Journal of Developmental Origins of Health and Disease (2018), **9**(1), 41–57.

doi:10.1017/S204017441700068X
Themed Issue: DOHaD AFRICA

ORIGINAL ARTICLE

Psychological morbidity and parenting stress in mothers of primary school children by timing of acquisition of HIV infection: a longitudinal cohort study in rural South Africa

T. J. Rochat[1,2,3,4,5]*, B. Houle[6,7,8], A. Stein[4,6], R. M. Pearson[4,9], M. L. Newell[10,11] and R. M. Bland[1,11,12]

[1]*Africa Health Research Institute, Durban, South Africa*
[2]*Human and Social Development Research Programme, Human Sciences Research Council, Durban, South Africa*
[3]*MRC/Developmental Pathways to Health Research Unit, School of Clinical Medicine, University of Witwatersrand, Johannesburg, South Africa*
[4]*Department of Psychiatry, University of Oxford, Oxford, UK*
[5]*Stellenbosch Institute for Advanced Study (STIAS), Wallenberg Research Centre at Stellenbosch University, Stellenbosch, South Africa*
[6]*MRC/Wits Rural Public Health and Health Transitions Research Unit (Agincourt), School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, South Africa*
[7]*School of Demography, The Australian National University, Canberra, ACT, Australia*
[8]*CU Population Center, Institute of Behavioral Science, University of Colorado at Boulder, Boulder, CO, USA*
[9]*School of Social and Community Medicine, Bristol University, Bristol, UK*
[10]*Global Health Research Institute, Human Development and Health, Faculty of Medicine, University of Southampton, Southampton, UK*
[11]*School of Public Health, Faculty of Health Sciences, University of Witwatersrand, Johannesburg, South Africa*
[12]*Royal Hospital for Sick Children and Institute of Health and Wellbeing, University of Glasgow, Glasgow, UK*

Longitudinal maternal mental health data are needed from high HIV prevalence settings. The Siyakhula Cohort (SC) is a population-based cohort of HIV-positive and negative mothers ($n=1506$) with HIV-negative children ($n=1536$) from rural South Africa. SC includes 767 HIV-negative mothers; 465 HIV-positive in pregnancy; 272 HIV-positive since pregnancy ($n=2$ missing HIV status). A subgroup ($n=890$) participated in a non-randomized breastfeeding intervention [Vertical Transmission Study (VTS)]; the remaining ($n=616$) were resident in the same area and received antenatal care at the time of the VTS, but were not part of the VTS, instead receiving the standard of care Prevention of Mother-to-Child Transmission (PMTCT) Programme. In secondary analysis we investigated the prevalence of, and factors associated with, psychological morbidity amongst mothers who were still the primary caregiver of the child (1265 out of 1506) at follow-up (7–11 years post-birth). We measured maternal depression (Patient Health Questionnaire-9), anxiety (General Anxiety Disorder Scale-7) and parenting stress (Parenting Stress Index-36), using standardized cut-offs and algorithms. In total, 75 (5.9%) mothers met criteria for depression, 37 (2.9%) anxiety and 134 (10.6%) parenting stress. Using complete case logistic regression ($n=1206$ out of 1265 mothers) as compared to being HIV-negative, testing HIV-positive in pregnancy doubled odds of depression [adjusted odd ratios (aOR) = 1.96 [1.0–3.7] $P=0.039$]. Parenting stress was positively associated with acquisition of HIV after pregnancy (aOR = 3.11 [1.9–5.2] $P<0.001$) and exposure to household crime (aOR = 2.02 [1.3–3.2] $P=0.003$); negatively associated with higher maternal education (aOR = 0.29 [0.1–0.8] $P=0.014$), maternal employment (aOR = 0.55 [0.3–0.9] $P=0.024$). Compared with the standard of care PMTCT, VTS mothers had reduced odds of parenting stress (aOR = 0.61 [0.4–0.9] $P=0.016$). Integrating parental support into mostly bio-medical treatment programmes, during and beyond pregnancy, is important.

Received 16 March 2017; Revised 15 July 2017; Accepted 1 August 2017; First published online 13 September 2017

Key words: anxiety, depression, HIV, maternal, parenting stress

Introduction

Maternal psychological morbidity is a global public health challenge, with potential impact on children's development, especially through reduced parenting or caregiving capacity.[1–4] Maternal psychological morbidity is concerning, not only because of its high costs to health services,[5] but because of its impact on the mother's own health and on the health and development of her children.[1,2]

*Address for correspondence: Dr Tamsen Rochat, Human and Social Development Programme, Human Sciences Research Council 5th Floor, The Atrium, 430 Ridge Road, Durban, South Africa, 4001, or: P O Box 37429, Overport, Durban, South Africa, 4067.
(Email trochat@hsrc.ac.za)

Two recent reviews from both high-income countries (HIC)[3] and low- and middle-income countries (LMIC)[4] illustrate that maternal psychological morbidity is highly prevalent and contributes significantly to burden of disease. Despite the documented heavy burden in LMIC, maternal psychological morbidity often remains under-researched, undetected and untreated in these settings.

The impact of maternal psychological morbidity on children has been reported following fetal, early and later life exposures to maternal psychological disorders, including but not limited to depression, with varying effects throughout childhood.[3,6,7] Historically maternal depression has been more widely studied,[1] but recent literature has begun to examine the impact of maternal anxiety, finding specific and significant impacts on

later child development.[8] Perinatal depression and anxiety are highly comorbid although there is much less literature on anxiety, and there is evidence that both are associated with adverse fetal, birth and child outcomes. These include preterm birth, low birth weight, disorganized attachment, poor infant growth, child emotional difficulties, poorer child cognitive outcomes and increased risk of child mental illness.[3,9–11] Some studies have shown that antenatal anxiety, independent of antenatal depression, is associated with lower academic performance in later childhood. Importantly, in Africa specifically, where children are frequently cared for by alternative primary caregivers, there is evidence to suggest that psychological morbidity amongst non-maternal caregivers (fathers, grandparents or aunts) also have effects on children.[12]

Common mental disorders such as depression and anxiety are of particular interest in the context of parenting. Generally depression is characterized by symptoms of low mood, loss of interest and suicide ideation, whereas anxiety is characterized by worry, restlessness and feeling panicky. Both depression and anxiety are known to lead to cognitive and perceptual difficulties, such as rumination, and avoidant coping which can lower capacities for caregiving.[13] Parenting stress,[14] although not a disorder *per se*, may be characterized by depression and anxiety symptoms which are specifically focussed on the parenting role, and may influence the parent's self-perceptions and confidence in parenting, may cause difficulties in the parent–child relationship, and may lead to the parent holding negative perceptions of the child and their needs. An emerging literature has focussed on parenting stress[13] and its contribution to parenting or caregiving behaviour, in particular given its associations with later parental neglect and abuse, particularly in high risk families.[15] Parenting stress is an important psychological construct,[14] reflecting the extent to which mental health difficulties affect parenting capacities and quality of the parent–child relationship. In HIC parenting stress is linked to child neglect and abuse;[15] the few studies conducted in Africa report high levels of parenting stress,[16] including among HIV-positive mothers.[17–19]

HIV infection, common in childbearing women in Africa, has been associated with co-morbid psychological morbidity,[20–23] which in turn has been associated with poor HIV outcomes, including disease progression and reduced treatment adherence.[24,25] Interventions targeting mental health may mitigate these effects, with significant benefit for parents, children and society;[3] particularly in HIV-affected populations where the public health benefits of interventions likely span multiple health domains.[26,27] Given these combined effects on both maternal and child health, and on child development, research is urgently needed to inform targeting and timing of interventions in relation to mental health in areas where risk is high and resources scarce.[28]

We examined psychological morbidity, including parenting stress and associated factors in a longitudinal population-based sample of HIV-positive and negative mothers with primary school-aged children in rural South Africa, focussing on the timing of HIV diagnosis and exposure to the pregnancy/postnatal home visiting programme to support exclusive breastfeeding.

Methods

Ethics permission was granted by the Biomedical Research Ethics Committee, University of KwaZulu-Natal, South Africa (BF184/12). Written informed consent was obtained from mothers and, where appropriate, designated primary caregivers who completed the mental health assessments.

The Africa Health Research Institute (AHRI) was formed in 2016 following a merger between the Africa Centre for Population Health (Africa Centre) and the KwaZulu-Natal Research Institute for TB-HIV (KRITH). AHRI hosts a longitudinal Demographic Surveillance System[29] (DSS) with surveillance of households and individuals including vital events, household composition, care-giving practices, socio-economic circumstances and HIV status. Since 2015, AHRI links demographic data to patient clinical records from 11 primary health care clinics within a defined Population Intervention Platform Surveillance Area (PIPSA). The AHRI data platform was used as a sampling frame for this population based research, identifying all mothers who had delivered a child in the period 2001–2006 for eligibility screening. The PIPSA community spans a geographical area of ~840 km^2 of the Hlabisa health sub-district in rural northern KwaZulu-Natal, South Africa. The larger sub-district includes 18 primary health clinics, of which 11 are in PIPSA, and one district-level hospital. The study population is predominantly rural, with one peri-urban township, and high HIV prevalence.[30] A successful Prevention of Mother-to-Child Transmission (PMTCT) of HIV programme was implemented in 2001,[31] and an HIV treatment programme, with provision of free drugs and clinical care, in 2004.[32]

The Siyakhula Cohort (SC)[33] is nested within the PIPSA platform, with data on HIV-exposure in fetal and early life. Using the population platform as a sampling frame, 2515 potential child participants were identified, of whom 1592 children met eligibility criteria. Mothers and their children were eligible for enrolment in SC if the child was HIV-negative, aged 7–11 years, born and still resided in the sub-district, if their mother's HIV status during pregnancy was known, if she received her antenatal care for the child in the sub-district, and both mother and child were still alive. Mother–child pairs were eligible to be included in SC if they received antenatal care in any one of the 18 sub-district clinics in the period 2001–2006.

In SC, at birth, all mothers benefited from the PMTCT programme, while a subgroup ($n = 890$) participated in an additional exclusive breastfeeding intervention, the Vertical Transmission Study (VTS).[34] The VTS was a non-randomized, prospective, intervention cohort study (2001–2006) which included antenatal and postnatal home-based breastfeeding support by lay counsellors.[35] These 890 women all received the VTS intervention, while the remaining women ($n = 616$) in SC were not part of VTS but were resident in the sub-district at the time of VTS (2001–2006). Non-VTS women received the standard of care PMTCT programme. The sample thus reflects two groups of women: those who received VTS ($n = 890$) and those who received the standard of care PMTCT ($n = 616$).[33]

Each group (VTS and non-VTS) includes women who are HIV positive and negative:

i. *VTS* HIV-positive pregnancy (327), positive post (166), negative (395), missing (2).
ii. *Non-VTS* HIV-positive pregnancy (138), positive post (106), negative (372).

The primary aim of SC was to examine the longitudinal effects of exclusive breastfeeding on child development in HIV-negative children.[36] Child development measures included objective measures of cognition, executive function and physical growth as well as children's mental health collected by parent report.[33] The sampling frame for the SC is thus the HIV-negative child. HIV-positive children were not included in the SC as their developmental trajectories are known to be distinct and influenced by HIV disease processes.

Given that the child's mental health would most likely be affected by the mental health of their current primary caregiver, rather than that of the biological mother *per se*, if a biological mother no longer identified herself as the primary caregiver, efforts were made to collect mental health data from the primary caregiver of the SC child. Thus in this cohort, if someone other than the biological mother was identified as the primary caregiver to the study child, that caregiver was consented into the study and completed the mental health assessments.

Measurements

Maternal and child HIV status (from pregnancy/birth to 2 years postnatally) was prospectively documented in the VTS; and for both VTS and DSS mothers, HIV status from pregnancy onwards was available from the DSS and the Road-to-Health Card (RTHC; a parent-held child health record). Thus, maternal HIV status in pregnancy and in the current SC were verified from data in the VTS, DSS, RTHC and maternal self-report. If a SC mother did not know her own, or her child's, current HIV status, at follow-up 7–11 years post-birth, wherever possible, HIV testing was facilitated at the nearest clinic, in line with standards of care in the health district. Maternal HIV status was defined as:

i. HIV-negative: mothers currently HIV-negative.
ii. HIV-positive pregnancy: mothers tested HIV-positive in pregnancy.
iii. HIV-positive since pregnancy: mothers were HIV-negative in pregnancy but HIV-positive at the time of the current data round (2012–2014).

Psychological morbidity was assessed using standardized psychological measures, widely used in Africa, including with HIV-positive populations. Cronbach's α was used to examine reliability in this research.

Depression and anxiety were assessed using two scales from the Patient Health Questionnaire (PHQ). The Depression Scale (PHQ-9)[37] and the General Anxiety Scale (GAD-7)[37] were developed from the mood and anxiety modules of the Primary Care Evaluation of Mental Disorders, a diagnostic tool used in primary health care settings. The PHQ-9 and GAD-7 can be scored using standardized risk cut-offs or a clinical algorithm which assesses whether the participant/patient meets minimum Diagnostic and Statistical Manual diagnostic requirements for symptoms (present/absent) and frequency.

PHQ-9: A nine-item scale examining diagnostic criteria for major depressive episodes, completed by either self-report or interview format. Scores are allocated (0–3) for the response categories 'not at all', 'several days', 'more than half the days', 'nearly every day'. If any symptoms are endorsed, a single severity item is completed. In this research the PHQ-9 was delivered in interview format, including the item on suicide ideation. Mothers reporting suicide ideation were referred to a psychologist in the local health services. The scale was reliable in this research (Cronbach's α 0.81).

GAD-7: A seven-item scale, enquiring about the diagnostic criteria for generalized anxiety; using same scoring categories as the PHQ-9, also completed in interview format. The scale was reliable in this research (Cronbach's α 0.81).

Parenting Stress Index (PSI)-36: Parenting stress was assessed using PSI-36, a 36-item scale measuring stress related to the parental role, the parent–child relationship and the degree to which the parent finds the child difficult.[14] Statements are scored 1 (strongly disagree) to 5 (strongly agree). It was delivered in interview format. The scale was reliable in this research (Cronbach's α 0.89).

Maternal IQ: Maternal IQ was assessed using the Standard Ravens Progressive Matrix.[38] Noting that this assessment was only completed by biological mothers and not alternative primary caregivers.

All assessments were conducted with mothers, or where appropriate the identified alternative primary caregivers, in their homes, by trained research assistants. Assessment by mental health professionals was not feasible due to resource constraints. Regular supervision and quality assurance checks were conducted by a clinical psychologist (T.J.R.) and psychiatrist (A.S.) and three masters-level psychology graduates.

Data analysis

To be included in the final analytic data set for this secondary analysis, a mental health assessment, along with two key variables needed to be available:

i. Pregnancy and current HIV status ($n = 2$ missing);
ii. Data to confirm whether the mental health assessment was that of a mother or alterative caregiver ($n = 1$ missing).

A total sample 1506 mental health assessments were available from SC. Of these, two mothers did not have current HIV status available and were removed from the analytic data set. A further one assessment had a missing variable to indicate if the mental health data belonged to either a mother or a primary caregiver, and was also removed. This reduced the analytic sample to 1503 individuals with valid data, including 1265 mothers and 238 caregivers.

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

We determined clinical risk of depression using the PHQ-9 diagnostic algorithm requiring at least one Criteria A (mood, loss of interest) and 2–4 Criteria B (weight, sleep, agitation/retardation, fatigue, guilt, concentration, suicidality) for > half the days. We determined clinical risk of anxiety using the GAD-7 diagnostic algorithm requiring meeting Criteria A (anxiety) and ⩾3 symptoms from Criteria B (worry, restlessness, fatigue, concentration, irritability, sleep) for > half the days. As moderate psychological symptoms may affect parenting capacity, we tested the models using a standardized cut-off (⩾10) for comparative purposes, examining whether similar risks operate for moderate *v.* severely reported risk.

To determine parenting stress, items are scored into subscales, with each subscale score ranging from 12 to 60. The PSI-36 Total Stress score is a composite score of the three subscales (scores range 36–180) with higher scores indicating higher parental stress.[39] A cut-off ⩾90 is considered elevated parenting stress. We used the 90th percentile cut-off to determine clinically relevant risk of parenting stress. We present models for elevated (⩾90/50th percentile) parenting stress.

For psychometric scales with missing items, we imputed a respondent's missing item values using their mean value across their completed items (excluding completely missing scales). In total, 104 items were imputed across the three scales (of 1504, 7%).

Models

Analyses were completed using STATA version 14. We assessed clinical psychological morbidity separately for mothers and caregivers. For mothers, we used complete case logistic regression including 1206 mothers who had all data available for the following variables: age, education, IQ, HIV status, employment, relationship status, number of dead children, exposure indicator (VTS/DSS), number of resident adults and children (including the mother and study child), fridge ownership, urban residence, exposure to crime, overnight hospitalizations since the child's birth, TB status (ever diagnosed), and use of any chronic medication. For HIV-positive mothers we examined associations with antiretroviral therapy (ART) status (on ART, not on ART and not eligible, and not on ART and eligible); we found no significant associations between ART status and psychological morbidity and therefore include only HIV status in the final model. We also examined comorbidity of clinical depression and anxiety as outcomes, showing similar associations, and report comorbid associations descriptively only.

For alternative caregivers, we have limited data; in logistic regression we included caregiver age, education and relationship to the mother. For consistency, in Table 1b we report caregiver characteristics by maternal HIV status.

Results

The cohort (Fig. 1) included 1561 eligible mothers, of whom 1506 mothers with 1536 children aged 7–11 years completed all assessments: 890 mothers from the VTS; 616 mothers from the DSS, whose children were born and resident in the DSS at the time of the VTS. Two mothers were excluded as they had missing HIV status, the remaining 1504 were grouped as follows: HIV-negative ($n = 767$); HIV-positive in pregnancy ($n = 465$); HIV-positive since pregnancy ($n = 272$). Most mothers were the primary caregiver of the child (239 alternative caregivers).

At the most recent assessment, most mothers were in their thirties, with some education (Table 1a). Mothers who were HIV-positive since pregnancy were younger, had fewer deceased children, and were more likely to have a new partner than the other groups. Almost half the HIV-positive mothers reported being with a new partner, while two-thirds of HIV-negative women were still in a relationship with the biological father of the index child.

Alternative primary caregivers tended to be older with slightly lower education than caregiving mothers (Table 1b). The alternative caregivers for children of HIV-negative mothers were most commonly the children's grandparents, while those for children of HIV-positive mothers were grandparents, the mother's siblings or other relatives.

Psychological morbidity

Psychological morbidity was more common in HIV-positive than negative mothers (Table 2), with over one-quarter of HIV-positive and 13% of HIV-negative women meeting criteria for one or more clinical disorders. Clinical depression and anxiety were co-morbid in some mothers (16 out of 112, 6%).

HIV in mothers was strongly associated with odds of clinical depression and parenting stress, varying by timing of infection (Fig. 2).

In all three groups, rates of clinical parenting stress were higher than of depression or anxiety. In the HIV-positive group, parenting stress was double that of the HIV-negative group (Fig. 3).

Depression and parenting stress were not highly correlated, and appear to reflect differing psychological constructs (Table 3).

In multivariable analysis (Table 4), compared to being HIV-negative, being diagnosed with HIV in pregnancy doubled the odds of depression (and 1.8 times the odds of clinical parenting stress), but the association with anxiety did not reach statistical significance. Being HIV-positive since pregnancy was associated with triple the odds of clinical parenting stress (Table 4).

Different factors increased or decreased the odds of depression or parenting stress. Being with a new partner was associated with reduced odds of depression, while residing in a household with four or more adults increased depression odds, and a higher number of resident children halved the odds of depression (Table 4).

The family's exposure to crime doubled the odds of parenting stress; higher maternal education, maternal employment and still being in a relationship with the biological father of the index child reduced the odds of parenting stress. As compared

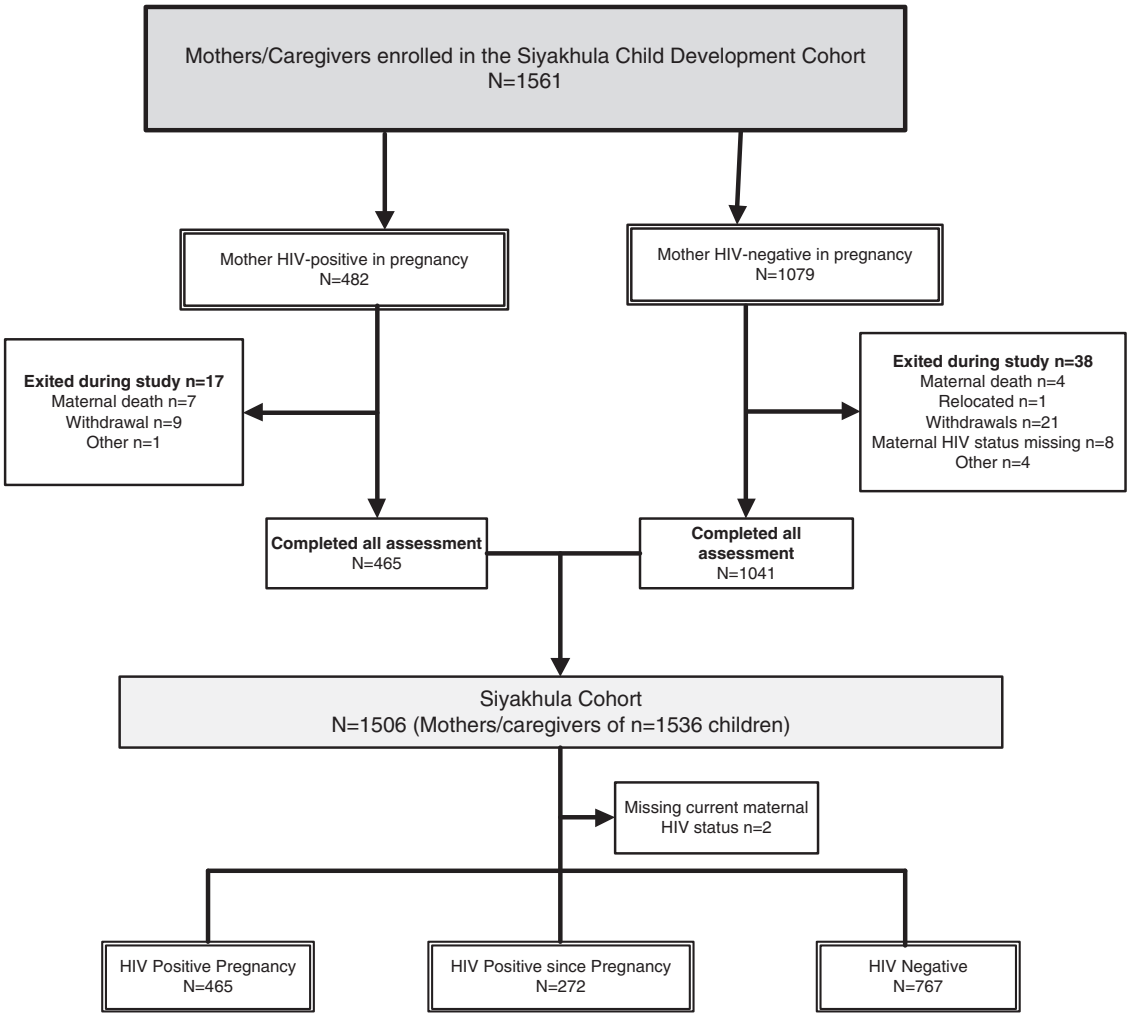

Fig. 1. Consort diagram of mothers enrolled in the cohort by HIV status.

with DSS mothers, VTS mothers had significantly reduced odds of parenting stress (40% less likely).

Since a diagnosis of HIV during or post-pregnancy increased the odds of parenting stress and VTS reduced odds of parenting stress, we further explored the interaction between maternal HIV status, parenting stress and exposure to the VTS intervention, and it did not result in an improvement in model fit ($P = 0.24$).

Anxiety in mothers was not associated with HIV status (Table 4). Reporting two or more hospitalizations in the past year increased odds, but in unadjusted analysis only.

Alternative caregivers had similar rates of depression (5.5%), lower rates of parenting stress (5.5%) and higher anxiety (4.6%) than mothers (Table 2) Having at least some high school education decreased the odds of caregiver clinical depression by 90% compared with no education (Table 5). None of the variables explored were significantly associated with clinical anxiety or parenting stress in the caregivers.

Similar factors were associated with elevated mental distress and parenting stress (Table 6).

Discussion

This research adds to our understanding of psychological morbidity in Africa by reporting on a spectrum of mental disorders (depression, anxiety and parenting stress) in HIV-positive and HIV-negative mothers of primary school-aged children, relative to the timing of HIV infection. We demonstrate that timing of HIV infection acquisition may play an important role in a mother's vulnerability to psychological morbidity. A decade post-delivery,[40] women diagnosed with HIV infection in pregnancy have increased vulnerability to clinical depression and parenting stress, whereas women with a diagnosis of HIV infection after delivery have increased vulnerability to parenting stress. Depression and parenting stress were not very highly correlated suggesting they represent differing psychological stressors in this context.

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

Table 1a. *Sample descriptive for mothers by HIV status* (n = *1265)*

	HIV-negative[a] (*n* = 663)		HIV-positive pregnancy[a] (*n* = 376)		HIV-Positive post-pregnancy[a] (*n* = 226)		Total (*n* = 1265)		
	n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*P*-value
Age									**<0.001**
⩽30 years	163	(24.6)	58	(15.4)	103	(45.6)	324	(25.6)	
31-40 years	266	(40.1)	205	(54.5)	68	(30.1)	539	(42.6)	
41+ years	234	(35.3)	113	(30.1)	55	(24.3)	402	(31.8)	
Education									0.071
None	46	(7.1)	23	(6.2)	13	(5.9)	82	(6.6)	
Primary	240	(36.8)	138	(37.5)	74	(33.3)	452	(36.4)	
Some high school	200	(30.7)	140	(38.0)	75	(33.8)	415	(33.4)	
Matriculation	166	(25.5)	67	(18.2)	60	(27.0)	293	(23.6)	
Missing	11		8		4		23		
IQ (Ravens score)[b]									0.584
Low	352	(53.7)	201	(54.0)	112	(50.0)	665	(53.1)	
High	304	(46.3)	171	(46.0)	112	(50.0)	587	(46.9)	
Missing	7		4		2		13		
Paid employment									**0.013**
No	492	(74.4)	258	(68.6)	179	(79.2)	929	(73.6)	
Yes	169	(25.6)	118	(31.4)	47	(20.8)	334	(26.4)	
Missing	2		0		0		2		
Relationship status									**<0.001**
Single	77	(11.7)	72	(19.4)	53	(24.0)	202	(16.2)	
With biological father	428	(65.0)	129	(34.8)	60	(27.1)	617	(49.4)	
New partner	153	(23.3)	170	(45.8)	108	(48.9)	431	(34.5)	
Missing	5		5		5		15		
Dead biological children									**0.001**
0-3	497	(75.0)	250	(66.5)	179	(79.2)	926	(73.2)	
4+	166	(25.0)	126	(33.5)	47	(20.8)	339	(26.8)	
Intervention exposure									
DSS	350	(52.8)	130	(34.6)	97	(42.9)	577	(45.6)	**<0.001**
VTS	313	(47.2)	246	(65.4)	129	(57.1)	688	(54.4)	
Resident adults									0.110
0-3	389	(58.7)	235	(62.8)	122	(54.2)	746	(59.1)	
4+	274	(41.3)	139	(37.2)	103	(45.8)	516	(40.9)	
Missing	0		2		1		3		
Resident children									**0.007**
0-3	223	(33.6)	162	(43.2)	89	(39.6)	474	(37.5)	
4+	440	(66.4)	213	(56.8)	136	(60.4)	789	(62.5)	
Missing	0		1		1		2		
Fridge ownership[c]									0.159
No	165	(24.9)	100	(26.6)	71	(31.4)	336	(26.6)	
Yes	498	(75.1)	276	(73.4)	155	(68.6)	929	(73.4)	
Residence[d]									0.041
Rural	585	(88.4)	313	(83.5)	202	(89.4)	1100	(87.1)	
Urban	77	(11.6)	62	(16.5)	24	(10.6)	163	(12.9)	
Missing	1		1		0		2		
Crime exposure[c]									0.298
No	592	(89.3)	327	(87.0)	194	(85.8)	1113	(88.0)	
Yes	71	(10.7)	49	(13.0)	32	(14.2)	152	(12.0)	
Hospitalization[e]									**<0.001**
0	593	(89.4)	274	(72.9)	193	(85.4)	1060	(83.8)	
1	53	(8.0)	71	(18.9)	21	(9.3)	145	(11.5)	
2+	17	(2.6)	31	(8.2)	12	(5.3)	60	(4.7)	

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

Table 1a. (*Continued*)

	HIV-negative[a] (*n* = 663)		HIV-positive pregnancy[a] (*n* = 376)		HIV-Positive post-pregnancy[a] (*n* = 226)		Total (*n* = 1265)		
	n	(%)	*n*	(%)	*n*	(%)	*n*	(%)	*P*-value
TB diagnosis (ever)									**<0.001**
No	632	(95.9)	269	(71.7)	185	(81.9)	1086	(86.2)	
Yes	27	(4.1)	106	(28.3)	41	(18.1)	174	(13.8)	
Missing	4		1		0		5		
Chronic medication[f]									0.108
No	584	(88.4)	321	(85.8)	206	(91.2)	1111	(88.1)	
Yes	77	(11.6)	53	(14.2)	20	(8.8)	150	(11.9)	
Missing	2		2		0		4		
ART status[g]									0.353
Negative	663	(100.0)	0	(0.0)	0	(0.0)	663	(52.5)	
On ART	0	(0.0)	241	(64.1)	131	(58.2)	372	(29.4)	
Not on ART, not eligible	0	(0.0)	127	(33.8)	88	(39.1)	215	(17.0)	
Not on ART, eligible	0	(0.0)	8	(2.1)	6	(2.7)	14	(1.1)	
Missing	0		0		1		1		

ART, antiretroviral therapy.

All measures based on current status at time of interview.

Bold values are statistically significant at $P < 0.050$.

[a]Maternal HIV status in pregnancy and in the current Siyakhula data were verified from data in the Vertical Transmission Study (VTS) and Demographic Surveillance System (DSS), the Road-to-Health Card and maternal self-report.

[b]Binary indicator split on the median. Assessed using the Standard Ravens Progressive Matrix.

[c]Collected as part of a socio-economic status questionnaire.

[d]Based on household location.

[e]Self-report hospitalization for inpatient care, for at least one night.

[f]Self-report being on any chronic medication.

[g]Based on self-report. Not eligible defined as recent CD4 count ⩾ 350; eligible defined as recent CD4 count <350.

Depression in mothers has been shown to be important not only because of its impact on social functioning but because it is associated with increased difficulties in the children.[3,4] It is important to understand factors that raise the risk for maternal depression. Possible explanations for the association between a diagnosis of HIV antenatally and later maternal depression include: HIV diagnosis during pregnancy is a negative life event[22,41] which may initiate a vulnerability to maternal depression, particularly in the context of poor support; and/or vulnerability to depression may precede HIV infection in pregnancy,[22] with HIV and depression sharing common risk factors.[42] In this case, the observed association reflects that a history of depression leads to greater vulnerability to further episodes of depression.[22,43] Identification and treatment of depression during pregnancy may have important preventative effects.[44]

Since HIV-positive mothers appear to remain vulnerable to depression over time, relying on pregnancy or postnatal screening for depression alone is insufficient;[13] this has also been demonstrated to be important outside of the context of HIV.[45] Instead mental health screening should be integrated into broader HIV and other health programmes across the life course,[46] particularly since clinical depression is known to negatively impact treatment outcomes[24,25] on antenatal care in subsequent pregnancies, and may interfere with caregiving capacity.[3] Understanding contextual factors associated with later clinical depression, including length of HIV infection, disease progression and treatment effects,[25,47] provides opportunities to intervene. Further, having a new partner at the time of the survey rather than being single was associated with reduced odds of clinical depression, highlighting the importance of providing partner, and family-friendly HIV and health services.[46,48] Currently, most screening for depression in Africa occurs in antenatal care, which is often considered partner-unfriendly.[49] Screening is only cost effective where interventions can be made available, and in turn interventions need to consider the timing and developmental stage of the child,[50] as well as HIV disease stage, given that mothers may have different needs around the time of their diagnosis, their treatment initiation, and the longer-term management of illnesses, each of which may place different demands on them as parents.[13] Most mothers in Southern Africa are diagnosed in the perinatal period;[22,23,51] when interventions might primarily focus on supporting adjustment to the medical and psychological demands of being HIV-positive.[22] Several successful interventions have been documented in Southern Africa, most delivered though home-visiting programmes using lay professional staff, thus reducing the burden on already over scribed health services.[52–54] These interventions tend to focus

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

Table 1b. *Sample descriptive for 238 mothers and their child's alternative caregivers (grouped by mothers HIV status)*

	Negative (n = 104)		Positive pregnancy (n = 88)		Positive post-pregnancy (n = 46)		Total (n = 238)		
	n	(%)	n	(%)	n	(%)	n	(%)	P-value
Caregiver characteristics									
Age									0.135
<40 years	20	(21.1)	26	(34.7)	13	(29.5)	59	(27.6)	
⩾40 years	75	(78.9)	49	(65.3)	31	(70.5)	155	(72.4)	
Missing	9		13		2		24		
Education									0.731
None	18	(19.4)	17	(21.5)	12	(30.0)	47	(22.2)	
Primary	46	(49.5)	36	(45.6)	17	(42.5)	99	(46.7)	
Some high school	29	(31.2)	26	(32.9)	11	(27.5)	66	(31.1)	
Missing	11		9		6		26		
Relationship to mother									**<0.001**
Mothers parent	72	(69.2)	43	(50.0)	30	(65.2)	145	(61.4)	
Mothers sibling	19	(18.3)	17	(19.8)	15	(32.6)	51	(21.6)	
Other relative	13	(12.5)	26	(30.2)	1	(2.2)	40	(16.9)	
Missing	0		2		0		2		
Mother characteristics									
Education									0.509
None	18	(19.4)	17	(21.5)	12	(30.0)	47	(22.2)	
Primary	46	(49.5)	36	(45.6)	17	(42.5)	99	(46.7)	
Some high school	17	(18.3)	18	(22.8)	4	(10.0)	39	(18.4)	
Matriculation	12	(12.9)	8	(10.1)	7	(17.5)	27	(12.7)	
Missing	11		9		6		26		
Relationship status									**0.034**
Single	22	(21.4)	12	(14.1)	6	(13.0)	40	(17.1)	
With biological father	32	(31.1)	20	(23.5)	6	(13.0)	58	(24.8)	
New partner	49	(47.6)	53	(62.4)	34	(73.9)	136	(58.1)	
Missing	1		3		0		4		
Intervention exposure									0.064
DSS	22	(21.2)	8	(9.1)	9	(19.6)	39	(16.4)	
VTS	82	(78.8)	80	(90.9)	37	(80.4)	199	(83.6)	
Resident adults									0.725
0-3	64	(61.5)	59	(67.0)	29	(63.0)	152	(63.9)	
4+	40	(38.5)	29	(33.0)	17	(37.0)	86	(36.1)	
Resident children									0.129
0-3	34	(32.7)	35	(39.8)	23	(50.0)	92	(38.7)	
4+	70	(67.3)	53	(60.2)	23	(50.0)	146	(61.3)	
Crime exposure									0.191
No	89	(85.6)	82	(93.2)	39	(84.8)	210	(88.2)	
Yes	15	(14.4)	6	(6.8)	7	(15.2)	28	(11.8)	
Hospitalizations[a]									**0.001**
0	97	(93.3)	63	(71.6)	38	(82.6)	198	(83.2)	
1	7	(6.7)	19	(21.6)	7	(15.2)	33	(13.9)	
2+	0	(0.0)	6	(6.8)	1	(2.2)	7	(2.9)	
ART status									0.636
Negative	104	(100.0)	0	(0.0)	0	(0.0)	104	(43.7)	
On ART	0	(0.0)	36	(41.4)	22	(46.8)	58	(24.4)	
Not on ART	0	(0.0)	51	(58.6)	25	(53.2)	76	(31.9)	
Missing	0		1		0		1		

VTS, Vertical Transmission Study; DSS, Demographic Surveillance System; ART, antiretroviral therapy.
Bold values are statistically significant at $P < 0.050$.
[a]Hospitalization for inpatient care, for at least one night.

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

Table 2. *Clinical depression, anxiety, and parenting stress amongst mothers and caregivers by HIV status of the mother*

	HIV-negative	HIV-positive (pregnancy)	HIV-positive (post-delivery)	*F* statistic	Subtotal mother	Subtotal caregivers	Total mothers and caregivers
Clinical disorders	*n* = 663 (%)	*n* = 376 (%)	*n* = 226 (%)	*n* (%)	*n* = 1265 (%)	*n* = 238 (%)	*n* = 1503[a] (%)
Depression	28 (4.2)	32 (8.5)	15 (6.6)	**0.017**	75 (5.9)	12 (5.0)	87 (5.8)
Anxiety	14 (2.1)	15 (4.0)	8 (3.5)	0.188	37 (2.9)	11 (4.6)	48 (3.1)
Parenting stress	45 (6.8)	46 (12.2)	43 (19.0)	**<0.001**	134 (10.6)	13 (5.5)	147 (9.8)
Cumulative disorders	87 (13.1)[b]	93 (24.7)	66 (29.2)	–	246 (19.4)[b]	36 (15.1)	282 (18.7)

[a]Of 1503 out of 1506 with valid mental health data and known HIV status.
[b]Out of these 246 women 112 met criteria for either depression or anxiety and 16 out of 112 (6%) met criteria for both.

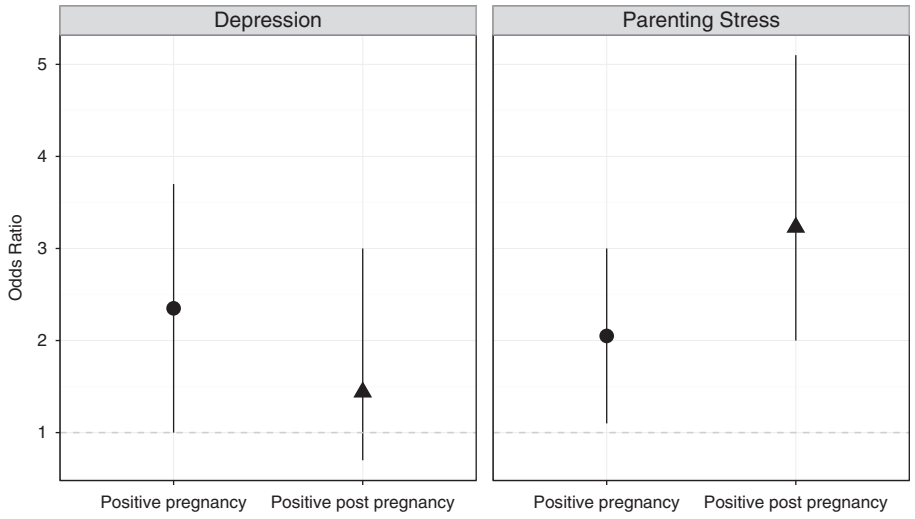

Fig. 2. Depression and parenting stress odds ratio.

on health education to enhance parental health behaviours, HIV awareness and support around maternal health (including education on the link between adherence and mental health), child health as well as information on reducing vertical transmission. Adherence to ART,[24] support for breastfeeding,[55] such as that delivered by lay counsellors VTS,[35] and providing child stimulation, such as is provided by lay professionals in the WHO Child Care for Development, may be particularly suited to the early years of life.[56] In later years, mothers may face challenges related to periods of illness often coinciding with middle and later childhood where support for parent–child communication about HIV and HIV disclosure may then become particularly salient,[13,57] likewise successful interventions have been documented using lay counsellor home visiting models.[19,58]

We show, for the first time in a Southern African population of parents of primary school-aged children, that parenting stress (above the clinical threshold) rather than depression or anxiety, contributes most to psychological distress in all mothers. While some stress is a normal part of the parenting experience, parenting stress occurs when parenting demands begin to exceed the psychological and social capacities and resources of the parent.[17,19] Parenting stress is concerning because it is strongly associated with dysfunctional parenting behaviours and poor child outcomes, including child neglect.[14] Interestingly, parenting stress is more strongly associated with a *later* (or more recent) diagnosis of HIV, which suggests that becoming HIV-positive during the course of parenthood may introduce specific risks which are qualitatively different from learning that you are HIV-positive during pregnancy. It is plausible that mothers who are diagnosed with HIV during pregnancy receive additional parenting support through the provision of PMTCT services, which helps them adjust to their role as an HIV-positive parent, while mothers who are diagnosed later, particularly beyond pregnancy, may receive less support at the time of their diagnosis. This is further supported by the finding that exposure to the VTS intervention[35] (which provided additional support to PMTCT services, including home visiting postnatally, and nurse-led clinic visits to 24 months) significantly reduced odds of parenting stress, suggesting that – as has been shown in this[36] and other adverse settings[59] – early interventions have long-lasting effects on parenting capacity and

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

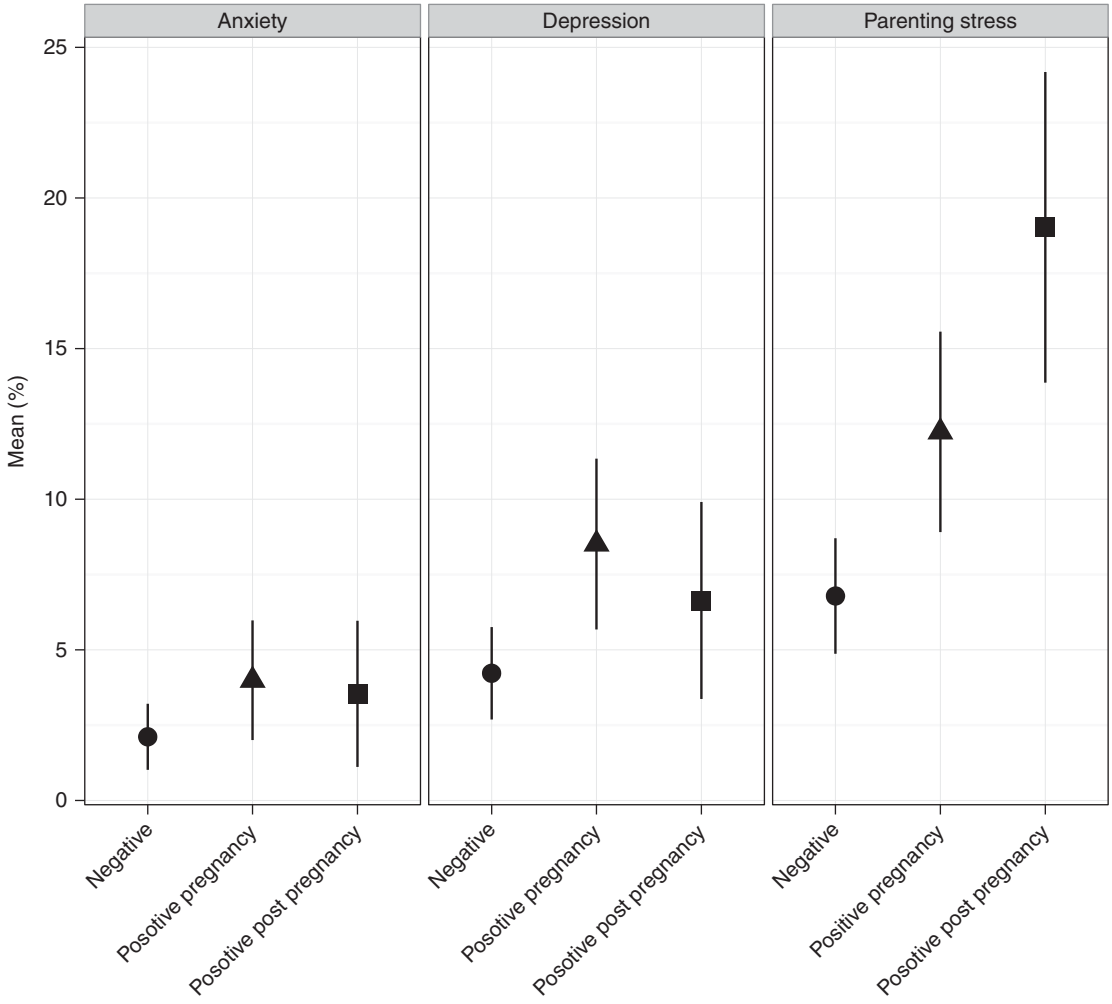

Fig. 3. Prevalence of clinical depression, anxiety and parenting stress amongst mothers by HIV status.

Table 3. *Correlation matrix for clinical depression, anxiety and parenting stress amongst mothers*

	Depression	Anxiety	Parenting stress
Depression	1		
Anxiety	0.624	1	
Parenting stress	0.392	0.411	1

may enable mothers to cope better with later stressors such as a newly diagnosed HIV infection or exposure to crime. Elsewhere we have demonstrated that exclusive breastfeeding in the VTS cohort led to lower behavioural problems in children and these factors are likely interrelated.[57] Interestingly, the VTS intervention was not associated with reduced odds of later depression or anxiety, suggesting that its value is in providing specific parenting support, which may have been too generic and health orientated in its nature, to impact on affective or anxious symptomology.

In line with existing literature,[4] exposure to crime in the past year doubled the odds of parenting stress, whereas maternal education and paid employment reduced the odds. As with depression, the supportive role of the biological father, both in the relationship with the mother and as co-parent to the child, was particularly important in reducing parenting stress.

Although anxiety is known to be highly prevalent in pregnancy and to have specific effects on children,[8] we found that levels were low in this cohort. The direction of associations of variables with anxiety were similar to those reported in the literature,[60] but these were not statistically significant. We find that caregiver anxiety is twice the rate of anxiety in mothers, concerning given that growing evidence suggests that caregiver mental health can have an impact on caregiving capacity.[12] Further research is needed to examine this issue, in particular since very limited data on caregivers were available in this study and the relatively small sample size of alternative caregivers in this research.

Strengths of this research are that it examines a wide spectrum of mental disorders in HIV-positive and uninfected

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

Table 4. *Factors associated with clinical disorders in mothers*

	Clinical depression (n = 1206)		Clinical anxiety (n = 1206)		Clinical parenting stress (n = 1206)	
	OR [CI] P	aOR [CI] P	OR [CI] P	aOR [CI] P	OR [CI] P	aOR [CI] P
Age						
⩾30 years	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
31–40 years	1.52 [0.8–2.9] 0.213	1.15 [0.5–2.4] 0.717	1.28 [0.5–3.4] 0.626	1.19 [0.4–3.5] 0.749	1.13 [0.7–1.8] 0.606	1.11 [0.6–1.9] 0.710
41+ years	1.40 [0.7–2.8] 0.343	0.74 [0.3–1.7] 0.492	2.26 [0.9–5.8] 0.090	2.04 [0.6–6.6] 0.233	0.92 [0.6–1.5] 0.750	0.62 [0.3–1.2] 0.154
Education						
None	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Primary	0.73 [0.3–1.7] 0.479	0.76 [0.3–1.9] 0.560	0.38 [0.1–1.1] 0.083	0.44 [0.1–1.4] 0.156	1.12 [0.5–2.3] 0.755	0.97 [0.5–2.1] 0.939
Some high school	0.63 [0.3–1.5] 0.304	0.72 [0.3–1.9] 0.517	0.54 [0.2–1.5] 0.248	0.85 [0.3–2.8] 0.788	0.83 [0.4–1.7] 0.627	0.64 [0.3–1.4] 0.280
Matriculation	0.39 [0.1–1.0] 0.062	0.50 [0.2–1.6] 0.237	0.33 [0.1–1.1] 0.072	0.66 [0.2–2.8] 0.576	**0.34 [0.1–0.8] 0.015**	**0.29 [0.1–0.8] 0.014**
Ravens[a]						
Low	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
High	0.72 [0.4–1.2] 0.187	0.88 [0.5–1.5] 0.659	0.56 [0.3–1.1] 0.103	0.57 [0.3–1.2] 0.156	**0.66 [0.5–1.0] 0.032**	0.79 [0.5–1.2] 0.283
HIV status[b]						
Negative	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Positive pregnancy	**2.16 [1.3–3.7] 0.005**	**1.96 [1.0–3.7] 0.039**	1.82 [0.9–3.9] 0.118	1.62 [0.7–3.9] 0.283	**1.90 [1.2–3.0] 0.005**	**1.79 [1.1–3.0] 0.026**
Positive since pregnancy	1.50 [0.8–3.0] 0.246	1.44 [0.7–3.0] 0.337	1.71 [0.7–4.1] 0.236	1.75 [0.7–4.5] 0.250	**3.23 [2.0–5.1] <0.001**	**3.11 [1.9–5.2] <0.001**
Paid employment						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	0.62 [0.3–1.2] 0.132	0.63 [0.3–1.2] 0.165	1.22 [0.6–2.5] 0.596	1.19 [0.6–2.6] 0.650	**0.51 [0.3–0.8] 0.007**	**0.55 [0.3–0.9] 0.024**
Relationship status						
Single	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
With bio father	0.67 [0.4–1.2] 0.197	0.81 [0.4–1.5] 0.521	0.69 [0.3–1.6] 0.389	0.82 [0.3–2.0] 0.670	**0.54 [0.3–0.9] 0.012**	**0.58 [0.3–1.0] 0.050**
New partner	**0.43 [0.2–0.9] 0.018**	**0.38 [0.2–0.8] 0.011**	0.65 [0.3–1.6] 0.356	0.75 [0.3–2.0] 0.563	0.74 [0.5–1.2] 0.243	0.69 [0.4–1.2] 0.184
Dead biological children						
⩽3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
>3	1.59 [1.0–2.6] 0.073	1.39 [0.8–2.4] 0.245	1.77 [0.9–3.5] 0.103	1.49 [0.7–3.1] 0.292	1.45 [1.0–2.2] 0.061	1.39 [0.9–2.2] 0.137
Intervention exposures						
DSS	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
VTS	1.30 [0.8–2.1] 0.305	1.30 [0.8–2.2] 0.334	0.92 [0.5–1.8] 0.796	0.88 [0.4–1.8] 0.716	0.74 [0.5–1.1] 0.101	**0.61 [0.4–0.9] 0.016**
Resident adults						
0–3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
4+	1.38 [0.8–2.2] 0.196	**1.83 [1.1–3.1] 0.027**	1.06 [0.5–2.1] 0.873	1.14 [0.6–2.3] 0.719	0.99 [0.7–1.4] 0.957	1.07 [0.7–1.6] 0.754
Resident children						
0–3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
4+	0.67 [0.4–1.1] 0.114	**0.58 [0.3–1.0] 0.041**	0.83 [0.4–1.6] 0.591	0.88 [0.4–1.8] 0.729	0.82 [0.6–1.2] 0.286	0.75 [0.5–1.1] 0.161
Fridge ownership[c]						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	**0.59 [0.4–1.0] 0.042**	**0.57 [0.3–1.0] 0.046**	0.96 [0.5–2.0] 0.918	0.99 [0.4–2.2] 0.981	0.78 [0.5–1.2] 0.232	1.01 [0.7–1.6] 0.954

Table 4. (*Continued*)

	Clinical depression (n = 1206)		Clinical anxiety (n = 1206)		Clinical parenting stress (n = 1206)	
	OR [CI] P	aOR [CI] P	OR [CI] P	aOR [CI] P	OR [CI] P	aOR [CI] P
Urban residence[d]						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.26 [0.6–2.5] 0.517	1.58 [0.7–3.4] 0.231	1.19 [0.5–3.1] 0.727	1.14 [0.4–3.2] 0.809	0.74 [0.4–1.4] 0.347	0.77 [0.4–1.5] 0.451
Crime exposure[c]						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.23 [0.6–2.5] 0.563	1.26 [0.6–2.6] 0.535	2.10 [0.9–4.7] 0.071	1.95 [0.8–4.5] 0.122	**2.02 [1.3–3.2] 0.003**	**1.92 [1.2–3.2] 0.010**
Hospitalization[e]						
0	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
1	1.21 [0.6–2.5] 0.604	0.97 [0.4–2.1] 0.932	1.40 [0.5–3.7] 0.501	1.29 [0.5–3.6] 0.625	0.93 [0.5–1.7] 0.821	0.80 [0.4–1.5] 0.485
2+	2.00 [0.8–4.9] 0.126	1.45 [0.5–3.8] 0.454	**3.49 [1.3–9.5] 0.014**	2.97 [1.0–9.1] 0.057	0.95 [0.4–2.3] 0.912	0.59 [0.2–1.5] 0.272
TB ever						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.64 [0.9–3.0] 0.114	1.16 [0.6–2.3] 0.669	1.25 [0.5–3.1] 0.620	0.79 [0.3–2.2] 0.655	1.44 [0.9–2.3] 0.143	1.00 [0.6–1.7] 0.997
Chronic medication[f]						
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.59 [0.8–3.0] 0.161	1.20 [0.6–2.4] 0.620	1.19 [0.5–3.1] 0.727	0.68 [0.2–1.9] 0.474	1.43 [0.9–2.4] 0.174	1.37 [0.8–2.5] 0.283

OR, odds ratio; CI, confidence interval; aOR, adjusted odd ratio; VTS, Vertical Transmission Study; DSS, Demographic Surveillance System.

All measures based on current status at time of interview.

Bold values are statistically significant at $P < 0.050$.

[a]Binary indicator split on the median. Assessed using the Standard Ravens Progressive Matrix.

[b]Maternal HIV status in pregnancy and in the current Siyakhula data were verified from data in the VTS and DSS, the Road-to-Health Card and maternal self-report.

[c]Collected as part of a socio-economic status questionnaire.

[d]Based on household location.

[e]Self-report hospitalization for inpatient care, for at least one night.

[f]Self-report being on any chronic medication.

Table 5. *Logistic regressions of clinical depression, anxiety and parenting stress on age, education and relation to mother: caregivers only*

	Clinical depression (n = 207)		Clinical anxiety (n = 207)		Clinical parenting stress (n = 208)	
	OR [CI] *P*	aOR [CI] *P*	OR [CI] *P*	aOR [CI] *P*	OR [CI] *P*	aOR [CI] *P*
Age						
<40 years	0.15 [0.0–1.2] 0.068	0.23 [0.0–3.0] 0.260	1.06 [0.3–3.5] 0.928	2.03 [0.3–15.5] 0.495	1.81 [0.6–5.3] 0.283	4.53 [0.5–42.2] 0.184
40+ years	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Education						
None	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Primary	0.76 [0.3–2.2] 0.614	0.80 [0.3–2.4] 0.685	0.81 [0.2–2.9] 0.744	0.78 [0.2–2.9] 0.711	1.27 [0.3–5.0] 0.730	1.15 [0.3–4.8] 0.850
Some high school or more	**0.11 [0.0–0.9] 0.042**	0.20 [0.0–2.0] 0.168	0.53 [0.1–2.5] 0.415	0.33 [0.0–2.4] 0.273	0.96 [0.2–4.5] 0.954	0.77 [0.1–4.8] 0.783
Relation to mother						
Parent	4.67 [0.6–36.6] 0.143	1.57 [0.2–13.5] 0.682	0.91 [0.2–3.5] 0.891	0.83 [0.1–5.5] 0.846	2.95 [0.4–24.0] 0.312	7.49 [0.4–139.5] 0.177
Sibling	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Other	2.29 [0.2–26.4] 0.505	2.74 [0.2–37.1] 0.449	0.73 [0.1–4.6] 0.734	0.54 [0.1–3.9] 0.541	6.45 [0.7–58.1] 0.096	5.28 [0.6–50.7] 0.149

OR, odds ratio; CI, confidence interval; aOR, adjusted odd ratio.

mothers of primary school-aged children, relative to the timing of HIV infection. Longitudinal studies of HIV-positive women are scarce and the longer-term impact of an HIV diagnosis during pregnancy on a mother's later mental health and parenting capacity is under-researched, despite it contributing to a significant public health burden. The limitations of this research include the lack of a pregnancy or postnatal measure of mental health or the use of a clinical interview method to provide a diagnosis at the current time point. While we are able to control for some of the robust factors commonly associated with parenting stress in the literature (maternal education, IQ, employment, exposure to crime) it is possible that characteristics inherent to the mother, which were not measured in this study (such as the mother's personality traits and her desire for parenting), may confound later parenting stress outcomes.

Implications

The expansion of HIV treatment in Africa presents an important opportunity for integrating mental health, parental support and care into these mostly bio-medical programmes. Directing public health investments requires an understanding of how HIV infection impacts on maternal parenting capacities, and an acknowledgement that men, and fathers in particular, play an important role in supporting women in their role as parents.

Future research should consider the challenges inherent in programmes which target only pregnant or postnatal women, with less attention paid to women diagnosed in the course of parenting; similarly many studies focus on depressive syndromes, while few pay attention to parenting stress in the context of HIV, which more directly reflects distress and dysfunction in the parenting role.

Acknowledgements

The authors are grateful to all women and children enrolled in the study; the field and data management team, in particular Samu Dube and Joanie Mitchell; Colin Newell, Kobus Herbst, Dickman Gareta and Ant Snyman for data management during the study and analyses. The authors acknowledge the contribution and support of the original VTS investigators not directly involved in this publication: Hoosen Coovadia, Anna Coutsoudis and Nigel Rollins. The authors thank the Community Engagement Office of AHRI and Community Advisory Board for their guidance throughout the study and the Hlabisa and KwaZulu-Natal Department of Health for research permission and health facility-based support of research procedures. Authors' contributions: T.R. contributed to securing funding, study design and implementation of the research; she participated in data analysis and interpretation, drafted and critically revised the manuscript. B.H. led data analysis and interpretation, drafted and critically revised the manuscript. A.S. contributed to securing funding, study design and participated in the interpretation of data and critically

Table 6. *Logistic regressions of elevated mental distress and parenting stress on mother and household characteristics*

	Elevated mental distress[a]		Elevated parenting stress[b]	
	OR [CI] *P*-value	aOR [CI] *P*-value	OR [CI] *P*-value	aOR [CI] *P*-value
Age				
⩾30 years	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
31–40 years	1.05 [0.7–1.6] 0.836	0.87 [0.5–1.4] 0.573	1.09 [0.7–1.6] 0.655	1.12 [0.7–1.7] 0.622
41+ years	1.34 [0.9–2.1] 0.175	0.83 [0.5–1.4] 0.500	1.10 [0.7–1.6] 0.652	0.78 [0.5–1.3] 0.352
Education				
None	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Primary	0.65 [0.4–1.1] 0.134	0.65 [0.4–1.2] 0.161	0.81 [0.5–1.4] 0.458	0.75 [0.4–1.3] 0.333
Some high school	**0.50 [0.3–0.9] 0.019**	0.52 [0.3–1.0] 0.051	**0.56 [0.3–1.0] 0.050**	**0.50 [0.3–1.0] 0.035**
Matriculation	**0.39 [0.2–0.7] 0.003**	**0.42 [0.2–0.9] 0.022**	**0.35 [0.2–0.7] 0.001**	**0.34 [0.2–0.7] 0.004**
Ravens				
Low	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
High	0.95 [0.7–1.3] 0.754	1.21 [0.8–1.7] 0.299	**0.62 [0.5–0.8] 0.002**	0.74 [0.5–1.0] 0.085
HIV status				
Negative	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Positive pregnancy	**1.71 [1.2–2.4] 0.004**	**1.63 [1.1–2.5] 0.023**	**1.53 [1.1–2.2] 0.018**	1.31 [0.9–2.0] 0.205
Positive since pregnancy	1.49 [1.0–2.3] 0.068	1.45 [0.9–2.3] 0.122	**2.30 [1.6–3.4] <0.001**	**2.02 [1.3–3.1] 0.001**
Paid employment				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	0.83 [0.6–1.2] 0.334	0.86 [0.6–1.3] 0.468	0.70 [0.5–1.0] 0.053	0.76 [0.5–1.1] 0.162
Relationship status				
Single	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
With bio father	0.66 [0.4–1.0] 0.052	0.74 [0.5–1.2] 0.191	**0.52 [0.4–0.8] 0.002**	**0.53 [0.3–0.8] 0.005**
New partner	**0.54 [0.3–0.9] 0.008**	**0.52 [0.3–0.8] 0.008**	0.76 [0.5–1.2] 0.200	0.77 [0.5–1.2] 0.247
Dead biological children				
⩽3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
>3	**1.53 [1.1–2.2] 0.014**	1.29 [0.9–1.9] 0.174	1.34 [1.0–1.9] 0.074	1.23 [0.9–1.8] 0.263
Intervention exposures				
DSS	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
VTS	1.02 [0.7–1.4] 0.891	1.00 [0.7–1.4] 0.989	0.88 [0.6–1.2] 0.388	0.78 [0.6–1.1] 0.129
Resident adults				
0–3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
4+	1.07 [0.8–1.5] 0.675	1.13 [0.8–1.6] 0.476	0.94 [0.7–1.3] 0.687	0.99 [0.7–1.4] 0.938
Resident children				
0–3	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
4+	1.01 [0.7–1.4] 0.974	1.01 [0.7–1.4] 0.964	0.83 [0.6–1.1] 0.231	0.79 [0.6–1.1] 0.155
Fridge ownership				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	**0.68 [0.5–1.0] 0.027**	0.70 [0.5–1.0] 0.063	**0.71 [0.5–1.0] 0.039**	0.91 [0.6–1.3] 0.619
Urban residence				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.18 [0.7–1.9] 0.497	1.33 [0.8–2.2] 0.261	0.75 [0.5–1.2] 0.252	0.81 [0.5–1.4] 0.443
Crime exposure				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.28 [0.8–2.0] 0.290	1.24 [0.8–2.0] 0.381	**2.06 [1.4–3.1] <0.001**	**1.97 [1.3–3.0] 0.001**
Hospitalization				
0	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
1	1.11 [0.7–1.8] 0.678	1.04 [0.6–1.8] 0.888	0.81 [0.5–1.3] 0.407	0.72 [0.4–1.2] 0.226
2+	**2.76 [1.5–5.0] 0.001**	**2.29 [1.2–4.3] 0.010**	1.65 [0.9–3.0] 0.105	1.16 [0.6–2.3] 0.666
TB ever				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	1.39 [0.9–2.1] 0.128	1.01 [0.6–1.6] 0.954	1.34 [0.9–2.0] 0.162	1.01 [0.6–1.6] 0.979
Chronic medication				
No	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]	1.00 [1.0–1.0]
Yes	**1.62 [1.0–2.5] 0.030**	1.23 [0.8–2.0] 0.401	**1.64 [1.1–2.5] 0.018**	1.49 [0.9–2.4] 0.096

OR, odds ratio; CI, confidence interval; aOR, adjusted odd ratio; VTS, Vertical Transmission Study; DSS, Demographic Surveillance System. Bold values are statistically significant at $P < 0.050$.

[a]Patient Health Questionnaire (PHQ)-9 scores can range 0–27 (10–14 moderate risk; 15–19 moderate to severe; 20–27 severe) for General Anxiety Scale-7 scores can range from 0–21 (5 moderate risk; 10 moderate to severe; 15 severe). The PHQ-9 has been found to have acceptable diagnostic properties for detecting major depressive disorder for cut-off scores between 8 and 11. We use the most common cut-off for risk ⩾10 on either depression, or anxiety or both as an indicator of elevated mental health risk.

[b]Parenting stress at a score of ⩾90 or the 50th percentile was used to determine elevated parenting stress.

https://doi.org/10.1017/S204017441700068X Published online by Cambridge University Press

revised the manuscript. R.P. participated in data analysis and interpretation and critically revised the manuscript. M.-L.N. participated in the interpretation of data and critically revised the manuscript. R.B. contributed to securing funding, study design and implementation of the research; participated in the interpretation of data and critically revised the manuscript.

Financial Support

The reenrolment and assessment of the cohort was funded by Grand Challenges Canada, Saving Brains (Grand Challenges 0063-03). The sponsor of the study (Grand Challenges, Canada) required a standard set of core metrics across all 11 funded cohorts, including socio-demographic and economic variables and data on child cognition. Other than this the funder played no role in study design, data collection, data analysis, data interpretation or writing the manuscript. The Africa Centre for Population Health, now called the AHRI, where the research took place is funded by the Wellcome Trust (Grant Numbers: Previous Africa Centre 097410/Z/11/Z Current AHRI 201433/Z/16/Z). The DSS is co-funded by the South African Department of Science and Technology through the DST/MRC South African Population Research Infrastructure Network (SAPRIN). The original VTS was funded separately (Wellcome Trust, UK 063009/Z/00/2). The support of the DST-NRF Centre of Excellence (CoE) in Human Development towards data analysis is acknowledged. Opinions expressed and conclusions arrived at are those of the authors and are not necessarily to be attributed to the funders. T.R. receives salary support from the Human Sciences Research Council in South Africa and is supported by the Newton Advanced Fellowship Scheme (AF160108) through the University of Bristol. T.R. and A.S. receive support from an MRC Public Health Intervention Development scheme grant (MC_PC_14096).

Conflicts of Interest

None.

Ethical Standards

Ethics permission was granted by the Biomedical Research Ethics Committee, University of KwaZulu-Natal, South Africa (BF184/12). Written informed consent was obtained from mothers and, where appropriate, designated primary caregivers who completed the mental health assessments.

References

1. Howard LM, Molyneaux E, Dennis C-L, *et al*. Non-psychotic mental disorders in the perinatal period. *Lancet*. 2014; 384, 1775–1788.
2. Gelaye B, Rondon MB, Araya R, Williams MA. Epidemiology of maternal depression, risk factors, and child outcomes in low-income and middle-income countries. *Lancet Psychiatry*. 2016; 3, 973–982.
3. Stein A, Pearson RM, Goodman SH, *et al*. Effects of perinatal mental disorders on the fetus and child. *Lancet*.. 2014; 384, 1800–1819.
4. Herba CM, Glover V, Ramchandani PG, Rondon MB. Maternal depression and mental health in early childhood: an examination of underlying mechanisms in low-income and middle-income countries. *Lancet Psychiatry*. 2016; 3, 983–992.
5. Bauer A, Parsonage M, Knapp M, Iemmi V, Adelaja B. *Costs of Perinatal Mental Health Problems*. 2014. London School of Economics and Political Science: London.
6. Kingston D, Tough S. Prenatal and postnatal maternal mental health and school-age child development: a systematic review. *Matern Child Health J*. 2014; 18, 1728–1741.
7. Van Der Waerden J, Galéra C, Larroque B, *et al*. Maternal depression trajectories and children's behavior at age 5 Years. *J Pediatr*. 2015; 166, 1440-8. e1.
8. Pearson RM, Bornstein MH, Cordero M, *et al* Maternal perinatal mental health and offspring academic achievement at age 16: the mediating role of childhood executive function. *J Child Psychol Psychiatry*. 2016; 57, 491–501.
9. Ding X-X, Wu Y-L, Xu S-J, *et al*. Maternal anxiety during pregnancy and adverse birth outcomes: a systematic review and meta-analysis of prospective cohort studies. *J Affect Disord*. 2014; 159, 103–110.
10. Grigoriadis S, VonderPorten EH, Mamisashvili L, *et al*. The impact of maternal depression during pregnancy on perinatal outcomes: a systematic review and meta-analysis. *J Clin Psychiatry*. 2013; 74, 321–341.
11. Grote NK, Bridge JA, Gavin AR, *et al*. A meta-analysis of depression during pregnancy and the risk of preterm birth, low birth weight, and intrauterine growth restriction. *Arch Gen Psychiatry*. 2010; 67, 1012–1024.
12. Hancock KJ, Mitrou F, Shipley M, Lawrence D, Zubrick SR. A three generation study of the mental health relationships between grandparents, parents and children. *BMC Psychiatry*. 2013; 13, 299.
13. Rochat T, Netsi E, Redinger S, Stein A. Parenting and HIV. *Curr Opin Psychol*. 2017; 15, 155–161.
14. Abidin R. *Parenting Stress Index Professional Manual*, 3rd edn, 1995. Psychological Assessment Resources Incorporated: Lutz, FL.
15. Pereira J, Vickers K, Atkinson L, *et al*. Parenting stress mediates between maternal maltreatment history and maternal sensitivity in a community sample. *Child Abuse Negl*. 2012; 36, 433–437.
16. Åsander A-S, Björkman A, Belfrage E, Faxelid E. HIV-infected African parents living in Stockholm, Sweden: disclosure and planning for their children's future. *Health Soc Work*. 2009; 34, 107–115.
17. Allen AB, Finestone M, Eloff I, *et al*. The role of parenting in affecting the behavior and adaptive functioning of young children of HIV-infected mothers in South Africa. *AIDS Behav*. 2014; 18, 605–616.
18. Richter LM, Rochat TJ, Hsiao C, Zuma TH. Evaluation of a brief intervention to improve the nursing care of young children in a high HIV and AIDS setting. *Nurs Res Pract*. 2012; 2012, 2137–2145.
19. Rochat TJ, Arteche AX, Stein A, Mitchell J, Bland RM. Maternal and child psychological outcomes of HIV disclosure to young children in rural South Africa: the Amagugu intervention. *AIDS*. 2015; 29, S67–S79.
20. Sowa NA, Cholera R, Pence BW, Gaynes BN. Perinatal depression in HIV-infected African women: a systematic review. *J Clin Psychiatry*. 2015; 76, 1385–1396.

21. Kapetanovic S, Dass-Brailsford P, Nora D, Talisman N. Mental health of HIV-seropositive women during pregnancy and postpartum period: a comprehensive literature review. *AIDS Behav*. 2014; 18, 1152–1173.
22. Rochat TJ, Tomlinson M, Bärnighausen T, Newell ML, Stein A. The prevalence and clinical presentation of antenatal depression in rural South Africa. *J Affect Disord*. 2011; 135, 362–373.
23. Rochat TJ, Richter LM, Doll HA, Buthelezi NP, Tomkins A, Stein A. Depression among pregnant rural South African women undergoing HIV testing. *Jama*. 2006; 295, 1376–1378.
24. Nachega JB, Uthman OA, Anderson J, Peltzer K, *et al*. Adherence to antiretroviral therapy during and after pregnancy in low-income, middle-income, and high-income countries: a systematic review and meta-analysis. *AIDS*. 2012; 26, 2039–2052.
25. Sin NL, DiMatteo MR. Depression treatment enhances adherence to antiretroviral therapy: a meta-analysis. *Ann Behav Med*. 2014; 47, 259–269.
26. Stein A, Desmond C, Garbarino J, *et al*. Predicting long-term outcomes for children affected by HIV and AIDS: perspectives from the scientific study of children's development. *AIDS*. 2014; 28(Suppl. 3), S261–S268.
27. Collins PY, Holman AR, Freeman MC, Patel V. What is the relevance of mental health to HIV/AIDS care and treatment programs in developing countries? A systematic review. *AIDS*. 2006; 20, 1571–1582.
28. Patel V, Chowdhary N, Rahman A, Verdeli H. Improving access to psychological treatments: lessons from developing countries. *Behav Res Ther*. 2011; 49, 523–528.
29. Tanser F, Hosegood V, Bärnighausen T, *et al*. Cohort profile: Africa Centre Demographic Information System (ACDIS) and population-based HIV survey. *Int J Epidemiol*. 2007; 37, 956–962.
30. Tanser F, Bärnighausen T, Grapsa E, Zaidi J, Newell M-L. High coverage of ART associated with decline in risk of HIV acquisition in rural KwaZulu-Natal, South Africa. *Science.*. 2013; 339, 966–971.
31. Le Doaré K, Bland R, Newell M-L. Neurodevelopment in children born to HIV-infected mothers by infection and treatment status. *Pediatrics.*. 2012; 130, 1–9.
32. Houlihan CF, Bland RM, Mutevedzi PC, *et al*. Cohort profile: Hlabisa HIV treatment and care programme. *Int J Epidemiol*. 2011; 40(2), 318–326.
33. Rochat T, Houle B, Stein A, Pearson RM, Newell ML, Bland R. Cohort Profile: The Siyakhula Cohort, rural South Africa. Online first. *International Journal of Epidemiology*. 2017; doi: https://doi.org/10.1093/ije/dyx148
34. Coovadia HM, Rollins NC, Bland RM, *et al*. Mother-to-child transmission of HIV-1 infection during exclusive breastfeeding in the first 6 months of life: an intervention cohort study. *Lancet.*. 2007; 369, 1107–1116.
35. Bland R, Coovadia H, Coutsoudis A, Rollins N, Newell M. Cohort profile: mamanengane or the Africa centre vertical transmission study. *Int J Epidemiol*. 2010; 39, 351–360.
36. Rochat TJ, Houle B, Stein A, et al. Exclusive breastfeeding and cognition, executive function, and behavioural disorders in primary school-aged children in rural South Africa: a cohort analysis. *PLoS medicine*. 2016; 13(6), e1002044.
37. Kroenke K, Spitzer RL, Williams JBW, Löwe B. The Patient Health Questionnaire Somatic, Anxiety, and Depressive Symptom Scales: a systematic review. *Gen Hosp Psychiatry*. 2010; 32, 345–359.
38. Raven J, Raven JC, Court JH. *Raven's Standard Progressive Matrices (SPM) Manual*, 2000 edn, 2004. Pearsons: Bloomington, IN.
39. Haskett ME, Ahern LS, Ward CS, Allaire JC. Factor structure and validity of the parenting stress index-short form. *J Clin Child Adolesc Psychol*. 2006; 35, 302–312.
40. Mkwanazi NB, Rochat TJ, Bland RM. Living with HIV, disclosure patterns and partnerships a decade after the introduction of HIV programmes in rural South Africa. *AIDS care*. 2015; 27(sup1), 65–72.
41. Rochat TJ, Bland RM, Tomlinson M, Stein A. Suicide ideation, depression and HIV among pregnant women in rural South Africa. 2013; 5(3A), 650–661.
42. Mitchell J, Wight M, Van Heerden A, Rochat TJ. Intimate partner violence, HIV, and mental health: a triple epidemic of global proportions. *International Review of Psychiatry*. 2016; 28(5), 452–463.
43. Hammerton G, Mahedy L, Mars B, *et al*. Association between maternal depression symptoms across the first eleven years of their child's life and subsequent offspring suicidal ideation. *PloS ONE.*. 2015; 10, e0131885.
44. Rochat TJ, Tomlinson M, Newell M-L, Stein A. Detection of antenatal depression in rural HIV-affected populations with short and ultrashort versions of the Edinburgh Postnatal Depression Scale (EPDS). *Arch Womens Ment Health*. 2013; 16, 401–410.
45. Woolhouse H, Gartland D, Mensah F, Giallo R, Brown S. Maternal depression from pregnancy to 4 years postpartum and emotional/behavioural difficulties in children: results from a prospective pregnancy cohort study. *Arch Womens Ment Health*. 2016; 19, 141–151.
46. Rochat TJ, Bland R, Coovadia H, Stein A, Newell M-L. Towards a family-centered approach to HIV treatment and care for HIV-exposed children, their mothers and their families in poorly resourced settings. *Future Virol*. 2011; 6, 687–696.
47. Ickovics JR, Hamburger ME, Vlahov D, *et al*. Mortality, CD4 cell count decline, and depressive symptoms among HIV-seropositive women: longitudinal analysis from the HIV Epidemiology Research Study. *JAMA.*. 2001; 285, 1466–1474.
48. Fotso JC, Higgins-Steele A, Mohanty S. Male engagement as a strategy to improve utilization and community-based delivery of maternal, newborn and child health services: evidence from an intervention in Odisha, India. *BMC Health Serv Res*. 2015; 15, S5.
49. Yargawa J, Leonardi-Bee J. Male involvement and maternal health outcomes: systematic review and meta-analysis. *J Epidemiol Commun Health*. 2015; 69, 604–612.
50. Black MM, Walker SP, Fernald LC, *et al*. Early childhood development coming of age: science through the life course. *Lancet.*. 2017; 389, 77–90.
51. Stein A, Krebs G, Richter L, *et al*. Babies of a pandemic. *Arch Dis Child*. 2005; 90, 116–118.
52. Rotheram-Borus M-J, Richter L, Van Rooyen H, *et al*. Project Masihambisane: a cluster randomised controlled trial with peer mentors to improve outcomes for pregnant mothers living with HIV. *Trials*. 2011; 12, 2.

53. Tomlinson M, Rotheram-Borus MJ, le Roux IM, *et al*. Thirty-six-month outcomes of a generalist paraprofessional perinatal home visiting intervention in South Africa on maternal health and child health and development. *Prev Sci*. 2016; 17, 937–948.
54. Richter L, Rotheram-Borus MJ, Van Heerden A, *et al*. Pregnant women living with HIV (WLH) supported at clinics by peer WLH: a cluster randomized controlled trial. *AIDS Behav*. 2014; 18, 706–715.
55. Rollins NC, Bhandari N, Hajeebhoy N, *et al*. Why invest, and what it will take to improve breastfeeding practices? *Lancet*. 2016; 387, 491–504.
56. Richter LM, Daelmans B, Lombardi J, *et al*. Investing in the foundation of sustainable development: pathways to scale up for early childhood development. *Lancet*. 2017; 389, 103–118.
57. Rochat TJ, Mitchell J, Stein A, Mkwanazi NB, Bland RM. The Amagugu intervention: a conceptual framework for increasing HIV disclosure and parent-led communication about health among HIV-infected parents with HIV-uninfected primary school-aged children. *Front Public Health*. 2016; 4, 183.
58. Rochat TJ, Stein A, Cortina-Borja M, Tanser F, Bland RM. The Amagugu intervention for disclosure of maternal HIV to uninfected primary school-aged children in South Africa: a randomised controlled trial. *The Lancet HIV*. 2017; Online First doi: 10.1016/S2352-3018(17)30133-9.
59. Yousafzai AK, Obradović J, Rasheed MA, *et al*. Effects of responsive stimulation and nutrition interventions on children's development and growth at age 4 years in a disadvantaged population in Pakistan: a longitudinal follow-up of a cluster-randomised factorial effectiveness trial. *Lancet Glob Health*. 2016; 4, e548–e558.
60. Biaggi A, Conroy S, Pawlby S, Pariante CM. Identifying the women at risk of antenatal anxiety and depression: a systematic review. *Journal of affective disorders*. 2016; 191, 62–77.