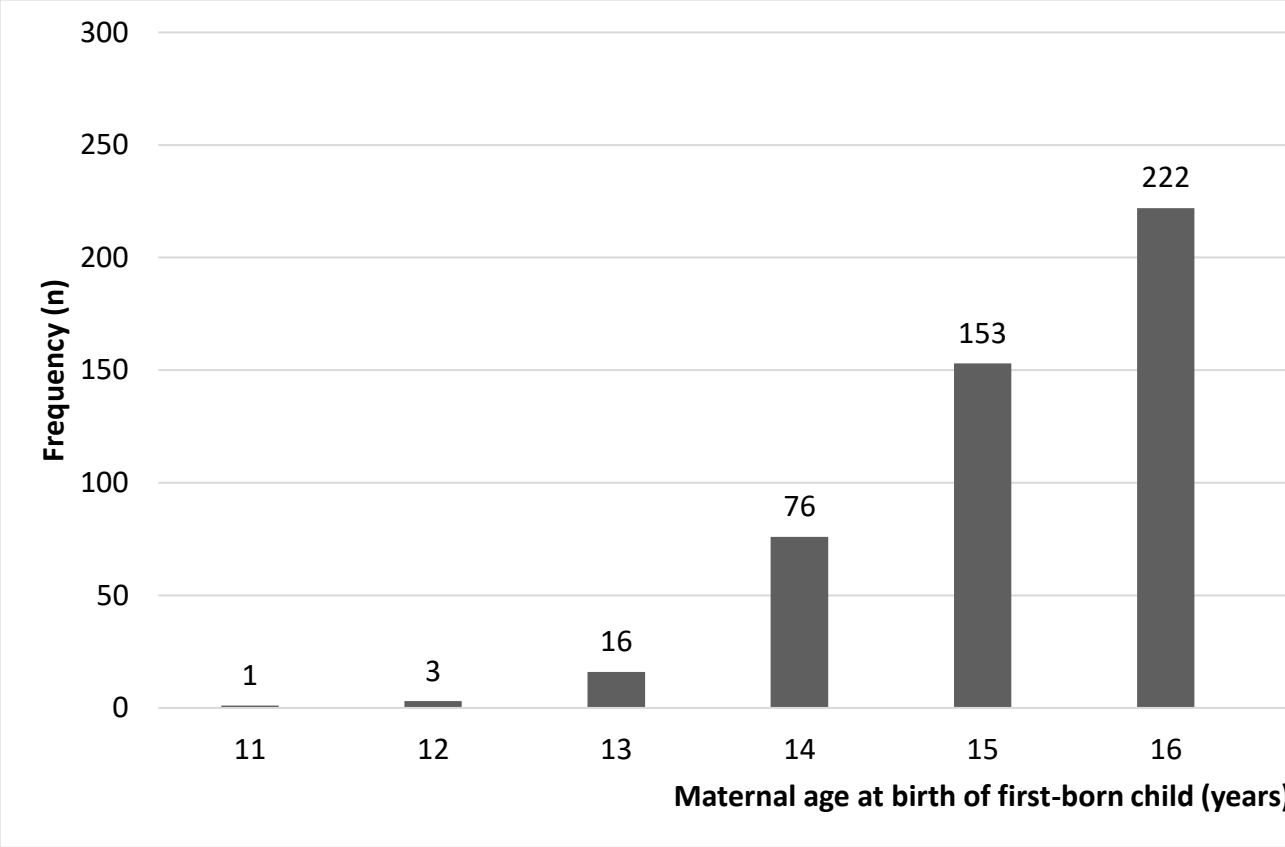


Figure 5-2 Maternal age at birth of first-born child among adolescent mothers (n=1002)

Table 5-1).

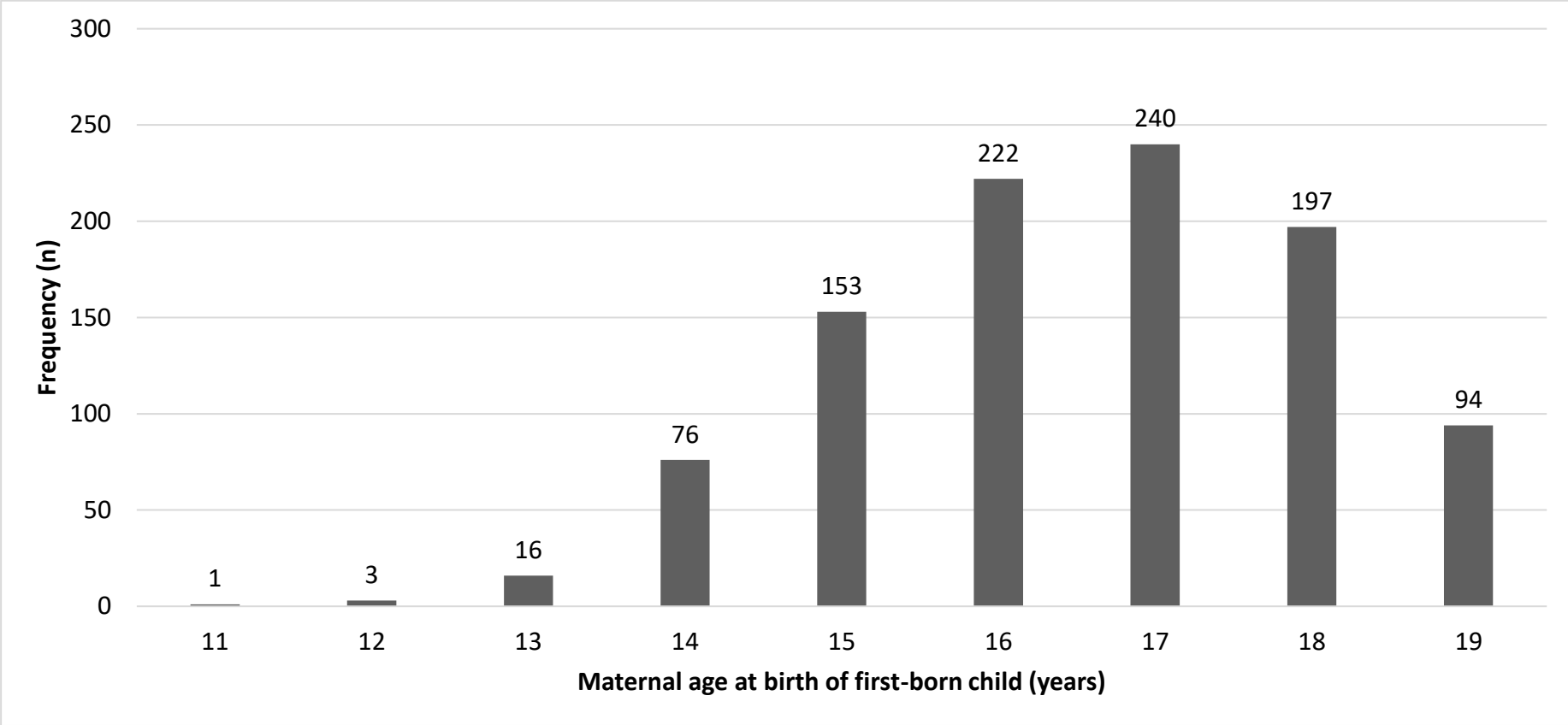


Figure 5-2 Maternal age at birth of first-born child among adolescent mothers (n=1002)

Table 5-1 Sociodemographic characteristics of adolescent mothers and their children (including hypothesised correlates for adolescent maternal mental health) stratified according to maternal HIV status (n=1002)

	M(IQR)/M(SD)/N(%)			**X^2/ *t*, *p*-value**
	Total sample (n=1002)	**Living with HIV (n=272)**	**Not living with HIV (n=730)**	
Maternal characteristics				
Maternal age (current; years)	18 (17-19)	19 (18-21)	18 (17-19)	**175.86, 0.0001**
Maternal age at birth of first child (years)	17 (16-18)	17 (16-18)	16 (15-17)	**59.64, 0.0001**
Has more than one child	88 (8.8%)	54 (19.9%)	34 (4.7%)	**57.11, <0.0001**
Living in a rural area	290 (28.9%)	68 (25.0%)	222 (30.4%)	2.82, 0.09
Informal housing	219 (22.3%)	67 (25.6%)	152 (21.1%)	2.18, 0.14
In a relationship (current)	659 (66.4%)	192 (71.9%)	467 (64.3%)	**5.03, 0.03**
Child characteristics				
Child age (months)	15 (6-29)	25 (8-39)	13 (5.5-24)	**51.34, 0.0001**
Child biological sex (female)	488 (48.7%)	137 (50.4%)	351 (48.1%)	0.41, 0.52
Hypothesised correlates for adolescent maternal mental health				
Individual-level factors				
Any abuse	45 (4.5%)	15 (5.5%)	30 (4.1%)	0.91, 0.34

	M(IQR)/M(SD)/N(%)			**X^2/ *t*, *p*-value**
	Total sample (n=1002)	**Living with HIV (n=272)**	**Not living with HIV (n=730)**	
Lack of food security	291 (29.0%)	89 (32.7%)	202 (27.7%)	2.45, 0.12
Number of necessities (0-8)	5.22 (2.22)	4.71 (2.33)	5.42 (2.15)	**19.08, 0.0001**
Lack of access to all basic necessities (8)	807 (80.5%)	227 (83.5%)	580 (79.5%)	2.03, 0.16
No grant receipt	74 (7.4%)	9 (3.3%)	65 (8.9%)	**9.07, 0.003**
Highest school grade completed	9.63 (1.67)	9.55 (1.87)	9.66 (1.59)	0.94, 0.35
Not in work or education	446 (44.5%)	187 (68.8%)	259 (35.5%)	**88.81, <0.0001**
Age disparity with father of child (how many years older is the father of the child than the mother?)	4 (2-6)	5 (2-8)	3 (2-5)	**20.31, 0.0001**
Age disparate relationship (father of child; ≥5 years)	368 (40.1%)	128 (52.0%)	240 (35.8%)	**19.82, <0.0001**
Interpersonal-level factors				
Perceived social support score	13.39 (2.06)	13.22 (2.16)	13.45 (2.02)	1.63, 0.10
Lack of social support	122 (12.2%)	44 (16.2%)	78 (10.7%)	**5.59, 0.02**
Not supported during pregnancy	179 (17.9%)	51 (18.8%)	128 (17.5%)	0.20, 0.65
Community-level factors				
Any exposure to community violence	267 (26.7%)	64 (23.5%)	203 (27.8%)	1.86, 0.17

Note. Available data: Informal housing n=981|In a relationship n=993|Age disparate relationship (father of child; ≥5 years) n=917

5.4.2 Prevalence of likely common mental disorder among adolescent mothers

One hundred and twenty-six (12.6%) participants scored above the cut-off on at least one mental health symptomology measure and were classified as experiencing likely *common mental disorder*. The prevalence of mental health comorbidities (defined as scoring above the cut-off on two or more mental health symptomology measures) was 2.7%. Within the four individual mental health symptomology scales, 8.1% were classified as experiencing depressive symptoms, 0.8% anxiety symptoms, 0.6% posttraumatic stress symptoms and 6.4% suicidality symptoms (see **Figure 5-3** /**Appendix 3, Table 9-5**.

Compared to adolescent mothers not living with HIV, adolescent mothers living with HIV reported at greater prevalence of likely *common mental disorder* (16.2% [95% CI: 12.3%-21.0%] vs. 11.2% [95% CI: 9.1%-13.7%]; X^2=4.41, *p*=0.04), mental health comorbidities (4.8% vs. 1.9%, X^2=6.19, *p*=0.01) and depressive symptoms (11.4% vs. 6.9%; X^2=5.52, *p*=0.02). Symptomology scores relating to anxiety, posttraumatic stress, and suicidality were similar among mothers regardless of HIV status (see **Figure 5-3**/**Appendix 3, Table 9-5**). See **Appendix 3, Table 9-5** for detail relating to individual mental health symptom scales (including stratification according to maternal HIV status).

5.4.3 Frequency of hypothesised correlates for adolescent maternal mental health

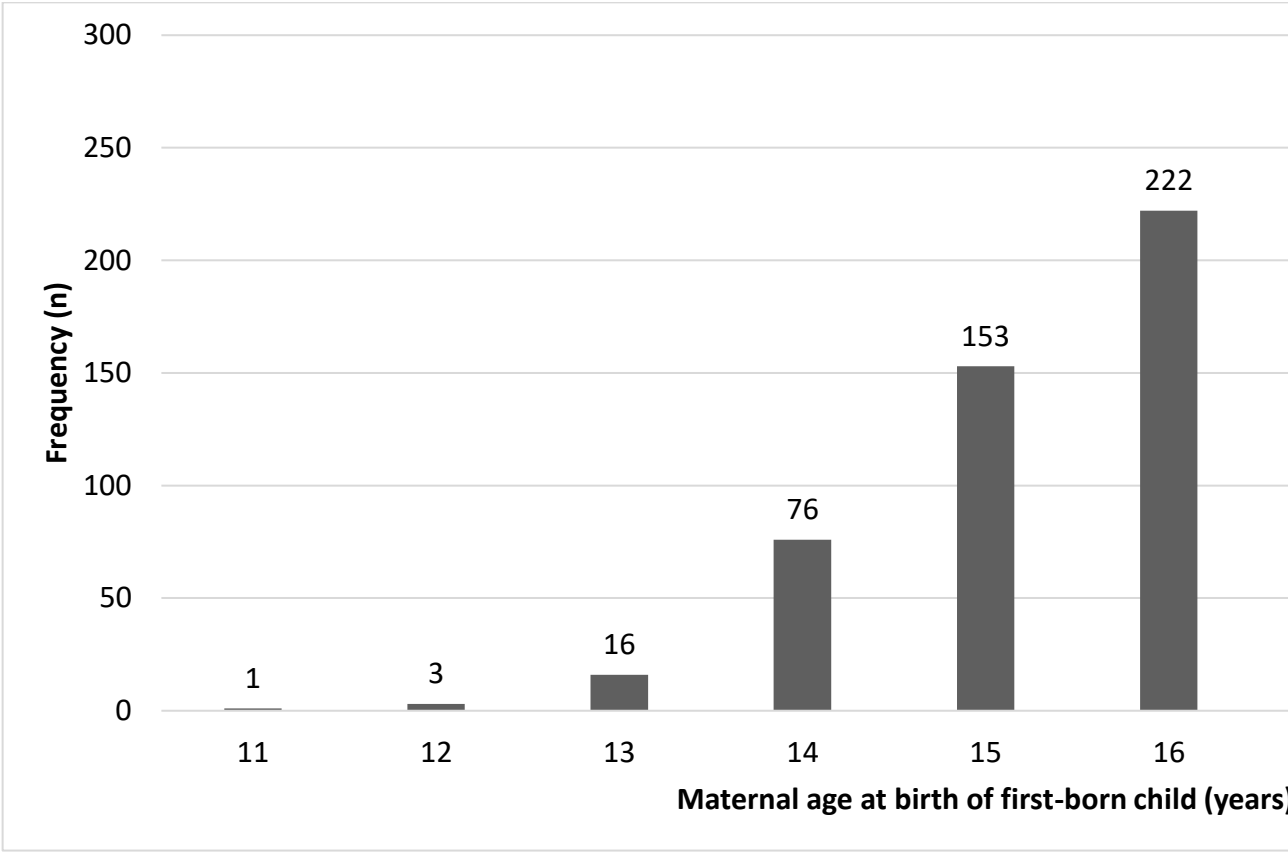


Figure 5-2 Maternal age at birth of first-born child among adolescent mothers (n=1002)

Table 5-1 presents the frequencies of the hypothesised correlates associated with adolescent maternal mental health. These hypothesised correlates are utilised within subsequent logistic regression models exploring cross-sectional associations between maternal factors and maternal mental health. At an ***individual-level,*** 4.5% of adolescent mothers reported experience of abuse (physical/emotional[weekly/monthly] or sexual abuse [ever]: **Appendix 3**,

Table 9-6 details individual measures of abuse according to likely common mental disorder status in the sample), 29.0% were food insecure, 80.5% did not have access to all assessed basic necessities, 44.5% were not in paid work or education and, 40.1% had experienced an age disparate relationship with the father of their child (5+years). At an ***interpersonal-level,*** 12.2% of adolescent mothers were classified as not experiencing high social support, and 17.9% did not feel supported during their pregnancy. At a ***community-level,*** over a quarter (26.7%) of mothers reported experience of violence within their community (see

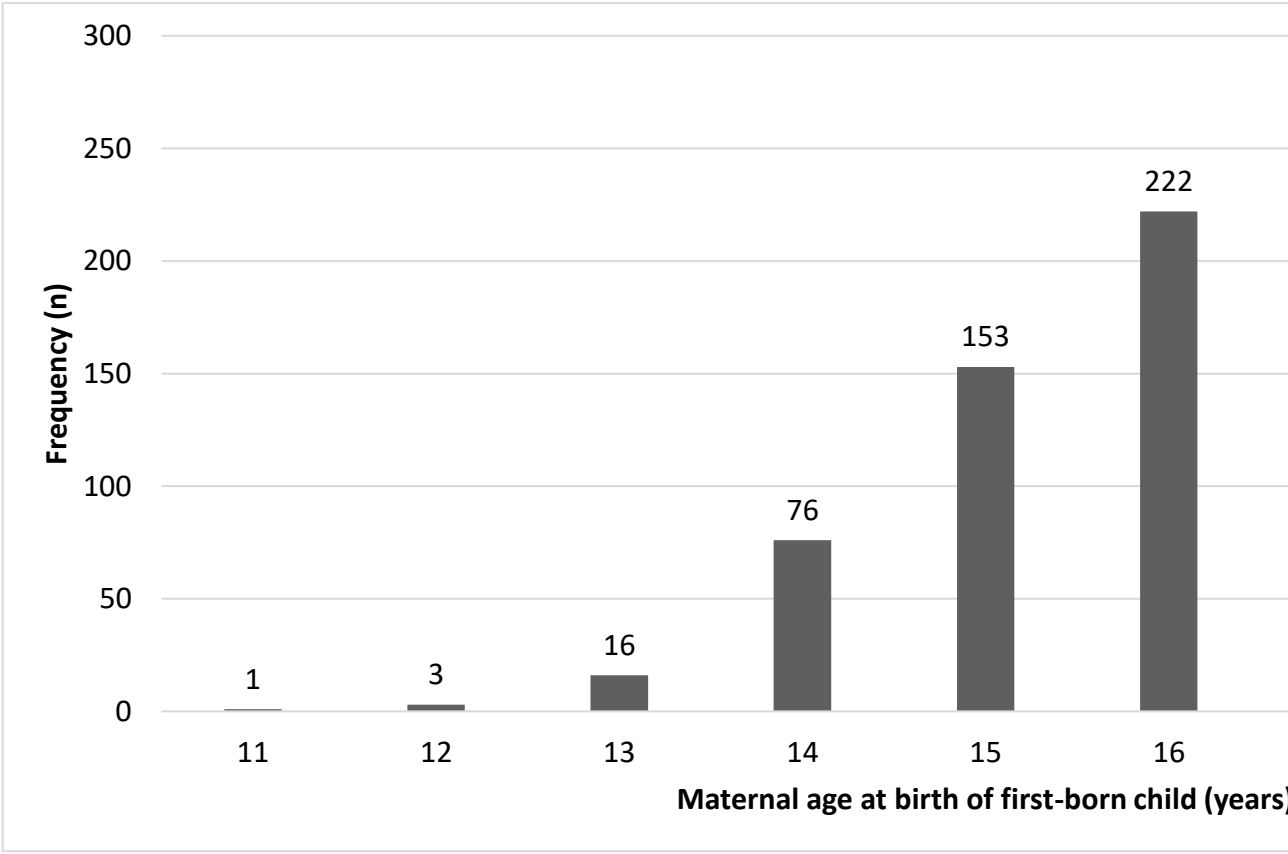
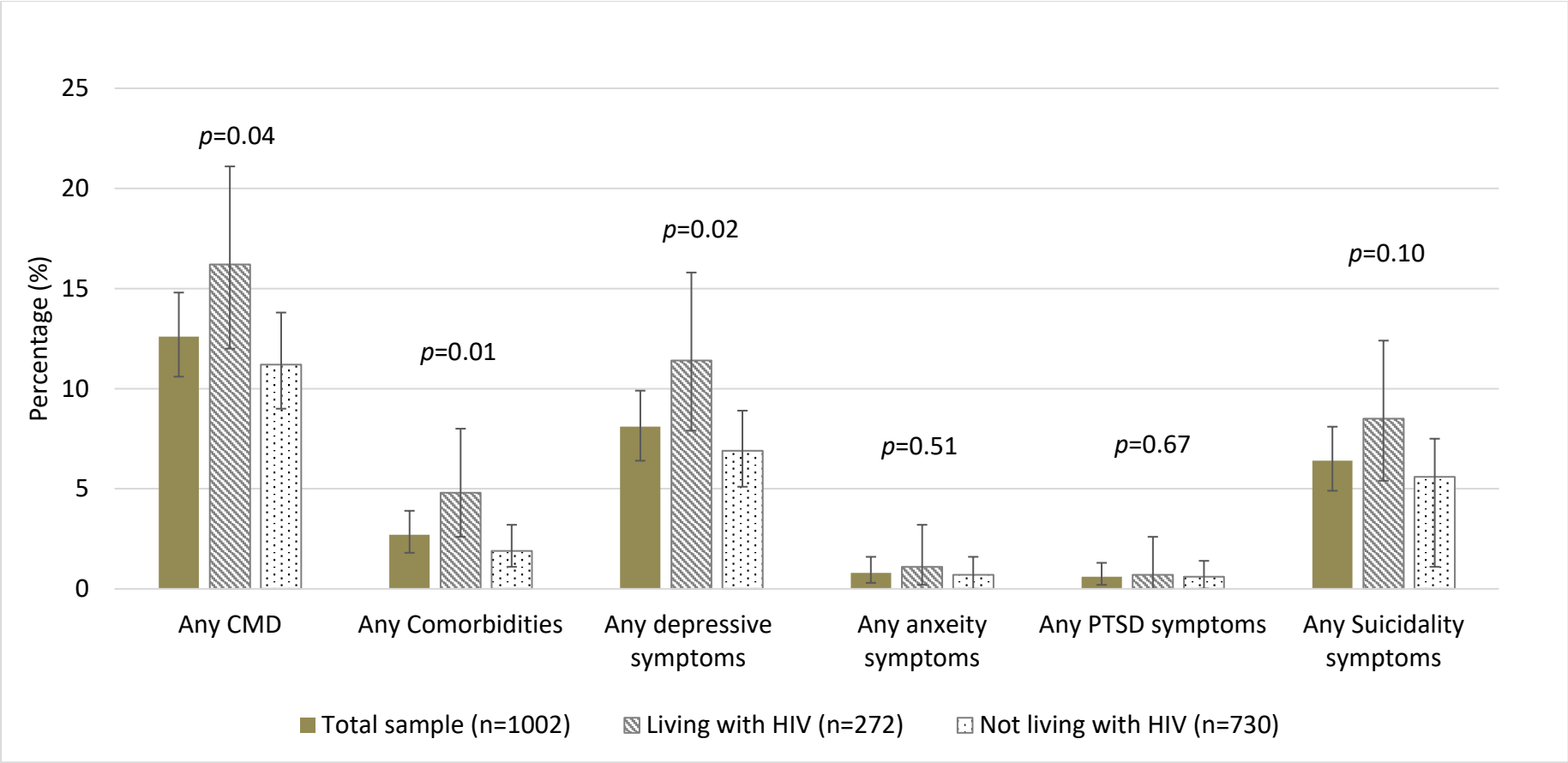


Figure 5-2 Maternal age at birth of first-born child among adolescent mothers (n=1002)

Table 5-1).



Note. CMD: Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Mental health comorbidities (experiencing two or more common mental disorders concurrently) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

Figure 5-3 Prevalence of mental health symptoms among adolescent mothers stratified according to maternal HIV status (n=1002)

5.4.4 Correlates for common mental disorder

Table 5-2 presents as series of logistic regression models exploring associations between (binary) hypothesised correlates for maternal mental health and the presence of any likely *common mental disorder* among adolescent mothers in the sample. Models (1-5) progress in a stepwise manner. Model 1 presents the univariable associations between hypothesised factors and any *common mental disorder*. Models 2-5 present multivariable associations and progress sequentially to include sociodemographic factors (2), individual- level (3), interpersonal- level (4) and community- level (5). When all sociodemographic characteristics, and hypothesised, individual-level, interpersonal-level, and community-level factors were entered simultaneously within a logistic regression model (**Table 5-2**, Model 5); probable correlates for likely CMD among adolescent mothers were any experience of abuse (OR=2.54 [95% CI: 1.20-5.50], *p*=0.01), a lack of perceived social support (OR=4.09 [95% CI: 2.48-6.74], *p*=<0.0001), and exposure to community violence (OR=2.09 [95% CI: 1.33-3.27], *p*=0.001). Identified correlates spanned individual-level, interpersonal-level, and community-level factors. Statistically significant factors remained so after applying the Benjamini Hochberg procedure for multiple testing (utilising a false discovery rate of 10%[371]). To explore potential differences in correlates for likely common mental disorder among adolescent mothers living with HIV and those not living with HIV interaction terms were additionally explored. However, there was limited evidence of interaction effects between correlates and maternal HIV status, as the observed interactions do not appear to be of a large magnitude. For illustrative purposes, a series of logistic regression models exploring the association between hypothesised correlates and the presence of likely common mental disorder stratified according to maternal HIV status were undertaken (see **Appendix 3**,

Table 9-7).

Table 5-2 Logistic regression models exploring associations between hypothesised correlates and adolescent maternal mental health (n=1002)

	Any common mental disorder									
	Model 1		Model 2		Model 3		Model 4		Model 5	
	OR (95% CI)	*p*	AOR (95%CI)	*p*	AOR (95%CI)	*p*	AOR (95%CI)	*p*	AOR (95%CI)	*p*
Sociodemographic factors										
Maternal age at birth of first child (years)	0.99 (0.87-1.12)	0.82	1.01 (0.88-1.16)	0.91	0.98 (0.84-1.14)	0.77	0.98 (0.84-1.14)	0.77	0.96 (0.82-1.12)	0.66
Maternal HIV	1.53 (1.02-2.27)	**0.04**	1.34 (0.85-2.12)	0.21	1.18 (0.73-1.91)	0.52	1.12 (0.67-1.87)	0.66	1.23 (0.75-2.11)	0.39
Child age (months)	1.01 (1.00-1.02)	**0.006**	1.01 (1.00-1.02)	0.14	1.01 (1.00-1.02)	0.10	1.01 (1.00-1.03)	0.07	1.01 (0.99-1.02)	0.14
More than one child	1.92 (1.10-3.34)	**0.02**	1.60 (0.82-3.13)	0.17	1.30 (0.64-2.63)	0.47	1.16 (0.56-2.42)	0.69	1.28 (0.61-2.66)	0.51
In a relationship (current)	0.96 (0.65-1.43)	0.85	0.90 (0.60-1.34)	0.60	0.94 (0.61-1.47)	0.80	0.94 (0.60-1.48)	0.80	0.94 (0.59-1.48)	0.79
Living in a rural area	0.64 (0.41-0.97)	0.05	0.66 (0.42-1.05)	0.08	0.72 (0.43-1.20)	0.20	0.81 (0.48-1.35)	0.42	0.91 (0.53-1.53)	0.70

	Any common mental disorder									
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR (95% CI)	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***
Informal housing	1.17 (0.76-1.81)	0.48	1.06 (0.68-1.65)	0.81	0.88 (0.54-1.43)	0.60	0.82 (0.50-1.36)	0.45	0.76 (0.46-1.27)	0.30
Individual level factors										
Any abuse	3.81 (1.99-7.30)	**<0.0001**	-	-	3.17 (1.52-6.56)	**0.002**	2.83 (1.33-5.98)	**0.007**	2.54 (1.20-5.40)	**0.01**
Lack of food security	1.06 (0.71-1.60)	0.77	-	-	0.94 (0.59-1.49)	0.80	0.84 (0.52-1.35)	0.46	0.86 (0.53-1.40)	0.54
Lack of access to basic necessities	0.97 (0.61-1.55)	0.91	-	-	1.05 (0.62-1.80)	0.86	0.96 (0.55-1.65)	0.87	0.94 (0.55-1.64)	0.84
No grant receipt	1.38 (0.72-2.64)	0.33	-	-	1.41 (0.70-2.87)	0.34	1.55 (0.75-3.19)	0.23	1.50 (0.73-3.09)	0.27
Not in work or education	1.79 (1.22-2.61)	**0.003**	-	-	1.70 (1.07-2.68)	**0.02**	1.62 (1.01-2.58)	0.05	1.57 (0.98-2.52)	0.06
Age disparate relationship	1.35 (0.93-1.96)	0.11	-	-	1.11 (0.73-1.70)	0.61	1.21 (0.79-1.86)	0.38	1.22 (0.79-1.88)	0.38

	Any common mental disorder									
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
	OR (95% CI)	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***	**AOR (95%CI)**	***p***
Interpersonal level factors										
Lack of social support	4.28 (2.75-6.65)	**<0.0001**	-	-	-	-	3.88 (2.37-6.36)	**<0.0001**	4.09 (2.48-6.74)	**<0.0001**
Not supported during pregnancy	1.52 (0.97-2.38)	0.06	-	-	-	-	1.31 (0.80-2.17)	0.29	1.42 (0.85-2.36)	0.18
Community factors										
Exposure to community violence	2.08 (1.41-3.06)	**<0.0001**	-	-	-	-	-	-	2.09 (1.33-3.27)	**0.001**
			R^2= 0.02		**R^2=0.05**		**R^2=0.09**		**R^2=0.11**	

Note. OR: Odds Ratio | AOR: Adjusted Odds Ratio | 95%CI: 95% Confidence Interval | Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) |Model 1. Univariable model | Model 2. Multivariable model including all sociodemographic factors listed | Model 3. Multivariable model including all sociodemographic and individual- level factors listed| Model 4. Multivariable model including all sociodemographic, individual-, and interpersonal- level factors listed | Model 5. Multivariable model including all sociodemographic, individual-, interpersonal- and community-level factors listed

5.5 Discussion

This is the first known series of analyses exploring the relationship between hypothesised correlates and likely common mental disorder among adolescent mothers affected by HIV within South Africa. The prevalence of likely common mental disorder among adolescent mothers was 12.6%, and adolescent mothers living with HIV were more likely to report probable common mental disorder and likely mental health comorbidities (largely driven by depressive and suicidality symptomology) when compared to adolescent mothers not living with HIV (16.2% vs. 11.2% and, 4.8% vs. 1.9%, respectively). Identified correlates for likely common mental disorder among adolescent mothers, were any experience of abuse (verbal, physical or sexual), a lack of perceived social support and, exposure to community violence. There was limited evidence of interaction effects between hypothesised associated factors and maternal HIV status, suggesting that the factors for likely common mental disorder and the magnitude of the associations are similar among adolescent mothers living with and without HIV. Identified associated factors have potential implications for the design of policy and programming to support adolescent mothers and their children within the context of HIV. Violence prevention is seemingly a critical component of adolescent mothers' psychosocial wellbeing, if unaddressed. Support groups may be of benefit to the psychosocial wellbeing of adolescent mothers within this context.[407] It is likely that the perceived support received by adolescent mothers in the sample is provided at an inter-personal level by adolescents' immediate social networks (i.e., family members) – the positive impacts of which are often hard to replicate within interventions.[408,409] However, group participation has previously been linked with greater resilience among adolescents within similar contexts and may provide benefit.[385]

The findings from these analyses support findings from **Chapter 4** which highlight worse mental health burden among adolescent mothers compared to adolescent non-mothers, particularly among adolescent mothers living with HIV, and extends the literature to explore possible correlates (risk factors) for mental health burden among this population. The data highlight the importance of abuse exposure, social support

and, community violence for adolescent maternal mental health within South Africa. Findings additionally support previous studies of broader samples (such as those identified in section **2.4**), which may have included adolescent mothers (both living with and not living with HIV), which identified poor maternal mental health as being associated with reported abuse exposure,[294,308,311,316,320] and social support.[86,294,328] These results also extend such literature to include mothers (including mothers beyond the postpartum period), as much of the previous evidence focuses on the pregnancy or the immediate postpartum period.

Comparable associations have been found within previous studies exploring risk and protective factors for maternal mental health within adult populations affected by HIV in sub-Saharan Africa,[410,411] and adolescent mothers (not necessarily affected by HIV) in the USA.[412,413] These results also support broader evidence from the field of mental health identifying abuse and violence exposure[414,415] as being associated with worse mental health outcomes, and social support[416] as being associated with improved mental health outcomes – these results highlight a lack of social support as being a potential risk factor for likely common mental disorder and therefore the presence of social support is likely protective. However, it should be noted that these models are exploratory (i.e., only a modest amount of variation within the sample was explained by the model and the relationships are cross-sectional) and thus additional factors are likely to impact on common mental disorder among adolescent mothers affected by HIV in South Africa. Further exploration of the influence of differing exposures on likely common mental disorder and the impact of such factors on the familial and social environment of adolescent mothers may be useful within the development of preventative programming and interventions to support adolescent maternal mental health. Results also identify how possible contributors to poor maternal mental health span beyond the individual level, and in line with the complex associations suggested in Bronfenbrenner's socio-ecological model,[278] may also include factors from the broader social environment (i.e., interpersonal and, community level). This may have implications for the development of policy and intervention to promote mental health which often focuses on the individual, as broader influences may also have an impact. Further research is required to explore

a broader range of factors and, possible avenues to reduce risk factors and promote protective factors for mental health and wellbeing among adolescent mothers within the South African context.

5.5.1 Strengths & limitations of the analyses

These analyses should be considered within the context of study limitations. First, these analyses only include a limited number of correlates, based on those available within the dataset. Given the novelty of the research undertaken with this population, a selection of correlates identified from existing literature were included within analyses as an exploratory first step within the field. As such, these correlates likely only reflect a small proportion of the factors expected to contribute to likely common mental disorder. Additional factors which were not assessed within this study (e.g., grief,[224] child health[224,328]) may also be associated with likely common mental disorder.[74] Additionally, analyses do not explore how different factors interact to impact on mental health beyond the interaction with HIV status. The interaction tests utilised to explore mental health and HIV status within these analyses are likely underpowered as large sample sizes are required for such test. As such, analyses represent a partial view, and provide a foundation to future investigations into contributors to the mental health of adolescent mothers within South Africa. Second, these analyses are exploratory and do not explore the interactions between and within different levels of the socio-ecological model, or between the individual and their broader context. Explorations within and between levels often may result in recommendations that are most valuable in terms of guiding meaningful public policy.[280] Thus, further exploration of amenable factors within the lives of adolescent mothers affected by HIV is required to provide definitive policy and programming directives.

Despite limitations, these initial findings are drawn from a robust sample of adolescent mothers within South Africa, the largest study of its kind, and offer insight into mental health need within this population. Additional strengths and limitations of these data and analyses are discussed in sections **3.1.5** and **8.3** of this thesis.

5.5.2 Chapter summary & conclusions

Little is known about to the mental health of adolescent mothers affected by HIV within sub-Saharan Africa, and this population remain substantially underserved regarding mental health provision. These analyses address a critical evidence gap relating to correlates associated with the mental health of adolescent mothers. While exploratory, these results have implications for the design of interventions, policy and programming for adolescent mothers and their children within sub-Saharan Africa. Analyses suggest groups of adolescent mothers at a higher risk for likely common mental disorder including those living with HIV, those who have experienced abuse (verbal, physical, or sexual), those lacking social support and those experiencing community violence. Identified factors span individual, interpersonal and community levels have the potential to impact adolescent maternal mental health within South Africa. Rigorous intervention research is needed to determine avenues in which risk factors can be reduced and protective factors promoted for mental health burden among this population. However, these data provide a foundation for further research required to inform health policy and scalable interventions to promote improved outcomes for adolescents and their children.

Chapter 6 Maternal mental health & the cognitive development of children born to adolescent mothers within the context of HIV in South Africa

The preceding chapters of this thesis focus on addressing the lack of evidence relating to likely common mental disorder among adolescent mothers in the context of HIV within sub-Saharan Africa – exploring the prevalence of likely common mental disorder (**Chapter 4**, **Chapter 5**), and risk factors (correlates) for likely common mental disorder (**Chapter 5**) among the population of interest. Explorations of implications beyond the individual (i.e., outcomes for children born to adolescent mothers within the context of HIV) in relation to adolescent mental health are seemingly also unaddressed within the current evidence base. This chapter aims to extend the existing literature to explore the cognitive development of children born to adolescent mothers within the context of HIV and maternal mental health.

Early child development provides a foundation for long term health and wellbeing among children and has implications for their social networks and broader society.[173] Child cognitive development is a domain of development which encapsulates children's perception and understanding of their environment. Such skills include language development, motor development, reasoning, memory, and information processing[175,417,418] (see section **1.7.1** for a brief overview of the child development literature). In sub-Saharan Africa, children are often exposed to multiple forms of deprivation.[178-181] As a result, over two thirds of children (approximately 66%) under 5 years of age do not reach their cognitive potential.[182] This places children living within sub-Saharan Africa at the highest risk of poor child development, globally.[182] Factors such as adolescent motherhood, poor maternal mental health, and HIV (those core to the works in this thesis) may contribute to such risk. Evidence from different global settings suggests that children born to adolescent mothers have been found to be at an increased risk of adversity, including poorer health, neonatal, cognitive, behavioural, and educational outcomes.[164-166] Likewise, there is a strong body of literature highlighting the adverse impacts of HIV on children, particularly in

relation to developmental delay.[202,419] Risk factors for developmental delay among children affected by HIV include: HIV disease severity (i.e., younger age of diagnosis or lower CD4 counts),[420-424] in-utero HIV exposure (i.e., children who are HIV exposed uninfected [HEU] have been found to have poorer cognitive performance compared to children who are HIV unexposed [HU]),[424-427] exposure to antiretroviral therapy (ART; i.e., ART related neurotoxicity)[113] as well as contributions from the environment such as psychosocial and socioeconomic factors (e.g., exposure to the impacts of poverty, a lack of food security, a lack of stimulation, stigma and discrimination, caregiver illness, bereavement and poor maternal mental health).[111,173,417,428-431] The literature on adolescent mothers and maternal HIV infection have both separately demonstrated child development impacts. There remains a dearth of understanding on the experiences when both co-occur. For children born to adolescent mothers living with HIV, implications for child cognitive development may be compounded.

Similarly, it is well established that mental health experience has broad implications for both parents and their child(ren).[14,206,224] Existing literature has identified poor parental mental health as being associated with poor growth and development outcomes (inclusive of cognitive development) among children born to adult mothers[205,206,224] and fathers,[208] and adult mothers living with HIV.[192] For pregnant adolescents (current or previously), poor mental health has been found to have adverse impacts for both parent and child (e.g., bonding, child development).[153,390,432] However, the combination of phenomena are yet to be explored. It is important to understand whether parental mental health in the presence of HIV and adolescent pregnancy/parenthood (motherhood) is similarly problematic. The wellbeing and developmental trajectory of adolescent mothers and their children is critical not only to individuals and the efforts towards the elimination of HIV,[136,157,158] but also to the success of the sub-Saharan African region as a whole.[136,138,386] It therefore remains critical to identify need, and those groups who may be particularly vulnerable. An understanding of the realities of these key populations will inform how best to support this group and ensure adequate policy and programming that is reflective of need.[136]

Using cross-sectional data from the ***HEY BABY study***, this chapter aims to explore the cognitive development of children (0-68 months) born to adolescent mothers in South Africa within the context of HIV, and maternal likely common mental disorder. The sample utilised in this chapter differs slightly (based on slightly different inclusion criteria) to the sample used in **Chapter 5**. This chapter is divided into three sections. The first section explores age-standardised cognitive development scores of children born to adolescent mothers compared to normative reference data utilised in the development of the Mullen Scales of Early Learning (including exploring child development scores according to child age to identify key periods of development for children born to adolescent mothers), to assess how children born to adolescent mothers in the context of HIV are faring with regards to their cognitive development. The second section explores the cognitive development scores of children born to adolescent mothers according to maternal HIV status and maternal mental health status. The final section examines the cognitive development scores of children born to adolescent mothers according to child HIV status (living with HIV, HIV exposed uninfected [HEU], and HIV unexposed uninfected [HUU]).

The works produced within the development of this chapter have resulted in the following peer-reviewed publications:

Steventon Roberts, K.J., Sherr, L., Haag, K., Smith, C., Jochim, J., Toska, E., Marlow, M. & Cluver, L. (2022) Adolescent parenthood and HIV-infection in South Africa—Associations with child cognitive development. PLOS Global Public Health, 2(5), e0000238. https://doi.org/10.1371/journal.pgph.0000238

Steventon Roberts, K. J., Smith, C., Cluver, L., Toska, E., Jochim, J., Wittesaele, C., ... & Sherr, L. (2022). Adolescent mothers and their children affected by HIV—An exploration of maternal mental health, and child cognitive development. Plos one, 17(10), e0275805. https://doi.org/10.1371/journal.pone.0275805

Sherr, L., Haag, K., **Steventon Roberts, K. J.**, Cluver, L. D., Wittesaele, C., Saliwe, B., ... & Toska, E. (2022). The development of children born to young mothers with no, first-

or second-generation HIV acquisition in the Eastern Cape province, South Africa: a cross-sectional study. BMJ open, 12(10), e058340. http://dx.doi.org/10.1136/bmjopen-2021-058340

Steventon Roberts, K.J., Smith, C., Toska, E., Cluver, L., Wittesaele, C., Langwenya, N., Shenderovich, Y., Saal, W., Jochim, J., Chen, J. & Sherr, L. Exploring the cognitive development of children born to adolescent mothers in South Africa. Infant and Child Development, e2408.

6.1 Section 1: Exploring the cognitive development of children born to adolescent mothers in South Africa – how are the children of adolescent mothers in South Africa faring?

6.1.1 Aim and objectives

The analyses in this section aim to explore the cognitive development of children born to adolescent mothers in South Africa (measured using the Mullen Scales of Early Learning[185]) in relation to existing data. Specific objectives are to:

Objective 1: Compare the child cognitive development scores of children born to adolescent mothers to normative reference scores (utilised within the development of the Mullen Scales of Early Learning[185])

Objective 2: Explore child cognitive development scores according to child age (utilising age bands) to identify key periods of development for children of adolescent mothers (0-68 months)

Objective 3: To explore the cognitive development scores of children born to adolescent mothers compared to data from children of adult mothers in the sub-Saharan African region (pooled and weighted data drawn from a systematic search of studies utilising the Mullen Scales of Early Learning[185] in the sub-Saharan African region)

6.1.2 Methods

6.1.2.1 Participants and procedure

Cross-sectional data utilised is drawn from the ***HEY BABY study*** (see section **3.1.3** for detail regarding participants and procedure). These analyses only present data for adolescent mothers (mothers who had given birth between the ages of 10-19 years) and their first-born children (≤68 months; in keeping with the validated age range of the Mullen Scales of Early Learning). Young mothers who gave birth outside of the adolescent age range of 10-19 years, children above 68 months of age at the time of the questionnaire, and second/third born children were excluded from analyses.

Given the high prevalence of HIV in the sample (24.1%) and the known impacts of living with HIV on child cognitive development,[169] those children who were identified as living with HIV or their HIV status was unknown, were also excluded from analyses (n=18). Therefore HIV-exposed and uninfected children are compared to HIV unexposed children. Overall, n=954 adolescent mother-child dyads were included within the subsequent analyses (see **Figure 6-1**).

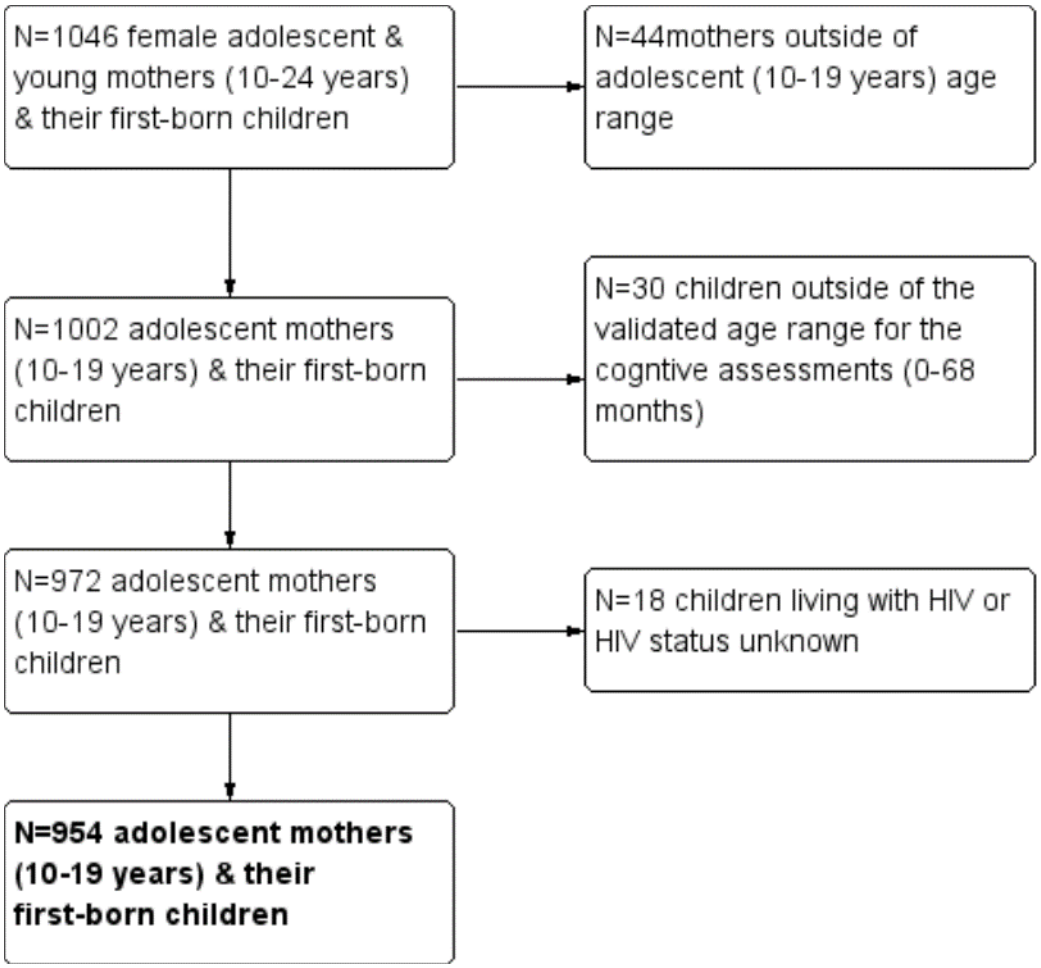


Figure 6-1 Participant selection for analyses exploring the cognitive development scores of children born to adolescent mothers

6.1.2.2 Measures

These analyses utilise data relating to both adolescent mothers and their first-born children from a range of self-report questionnaires and standardised development assessments.

Adolescent mothers

Sociodemographic characteristics were gathered via self-report measures. Sociodemographic characteristics include **maternal age (years)**, **relationship status**, **housing status**, **access to resources** (i.e., food security), **maternal education and/or employment** and **maternal violence exposure**. Additional sociodemographic characteristics include: **maternal age at birth of child** (obtained from participant self-report and corroborated with child dates of birth obtained from child medical records), **maternal HIV status** (obtained through clinical notes and corroborated by participant or caregiver report on a case-by-case basis), **perceived social support** measured using 8 items from the Medical Outcomes Study (MOS) Social Support Survey[405] and, **any common mental disorder.**[386] Participants were classified as experiencing likely common mental disorder if they scored above the cut-off on any of the four mental health symptomology measures utilised within the study (see section **3.4**): depressive symptoms [Child Depression Inventory Short Form ≥3/10 items[342,343]] anxiety symptoms [Revised Children's Manifest Anxiety Scale ≥10/14 items[360,361]] posttraumatic stress symptoms [Child PTSD checklist-12 items over four domains of posttraumatic stress disorder , scoring ≥1 on each of the four domains of the scale: re-experience, voidance, hyperarousal and dysphoria[54,344,363]], and suicidality symptoms [any; Mini International Psychiatric Interview for Children and Adolescents ≥1/5 items[365]]).

Children born to adolescent mothers

Sociodemographic characteristics were collected via adolescent mother/caregiver report. Child sociodemographic characteristics include **age (months)**, **biological sex**, and **childcare attendance**. Data were corroborated with data from child medical records where possible. Quartiles (to ensure equal distribution within analyses) were used to explore the relationship between child age (months) and child cognitive development scores within the sample. **Child HIV status** was ascertained through clinical notes and corroborated by adolescent mother/caregiver report on a case-by-case basis.

Child cognitive development was assessed across five developmental domains (gross motor skills, fine motor skills, visual reception, expressive language, receptive language) using the Mullen Scales of Early Learning.[185] Scales were translated into isiXhosa and images were adapted to be contextually relevant e.g., a hairbrush was substituted with a comb. Children were scored across several assessments relating to each domain and raw scores transformed to age standardised t-scores (range 20-80). T-scores for four developmental domains – fine motor, visual reception, expressive language, receptive language – were combined (and converted to age standardised t-scores) to create a composite score of generalised cognitive functioning (range 49-155). Only children <=39 months (n=848) were eligible to complete the gross motor skills assessment (based on standard testing procedure).[185] All children completed assessments for all other developmental domains (n=954).

Development scores of children in the sample were compared to normative reference data (USA derived children developing as expected) outlined in the scoring criteria of the Mullen Scales of Early Learning. Based on this reference population, for the five developmental domains a mean score of 50 (SD: 10) would be expected and for the early learning composite score a mean of 100 (SD:20) would be expected.[185] Descriptive categories of the Mullen Scales of Early Learning were also utilised to identify children at risk for developmental delay. Based on standardised coding,[185] children were classified as scoring *Average and Above* (*t*-score:40-80) and *Below Average* (*t*-score:20-39*)* within the five developmental domains. For the composite score of early learning, based on standardised coding,[185] cut-offs were prorated for summed t-scores (visual reception, fine motor, receptive language, expressive language). Children were classified as scoring *Average and above* (summed [standardised] *t*-score: 85-155) and *Below Average* (summed [standardised] *t*-score: 49-84). The Mullen Scales of Early Learning have been found to have good psychometric properties, have been adapted for use in South Africa and have been utilised widely within sub-Saharan Africa.[192,196,201,433]

6.1.2.3 Statistical analyses

Sample characteristics were summarised utilising descriptive statistics. Comparisons between mean cognitive development scores in the sample and the mean score previously identified in reference population utilised in the development of the Mullen Scales of Early Learning[185] were undertaken using one-sample t-tests. To explore age related differences in the sample, ANOVA was used to explore t-scores across each of the developmental domains according to the four age quartiles. Where differences were identified, Tukey's HSD post hoc tests were undertaken to further explore differences between groups. Chi-square tests were utilised to explore the proportion of children in the sample who were identified as being at risk for cognitive delay (scoring *Below Average* on the composite score for early learning) according to the four age quartiles. Age related differences were further examined using linear regression models exploring the cross-sectional associations between child age (quartiles) and cognitive development scores. Marginal effects were also estimated to identify average cognitive development scores while accounting for covariates (i.e., covariates were kept at mean/average values). Covariates were included within multivariable regression models if they were associated with both or either of the predictor and outcome variables ($p<0.02$)[369,370] or were identified as relevant within the literature.[434] The Benjamini Hochberg procedure was undertaken to account for multiple testing within regression models (employing a false discovery rate of 10%).[371]

In addition to comparing the study data to that derived from a USA reference population,[185] sensitivity analyses were undertaken to explore study data in relation to the cognitive development scores (assessed using the Mullen Scales of Early Learning[185]) of children of adult mothers from the sub-Saharan African region. To address the absence of reference data relating to the Mullen Scales of Early Learning from the sub-Saharan African region, a systematic search of the literature was undertaken. Available data was pooled and weighted for comparison. Using a pre-determined search strategy, studies considered for inclusion within this review were identified through a systematic search of electronic bibliographic databases (see **Appendix 4** for further details on the systematic review methodology, and how

pooled estimates of Mullen t-scores from multiple studies were obtained). Where possible, data were extracted according to child HIV status (HIV exposed uninfected/HIV unexposed uninfected [classified as developing as expected]). Two sample t-tests were used to make comparisons between mean cognitive development scores in the sample and mean scores obtained from pooled data from the sub-Saharan African region. Comparisons stratified according to HIV status (HIV exposed uninfected and HIV unexposed [classified as developing as expected]) were also undertaken to take account of factors that may impact development (e.g., HIV exposure), and through identifying children classified as developing as expected (HIV unexposed) to establish normative reference data.

6.1.3 Results

6.1.3.1 Sociodemographic characteristics

Table 6-1 presents both maternal and first-born child characteristics. The median age of adolescent mothers at the birth of their first child was 17 years (IQR: 16-18 years). Nearly a quarter, 24.1% (230/954), of adolescent mothers in the sample were living with HIV. Two thirds of mothers reported being in a relationship (622; 65.8%) and 6.7% (64/954) reported having more than one living child. Most of the sample (71.6%;683/954) reported being food secure and the majority (92.5%; 882/954) were accessing social protection in the form of cash grants. The median highest school grade currently achieved was grade 10 among mothers and 56.9% (543/954) reported being in either education or employment. Over a quarter (27.0%; 258/954) of mothers had been exposed to violence within their communities and 7.4% (71/954) had any previous experience of domestic violence. Most (85.7%; 818/954) mothers identified as the main caregiver of their child and, 25.3% (224/886) children attended childcare or a creche at least once a week. The average scores of perceived social support among adolescent mothers were high (14; scale 0-14) and, 12.6% (120/954) were classified as experiencing common mental disorder (defined as depression, anxiety, posttraumatic stress and/or suicidality symptoms). Among the children of adolescent mothers, 48.1% (459/954) were female and the average age was 14.5 months (median; interquartile range: 6-28 months).

Table 6-1 Sample characteristics of adolescent mothers and their children (n=954)

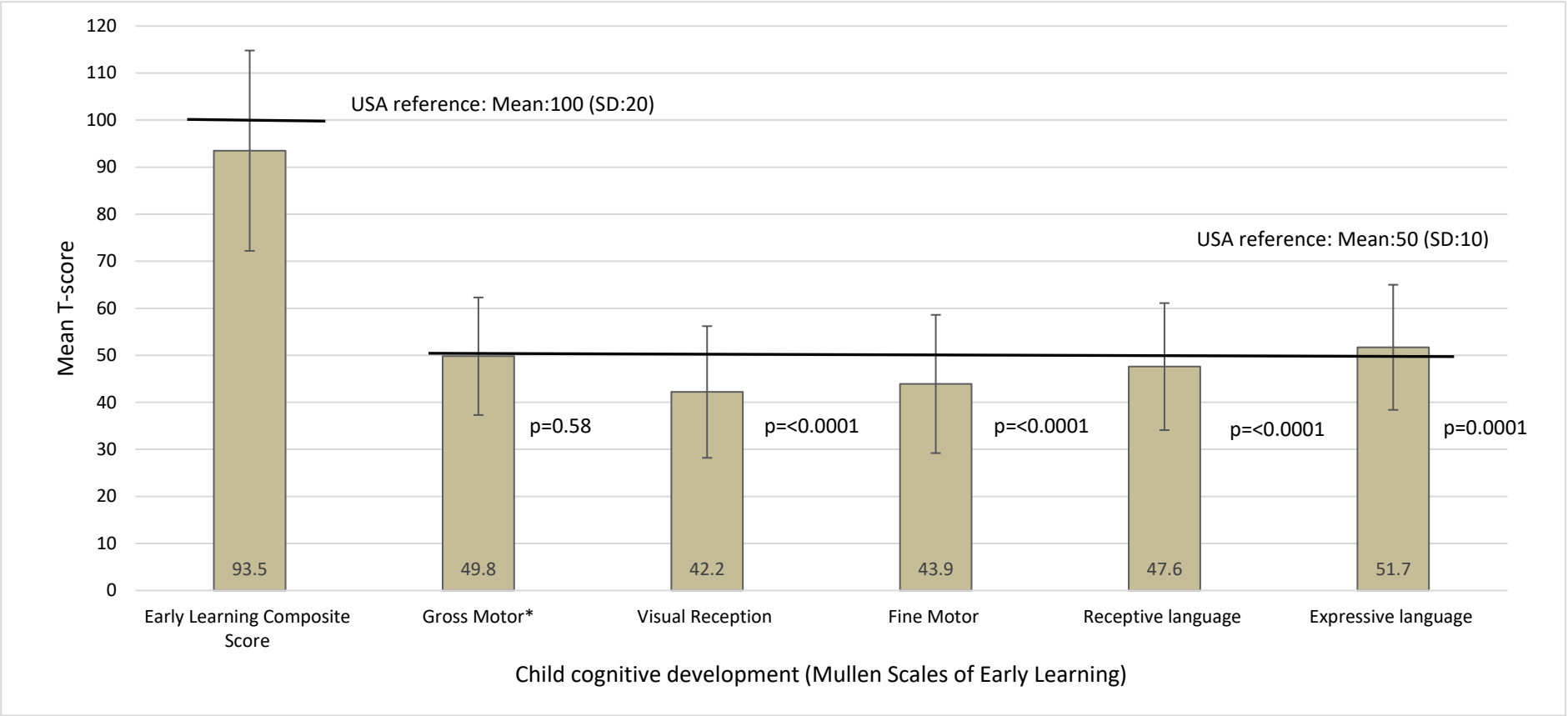
	Total sample (n=954) N(%) M(IQR)*
Maternal characteristics	
Current age (years)	18 (17-19)
Age at birth of child (years)	17 (16-18)
Living with HIV	230 (24.1%)
In a relationship	622 (65.8%)
Has more than one child[a]	64 (6.7%)
Food secure	683 (71.6%)
Household cash grant receipt	882 (92.5%)
Number of necessities can afford (0-8)	6 (4-7)
Informal housing	205 (21.9%)
Maternal education – highest grade achieved (0-12)	10 (9-11)
In education or employment	543 (56.9%)
Community violence exposure	258 (27.0%)
Domestic violence exposure	71 (7.4%)
Mother identifies as the primary caregiver of their child	818 (85.7%)
Use of formal childcare (n=886)	224 (25.3%)
Perceived social support (0-14)	14 (14-14)
Any common mental disorder[b]	120 (12.6%)
Child characteristics	
Child biological sex (female)	459 (48.1%)
Child age (months)	14.5 (6-28)

Available data: Use of formal childcare (sample n=886) |*M(IQR): Median (Interquartile Range) |[a]Report of having two or three live children| [b]Likely common mental disorder (scoring above the cut-off on one or more screen measure for mental health)

6.1.3.2 Cognitive development of children born to adolescent mothers compared to the Mullen Scales of Early Learning reference population

Figure 6-2 presents the cognitive development scores (as well as individual domain scores) of children born to adolescent mothers in this study. When compared to the

standardised USA reference population utilised within the development of the Mullen Scales of Early Learning, first born children of adolescent mothers performed significantly (statistically) lower on three of the five domains of cognitive development (visual reception, fine motor, receptive language), as well as the composite score of early learning (t=-9.49, p=<0.0001). Similar scores between the sample of children born to adolescent mothers and the USA reference population were identified in relation to gross motor skills scoring and expressive language scores were found to be higher within the study sample compared to the Mullen reference population (t=3.87, p=<0.0001; see **Figure 6-2**). The cognitive development scores of children born to adolescent mothers compared to scores from the USA reference population are additionally presented in **Appendix 4**, **Table 9-8**.



*Gross motor scores n=848 | SD: Standard Deviation | Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

Figure 6-2 Cognitive development scores of children born to adolescent mothers compared to the Mullen Scales of Early Learning reference group

6.1.3.3 Differences in the cognitive development of children born to adolescent mothers according to child age

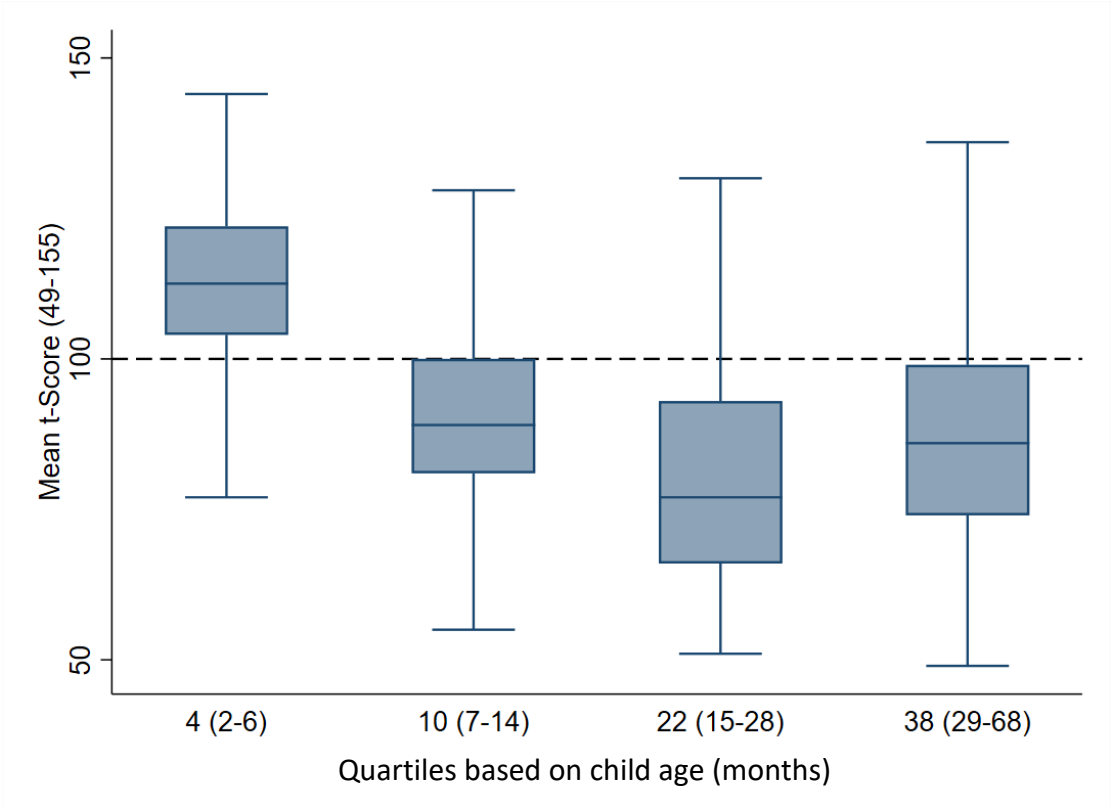
Table 6-2 and **Figure 6-3** present child cognitive development scores according to child age divided into quartiles (months). Differences between quartiles were identified among all the sub-scales of the Mullen Scales of Early Learning including the Early Learning Composite Score and a decline in age-adjusted score was noted by the second quartile which then remained at a relatively stable level (median child age: 10 months [IQR:8-12, Range:7-14]). Notably, post hoc testing identified that all subsequent quartiles differed from the first quartile (median chid age: 4 months [IQR: 3-5, Range: 2-6]).

To explore age related differences further, the proportion of children scoring *Below Average* and *Average and above* (based on the Mullen reference group) were examined. For composite scores of early learning, group differences were identified across age quartile (X^2=203.0, *p*=<0.0001). 3.1% of children were classified as scoring *Below* Average in the first quartile (Median child age:4 months [IQR:3-5; Range:2-6]), 36.7% scored *Below Average* in the second quartile (Median child age:10 months [IQR: 8-12, Range:7-14), 62.3% scored *Below Average* in the third quartile (Median child age:22 months [IQR:18-24, Range:15-28]), and 46.1% scored *Below Average* in the fourth quartile (Median child age:38 months [IQR:33-46.5, Range:29-68).

Table 6-2 Differences in the cognitive development scores of children born to adolescent mothers according to child age (n=954)

Child cognitive development scores (Mullen scales of Early Learning; T-Scores)	**Quartiles based on child age (months)**				***F, p*-value**
	1 (n=256)	***2 (n=221)***	***3 (n=249)***	***4 (n=228)***	
Child age in months M(IQR)[#]	4 (3-5; Range:2-6)	10 (8-12; Range:7-14)	22 (18-24; Range:15-28)	38 (33-46.5; Range:29-68)	
Gross motor*	**51.2 (9.9)**	**50.7 (11.5)**	**51.0 (13.0)**	**42.5 (15.7)[a,b, c]**	**16.89, <0.0001**
Visual reception	**53.1 (8.3)**	**40.5 (11.0)[a]**	**33.0 (13.4)[a,b]**	**41.6 (14.9)[a,c]**	**118.9, <0.0001**
Fine motor	**50.3 (8.9)**	**43.2 (12.7)[a]**	**41.0 (17.3)[a]**	**40.5 (15.4)[a]**	**25.5, <0.0001**
Receptive language	**58.2 (11.1)**	**46.8 (11.3)[a]**	**40.7 (10.2)[a,b]**	**43.9 (13.9)[a]**	**108.2, <0.0001**
Expressive language	**62.8 (8.9)**	**49.5 (11.1)[a]**	**43.9 (10.6)[a.b]**	**49.8 (14.1)[a,c]**	**127.4, <0.0001**
Composite score of early learning^	**112.2 (13.3)**	**90.6 (15.8)[a]**	**80.9 (18.8)[a,b]**	**88.9 (21.7)[a,c]**	**145.8, <0.0001**

*Gross motor scores n=848|[#]Median (Interquartile Range)|[^] Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155) |[a] Tukey's HSD post hoc test indicates that value is significantly (statistically) different from quartile 1 (*p*=<0.05) | [b] Tukey's HSD post hoc test indicates that value is significantly (statistically) different from quartile 2 (*p*=<0.05) | [c] Tukey's HSD post hoc test indicates that value is significantly (statistically) different from quartile 3 (*p*=<0.05)



Note. Quartiles depict median and range. Mean t-score of 100 based on USA reference group.

Figure 6-3 Differences in the cognitive development scores of children born to adolescent mothers according to child age (months; quartiles, n=954)

Table 6-3 presents a series of linear regression models exploring the cross-sectional association between child age (quartiles) and child cognitive development scores. After adjusting for covariates, similar patterns of development scores were identified across all domains of the Mullen Scales of Early Learning, apart from the gross motor domain, and the composite scores of early learning. Compared to the first age quartile (median child age: 4 months [IQR: 3-5, Range:2-6]), children in the second age quartile (median child age: 10 months [IQR: 8-12, Range:7-14) were scoring lower on cognitive assessments. Scores on cognitive domains reduced further by the third age quartile (median child age: 22 months [IQR: 18-24, Range: 15-28]) and improved slightly (compared to the third age quartile) by the fourth age quartile (median child age: 38 months [IQR: 33-46.5, Range: 29-68]). For gross motor skill scores there was no difference identified among children in the second age quartile (median child age:

10 months [IQR: 8-12, Range:7-14]) compared to the first age quartile (median child age: 4 months [IQR:3-5, Range:2-6]), nor the third age quartile (median child age: 22 months [IQR: 18-24, Range: 15-28]). However, compared to children in the first age quartile (median child age: 4 months [IQR: 3-5, Range:2-6]), children in the fourth age quartile (median child age: 38 months [IQR: 33-46.5, Range: 29-68]) scored lower on the gross motor skills domain. These associations remained statistically significant when using the Benjamini Hochberg procedure for multiple testing with a false discovery rate of 10%.

Figure 6-4 presents the adjusted mean scores (set to the average levels of all included covariates) for each of the developmental domains according to child age quartiles, reflecting the regression models above.

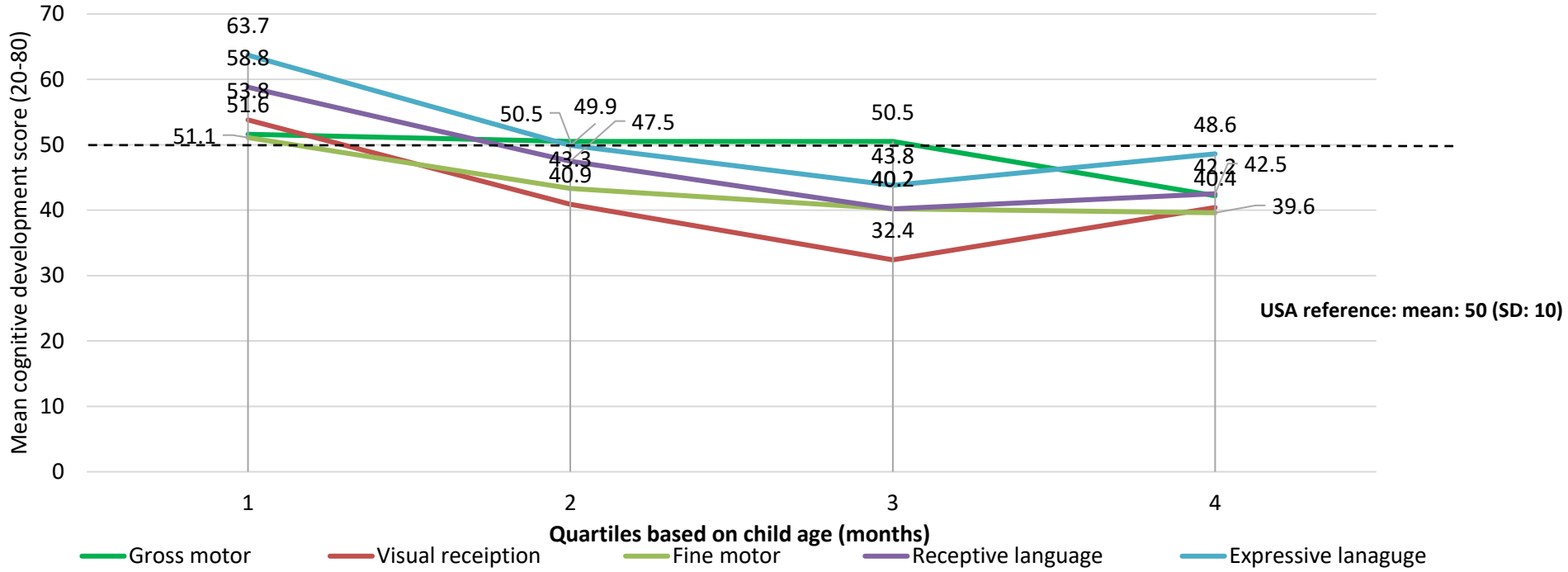
Table 6-3 Linear regression models exploring the association between child age (months; quartiles) and child cognitive development (n=954)

		Composite score of early learning		Gross motor*		Visual reception		Fine motor		Receptive language		Expressive language	
Child age quartile	**Child Age (months; median [IQR])**	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
Model 1.													
1 (n=256)	4 (3-5)	**Ref.**		**Ref.**		**Ref.**		**Ref.**		**Ref.**		**Ref.**	
2 (n=221)	10 (8-12)	-21.6 (-24.8, -18.4)	**<0.0001**	-0.47 (-2.7, 1.7)	0.67	-12.6 (-14.7, -10.4)	**<0.0001**	-7.1 (-9.6, -4.5)	**<0.0001**	-11.4 (-13.5, -9.3)	**<0.0001**	-13.3 (-15.3, -11.2)	**<0.0001**
3 (n=249)	22 (18-24)	-31.3 (-34.4, -28.2)	**<0.0001**	-0.26 (-2.4, 1.9)	0.81	-20.1 (-22.2, -18.0)	**<0.0001**	-9.3 (-11.7, -6.8)	**<0.0001**	-17.5 (-19.6, -15.5)	**<0.0001**	-18.9 (-20.9, -16.9)	**<0.0001**
4 (n=228)	38 (33-46.5)	-23.3 (-26.4, -20.1)	**<0.0001**	-8.7 (-11.4, -6.1)	**<0.0001**	-11.4 (-13.6, -9.3)	**<0.0001**	-9.8 (-12.3, -7.3)	**<0.0001**	-14.3 (-16.4, -12.2)	**<0.0001**	-13.0 (-15.0, -10.9	**<0.0001**
Model 2.													
1 (n=256)	4 (3-5)	Ref.		Ref.		Ref.		Ref.		Ref.		Ref.	
2 (n=221)	10 (8-12)	-22.3 (-25.6, -19.0)	**<0.0001**	-1.2 (-3.5, 1.1)	0.31	-12.9 (-15.1, 10.7)	**<0.0001**	-7.8 (-10.4, -5.1)	**<0.0001**	-11.3 (-13.5, -9.1)	**<0.0001**	-13.8 (-15.9, -11.7)	**<0.0001**
3 (n=249)	22 (18-24)	-33.6 (-37.0, -30.3)	**<0.0001**	-1.2 (-3.5, 1.2)	0.33	-21.4 (-23.7, -19.2)	**<0.0001**	-10.9 (-13.6, -8.2)	**<0.0001**	-18.5 (-20.8, -16.3)	**<0.0001**	-19.9 (-22.0, -17.7)	**<0.0001**

4 (n=228)	38 (33-46.5)	-27.0 (-30.9, -23.0)	**<0.0001**	-9.4 (-12.6,-6.3)	**<0.0001**	-13.4 (-16.1, -10.7)	**<0.0001**	-11.5 (-14.7, -8.3)	**<0.0001**	-16.2 (-18.9, -13.6)	**<0.0001**	-15.1 (-17.7, -12.5)	**<0.0001**

*Gross motor scores n=848| Model 1. Univariable analyses | Model 2. Multivariable analyses. Covariates included with Model 2: maternal HIV status (living with HIV), maternal mental health (any common mental disorder), maternal age at birth of child (years), maternal relationship status (in a relationship), food security (food secure), maternal education (highest school grade achieved), number of basic necessities household can afford, child sibling status (has siblings), maternal cash grant receipt (yes), maternal community violence exposure (no), maternal domestic violence exposure (yes), maternal perceived social support, maternal work or education status (in work or education), child early child development programme attendance (yes), child biological sex (female).

Figure 6-4 Adjusted mean cognitive development scores obtained for children born to adolescent mothers stratified according to child age (months; quartiles, n=954)



Note. Gross motor scores n=848 | Quartiles depict median and range: 1= 4 months (2-6) 2=10 months (7-14) 3=22 months (15-28) 4=38 months (29-68)| Covariates include: maternal HIV status (living with HIV), maternal mental health (any common mental disorder), maternal age at birth of child (years), maternal relationship status (in a relationship), food security (food secure), maternal education (highest school grade achieved), number of basic necessities household can afford, child sibling status (has siblings), maternal cash grant receipt (yes), maternal community violence exposure (no), maternal domestic violence exposure (yes), maternal perceived social support, maternal work or education status (in work or education), child early child development programme attendance (yes), child biological sex (female)

6.1.3.4 Cognitive development scores of children born to adolescent mothers compared to data from children of adult mothers in the sub-Saharan African region

To provide an overview of Mullen t-scores from the existing literature undertaken in the sub-Saharan African region, a systematic review of the literature was undertaken. Sample size and standardised Mullen t-scores were used to weight and calculate pooled data for Mullen t-scores from the sub-Saharan African region. Pooled data were also calculated according to whether children were *HIV-exposed uninfected* (*HEU*) or *developing as expected* (based on sample characteristics detailed within studies included within the pooled data estimates).

Standardised Mullen t-scores from nine studies (17 manuscripts) were included within pooled data estimates (see **Figure 6-5**). **Table 6-4** details the Mullen t-scores obtained from all included studies as well as pooled data (based on means [SD]). All studies included children born to adult mothers.

Figure 6-5 Flow diagram of sub-Saharan African studies included in pooled data (t-scores) for Mullen Scales of Early Learning

Table 6-4 Studies identified for inclusion within pooled data estimates from the sub-Saharan African region and calculated pooled Mullen Scales of Early Learning t-scores

	Author (year)	Country	Total sample (n)	Child age (months)	Study population (children)	Composite score of early learning t-score[a]	Gross motor t-score	Visual reception t-score	Fine motor t-score	Receptive language t-score	Expressive language t-score
1	Mebrahtu et al. 2020[192] /Mebrahtu et al 2018[194] /Mebrahtu 2020[193] /Mebrahtu et al. 2019[435]	Zimbabwe	562	11.9 (6.5)	HEU	102.5 (17.9)	50.5 (10.9)	53.1 (12.7)	50.8 (11.4)	47.7 (11.5)	52.9 (10.7)
2	Kashala-Abotnes et al. 2019[436]	Democratic Republic of Congo	114	31.0 (4.0)	Developing as expected	79.4 (16.0)	41.1 (11.3)	37.4 (11.3)	37.2 (13.2)	41.7 (10.3)	38.4 (9.8)
3	Familiar et al. 2016[437]~	Uganda	164	34.1 (4.4)	HEU	71.7 (10.9)	26.3 (3.1)	29.9 (9.1)	35.0 (8.5)	38.3 (8.2)	35.7 (9.7)
4	Chhaya et al. 2018[438]	Uganda	31	9.1 (1.9)	HEU	96.4 (13.2)	51.4 (9.2)	48.4 (10.9)	48.5 (11.7)	44.0 (9.7)	51.7 (8.6)
5	Boivin et al. 2021[198] /Garrison et al. 2021[439] /Mireku et al. 2020[440] /Mireku et al. 2015[441] / Bodeau-Livinec et al. 2019[442] /Koura et al 2013[200]	Benin	747	12.1 (0.7)	Developing as expected (mothers recruited to a trial comparing preventative treatments for malaria and helminth infection)	98.7 (11.2)	51.3 (14.1)	50.5 (10.4)	50.2 (9.5)	46.6 (6.7)	49.3 (10.4)
6	Boivin et al. 2017[197]	Uganda	221	34.4 (5.1)	HEU	70.8 (11.2)	26.5 (3.3)	29.6 (9.0)	33.9 (8.6)	38.1 (8.3)	35.6 (9.9)
7	Boivin et al. 2013[195]	Uganda	119	33.6 (4.0)	HEU	85.1 (16.2)	37.1 (9.8)	39.6 (11.6)	41.1 (11.2)	46.2 (9.6)	41.2 (10.4)
8	Boivin et al. 2019[196]^*	Uganda & Malawi	374	12.0	Developing as expected (HUU)	95.2 (14.5)	47.9 (10.7)	49.2 (10.0)	50.6 (8.9)	45.0 (9.3)	44.7 (10.1)

	Author (year)	Country	Total sample (n)	Child age (months)	Study population (children)	Composite score of early learning t-score[a]	Gross motor t-score	Visual reception t-score	Fine motor t-score	Receptive language t-score	Expressive language t-score
9	Familiar et al 2018[199]^	Uganda	149	12.0	Developing as expected (HUU)	102.8 (15.3)	52.6 (11.7)	52.9 (8.9)	54.4 (12.9)	46.7 (7.0)	50.8 (10.9)
Pooled Data											
	-	**-**	**2481**	**17.3 (2.8)**	**Total sample**	**93.4 (14.6)**	**45.7 (10.6)**	**46.7 (10.7)**	**47.0 (9.7)**	**44.8 (7.7)**	**46.4 (10.3)**
	-	**-**	**1384**	**13.6 (0.7)**	**Developing as expected**	**96.6 (14.2)**	**49.7 (12.7)**	**49.3 (10.2)**	**49.7 (10.0)**	**45.8 (7.7)**	**47.3 (10.3)**
	-	**-**	**1097**	**22.0 (5.5)**	**HEU**	**89.4 (15.2)**	**40.6 (8.0)**	**43.3 (11.2)**	**38.9 (10.3)**	**39.2 (8.5)**	**39.5 (10.1)**

All values are Mean (SD) unless otherwise stated |When manuscripts detailed data from the same study the largest/most relevant sample were selected for inclusion (first study listed) | HEU: HIV-exposed uninfected | HUU: HIV-unexposed uninfected|~data for children living with HIV excluded from pooled data | ^only HUU data reported |*only data for children at 12 months of age included | [a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

Cognitive development scores of children of adult mothers in sub-Saharan Africa compared to the USA derived Mullen Scales of Early Learning reference population

When compared to the standardised USA reference population utilised within the development of the Mullen Scales of Early Learning, on average children born to adult mothers in the sub-Saharan African region performed lower on all five domains of cognitive development as well as the composite early learning score (*t=13.28, p=<0.0001;* see

Table 6-5).

Table 6-5 Cognitive development scores of children born to adult mothers (pooled data from sub-Saharan Africa) compared to the Mullen Scales of Early Learning reference group

Child cognitive development (Mullen scales of Early Learning; T-Scores)	***Mean (SD)***		***t, p*-value**
	Pooled data from sub-Saharan Africa (n=2481)	**Mullen Scales reference group (US population)**	
Composite score of early learning[a]	93.4 (14.6)	100 (20)	**-13.28, <0.0001**
Gross motor	45.7 (10.6)	50 (10)	**-14.70, <0.0001**
Visual reception	46.7 (10.7)	50 (10)	**-11.22, <0.0001**
Fine motor	47.0 (9.7)	50 (10)	**-10.73, <0.0001**
Receptive language	44.8 (7.7)	50 (10)	**-20.52, <0.0001**
Expressive language	46.4 (10.3)	50 (10)	**-12.49, <0.0001**

Gross motor scores n=848 |[a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

Cognitive development of children born to adolescent mothers compared to children of adult mothers in sub-Saharan Africa

On average, children included in the ***HEY BABY*** sample were older than the children included within the pooled data drawn from sub-Saharan African studies (18.6 months vs. 17.3 months, *t*=4.21, *p*=<0.0001). Using the full sample of pooled data, composite scores of early learning were, on average, similar among children born to adolescent mothers (***HEY BABY*** sample) and those children of adult mothers (obtained from multiple studies *[t=0.16, p=0.87];* see

Table 6-6 for comparisons on each developmental domain]).

Table 6-6 Cognitive development scores of children born to adolescent mothers compared to children born to adult mothers (pooled data from sub-Saharan Africa)

Child cognitive development (Mullen scales of Early Learning; T-Scores)	***Mean (SD)***		***t, p*-value**
	Children born to adolescent mothers (n=954)	**Pooled estimated from sub-Saharan Africa (n=2481)**	
Child age (months)	18.6 (14.7)	17.3 (2.8)	**4.21, <0.0001**
Composite score of early learning[a]	93.5 (21.3)	93.4 (14.6)	0.16, 0.87
Gross motor	49.8 (12.5)	45.7 (10.6)	**9.64, <0.0001**
Visual reception	42.2 (14.0)	46.7 (10.7)	**-10.09, <0.0001**
Fine motor	43.9 (14.7)	47.0 (9.7)	**-7.19, <0.0001**
Receptive language	47.6 (13.5)	44.8 (7.7)	**7.60, <0.0001**
Expressive language	51.7 (13.3)	46.4 (10.3)	**12.41, <0.0001**

Gross motor scores n=848 | [a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

To further explore comparisons between the children of adolescent mothers in the ***HEY BABY*** sample and children of adult mothers (pooled data obtained from multiple studies), data was stratified according to HIV status (HIV-exposed uninfected, HIV

unexposed uninfected [classified as developing as expected]). Among children who were HIV-exposed uninfected/children born to mothers living with HIV (not including children living with HIV), children born to adolescent mothers (in the ***HEY BABY*** sample) were on average older than children of adult mothers (in the pooled sample data; 24.2 months vs. 22.0 months, *t=3.84, p=0.0001*). Among this group, composite scores of early learning were similar among children born to adolescent mothers (in the ***HEY BABY*** sample) and children of adult mothers (in the pooled sample data; *t=1.89, p=0.06;* see **Table 6-7** for comparisons on each developmental domain). Among children who were classified as developing as expected, children born to adolescent mothers (***HEY BABY*** sample) were on average older than children of adult mothers (pooled sample; 16.8 months vs. 13.6 months, *t=8.86, p=<0.0001*). Among this group, children born to adolescent mothers (***HEY BABY*** sample) were on average found to have lower composite scores of early learning compared to children born to adult mothers (pooled sample; 94.0 vs. 96.6, *t=-3.39, p=0.0007*; see **Table 6-8** for comparisons on each developmental domain]).

Table 6-7 Cognitive development scores of children born to adolescent mothers compared to children born to adult mothers (pooled data from sub-Saharan Africa): Subset of children who are HIV exposed uninfected

Child cognitive development (Mullen scales of Early Learning; T-Scores)	***Mean (SD)***		***t, p*-value**
	Children born to adolescent mothers (n=230)	**Pooled estimated from sub-Saharan Africa (n=1097)**	
Child age (months)	24.4 (16.9)	22.0 (5.5)	**3.84, 0.0001**
Composite score of early learning[a]	91.7 (22.7)	89.4 (15.2)	1.89, 0.06
Gross motor	47.3 (13.4)	40.6 (8.0)	**10.08, <0.0001**
Visual reception	41.1 (13.9)	43.3 (11.2)	**-2.59, 0.01**
Fine motor	42.0 (15.5)	38.9 (10.3)	**3.75, 0.0002**
Receptive language	46.8 (14.7)	39.2 (8.5)	**10.63, <0.0001**
Expressive language	51.3 (14.3)	39.5 (10.1)	**14.87, <0.0001**

Gross motor scores n=848 | [a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

Table 6-8 Cognitive development scores of children born to adolescent mothers not living with HIV compared to children born to adult mothers (pooled data from sub-Saharan Africa) classified as developing as expected

Child cognitive development (Mullen scales of Early Learning; T-Scores)	*Mean (SD)*		*t, p*-value
	Children born to adolescent mothers (n=724)	Pooled estimated from sub-Saharan Africa (n=1384)	
Child age (months)	16.8 (13.4)	13.6 (0.7)	**8.86, <0.0001**
Composite score of early learning[a]	94.0 (20.7)	96.6 (14.2)	**-3.39, 0.0007**
Gross motor	50.4 (12.2)	49.7 (12.7)	1.21, 0.22
Visual reception	42.5 (14.3)	49.3 (10.2)	**-12.60, <0.0001**
Fine motor	44.5 (14.3)	49.7 (10.0)	**-9.73, <0.0001**
Receptive language	47.8 (13.1)	45.8 (7.7)	**4.41, <0.0001**
Expressive language	51.8 (13.0)	47.3 (10.3)	**8.68, <0.0001**

Gross motor scores n=848 |[a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

6.1.4 Discussion

This is the first known exploration of cognitive development among children born to adolescent mothers in South Africa. The results were compared to normative reference values obtained from a standardised validated cognitive development performance inventory. Further, this is the first known comparison of development according to age bands. Overall, children in the sample (0-68 months) obtained lower average development scores compared to the reference population utilised within the development of Mullen Scales of Early Learning. However, within individual domains no comparable scores were identified on the gross motor domain and, children in the sample were overall found to score slightly higher on the expressive language domain compared to the reference population. Differences according to age were identified within the sample. Cognitive development scores were found to be similar among younger children within the sample compared to the reference population whereas older children in the sample were found to have lower development scores. Further, compared to children of adult mothers in the sub-Saharan African region, children born to adolescent mothers (classified as developing as expected) were found to have lower overall cognitive development scores. Yet, within individual domains, gross motor scores were similar among children of adolescent mothers and adult mothers, and children born to adolescent mothers on average had slightly higher receptive language scores comparative to children born to adult mothers in the region. Findings from these analyses, support previous research identifying children within low-and-middle income countries as being at risk for cognitive adversity,[173,177,417,433,443] and address the evidence gap regarding the cognitive development of children of adolescent mothers affected by HIV. Information on the long-term implications of these scores on future attainment is currently limited. However, it is vital to further understand the consequences of these findings.

6.1.4.1 Cognitive performance of children born to adolescent mothers

Differences in the cognitive performance scores of the sample and the normative Mullen reference data[185] were found within overall cognitive development and the

majority of the individual subscales (apart from gross motor skills). Similarity among gross motor skill scores is possibly due to the gross motor skills sub-scale assessing broader measures of development (i.e., sitting, standing, walking running), for which there may be less variation in the sample, particularly given that the gross motor scales were only undertaken among children <39 months of age. On average, expressive language scores in the sample were slightly elevated compared to those in the Mullen Scales of Early Learning reference data. There is a strong body of evidence which has identified an association between motor skill development and expressive language skills. As children develop new motor skills, the way they interact with their environment and as such their ability communicate changes, often increasing.[444] This hypothesis is supported by the overall average scores within the sample being similar in the gross motor and expressive language sub-scales. Differences in sub-scale scores highlight potentially different developmental trajectories of children born to adolescent mothers in South Africa and the normative reference data (children of adult mothers in the USA), possibly due to contextual factors such as service access. The high prevalence of HIV within the region and, thereafter, the high prevalence of HEU children may be a consideration and a contributor to varying cognitive development trajectories.

Given that the Mullen score lacks a specific reference sample from the sub-Saharan African region, and thus the lack of culturally and geographically relevant reference data, all available study results which had used Mullen t-scores were summarised to be able to make comparisons between the development of children born to adolescent mothers and those born to adult mothers in the region. Differences in the cognitive performance scores of children born to adolescent mothers (classified as developing as expected) and pooled data drawn from children born to adult mothers in the sub-Saharan African region were also identified. Like the findings relating to the USA derived reference data, gross motor scores were similar among the groups. Similarly, receptive language scores in the sample were slightly elevated compared to the data from children born to adult mothers in the region, again highlighting potentially differing developmental trajectories for children born to adolescent mothers compared to children of adult mothers. Overall lower cognitive

development scores among children born to adolescent mothers compared to children of adult mothers in the region also highlight a potential risk of developmental delay among children born to adolescent mothers. It should also be noted that children born to adolescent mothers were slightly older than children of adult mothers. Lower developmental scores were linked to increasing age in the broader findings of this study, thus findings relating to children of adolescent mothers being older than the children of adult mothers (obtained from pooled data) further support the notion of a potential risk of developmental delay among children born to adolescent mothers in South Africa. As such there is a potential need for support to promote the development of children born to adolescent mothers.

6.1.4.2 Differences in cognitive performance according to age

Within an age stratified sample, differences in development scores began to be observed by the second quartile (Median 10 months; IQR: 8-12) and continued to be evident through the older aged children within the sample within both composite scoring and scoring on individual subscales. However, this finding should be interpreted with caution as these data are cross-sectional and therefore while these differences may be attributable to child age, the possible role of other factors which may have impacted on the development trajectory of these children (e.g., environmental changes or experiences over calendar time) cannot be wholly ruled out. Nevertheless, these findings support previous literature identifying reduced cognition among children living within low resourced settings within their first 12 months of age,[200,433,445] as they begin to be increasingly exposed to environmental factors. For example, a recent study exploring the cognitive development of children in the Gambia found that with rising age (up until 24 months; quartiles 2 and 3), the proportion of children classified as scoring *Below Average* (on the composite scores of early learning), and therefore were at risk for cognitive delay, continued to rise. This proportion reduced for older children (median child age: 38 months [IQR: 33-46.5]), perhaps indicative exposure to increased environmental stimuli or differing skill development trajectories.[433]

However, variation in individual subscales should be noted e.g., visual reception scores were much lower than other domains by the second age quartile, and while language and visual reception t-scores were higher among those children in the fourth age quartile (median child age: 38 months [IQR: 22-46.5]), motor skill scores continued to decline, perhaps suggesting that on average motor skills are developing at a rate slower than expected. Such differences in the onset of decline among differing developmental domains may be due to the differing timings in which such developmental milestones are expected to ensue.[433] Furthermore, findings support literature identifying disparities within perceptual domains as an early indication for adverse child development outcomes. As such, these results highlight potential risk for cognitive delay among this sample,[433] and a core developmental period where risk for cognitive delay may emerge within such settings.

This lower scoring is likely due to potential developmental challenges faced by children living in a context of high poverty, high HIV burden, challenges of adolescent parenthood (e.g. poor food security or nutrition, linked to poverty, may have implications for growth and stunting).[446] Additionally, while those children known to be living with HIV were excluded from analyses, almost a quarter of children within the sample were potentially HIV exposed. There is a body of literature detailing the association between HIV exposure and child developmental challenges.[427,447,] Furthermore, differences may be explained by differing growth trajectories of children within South Africa and those within the USA reference group (i.e. children learning different cognitive skills at different rates or in different orders). Differences between the children in the sample and the reference group may also be due to some of the items administered within the Mullen scales potentially not being relevant to the South African setting. However, it should be noted that the Mullen Scales of Early Learning[185] have been previously utilised within the study of child development within South Africa and the sub-Saharan African region.[201]

Nevertheless, these analyses highlight the potential need for intervention to enhance child development outcomes among this population. High quality care and programmatic responses such as book sharing have previously been found to

improve child development outcomes, providing promising avenue for intervention.[448] Parenting interventions have also been found to be particularly successful in bolstering cognitive development (inclusive of language and motor skills) within such settings and, magnified effects have been identified among interventions which include a component on responsive caregiving.[449] While there has been a recent shift towards programming for adolescent mothers affected by HIV and their children,[136] the effectiveness of interventions for adolescents living with HIV and their children remains largely unknown. As such, interventions may require tailoring to meet the specific needs of adolescent mothers within settings of high HIV prevalence and their children.

6.1.4.3 Limitations of the analyses

Study limitations should be considered within the interpretation of findings from these analyses. Firstly, data within these analyses is cross-sectional and thus, the comparisons between age groups do not represent a longitudinal analysis of development trajectories, but instead a comparison of different children of differing ages. Secondly, the Mullen Scales of Early Learning were developed in and use a reference group from the USA.[185] However, it should be noted that the Mullen Scales of Early Learning have been utilised extensively throughout sub-Saharan Africa,[201] including South Africa,[201] and that an independent assessment of child cognitive development is preferable to caregiver reporting. To address this issue, data from the sub-Saharan African region were systematically summarised and comparisons with the sample were made. It should be noted that summary data did not include data from South Africa due to the variability in scoring of the Mullen Scales of Early Learning utilised within previous studies. Thirdly, due to the age distribution of children within the sample, age quartiles were utilised within the exploration of cognitive development. Future studies with equally distributed samples, may benefit from repeating analyses based on age categories rather than quartiles to pinpoint key developmental periods. Fourthly, the timing relating to the use of the Mullen Scales of Early Learning should remain a consideration (i.e., differing contextual factors in previous studies utilising the Mullen Scales of Early Learning compared to current

data may have implications for child development scoring. Finally, it was beyond the scope of this study to explore the profile of children living with HIV.

Future studies will be strengthened if they utilise longitudinal data to explore changes in child cognitive development throughout the development course of children born to adolescent mothers. Additional avenues of research include further exploring the cognitive development according to maternal HIV status, the cognitive profiles of second and third born children of adolescent mothers, how adolescent mothers and their children compare to children of adult populations within South Africa, as well as pathways/factors promoting the cognitive development of children born to adolescent mothers within such contexts. The strengths and limitations of these data and analyses are discussed further in sections **3.1.5** and **8.3** of this thesis.

6.1.4.4 Section summary & conclusions

These findings address a critical evidence gap regarding the cognitive development of children born to adolescent mothers, and identify a potential need for intervention to promote child cognitive development within early childhood for this group. Children born to adolescent mothers in this setting were found to score lower than the reference population, and while the younger aged children in the sample were comparable to the reference population, older children were found to score lower across development domains – identifying a core developmental period that may be amenable to intervention. Findings also identify a potential risk of developmental delay among children born to adolescent mothers compared to children of adult mothers in the sub-Saharan African region. Existing interventions for the promotion of child cognitive development maybe appropriate, however adaptation may be required for the specific needs of children born to adolescent mothers affected by HIV within the South African context.

6.2 Section 2: Exploring the cognitive development of children born to adolescent mothers in South Africa according to maternal HIV and maternal mental health status

6.2.1 Aim and objectives

These analyses aim to examine the cross-sectional relationship between maternal mental health (operationalised as likely common mental disorder see section **3.4**) and the cognitive development of children (measured using the Mullen Scales of Early Learning[185]) born to adolescent mothers affected by HIV in South Africa. Specific objectives are to:

Objective 1: Examine the cognitive development scores of children (0-68 months) born to adolescent mothers according to maternal HIV status

Objective 2: Examine the cognitive development scores of children (0-68 months) born to adolescent mothers according to maternal mental health status

Objective 3: Explore the cross-sectional associations between maternal mental health and HIV status, and child cognitive development scores

Sensitivity analyses was also undertaken to examine cross-sectional associations between sample characteristics and child cognitive development scores to explore possible risk and protective factors (correlates) that may be associated with child development to identify those children who may be at the greatest risk of cognitive delay.

6.2.2 Methods

6.2.2.1 Participants and procedure

Cross-sectional data utilised within these analyses is drawn from the ***HEY BABY study*** (see section **3.1.3** for detail regarding participants and procedure). The data and sample utilised in this section have been outlined in section 1 of this chapter (see

section **6.1.2** above), as the proceeding analyses utilise the same sample. Overall, n=954 adolescent mother-child dyads were included within the subsequent analyses.

6.2.2.2 Measures

These analyses utilise cross-sectional data relating to both adolescent mothers and their first-born children from a range of self-report and standardised assessments.

Adolescent mothers

Sociodemographic characteristics utilised in this section have been outlined in section 1 of this chapter (see section **6.1.2** above).

Maternal mental health status

For a detailed overview of the mental health symptomology measures utilised within analyses see section **3.4**. All participants within the current sample responded to all items of the four validated mental health symptomology measures used within these analyses (see below). Cut-off scores were utilised to identify prevalence of a positive screen for each mental health domain (indicative of experiencing poor mental health). As detailed in **Chapter 5**, participants were classified as experiencing likely **common mental disorder**[386] if they scored above the cut-off on any of the four mental health symptomology measures utilised within the study (depression, anxiety, posttraumatic stress, suicidality; see section **3.4**). Participants were classified as experiencing any likely **mental health comorbidities (MHCs)** if a participant scored above the cut-off on two or more of the mental health measures within the study (see above).

Children born to adolescent mothers

Sociodemographic characteristics were routinely collected from adolescent mother/caregiver report. Child characteristics include age (months), biological sex and HIV status (corroborated with medical records on a case-by-case basis).

Child cognitive development was assessed across five developmental domains (gross motor skills, fine motor skills, visual reception, expressive language, receptive language) using the Mullen Scales of Early Learning.[185] An overview of the use of the Mullen Scales of Early Learning in this section is provided in section 1 of this chapter (see section **6.1.2** above).

6.2.2.3 Statistical analyses

Sample characteristics (including child development scores) were explored according to maternal HIV status utilising Chi-square tests, t-tests and Kruskal Wallis tests where appropriate. T-tests and ANOVA tests were utilised to explore child cognitive development scores according to likely maternal common mental disorder and, likely common mental disorder and the experience of living with HIV combined, respectively. Linear regression models were used to explore the cross-sectional associations between maternal mental health and HIV status, and child cognitive development. Additional covariate factors were included in multivariable regression models if there were identified as being relevant factors within the relationship between child cognitive development and maternal mental health and/or HIV status or if they were found to be associated ($p<0.02$)[369,370] with either, or both, the predictor and outcome variables. Tukey's HSD post hoc testing was used within univariable analyses to explore group differences among continuous variables where associations between variables were identified. The Benjamini Hochberg procedure was undertaken to account for multiple testing within regression models (employing a false discovery rate of 10%).[371]

Sensitivity analyses

To further explore the relationship between maternal likely common mental disorder and child cognitive development, linear regression models (inclusive of covariates) were used to explore the cross-sectional associations between individual mental health symptomology scores (depression [0-10], anxiety [0-14], posttraumatic stress [0-12], and suicidality [0-5]). Additional linear regression models (inclusive of covariates) were also undertaken to explore cross-sectional associations between

sample characteristics and child cognitive development to explore possible risk and protective factors that may be associated with chid cognitive development scores in the sample. Regression assumptions for these analyses were met. The Benjamini Hochberg procedure was undertaken to account for multiple testing within regression models (employing a false discovery rate of 10%).[371]

6.2.3 Results

6.2.3.1 Sociodemographic characteristics

Table 6-9 presents sample characteristics according to maternal HIV status. Almost a quarter (24.1%; 230/954) of adolescent mothers in the sample were living with HIV. The median age of adolescent mothers at the birth of their first child was 18 years (IQR: 17-19 years). A small proportion (6.7%; 64/954) of adolescent mothers reported having more than one child. Like findings in section **5.4.1**, adolescent mothers living with HIV in the sample were older at the birth of their first child compared to adolescent mothers not living with HIV (18 years vs. 16 years, *t*=83.5, *p*=0.0001). Mothers living with HIV were more likely to report having more than one child (14.8% vs. 4.1%, X^2= 31.6, p<0.0001) and more likely to receive social protection in the form of cash grants (97.0% vs. 91.0%, X^2=8.81, *p*=0.003). Mothers living with HIV were less likely to be able to afford basic necessities (scale range 0-8 [5 vs. 6, *t*=15.4, *p*=0.0001]), and less likely to be in education or employment (32.6% vs. 64.6%, X^2=73.0, *p*=<0.0001). Similar proportions were identified relating to food security, housing, educational attainment, violence exposure, childcare attendance, and perceived social support according to maternal HIV status. Child biological sex did not differ according to maternal HIV status. However, children of adolescent mothers living with HIV were more likely to be older (23 months vs. 13 months, *t*=33.8, *p*=0.0001).

Table 6-9 Sample characteristics of adolescent mothers and their children according to adolescent maternal HIV status (n=954)

	N(%) M(IQR)			t/X^2, *p*-value
	Total sample (n=954)	Adolescent mothers living with HIV (n=230)	Adolescent mothers not living with HIV (n=724)	
Current age (years)	18 (17-19)	19 (18-21)	18 (17-19)	**149.4, 0.0001**
Age at birth of child (years)	17 (16-18)	18 (17-18)	16 (15-17)	**83.5, 0.0001**
In a relationship	622 (65.8%)	161 (71.2%)	461 (64.0%)	**3.97, 0.05**
Has more than one child	64 (6.7%)	34 (14.8%)	30 (4.1%)	**31.6, <0.0001**
Food secure	683 (71.6%)	157 (68.3%)	526 (72.7%)	1.65, 0.20
Household cash grant	882 (92.5%)	223 (97.0%)	659 (91.0%)	**8.81, 0.003**
Number of necessities can afford (0-8)	6 (4-7)	5 (3-7)	6 (4-7)	**15.41, 0.0001**
Informal housing	205 (21.9%)	55 (24.4%)	150 (21.0%)	1.16, 0.28
Maternal education – highest grade achieved	10 (9-11)	10 (8-11)	10 (9-11)	**0.05, 0.83**
In education or employment	543 (56.9%)	75 (32.6%)	468 (64.6%)	**73.0, <0.0001**
Community violence exposure	258 (27.0%)	56 (24.4%)	202 (27.9%)	1.12, 0.29
Domestic violence exposure	71 (7.4%)	19 (8.3%)	52 (7.2%)	0.29, 0.59
Childcare attendance	224 (25.3%)	64 (29.5%)	160 (23.9%)	2.70, 0.10
Social support (0-14)	14 (14-14)	14 (14-14)	14 (14-14)	1.61, 0.20
Maternal mental health symptoms				
Any common mental disorder	120 (12.6%)	40 (17.4%)	80 (11.1%)	**6.38, 0.01**
Any mental health comorbidities	27 (2.8%)	13 (5.7%)	14 (1.9%)	**8.78, 0.003**
Any depressive symptoms (>=3)	77 (8.1%)	29 (12.6%)	48 (6.6%)	**8.41, 0.004**
Any anxiety symptoms (>=10)	8 (0.8%)	3 (1.3%)	5 (0.7%)	0.79, 0.41

	N(%) M(IQR)			t/X^2, *p*-value
	Total sample (n=954)	**Adolescent mothers living with HIV (n=230)**	**Adolescent mothers not living with HIV (n=724)**	
Any PTSD symptoms*	6 (0.6%)	2 (0.9%)	4 (0.6%)	0.28, 0.60
Any suicidality symptoms	62 (6.5%)	21 (9.1%)	41 (5.7%)	3.45, 0.06
Depressive symptoms score (0-10)	0.72 (1.4)	0.96 (1.8)	0.64 (1.3)	-**3.01, 0.002**
Anxiety symptoms score (0-14)	0.74 (1.9)	0.59 (1.9)	0.80 (1.9)	1.45, 0.15
PTSD symptoms score (0-12)	0.81 (1.5)	0.83 (1.6)	0.80 (1.5)	-0.26, 0.79
Suicidality symptoms score (0-5)	0.18 (0.8)	0.31 (1.1)	0.14 (0.7)	**-2.77, 0.006**
Child outcomes				
Child biological sex (female)	459 (48.1%)	111 (48.3%)	348 (48.1%)	0.002, 0.96
Child age (months)	14.5 (6-28)	23 (17-37)	13 (5-24)	**33.8, 0.0001**

*Gross motor n=848 | Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health), Mental health comorbidities (experiencing two or more common mental disorders concurrently

6.2.3.2 Prevalence of likely maternal common mental disorder

One hundred and twenty adolescent mothers (12.6%) were classified as experiencing likely common mental disorder (scoring above the cut-off on at least one mental health symptomology screening measure; depression, anxiety, posttraumatic stress, suicidality). Less than three percent (2.8%; 27/954) of adolescent mothers were classified as experiencing likely mental health comorbidities (scoring above the cut-off on two or more measures of mental health symptomology [see above]). Like findings in section **5.4.2**, focusing on individual symptomology scales, 8.1% of the sample were classified as experiencing depressive symptomology, 0.8% anxiety symptomology, 0.6% posttraumatic stress symptomology and 6.5% reported suicidality symptomology. Adolescent mothers living with HIV were more likely to be classified as experiencing likely common mental disorder (17.4% vs. 11.1%, X^2=6.38, *p*=0.01) and likely mental health comorbidities (5.7% vs. 1.9%, X^2=8.78, *p*=0.003)

compared to mothers not living with HIV. Within individual scales, adolescent mothers living with HIV were more likely to report depressive symptomology compared to adolescent mothers not living with HIV (12.6% vs. 6.6%, X^2=8.41, *p*=0.004) and a trend was identified for adolescent mothers living with HIV to be more likely to report suicidality symptomology compared to mothers not living with HIV (9.1% vs. 5.7% respectively, X^2=3.45, *p*=0.06). Similar proportions of anxiety and posttraumatic stress symptomology were identified when stratifying according to maternal HIV status (see **Table 6-9**).

6.2.3.3 Child cognitive development scores by maternal HIV status

Children born to adolescent mothers living with HIV, who were not living with HIV themselves (i.e., HIV exposed uninfected) were found to have lower scores on all domains of cognitive development compared to children born to adolescent mothers not living with HIV, although this only reached statistical significance on the gross motor (47.3 vs. 50.4, *t*=3.03, *p*=0.002), and the fine motor domains (42.0 vs. 44.5, *t*=2.23, *p*=0.03).

Table 6-10 Cognitive development scores of children born to adolescent mothers according to maternal HIV status (n=954)

	Total sample (n=954)	Adolescent mothers living with HIV (n=230)	Adolescent mothers not living with HIV (n=724)	*t*, *p*-value
Child cognitive development (Mullen scales; T-scores)				
Gross motor*	49.8 (12.5)	47.3 (13.4)	50.4 (12.2)	**3.03, 0.002**
Visual reception	42.2 (14.0)	41.1 (13.9)	42.5 (14.3)	1.32, 0.19
Fine motor	43.9 (14.7)	42.0 (15.5)	44.5 (14.4)	**2.23, 0.03**
Receptive language	47.6 (13.5)	46.9 (14.7)	47.8 (13.1)	0.87, 0.38
Expressive language	51.7 (13.3)	51.3 (14.3)	51.8 (13.0)	0.45, 0.65
Composite score of early learning[a]	93.5 (21.3)	91.7 (22.7)	94.0 (20.8)	1.48, 0.14

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

6.2.3.4 Child cognitive development scores by likely maternal common mental disorder status

Table 6-11 presents the cognitive development scores of children according to likely maternal common mental disorder. While child development scores (on all domains) were slightly lower among children whose mothers were classified as experiencing common mental disorder compared to those mothers not experiencing common mental disorder, these differences did not reach statistical significance. For illustrative purposes, the cognitive development scores of children born to adolescent mothers according to individual maternal mental health domains (above cut-off; depressive, anxiety, posttraumatic stress, and suicidality symptoms) are presented in **Appendix 4, Table 9-9**, **Table 9-10**, **Table 9-11**, and **Table 9-12**.

Table 6-11 Cognitive development scores of children born to adolescent mothers according to maternal common mental disorder status (n=954)

	Total sample (n=954)	**Maternal common mental disorder (n=120)**	**No Maternal common mental disorder (n=834)**	***t*, *p*-value**
Child cognitive development (Mullen scales; T-scores)				
Gross motor*	49.8 (12.5)	49.2 (13.3)	49.8 (12.4)	0.47, 0.64
Visual reception	42.2 (14.0)	42.2 (14.8)	42.2 (14.1)	-0.03, 0.97
Fine motor	43.9 (14.7)	43.7 (15.8)	43.9 (14.5)	0.18, 0.86
Receptive language	47.6 (13.5)	45.7 (13.5)	47.8 (13.4)	1.60, 0.11
Expressive language	51.7 (13.3)	*51.5 (13.0)*	51.7 (13.4)	0.13, 0.90
Composite score of early learning[a]	93.5 (21.3)	92.5 (22.1)	93.6 (21.1)	0.54, 0.58

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155) | Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health), Mental health comorbidities (experiencing two or more common mental disorders concurrently)

6.2.3.5 Child cognitive development by the syndemic of likely maternal common mental disorder and maternal HIV

Table 6-12 presents child cognitive development scores according to four groups based on maternal HIV and common mental disorder status; 1) living with HIV and classified as reporting common mental disorder, 2) living with HIV and not classified as reporting common mental disorder, 3) not living with HIV and reporting common mental disorder, and 4) not living with HIV and not classified as experiencing common mental disorder. Group differences were identified among the gross motor skill scores. Post-hoc testing identified the gross motor skills scores among children of adolescent mothers living with HIV who were not classified as reporting likely common mental disorder differed from the scores of children of adolescent mothers not living with HIV and not classified as experiencing likely common mental disorder (p=0.01). Similar scoring between groups was identified on all other cognitive scales (visual reception, fine motor, expressive language, receptive language, and the overall composite score of development).

Table 6-12 Cognitive development of children born to adolescent mothers according to maternal HIV and common mental disorder status (n=954)

Child cognitive development (Mullen scales; T-scores)	Mean (SD)				*F*, *p*-value
	HIV & CMD (n=40)	HIV & No CMD (n=190)	No HIV & CMD (n=80)	No HIV & No CMD (n=644)	
Gross motor*	48.7 (15.3)	47.0 (13.0)[a]	49.5 (12.4)	50.6 (12.2)	**3.36, 0.02**
Visual reception	40.4 (13.7)	41.2 (13.9)	43.1 (15.3)	42.4 (14.1)	0.67, 0.57
Fine motor	41.2 (16.6)	42.2 (15.3)	44.9 (15.4)	44.4 (14.2)	1.74, 0.16
Receptive language	45.2 (14.1)	47.2 (14.8)	46 (13.3)	48.0 (13.0)	1.04, 0.38
Expressive language	51.0 (13.8)	51.4 (14.5)	51.8 (12.6)	51.8 (13.1)	0.08, 0.97
Composite score of early learning[a]	90.0 (22.6)	92.0 (22.8)	93.7 (21.8)	94.1 (20.6)	0.83, 0.48

*Gross motor n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155) | [b] Tukey's HSD post hoc test indicates that value is significantly (statistically) different from the no HIV, No CMD group (*p*=0.01) | Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health), mental health comorbidities (experiencing two or more common mental disorders concurrently.

6.2.3.6 Associations between combined likely maternal common mental disorder and maternal HIV status and, child cognitive development

Table 6-13 presents a series of linear regression models exploring the cross-sectional associations between likely maternal common mental disorder and maternal HIV status and, child cognitive development scores. After adjusting for covariates (**Table 6-13**, **model 4**), maternal HIV was found to be associated with reduced child gross motor scores (*B*=-2.90 [95%CI: -5.35, -0.44], *p*=0.02), however, no other associations were identified between likely maternal common mental disorder, or maternal HIV status (including interaction terms), and child cognitive development scores.

6.2.3.7 Sensitivity analyses

To further explore the relationship between mental health and child cognitive development, a series of linear regression models exploring the association between individual mental health symptom scales and child cognitive development scores were undertaken (**Table 6-14**). After adjusting for covariates, posttraumatic stress symptomology scores were found to be associated with reduced gross motor, visual reception, fine motor, and receptive language skill scores as well as composite scores of early learning. No association was identified between posttraumatic stress scores and expressive language skill scores. No other mental health symptomology scores (depressive, anxiety, or suicidality) were found to be associated with child cognitive development scores (see **Table 6-14**).

While no association was identified between maternal common mental disorder, maternal HIV status and child cognitive development scores within the core analyses of this study, further sensitivity analyses were undertaken to explore potential risk and protective factors that may be associated with overall child cognitive development scores in this sample. Within these models, maternal educational attainment was found to be protective of composite scores of early learning (associated with higher composite scores of early learning), and increased child age (months) was found to be associated with reduced composite scores of early

learning. These factors remained significant using the Benjamini Hochberg procedure for multiple testing with a false discovery rate of 10%.

Table 6-13 Linear regression models exploring the association between maternal HIV and common mental disorder status and the cognitive development of children born to adolescent mothers (n=954)

	Gross motor		Visual reception		Fine motor		Receptive language		Expressive language		Composite score of early learning[a]	
	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
Model 1.												
Living with HIV (n=230)	-3.12 (-5.16, -1.08)	**0.003**	-1.42 (-3.53, 0.69)	0.19	-2.47 (-4.65, -0.29)	**0.03**	-0.76 (-2.77, 1.25)	0.46	-0.45 (-2.44, 1.54)	0.66	-2.32 (-5.49, 0.85)	0.15
Common Mental Disorder (n=120)	-0.34 (-2.94, 2.26)	0.78	0.20 (-2.52, 2.93)	0.88	0.01 (-2.80, 2.82)	0.99	-2.02 (-4.60, 0.57)	0.13	-0.13 (-2.69, 2.44)	0.92	-0.89 (-4.98, 3.19)	0.67
Model 2.												
Living with HIV (n=230)	-3.52 (-5.74, -1.31)	**0.002**	-1.19 (-3.49, 1.10)	0.31	-2.23 (-4.60, 0.14)	0.07	-0.74 (-2.92, 1.44)	0.50	-0.40 (-2.56, 1.76)	0.72	-2.07 (-5.51, 1.38)	0.24
Common Mental Disorder (n=120)	-1.11 (-4.20, 1.96)	0.48	0.68 (-2.62, 3.98)	0.69	0.50 (-2.91, 3.90)	0.77	-1.99 (-5.12, 1.15)	0.21	-0.02 (-3.12, 3.09)	0.99	-0.37 (-5.32, 4.57)	0.88
Living with HIV*Common Mental Disorder (n= 40)	2.74 (-3.04, 8.52)	0.35	-1.49 (-7.35, 4.36)	0.62	-1.55 (-7.60, 4.49)	0.61	-0.11 (-5.67, 5.46)	0.97	-0.34 (-5.85, 5.17)	0.90	-1.64 (-10.43, 7.14)	0.71
Model 3*												
Living with HIV (n=230)	-2.47	**0.04**	1.29	0.30	-1.22	0.35	2.24	0.05	2.14	**0.07**	2.27	0.21

	Gross motor		Visual reception		Fine motor		Receptive language		Expressive language		Composite score of early learning[a]	
	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
	(-4.78, -0.15)		(-1.13, 3.73)		(-3.75, 1.32)		(-0.01, 4.50)		(0.15, 4.42)		(-1.30, 5.85)	
Common Mental Disorder (n=120)	-0.13 (-2.89, 2.64)	0.93	1.24 (-1.65, 4.12)	0.40	0.45 (-2.57, 3.46)	0.77	-0.56 (-3.24, 2.11)	0.68	0.50 (-2.21, 3.25)	0.72	0.74 (-3.50, 4.99)	0.73
Model 4*												
Living with HIV (n=230)	-2.90 (-5.35, -0.44)	**0.02**	1.31 (-1.28, 3.89)	0.32	-1.25 (-3.95, 1.45)	0.36	1.97 (-0.42, 4.37)	0.11	2.00 (-0.43, 4.42)	0.11	2.07 (-1.74, 5.87)	0.29
Common Mental Disorder (n=120)	-1.01 (-4.25, 2.24)	0.54	1.27 (-2.21, 4.74)	0.48	0.36 (-3.27, 3.99)	0.85	-1.56 (-4.37, 2.06)	0.48	0.18 (-3.08, 3.44)	0.91	0.29 (-4.82, 5.40)	0.91
Living with HIV*Common Mental Disorder (n= 40)	3.03 (-2.82, 8.88)	0.31	-0.08 (-6.00, 5.83)	0.98	0.26 (-5.91, 6.44)	0.93	1.82 (-3.66, 7.30)	0.52	0.96 (-4.60, 6.51)	0.74	1.38 (-7.32, 10.09)	0.76

Model 1/Model 2: Univariable analyses | Model 3/Model 4. Multivariable analyses inclusive of covariates: Maternal age at birth (years), Maternal relationship status (in a relationship), Food security, Maternal educational attainment, Access to basic necessities, mother has more than one child, access to social protection (cash grants) exposure to community violence, exposure to domestic violence, perceived social support, in school or education (maternal), ECD programming attendance, child age (months), child biological sex (female) | [a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

Table 6-14 Linear regression models exploring the association between individual maternal mental health symptomology scales and child cognitive development (n=954)

	Child cognitive development (Mullen scales; T-scores) – Composite score of early learning			
	***B* (95% CI)**	***p*-value**	**Adjusted *B* (95% CI)**	***p*-value**
Depressive symptom scores (0-10)				
Gross motor*	-0.56 (-1.16, 0.04)	0.07	-0.34 (-0.96, 0.28)	0.28
Visual reception	-0.37 (-1.00, 0.26)	0.25	-0.10 (-0.76, 0.55)	0.76
Fine motor	-0.45 (-1.10, 0.19)	0.17	-0.11 (-0.80, 0.58)	0.76
Receptive language	-0.81 (-1.41, -0.22)	**0.007**	-0.39 (-0.99, 0.22)	0.21
Expressive language	-0.19 (-0.78, 0.40)	0.53	0.001(-0.61, 0.62)	0.99
Composite score of early learning[a]	-0.87 (-1.81, 0.07)	0.07	-0.31 (-1.28, 0.66)	0.53
Anxiety symptom scores (0-14)				
Gross motor*	-0.01 (-0.46, 0.45)	0.97	-0.08 (-0.57, 0.41)	0.76
Visual reception	-0.22 (-0.70, 0.26)	0.37	-0.11 (-0.63, 0.41)	0.68
Fine motor	0.01 (-0.48, 0.51)	0.96	0.004 (-0.54, 0.55)	0.99
Receptive language	-0.13 (-0.59, 0.32)	0.57	0.04 (-0.44, 0.52)	0.88
Expressive language	-0.04 (-0.49, 0.41)	0.86	0.10 (-0.38, 0.59)	0.68
Composite score of early learning[a]	-0.17 (-0.89, 0.55)	0.65	0.03 (-0.74, 0.79)	0.95
Posttraumatic stress symptom scores (0-12)				

	Child cognitive development (Mullen scales; T-scores) – Composite score of early learning			
	***B* (95% CI)**	***p*-value**	**Adjusted *B* (95% CI)**	***p*-value**
Gross motor*	-0.66 (-1.21, -0.10)	**0.02**	-0.79 (-1.35, -0.22)	**0.007**
Visual reception	-1.01 (-1.60, -0.43)	**0.001**	-0.85 (-1.46, -0.24)	**0.006**
Fine motor	-0.96 (-1.57, -0.36)	**0.002**	-1.04 (-1.67, -0.40)	**0.001**
Receptive language	-0.74 (-1.29, -0.18)	**0.009**	-0.61 (-1.17, -0.05)	**0.03**
Expressive language	-0.46 (-1.01, 0.09)	**0.10**	-0.34 (-0.91, 0.23)	0.24
Composite score of early learning[a]	-1.51 (-2.38, -0.63)	**0.001**	-1.35 (-2.24, -0.46)	**0.003**
Suicidality symptom scores (0-5)				
Gross motor*	-1.13 (-2.27, 0.01)	0.05	-0.83 (-1.96, 0.29)	0.15
Visual reception	-0.35 (-1.47, 0.78)	0.55	0.12 (-1.00, 1.24)	0.83
Fine motor	-0.85 (-2.01, 0.31)	0.15	-0.40 (-1.57, 0.77)	0.50
Receptive language	-0.75 (-1.81, 0.31)	0.17	-0.17 (-1.15, 0.82)	0.74
Expressive language	-0.59 (-1.64, 0.46)	0.27	-0.23 (-1.27, 0.81)	0.66
Composite score of early learning[a]	-1.21 (-2.89, 0.47)	0.16	-0.29 (-1.35, 0.76)	0.58

Adjusted models: Multivariable analyses inclusive of covariates: Maternal age at birth (years), Maternal relationship status (in a relationship), Food security, Maternal educational attainment, Access to basic necessities, mother have more than one child, access to social protection (cash grants) exposure to community violence, exposure to domestic violence, perceived social support, in school or education (maternal), ECD programming attendance, child age (months), child biological sex (female) | [a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

Table 6-15 Linear regression models exploring factors associated with the cognitive development of children born to adolescent mothers in South Africa (n=954)

	Gross motor		Visual reception		Fine motor		Receptive language		Expressive language		Composite score of early learning	
	B (95% CI)	*p*	*B* (95% CI)	*p*	*B* (95% CI)	*p*	*B* (95% CI)	*p*	*B* (95% CI)	*p*	*B* (95% CI)	*p*
Model 1.												
Living with HIV (n=230)	-2.90 (-5.35, -0.44)	**0.02**	1.31 (-1.28, 3.89)	0.32	-1.25 (-3.95, 1.45)	0.36	1.97 (-0.42, 4.37)	0.11	2.00 (-0.43, 4.42)	0.11	2.07 (-1.74, 5.87)	0.29
Common Mental Disorder (n=120)	-1.01 (-4.25, 2.24)	0.54	1.27 (-2.21, 4.74)	0.48	0.36 (-3.27, 3.99)	0.85	-1.56 (-4.37, 2.06)	0.48	0.18 (-3.08, 3.44)	0.91	0.29 (-4.82, 5.40)	0.91
Living with HIV*Common Mental Disorder (n= 40)	3.03 (-2.82, 8.88)	0.31	-0.08 (-6.00, 5.83)	0.98	0.26 (-5.91, 6.44)	0.93	1.82 (-3.66, 7.30)	0.52	0.96 (-4.60, 6.51)	0.74	1.38 (-7.32, 10.09)	0.76
Maternal age at birth	-0.09 (-0.81, 0.63)	0.80	-0.75 (-1.51, -0.01)	0.05	0.15 (-0.64, 0.94)	0.71	-0.56 (-1.26, 0.15)	0.12	-0.59 (-1.30, 0.12)	0.10	-0.85 (-1.96, 0.27)	0.14
In a relationship	0.65 (-1.14, 2.45)	0.48	1.57 (-0.35, 3.50)	0.11	0.31 (-1.70, 2.32)	0.76	1.84 (-0.06, 3.63)	**0.04**	1.61 (-0.20, 3.42)	0.08	2.48 (-0.36, 5.31)	0.09
Food Secure	-2.37 (-4.42, -0.31)	**0.02**	1.53 (-0.64, 3.71)	0.17	-1.46 (-3.73, 0.82)	0.21	-0.73 (-2.75, 1.28)	0.48	0.88 (-1.16, 2.93)	0.40	0.11 (-3.09, 3.32)	0.95
Maternal education – highest grade	0.82 (0.22, 1.41)	**0.007**	1.13 (0.52, 1.76)	**<0.0001**	0.66 (0.01, 1.30)	0.05	0.71 (0.14, 1.28)	**0.02**	0.66 (0.08, 1.24)	**0.03**	1.49 (0.58, 2.40)	**0.001**
Access to basic necessities	0.02 (-0.40, 0.44)	0.93	0.01 (-0.44, 0.46)	0.97	0.16 (-0.31, 0.63)	0.50	0.24 (-0.17, 0.66)	0.25	-0.02 (-0.40, 0.44)	0.92	0.21 (-0.46, 0.87)	0.54
Child has siblings	2.81	0.24	1.01	0.59	2.90	0.14	1.96	0.26	1.06	0.55	3.34	0.23

	Gross motor		Visual reception		Fine motor		Receptive language		Expressive language		Composite score of early learning	
	(-1.84, 7.47)		(-2.70, 4.73)		(-0.99, 6.78)		(-1.48, 5.41)		(-2.43, 4.55)		(-2.14, 8.81)	
Social protection – cash grant	3.48 (0.11, 6.84)	**0.04**	-2.73 (-6.28, 0.82)	0.13	1.33 (-2.38, 5.04)	0.48	-2.03 (-5.31, 1.26)	0.23	-3.69 (-7.02, -0.35)	**0.03**	-3.63 (-8.85, 1.60)	0.17
Exposure to community violence	-0.35 (-2.39, 1.68)	0.67	-0.15 (-2.31, 2.01)	0.89	0.56 (-1.69, 2.82)	0.63	0.19 (-1.81, 2.19)	0.86	1.09 (-0.94, 3.12)	0.29	0.90 (-2.27, 4.08)	0.58
Exposure to domestic violence	1.51 (-1.93, 4.96)	0.39	-0.71 (-2.92, 4.34)	0.70	-0.78 (-4.57, 3.01)	0.69	-0.28 (-3.64, 3.08)	0.87	0.41 (-2.99, 3.82)	0.81	-0.20 (-5.54, 5.14)	0.94
Perceived social support	-0.35 (-0.78, 0.08)	0.11	-0.07 (-0.52, 0.39)	0.77	-0.01 (-0.46, 0.48)	0.97	0.11 (-0.31, 0.53)	0.60	-0.07 (-0.36, 0.49)	0.76	-0.04 (-0.63, 0.70)	0.91
In school or education	0.48 (-1.47, 2.44)	0.63	-0.85 (-2.95, 1.24)	0.42	0.02 (-2.17, 2.21)	0.98	-0.58 (-2.52, 1.36)	0.56	-0.69 (-2.65, 1.28)	0.49	-0.95 (-4.04, 2.13)	0.54
Childcare attendance	1.02 (-1.41, 3.45)	0.41	1.64 (-0.84, 4.11)	0.20	2.83 (0.24, 5.41)	**0.03**	1.63 (-0.66, 3.92)	0.16	1.44 (-0.88, 3.77)	0.22	3.49 (-0.15, 7.13)	0.06
Child age (months)	-0.29 (-0.39, -0.20)	**<0.0001**	-0.28 (-0.36, -0.20)	**<0.0001**	-0.27 (-0.35, -0.18)	**<0.0001**	-0.36 (-0.44, -0.29)	**<0.0001**	-0.30 (-0.37, -0.22)	**<0.001**	-0.57 (-0.69, -0.45)	**<0.0001**
Child biological sex (female)	-0.30 (-2.02, 1.42)	0.73	0.71 (-1.12, 2.55)	0.45	-0.26 (-2.18, 1.66)	0.79	-0.96 (-2.66, 0.74)	0.27	-0.76 (-2.48, 0.97)	0.39	-0.60 (-3.31, 2.10)	0.66

Model 1: Multivariable analyses inclusive of covariates listed |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

6.2.4 Discussion

These analyses provide an explicit examination of the relationship between maternal mental health and the cognitive development of children born to adolescent mothers living with and affected by HIV in sub-Saharan Africa. Results highlight possible risk and protective factors (correlates) for cognitive development among children born to adolescent mothers within this setting. Almost a quarter (24.1%) of adolescent mothers were living with HIV in the sample and 12.6% were categorised as experiencing likely common mental disorder (depressive, anxiety, posttraumatic stress, or suicidality symptomology). Child cognitive development scores on motor domains were found to be lower among children born to adolescent mothers living with HIV compared to adolescent mothers not living with HIV. Prevalence of likely common mental disorder and mental health comorbidities was found to be elevated among adolescent mothers living with HIV compared to adolescent mothers not living with HIV (17.4% vs. 11.1%). Overall, child cognitive development domains did not differ according to adolescent likely common mental disorder status. While no associations were identified between this broad measure of maternal mental health (including interactions with maternal HIV status) and overall child cognitive development scores, sensitivity analyses identified a relationship between increased maternal posttraumatic stress symptomology and poorer child cognitive development scores. Sensitivity analyses further exploring risk and protective factors for child cognitive development identified maternal educational attainment as being associated with improved child cognitive development scores while increasing child age was found to be associated with lower child cognitive development scores. This is the first explicit exploration of maternal mental health and the cognitive development of children born to adolescent mothers living with and affected by HIV in both South Africa, and within sub-Saharan Africa. These results highlight the ongoing need for attention to the development of children born to adolescent mothers within South Africa. Findings underline a specific need to identify and support adolescent maternal mental health where required, the potential need to explore trauma events with this group beyond screening activities for the benefit of both adolescent mothers and their children and, the need to promote educational

attainment and school return for adolescent mothers following the birth of their child(ren).

6.2.4.1 Adolescent maternal mental health

The findings from these analyses address a critical evidence gap regarding adolescent maternal mental health and child development within the context of HIV.[386] These data support prevalence estimates of common mental disorder among adolescent mothers living with HIV in South Africa (undertaken in **Chapter 4)**. Results from **Chapter 4** identified elevated prevalence of common mental disorder among adolescent mothers living with HIV compared to adolescent non-mothers and adolescent mothers not living with HIV. Results from the current analyses additionally support some of the nuanced findings of this previous study identifying elevated depressive and suicidality symptomology among adolescent mothers living with HIV.[450] Findings from the present analyses extend the current literature to explore the cognitive development of children born to adolescent mothers within the context of likely common mental disorder experience and HIV.

6.2.4.2 Child cognitive development by maternal HIV status

Findings from these analyses highlight a potential risk of cognitive delay among children born to mothers living with HIV, specifically those children who are likely HIV-exposed uninfected. Children known to be living with HIV were excluded from these analyses due to evidence from previous literature highlighting the impacts of living with HIV on child cognitive development.[169] Yet, these data support suggestions that while the cognitive development of HIV-exposed children, and those HIV unexposed may be somewhat similar, there may be some negative impact of HIV-exposure (i.e., impact of infection or the ART given in PMTCT) on the cognitive development of children not living with HIV.[211,451] These analyses expand previous investigations to explore children born to adolescent mothers. However, it should be noted that in-utero HIV exposure was not formally assessed in these analyses.

6.2.4.3 Child cognitive development by adolescent maternal mental health

The absence of a relationship between overall likely maternal common mental disorder (inclusive of interactions with maternal HIV) and child cognitive development within both crude and multivariable analyses are inconsistent with previous studies that identify child cognitive and motor development to be adversely affected by poor maternal mental health.[206,452] Given that the broad measure of likely common mental disorder utilised within this study was not found to be associated with child cognitive development scores, a detailed exploration of mental health symptomology was required. Sensitivity analyses exploring individual symptom scales (depression, anxiety, posttraumatic stress, and suicidality) identified higher posttraumatic stress symptomology scores among adolescent mothers to be associated with worse child cognitive development scores, despite the number of adolescent mothers within the sample reaching the partial threshold for posttraumatic stress symptomology being low. Thus, associations between adolescent maternal mental health and child cognitive development should not be wholly ruled out in this setting. Given this finding, the definition of likely common mental disorder used within this study may have attenuated the emerging effects of maternal mental health on cognitive development[453] however, it should be noted that no other symptomology scale was found to be associated with child cognitive development scores and that neither the classification of likely common mental disorder, nor the symptomology scores represent a mental health diagnosis. Such low rates of probable common mental disorder (i.e., global prevalence of depression among adolescents is approximately 3%)[23] indicate either high rates of resilience among adolescent mothers or potentially that common mental disorder takes on a different form within this setting and as such, different measurement may be required. Specific attention to individual aspects of mental health may need attention (e.g., posttraumatic stress) and measurement should be sensitive to different dimensions of mental health.

While much of the existing evidence alludes to a relationship between poor maternal mental health and adverse child development outcomes, some studies, inclusive of

those in LMIC, have failed to replicate such associations. As these analyses were cross-sectional, measurement of both likely common mental disorder and the child cognitive assessments were undertaken within in a similar time period. As such, comparisons with existing studies in which there was a time lag between mental health and child development assessments are complicated and those longitudinal studies, or those with a time lag between variable collection may demonstrate the association between maternal mental health and child development more explicitly.[454]

Incongruence between findings from this study and previous studies from LMIC may also be explained by differences in methodology. These analyses report data from a community drawn sample of adolescent mothers. Samples exploring mental health outcomes from clinical settings may be biased towards more acute experiences of poor mental health.[455] Previous community-based studies drawn from rural settings[452,456] have failed to identify an independent relationship between poor maternal mental health and child development outcomes. Likewise, it remains important to differentiate between transient and chronic maternal mental health problems as often the effects of poor mental health on child development are only identified in those studies exploring persistent common mental disorder. Moreover, the children in this sample are young and the possible impacts of poor maternal mental health on development may develop further over time.

Furthermore, these analyses focus on adolescent mothers affected by HIV and their children, as such the adolescent experience of parenthood may be more complex.[136] Adolescent mothers and their children may be exposed to an accumulation of risk associated with the complexity of the environment in which they live (i.e., exposure to poverty, HIV) which may mitigate the impact of maternal mental health on child cognitive development.[136] Nevertheless, despite prevalence of likely common mental disorder being low within this sample, it remains that these adolescent mothers should be identified and supported where required. Screening and support for adolescent maternal mental health, possibly through integration within existing services and intervention (e.g., antenatal care, sexual and reproductive health

services, childcare services), may be of benefit to both adolescent mothers and their child(ren).

6.2.4.4 Risk and protective factors for the cognitive development of children born to adolescent mothers

Sensitivity analyses were undertaken to further explore risk and protective factors for cognitive development among children born to adolescent mothers. Such analyses highlighted higher maternal educational attainment as being associated with an increase in child cognitive scores. Such findings support previous literature identifying child development being impacted by maternal education.[457] In South Africa, about a quarter of school-going girls discontinue their education during pregnancy,[148] and only between 30%-65% of adolescent mothers manage to return to education after their child(ren) are born.[147,458-460] Promoting educational attainment among adolescent mothers and supporting their return to school following childbirth might require increased efforts to address young mothers' unmet needs for childcare and lacking financial resources.[461] Further research is required to understand the pathway[457] through which maternal education might impact on child cognitive development and, the mechanisms in place to support the learning of and the promotion of education among adolescent mothers. Future studies exploring the impact of school interruptions and school return on child cognitive development would further enhance the evidence based regarding the development of children born to adolescent mothers.

Sensitivity analyses also highlight an age-related decline in cognitive performance of children born to adolescent mothers. This finding potentially underscores the role of critical developmental periods within child development and, a risk of cognitive delay for older children born to adolescent mothers in this setting. Future studies exploring the impact of child age on cognitive development scores (most notably longitudinal studies) are required to further develop an understanding of the development trajectory of children born to adolescent mothers affected by HIV in South Africa.

Overall, these findings emphasise the need for intervention to strengthen child development outcomes among this population. High quality care and evidenced based programming such as book sharing have previously been found to improve child development outcomes, and offer an encouraging avenue for intervention.[448] Parenting interventions have also been found to be particularly successful in enhancing cognitive development within such settings.[449] The integration of support for maternal mental health within such interventions may also be of benefit in this context. Future studies are encouraged to utilise longitudinal data to explore changes in maternal mental health and child cognitive development throughout the development course of children born to adolescent mothers, and further explore pathways/factors promoting the cognitive development of children born to adolescent mothers in the context of HIV. Additional avenues of research include exploring the cognitive development of second and third born children of adolescent mothers, the impact of mode of HIV infection as well as timing of maternal HIV acquisition within the context of likely common mental disorder and child cognitive development and, how adolescent mothers and their children compare to adult populations within the same setting.

6.2.4.5 Limitations of the analyses

Study limitations should be considered within the interpretation of findings from these analyses. The Mullen Scales of Early Learning were developed in and use a reference group from the USA.[185] While locally developed and validated assessment tools would have been preferable, such measures were not available. However, it should be noted that the Mullen Scales of Early Learning have been utilised extensively throughout sub-Saharan Africa, including within South Africa, and that an independent assessment of child cognitive development is preferable to caregiver reporting. Furthermore, it was beyond the scope of these analyses to explore the cognitive profile of children living with HIV. These analyses also do not explore other possible contributors to the cognitive development of children born to adolescent mothers such as stunting.[462-464] Stunting may have long-term negative implications for the cognitive development of children.[462-465] Children born to adolescent mothers may be at a greater risk of stunting due to the greater risk of preterm delivery and/or

greater likelihood of being small for gestational age.[466-470] Given this, further research would be well placed to explore the cognitive development of children born to adolescent mother in the context of stunting. The strengths and limitations of these data and analyses (inclusive of detail regarding cross-sectional and self-report data) are discussed further in sections **3.1.5** and **8.3** of this thesis.

6.2.4.6 Section summary & conclusions

How best to support families and the development of children within low- and middle-income countries remains a core development agenda. Children born to adolescent mothers affected by HIV may have specific requirements which necessitate tailored intervention. These results provide an exploratory first step within the examination of the relationship between likely common mental disorder among adolescent mothers and child cognitive development. Prevalence of likely common mental disorder was found to be elevated among adolescent mothers living with HIV. While there was a lack of an association identified between measures of overall maternal mental health (likely common mental disorder) and child cognitive development scores, sensitivity analyses identified a relationship between maternal posttraumatic stress symptomology and lower child development scores. Greater maternal educational attainment was also identified as a potential protective factor for child cognitive development. Targeting interventions to support the cognitive development of children of adolescent mothers most at risk may be of benefit. The integration of mental health screening and support within existing services accessed by adolescent mothers i.e., vertical services or within child development programming may also bolster outcomes for both adolescent mothers and their children. Promoting educational attainment and school return may additionally aid in boosting positive outcomes for this population.

6.3 Section 3: Exploring the cognitive development of children born to adolescent mothers in South Africa in the context of child HIV status

6.3.1 Background

The existing literature on adolescent pregnancy[471,472 473,474]and the existing literature on maternal HIV infection[111,169,170,211,451,475] have both demonstrated child development impacts. However, there is a dearth of understanding on the experiences when both co-occur. For children born to adolescent mothers living with HIV, implications for child cognitive development may be compounded. Section 2 of this chapter (above) provided a provisional exploration of child cognitive development scores according to maternal HIV status.

There is a strong body of literature highlighting the adverse impacts (both direct and indirect) of HIV on children inclusive of developmental delay.[111,169,170,202,211,419,451,475] Given the rise in programming focusing on the prevention of vertical HIV transmission prevention in recent years, fewer children are now living with HIV and there is a growing group of children who are HIV exposed but uninfected.[210] Previous investigations within both high income and, low-middle income countries, have identified worse development outcomes of children who are HIV infected and HIV exposed uninfected (HEU) compared to children who are HIV unexposed (HU).[211]

Early child development is a period of rapid and complex growth and skill development that is impacted by a multitude of factors such as biological, social, and environmental factors.[150] Among children living with HIV and those children who are HEU, cognitive deficits may be due to the direct physical and structural effects of HIV on the nervous system and cognition,[476] exposure to treatment and, broader factors related to child and/or maternal HIV infection.[211] Indirectly, HIV infection and HIV exposure (i.e. maternal HIV infection) may impact the environment that the child is exposed to, as familial HIV infection has been found to be associated with a greater likelihood of poverty, food insecurity, caregiver illness, mental health problems, distracted parenting, lone parenting, bereavement.[111] In addition to HIV playing a role within the developmental outcomes of children, the neurological development

of children has also been found to be impacted by quality of caregiving including knowledge of child rearing, early years stimulation, and parental mental health (which may be poorer in adolescents when compared to adult mothers,[390] and within both **Chapter 4** and **Chapter 5** has been found to be worse among adolescent mothers living with HIV compared to adolescent mothers not living with HIV).[450] Likewise, adverse child development outcomes have been found to be mitigated by interventions promoting early years stimulation and increased quality of caregiving.[477] Yet, the neurological profile of children born to adolescent mothers affected by HIV (both living with HIV, and living within HIV affected communities) remains underexplored and we are yet to understanding the implications of HIV exposure for these children.

6.3.2 Aim and objectives

These exploratory analyses aim to investigate the relationship between the HIV status of children born to adolescent mothers (living with HIV, HEU and HU) and child cognitive development outcomes. Specific objectives were to:

Objective 1: Examine the cognitive development scores of children (0-68 months) born to adolescent mothers according to child HIV status (living with HIV, HEU and HU)

Objective 2: Explore the cross-sectional associations between child HIV status, and child cognitive development scores among children (0-68 months) born to adolescent mothers

Based on previous literature (see section **1.7**), the candidate hypothesised that the cognitive performance of children born to adolescent mothers would be worst in children living with HIV, followed by children classified as HEU and, then HU children.

6.3.3 Methods

6.3.3.1 Participants and procedure

Cross-sectional data utilised within these analyses is drawn from the ***HEY BABY study*** (see section **3.1.3** for detail regarding participants and procedure). Only data for adolescent mothers (who had given birth between 10-19 years of age), and their first-born children (0-68 months) were included within subsequent analyses (n=920 adolescent mother-child dyads). Participants were excluded from analyses if they were older than 19 years at the birth of their first child (n=44), children were above 68 months of age (in line with the valid age range for the child development assessments used within this study [n=30]), or the HIV status of the child was unknown or unclear (n=52). Second and third born children were also excluded from these analyses.

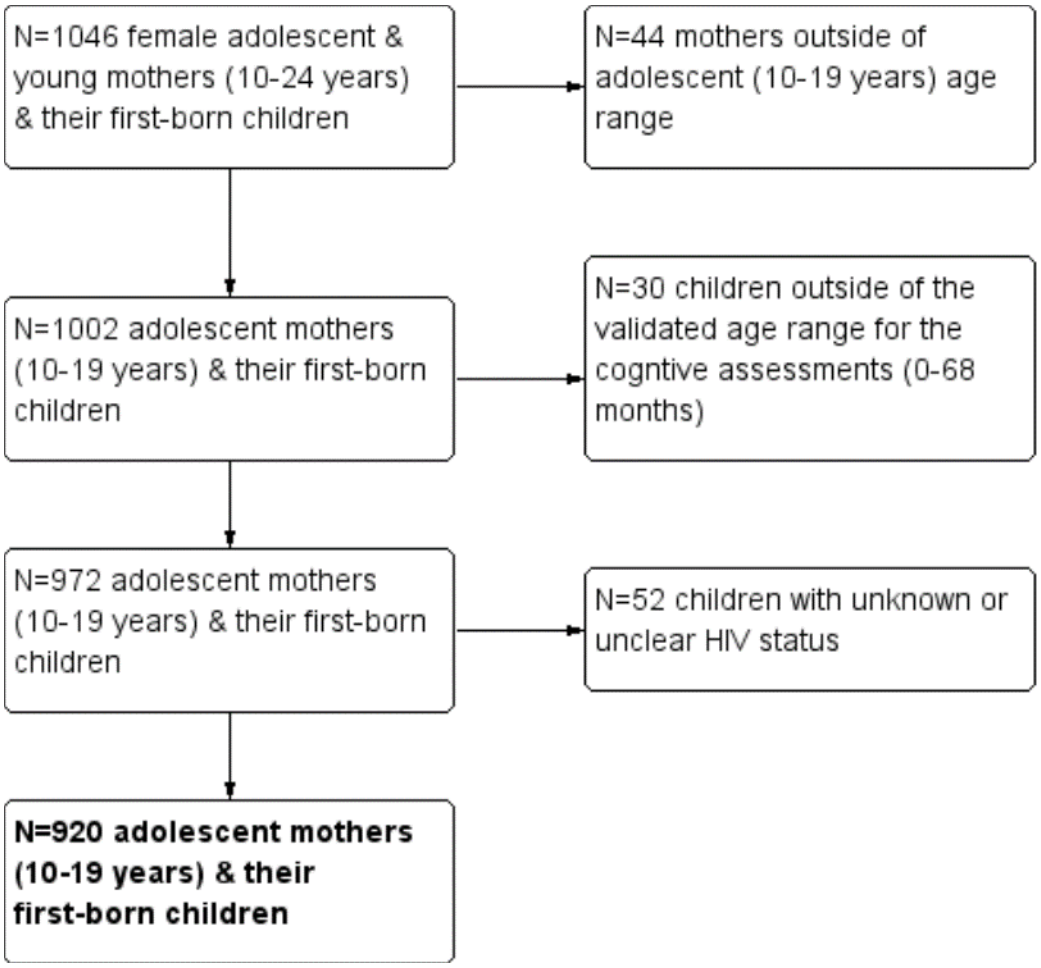


Figure 6-6 Participant selection for analyses exploring the cognitive development scores of children born to adolescent mothers according to child HIV status

6.3.3.2 Measures

Analyses utilise cross-sectional data relating to both adolescent mothers and their first-born children from a range of self-report measures and standardised assessments.

Adolescent mothers

Sociodemographic characteristics inclusive of **maternal age (years), maternal age at birth of first child (years)**, and maternal **relationship status** were routinely collected utilising self-report. **Socioeconomic status** was assessed utilising numerous measures: Access to necessities was assessed though multiple items- as such, adolescent mothers were asked if they had enough food in the past week and could

afford three meals daily (yes/no) and, whether they had access to a list of eight basic necessities for their both themselves and their children (0-8; e.g., enough clothes to keep you warm and dry). **Cash grant receipt** and **household employment** was assessed via maternal self-report. **Maternal education** was assessed by a single self-report item asking if mothers were at least a school grade behind where they should be according to their age (number school grades ahead/behind ranged from +2, -6), participants were classified as experiencing maternal education interruption if they were at least one school grade behind. **Social support** was measured using 8 items from the Medical Outcomes Study (MOS) Social Support Survey.[405] **Violence exposure** (both community and domestic) was ascertained by maternal self-report.

Maternal HIV status was ascertained through self-report and verified through clinical records. **Maternal mode of HIV acquisition** (vertical vs. horizontal) was not directly assessed in the study and should be interpreted with caution. This variable was derived using a logic tree based on field and clinical experience and has been used within previous explorations (see Sherr et al. 2018 for full details on how the variable was derived).[478] Adolescents who were living with HIV (n=200) were asked to report ART adherence in the past week.

Adolescent mothers were classified as experiencing **any common mental disorder**[386] if they scored above the cut-off on any of the four mental health symptomology measures utilised within the study (depression, anxiety, posttraumatic stress, suicidality; see section **3.4**).

Children born to adolescent mothers

Sociodemographic characteristics were routinely collected from adolescent mother/caregiver report. Child characteristics include **age (months)** and **biological sex**.

Child HIV status was ascertained through caregiver report and corroborated with child medical records (Road to Health Cards). Three groups of interest relating to child HIV status were created based on a combination of reported maternal and child

HIV status within the study (**living with HIV**, **HIV exposed-uninfected [HEU],** and **HIV unexposed [HU]**). Data relating to the discontinuation of breastfeeding were not available at the time of these analyses. As such, within analyses, vertical transmission data is indicative.

Child cognitive development was assessed using the Mullen Scales of Early Learning.[185] An overview of the use of the Mullen Scales of Early Learning in this section is provided in section 1 of this chapter (see section **6.1.2** above). The gross motor skills assessment was only undertaken with children <39 months of age (n=831/920; living with HIV=9, HEU=163, HU=659). All children within the validated age range (0-68 months) completed assessments for the remaining four domains.[185]

6.3.3.3 Statistical analyses

Summary statistics for each outcome were computed and ANVOA tests (including Tukey's HSD post hoc testing) and chi-square tests were used to explore sample characteristics according to child HIV status (living with HIV, HIV exposed uninfected, HIV unexposed). Within exploratory analyses, linear regression models were used to investigate the associations between child HIV status and child development. Three models were run: 1) univariable analyses exploring the association between child HIV status (as well as sociodemographic characteristics) and child cognitive development scores, 2) multivariable analyses inclusive of covariates, and 3) multivariable analyses exploring possible mitigating factors within the relationship between child HIV status and, child cognitive development. Covariates were included within multivariable regression models if there were found to be associated with both or either the predictor and outcome variables (within univariable analyses p=<0.2) or were identified as relevant within the literature.[369,370] Sample characteristics considered as covariates (a priori) included child age, child biological sex, maternal age, relationship status, socio-economic status, maternal education, social support, violence exposure, maternal ART adherence and, maternal mental health. The number of covariates within multivariable analyses was restricted to account for the small sample of children identified as living with HIV (n=11). Given this restriction, child age, child biological sex and number of necessities the mother could afford (as a measure of

socio-economic status) were included as covariates within model 2. Maternal education interruption and maternal age were included within model 3 to explore potential mitigating factors within the relationship between child HIV status and child cognitive development scores.

6.3.4 Results

6.3.4.1 Sociodemographic characteristics

Table 6-16 presents sample characteristics, both maternal and child, according to child HIV status (living with HIV, being HIV exposed uninfected [HEU], being HIV unexposed [HU]). A small proportion (1.2%; 11/920) of children were living with HIV, 20.5% (189/920) were classified as being HEU and, 78.3% (720/920) were classified as HU. As such, the known HIV transmission rate from mother to child was 5.5% (11/200). The mean age of mothers at the time of the birth of their child was 16.6 years (SD:1.5) in the total sample. Mothers of children who were HEU were older at the time of their birth (HEU: 17.4 years vs. living with HIV: 16.6 years vs. HU: 16.3 years). The mean age of mothers at baseline data collection was 18.0 years (SD:1.5). The mean age of children born to adolescent mothers at baseline was 17.9 months (SD:14.2). Children born to adolescent mothers living with HIV (living with HIV and HEU) were found to be older compared to those who were HU (living with HIV: 28.5 vs. HEU: 21.6 vs. HU: 16.8 months; F=76.2, p=<0.0001). No differences were identified according to biological sex of children born to adolescent mothers (overall 48% female). Adolescent mothers of children living with HIV were less likely to be food secure (living with HIV: 36.3% vs. HEU: 67.7% vs. HU: 72.8%; X^2=8.51, p=0.01) and, less likely to have access to basic necessities compared to other groups (living with HIV: 4.0 vs. HEU: 4.6 vs. HU: 5.4; F=12.5, p=<0.0001). Over half (57.5%;270/920) of adolescent mothers had experienced education interruption and were at least one school grade behind where they should be according to their age. Compared to mothers of children who were classified as HU, mothers of children who were classified as HEU were more likely to be at least one school grade behind (75.5% vs. 55.3%, X^2=7.46, p=0.02). Cash grant receipt was found to be high among all groups, although a trend was identified for households of HEU children to be more likely in

receipt of grants (HEU: 96.3% vs. children living with HIV: 90.9% vs. HU: 91.0%; X^2=5.83, *p*=0.05). Household employment perceived social support, and violence exposure among adolescent mothers were not found to differ according to child HIV status. For adolescent mothers living with HIV, 10.5% of mothers were Known to be vertically infected with HIV, and mode of HIV infection (vertical vs. horizontal) was similar among mothers of children living with HIV and HEU children (vertical HIV infection: 9.1% vs. 10.6%; X^2=0.02, *p*=0.88). ART adherence (in the past week) was found to be significantly lower among mothers of children living with HIV compared to HEU children (36.4% vs. 78.7%, *p*=0.001). One hundred and thirteen adolescent mothers (12.3%) scored above the cut-off on at least one measure of mental health symptomology. A trend was identified for mothers of HEU children to be more likely to report common mental disorder (HEU: 17.5% vs. children living with HIV: 9.1% vs. HU: 11.0%; X^2=5.95, *p*=0.05, see **Table 6-16**).

Table 6-16 Maternal and child sociodemographic characteristics according to according to child HIV status (n=920)

	Total sample (n=920)	HIV (n=11)	HEU (n=189)	HU (n=720)	X^2/*F*, *p*-value
Maternal characteristics					
Age (years; mean [SD])	18.0 (1.6)	19.2 (1.7)[a]	19.2 (1.7)[a]	17.7 (1.5)	**76.2, <0.0001**
Age at birth of first child (years; mean [SD])	16.6 (1.5)	16.6 (1.5)	17.4 (1.4)[a]	16.3 (1.4)	**45.8, <0.0001**
Food secure (had food for the past week and can afford 3 meals)	656 (71.3%)	4 (36.3%)	128 (67.7%)	524 (72.8%)	**8.51, 0.01**
Number of necessities mother can afford (0-8; mean [SD])	5.2 (2.2)	4.0 (2.1)	4.6 (2.4)[a]	5.4 (2.2)	**12.5, <0.0001**
Access to basic necessities	181 (19.7%)	1 (9.1%)	31 (16.4%)	149 (20.7%)	2.53, 0.28
Home receives any grant	847 (92.1%)	10 (90.9%)	182 (96.3%)	655 (91.0%)	5.83, 0.05
Someone at home is employed and a grant is received	526 (57.2%)	6 (54.6%)	111 (58.7%)	409 (56.8%)	0.26, 0.88
Maternal education interruption (school grade behind)	270 (57.5%)	2 (66.7%)	37 (75.5%)	231 (55.3%)	**7.46, 0.02**
Social support (highest score for all domains: MOSS)	812 (88.3%)	10 (90.9%)	158 (83.6%)	644 (89.4%)	5.01, 0.08
Exposure to community violence	123 (13.4%)	2 (18.2%)	25 (13.2%)	96 (13.3%)	0.22, 0.89
Any domestic violence or domestic arguments	70 (7.6%)	2 (18.2%)	16 (8.5%)	52 (7.2%)	2.09, 0.35
Mode of HIV infection (n=200)					0.02, 0.88
Vertical HIV infection	21 (10.5%)	1 (9.1%)	21 (10.6%)	n/a	
Horizontal (recent) HIV infection	179 (89.5%)	10 (90.9%)	169 (89.4%)	n/a	
Adherence to ART in the last week (n=200)	152 (76.4%)	4 (36.4%)	148 (78.7%)	n/a	**10.33, 0.001**

	Total sample (n=920)	HIV (n=11)	HEU (n=189)	HU (n=720)	X^2/*F*, *p*-value
Maternal characteristics					
Any common mental disorder*	113 (12.3%)	1 (9.1%)	33 (17.5%)	79 (11.0%)	5.95, 0.05
Child characteristics					
Age (Months; Mean [SD])	17.9 (14.2)	28.5 (13.2)[a]	21.6 (16.0)[a]	16.8 (13.5)	**12.2, <0.0001**
Biological sex (female)	442 (48.0%)	6 (54.6%)	89 (47.1%)	347 (48.2%)	0.26, 0.88

*Any common mental disorder- defined as scoring above the cut-off for at least one mental health measure (depressive, anxiety, posttraumatic stress, suicidality symptomology)|Tukey's HSD post hoc tests undertaken to identify mean differences between groups (for continuous variables only): [a] Statistically different from the HIV unexposed (HU) group (*p*=<0.05), [b] Statistically different from the HIV exposed uninfected (HEU) group (*p*=<0.05).

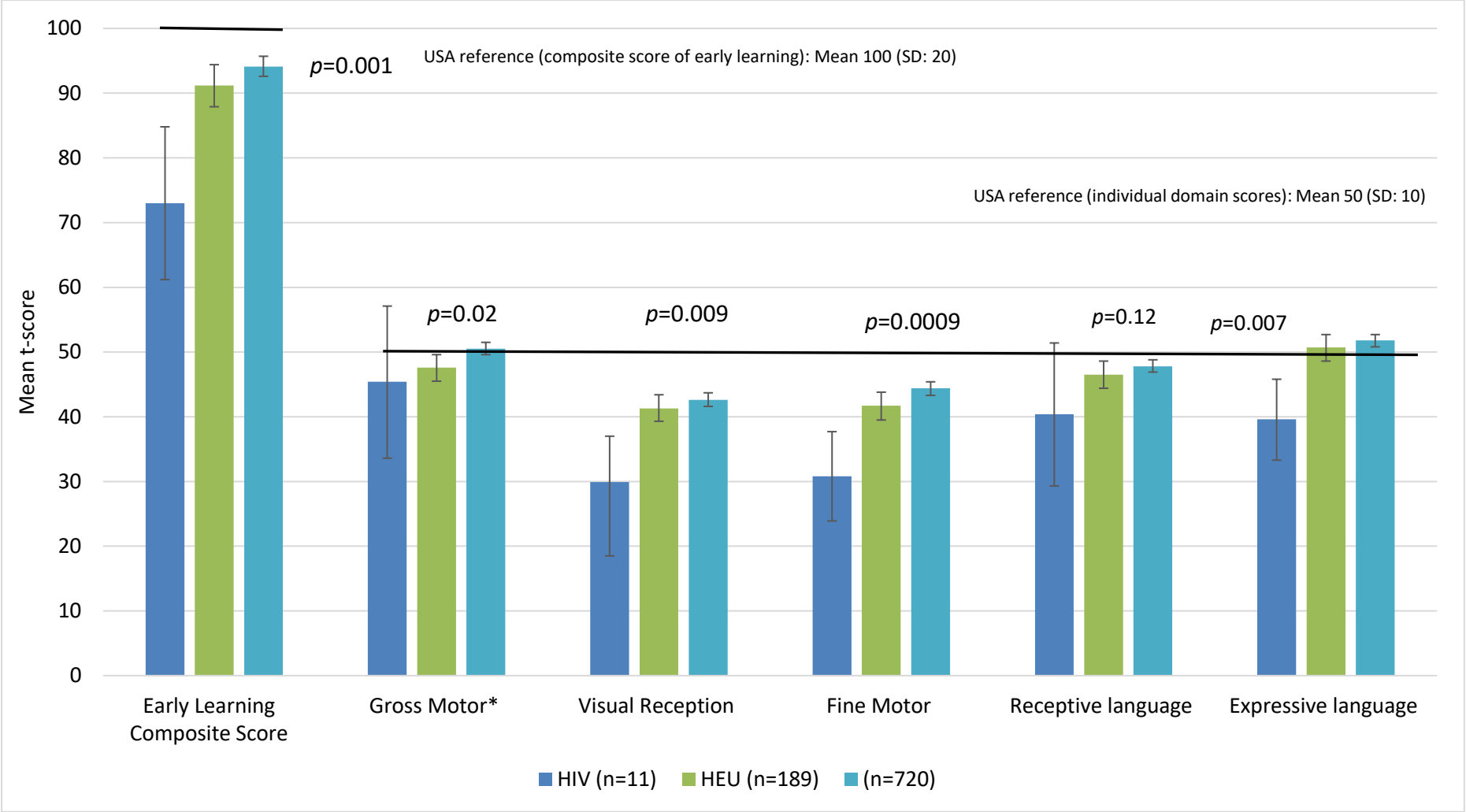
6.3.4.2 Cognitive development of children born to adolescent mothers

Table 6-17/**Figure 6-7** presents the cognitive develop scores of children according to child HIV status. The mean early years composite score for the sample was 93.2 (SD: 21.3), a score lower than expected compared to the USA reference population utilised within the development of the scale (93.2 vs. 100, t=9.67, p=<0.0001). Within crude analyses, average scores on all developmental domains (including the composite score, but exclusive of the language sub-domain) identified a stepwise pattern in which children classified as HU performed better than the children classified as HEU, who in turn performed better than the children classified as living with HIV. Further analyses with post hoc testing found no evidence of a difference between children who were living with HIV and HEU on the gross motor domain, and HEU children scored significantly (statistically) lower than HU children. Within the visual reception and fine motor domains, and within the overall composite score, children living with HIV had lower scores than both HEU and HU children. Within the expressive language domain children living with HIV had lower scores than HU children (see **Table 6-17**/**Figure 6-7**).

Table 6-17 Cognitive development of children born to adolescent mothers according to child HIV status (n=920)

Mullen Scales of Child Development (n=920; Mean [SD])	Total sample (n=920)	HIV (n=11)	HEU (n=189)	HU (n=720)	*F, p*-value
Early Learning Composite Score	93.2 (21.3)	73.0 (17.6)[a,b]	91.2 (22.7)	94.1 (20.8)	**6.45, 0.001**
Gross Motor*	49.9 (12.5)	45.4 (15.3)	47.6 (13.5)[a]	50.5 (12.2)	**3.91, 0.02**
Visual Reception	42.1 (14.3)	29.9 (10.6)[a,b]	41.3 (14.2)	42.6 (14.3)	**4.77, 0.009**
Fine Motor	43.7 (14.5)	30.8 (10.2)[a,b]	41.7 (15.1)	44.4 (14.3)	**7.09, 0.0009**
Receptive language	47.4 (13.5)	40.4 (16.4)	46.5 (14.8)	47.8 (13.0)	2.14, 0.12
Expressive language	51.5 (13.3)	39.6 (9.3)[a]	50.7 (14.2)	51.8 (13.0)	**4.94, 0.007**

*Gross motor n=831 (HIV=9, HEU=163, HU=659)| Individual domain scores range from 20-80 | Early Learning Composite Score ranges from 49-155 | Tukey's HSD post hoc tests undertaken to identify mean differences between groups: [a]Statistically different from the HU group (*p*=<0.05), [b]Statistically different from the HEU group (*p*=<0.05)



*Gross motor n=831 (HIV=9, HEU=163, HU=659) | Individual domain scores range from 20-80 | Early Learning Composite Score ranges from 49-155

Figure 6-7 Cognitive development scores of children born to adolescent mothers according to child HIV status (n=920)

6.3.4.3 Associations between child HIV status (living with HIV, HEU, HU) and child cognitive development

Table 6-18 presents linear regression models exploring the cross-sectional associations between child HIV status and composite scores of early learning. Within univariable analyses (model 1), a stepwise pattern was identified between child HIV status and the composite score for early learning i.e., children living with HIV were found to have lower scores than HU children (*p*=<0.0001) and a trend was identified for HEU children to have lower scores than HU children (*p*=0.10). A similar pattern was identified within multivariable analyses adjusting for demographic characteristics (model 2; children living with HIV [*B*=-14.9, 95% CI:-26.9, -2.95, *p*=0.02]). Model 3 presents potential characteristics mitigating the relationship between child HIV status and reduced child cognitive development scores. Within this multivariable model (model 3), maternal education interruption (being at least a school grade behind) was identified as a potential risk factor for reduced child cognitive development scores (*B*=-11.0 [95% CI:-14.9, -7.04], *p*=<0.0001), and older maternal age (at birth of child) was found to be a protective factor, associated with increased child cognitive development scores (*B*=1.79 [95% CI: 0.41, 3.17], *p*=0.01). Linear regression models exploring the cross-sectional associations between child HIV status and individual cognitive domain scales can be found in **Appendix 4**, **Table 9-13**.

Table 6-18 Linear regression models exploring the relationship between child HIV status and child cognitive development among children born to adolescent mothers (n=920)

	Early Learning Composite Score	
	***B* (95% CI)**	***p***
Model 1. (Univariable model)*		
HU (n=720)	1 (Ref.)	
HEU (n=189)	-2.84 (-6.24, 0.54)	0.10
HIV (n=11)	-21.1 (-33.7, -8.46)	**<0.001**
Child age (months)	-0.51 (-0.60,-0.42)	**<0.0001**
Child biological sex (female)	-1.30 (-4.06, 1.45)	0.35
Number of necessities mother can afford (0-8)	0.47 (-0.14, 1.09)	0.13
Maternal education interruption (school grade behind)	-8.87 (-12.59, -5.15)	**<0.0001**
Maternal age at birth of child (years)	0.75 (-0.18, 1.68)	0.12
Model 2. (Multivariable model adjusted for demographic characteristics) *		
HU (n=720)	1 (Ref.)	
HEU (n=189)	-0.28 (-3.55, 2.99)	0.87
HIV (n=11)	-14.9 (-26.9, -2.95)	**0.02**
Model 3. (Multivariable model adjusted for potential mitigating factors) *		
HU (n=720)	1 (Ref.)	

	Early Learning Composite Score	
	***B* (95% CI)**	***p***
HEU (n=189)	4.78 (-1.31, 10.9)	0.12
HIV (n=11)	-15.0 (-37.9, 7.85)	0.19
Maternal education interruption (school grade behind)	-11.0 (-14.9, -7.04)	**<0.0001**
Maternal age at birth of child (years)	1.79 (0.41, 3.17)	**0.01**

*Model 1. Univariable linear regression models | Model 2. Multivariable linear regression model. Covariates included within model 2: child age (months), child biological sex (female), number of necessities mother can afford (0-8) | Model 3. Exploratory multivariable linear regression model exploring possible mitigating factors for poor child cognitive development scores. Variables included in model 3: child HIV status, maternal education interruption, maternal age at birth of child (years)

6.3.5 Discussion

These analyses identify differences in child cognitive development scores according to child HIV status among children born to adolescent mothers in South Africa. The known HIV transmission rate from mother to child for the adolescents living with HIV was 5.5% (11/200). Crude analyses identify a stepwise pattern in relation to average child cognitive development scores according to child HIV status, with children living with HIV scoring lower than children who were classified as HEU, and children who were HEU scoring slightly lower than children who were classified as HU on the majority of child development domains. In multivariable analyses, children living with HIV disproportionately scored lower across domains of development explored compared to the HU children. Likewise, average scores for HEU children were lower than the HU group although this only reached statistical significance in relation to gross motor skills. Exploratory multivariable analyses identified maternal education interruption as a potential risk factor for lower child cognitive development scores and older maternal age (at the birth of their child) as a potential protective factor within this sample. This is the first known series of analyses exploring the association between child HIV status and child cognitive development outcomes for children born to adolescent mothers in South Africa. Findings from this study support previous research highlighting the role of HIV and maternal factors on the developmental trajectories of children born to adult mothers[479,480] and address a critical evidence gap regarding the cognitive profile of children born to adolescent mothers affected by HIV.

The crude HIV transmission rate from mother to child within this sample is seemingly above the South African national average (4.6%; n.b. confidence intervals are not available for this estimate)[481] and beyond global targets to eliminate mother to child transmission of HIV,[482] highlighting adolescent mothers as a specifically vulnerable and perhaps hidden and underserved group within the HIV response. The promotion of the prevention of vertical HIV transmission among adolescent mothers and adherence to ART would seemingly be beneficial to both adolescent mothers and their children, decreasing the number of children living with HIV within future

generations and thus having potential benefits for child development outcomes. However, tailoring of existing provision may be required to meet the specific needs of adolescent mothers. Previous research focusing on the retention of adolescents in HIV services within South Africa have identified numerous factors associated with retention and adherence (e.g., kind staff, cash to get to the clinic), such factors may also prove valuable in the retention of adolescents in PMTCT care.[122] Overall, children born to adolescent mothers within the sample were found to have lower scores on cognitive development tasks compared to the USA reference group from which the Mullen Scales of Early Learning were developed,[185] and children born to adult mothers within the sub-Saharan Africa region. As such, these findings highlight the potential risks of adolescent pregnancy for the cognitive development of children born to adolescent mothers. These analyses support previous studies, highlighting differences in cognitive performance among children affected by HIV– living with HIV, HEU and HU – born to adult mothers.[211] Children living with HIV seemingly scored lower on cognitive development tasks compared to children classified as HEU and HU. As such, those children living with HIV are potentially most at risk for cognitive delay and, programmatic responses known to encourage positive development outcomes within similar settings may be of benefit (e.g., book sharing).[477] However, tailoring to the specific needs of children born to adolescent mothers may be required. While it is encouraging that the difference in child development scores of children among children classified as HEU and HU was smaller than the difference between children living with HIV and those classified as HU, given the efforts to eliminate mother to child transmission of HIV, there are a growing number of children who are classified as HEU. As such, the promotion of cognitive development among this group should remain an ongoing consideration to promote potential within future generations, and it should be studied whether an early lack of developmental differences, as found in the current study, is retained as children grow older.

Exploratory analyses focusing on potential mitigating factors within the relationship between child HIV status and child cognitive development scores, highlighted maternal education interruption as being a potential risk factor for child cognitive development and older maternal age (at birth) as a potential protective factor for

child cognitive development among children born to adolescent affected by HIV. Given the cross-sectional nature of these analyses, we are unable to ascertain whether education interruption preceded the pregnancy, and thus may have been a contributing factor to pregnancy, or if the interruption to education was a result of the pregnancy during adolescence. Similarly, circumstances such as child developmental delay, which may require additional care from the mother, may result in mothers not returning to school following the birth of their child. Nevertheless, the promotion of education continuity and school reenrolment following birth may be of benefit to both adolescent mother and their child. Whilst the South African Department of Education supports the continued education of pregnant girls and young mothers, at least a quarter of adolescents might discontinue school during the pregnancy[461] and a large proportion of young mothers does not manage to return to school postpartum.[147,458-460,483] Yet, there remains a clear lack of evidence-based programmes that successfully address adolescent mothers' hurdles to return to school, for example through financial and childcare provisions.[136,461]

Within global literature, younger maternal age has previously been found to be associated with poorer development outcomes for children as well as harsher parenting practices and, less parental knowledge of child development,[164-166,484] which may have implications for child development attainment. These data suggest that children born to younger adolescent mothers may be at risk for lower cognitive outcomes and may require additional support. Such findings highlight the complexity of child cognitive development within this setting and the potential role of a broad range of factors within child development outcomes as both age of pregnancy and maternal education have been found to be associated with numerous factors such as poverty, stigma, and violence exposure.[144,485,486]

These data indicate that interventions should focus on several core factors. Firstly, continued efforts regarding the prevention of vertical HIV transmission including ensuring good treatment adherence for adolescent mothers during pregnancy and the postpartum period. Such efforts would support global targets to eliminate mother to child transmission of HIV. Secondly, bolstering child cognitive development

with existing interventions known to enhance development (e.g., early childhood stimulation and parenting interventions) may aid long term outcomes for children born to adolescent mothers affected by HIV. Thirdly, supporting adolescent mothers showing poor school performance might contribute to the positive cognitive development of their children. In addition to an enabling policy-environment, additional efforts that facilitate adolescents continued school enrolment during pregnancy and their timely return to school after birth are needed to reinforce adolescent mother educational attainment. However, the bidirectional relationship between school dropout and adolescent pregnancy may require further research to understand the complexity of this relationship and its impact on child cognitive developments. Nevertheless, supporting school return following pregnancy for adolescent mothers would aid in bolstering adolescent mother educational attainment. Finally, sexual, and reproductive health interventions focusing on contraception and risk management may aid in assisting adolescents to delay pregnancy until they are older. Despite this, to ensure the prosperous development of future generations, the needs of pregnant and parenting adolescents should be linked to adolescent pregnancy prevention efforts.

6.3.5.1 Limitations of the analyses

Findings should be interpreted within the context of some limitations. First, data presented are mostly self-report, including the assignment of groups relating to child HIV status. However, where possible, child medical records were utilised to confirm child HIV status. Second, the child development scales utilised within analyses (Mullen Scales of Early Learning) were developed using a reference population within the USA which may limit the cultural validity of the assessments. However, these measures have previously been used extensively within sub-Saharan Africa[201] and have deemed to be effective within independent assessment of child cognitive development as well as preferable over caregiver reporting. Third, the multivariable analyses undertaken as part of this study were exploratory and only include a small sample of children living with HIV. These analyses likely only present a segment of the complex mosaic of factors influencing the relationship between child HIV status and child cognitive development among children born to adolescent mothers in

South Africa. For instance, while main caregiver characteristics were presented to place this research in context. The role of other caregivers within the development of children was not explored within the current study. Future research is required to wholly understand the complexity of the lives of adolescent mothers and their children and the impact different exposures on child cognitive development. Likewise, it was beyond the scope of this study to explore child cognitive development according to mode of maternal HIV infection. For context, mode of maternal HIV infection was ascertained from a derived variable and included within descriptive analyses. However, further research is required to wholly understand the multigenerational effects of HIV on child cognitive development. Furthermore, while it is encouraging to identify only a small sample of children living with HIV within the sample, the small sample size within this group limited the statistical analyses that could be undertaken as part of this study and may have diluted the effect of HIV status on cognitive development. Nevertheless, these analyses provide an initial step in addressing a critical void within the literature relating to the development of children born to adolescent mothers within the context of HIV in sub-Saharan Africa. Given this, these analyses provide a platform for future investigations into the experience of children born to adolescent mothers affected by HIV. Future studies would benefit from longitudinal analyses of groups with a more equal distribution of HIV status to gain further clarity regarding the factors influencing the cognitive development of children born to adolescent mothers affected by HIV as well as further analyses of the impact of HIV on development beyond the early developmental period and, comparisons with adult mother-child dyads in the region. The strengths and limitations of these data and analyses are discussed further in sections **3.1.5** and **8.3** of this thesis.

6.3.5.2 Section summary & conclusions

These exploratory findings address a substantive evidence gap regarding the cognitive development of children born to adolescent mothers affected by HIV in South Africa and provide a foundation for future research regarding the children of adolescent mothers affected by HIV in sub-Saharan Africa. Child cognitive development scores were found to differ according to child HIV status. Compared to

children who were classified as HU, children who were classified as HEU were found to perform worse on cognitive tasks and, children living with HIV were found to perform worse overall. Existing interventions to bolster child cognitive development may be beneficial however, adaptation for the specific needs of adolescent mothers and their children may be required. Attention to maternal continuity of education and delayed conception may be additional interventions to consider. Targeted interventions particularly among younger adolescent mothers and those with lower educational attainment may identify those families who may be most in need.

6.4 Chapter summary

There is an absence of existing literature focusing on the mental health of adolescents experiencing pregnancy and parenthood affected by HIV in sub-Saharan Africa (see **Chapter 2**), there is likewise an absence of evidence on the broader context and issues relating to adolescent pregnancy, adolescent parenting, mental health, and HIV (e.g., impacts for children born to adolescent mothers) within the sub-Saharan African region. There is a strong body of evidence highlighting the impact of adolescent pregnancy and HIV on child development.[111,169,170,211,451,471-475278,279] Based on these notions, this chapter presents a series of exploratory analyses exploring the cognitive development of children born to adolescent mothers in South Africa.

In line with existing evidence in the field highlighting cognitive difficulties among children born to adolescent mothers, the cognitive development scores of children born to adolescent mothers in the ***HEY BABY study*** sample were overall found to be lower than the reference population (USA derived), and children born to adult mothers within sub-Saharan Africa (obtained from previous studies in the region). Findings seemingly identify a relationship between increased child age and lower child cognitive development scores - identifying a core developmental period that may be amenable to intervention.

As previously identified in **Chapter 4** and **Chapter 5**, prevalence of likely common mental disorder was found to be elevated among adolescent mothers living with HIV compared to adolescent mothers not living with HIV. Analyses identified a lack of an association between likely common mental disorder (including interactions with maternal HIV status) and child cognitive development scores. However, sensitivity analyses identified a relationship between maternal posttraumatic stress symptomology scores and worse child development scores. Greater maternal educational attainment was also identified as a potential protective factor for child cognitive development in the sample.

While limited differences in child cognitive development scores according to maternal HIV status were identified in the sample, child cognitive development scores were found to differ according to child HIV status. Compared to children who were classified as HU, children who were classified as HEU were found to perform worse on cognitive tasks and, children living with HIV were found to perform worse overall.

These findings provide an initial exploration of the development of children born to adolescent mothers in the context of HIV and maternal mental health in South Africa and highlight specific considerations for the cognitive development of children which may require policy and intervention to enhance outcomes. Such considerations including a potential core period of development, addressing maternal trauma and school return, and child exposure to HIV inclusive of living with HIV and being HIV exposed. Findings highlight specific avenues of enquiry for future research and introduce such considerations to the literature.

Chapter 7 Adolescent paternal mental health & the fathers of children born to adolescent mothers within the context of HIV in South Africa

Given the implications of pregnancy for female adolescents, adolescent mothers dominate the existing literature focusing on pregnancy and parenthood during adolescence. While in there is a growing interest in fatherhood within the field of global health, adolescent fathers and the fathers of children born to adolescent mothers (including those living with HIV) are often side-lined from research and policy agendas, particularly within low- and middle-income countries. Given the critical role of fathers during conception, pregnancy, parenting and across the life course of their children, such an absence of literature is a disservice. An understanding of fathers, their experience, and engagement with mothers and their children within the context of adolescent pregnancy and HIV has possible far-reaching consequences for policy and programming. See section **1.8** for a summary of the core issues surrounding fatherhood to set the scene for the works in this thesis

As detailed in section **1.8**, there is an absence of existing literature exploring adolescent fatherhood and the fathers of children born to adolescent mothers in the context of HIV. As a result, there is a complete absence of literature (at the time of writing this thesis) exploring the mental health of adolescent fathers within the context of HIV sub-Saharan Africa (see **Chapter 2**).

Utilising cross-sectional data from both the ***Adolescent HIV study*** and the ***HEY BABY study,*** the analyses within this chapter aim to build a narrative of fatherhood within the context of adolescent pregnancy/parenthood and HIV in South Africa. This chapter is divided into two sections. The first section utilises data from the ***Adolescent HIV study*** to explore the prevalence of adolescent fatherhood and, mental health according to fatherhood status. The second section utilises data (obtained from adolescent mother reporting) from the ***HEY BABY study***, to build an understanding of who the fathers of children born to adolescent mothers are, their

involvement in pregnancy and child rearing, and whether the characteristics of fathers differ according to maternal HIV or maternal mental health status. Analyses examine whether maternal and child characteristics differ according to paternal age or paternal involvement, and whether father characteristics differ according to key maternal characteristics including, maternal HIV and maternal mental health.

The works undertaken in the development of this chapter have resulted in the following presentations and invited talks:

Steventon Roberts, K.J. 2022: Men Matter Webinar hosted by the International AIDS Society. Invited talk (Keynote): Sizing up male involvement – Does it matter? May.

Roberts, K.J. 2021: International Symposium on Health Development of Vulnerable Populations. Invited talk: Mental health, adolescent parenthood, and HIV in South Africa. Remote, September.

Roberts, K.J. 2021: HIV and Adolescence Workshop: Paper: Adolescent parenting in the presence of HIV – insights into mental health and child development in South Africa. Remote, September (Poster presentation).

Roberts, K.J. 2020: The COVID-19 experience- a lens to inform the frontline webinar hosted by the Accelerate Hub: Paper: Adolescent fatherhood -Insights from existing data and potential impacts of COVID-19. Remote, December.

These works have also resulted in the in the below manuscript being prepared for peer-review publication:

Steventon Roberts, K.J. et al. Who are the fathers of children born to adolescent mothers in South Africa? In preparation.

7.1 Section 1: Adolescent fatherhood and paternal mental health in South Africa

7.1.1 Background

Adolescent mothers and their children only represent a partial view of the concept of adolescent parenthood. The mental health of adolescent fathers remains an unaddressed policy and global health issue. The mental health and wellbeing of adolescent fathers may have implications for their involvement, child outcomes, and broader familial outcomes. Like adolescent mothers, adolescent fathers may be particularly at risk for poor mental health, as adolescent fathers too navigate the challenges of the adolescent developmental period, alongside parenting. Within sub-Saharan Africa, such challenges may be exacerbated as adolescent fathers may be exposed to environmental factors such as poverty, communicable disease, and violence.[487,488] Existing explorations of mental health among fathers (often from the Global North) largely focus on paternal depression within little focus on other mental health conditions. Within existing studies (again largely from the Global North), paternal depression has been found to have detrimental impacts for children, impacting on development outcomes and leading to poor parent-child interactions. It has also been suggested that paternal depression may be a risk factor for poor mental health among children.

This section provides the first exploration of likely common mental disorder (expanding beyond explorations of paternal depression) among adolescent fathers (affected by HIV) in South Africa.

7.1.2 Aim and objectives

The analyses in this section aim to explore the mental health of adolescent fathers in a South African setting. Specific objectives are to:

Objective 1: Examine sample characteristics according to adolescent fatherhood status

Objective 2: Explore mental health symptoms according to adolescent fatherhood status

Objective 3: Explore mental health symptoms according to HIV status and number of children among adolescent fathers

7.1.3 Methods

7.1.3.1 Participants and procedure

These analyses included cross-sectional data for 566 male adolescents drawn from the ***Adolescent HIV study*** (n=1526; see section **0** for detail regarding participants and procedure). Only data for male adolescents <20 years of age were included within these analyses.

7.1.3.2 Measures

These analyses utilise cross-sectional data from a range of self-report questionnaires.

Sociodemographic characteristics were routinely gathered, including age (years), dwelling location (urban vs. rural), housing (informal vs. formal) via participant self-report.

Adolescent fatherhood status was obtained from a single binary item in which male adolescents (10-19 years) were asked if they had ever made somebody pregnant (yes/no). Fathers were also asked how many children they had fathered. All male adolescents who self-identified as having made somebody pregnant (regardless of the outcome of the pregnancy) were categorised as adolescent fathers for the purpose of analyses.

HIV status was ascertained through clinical notes and corroborated by participant or caregiver self-report on a case-by-case basis.

Mental health status. For a detailed overview of the mental health symptomology measures utilised within analyses see section **3.4**. All participants within the current

sample responded to all items of the four validated mental health symptomology measures used within these analyses. Cut-off scores were utilised to ascertain prevalence estimates for likely common mental disorder, mental health comorbidities, depression symptoms, anxiety symptoms, posttraumatic stress symptoms, and suicidality symptoms. Individual symptom scores are also presented. Participants were classified as experiencing likely **common mental disorder** [386] if they scored above the cut-off on any of the four mental health symptomology measures utilised within the study (depression, anxiety, posttraumatic stress, suicidality). Participants were classified as experiencing any likely **mental health comorbidities (MHCs)** if a participant scored above the cut-off on two or more of the mental health measures within the study.

7.1.3.3 Statistical analyses

Chi-square tests and st-test (Fisher's exact/Kruskal Wallis tests, where appropriate) were used to explore sample characteristics (including mental health symptoms) according to fatherhood status. Among adolescent fathers, Fisher's exact tests were used to explore mental health symptoms according to adolescent father's HIV status. Likewise, Fisher's exact tests and t-tests were used to explore mental health symptoms according to the number of children reported by adolescent fathers. Given the small number of fathers in the ***Adolescent HIV study*** sample, only univariable analyses is presented in this section.

7.1.4 Results

7.1.4.1 Sociodemographic characteristics

The median age of male adolescents in the sample was 15 years (IQR: 14-17 years). Most (77.0%) of the sample lived in an urban area. The majority of the sample lived in a formal housing structure (90.1%), and almost three quarters of the sample were living with HIV (72.7%). Of those in the sample living with HIV (n=411), the majority were living with vertically acquired HIV (88.5%).

7.1.4.2 Adolescent fatherhood

In total, 1.4% (n=8) of adolescent males in the sample were classified as experiencing fatherhood. Compared to non-fathers, adolescent fathers in the sample were on average older (19 years vs. 15 years, *t*=12.66, *p*=0.0004), and less likely to be living with HIV (37.5% vs. 73.1%, X^2=5.03, *p*=0.04; see **Table 7-1)**. Among adolescent fathers, the majority had one child (7/8), and one father had no children, possibly indicating that the mother of their child was still pregnant, had experienced pregnancy loss, or infant mortality. One father reported having more than one child.

Table 7-1 Sample characteristics according to adolescent fatherhood status (n=566)

	N (%)/M (IQR)/t (SD)			X^2/t, *p*-value
	Total sample (n=566)	**Fathers (n=8)**	**Non-fathers (n=558)**	
Sociodemographic characteristics				
Age (years)	15 (14-17)	19 (18-19)	15 (14-17)	**12.66, 0.0004**
Dwelling location				0.02, 1.00
Urban	436 (77.0%)	6 (75.0%)	430 (77.1%)	
Rural	130 (23.0%)	2 (25.0%)	128 (22.9%)	
Housing				0.06, 0.57
Formal structure	508 (90.1%)	7 (87.5%)	501 (90.1%)	
Informal (shack)	56 (9.9%)	1 (12.5%)	55 (9.9%)	
HIV Status				**5.03, 0.04**
Living with HIV	411 (72.6%)	3 (37.5%)	408 (73.1%)	
Not living with HIV	155 (27.4%)	5 (62.5%)	150 (26.9%)	
Mode of HIV infection*				1.42, 0.31
Horizontal transmission	47 (11.5%)	1 (33.3%)	46 (11.3%)	
Vertical transmission	363 (88.5%)	2 (66.7%)	361 (88.7%)	
Total number of children				-
0		1 (12.5%)		
1		7 (87.5%)		
Mental health symptoms				
Any common mental disorder				0.23, 0.49

	N (%)/M (IQR)/t (SD)			X^2/t, *p*-value
	Total sample (n=566)	**Fathers (n=8)**	**Non-fathers (n=558)**	
Yes	45 (8.0%)	1 (12.5%)	44 (7.9%)	
No	521 (92.1%)	7 (87.5%)	514 (92.1%)	
Any mental health comorbidities				**34.01, 0.03**
Yes	2 (0.3%)	1 (12.5%)	1 (0.2%)	
No	564 (99.7%)	7 (87.5%)	556 (99.8%)	
Depressive symptoms				0.98, 0.34
Yes	28 (5.0%)	1 (12.5%)	27 (4.8%)	
No	538 (95.0%)	7 (87.5%)	531 (95.2%)	
Score (0-10)	0.56 (1.12)	0.88 (2.10)	0.56 (1.11)	-0.79, 0.43
Anxiety symptoms				0.01, 1.00
Yes	1 (0.2%)	0 (0.0%)	1 (0.2%)	
No	564 (99.8%)	8 (100.0%)	556 (99.8%)	
Score (0-14)	0.58 (1.46)	0.63 (1.77)	0.58 (1.46)	-0.05, 0.96
Posttraumatic stress symptoms				0.18, 1.00
Yes	12 (2.12%)	0 (0.0%)	12 (2.1%)	
No	554 (97.9%)	8 (100.0%)	546 (97.9%)	
Score (0-19)	1.43 (3.15)	1.25 (3.15)	1.43 (3.78)	0.14, 0.89
Suicidality symptoms				7.15, 0.11
Yes	8 (1.4%)	1 (12.5%)	7 (1.3%)	
No	558 (98.6%)	7 (87.5%)	551 (98.7%)	
Score (0-5)	0.04 (0.37)	0.13 (0.35)	0.04 (0.37)	-0.67, 0.50

*Available data: Mode of HIV infection (n=410) | Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Mental health comorbidities (experiencing two or more common mental disorders concurrently) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

7.1.4.3 Mental health symptoms according to adolescent fatherhood status

In the total sample of adolescent males, prevalence of any likely common mental disorder was 8.0% (95% CI: 6.0%-10.5%), and prevalence of likely mental health comorbidities was low (0.3%). Prevalence of depressive symptoms was 5.0%, anxiety

symptoms was 0.2%, posttraumatic stress symptoms was 2.1%, and suicidality symptoms was 1.4%. Compared to male adolescents not experiencing fatherhood, adolescent fathers were more likely to report mental health comorbidities (scoring above the cut-off on two or more measures of mental health symptomology: 12.5% vs. 0.2%; X^2=34.01, *p*=0.03), although it must be noted that this is one person in the fathers group. A trend for adolescent fathers reporting a greater prevalence of suicidality symptoms compared to non-fathers was also identified (12.5% vs. 1.3%; X^2=7.15, *p*=0.11). Prevalence of depressive, anxiety, and posttraumatic stress symptomology, as well as overall prevalence of common mental disorder (scoring above the cut-off on one or more measure of mental health symptomology) were found to be similar among adolescent fathers and non-fathers (see **Table 7-1**).

7.1.4.4 Mental health symptoms by HIV status among adolescent fathers (n=8)

To further explore mental health symptoms among adolescent fathers in the sample mental health symptoms were examined according to adolescent father HIV status. Only one adolescent father reported any likely common mental disorder. This father was living with HIV. This father also reported likely mental health comorbidities, likely driven by depressive and suicidality symptoms (see **Table 7-2**).

Table 7-2 Mental health symptoms by HIV status among adolescent fathers (n=8)

Mental health symptoms	Adolescent father HIV status N (%)	
	Living with HIV (n=3)	Not living with HIV (n=5)
Any common mental disorder	1 (33.3%)	0 (0.0%)
Any mental health comorbidities	1 (33.3%)	0 (0.0%)
Any depressive symptoms	1 (33.3%)	0 (0.0%)
Depressive symptoms score (0-10)	2 (3.46)	0.20 (0.44)
Any anxiety symptoms	0 (0.0%)	0 (0.0%)
Anxiety symptoms score (0-14)	1.67 (2.89)	0 (0.0)
Any posttraumatic stress symptoms	0 (0.0%)	0 (0.0%)
Posttraumatic stress symptoms score (0-19)	3.33 (4.93)	0 (0.0)

Any suicidality symptoms	1 (33.3%)	0 (0.0%)
Suicidality symptoms score (0-5)	0.33 (0.57)	0 (0.0)

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Mental health comorbidities (experiencing two or more common mental disorders concurrently) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4**.

7.1.5 Discussion

These exploratory analyses provide the first examination of sample characteristics and mental health symptomology among adolescent males according to fatherhood status in the context of HIV in South Africa. Analyses provide a descriptive summary of mental health symptomology according to adolescent fatherhood status. 1.4% of adolescent males in the sample reported fatherhood. Despite the small number of fathers, mental health comorbidities were seemingly elevated among fathers in the sample compared to non-fathers in the sample. Among adolescent fathers, the father living with HIV was more likely to report poor mental health symptoms compared to adolescent fathers not living with HIV. These results highlight the ongoing need for an understanding of mental health within the context of adolescent fatherhood in South Africa. Further research is required to understand mental health symptoms among fathers and/or males within the experience of adolescent pregnancy and HIV.

The small prevalence of adolescent fathers in the sample is in sharp contrast to the prevalence of adolescent mothers in the same sample (1.4% vs. 15.2%, respectively – see section **4.3.1**). This may be due to the use of self-report data within the study and a reluctance to admit paternity, a lack of knowledge of the pregnancy or, suggests that the fathers of the children of adolescent mothers in the sample may be older. Given this, the prevalence of adolescent fathers in the sample may be underestimated. The experience of pregnancy during adolescents is not confined to females. Yet, adolescent males are often excluded from research, policy and programming efforts, and adolescent fathers living with HIV remain completely out of focus. Despite the relative rarity of adolescent fatherhood identified within this sample, it nonetheless remains an important issue which requires attention.

Currently, there is an alarming absence of knowledge relating to the mental health experiences of adolescent fathers (particularly within the context of HIV). Poor mental health has been linked to the experience of living with HIV among adolescents.[124,127] Adolescent fathers living with HIV, may have additional specific mental health needs as they are navigating adolescent development, pregnancy, parenting, and the challenges of living with HIV. There is an imperative need to support the mental health of adolescent parent families within the context of HIV. Yet, to do this effectively an evidence base is required. Future research directives would be well placed to explore existing databases to identify prevalence of mental health symptoms (e.g., establish mental health need) among adolescent fathers in the context of HIV. Likewise, both quantitative, and qualitative explorations are required to further understand the mental health needs of adolescents, risk and protective factors for mental health among this group, the impacts of paternal mental health (including positive mental health) for the individual, young mothers, and their children. Investigations into effective mental health provision are also required inclusive of interventions tailored to the specific needs of adolescent fathers, and existing successful models of provision for fathers, adolescents, adolescents living with HIV, or families.

Mental health screening remains a priority for this group. However, screening requires the engagement of adolescent fathers within provision. Possible avenues of engagement include efforts of service providers to extend beyond adolescent mothers (e.g., identifying who the fathers of children born to adolescent mothers are though antenatal care).

7.1.5.1 Limitations of the analyses

Several limitations should be considered within the interpretation of the results presented in this section. First, only data for a small sample of adolescent fathers (n=8) was available for analyses, and therefore the analyses provided are highly likely to be dramatically underpowered and should be interpreted with caution. Second, these analyses are exploratory therefore only provide preliminary insights into adolescent fatherhood and mental health symptomology. As such, only a limited

number of variables were available to explore mental health symptomology among adolescent fathers in the sample. Factors which may mediate or moderate any identified differences between groups have also not been included within analyses. Nor have factors specifically relating to the experience of fatherhood (i.e., pregnancy outcome, father involvement status, fathers' relationship with the mother of their child). As such, these analyses only present a partial exploration of mental health symptomology among adolescent fathers. Third, most of the sample utilised within these analyses were under 19 years of age. Some of these adolescents may still go on to father a child before 20 years of age. Consequently, these analyses only provide a snapshot relating the prevalence adolescent fatherhood at the time of data collection. Finally, these analyses focus on a biological definition of fatherhood (having made somebody pregnant), and do not explore the social concept of fatherhood, such as male partner involvement.[238] However, despite these limitations these findings provide insight into a wholly neglected topic (the mental health status of adolescent fathers in the context of HIV in South Africa; see **Chapter 2**) and provide a foundation for future research within the field. See sections **3.1.5** and **8.3** for further detail on the strengths and limitations of this data and the analyses undertaken in this chapter.

7.1.5.2 Section summary & conclusions

While adolescent mothers and their children within the context of HIV remain neglected in the current literature relating to mental health symptomology, adolescent fathers remain absent. The analyses presented in this section provides an initial exploration to begin to address this critical evidence gap. Among a sample of male adolescents, 1.4% were classified as experiencing fatherhood. Mental health comorbidities were seemingly elevated among fathers in the sample compared to non-fathers in the sample. Living with HIV may exacerbate poor mental health symptomology, however additional research is required to understand this relationship further. Findings provide an early exploration of the concepts of mental health, adolescent fatherhood, and HIV in South Africa. However, there remains an ongoing need to explore mental health symptoms among adolescent fathers within

the context of HIV in South Africa to adequately inform policy, programming, and future research efforts.

7.2 Section 2: Men matter: The forgotten fathers of children born to adolescent mothers in South Africa

7.2.1 Background

Section 1 (section **7.1**) of this chapter utilised existing data drawn from a sample of male adolescents to explore fatherhood and mental health status. In addition to self-report, an alternative methodology for exploring the topic of fatherhood in the context of adolescent pregnancy and HIV in sub-Saharan Africa would be to use data from adolescent maternal report. This section utilises data drawn from adolescent mothers' report (relating to the father of their first-born child) from the ***HEY BABY study*** to explore maternal and child characteristics according to key characteristics of fathers (i.e., age and involvement), and explores paternal characteristics according to key maternal characteristics (i.e., HIV status and maternal mental health status).

7.2.2 Aim and objectives

The analyses in this section aim to explore characteristics of the fathers of children born to adolescent mothers and their roles within the lives of adolescent mothers and their children. Specific objectives were to:

Objective 1: Examine whether maternal or child characteristics differ according to paternal age (i.e., adolescent father vs. non-adolescent father)

Objective 2: Examine whether maternal or child characteristics differ according to paternal involvement (i.e., involved vs. non-involved)

Objective 3: Explore whether father characteristics differ according to maternal HIV status

Objective 4: Explore whether father characteristics differ according to maternal mental health status

7.2.3 Methods

7.2.3.1 Participants and procedure

This study included data for 894 fathers obtained from adolescent mother report. Cross-sectional data utilised within these analyses is drawn from the ***HEY BABY study*** (see section **3.1.3** for detail regarding participants and procedure). Participants were excluded from analyses if young mothers had given birth aged 20 years and above (n=44), if children were above 68 months of age (in keeping with the validated age range of the Mullen Scales of Early Learning;[185] n=30), if the fathers were unknown to the mother (hence no fatherhood reported data), or if the father's age was unknown (n=78). Second and third born children were excluded from analyses relating to child cognitive development. In total, n=894 adolescent mother child-dyads were included within analyses.

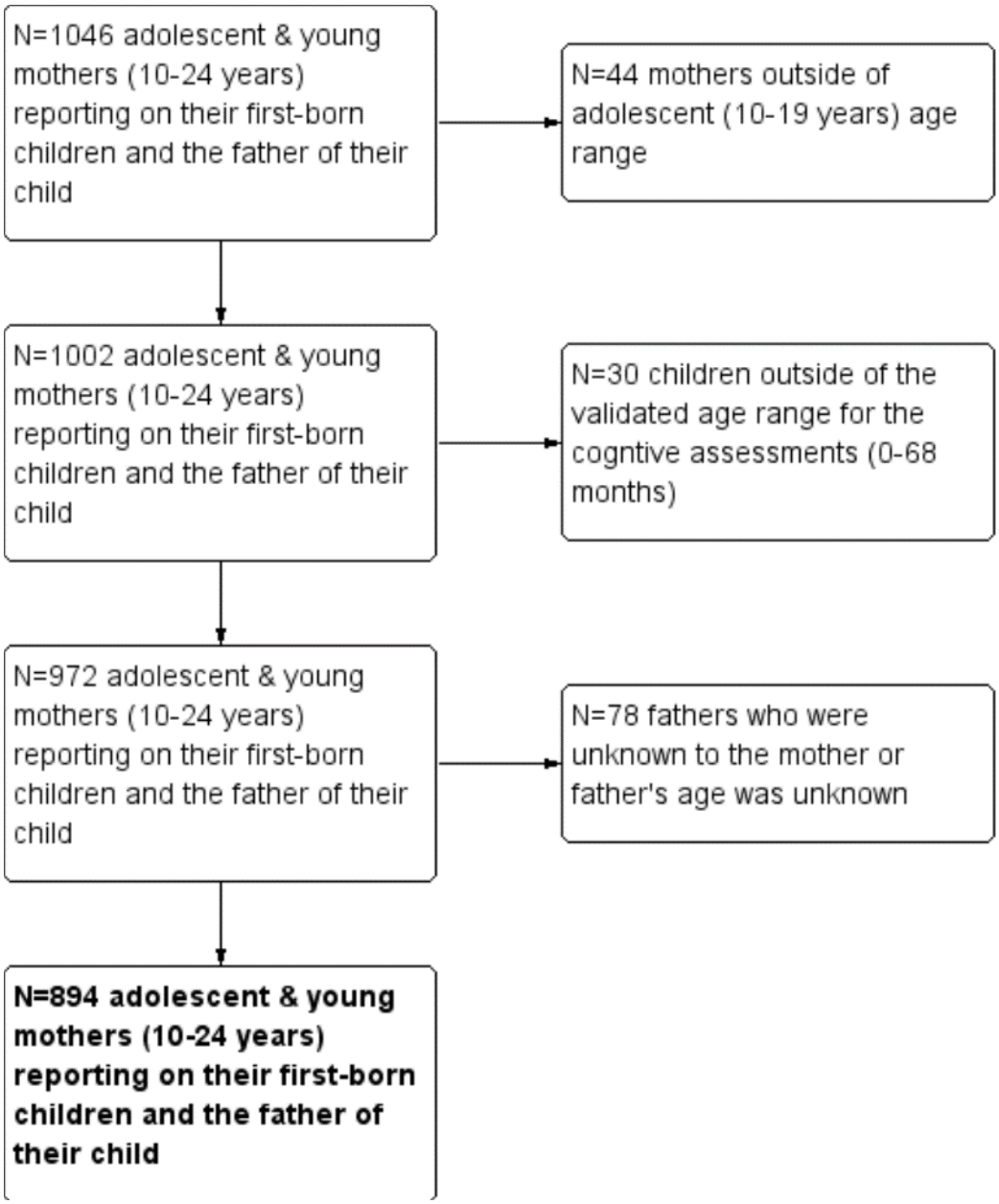


Figure 7-1 Participant selection for analyses exploring the fathers of children born to adolescent mothers

7.2.3.2 Measures

Data were obtained from a range of self-report and standardised assessments.

Fathers of children born to adolescent mothers

All data relating to the fathers of children born to adolescent mothers were obtained from maternal report including paternal age (years), paternal HIV status, residential

status, whether the father was the main caregiver of the child, domestic violence perpetration towards the mother (adolescent mothers were asked if they had experienced domestic violence perpetrated by the father of their child during their pregnancy), paternal reaction to pregnancy, and attendance at first antenatal appointment. Within these analyses, adolescent fatherhood refers to fathers 10-19 years of age.

A measure of paternal engagement was generated. This was calculated from responses to four questions posed to adolescent mothers relating to **father involvement** in childcare; whether the fathers *help look after the child*, *buys things for the child*, *helps with washing and food preparation* and, *spends time with the child* at least once every 2 weeks. These four questions were combined into a composite measure indicating father involvement (scored 0-4) with higher scores representative of involvement in more activities. This composite measure was also split into a binary measure of any involvement (scoring on at least one of the four above measures) and no involvement (not scoring on any of the above four measures).

Adolescent mothers

Maternal sociodemographic characteristics were obtained via participant self-report. Maternal sociodemographic characteristics include age (years), whether the mother has more than one child, whether the mother was in a relationship with the father of their (first/oldest) child (some/all of the time), and caregiver status. Additional characteristics include maternal age at birth (years; self-report corroborated with child dates of birth from child medical records on a case-by-case basis), maternal HIV status (obtained through self-report and corroborated with clinical notes on a case-by-case basis).

Maternal mental health was assessed utilising four validated mental health screening scales (see below). All mothers in the sample responded to all four screening measures. Cut-off scores were utilised to indicate experience of poor mental health across each measure. For a detailed overview of the mental health

symptomology measures utilised within analyses see section **3.4**. Participants were classified as experiencing any likely **common mental disorder (CMD)** if a participant scored above the cut-off on any of the mental health measures explored within the study (depressive symptoms [Child Depression Inventory Short Form ≥3/10 items[342,343]], anxiety symptoms [Revised Children's Manifest Anxiety Scale ≥10/14 items[360,361]], posttraumatic stress symptoms [Child PTSD checklist-12 items over four domains of posttraumatic stress disorder , scoring ≥1 on each of the four domains of the scale: re-experience, voidance, hyperarousal and dysphoria[54,344,363]], and suicidality [any; Mini International Psychiatric Interview for Children and Adolescents ≥1/5 items[365]]). Participants were classified as experiencing any likely **mental health comorbidities (MHCs)** if a participant scored above the cut-off on two or more of the mental health measures within the study (see above).

Children born to adolescent mothers

Child sociodemographic characteristics including age (months), and biological sex were routinely collected from adolescent mother/caregiver report and corroborated with child medical records on a case-by-case basis. **Child cognitive development** was assessed utilising the Mullen Scales of Early Learning,[185] administered by a trained interviewer. Children were scored on numerous assessments relating to five developmental domains (gross motor skills, fine motor skills, visual reception, expressive language, and receptive language). The Mullen Scales of Early Learning have been found to have good psychometric properties and have been utilised extensively across sub-Saharan Africa and within South Africa.[201] See section **6.1.2.2** for an overview of the Mullen Scales of Early Learning.

7.2.3.3 Statistical analyses

Chi-square tests and t-tests (Fisher's exact/Kruskal Wallis tests, where appropriate) were used to explore sample characteristics according to paternal age, father involvement, maternal HIV status and maternal mental health status. For illustrative purposes, father characteristics were also explored according to combined maternal

mental health and HIV status (see **Appendix 5, Table 9-14**)**.** Due to multiple testing, these analyses were not included within the core results of this section.

7.2.4 Results

7.2.4.1 Sociodemographic characteristics

The median age of adolescent mothers at the birth of their first child was 17 years (IQR: 16-18 years). A quarter (25.4%; 227/894) of the adolescent mothers in the sample were living with HIV. A small proportion (6.9%) of adolescent mothers had given birth to more than one child, and 85.5% of mothers reported that they were the main caregiver of their child(ren). The median age of fathers of children born to adolescent mothers at the time of the child's birth was 20 years (IQR:18-23 years [Range: 13-40 years]). Over half of adolescent mothers did not know the HIV status of the father of their child (53.5%; 478/894), and over half were in a relationship with the father of their child (52.6%; 470/894). Most fathers knew of their paternity status (98.1%; 877/894). Less than 1% of fathers were the main caregiver of their child (0.5%; 4/894). Very few - 4.9% (44/894) of fathers lived with their child and the mother of their child. Domestic violence perpetrated by the father of their child(ren) was reported by 3.9% (35/894) of adolescent mothers. A small proportion of fathers attended the first antenatal appointment with adolescent mothers (1.9%; 17/894), and 84.7% (757/894) of fathers were reported to have had a positive reaction to the pregnancy. The children born to adolescent mothers in the sample had a median age of 14 months (IQR:6-27 months; see **Table 7-3**).

Table 7-3 Maternal, paternal, and child characteristics according to paternal age (n=894)

	N (%)/Mean (SD)/Median (IQR)			t/X^2, *p*-value
	Total sample (n=894)	**Adolescent fathers (n=358)**	**Older fathers (n=536)**	
Maternal characteristics				
Maternal age (years)	18 (17-19)	18 (16-19)	19 (18-19)	**95.3, 0.0001**
Maternal age at birth of child (years)	17 (16-18)	16 (15-17)	17 (16-18)	**112.8, 0.0001**
Maternal HIV status (living with HIV)	227 (25.4%)	57 (15.9%)	170 (31.7%)	**28.3, <0.001**
Mother has more than one child	62 (6.9%)	22 (6.2%)	40 (7.5%)	0.57, 0.45
Mother is main caregiver for the child	764 (85.5%)	293 (81.8%)	471 (87.9%)	11.81, 0.07
Any common mental disorder[a]	110 (12.3%)	38 (10.6%)	72 (13.4%)	1.58, 0.21
Any mental health comorbidities[b]	24 (2.7%)	9 (2.5%)	15 (2.8%)	0.07, 0.80
Any depressive symptoms	72 (8.1%)	19 (5.3%)	53 (9.9%)	**6.08, 0.01**
Any anxiety symptoms	5 (0.6%)	0 (0.0%)	5 (0.9%)	3.36, 0.07
Any posttraumatic stress symptoms	6 (0.7%)	2 (0.6%)	4 (0.8%)	0.11, 0.74
Any suicidality symptoms	56 (6.3%)	27 (7.5%)	29 (5.4%)	1.66, 0.20
Paternal characteristics				
Paternal age (current, years)	22 (20-25)	20 (19-21)	24 (22-26)	**460.6, 0.0001**

	N (%)/Mean (SD)/Median (IQR)			t/X^2, *p*-value
	Total sample (n=894)	**Adolescent fathers (n=358)**	**Older fathers (n=536)**	
Paternal age at birth of child (years)	20 (18-23)	18 (17-19)	22 (21-25)	**643.2, 0.0001**
Unknown father HIV status	478 (53.5%)	206 (57.4%)	272 (50.8%)	**16.62, <0.0001**
In a relationship with child's mother	470 (52.6%)	190 (53.1%)	280 (52.2%)	0.97, 0.62
Father knows paternity status	877 (98.1%)	349 (97.5%)	528 (98.5%)	1.20, 0.27
Father is the main caregiver for the child	4 (0.5%)	2 (0.6%)	2 (0.4%)	0.17, 0.68
Father lives with mother and child	44 (4.9%)	7 (2.0%)	37 (6.9%)	**13.8, 0.008**
Domestic violence perpetration	35 (3.9%)	13 (3.6%)	22 (4.1%)	0.13, 0.72
Father engagement				
Father looks after child	66 (7.9%)	21 (6.3%)	45 (9.0%)	1.95, 0.16
Father helps buy things for the child	153 (18.3%)	54 (16.2%)	99 (19.7%)	1.66, 0.20
Father helps with washing/food preparation for the child	56 (6.7%)	21 (6.3%)	35 (7.0%)	0.14, 0.70
Father spends time with child	84 (10.0%)	29 (8.7%)	55 (10.9%)	1.13, 0.29
Any involvement	163 (19.5%)	57 (17.1%)	106 (21.1%)	2.06, 0.15
Involvement score (0-4)	0.43 (1.03)	0.37 (0.98)	0.47 (1.06)	1.25, 0.21
Mother and father argue about money	166 (18.6%)	50 (14.0%)	116 (21.6%)	**8.36, 0.004**
Father attended first antenatal appointment	17 (1.9%)	4 (1.1%)	13 (2.4%)	1.97, 0.16

	N (%)/Mean (SD)/Median (IQR)			t/X^2, *p*-value
	Total sample (n=894)	**Adolescent fathers (n=358)**	**Older fathers (n=536)**	
Father had positive reaction to pregnancy	757 (84.7%)	307 (85.8%)	450 (84.0%)	0.53, 0.46
Child characteristics				
Child age (months)	14 (6-27)	13 (5-28)	15 (7-27)	0.59, 0.44
Biological sex (female)	429 (48.0%)	176 (49.2%)	253 (47.2%)	0.33, 0.57
Child cognitive development				
Gross motor skills score	49.7 (12.7)	49.0 (12.3)	50.2 (12.9)	1.29, 0.20
Visual reception skills score	42.4 (14.3)	43.6 (14.7)	41.5 (14.0)	**-2.17, 0.03**
Fine motor skills score	44.1 (14.7)	45.2 (13.9)	43.5 (15.2)	-1.68, 0.09
Receptive language skills score	47.8 (13.5)	48.6 (13.4)	47.3 (13.6)	-1.50, 0.13
Expressive language skills score	51.8 (13.4)	52.2 (13.5)	51.6 (13.3)	-0.58, 0.56
Composite score of Early Learning[c]	93.9 (21.4)	96.6 (21.5)	92.8 (21.2)	-1.92, 0.06

Note: [a]Common mental disorder: scoring above the cut-off on one or more screening measure for mental health | [b]Mental health comorbidities: scoring above the cut-off on two or more screening measures for mental health | Available data: Any involvement/Involvement score (n=837), Gross motor skills score (n=798) | [c]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155)

7.2.4.2 Adolescent fatherhood

Prevalence of adolescent fatherhood (between the ages of 10-19 years at the time of the birth of their child) was 40% (358/894). Mothers of children born to adolescent fathers were more likely to be younger (16 vs. 17 years; X^2=112.8, *p*=0.0001) and, less likely to be living with HIV (15.9% vs. 31.7%; X^2=28.3, *p*=<0.0001) compared to mothers of children born to older fathers. Mothers of children born to adolescent fathers were less likely to know the HIV status of the father compared to older fathers (57.4% vs. 50.8%, X^2=16.6, *p*=<0.0001), less likely to live with the father of their child (2.0% vs. 6.9%, X^2=13.8, *p*=0.008) and less likely to argue about money with the father of their child (14.0% vs. 21.6%, X^2=8.36, *p*=<0.004). Similar prevalence rates were identified between adolescent fathers and older fathers relating to being in a relationship with the mother, knowing of their child, being the main caregiver for their child, being involved with their child, reaction to pregnancy, and domestic violence perpetration. Mothers of children born to adolescent fathers reported a lower prevalence of depressive symptoms compared to older fathers (5.3% vs. 9.9%, X^2=6.08, *p*=0.01). Prevalence of all other mental health symptoms was similar among adolescent and older fathers. For illustrative purposes, individual mental health symptomology scores are included in **Appendix 5**, **Table 9-15**.

Children born to adolescent fathers were found to have higher visual reception scores compared to older fathers (43.6 vs. 41.5, *t*=-2.17, *p*=0.03). Scores on all other child cognitive development domains, including the composite measure of early learning, were found to be similar regardless of father age (see **Table 7-3**).

7.2.4.3 Father involvement

Almost a fifth (19.5%; 163/837) of fathers were involved with their child (at least once every two weeks; see **Table 7-3**). Mothers of children who had involved fathers were less likely to report being the main caregiver of their child compared to fathers who were not involved with childcare (85.9% vs. 90.2%, X^2=19.0, *p*=0.002). Involved fathers were more likely to be older (21 vs. 20 years, *t*=4.30, *p*=0.04), in a relationship with the mother of their child (74.8% vs. 47.2%, X^2=40.8, *p*=<0.0001), more likely to live with their child (14.7% vs. 3.0%, X^2=49.3, *p*=<0.0001), more likely to be the main

caregiver of their child compared to non-involved fathers (2.5% vs. 0.0%). Mothers of children with involved fathers were less likely to know the HIV status of their child's father compared to not involved fathers (68.7% vs. 48.4%, X^2=25.6, *p*=<0.0001). Involved fathers were also more likely to attend the first antenatal appointment (4.3% vs. 1.5%, X^2=5.21, *p*=0.02) and were more likely to have a positive reaction to the adolescent mother's pregnancy (96.3% vs. 81.2%, X^2=22.6, *p*=<0.0001). Children of involved fathers were found to score lower on domains of gross motor (47.6 vs. 50.1, *t*=2.20, *p*=0.03) and fine motor skills (41.9 vs. 44.5, *t*=2.07, *p*=0.04) compared to children of not involved fathers. Scores on all other child cognitive domains, including the composite measure of early learning were found to be similar regardless of father involvement (see

Table 7-4). Maternal mental health symptoms were similar regardless of father involvement. For illustrative purposes, individual maternal mental health symptom scores according to father involvement status are included in **Appendix 5**, **Table 9-16**.

Table 7-4 Maternal, paternal, and child characteristics according to paternal involvement (n=837)

	N (%)/Mean (SD)/Median (IQR)		t/X^2, *p*-value
	Any father involvement (n=163)	**No father involvement (n=674)**	
Maternal characteristics			
Maternal age (*years*)	18 (17-19)	18 (17-19)	0.05, 0.83
Maternal age at birth of child (*years*)	17 (16-18)	17 (16-18)	1.90, 0.17
Maternal HIV status (*living with HIV*)	46 (28.2%)	172 (25.5%)	0.50, 0.48
Mother has more than one child	13 (8.0%)	46 (6.8%)	0.26, 0.61
Mother is main caregiver for the child	140 (85.9%)	608 (90.2%)	**19.0, 0.002**
Any common mental disorder[a]	19 (11.7%)	84 (12.5%)	0.08, 0.78
Any mental health comorbidities[b]	2 (1.2%)	21 (3.1%)	1.75, 0.28
Any depressive symptoms	13 (8.0%)	57 (8.5%)	0.04, 0.84
Any anxiety symptoms	1 (0.6%)	4 (0.6%)	0.0009, 1.00
Any posttraumatic stress symptoms	0 (0.0%)	5 (0.7%)	1.22, 0.59
Any suicidality symptoms	8 (4.9%)	42 (6.2%)	0.41, 0.52
Paternal characteristics			
Paternal age (*current, years*)	23 (20-25)	22 (20-25)	1.32, 0.25
Paternal age at birth of child (*years*)	21 (19-23)	20 (18-23)	**4.30, 0.04**
Adolescent father (*10-19 years*)	57 (35.0%)	277 (41.1%) `	2.06, 0.15
Unknown father HIV status	112 (68.7%)	326 (48.4%)	**25.6, <0.0001**
In a relationship with child's mother	122 (74.8%)	318 (47.2%)	**40.8, <0.0001**
Father is the main caregiver for the child	4 (2.5%)	0 (0.0%)	**n/a**
Father lives with mother and child	24 (14.7%)	20 (3.0%)	**49.3, <0.0001**
Domestic violence perpetration	7 (4.3%)	25 (3.7%)	0.12, 0.73
Father engagement			
Mother and father argue about money	26 (16.0%)	127 (18.8%)	0.73, 0.39
Father attended first antenatal appointment	7 (4.3%)	10 (1.5%)	**5.21, 0.02**

	N (%)/Mean (SD)/Median (IQR)		t/X^2, *p*-value
	Any father involvement (n=163)	**No father involvement (n=674)**	
Father had positive reaction to pregnancy	157 (96.3%)	547 (81.2%)	**22.6, <0.0001**
Child characteristics			
Child age (*months*)	13 (5-26)	14 (6-28)	0.69, 0.41
Biological sex (*female*)	80 (49.1%)	318 (47.2%)	0.19, 0.66
Child development scores			
Gross motor skills score	47.6 (11.6)	50.1 (12.9)	**2.20, 0.03**
Visual reception skills score	41.8 (14.8)	42.6 (14.2)	0.63, 0.53
Fine motor skills score	41.9 (14.3)	44.5 (14.8)	**2.07, 0.04**
Receptive language skills score	47.2 (13.9)	48.1 (13.5)	0.70, 0.48
Expressive language skills score	52 (13.4)	51.6 (13.5)	0.41, 0.68
Composite score of Early Learning[c]	94.4 (21.1)	92.2 (22.8)	1.18, 0.24

Note: Father involvement data available for n=837 | If father helps look after the child, buys things for the child, helps with washing and/or food preparation or spends time with the child at least once every two weeks they were classified as "involved" for the purpose of analyses|Available data: Gross motor skills score (n=748) | [a]Common mental disorder: scoring above the cut-off on one or more screening measure for mental health | [b]Mental health comorbidities: scoring above the cut-off on two or more screening measures for mental health | [c]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

7.2.4.4 Father characteristics according to adolescent maternal HIV status

Fathers of children born to adolescent mothers living with HIV were less likely to be adolescent fathers compared to fathers of children born to adolescent mothers not living with HIV (25.1% vs. 45.1%, X^2=28.3, *p*=<0.0001). Adolescent mothers living with HIV were more likely to know the HIV status of the father of their child compared to adolescent mothers not living with HIV (unknown father HIV status: 15.0% vs. 66.6%, X^2=260.9, *p*=<0.0001) and, more likely to be living with the father of their child (8.8% vs. 3.6%, X^2=23.7, *p*=<0.0001). Fathers of children born to adolescent mothers living

with HIV were more likely to have a positive reaction to the pregnancy compared to father of children born to adolescent mothers not living with HIV (89.0% vs. 83.2%, X^2=4.36, *p*=0.04; see

Table 7-5).

Table 7-5 Paternal characteristics according to maternal HIV status (n=894)

	N (%)/Mean (SD)/Median (IQR)		*t/* X^2, *p*-value
	Adolescent mothers living with HIV (n=227)	**Adolescent mothers not living with HIV (n=667)**	
Paternal characteristics			
Paternal age (*current, years*)	25 (22-28)	21 (20-24)	**92.3, 0.0001**
Paternal age at birth of child (*years*)	22 (19-25) Range: 14-38	20 (18-22) Range: 13-40	**58.1, 0.0001**
Adolescent father (*10-19 years*)	57 (25.1%)	301 (45.1%)	**28.3, <0.0001**
Unknown father HIV status	34 (15.0%)	444 (66.6%)	**260.9, <0.0001**
In a relationship with child's mother	118 (52.0%)	352 (52.8%)	3.76, 0.15
Father knows paternity status	224 (98.7%)	653 (97.9%)	0.55, 0.46
Father is the main caregiver for the child	1 (0.4%)	3 (0.5%)	0.0003, 0.99
Father lives with mother and child	20 (8.8%)	24 (3.6%)	**23.7, <0.0001**
Domestic violence perpetration	11 (4.9%)	24 (3.6%)	0.70, 0.40
Father engagement			
Father looks after child	18 (8.3%)	48 (7.8%)	0.06, 0.81
Father helps buy things for the child	43 (19.7%)	110 (17.8%)	0.41, 0.52
Father helps with washing/food preparation for the child	15 (6.9%)	41 (6.6%)	0.02, 0.90
Father spends time with child	25 (11.5%)	59 (9.5%)	0.67, 0.41
Any involvement	46 (21.1%)	117 (18.9%)	0.50, 0.48
Involvement score (*scored 0-4*)	0.46 (1.06)	0.42 (1.02)	0.23, 0.63
Mother and father argue about money	50 (22.0%)	116 (17.4%)	2.41, 0.12
Father attended first antenatal appointment	5 (2.2%)	12 (1.8%)	0.15, 0.70
Father had positive reaction to pregnancy	202 (89.0%)	555 (83.2%)	**4.36, 0.04**

Note: Available data: Any involvement/Involvement score (n=837)

7.2.4.5 Father characteristics according to adolescent maternal mental health status

Prevalence of likely mental disorder among adolescent mothers in the sample was 12.3% (110/894; see **Table 7-3**). Mothers of children born to adolescent fathers were less likely to report depressive symptoms compared to mothers of children born to older fathers (5.3% vs. 9.9%; X^2=6.08, *p*=0.01). Prevalence rates of all other mental health symptoms were found to be similar among mothers of adolescent and older fathers (see **Table 7-3**). Prevalence of mental health symptomology was similar regardless of fatherhood involvement status (see

Table 7-4). For illustrative purposes, mental health symptom scores are explored according to adolescent fatherhood, and father involvement status (see **Appendix 5**, **Table 9-15** and **Table 9-16**).

Compared to mothers not classified as experiencing likely common mental disorder, mothers classified as experiencing likely common mental disorder were more likely to know the HIV status of the fathers of their child(ren) (unknown HIV status: 40.0% vs. 55.4%, X^2=13.3, *p*=0.001), were less likely to be in a relationship with the father of their first born child (41.8% vs. 54.1%, X^2=13.3, *p*=0.03), were more likely to report domestic violence perpetrated by the father of their child (8.2% vs. 3.3%, *t*=6.07, *p*=0.01) and were more likely to argue about money with the father of their child (30.0% vs. 17.0%, X^2=10.8, *p*=0.0001; see

Table 7-6).

Table 7-6 Paternal characteristics according to maternal mental health status (n=894)

	N (%)/Mean (SD)/Median (IQR)		t/X^2, *p*-value
	Any common mental disorder (n=110)	No common mental disorder (n=784)	
Paternal characteristics			
Paternal age (*current, years*)	23 (21-26)	22 (20-25)	**5.02, 0.03**
Paternal age at birth of child (*years*)	21 (19-23)	20 (18-23)	1.25, 0.27
Adolescent father (*10-19 years*)	38 (34.6%)	320 (40.8%)	1.58, 0.21
Unknown father HIV status	44 (40%)	434 (55.4%)	**13.3, 0.001**
In a relationship with child's mother	46 (41.8%)	424 (54.1%)	**7.32, 0.03**
Father knows paternity status	110 (100%)	767 (2.17%)	2.43, 0.12
Father is the main caregiver for the child	0 (0.0%)	4 (0.5%)	0.56, 0.45
Father lives with mother and child	5 (4.6%)	39 (5.0%)	3.10, 0.54
Domestic violence perpetration	9 (8.2%)	26 (3.3%)	**6.07, 0.01**
Father engagement			
Father looks after child	8 (7.8%)	58 (7.9%)	0.002, 0.96
Father helps buy things for the child	16 (15.5%)	137 (18.7%)	0.60, 0.44
Father helps with washing/food preparation for the child	5 (4.9%)	51 (7.0%)	0.63, 0.43
Father spends time with child	11 (10.7%)	73 (10.0%)	0.05, 0.82
Any involvement	19 (18.5%)	144 (19.6%)	0.08, 0.78
Involvement score (*scored 0-4*)	0.39 (0.96)	0.43 (1.04)	0.43, 0.67
Mother and father argue about money	33 (30.0%)	133 (17.0%)	**10.84, 0.001**
Father attended first antenatal appointment	4 (3.6%)	13 (1.7%)	2.02, 0.16
Father had positive reaction to pregnancy	90 (81.8%)	667 (86.1%)	0.79, 0.38

Note: Available data: Any involvement/Involvement score (n=837)

7.2.5 Discussion

Fathers are all too often overlooked within research, policy, and programming in relation to pregnancy (including adolescent pregnancy) and child rearing, particularly within sub-Saharan Africa. These analyses provide the first detailed exploration of the characteristics of fathers of children born to adolescent mothers in the context of HIV in South Africa. Overall, father involvement was low (19.5% of fathers were involved with the care of their children at least once every 2 weeks and 0.5% of fathers were the main caregiver of their child). Prevalence of adolescent versus adult fatherhood was high (40%). Adolescent fatherhood was linked to younger maternal age, lower prevalence of maternal HIV, fathers being less likely to live with their child, and lower prevalence of arguments between adolescent mothers and fathers about finances. Involved fathers were more likely to be older, in a relationship with adolescent mothers, and more likely to live with their child. The fathers of children born to adolescent mothers living with HIV were more likely to be older, more likely to live with their child, and have a positive reaction to pregnancy. Maternal mental health was linked to being in a relationship with the father, heightened domestic violence perpetrated by the father of their child, and financial arguments. Analyses provide a descriptive summary of the characteristics of fathers of children born to adolescent mothers (based on adolescent mother report), as a foundation for future targeted research studies on the topics of interest.

Findings provide a preliminary exploration of the characteristics of fatherhood within the context of adolescent pregnancy and HIV in South Africa. A greater understanding of barriers to father involvement is required. Efforts to bolster father engagement, such as the inclusion of fathers within maternal and child service provision, may have benefits for fathers, adolescent mothers, and their children.[231-241] Adolescent fathers may have specific needs requiring tailored intervention to support and promote the wellbeing of adolescent parent families. Mental health support and existing HIV services may be an important access point to these families with benefits for parents and their child(ren). There remains a critical need for the inclusion of fathers within policy, programming, and research agendas.

These findings provide an initial exploration for prevalence rates of adolescent fatherhood within South Africa and provide a timely contribution to the literature focusing on adolescent fathers.[268] In support of previous studies emerging from South Africa, father involvement within the sample was low.[231,489,490] Uniquely, this study explores father involvement in several ways (involvement with their child, whether they are the main caregiver and, engagement with antenatal appointments). Involved fathers were more likely to attend the first antenatal appointment, highlighting the importance of encouraging father involvement from the early stages of pregnancy. Further research is required to explore barriers to father engagement (including adolescent father engagement) within the South African context. Possible barriers may include aspects of the cultural context, gender stereotypes, poverty and a lack of employment opportunities resulting in fathers migrating away from their child and, the exclusion of fathers from services and programming inclusive of health and education.[238] Supporting positive father involvement with their children and throughout pregnancy may be of benefit to adolescent mothers, their children, and fathers themselves.[231,233,234,491-493] However, it should be noted that the promotion of father involvement should equally promote women's autonomy and engagement in services.[494]

In contrast to previous literature, while some differences on individual child cognitive development subscale scores were identified according to father age and father involvement, no differences in overall composite early learning scores were identified. Previous research has identified father involvement as being beneficial for child development outcomes (both directly and indirectly).[238,495,496] These data provide an initial exploration of these father involvement and paternal age. Seemingly, the relationship between fatherhood and child cognitive development scores within the context of adolescent pregnancy and HIV may be more complex than these initial investigations. Within existing literature, living with HIV, or being exposed to HIV has been previously found to have impacts on child cognitive development.[111,167-170] These analyses did not exclude the small number of children (n=10) known to be living with HIV in the sample. The cognitive development scores of these children may have impacted on findings however, any differences are likely

to be minimal given the small sample of children known to be living with HIV. Further research exploring the longitudinal impacts of fatherhood characteristics on the cognitive development of children born to adolescent mothers affected by HIV, including mediating and moderating factors (i.e., child HIV exposure status, socioeconomic status) is required to expand our understanding and meaningfully contribute to beneficial policy and programming for this group.

Findings additionally provide rare insight into fatherhood characteristics within the context of adolescent pregnancy and HIV and, support previous literature identifying a higher risk of HIV among adolescent girls with older sexual partners.[497-499] Adolescent mothers remain disproportionately at risk of HIV infection compared to their non-mother counterparts[136] – with HIV incidence risk up to five times greater among this group.[154] As such, adolescent mothers with children born to older fathers are a particularly vulnerable group who may require intervention to reduce risk of HIV acquistion. Those adolescent mothers who are living with HIV require appropriate testing, care, and treatment inclusive of prevention of vertical HIV transmission.[157] Existing research has identified benefits of father/male partner involvement in HIV care, including PMTCT.[257,500] Given this, it is appropriate to consider the role of fathers within HIV services for adolescent mothers. Such involvement may also allow for access to fathers of children born to adolescent mothers and the promotion of HIV testing, treatment, and support among this group.[257]

While there is a growing body of evidence exploring maternal mental health within the context of adolescent pregnancy and HIV in sub-Saharan Africa (largely driven by the works associated with this thesis), the mental health experience of adolescent mothers remains largely unknown. These analyses are the first to explore such concepts within the context of fatherhood. Within the sample, prevalence of poor maternal mental health symptoms was similar regardless of father age or involvement. Findings support previous research highlighting relationship status,[501] violence exposure,[294,308,311,316,320] and domestic disputes[308,312] as being possibly linked to mental health and expand such literature to include adolescent mothers living with

and affected by HIV in South Africa. Mental health support and interventions may be an important access point for adolescent parent families, with benefits for adolescent mothers, fathers, and their children.

7.2.5.1 Limitations of these analyses

Study limitations should be considered within the interpretation of results. Firstly, these data are exploratory and thus, only provide initial insight into the characteristics of children born to adolescent mothers. Analyses explore only a limited number of characteristics and, factors which may mediate or moderate any differences between groups identified within analyses have not been explored. As such, these analyses present a partial view of fatherhood within the context of adolescent motherhood and provide a foundation for future research within this topic area. Second, data are drawn from adolescent mother report. Thus, the findings are confined to maternal views and subsequent research would benefit from data provided by fathers themselves inclusive of data relating to paternal mental health. Third, these data focus on fathers on children born to adolescent mothers and do not consider the involvement of male partners who are not the fathers of children born to adolescent mothers. Given this, these data may not be wholly representative of fathers/male partners involved in the lives of adolescent mothers and their children. Despite these limitations, these initial findings are drawn from a robust sample of adolescent mothers within South Africa and offer one of the first explorations of fatherhood within the context of adolescent motherhood and HIV. The strengths and limitations of these data and analyses are discussed in further detail in sections **3.1.5** and **8.3** of this thesis.

7.2.5.2 Section summary & conclusions

Adolescent mothers and their children affected by HIV remain substantially underserved with regard to policy and programming and are often neglected within research agendas. These analyses aimed to address this critical evidence gap, promote the notion of fathers within this context and, describe the characteristics of fathers of children born to adolescent mothers affected by HIV. Father involvement with their children was low in the sample, and prevalence of adolescent fatherhood

was high. Characteristics of fathers had possible impacts for both adolescent mothers and their children. Despite their exploratory nature, these analyses have implications for the design of interventions, policy, and programming for adolescent parent families within South Africa and provide a foundation for future research. Maternal HIV, maternal mental health, and child development should remain key considerations within future investigations. Efforts to support father engagement, such as the inclusion of fathers within maternal and child service provision, may have benefits for fathers, adolescent mothers, and their children. However, services and programming may require specific adaptation to meet the needs of adolescent fathers.

7.3 Chapter summary

Globally, there is limited existing evidence focusing on adolescent fatherhood, and the fathers of children born to adolescent mothers. Similarly, fatherhood/male partner involvement in the context of HIV remains underexplored. There is likewise an absence of literature focusing on the mental health of adolescent fathers (including within the context of HIV see **Chapter 2**) within sub-Saharan Africa. In response to this evidence gap, this chapter presents a series of exploratory analyses exploring metal health symptomology among adolescent fathers, the characteristics of fathers of children born to adolescent mothers (including father involvement), whether familial characteristics differ according to adolescent fatherhood status or paternal involvement, and whether father characteristics differ according to maternal HIV or mental health status in South Africa.

In section 1 (**7.1**) of this chapter, 1.4% of a sample of male adolescents were classified as experiencing adolescent fatherhood. The prevalence of adolescent fatherhood in this sample is considerably lower than the proportion of children that had an adolescent father, as reported by their adolescent mothers in section 2 (40%). These findings highlight the need for attention regarding the reporting of adolescent fatherhood. In addition, seemingly, mental health comorbidities were elevated

among adolescent fathers, and like adolescent mothers (see **Chapter 4**, **Chapter 5**), poor mental health may be elevated among adolescent fathers living with HIV.

Section 2 (**7.2**) of this chapter focuses on adolescent mother report of the fathers of their children. Overall, father involvement was low in the sample. Adolescent fatherhood was linked to younger maternal age, lower prevalence of maternal HIV, fathers being less likely to live with their child, and lower prevalence of arguments between adolescent mothers and fathers about finances. Involved fathers were more likely to be older, in a relationship with adolescent mothers, and more likely to live with their child. The fathers of children born to adolescent mothers living with HIV were more likely to be older, more likely to live with their child, and have a positive reaction to pregnancy. Poor maternal mental health was linked to being in a relationship with the father, heightened domestic violence perpetrated by the father of their child, and financial arguments.

The findings in this chapter provide an initial exploration of mental health symptomology among adolescent fathers, and the characteristics of fathers of children born to adolescent mothers within the context of HIV in South Africa. Findings expand existing investigations of fatherhood and male partner involvement to explore the concept of fatherhood in the context of adolescent fatherhood, HIV, and the sub-Saharan African region, as much of the existing literature is drawn from the Global North. These findings also provide insight into the concept of fatherhood within the context of adolescent pregnancy and HIV and highlight avenues of future enquiry. Despite their exploratory nature, these analyses have implications for the design of interventions, policy, and programming for adolescent parent families within South Africa (e.g., efforts to strengthen father engagement may be of benefit).

Chapter 8 Discussion & conclusions

The research undertaken in this thesis aimed to address a critical evidence gap by enhancing our understanding of mental health among adolescent parent families in the context of HIV within sub-Saharan Africa, and specifically in the Eastern Cape region of South Africa. To achieve this, quantitative methodologies were used to explore two linked data sources (the ***Adolescent HIV study***, and the ***HEY BABY study***) from South Africa. Likely common mental disorder *(*employing measures of depressive, anxiety, posttraumatic stress, and suicidality symptomology) was explored in relation to HIV among three groups: adolescent mothers (10-19 years of age), adolescent fathers, and fathers of children born to adolescent mothers. Additional analyses were also undertaken to explore the cognitive development of children born to adolescent mothers, and fatherhood within the context of adolescent motherhood to provide a broader overview of the experience of likely common mental disorder within this population.

Poor mental health has widespread impacts, not only for the individual but also broader society.[8,21,22] Yet, an understanding of poor mental health (inclusive of the measurement of poor mental health) among populations is often lacking – particularly within sub-Saharan Africa, and particularly among adolescents.[24-27] Such efforts are constrained by issues such as cost, limited resources, standardisation of measurement, and culture (i.e., different understandings of mental health).[502-505] Resources to diagnose mental health conditions are often limited or non-existent.[502-505] However, it remains critical to examine likely common mental disorder within populations to assess need, resource allocation, adequate programmatic response, and promote health equity.[506,507] The works within this thesis provide the only current insight into likely common mental disorder within the context of HIV and adolescent pregnancy within South Africa. Measurement of mental health within these works predominantly focuses on the presence and/or absence of current likely common mental disorder (a composite measure drawn from four symptomology scales ([depression, anxiety, posttraumatic stress, suicidality]). While these investigations provide insight into the mental health experience of adolescent parent

families affected by HIV, they do not offer a diagnostic of mental disorder (common practice within research of this nature), nor do they comprehensively explore variation within the mental health experience of this group (i.e., through qualitative works or through the exploration of variation within scores on individual scales) – practices that may further enhance understanding.[76,81] Nevertheless, these works examine the possible current and future needs of both a core population within the HIV response and our future generations.

This final chapter summarises the key findings of the thesis and contextualises findings in relation to existing evidence, policy agendas and current affairs. It also provides a discussion of the strengths and limitations of the works in this thesis, possible avenues of future research, as well as next steps and considerations for policy and programming.

8.1 Summary of main findings

8.1.1 What is currently known in relation to likely common mental disorder in the context of adolescent pregnancy and HIV in sub-Saharan Africa?

To explore the current evidence base, the candidate reviewed 2287 citations from electronic databases and hand searching (2059 quantitative studies, and 228 qualitative studies) to explore prevalence of likely common mental disorder, explorations of risk and protective factors for likely common mental disorder, and interventions for likely common mental disorder among adolescents living with HIV who have experienced pregnancy. This systematic review of the literature highlighted an absence of evidence focusing on the mental health of adolescent parent families in the context of HIV. Only a single study was identified focusing on the prevalence of depressive symptoms among adolescents living with HIV who were experiencing pregnancy (a sub-sample of the core study population [n=14]). No evidence was identified relating to risk and protective factors, nor interventions for likely common mental disorder among adolescents experiencing pregnancy (both mothers and fathers) living with HIV. The undertaking of this review identified the critical evidence

gaps relating to maternal mental health among adolescents experiencing pregnancy within the context of HIV. However, within the process of conducting this review it was clear that it is not that further data for the population of interest does not exist but that is difficult to attain such data due to challenges including a lack of stratification (e.g., age/HIV status), the clustering of data within broader groups (e.g., broader age groups – international data collection strategy often clusters adolescents with young adults [e.g., 15-24 years]), or legal and/or cultural issues (i.e., the potential emancipation of adolescents when they have a child, resulting in adolescents being classified as adults within data collection). Given this observation, it is clear that the evidence base relating to adolescents living with HIV who have experienced pregnancy could be rapidly expanded through the use of existing data.

The single existing study identified in the review (see above) only explored depressive symptomology among currently pregnant adolescents. Consequently, the understanding of mental health among this group was narrow in scope – explorations of other mental disorders, and beyond the pregnancy period are urgently required. There was also a notable absence of explorations relating to mental health in context of children born to adolescent mothers, and adolescent fathers (see **Chapter 2**). The findings from this systematic review directed the analyses of the proceeding chapters of this thesis.

8.1.2 Understanding prevalence of, and risk factors for adolescent maternal mental health in South Africa

Within an exploration of data from 723 female adolescents (both living with and without HIV) from the ***Adolescent HIV study***, the prevalence of pregnancy (to date, as those who had not yet reached 19 years of age, there was still the possibility of becoming pregnant) was 15.2%. Adolescent mothers in the sample had a higher prevalence of likely common mental disorder (scoring above the cut-off on measures of depressive, anxiety, posttraumatic stress disorder, and suicidality symptomology) compared to adolescents who had not experienced pregnancy (18.2% vs. 9.6%, respectively). In the context of HIV, prevalence of likely common mental disorder was higher among adolescent mothers living with HIV, compared to adolescent mothers

not living with HIV, and adolescents who had never experienced pregnancy (both living with and not living with HIV [overall proportion of the sample living with HIV; 70.5%]; 23% vs. 12.2% vs. 9.6%, respective).

Similarly, prevalence of likely mental health comorbidities (likely driven by symptoms of depression and suicidality) within unadjusted analyses of the sample was found to be higher among adolescent mothers, regardless of HIV status, indicating that experience of pregnancy/motherhood may drive more complex mental health burden.

To explore prevalence of likely common mental disorder further, additional analyses utilising data from 1002 adolescent mothers (from the ***HEY BABY study***) was undertaken. The prevalence of likely common mental disorder among adolescent mothers was found to be lower than the prevalence estimate identified in the ***Adolescent HIV study*** (above, 12.6% vs. 18.2%, respectively). In keeping with the above findings, adolescent mothers living with HIV were more likely to report likely common mental disorder and likely mental health comorbidities (again driven by depressive and suicidality symptomology) when compared to adolescent mothers not living with HIV (16.2% vs. 11.2% and, 4.8% vs. 1.9%, respectively). The prevalence of likely common mental disorder among adolescent mothers living with HIV within the ***HEY BABY study*** was found to be similar to the prevalence estimate identified among adolescent mothers living with HIV in the ***Adolescent HIV study*** (16.2% [95% CI: 12.3%-21.0%] vs. 23.0% [95% CI: 14.1%-35.15%], respectively), and was similar among adolescent mothers not living with HIV (11.2% [95% CI: 9.1%-13.7%] vs. 12.2% [95% CI: 5.6%-24.7%], respectively).

Identified risk factors for likely common mental disorder among adolescent mothers (sample n=1002; ***HEY BABY study***), were violence exposure (namely experience of abuse [verbal, physical or sexual], and community violence), and a lack of perceived social support. These data suggested that risk factors for likely common mental disorder were similar among adolescent living with and without HIV. These findings also identify how possible contributors to poor maternal mental health span beyond

the individual level and may also include factors from the broader social environment.

8.1.3 Broadening explorations beyond individual adolescent maternal mental health in the context of HIV: how are the children of adolescent mothers in South Africa faring?

The cognitive development of children born to adolescent mothers (from the ***HEY BABY*** study) was explored within three series of analyses. First, comparisons between child cognitive development in the sample, normative reference values, and pooled data from adult mothers in sub-Saharan Africa were explored. In addition to this cognitive development scores were explored according to child age. Second, explorations of child cognitive development scores according to maternal mental health and HIV status (including exploratory analyses of risk and protective factors for child cognitive development scores) were undertaken. Third, child cognitive development scores were examined according to child HIV status.

Overall, first-born children (0-68 months) of adolescent mothers were found to have lower development scores compared to reference data utilised in the development of a standardised validated cognitive development performance inventory (Mullen Scales of Early Learning; drawn from the USA[185]) and compared to the children of adult mothers in the sub-Saharan African region. Differences according to age were also identified within the sample. Cognitive development scores were found to be similar among younger children within the sample compared to the reference population however, older children in the sample were found to have lower development scores when compared to the reference population. These findings highlight children born to adolescent mothers in South Africa as being at risk of cognitive adversity.

Further analyses were undertaken to explore risk and protective factors for child cognitive development among this population, including examining the relationship between adolescent maternal mental health and the cognitive development of their first-born children. Overall, child scores on cognitive development domains did not

differ according to adolescent likely common mental disorder status. However, while no associations were identified between this broader measure of maternal mental health (including interactions with maternal HIV status) and overall child cognitive development scores, sensitivity analyses identified a relationship between increased maternal posttraumatic stress symptomology and lower child cognitive development scores. Additional sensitivity analyses exploring risk and protective factors for child cognitive development identified maternal educational attainment as being associated with improved child cognitive development scores while (as above) increasing child age was found to be associated with lower child cognitive development scores.

To further explore child cognitive development in the context of HIV in this population, explicit examinations of child cognitive development scores according to child HIV status were undertaken. The known HIV transmission rate from mother to child for the adolescents living with HIV was 5.5% in the sample. A stepwise pattern in relation to average child cognitive development scores according to child HIV status was identified, with children living with HIV performing worse than children who were classified as HEU, and children who were HEU performing slightly worse than children who were classified as HU on the majority of child development domains. Overall, children living with HIV had lower scores on domains of development explored compared to the HU children. Similarly, average cognitive development scores for HEU children were lower than the HU group although this only reached statistical significance in relation to gross motor skills. To explore possible risk and protective factors for child cognitive development in relation to child HIV status, exploratory multivariable analyses identified maternal education interruption as a potential risk factor for lower child cognitive development scores and older maternal age (at the birth of their child) as a potential protective factor.

8.1.4 The (often) forgotten group – exploring fatherhood in the context of adolescent pregnancy, mental health, and HIV.

The ***Adolescent HIV study*** data was used to explore adolescent paternal mental health. A small proportion of adolescent males in the sample reported fatherhood

(1.4%). This prevalence is in sharp contrast to the prevalence of adolescent mothers in the same sample (15.2%; see above). Despite the small number of fathers, mental health comorbidities were seemingly elevated among fathers in the sample compared to non-fathers in the sample. Among adolescent fathers, the father living with HIV was more likely to report poor mental health symptoms compared to adolescent fathers not living with HIV.

To explore fatherhood further adolescent maternal report of the characteristics of the fathers of their first-born children were utilised (the ***HEY BABY study***) to provide a descriptive summary in relation to fatherhood, adolescent pregnancy, HIV, and mental health in the sample. Overall, father involvement was low (19.5% of fathers were involved with the care of their children at least once every 2 weeks, and 0.5% of fathers were the main caregiver of their child). Prevalence of adolescent fatherhood was 40%. Adolescent fatherhood was linked to younger maternal age, lower prevalence of maternal HIV, fathers being less likely to live with their child, and lower prevalence of arguments between adolescent mothers and fathers about finances. Involved fathers were more likely to be older, in a relationship with adolescent mothers, and more likely to live with their child. The fathers of children born to adolescent mothers living with HIV were more likely to be older, more likely to live with their child, and have a positive reaction to pregnancy. Poor maternal mental health was linked to being in a relationship with the father, heightened domestic violence perpetrated by the father of their child, and arguments about finances.

8.2 Contextualising findings

This section provides a brief overview of some of the contextual considerations relating to the findings of this thesis, the interpretation of data, and the applicability of findings to future research, policy, and programming efforts.

8.2.1 Mental health services in South Africa – a critical treatment gap

Findings from this thesis highlight mental health need among adolescent parent families and propose that more attention to such needs is required. However, moving such findings from the field of research to policy and practice is met with substantial challenges. For instance, existing mental health provision in South Africa is scant, and there remains a lack of infrastructure for mental health services (e.g., budget limitations, a lack of trained providers). At a national level, approximately 5% of the health budget is focused on services for mental health[508,509] (a figure lower than most developed countries globally, and the majority of which is seemingly on hospital care),[508] and spending varies between provinces (range 2.1%- 7.7%: six out of nine South African provinces spent less than 5% of their budgets on mental health services).[509]

It is estimated that 92% of uninsured adults experiencing mental disorder in South Africa do not access mental health services. For children and adolescents, there is a substantial absence of mental health services – approximately 6.8% of inpatient services and 5.8% of outpatient services are for children and adolescents. Similarly, at a national level there are only 0.02 child psychiatrists per 100, 000 of the uninsured population, and only three provinces (Free State, Gauteng, and the Western Cape – notably not Eastern Cape province [from where the data utilised within this thesis was drawn]) report the availability of publicly available child psychiatrists.[509]

While a new mental health policy framework is expected, South Africa's current mental health policy plan (South Africa's Mental Health Policy and Strategic Plan 2013-2020[510]) has lapsed. A national child and adolescent mental health policy and guidelines were introduced in 2003[511] and is yet to be updated. However, the mental health policy for children and adolescents was seemingly not implemented at a provincial level. A 2018 review of provincial child and adolescent mental health policies within South Africa identified that no province in South Africa has a child and adolescent mental health policy or plans to support the national child and adolescent mental health policy developed in 2003.[512] Child and adolescent mental health is occasionally highlighted in relation to support other health conditions (e.g., alongside

policies relating to TB and HIV), however, there is a lack of evidence that children and adolescents, or child and adolescent mental health professionals were included within policy development.[512] The current national policy guidelines for child and adolescent mental health have a single mention of adolescent pregnancy in reference to providing information relating to substance abuse to pregnant adolescents in education programmes.[511] There is no further mention of this group in relation to mental disorder, HIV, or pregnant or parenting adolescents outside of educational programmes.[511] Maternal mental health was highlighted within South Africa's mental health policy plan however, there is no specific mention in relation to adolescent pregnancy and/or parenthood.[510] To effectively support the mental health needs of adolescent parent families, research and evidence is required to explore barriers and enablers to policy and service development within South Africa including investigations into quality, acceptability, sustainability, and scale-up.[513]

8.2.2 Progressing within global development agendas

At an international level, the data presented within this thesis may provide critical insight into the mental health state of parenting adolescents and the development of their children which may contribute to/affiliate with global development targets such as the Sustainable Development Goals.[163] The Sustainable Development Goals go beyond the Millennium Development Goals to support thriving rather than just surviving. Given this, health and wellbeing (SDG 3: which highlights a need to bolster mental health and child development) features within the development priorities to be achieved by 2030. While the focus of SDG 5 (gender equality) focuses on promoting the needs of and empowering women and girls, there remains a moral requirement to promote the needs of men and boys where their needs may be neglected. The works in **Chapter 7,** respond to an absence of focus on the needs of fathers in the context of adolescent pregnancy and may provide insight.[163]

There is a growing movement to support needs when vulnerabilities may overlap within polygonal organisations such as the World Health Organization and UNICEF, including the needs of adolescent mothers affected by HIV. Calls to action have focused on the engagement of adolescent and young mothers living with HIV, the

need for funding and resources, policy reform, developing programming.[514,515] Yet, such action requires a sound evidence based to be effective, sustainable, and scalable. The works within this thesis aim to contribute to the evidence base in relation to this group so that adolescent parent families remain a part of future policy agendas and effective policy and programming may be developed to address need. The works developed within **Chapter 2** of this thesis have directly contributed to this aim, and have resulted in a peer-review publication which is referenced in a 2021 technical brief focusing of the needs of adolescent and young mothers living with HIV developed by the World Health Organization and UNICEF.[514] While there is a growing focus on the needs of adolescent and young mothers living with HIV, their children and the fathers of children born to adolescent mothers often remain neglected within such efforts. The works within this thesis highlight potential needs beyond individual adolescent mothers. Building an awareness of such needs is a critical next step. To promote such and awareness, the candidate engaged in dissemination activities (see ***Publications, presentations and scholarships arising from the works in this thesis***) including publishing an invited comment for the *Lancet Child and Adolescent Health* journal highlighting findings from the thesis, the need for awareness in relation to this group, and a discussion of possible ways forward to promote mental health among this population.[159]

8.2.3 A growing interest in mental health in the context of HIV

Recent decades have led to mammoth advances in the prevention and treatment of HIV and have given rise to the possibility of an end to the HIV epidemic. Yet, barriers to progression remain including the need to address poor mental health among individuals living with HIV, and those at risk of acquiring HIV.[99] The current UNAIDS goals (to be achieved by 2025 in preparation for meeting the Sustainable Development Goals in 2030) focus on HIV prevention, individuals knowing their HIV status, initiation of treatment, viral suppression, the elimination of vertical HIV transmission, and access to HIV and sexual and reproductive health.[98] These targets seemingly will not be achieved without consideration of the mental health of individuals, as poor mental health has been found to impact on adherence and

treatment access.[99] The recognition of the need for integrated services in response to intersecting vulnerabilities is apparent as there is an additional UNAIDS target focusing on linking individuals to integrated services.[98] However, the need to bolster mental health remains. Globally, there is a growing call to focus on the mental health needs of populations living with HIV and the need for mental health services to be integrated in the HIV response.[99,516] Such integration has begun,[517] however there is a notable gap of integrated services in low- and middle-income countries (where individuals may have numerous challenges impacting on their mental health).[518] The findings from this thesis highlight mental health needs which may require support and go beyond the current focus on two intersecting vulnerabilities (i.e., HIV and mental health) within the existing calls for action to highlight the complex intersections of vulnerabilities for particular sub-populations (e.g., pregnancy, HIV, mental health). These findings also highlight the potential for positive impacts across generations through the promotion of mental health. Investment in mental health holds great returns (e.g., a 2016 modelling estimate proposed that for every 1 USD invested in services for depression and anxiety, the return would be 4 USD in relation to health and workforce contributions).[519] In the context of diminished funding (see section **8.2.6**), an understanding of and investment in mental health may be a wise strategy to improve wellbeing now and for future generations.

8.2.4 Beyond the individual: intergenerational impacts and the broader social environment

While poor mental health predominately has impacts for the individual, the impacts beyond the individual should also remain a consideration. It is well documented that the experience of poor mental health ramifies beyond the individual and has impacts for social networks and broader society,[520,521] and that parental mental health has impacts for children (see section **1.7.3**). The analyses within this thesis begin to contextualise mental health beyond the individual highlighting the potential intergeneration effects of poor maternal mental health (namely higher posttraumatic stress scores) on child cognitive development scores and identifying possible risk factors for poor mental health within the broader social environment. These analyses

only partially represent the realities of adolescent parent families in the context of HIV as only risk factors for which data were available were explored and intergenerational impacts were only explored in relation to first born children. Explorations focusing on subsequent children are required. The candidate is currently involved in analyses focusing on explorations of maternal mental health and child cognitive development in relation to subsequent children born to adolescent mothers (including second children born to mothers 10-19 years of age, and second children born to older mothers).

8.2.5 A caution to not pathologise children and adolescents

The works within this thesis provide an initial first step in the response to an absence of research focusing on the needs of adolescent parent families affected by HIV. As such, it was critical to identify where there may be need for support and intervention to mobilise action (policy, support, funding) and put parenting adolescents affected by HIV on the policy agenda so that, in turn, outcomes may be enhanced for this group. However, such efforts have both positive and negative impacts, and it remains important not to pathologise the experience of adolescents experiencing difficult circumstances[522] - such as those from which the data was collected from for use in this thesis. The focus on psychological distress among adolescent parent families affected by HIV, while promoting a need for attention, also risks medicalising the experiences of this group and may influence how communities may see and respond to this group, or how individuals may see themselves or access support. A focus on pathology within these exploratory works also surpasses an understanding of resilience and coping within their social context. While there remains a need to identify those adolescents in need of intervention and support, future efforts exploring risk of poor mental health should be balanced with research focusing on resilience and coping, inclusive of identifying and supporting social process that enhancing coping skills among this population.[522-524]

8.2.6 A shifting landscape

The global and national context is critical within the interpretation of findings in this thesis, and their applicability to meaningful future policy, programming, and research efforts. The current COVID-19 pandemic has highlighted particular vulnerabilities within our communities. The data presented in this thesis were collected prior to the COVID-19 crisis. Consequently, this should be considered in the interpretation of findings and recommendations for policy, programming, and future research. The emergence of COVID-19 as a global pandemic in December 2019, altered priorities, funding, and programming worldwide, including South Africa. Fiscal capacity and general access to resources may have reduced, and communities have been challenged by increased food insecurity, reduced economic opportunities, rising levels of violence, and disruptions to healthcare (e.g., mental health provision, sexual and reproductive health services, access to HIV services).[525-530] Shifting priorities may result in adolescent parent families affected by HIV being further side-lined from global agendas. However, seemingly the intersecting needs of the population of interest in this thesis may have increased – enhancing the need for policy and programming intervention. Mental health challenges among this population may have been compounded by the COVID-19 crisis, and there is heightened awareness among polygonal organisations of the urgent need to address mental ill-health (particularly among children, and adolescents).[531-533] Similarly, the COVID-19 crisis (like the Ebola crisis) has seemingly led to an increase in unintended pregnancies among adolescents,[138,527,534-536] likely driven by school closures and disruptions in health care. The population of adolescent parent families affected by HIV is therefore likely growing. Hence, the findings within this thesis may have more pertinent applicability to our current global context. Further research to build an evidence-base in the era of COVID-19, inclusive of the comorbid experience of living with HIV and COVID-19 is required. However, in the meantime, these finding may provide insight into ongoing challenges in South Africa and beyond.

Similarly, current instability in the global economy (e.g., rising inflation)[537] have likely resulted in reduced fiscal capacity of governments, donors, policy makers, research

grants, organisations, and programmes. As a result, within this novel landscape funding priorities may shift, and the needs of adolescent parent families affected by HIV may be further neglected. However, as stated in section **1.2**, the promotion of adolescent potential and our future generations in critical to the success and prosperity of our future economies and the wellbeing of our population. As such, the needs of adolescents (including adolescent parents and their children affected by HIV) should remain at the forefront of our agendas. Failure to respond to the needs of this group may have severe ramifications for adolescent parents and their children and may hinder the attainment of global development goals (e.g., the UN Sustainable Development Goals).[163]

8.3 Limitations & strengths of the works within this thesis

The specific limitations of each series of analyses included within this thesis are included within each standalone chapter. Additional strengths and limitations relating to the datasets and measures utilised in this thesis are presented in section **3.1.5**. The below sections present a discussion of the limitations and strengths of this thesis as a whole.

8.3.1 Limitations

The data presented within this thesis should be interpreted within the context of data and study limitations including broad considerations relating to bias, confounding, and chance. This section provides an overview of some of the specific limitations of this thesis.

First, the studies from which data utilised within this thesis were drawn were not specifically undertaken to explore mental health. Hence, it was not possible to explore some factors which may have impacted on mental health experience within this population. For example, stigma may be experienced in relation to mental health,[538] adolescent pregnancy,[539] and HIV,[540] and subsequently may impact on mental health experience. However, it was not possible to explore data relating to stigma within this thesis. Future research would benefit from the inclusion of stigma

measures relating to mental health, HIV and adolescent pregnancy. Furthermore, the mental health measures utilised within this thesis were validated for populations up to 18 years of age. The adolescent sample in this thesis bridges both childhood and adolescents (10-19 years). Given the absence of data on this population (e.g., due to the clustering of data for adolescents within broader age groups [e.g., 15-24 years], in international data collection strategies), the decision was made to expand the sample to 19 years of age to ensure that it was fully representative of the experience of adolescents. It should also be noted that the screening measures of mental health symptomology utilised are not diagnostic (but were deemed appropriate given their practicality in large scale studies). As such, throughout the thesis, the candidate refers to cut-offs for *likely* common mental disorder, and *likely* symptomology (depressive, anxiety, posttraumatic stress, suicidality). While these measures and the subsequent classifications hold clinical utility, individuals who experience mental health symptomology but do not reach the clinical threshold may be missed within analyses. To account for this symptomology scores for individual analyses have been included within appendices, where appropriate. While there is movement within the field of global mental health towards broader classifications of mental health experience to ensure that individual experiences are acknowledged,[76,81] such detail is often not included within current clinical, research, or policy practice within sub-Saharan Africa.[76] Hence, the cut-offs and classifications utilised within this thesis were deemed the most relevant for summarising the experience and needs of the population of interest, and the most accessible to policymakers. Some of the mental health symptomology measures utilised with the works in this thesis focus on mental health experience in the past two weeks/month. Given this, the prevalence estimates of likely common mental disorder provided only provide a snapshot of current mental health symptoms, and do not include previous experience of poor mental health symptoms or indicate how mental health symptoms might vary over time.

Second, despite efforts to expand the current literature to explore mental health comorbidities among adolescent mothers, analyses exploring differences between groups in relation to mental health comorbidities (e.g., **Chapter 4** and **Chapter 5**) and, associations between mental health comorbidities and, child cognitive development

(in **Chapter 6**) were underpowered due to the promising finding that only a small sub-sample of the population experienced mental health comorbidities. As a result, this increases the potential for type 2 error within analyses. Nevertheless, the analyses undertaken within this thesis moved beyond the existing, often narrow, investigations (frequently focusing on depressive symptoms) to explore a broader array of mental health symptoms (i.e., depression, anxiety, posttraumatic stress, suicidality).

Third, analyses relating to child cognitive development (**Chapter 6**) utilises the Mullen Scales of Early Learning, a measure developed within the Global North which utilises a USA reference population.[185] Consequently, the potential for cultural bias should remain a consideration (e.g., some test items and stimuli within the Mullen Scales may not be wholly appropriate for the study setting [i.e., within the picture vocabulary section of the assessment, children are asked to draw items such as a lamp]). However, the Mullen Scales of Early Learning have previously been utilised in both sub-Saharan Africa and South Africa and comparisons of the data within this thesis, and these existing studies have been undertaken (**Chapter 6**). Nevertheless, such cultural considerations raise the issue of the measurement of child cognitive development within the Global South, including cultural sensitivity, and the accessibility of such measures (e.g., the Mullen Scales of Early Learning are copyrighted and as such, there is a fee to use the scale). To further enhance our understanding and ensure that the cognitive development of children remains on the global agenda, it remains important to ensure that measures are easily available, locally validated and, where possible, utilise local reference populations to ensure cultural relevance and validity.

Finally, the focus on this thesis has been on likely common mental disorder defined utilising measures of depressive, anxiety, posttraumatic stress, and suicidality symptoms. As such, broader investigations of mental health including substance abuse, and severe mental disorder are not included within analyses. To develop a holistic view of mental ill-health among adolescent parent families, future research with a broader scope is required.

8.3.2 Strengths

Despite the identified limitations the works within this thesis have numerous strengths. This section provides a brief overview of some of the strengths and the benefits of analyses undertaken as part of this thesis.

This research highlights likely common mental disorder among adolescent parent families affected by HIV as an issue of concern and provides important information relating to factors potentially contributing to likely common mental disorder risk, the relationship between likely maternal common mental disorder and child development, and builds a narrative of adolescent fatherhood within the context of likely common mental disorder and HIV within sub-Saharan Africa. Findings highlight the need for mental health screening and support for adolescent parent families. Findings also provide key insights for mental health programming among adolescent mothers (particularly those living with HIV) and their children, as well as a foundation for an evidence base to allow policy and programme development to benefit such families.

As far as the candidate is aware, the collection of works within this thesis are the first known to explore likely common mental disorder among adolescent parent families living with/affected by HIV in sub-Saharan Africa. Adolescent mothers and their children affected by HIV remain a core population within the prospects of sub-Saharan Africa, and in the HIV response.[514] The systematic review undertaken (see **Chapter 2**) was the first to summarise the existing literature relating to common mental disorder and adolescent pregnancy/parenthood within the context of HIV within sub-Saharan Africa, and the analyses presented within subsequent chapters are the first known explicit explorations of 1) likely common mental disorder among adolescent mothers within the context of HIV, 2) the association between maternal likely common mental disorder and child cognitive development among children born to adolescent mothers within the context of HIV, and 3) likely common mental disorder within the context of adolescent fatherhood and HIV within South Africa. Given the novelty of the analyses undertaken, the works within this thesis make a unique contribution to the global literature relating to adolescent mothers and their

children within sub-Saharan Africa, and South Africa. Consequently, dissemination and policy engagement has been a core priority throughout the development of this thesis.

The overall findings from this thesis emphasises the importance of mental health among adolescent parent families within the context of HIV in South Africa. These findings provide valuable evidence regarding likely common mental disorder among this population. Such findings can contribute to the development of policy and programming within South Africa, highlighting the broad evidence, screening, and treatment gap for mental health among adolescent parent families in South Africa as well as, the implications for mental health and wellbeing beyond the individual.

8.4 Recommendations for future research

The analyses within this thesis have emphasised a critical evidence gap within existing literature, and the need to develop an evidence base relating to the mental health of adolescent parent families affected by HIV in South Africa (and more broadly sub-Saharan Africa). Consequently, there are numerous areas which would benefit from future research. Specific avenues of future research relating to each series of analyses are discussed within each of the respective results chapters of this thesis. This section gives an overview of some of the core priorities for future avenues of research.

8.4.1 Utilising existing data

As detailed within **Chapter 2**, little is known regarding the mental health experiences of adolescents who have experienced pregnancy and are living with HIV. However, it is not that data for this group is not in existence but often it is not analysed stratified by HIV status and adolescent pregnancy. An exercise to expand the evidence base relating to this population would be to perform these stratified analyses using existing study datasets, ensuring that mental health data in the context of adolescent pregnancy and HIV can be meaningfully collated across studies and utilised. The feasibility of such an exercise may be hindered by common barriers to data sharing

within academic and policy spaces. Nevertheless, an expansion of the evidence base in this way is possible and remains valuable.

8.4.2 Longitudinal research

There remains a need for longitudinal research to explore the topics of interest. This thesis presents cross-sectional data only and is thus an initial movement within the development of a problem theory relating to likely common mental disorder among adolescent parents affected by HIV and their children. Future longitudinal research would allow for associations to be explored within the context of temporality to suggest causal effect. Longitudinal analyses would also allow for the examination of changes in mental health symptomology and possible predictive factors over time, as adolescents and their children age and move through critical periods of development. This thesis focuses on the short-term context of adolescent pregnancy, HIV, and mental health for adolescents and their children; however, it is likely that there are longer term impacts of such experiences that warrant exploration. For example, how does the trajectory of development among children born to adolescent mothers change over time? Are the minor differences in development scores between children born to adolescent mothers who are classified as HEU and those classified as HU (see section **6.3.4**) retained as children grow older? Are there long-term impacts of the experience of adolescent pregnancy for maternal mental health? The availability of longitudinal data would also allow for the investigation of possible causal pathways for likely common mental disorder as well as the identification of mediating factors within such relationships. Due to the COVID-19 pandemic and the resulting restrictions implemented within South Africa, the second round of data collection for the ***HEY BABY study*** was delayed. These data were consequently not included within this thesis. At the time of the submission of this thesis, data collection activities have resumed telephonically, and the candidate plans to continue the lines of enquiry within this thesis (including exploring mental health within the context of COVID-19) within her postdoctoral activities.

8.4.3 Qualitative research

This thesis presents quantitative data only. As such, these data and the explorations undertaken as part of this thesis lack contextual insight that could be gleaned from qualitative data analyses. Qualitative studies may be particularly valuable within, 1) the exploration of mental health experience for adolescents inclusive of conceptualisations of mental health, social and contextual factors/systems which may impact on mental health experience (e.g., social support networks), 2) developing further understanding of pregnancy and parenting experience (including risk and protective factors for mental ill-health), and 3) the acceptability and feasibility of interventions to support mental health and wellbeing among this population. Qualitative explorations are beginning to be undertaken,[88,325,326] however further research is required to broaden the scope and generalisability of findings.

8.4.4 Exploring the population of interest further

Analyses within this thesis focused primarily on the experiences of adolescent mothers (10-19 years) and their first-born children. Future research would be well placed to explore outcomes for this population as they progress through childhood, adolescence and adulthood to identify those most at risk (i.e., of likely common mental disorder/poor child cognitive development outcomes) who may require intervention. Further research is also required to explore the concepts of likely common mental disorder and child cognitive development for multiparous mothers and their children (i.e., what is the mental health experience of adolescents experiencing repeat pregnancy, and how are their children faring?). While likely common mental disorder among adolescent fathers (identified within the ***Adolescent HIV study***) is explored within section **7.1** of this thesis, the sample size within this exploration was small, and therefore such analyses are likely underpowered. These data were supplemented with data relating to the fatherhood experience within the context of the research questions within this thesis from adolescent mother report (taken from the ***HEY BABY study***), however, future research focusing on the mental health and parenting experience of fathers of children born to adolescent mothers

(including adolescent fathers) is needed to accurately represent the experience of these fathers within the context of HIV in South Africa.

The works within thesis provide only an initial exploration relating to the mental health experience of adolescent parent families. The candidate deemed it important to provide an overview of mental health experience (i.e., prevalence, risk factors, possible relationships with child cognitive development) as a foundational step in building the evidence base in relation to an absence of existing research. Yet, these works are not wholly comprehensive, and the studies from which data was drawn for use in this thesis (the ***Adolescent HIV***, and ***HEY BABY study***) were not specifically set up to explore mental health. As such, aspects of mental health experience were not investigated and would be well placed to be explored in future research. Possible examples include:

1. Exploring adolescent mental health within the postpartum period – much of the existing literature on maternal mental health focuses on postnatal depression, and investigations within this period may allow for specificity relating to mental health within the early parenting experience
2. Exploring positive mental health such as resilience - the analyses in this thesis focused on the presence and absence of likely common mental disorder as it was not possible to look at specific measures of positive mental health
3. Examining a broader range of risk and protective factors for poor mental health inclusive of exploring the concept of stigma and factors such as caregiver support
4. Further explorations of the experience of children born to adolescent mothers affected by HIV including the examination of a broader range of risk and protective factors for child cognitive development (including pathways in which parental characteristics may impact on child outcomes e.g., how maternal education interruption may impact on child cognitive development), and explorations of child development outcomes beyond the focus on child cognitive development

5. Exploring the impact of mode of HIV acquisition in relation to the mental health and wellbeing of adolescent parent families
6. Further comparisons with adult mother-child dyads in South Africa and the broader sub-Saharan African region beyond explorations of child cognitive development
7. Further explorations of fatherhood and the impact of father characteristics (e.g., involvement) on outcomes for adolescent parent families including extending investigations beyond the biological father (e.g., to male partners of adolescent mothers who are not the father of their child)

8.4.5 Interventions for parental common mental disorder & child cognitive development

The findings within this thesis highlight the potential importance of interventions for the prevention and treatment of likely common mental disorder among adolescent parents affected by HIV, and interventions to support the cognitive development of children born to adolescent mothers. Yet, successful intervention may be impeded by the sparse data focusing on mental disorder within low- and middle-income countries, particularly for adolescents. The systematic review undertaken as part of this thesis (**Chapter 2**) identified no existing studies exploring interventions for likely common mental disorder specifically among adolescents experiencing pregnancy within the context of HIV. Analyses within **Chapter 5** identify risk factors for likely common mental disorder among adolescent mothers affected by HIV as being exposure to violence and a lack of social support. Given this, further research is required to explore violence prevention interventions and social support in the context of likely common mental disorder among adolescent parents. Other possible modifiable factors which may be associated with (or mediating associations) with likely common mental disorder require exploration to inform effective provision and identify groups who may be particularly vulnerable to experiencing mental ill-health.

The effectiveness and acceptability of interventions already in place in the treatment or prevention of likely common mental disorder among adolescents (including those living with HIV) and/or parents within sub-Saharan Africa (e.g., the Philani

intervention, in which home-based visits from community health workers improved both maternal mental health and child development outcomes among HIV affected adults[541]) should be explored among adolescent parents living with or affected by HIV, as adaptation of programmes/interventions to the specific needs of adolescent parents (i.e., age appropriateness of materials or the addition of a parenting component) may be required. Similarly, the effectiveness of existing interventions to support cognitive development should be explored among children born to adolescent mothers in the context of HIV. Possible beneficial interventions which have previously been found to be effective include cognitive stimulation (e.g., book sharing) and parenting interventions. However, again, these programmes may require adaptation to the specific needs of adolescent parent families. Should such interventions be acceptable and effective, explorations of cost-effectiveness, scalability, and sustainability may be required to ensure provision effectively reaches and supports the target population of adolescent parent families.

Given the intersection of difficulties experienced by these adolescents and their children (i.e., adolescent pregnancy, HIV, and environmental challenges), combinations of interventions may be required to attenuate the impact of multiple possible vulnerabilities. Recent studies have explored the impact of combinations of interventions on multiple outcomes of health and wellbeing among adolescents in sub-Saharan Africa (see section **8.5.8** for an overview of the concept behind such studies) and have identified effectiveness. Similar investigations exploring the impact of multiple interventions (e.g., childcare access, cash grant receipt) on multiple health and wellbeing outcomes (e.g., maternal mental health, school enrolment, child cognitive development) for adolescent mothers and their children in the context of HIV are currently ongoing. Yet, further examinations of different combinations of provision are required.

8.4.6 Impacts of COVID-19 on adolescent parent families affected by HIV

As mentioned above in section **8.2.6**, the impact of the COVID-19 pandemic has led to a rise in adolescent pregnancies,[138,534-536] and poor mental health globally.[531-533] As

such, the topics of focus within this thesis are potentially more important now than at the time of the commencement of this thesis. Mental health difficulties among the general population increased during the COVID-19 pandemic, which has led to mental health being highlighted within global research and policy agendas.[542-544] However, as detailed in section **8.2.6**, funding priorities may have shifted. To ensure that adolescent parent families affected by HIV are not side-lined from research and policy agendas, up to date research is required including an understanding of the current (post COVID-19 onset) needs of this population and impacts specifically relating to COVID-19 (e.g., impacts of national lockdowns).

8.4.7 Planned next steps

The works within this thesis provide an initial exploration of mental health within the context of adolescent parent families affected by HIV and have given rise to unexplored questions relating to this population. As such, there remains a need for further evidence relating to the mental health of this group. Utilising both the data used in this thesis and available longitudinal data, analyses beyond the works presented in this thesis are ongoing within the candidate's postdoctoral activities. Ongoing and planned analyses (at the time of submission) include:

1. Longitudinal explorations of the prevalence of likely common mental disorder adolescent mothers living with and affected by HIV (pre and post COVID-19 onset)
2. Longitudinal explorations of risk and protective factors for maternal mental health among adolescent mothers living with and affected by HIV
3. Examinations of child cognitive development of children according to child HIV status (utilising maternal mode of HIV acquisition) to examine the generational impacts of HIV infection
4. Explorations of maternal mental health among multiparous adolescent mothers living with HIV and affected by HIV, and child development outcomes for children born to adolescent mothers living with and affected by HIV with siblings

5. Explorations of the impacts of childcare usage on child cognitive development among children born to adolescent mothers living with and affected by HIV
6. Examinations of maternal mental health among adolescent mothers living with and affected by HIV in relation to postpartum school return
7. Examinations of combinations of interventions to promote multiple health and wellbeing outcomes for adolescent mothers living with and affected by HIV and their children

8.5 Recommendations for policy and programming

The core priority emerging from the works in this thesis is the need for attention to be given to adolescent parent families in the context of HIV, and the need for a broader evidence base to allow for policy and programming to be adequately informed. While the works within this thesis focus on parental mental health, seemingly the experiences of adolescent parent families are complex, and adolescent parent families in the context of HIV face multiple vulnerabilities. Consequently, the findings within this thesis have numerous possible implications for policy and programming which span beyond the promotion of parental mental health for this population. This section provides an overview of some of the core recommendations for policy and programming based on the findings within this thesis. Moving forward, future policy and programming must identify and respond to need, explore the effectiveness of provision (what works best under which circumstances?), examine cost-effectiveness, and navigate how scalability and sustainability can be achieved.

8.5.1 Enhancing international data collection strategy

As mentioned in section **8.4.1**, it is not simply that data for adolescents experiencing pregnancy (both mothers and fathers) living with HIV does not exist, but often it is not available in an inaccessible format or clustered within broader groups. International data collection strategy often clusters adolescents with younger children or young adults (i.e., 0-17 years or 15 -24 years). As a result, data relating to adolescents (10-19 years) only is often not available. Thus, the potential needs of

adolescents often remain unknown, and this group often remain side-lined in research and policy agendas. One immediate way to enhance the profile of adolescents within such agendas would be to ensure that data is available for 10–19-year-olds to allow for the adequate assessment of need and experience.

8.5.2 Addressing the mental health needs of adolescent parent families affected by HIV

8.5.2.1 Enhancing screening and monitoring of mental health for adolescent parent families affected by HIV

To be able to effectively respond to mental health need and allocate resources, it is essential that need is assessed.[330] Hence, the screening and monitoring of mental health for adolescent parent families is essential. Amalgamating screening, monitoring and referral efforts with existing services accessed by adolescent parent families affected by HIV (i.e., antenatal care, postnatal care, HIV services, or provision for children born to adolescent mothers) may be of benefit. Based on the findings in this thesis, identifying and responding to mental health needs may have benefits for both the adolescent parent, and their child(ren). Screening and monitoring tools for mental health already being utilised in services primarily set up to serve adult populations (e.g., antenatal/postnatal care) may require adaptation to ensure that measurement is appropriate and meets the needs of adolescents.

8.5.2.2 Promoting mental health

There is a need to address the mental health needs of adolescent parent families in the context of HIV. Seemingly, this population may have needs which require specific intervention or the adaptation of existing interventions. To adequately support the development of such interventions further evidence relating to the mental health needs of adolescent parent families affected by HIV, including broader investigations of risk and protective factors for the mental health of group is required. There are, however, potential avenues of future mental health provision for adolescent mothers affected by HIV. For example, the peer-mentor delivered, Paediatric-Adolescent Treatment Africa's (PATA) Ask-Boost-Connect-Discuss intervention has been piloted

in Zambia, Uganda, Malawi & Tanzania.[136,545] Yet, the effectiveness of this intervention unknown at present.

The rapid evaluation and potential adaptation of existing successful models of mental health provision (both preventative and responsive) for adolescents, families, adolescent parents, and adolescents living with HIV may also inform mental health responses for this highly vulnerable group. For example, PRemIum for aDoLEscents (PRIDE), an effective transformative approach to provision in which a stepped series of evidence-based mental health interventions were implemented by lay counsellors in low-income schools in India. Adolescents received lay counsellor support alongside comic style booklets focused on problem solving and coping skills, or booklets alone. Remission rates ranged from 40-60%.[546] PRIDE is currently being piloted among HIV affected youth in Kenya. Further examinations of effective components, and the applicability beyond India and the school setting may provide insight for possible scalable avenues of intervention for adolescent parent families. Evidence based interventions for adult parents in high HIV prevalence settings which may also provide insight. For example, the Philani Intervention, where home-based visits from community health workers were found to improve both maternal mental health and child development outcomes in South Africa.[541]

Much of the existing provision to promote mental health focuses on the individual. Findings from this thesis identified broader contextual factors as being possible risk factors for poor mental health among adolescent mothers affected by HIV in South Africa - exposure to violence and a lack of social support. Given this, violence prevention interventions (e.g., economic interventions,[547] conflict resolution skill building[548]), and likewise social support interventions (e.g., group support[407]) may be of benefit to adolescent maternal mental health in this setting. However, adaptation may be required to support the needs of adolescent mothers.[547]

Clearly there is an urgent need for the development of evidence-based policy and programming for this group. Considerations for the future development of mental health provision include, the quality of services provided,[513] mode of delivery, a lack

of existing infrastructure for mental health provision (e.g., a lack of trained mental health professionals may result in a need for task sharing), the involvement of adolescent parent families affected by HIV within the development of services, the integration of provision within existing services accessed by the population of interest (which may allow for low-cost, scalable provision), and the potential need for a familial-level lens to promote benefits for parents, and across generations.

8.5.3 Bolstering the cognitive development of children born to adolescent mothers

It is important not to forget the children of adolescent mothers within policy and programming agendas. Findings from this thesis identify children born to adolescent mothers (particularly those living with or exposed to HIV) as being at risk for cognitive adversity. Given this, there is an urgent need to bolster cognitive development among this group. Existing provision including early childhood stimulation (i.e., book sharing which have been evaluated within the South African context[448]), and parenting interventions (particularly those including a responsive caregiving component)[449] may provide promising avenues of interventions for children born to adolescent mothers in the context of HIV. However, given the paucity of research available relating to children of adolescent mothers in the context of HIV, existing provision may require adaptation to meet the specific needs of such children and their families. Adaptation of provision implemented outside of South Africa may also require adaptation to the South African context. Inherently, future evaluation of the effectiveness of existing intervention for the population of interest, as well as investigations of scalability and sustainability will be required to ensure effective support. However, in the meantime, targeting provision particularly among younger adolescent mothers and those with lower educational attainment may identify those families who may be most in need (see **Chapter 6**).

8.5.4 Supporting father engagement

Fathers should not be forgotten in efforts to support adolescent mothers and their children in the context of HIV, as inclusion may have benefits for fathers, adolescent

mothers, and their children. There are clear benefits to father engagement (see section **7.2**) and interventions to promote father involvement may also be of benefit (e.g., within PMTCT efforts, antenatal, postnatal care). Existing provision to support male partner engagement (e.g., community outreach)[493] may require adaptation to the needs of adolescent fathers and/or fathers of children born to adolescent mothers. Likewise, broader couple/family-level provision should be carefully designed to ensure any specific needs of adolescent parent families are being addressed (i.e., consideration should be given to couple dynamics).[493]

8.5.5 Promoting provision for sexual and reproductive health among adolescents

Sexual and reproductive health interventions are often the focus of research and policy in relation to adolescent pregnancy. Data presented in this thesis, identify that 87.7% of pregnancies among young mothers within the **HEY BABY study** were unplanned and unwanted (see **Table 3-3**). These data suggest that there remains a critical need for knowledge and services relating to sexual and reproductive health among adolescents. Provision focusing on contraception and risk management may aid in assisting adolescents to delay pregnancy until they are older, which may have benefits for both adolescents, and their children (see section **6.2**). Yet, to ensure the prosperous development of future generations, pregnancy prevention efforts alone are not sufficient, and the needs of pregnant and parenting adolescents should be included within adolescent pregnancy prevention efforts and sexual and reproductive health services. As such, efforts to promote sexual and reproductive health should include both adolescents who have not experienced pregnancy, and those who have experienced pregnancy – as delaying pregnancy may have benefits in relation to both first-born children and subsequent children thereafter.

8.5.6 Prevention of vertical HIV transmission

The promotion of prevention of vertical HIV transmission among adolescent mothers and their children, HIV testing, and adherence to ART during pregnancy, the postpartum period and beyond should remain a core policy agenda. PMTCT of HIV

has benefits for both adolescent mothers and their children - decreasing the number of children living with HIV within future generations, and thus having potential benefits for child development outcomes (see section **1.7** and section **6.3**). Such efforts would also support global targets to eliminate mother to child transmission of HIV. Existing PMTCT programmes may require adaptation to respond to adolescent needs and ensure engagement. Previous research has highlighted that retention in HIV care and adherence to ART among adolescents were improved by factors such as adequate stocks of medication, staff with time for adolescents, adolescents being accompanied to clinics, adequate finances to get to the clinic safely, and staff who were kind.[122] Similar factors many need to be considered in the development of adolescent friendly PMTCT services.

However, focusing on PMTCT should not neglect the needs of children already living with HIV or the growing number of children who are classified as HEU (as a result of successful PMTCT efforts). Hence, the promotion of cognitive development among these groups should remain an ongoing consideration to promote potential within future generations.

8.5.7 Promoting educational attainment among female adolescents

There is a bidirectional relationship between school dropout and adolescent pregnancy – as school dropout may lead to adolescent pregnancy and vice versa, adolescent pregnancy may lead to school dropout. Seemingly, educational attainment among adolescent mothers may benefit child cognitive development (see section **6.2**). Hence, postpartum school return may have benefits for both adolescent mothers and their children. Whilst the South African Department of Education supports the continued education of pregnant girls and young mothers, at least a quarter of adolescents might discontinue school during the pregnancy[461] and a large proportion of young mothers do not manage to return to school postpartum.[147,458-460,483] While an enabling policy-environment is of benefit, additional efforts that facilitate adolescents continued school enrolment during pregnancy and their timely return to school after birth are needed to encourage adolescent mother educational attainment. Currently, there are a lack of evidence-based programmes that

successfully address adolescent mothers' potential hurdles to return to school, for example financial and childcare provisions. Developing further understanding of such hurdles and responding to these needs may encourage both school return and educational attainment, and in turn have positive impacts for child cognitive development, and as such our future generations.

8.5.8 Combinations of interventions to promote outcomes for adolescent parent families – a way forward?

The experiences of adolescent parent families in the context of HIV are seemingly complex, as this group experiences multiple syndemics of risk and vulnerability. Thus, siloed interventions may not provide sufficient support, and multiple interventions may be required to address different vulnerabilities (i.e., poor maternal mental health, poor child cognitive development). Similarly, multiple interventions may be required to address single vulnerabilities which may have impacts across generations (i.e., poor maternal mental health). For instance, the findings within this thesis indicate that possible contributors to poor maternal mental health span beyond the individual level and may also include factors from the broader social environment. Consequently, a broader array of interventions may be required to address poor maternal mental health. Provision recipient may also differ (i.e., adolescent mother, father, child(ren)) based on need. Combinations of interventions targeting adolescent parent families may therefore be a promising future directive for effective provision for this group. An example of an intervention with multiple components previously utilised is the Determined, Resilient, Empowered, AIDS-free, Mentored, and Safe (DREAMS) initiative. DREAMS provided combinations of provision for female adolescents affected by HIV inclusive of social protection (e.g., cash transfers), parenting programmes, and sexual and reproductive health provision.[549] Possible effective combinations of provision for adolescent parent families will require further investigation however, promising avenues of interest include mental health support, parenting programmes, and early child stimulation.

Similarly, identifying single provision that has a simultaneous impact on a range of outcomes, as demonstrated by the concept of *development accelerators* (supported

by the United Nations Development Programme),[550] may also be of benefit among this population – particularly within the new global reality of reduced fiscal capacity of government and organisations. Combinations of *accelerators* have also been found to have a greater reach of beneficial effects compared to single *accelerators* alone (e.g., among adolescents living with HIV receiving three *accelerators* in combination had positive impacts for education, health, gender equity and violence prevention outcomes).[551] Such combinations may also allow for benefits across multiple generations (e.g., adolescent mothers and their children). Which combinations of *accelerators* may benefit adolescent parent families affected by HIV are currently unknown, however, this is currently being tested. The concept of *accelerators* holds compelling potential for the future of provision for this group. Future priorities include identifying *accelerators* that respond directly to the identified vulnerabilities among adolescent parent families (e.g., those outlined in this thesis), evaluating the cost-effectiveness of *accelerator* combinations, and if appropriate, exploring implementation.

8.6 Conclusions

The analyses within this thesis address a critical evidence gap. They form the largest exploration of mental health among adolescent parent families within the context of HIV globally. These analyses explore mental health utilising data relating to three groups (adolescent mothers, children born to adolescent mothers, and the fathers of children born to adolescent mothers) and broaden previous investigations (which frequently focus on depression) to explore an array of mental health symptomologies. The findings from this thesis highlight; 1) adolescent mothers (particularly those living with HIV) as being at risk of poor mental health symptoms, 2) violence exposure and a lack of social support as potential risk factors for poor mental health among adolescent mothers, 3) the potential impact of poor adolescent maternal mental health on child development outcomes (specifically child cognitive development), 4) the possible need for specific intervention for children born to adolescent mothers living with HIV (e.g., efforts to bolster cognitive development - particularly among children whose mothers' have reported post-traumatic stress

symptoms, children living with HIV, and children who are HIV-exposed uninfected-may be of benefit), 5) the need to explore the mental health of adolescent fathers (particularly those living with HIV) within sub-Saharan Africa, and 6) the need to build knowledge relating to the fathers of children born to adolescent mothers and support engagement among this group. Seemingly, this population may have needs which require specific intervention or the adaptation of existing provision. There is an urgent need to support adolescent parent families affected by HIV in South Africa, and mental health provision should be key within future support efforts. Future investment is required to enhance the mental health of such families. Core immediate priorities include building a more extensive evidence base (utilising a family-level lens) to allow for policy and programming efforts to be adequately informed, introducing routine mental health screening (e.g., within existing services), and evaluating the effectiveness of existing mental health provision among this population. Explorations of scalability and sustainability should also be considered to ensure enduring support across generations. The works within this thesis provide a foundation for future works. However, in the interim, these works contribute to emphasising the needs of adolescent parent families within South Africa as well as the need for services for this population, and, in turn, hopefully contribute to the future wellbeing of adolescent parents, their children, and future generations.

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Chapter 9 Appendices

9.1 Appendix 1

Allied works

Articles in peer reviewed journals

2022

Sherr, L., Mebrahtu, H., Mwaba, K., Nurova, N., Chetty, A. N., Swartz, A., Cluver, L., **Steventon Roberts, K.J.** & Lachman, J. M. (2022). 'Tipping the balance'–an evaluation of COVID-19 parenting resources developed and adapted for child protection during global emergency responses. Health Psychology and Behavioral Medicine, 10(1), 676-694. https://doi.org/10.1080/21642850.2022.2104285

Sherr, L., Haag, K., Tomlinson, M., Rudgard, W. E., Skeen, S., Meinck, F., Du Toit, S., **Steventon Roberts, K.J.**, Gordon, S., Desmond, C. & Cluver, L. (2022). Understanding accelerators to improve SDG-related outcomes for adolescents–an investigation into the nature and quantum of additive effects of protective factors to guide policy making. PLoS ONE.

Haag, K., Du Toit, S., Skeen, S., **Steventon Roberts, K.**, Chideya, Y., Notholi, V., ... & Tomlinson, M. (2022). Predictors of COVID-related changes in mental health in a South African sample of adolescents and young adults. Psychology, Health & Medicine, 1-17. https://doi.org/10.1080/13548506.2022.2108087

Du Toit, S., Haag, K., Skeen, S., Sherr, L., Orkin, M., Rudgard, W. E., Marlow, M., Mebrahtu, H., **Steventon Roberts, K.J.** & Tomlinson, M. (2022). Accelerating progress towards improved mental health and healthy behaviours in adolescents living in adversity: findings from a longitudinal study in South Africa. Psychology, Health & Medicine, 1-13. https://doi.org/10.1080/13548506.2022.2108081

Mebrahtu, H., Skeen, S., Rudgard, W. E., Du Toit, S., Haag, K., **Roberts, K. J.**, ... & Sherr, L. (2022). Can a combination of interventions accelerate outcomes to deliver on the Sustainable Development Goals for young children? Evidence from a longitudinal study in South Africa and Malawi. Child: Care, Health and Development, 48(3), 474-485. https://doi.org/10.1111/cch.12948

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Mebrahtu, H., Skeen, S., Rudgard, W. E., Toit, S. D., Haag, K., **Roberts, K.J.**, ... & Sherr, L. (2021). Combined interventions to accelerate delivery on outcomes for young children affected by HIV in southern Africa. Journal of the International AIDS Society, 24(S4), 47-49.

Quinlan-Davidson, M., **Roberts, K.J.**, Devakumar, D., Sawyer, S. M., Cortez, R., & Kiss, L. (2021). Evaluating quality in adolescent mental health services: a systematic review. BMJ open, 11(5), e044929. http://dx.doi.org/10.1136/bmjopen-2020-044929

Sherr, L., **Roberts, K.J.**, Tomlinson, M., Skeen, S., Mebrahtu, H., Gordon, S., ... & Cluver, L. D. (2021). Food Should not be Forgotten: Impacts of Combined Cash Transfer Receipt and Food Security on Child Education and Cognition in South Africa and Malawi. AIDS and Behavior, 1-12. https://doi.org/10.1007/s10461-021-03317-6

2020

Sherr, L., **Roberts, K.J.**, Mebrahtu, H., Tomlinson, M., Skeen, S., & Cluver, L. D. (2020). The food of life: an evaluation of the impact of cash grant receipt and good parenting

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Roberts, K.J., Gordon, S., Sherr, L., Stewart, J., Skeen, S., Macedo, A., & Tomlinson, M. (2020). 'When you are a data collector you must expect anything'. Barriers, boundaries, and breakthroughs: insights from the South African data-collection experience. Global Health Promotion, 27(2), 54-62. https://doi.org/10.1177/1757975918811093

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Sherr, L., **Roberts, K.J.**, & Croome, N. (2019). Parenting concepts and experiences of adults abandoned as infants. Vulnerable Children and Youth Studies, 14(1), 36-49. https://doi.org/10.1080/17450128.2018.1554866

2018

Sherr, L., **Roberts, K.J.** & Croome, N. (2018). Disclosure and identity experiences of adults abandoned as babies: A qualitative study. Cogent Psychology, 5(1), 1473744. https://doi.org/10.1080/23311908.2018.1473744

Macedo, A., Sherr, L., Tomlinson, M., Skeen, S. & **Roberts, K.J.** (2018). Parental Bereavement in Young Children Living in South Africa and Malawi: Understanding Mental Health Resilience. Journal of Acquired Immune Deficiency Syndromes, 78(4), 390-398. https://doi.org/10.1097/qai.0000000000001704

Sherr, L., **Roberts, K.J.**, Hothi, S. & Balchin, N. (2018). Never too old to learn: parenting interventions for grandparents - a systematic review. Cogent Social Sciences, 4 (1), 1-22. https://doi.org/10.1080/23311886.2018.1508627

Reports/policy engagement activities:

Sherr, L., Cluver, L., Tomlinson, M., Idele, P., Banati, P., Anthony, D., **Roberts, K.J.**, Haag, K. & Hunt, X. (2021). Mind Matters: Lessons from past crises for child and adolescent mental health during COVID-19. Prepared for UNICEF Office of Research-Innocenti.

Sherr, L., Cluver, L., Tomlinson, M., Idele, P., Banati, P., Anthony, D., **Roberts, K.J.**, Haag, K. & Hunt, X. (2020). Accelerated solutions to COVID-19: Societal impacts and responses for children, adolescents, families, and communities. Prepared for UNICEF Office of Research-Innocenti.

Roberts, K.J. & Sherr, L. (2020). The impact of social protection (cash grants & good nutrition) on child educational and cognitive outcomes in South Africa and Malawi. Prepared for the Collation for Children Affected by AIDS. Accompanying interview: https://childrenandhiv.org/blog/university-college-london-researcher-discusses-award-winning-project-utilizing-childcare-data/. Accompanying webinar: https://www.youtube.com/watch?v=pWC4Avs5_fs.

Sherr, L & **Roberts, K.J.** (2019). Learning through play: Lessons learned report. Prepared for Save the Children, Denmark.

Sherr, L. & **Roberts, K.J.** (2018). Promoting cognitive development for young children in South Africa. Prepared for One-to-One Children's Fund.

Conference Presentations:

Steventon Roberts, K.J. et al. 2022: HIV & Pediatrics 2022: Paper: Repeat-motherhood among adolescents living with HIV in South Africa. Montreal, Canada, July (Poster presentation).

Roberts, K.J. 2021: International AIDS Society Conference: Paper: Impact of social protection (combined cash transfer receipt and food security) on child cognition and education for children affected by HIV in South Africa and Malawi. Remote, July. (Poster presentation).

Roberts, K.J. 2019: AIDS Impact 14th International Conference: Paper: Mental wellbeing amongst caregivers of HIV-affected children in South Africa: An exploratory analysis of predictors of positive mental health and its implications for child wellbeing. London, UK. July.

Roberts, K.J. 2019: 9th South African AIDS Conference: Paper: Mental wellbeing amongst caregivers of HIV-affected children in South Africa: predictors of positive mental health and its implications for child wellbeing. Durban, South Africa. June. (Poster presentation). Workshops/Invited talks (selection):

Workshops/Invited talks:

Roberts, K.J. 2021: Is that a patch of blue sky? Play, Joy and Learning webinar hosted by the University of Greenwich. Keynote: COVID-19: Accelerated solutions for children and adolescents. Remote, June.

Roberts, K.J. 2021: Harnessing social protection to improve HIV outcomes for children and adolescents webinar hosted by The Coalition for Children Affected by AIDS (400+ attendees). Remote, February.

9.2 Appendix 2

Appendices for **Chapter 4**

Table 9-1 Sample characteristics according to HIV status (female adolescents [10-19 years], n=723)

	N(%)/M(IQR)/M(SD)			t / X^2, p-value
	Total sample (n=723)	**Living with HIV (n=510)**	**Not living with HIV (n=213)**	
Sociodemographic characteristics				
Current age (years)	15 (13-18)	15 (13-18)	16 (13-18)	**6.63, 0.01**
Dwelling location (rural)*	195 (27.1%)	133 (26.2%)	62 (29.1%)	0.65, 0.42
Housing (informal)*	109 (15.4%)	84 (16.8%)	25 (11.9%)	2.87, 0.09
Orphanhood status (one or both parents have died)	381 (52.7%)	301 (59.0%)	80 (37.6%)	**27.76, <0.0001**
School enrolment (yes)	628 (86.9%)	447 (87.6%)	181 (85.0%)	0.94, 0.33
Cash grant receipt (yes)	677 (93.6%)	480 (94.1%)	197 (92.5%)	0.67, 0.41
Adolescent pregnancy				
Sexually active	315 (43.6%)	197 (38.6%)	118 (55.4%)	**17.19, <0.0001**
Age of sexual debut (years)*	16 (15-17)	16 (15-17)	16 (15-17)	0.01, 0.92
Adolescent motherhood (ever)	110 (15.2%)	61 (12.0%)	49 (23.0%)	**14.20, <0.0001**

	N(%)/M(IQR)/M(SD)			*t* / X^2, *p*-value
	Total sample (n=723)	**Living with HIV (n=510)**	**Not living with HIV (n=213)**	
Reported age of last pregnancy (years)*				8.74, 0.19
14	4 (3.6%)	2 (3.3%)	2 (4.1%)	
15	19 (17.3%)	6 (9.8%)	13 (26.5%)	
16	19 (17.3%)	10 (16.4%)	9 (18.4%)	
17	28 (25.5%)	15 (24.6%)	13 (26.5%)	
18	28 (25.5%)	19 (31.2%)	9 (18.4%)	
19	10 (9.1%)	7 (11.5%)	3 (6.1%)	
20 (became pregnant when 19 years and currently pregnant)	2 (1.8%)	2 (3.3%)	0 (0.0%)	
Reported age of last pregnancy (years)*	17 (16-18)	17 (15-18)	17 (16-18)	6.69, 0.009
Unplanned*	80 (98.8%)	34 (97.1%)	46 (100%)	1.33, 0.25
Unwanted*	80 (98.8%)	34 (97.1%)	46 (100%)	1.33, 0.25
Total number of pregnancies*				**13.71, 0.003**
None	492 (81.7%)	354 (85.3%)	138 (73.8%)	
1	102 (16.9%)	56 (13.5%)	46 (24.6%)	
2+	8 (1.3%)	5 (1.2%)	3 (1.6%)	
Total number of children*				**11.63, 0.003**

	N(%)/M(IQR)/M(SD)			*t* / X^2, *p*-value
	Total sample (n=723)	**Living with HIV (n=510)**	**Not living with HIV (n=213)**	
None	492 (81.7%)	354 (85.3%)	138 (73.8%)	
1	102 (16.9%)	56 (13.5%)	46 (24.6%)	
2	8 (1.3%)	5 (1.2%)	3 (1.6%)	
Mental health symptoms				
Any common mental disorder	79 (10.9%)	52 (10.2%)	27 (12.7%)	0.95, 0.33
Any mental health comorbidities	20 (2.8%)	12 (2.4%)	8 (3.8%)	1.10, 0.29
Any depressive symptoms	50 (6.9%)	33 (6.5%)	17 (8.0%)	0.53, 0.47
Depressive symptoms score (0-10)	0.65 (1.21)	0.63 (1.14)	0.69 (1.36)	0.66, 0.51
Any anxiety symptoms	10 (1.4%)	5 (1.0%)	5 (2.4%)	2.06, 0.15
Anxiety symptoms score (0-14)	1.15 (2.20)	1.03 (2.00)	1.43 (2.59)	**2.27, 0.02**
Any posttraumatic stress symptoms	4 (0.6%)	1 (0.2%)	3 (1.4%)	4.01, 0.08
Posttraumatic stress symptoms score (0-19)	0.89 (1.97)	0.85 (1.76)	0.99 (2.38)	0.87, 0.38
Any suicidality symptoms	44 (6.1%)	29 (5.7%)	15 (7.0%)	0.48, 0.49
Suicidality symptoms scores (0-5)	0.16 (0.73)	0.16 (0.75)	0.15 (0.68)	-0.06, 0.95

*Available data (total n included in analyses): Dwelling location (n=721) | Housing (n=709) | Age of sexual debut (n=242) only reported for those who reported being sexually active | Unplanned (n=81) only reported for those who reported motherhood | Unwanted (n=81) only reported for those who reported motherhood | Total number of pregnancies (n=602) | Total number of children (n=602). Any symptoms represent scoring above the pre-determined cut-off for the measures see section 3.4.

Table 9-2 Mental health symptom scores stratified according to adolescent motherhood status (female adolescents [10-19 years], n=723)

Mental health symptom scores	M (SD)			*t*, *p*-value
	Total sample (n=723)	Adolescent mother (n=110)	Never pregnant adolescent (n=613)	
Depressive symptoms scores (0-10)	0.65 (1.21)	0.84 (1.59)	0.62 (1.13)	-1.77, 0.08
Anxiety symptoms scores (0-14)	1.15 (2.20)	1.59 (2.75)	1.07 (2.08)	**-2.32, 0.02**
Posttraumatic stress symptoms scores (0-19)	0.89 (1.97)	0.75 (1.46)	0.92 (2.04)	0.85, 0.40
Suicidality symptoms scores (0-5)	0.16 (0.73)	0.35 (1.06)	0.12 (0.65)	**-2.95, 0.003**

Table 9-3 Mental health symptoms stratified according to combined motherhood and HIV status (female adolescents [10-19 years], n=723)

	N (%) / M(SD)					t /X^2, p-value
	Total sample (n=723)	**No HIV & never pregnant (n=164)**	**No HIV & motherhood (n=49)**	**HIV & never pregnant(n=449)**	**HIV & motherhood (n=61)**	
Mental health symptoms (prevalence)						
Any common mental disorder	79 (10.9%)	21 (12.8%)	6 (12.2%)	38 (8.5%)	14 (23.0%)	**12.54, 0.006**
Any mental health comorbidities	20 (2.8%)	4 (2.4%)	4 (8.2%)	7 (1.6%)	5 (8.2%)	**14.49, 0.002**
Any depressive symptoms	50 (6.9%)	13 (7.9%)	4 (8.2%)	23 (5.1%)	10 (16.4%)	**11.13, 0.01**
Any anxiety symptoms	10 (1.4%)	3 (1.8%)	2 (4.1%)	3 (0.7%)	2 (3.3%)	**6.14, 0.04**
Any posttraumatic symptoms	4 (0.6%)	3 (1.8%)	0 (0.0%)	1 (0.2%)	0 (0.0%)	6.36, 0.18
Any suicidality symptoms	44 (6.1%)	10 (6.1%)	5 (10.2%)	20 (4.5%)	9 (14.8%)	**11.56, 0.009**
Mental health symptoms scores						
Depressive symptoms scores (0-10)	0.65 (1.21	0.71 (1.33)	0.63 (1.45)	0.58 (1.04)	1 (1.68)	2.10, 0.55
Anxiety symptoms scores (0-14)	1.15 (2.20)	1.43 (2.52)	1.45 (2.84)	0.93 (1.87)	1.70 (2.70)	6.88, 0.08
Posttraumatic stress symptoms scores (0-19)	0.89 (1.97)	1.15 (2.64)	0.45 (0.98)	0.83 (1.77)	0.98 (1.73)	1.49, 0.68
Suicidality symptoms scores (0-5)	0.16 (0.73)	0.12 (0.57)	0.27 (0.95)	0.12 (0.67)	0.41 (1.14)	1.99, 0.57

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health), Mental health comorbidities (experiencing two or more common mental disorders concurrently). Any symptoms represent scoring above the pre-determined cut-off for the measures see section 3.4.

9.3 Appendix 3

Appendices for **Chapter 5.**

Table 9-4 Maternal age at birth of first-born child among adolescent mothers (n=1002)

Maternal age at birth of first child (years)	Frequency (n)	Percentage of sample (%)
11	1	0.1%
12	3	0.3%
13	16	1.6%
14	76	7.6%
15	153	15.3%
16	222	22.2%
17	240	24.0%
18	197	19.7%
19	94	9.4%

Table 9-5 Mental health symptoms among adolescent mothers stratified according to maternal HIV status (n=1002)

Mental health symptoms	N (%) / M(SD)			*t/X²*, *p*-value
	Total sample (n=1002)	Living with HIV (n=272)	Not living with HIV (n=730)	
Any common mental disorder	126 (12.6%)	44 (16.2%)	82 (11.2%)	**4.41, 0.04**
Any mental health comorbidities	27 (2.7%)	12 (4.8%)	14 (1.9%)	**6.19, 0.01**
Any depressive symptoms	81 (8.1%)	31 (11.4%)	50 (6.9%)	**5.52, 0.02**
Depressive symptoms scores (0-10)	0.73 (1.44)	0.94 (1.73)	0.64 (1.30)	**-2.96, 0.003**
Any anxiety symptoms	8 (0.8%)	3 (1.1%)	5 (0.7%)	0.44, 0.51
Anxiety symptoms scores (0-14)	0.74 (1.86)	0.58 (1.80)	0.79 (1.88)	1.61, 0.12
Any posttraumatic stress symptoms	6 (0.6%)	2 (0.7%)	4 (0.6%)	0.12, 0.67
Posttraumatic stress symptoms scores (0-12)	0.81 (1.54)	0.86 (1.60)	0.79 (1.52)	-0.61, 0.54
Any suicidality symptoms	64 (6.4%)	23 (8.5%)	41 (5.6%)	2.67, 0.10
Suicidality symptoms scores (0-5)	0.18 (0.81)	0.30 (1.09)	0.14 (0.68)	**-2.74, 0.006**

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Mental health comorbidities (experiencing two or more common mental disorders concurrently) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section 3.4.

Table 9-6 Abuse experience among adolescent mothers stratified according to mental health status (n=1002)

	Total sample (n=1002)	Any common mental disorder (n=126)	No common mental disorder (n=876)	X^2, *p*-value
Emotional abuse	39 (3.9%)	15 (11.9%)	24 (2.74%)	24.74, <0.0001
Physical abuse	14 (1.4%)	6 (4.8%)	8 (0.9%)	11.84, 0.001
Sexual abuse	44 (4.4%)	14 (11.1%)	30 (3.4%)	15.50, <0.0001

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Emotional abuse (weekly/monthly), physical abuse (weekly/monthly), sexual abuse (ever).

Table 9-7 Logistic regression models exploring associations between hypothesised risk factors and adolescent maternal mental health stratified according to maternal HIV (n=1002)

	Any common mental disorder															
	Living with HIV								Not living with HIV							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	AOR (95% CI)	*p*	AOR (95%CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*
Sociodemographic factors																
Maternal age at birth (years)	1.04 (0.82-1.31)	0.76	0.99 (0.76-1.27)	0.91	0.95 (0.73-1.25)	0.73	0.97 (0.74-1.28)	0.82	0.98 (0.82-1.17)	0.82	0.93 (0.76-1.13)	0.47	0.94 (0.77-1.14)	0.52	0.92 (0.76-1.13)	0.43
Child age (months)	1.00 (0.98-1.02)	0.86	0.99 (0.97-1.02)	0.78	0.99 (0.97-1.02)	0.66	0.99 (0.97-1.02)	0.66	1.02 (1.00-1.04	**0.02**	1.02 (1.00-1.04)	**0.01**	1.03 (1.01-1.04)	**0.007**	1.02 (1.00-1.04)	**0.02**
More than one child	2.58 (1.03-6.49)	**0.04**	1.85 (0.67-5.13)	0.24	1.97 (0.67-5.75)	0.22	2.05 (0.70-6.02)	0.19	1.11 (0.39-3.18)	0.85	0.81 (0.26-2.48)	0.71	0.69 (0.21-2.25)	0.54	0.79 (0.24-2.58)	0.70
In a relationship (current)	1.19 (0.56-2.54)	0.65	1.14 (0.49-2.65)	0.76	1.36 (0.56-3.30)	0.50	1.22 (0.49-3.04)	0.68	0.81 (0.50-1.31)	0.39	0.88 (0.52-1.50)	0.64	0.83 (0.48-1.43)	0.50	0.85 (0.49-1.46)	0.55
Living in a rural area	1.04 (0.48-2.23)	0.93	0.89 (0.37-2.10)	0.78	0.90 (0.37-2.22)	0.82	0.94 (0.37-2.35)	0.89	0.53 (0.30-0.96)	0.03	0.69 (0.36-1.31)	0.26	0.79 (0.41-1.53)	0.49	0.88 (0.45-1.72)	0.71
Informal housing	0.84 (0.39-1.82)	0.66	0.59 (0.25-1.42)	0.24	0.55 (0.22-1.36)	0.19	0.49 (0.19-1.24)	0.13	1.15 (0.66-2.00)	0.62	1.05 (0.57-1.91)	0.88	0.99 (0.54-1.85)	0.99	0.95 (0.51-1.78)	0.88
Individual level factors																
Any abuse	-	-	2.64 (0.66-10.54)	0.17	2.65 (0.66-10.72)	0.17	2.12 (0.50-8.99)	0.31	-	-	4.60 (1.89-11.17)	**0.001**	3.82 (1.53-9.56)	**0.004**	3.56 (1.42-8.91)	**0.007**
Lack of food security	-	-	1.92 (0.91-4.05)	0.09	1.61 (0.72-3.58)	0.25	1.51 (0.66-3.48)	0.33	-	-	0.52 (0.27-1.00)	0.05	0.49 (0.26-0.96)	**0.03**	0.52 (0.27-1.01)	0.05

	Any common mental disorder															
	Living with HIV								Not living with HIV							
	Model 1		Model 2		Model 3		Model 4		Model 1		Model 2		Model 3		Model 4	
	AOR (95% CI)	*p*	AOR (95%CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*	AOR (95% CI)	*p*
Lack of access to basic necessities	-	-	2.15 (0.59-7.79)	0.24	1.51 (0.41-5.63)	0.54	1.51 (0.40-5.71)	0.54	-	-	0.79 (0.43-1.45)	0.45	0.74 (0.40-1.38)	0.35	0.74 (0.40-1.37)	0.33
No grant receipt	-	-	0.86 (0.09-8.27)	0.89	0.69 (0.06-8.66)	0.78	0.92 (0.08-10.8)	0.95	-	-	1.53 (0.72-3.27)	0.28	1.69 (0.78-3.63)	0.18	1.60 (0.74-3.47)	0.23
Not in work or education	-	-	2.02 (0.81-5.05)	0.13	2.07 (0.78-5.48)	0.14	2.13 (0.79-5.74)	0.13	-	-	1.80 (1.04-3.13)	**0.04**	1.74 (1.00-3.05)	0.05	1.67 (0.95-2.94)	0.07
Age disparate relationship	-	-	0.99 (0.48-2.04)	0.97	1.22 (0.56-2.64)	0.62	1.11 (0.50-2.47)	0.79	-	-	1.39 (0.76-2.17)	0.34	1.33 (0.78-2.25)	0.29	1.34 (0.79-2.29)	0.28
Interpersonal level factors																
Lack of social support	-	-	-	-	5.05 (2.13-11.98)	**<0.001**	5.98 (2.44-14.69)	**<0.001**	-	-	-	-	3.28 (1.72-2.52)	**<0.001**	3.34 (1.75-6.39)	**<0.001**
Not supported during pregnancy	-	-	-	-	0.81 (0.31-2.12)	0.66	0.84 (0.31-2.27)	0.73	-	-	-	-	1.35 (0.72-2.52)	0.34	1.44 (0.77-2.71)	0.25
Community factors																
Exposure to community violence	-	-	-	-	-	-	2.97 (1.26-7.02)	**0.01**	-	-	-	-	-	-	1.62 (0.93-2.82)	0.09
	R2=0.02		**R2=0.07**		**R2=0.13**		**R2=0.16**		**R2=0.03**		**R2=0.07**		**R=0.10**		**R2=0.11**	

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health), Mental health comorbidities (experiencing two or more common mental disorders concurrently) |Logistic regression models sequential | Model 1. Multivariable model including all sociodemographic factors listed | Model 2. Multivariable model including all sociodemographic and individual- level factors listed | Model 3. Multivariable model including all sociodemographic, individual-, and interpersonal- level factors listed | Model 4. Multivariable model including all sociodemographic, individual-, interpersonal- and community- level factors listed

9.4 Appendix 4

Appendices for **Chapter 6**.

Pooled Mullen Scales of Early Learning t-scores from sub-Saharan Africa

Inclusion and exclusion criteria

Studies were included if Mullen t-scores (standardised scores) were clearly identifiable, and data was drawn from a sub-Saharan African population. Studies were excluded if child age and t-scores (for all domains of the Mullen Scales of Early Learning) we not identifiable, children in the sample were solely living with HIV or, were identified as having a developmental disability. When manuscripts were identified as being drawn from the same study, the manuscript with the largest/most representative sample was included within the pooled data. When samples included data stratified by HIV status (living with HIV, HIV exposed uninfected and, HIV unexposed uninfected) data was extracted for children who were HIV exposed uninfected and/or HIV unexposed uninfected.

Search strategy and selection criteria

Using a pre-determined search strategy, studies considered for inclusion within this review were identified through a systematic search of electronic bibliographic databases. Databases searched included: PsycINFO (1806-present) and, PubMed (including Medline, 1966-present). Search terms included all sub-Saharan African countries and “Mullen”. Citations within manuscripts selected for full-text review were also used to identify additional studies for inclusion with the pooled data. Database searches were undertaken in August 2021.

Data extraction

All titles and abstracts identified were examined for relevance. Full manuscripts of any potentially relevant studies were obtained and assessed for inclusion based on

the above inclusion criteria. Information extracted from relevant manuscript included publication detail, geographical location, sample details, methodology, details of measurement and standardised t-scores.

Data synthesis

Sample size and standardised Mullen t-scores were used to weight and calculate pooled data for Mullen t-scores from the sub-Saharan African region. Pooled data were also calculated according to whether children were HIV-exposed uninfected or developing as expected (based on sample characteristics detailed within studies included within the pooled data estimates).

Table 9-8 Cognitive development scores of children born to adolescent mothers compared to the Mullen Scales of Early Learning reference group

Child cognitive development (Mullen Scales of Early Learning; T-Scores)	***Mean (SD)***		***t, p*-value**
	Children born to adolescent mothers (n=954)	**Mullen Scales reference group (US population)**	
Composite score of early learning[a]	93.5 (21.3)	100 (20)	**-9.49, <0.0001**
Gross motor*	49.8 (12.5)	50 (10)	-0.56, 0.58
Visual reception	42.2 (14.0)	50 (10)	**-17.06, <0.0001**
Fine motor	43.9 (14.7)	50 (10)	**-12.86, <0.0001**
Receptive language	47.6 (13.5)	50 (10)	**-5.62, <0.0001**
Expressive language	51.7 (13.3)	50 (10)	**3.87, 0.0001**

[a]Early Learning Composite Score: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155) |*Gross motor scores n=848

Table 9-9 Cognitive development scores of children born to adolescent mothers according to maternal report of depressive symptoms (above cut-off; n=954)

	Depression symptoms (n=77)	No depression symptoms (n=877)	*t*, *p*-value
Gross motor*	48.3 (12.7)	49.9 (12.5)	0.98, 0.33
Visual reception	41.6 (14.6)	42.2 (14.1)	0.38, 0.71
Fine motor	43.8 (1.9)	43.9 (14.5)	0.07, 0.95
Receptive language	44.4 (13.5)	47.8 (13.4)	2**.16, 0.03**
Expressive language	50.8 (12.4)	51.7 (13.4)	0.60, 0.54
Composite score of early learning[a]	91.2 (22.5)	93.7 (21.2)	0.96, 0.34

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

Table 9-10 Cognitive development scores of children born to adolescent mothers according to maternal report of anxiety symptoms (above cut-off; n=954)

	Anxiety symptoms (n=8)	No anxiety symptoms (n=946)	*t*, *p*-value
Gross motor*	47.1 (12.2)	49.8 (12.5)	0.60, 0.55
Visual reception	39.1 (14.2)	42.2 (14.2)	0.61, 0.54
Fine motor	46.0 (17.3)	43.9 (14.6)	-0.41, 0.68
Receptive language	42.9 (14.4)	46.6 (13.5)	0.99, 0.32
Expressive language	53.9 (16.4)	51.7 (13.3)	-0.47, 0.64
Composite score of early learning[a]	92.1 (28.0)	93.4 (21.2)	0.18, 0.86

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

Table 9-11 Cognitive development scores of children born to adolescent mothers according to maternal report of posttraumatic stress symptoms (above cut-off; n=954)

	PTSD symptoms (n=6)	No PTSD symptoms (n=948)	*t*, *p*-value
Gross motor*	42.0 (10.7)	49.8 (12.5)	1.24, 0.21
Visual reception	33.7 (12.2)	42.2 (14.2)	1.47, 0.14
Fine motor	39.0 (14.1)	43.9 (14.7)	0.82, 0.41
Receptive language	38.2 (9.8)	47.6 (13.5)	**1.71, 0.09**
Expressive language	47.8 (14.9)	51.7 (13.3)	0.70, 0.48
Composite score of early learning[a]	81.3 (21.9)	93.5 (21.2)	1.40, 0.16

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

Table 9-12 Cognitive development scores of children born to adolescent mothers according to maternal report of suicidality symptoms (above cut-off; n=954)

	Suicidality symptoms (n=62)	No suicidality symptoms (n=892)	*t*, *p*-value
Gross motor*	50.5 (14.3)	49.7 (12.4)	-0.44, 0.66
Visual reception	42.0 (15.2)	42.2 (14.1)	0.09, 0.93
Fine motor	43.0 (14.6)	44.0 (14.7)	0.50, 0.61
Receptive language	47.2 (13.5)	47.6 (13.5)	0.19, 0.85
Expressive language	51.2 (12.5)	51.7 (13.4)	0.27, 0.79
Composite score of early learning[a]	92.6 (20.4)	93.5 (21.3)	0.33, 0.74

*Gross motor scores n=848 |[a]Composite score of early learning: Age standardised composite score of fine motor, visual reception, expressive language, receptive language domains (range 49-155).

Table 9-13 presents linear regression models exploring the cross-sectional associations between child HIV status and scores for individual developmental domains. Univariable analyses (model 1) present a similar stepwise pattern identified between child HIV status and individual developmental domain scores i.e., children living with HIV were found to perform worse across all developmental domains, reaching significance for visual reception, fine motor, and expressive language domains. This pattern was retained within multivariable analyses (model 2). With exploratory analyses exploring potential characteristics mitigating the relationship between child HIV status and individual developmental domain scores (model 3), maternal education interruption (being at least a school grade behind) was identified as a potential risk factor for reduced scores across all individual developmental domains. Older maternal age (at birth of child) was found to be associated with increased expressive language and receptive language scores (see **Table 9-13**).

Table 9-13 Linear regression models exploring the relationship between child HIV status and child cognitive development (individual development scales) among children born to adolescent mothers

	Gross motor skills		Visual reception				Receptive language		Expressive language	
	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
Model 1. (Univariable model) *										
HU (n=720)	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
HEU (n=189)	-2.83 (-4.97, -0.68)	0.01	-1.32 (-3.60, 0.96)	0.26	-2.70 (-5.01, -0.39)	**0.02**	-1.26 (-3.42, 0.90)	0.25	-1.08 (-3.20, 1.04)	0.32
HIV (n=11)	-5.02 (-13.24, 3.21)	0.23	-12.6 (-21.1, -4.18)	**0.003**	-13.6 (-22.2, -5.03)	**0.002**	-7.32 (-15.3, 0.71)	**0.07**	-12.2 (-20.1, -4.29)	**0.003**
Child age (months)	-0.23 (-0.31, -0.15)	**<0.0001**	-0.23 (-0.30, -0.17)	**<0.0001**	-0.23 (-0.30, -0.17)	**<0.0001**	-0.32 (-0.38, -0.27)	**<0.0001**	**-0.28 (-0.34, -0.22)**	**<0.0001**
Biological sex (female)	-0.81 (-2.52, 0.89)	0.35	0.27 (-1.5, 2.12)	0.77	-0.83 (-2.70, 1.05)	0.39	-1.39 (-3.14, 0.35)	0.12	-0.08 (-2.54, 0.90)	0.35
Number of necessities mother can afford (0-8)	0.03 (-0.35, -0.42)	0.87	0.30 (-0.11, -0.71)	0.16	0.26 (-0.16, 0.68)	0.22	0.29 (-0.10, 0.68)	0.15	0.15 (-0.23, 0.54)	0.44

	Gross motor skills		Visual reception				Receptive language		Expressive language	
	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
Maternal age at birth of child (years)	-0.05 (-0.63, 0.54)	0.88	0.26 (-0.37, 0.89)	0.41	0.50 (-0.14, 1.14)	0.12	0.32 (-0.27, 0.92)	0.29	0.54 (-0.04, 1.13)	0.07
Maternal education interruption (school grade behind)	-2.52 (-4.79, -0.25)	**0.03**	-6.12 (-8.61, -3.6)	**<0.0001**	-2.84 (-5.38, -0.29	**0.03**	-4.29 (-6.63, -1.96)	**<0.0001**	-5.04 (-7.34, -2.73)	**<0.0001**
Model 2. (Multivariable model adjusted for demographic characteristics) *										
HU (n=720)	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	
HEU (n=189)	-2.23 (-4.38, -0.07)	**0.04**	-0.07 (-2.34, 2.20)	0.95	-1.57 (-3.87, 0.74)	0.18	0.41 (-1.66, 2.49)	0.70	0.28 (-1.80, 2.35)	0.79
HIV (n=11)	-3.01 (-11.2, 5.15)	0.47	-9.72 (-18.0, -1.41)	**0.02**	-10.9 (-19.4, -2.46)	**0.01**	-3.34 (-11.0, 4.27)	0.39	-8.90 (-16.5, -1.30)	**0.02**
Model 3. (Multivariable model adjusted for potential mitigating factors) *										
HU (n=720)	1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)		1 (Ref.)	

	Gross motor skills		Visual reception				Receptive language		Expressive language	
	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***	***B* (95% CI)**	***p***
HEU (n=189)	1.96 (-1.85, 5.76)	0.31	3.10 (-0.99, 7.20)	0.14	2..53 (-1.66, 6.72)	0.24	2.70 (-1.13, 6.52)	0.17	1.32 (-2.45, 5.10)	0.49
HIV (n=11)	-1.18 (-14.9, 12.6)	0.87	-4.41 (-19.8, 11.0)	0.57	-13.9 (-29.7, 1.82)	0.08	-3.89 (-18.3, 10.5)	0.60	-8.63 (-22.83, 5.57)	0.23
Maternal education interruption (school grade behind)	-2.60 (-5.05, -0.14)	**0.04**	-7.33 (-9.97, -4.68)	**<0.0001**	-3.54 (-6.25, -0.84)	**0.01**	-5.59 (-8.06, -3.12)	**<0.0001**	-6.28 (-8.72, -3.84)	**<0.0001**
Maternal age at birth of child (years)	-0.06 (-0.95, 0.83)	0.90	0.99 (0.05, 1.92)	**0.04**	0.55 (-0.40, 1.50)	0.26	1.11 (0.24, 1.98)	**0.01**	1.18 (0.32, 2.04)	**0.007**

Note. Available data for Gross motor skills scores: HIV=9, HEU=163, HU=659 | *Model 1. Univariable linear regression models | Model 2. Multivariable linear regression model. Covariates included within model 2: child age (months), child biological sex (female), number of necessities mother can afford (0-8) | Model 3. Exploratory multivariable linear regression model exploring possible mitigating factors for poor child cognitive development scores. Variables included in the model: child HIV status, maternal education interruption, maternal age at birth of child (years)

9.5 Appendix 5

Appendices for **Chapter 7**.

Table 9-14 Paternal characteristics according to combined maternal mental health and HIV status (n=894)

	N (%)/Mean (SD)/Median (IQR)				t/X^2, *p*-value
	No maternal HIV & no CMD (n=594)	**No maternal HIV & CMD (n=73)**	**Maternal HIV & no CMD (n=190)**	**Maternal HIV & CMD (n=37)**	
Paternal characteristics					
Paternal age (*current, years*)	21 (20-24)	22 (20-24)	25 (22-28)	25 (22-27)	**95.45, 0.0001**
Paternal age at birth of child (*years*)	20 (18-22)	20 (19-23)	22 (19-26)	22 (20-24)	**58.49, 0.0001**
Adolescent father (*10-19 years*)	270 (45.5%)	31 (42.5%)	50 (26.3%)	7 (18.9%)	**29.21, <0.0001**
Unknown father HIV status	406 (68.4%)	38 (52.1%)	28 (14.7%)	6 (16.2%)	**278.8, <0.0001**
In a relationship with child's mother	325 (54.7%)	27 (37.0%)	99 (52.1%)	19 (51.4%)	**14.30, 0.03**
Father knows paternity status	580 (97.6%)	73 (100%)	187 (98.4%)	37 (100%)	2.90, 0.41
Father is the main caregiver for the child	3 (0.5%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	0.57, 0.90
Father lives with mother and child	21 (3.5%)	3 (4.1%)	18 (9.5%)	2 (5.4%)	**35.91, <0.001**
Domestic violence perpetration	18 (3.0%)	6 (8.2%)	8 (4.2%)	3 (8.1%)	6.60, 0.09

	N (%)/Mean (SD)/Median (IQR)				t/X^2, *p*-value
	No maternal HIV & no CMD (n=594)	**No maternal HIV & CMD (n=73)**	**Maternal HIV & no CMD (n=190)**	**Maternal HIV & CMD (n=37)**	
Father engagement					
Father looks after child	44 (8.0%)	4 (6.0%)	14 (7.7%)	4 (11.1%)	0.87, 0.83
Father helps buy things for the child	99 (17.9%)	11 (16.4%)	38 (20.9%)	5 (13.9%)	1.49, 0.68
Father helps with washing/food preparation for the child	39 (7.1%)	2 (3.0%)	12 (6.6%)	3 (8.3%)	1.76, 0.63
Father spends time with child	53 (9.6%)	6 (9.0%)	20 (11.0%)	5 (13.9%)	0.98, 0.81
Any involvement	105 (19.0%)	12 (17.9%)	39 (21.4%)	7 (19.4%)	0.62, 0.89
Involvement score (*scored 0-4*)	0.43 (1.04)	0.34 (0.88)	0.46 (1.05)	0.47 (1.10)	0.29, 0.96
Mother and father argue about money	98 (16.5%)	18 (24.7%)	**35 (18.4%)**	**15 (40.5%)**	**15.29, 0.002**
Father attended first antenatal appointment	8 (1.4%)	4 (5.5%)	5 (2.6%)	0 (0.0%)	7.25, 0.06
Father had positive reaction to pregnancy	498 (83.8%)	57 (78.1%)	169 (89.0%)	33 (89.2%)	6.02, 0.11

Note. Common mental disorder (scoring above the cut-off on one or more screen measure for mental health) | Any symptoms represent scoring above the pre-determined cut-off for the measures see section **3.4.**

Table 9-15 Maternal mental health symptom scores according to adolescent fatherhood status (n=894)

	N (%)/Mean (SD)/Median (IQR)			*t, p*-value
	Total sample (n=894)	**Adolescent fathers (n=358)**	**Older fathers (n=536)**	
Maternal characteristics				
Depressive symptoms scores (0-10)	0.72 (1.45)	0.58 (1.19)	0.81 (1.59)	**2.26, 0.02**
Anxiety symptoms scores (0-14)	0.72 (1.78)	0.66 (1.60)	0.76 (1.88)	0.89, 0.37
Posttraumatic stress symptoms scores (0-12)	0.75 (1.51)	0.72 (1.44)	0.77 (1.56)	0.45, 0.66
Suicidality symptoms scores (0-5)	0.17 (0.78)	0.19 (0.76)	0.16 (0.79)	-0.54, 0.59

Table 9-16 Maternal mental health symptom scores according to father involvement status (n=894)

	N (%)/Mean (SD)/Median (IQR)		*t, p*-value
	Any father involvement (n=163)	**No father involvement (n=674)**	
Maternal characteristics			
Depressive symptoms scores (0-10)	0.77 (1.54)	0.72 (1.45)	-0.43, 0.67
Anxiety symptoms scores (0-14)	0.68 (1.49)	0.72 (1.83)	0.25, 0.80
Posttraumatic stress symptoms scores (0-12)	0.68 (1.29)	0.76 (1.53)	0.57, 0.57
Suicidality symptoms scores (0-5)	0.12 (0.60)	0.18 (0.84)	0.88, 0.38