The relationship between HIV, vulnerability, and school education in eastern Zimbabwe

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Declaration of originality

I hereby declare that this thesis is my own original work and that I am its sole author. Where other people have contributed to the work this has been properly acknowledged and duly referenced.

Copyright declaration

Abstract

HIV severely affects children in sub-Saharan Africa. It is important to understand not only the effects of HIV on children, but also how to mitigate them and prevent future infections, with education as one possible avenue. This thesis investigates associations between HIV and education in youth participating in the Manicaland HIV/STD Prevention Project in eastern Zimbabwe from 1998 to 2011. In the first HIV prevalence survey from a general population sample of Zimbabwean children (aged 2-17 from 2009-2011), HIV prevalence was 2.1%, and was primarily due to mother-to-child transmission. Antiretroviral therapy coverage was low (<25%) and driven by a lack of diagnosis. Therefore, increased testing and diagnosis should be a priority to improve the outlook of HIV-positive children in this population. Providing context for my detailed analyses of education, I show that although education has increased over time in Zimbabwe, it suffered during the economic turmoil of the 2000s, and females consistently achieve lower education levels than males. Increasing education is important because children with educated parents are more likely to be educated themselves, and education appears to be protective against HIV, particularly for females. Conversely, orphanhood is associated with poorer educational outcomes and substance use, which is associated with higher levels of sexual risk behaviours. School enrolment, however, mitigates these effects and is associated with lower levels of substance use and risky sex. Thus, I illustrate one pathway through which education may decrease HIV risk. Moving beyond problems to their solutions, I demonstrate that schools can impact on the education and wellbeing of vulnerable children: high quality schools were associated with better education outcomes and higher wellbeing, suggesting that schools are well placed to improve children's lives. The findings of this thesis suggest how education can support HIV-affected children and play a role in decreasing HIV in sub-Saharan Africa.

Table of contents

List of figures

List of tables

Commonly used acronyms

Throughout this thesis I have used several abbreviations. I have endeavoured to define each abbreviation at its first use, but, for reference, I have also provided the most commonly used of these acronyms below:

- AIDS: acquired immunodeficiency syndrome
- AOR: Adjusted odds ratio
- ART: antiretroviral therapy
- ARV: antiretroviral drug
- BEAM: Basic Education Assistance Module
- CI: confidence interval
- HIV: human immunodeficiency virus
- M&E: monitoring and evaluation
- MoHCW: Ministry of Health and Child Welfare
- MTCT: mother-to-child transmission (of HIV)
- NGO: non-governmental organisation
- OR: odds ratio
- OVC: orphans and vulnerable children
- PCA: principal components analysis
- PMTCT: prevention of mother-to-child transmission (of HIV)
- RR: relative risk
- SES: socio-economic status
- SFA: subsistence farming area
- SSA: sub-Saharan Africa

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1 Introduction and literature review

Sub-Saharan Africa (SSA) is the region of the world most severely affected by the HIV epidemic. In 2012, UNAIDS estimated that there were 25 million people living with HIV in the region, roughly 70% of the global total [1]. This is despite SSA comprising only 12% of the world's population. HIV/AIDS has erased decades of progress in increasing life expectancy in many countries in SSA. In the countries most affected by HIV, average life expectancy has fallen by 20 years [2,3]. Zimbabwe has been one of the countries hardest hit by the HIV epidemic, with a peak prevalence of 29% in adults aged 15 and up in 1997 [4], and is the setting for the work in this thesis.

The African region has, however, begun to make great progress in the fight against HIV. In 2011, 1.6 million people acquired HIV in SSA, which represents a greater than 25% decrease in HIV incidence compared to when the epidemic peaked in the mid-1990s [1]. The progress in the fight against HIV in SSA is, however, fragile and unevenly distributed. Although the overall incidence of HIV is decreasing, the number of new cases outpaces the number of people placed on treatment. Access to treatment is being expanded and millions of lives are being extended, but campaigns to prevent new infections continue to be lacking in many areas [1]. The fight against HIV is further complicated because the widely differing characteristics of epidemics between countries and regions mean that any response must be guided by the nature and context of the epidemic in a particular area. The impact of HIV/AIDS is linked to many other problems, such as poverty and poor public infrastructure. Efforts to control HIV/AIDS must consider these realities by implementing region-specific strategies to combat HIV. In SSA, the HIV epidemics are diverse, generalized, and affect women and young people disproportionately. In 2013, children accounted for 9.1% of people living with HIV in SSA, up from 8.8% in 2001 [5,6]. That being said, the number of newly infected children decreased from 500,000 (95% CI: 460,000-560,000) in 2001 to 230,000

(95% CI: 200,000-280,000) in 2012, largely due to the scale-up of prevention of mother-to-child transmission (PMTCT) programmes [1]. Even though HIV incidence in infants is declining, adolescent access to HIV interventions, including sexual and reproductive education and health services, including antiretroviral therapy (ART), varies drastically between countries [7]. In order to halt the spread of HIV, countries in SSA will need to intensify efforts in HIV prevention, treatment, and care, with a stronger focus on the specific needs of women and young people [7]. In this thesis I explore education as one of the possible avenues that could be used to both decrease HIV incidence and improve the outlook of children already affected by HIV. To that end, the remainder of this introductory chapter will provide background information on HIV in children, vulnerability, and education to contextualise my work.

1.1 HIV in children

An estimated 3.2 million children (aged 0-14 years) were HIV-positive at the end of 2013, and ~90% of them lived in SSA [6] (Table 1.1). Global and national estimates for HIV prevalence in children are based on models, which, in turn, are based on HIV prevalence estimates for adults, rather than direct observation of HIV prevalence in children. In resource-poor countries, such as those in SSA, where HIV prevalence in adults is above five percent, child mortality rates have not decreased at the same rate as has been the case globally [8]. That being said, thanks to the scaling-up of treatment and prevention programmes, the number of children receiving ART in low- and middle-income countries increased from ~75,000 in 2005 to 354,000 in 2009 [9] to 647,000 in 2012 [1]. Despite this, in SSA, where most of the children in need of ART live, children have less access to ART than adults (32% in children verses 68% in adults) and, in 9 of the 22 countries prioritized by the Global Plan, 25% or less of treatment-eligible children were receiving ART in 2012 [1,7].

The 2013 national estimates for Zimbabwe indicate that 170,000 children aged 0-14 (~3.2%) are living with HIV and that there are close to 900,000 children who have lost one or both of their parents to HIV [10]. Although Zimbabwe has been working on scaling-up its ART programmes, only 46% of eligible children were receiving ART in 2013, as compared to 77% of eligible adults [10]. Nonetheless, these percentages do represent a marked increase in coverage from 2007 when 31% of adults and less than 10% of children were receiving ART [10], and reflect the level of priority that the government has given to the national HIV response.

Table 1-1 HIV statistics in children

HIV statistics in children	
Children living with HIV globally (2011):	3.3 million (95% CI: 3.1 million - 3.8 million) [11]
Children living with HIV in SSA (2011):	3.1 million (95% CI: 2.8 million - 3.4 million) (~90% of total number of HIV-positive children) [11]
Children newly infected with HIV (2012):	260,000 (95% CI: 230 000–320 000) [1]
Children who died of AIDS (2009):	260,000 (95% CI: 150 000–360 000) (~14% of total AIDS-related deaths) [5]
Children who have lost one or both parents to AIDS (2011):	17.3 million (95% CI: 16.3 million–20.0 million) (~88% live in SSA) [11]
Children receiving ART in SSA (2013)	22% (95% CI: 20-24%) [6]

1.2 HIV transmission in children

In Africa, there has been debate around non-perinatal sources of HIV infection in children and the degree to which they play a role in HIV acquisition in young children [12,13]. Currently, the general public assumption is that child HIV infection occurs almost exclusively through mother-to-child transmission (MTCT), although, as noted, debate still exists in the literature [12,13]. In chapter 2, I will therefore be examining the possibility of non-MTCT in a population of children and adolescents aged 2-17. The inclusion of older adolescents in this population is notable as it has been suggested that adolescents with HIV might be long-term survivors of MTCT, and not the result of sexual HIV acquisition [14,15],. To provide context for this portion of

chapter 2, I have included below a summary of the hypothesised ways through which children may acquire HIV.

1.2.1 *Mother-to-child transmission (MTCT) of HIV*

Most children are believed to have acquired HIV perinatally from their HIV-positive mothers either during pregnancy, labour, delivery, or breastfeeding. The number of children infected through MTCT has dropped greatly in recent years due to scaled PMTCT programmes: MTCT can be reduced from 20-45% to 5% in the breastfeeding population and to 2% in the non-breastfeeding population through the use of drug regimens [5]. In SSA, the percentage of HIV-positive women who received ART for PMTCT purposes increased from 15% in 2005 to 54% in 2009 [16] to 64% in 2012 [1]. Such interventions are, however, not widely accessible or available in many resource-limited countries where the burden of HIV is highest, and approximately 700 infants were infected with HIV every day in 2013 [6].

In Zimbabwe, as in many other African countries, there has been a concerted effort to scale up PMTCT programmes and to move towards more efficacious regimens. Originally, single dose nevirapine (sdNVP) was used to prevent MTCT, which was around 40% effective [17]. The mother received a single oral tablet of nevirapine (NVP) at the start of labour and a single oral dose of NVP was given to her child within 72 hours of birth. In more recent years, sdNVP has been phased out due to worries about resistance and more efficacious regimens becoming available; it has since been to be replaced by more comprehensive PMTCT regimens (Table 1-2), the first of which was Option A. Introduced in 2006, Option A comprised lifelong ART for women eligible for treatment (*i.e.* CD4 count ≤250 cells/mm^3 in 2006, or WHO clinical stage 3 or 4) and, for ineligible women, recommended twice-daily azidothymidine (AZT) during pregnancy, sdNVP at the start of labour, plus twice-daily AZT and lamivudine (3TC) for a week after birth [18]. For breastfeeding infants, Option A comprised daily NVP for four to six weeks and until one week after breastfeeding had ended,

and, for non-breastfeeding infants, four to six weeks of daily NVP, or sdNVP and four to six weeks of AZT.

The current recommended standard (2013 WHO guidelines) is either Option B or Option B+ [18] (Table 1-2). Under Option B all women receive a triple-drug antiretroviral (ARV) regimen throughout pregnancy and until one week after breastfeeding ends, but those women who are not eligible for ART under WHO guidelines then stop treatment. Option B+ is the same as Option B, except that all women remain on ART after breastfeeding has ended, regardless of their CD4 count or clinical stage. With both Option B and Option B+, all children born to HIV-positive mothers receive daily NVP from birth until six weeks of age if they are breastfeeding, and daily NVP or twice-daily AZT from birth until four to six weeks of age if they are not breastfeeding [18]. Under the WHO guidelines, exclusive breastfeeding is recommended until the age of six months and breastfeeding with complementary foods until the age of one provided that the mother is taking ARVs [18].

Table 1-2 Summary of recent PMTCT regimens

	Option A (2006-2013)	Option B (2010-present)	Option B+ (2013-present)
Mother			
Eligible for ART	Lifelong ART	Lifelong ART	Lifelong ART
Ineligible for ART	Twice-daily AZT during pregnancy, sdNVP plus twice-daily AZT and 3TC at delivery and for 1 week postpartum	ART until 1 week after cessation of breastfeeding	Lifelong ART
Child			
Breastfeeding	4-6 weeks of daily NVP and until 1 week after cessation of breastfeeding	Daily NVP for 6 weeks	4-6 weeks of daily NVP or twice-daily AZT
Not breastfeeding	4-6 weeks of daily NVP or sdNVP and twice-daily AZT	Daily NVP for 6 weeks	4-6 weeks of daily NVP or twice-daily AZT

NB: Time spans indicate the years during which the regimen has been recommended by the WHO, not necessarily when it was first or last used

Current preferred ART regimen: Tenofovir Disoproxil Fumarate (TDF) + 3TC or emtricitabine (FTC) + efavirenz (EFV) [18]

Although the new PMTCT programmes have been effective in decreasing the number of children infected through MTCT, they are not without their faults. Despite the lower efficacy

of sdNVP, it was a low cost, easy-to-use method of PMTCT, whereas the new regimens are more complex and require multiple clinic visits [17,18]. Despite the intensive scaling-up of programmes for PMTCT services, this remains a barrier to PMTCT services in parts of Africa where many women live large distances away from their nearest clinic. Cost and/or unavailability of transport, child care duties, heavy workloads, and other responsibilities can all be barriers to accessing PMTCT. Additionally, clinics are often understaffed, poorly funded, and suffer from drug stock-outs [10], which limit their capacity to provide PMTCT services that meet the WHO guidelines [19]. Even when services are easily accessible for women, there can remain personal, social, and cultural reasons why women do not access PMTCT services, including fear of stigma and discrimination. As a consequence of this, roughly two-thirds of women in low- and middle-income countries were unaware of their HIV status [20], whether it is negative or positive, and only 54% of HIV-positive pregnant women were accessing effective PMTCT treatment. Despite these challenges, much progress has been made in scaling up PMTCT programmes in developing countries and child HIV infections have dropped by 43% from 2003 to 2011 [21]. Between 2010 and 2011, PMTCT programmes in low- and middle-income countries have averted almost 410,000 child HIV infections [21].

In Zimbabwe, HIV prevalence in pregnant women was estimated at 16% in 2013 and approximately 14,600 children are infected every year through MTCT [1], making it the second highest source of HIV infection in the country after heterosexual sex [22]. Zimbabwe is working towards the elimination of MTCT through scaling-up PMTCT programmes that test pregnant women for HIV and provide access to ARVs, which virtually eliminate the risk of MTCT. Zimbabwe's PMTCT programme provided ARVs to 81% of pregnant HIV-positive women in 2013, a massive increase from the 6.6% who received ARVs in 2005 [10,22]. As of 2013, Zimbabwe has adopted Option B+ in its PMTCT clinics to work towards the elimination of MTCT [10].

1.2.2 *Non-mother-to-child HIV transmission*

In Africa, there is a body of evidence that suggests that children can also acquire HIV horizontally, not just through MTCT. Gisselquist, Potterat and Brody (2004) reviewed studies of HIV prevalence in inpatient children conducted in Africa and concluded that in 9 of 13 studies non-MTCT of HIV was common: researchers documented over 300 cases of HIV-positive children with HIV-negative mothers [12]. In Swaziland, a total of 50 children aged 2-12 from the 2006-2007 Swaziland Demographic Health Survey were HIV-positive, of whom 11 (22%; 95% CI: 11-33%) had HIV-negative mothers [23]. A 2004 study in South Africa examined 3471 pairs of children aged 2-9 years and their mothers; of the 482 children with HIV (13.9%; 95% CI: 13–15%), 7 (1.45%) had HIV-negative mothers [24]. Additionally, Omatade *et al.* (2001) found just one HIV-concordant mother-child pair out of 460 randomly selected pairs in Nigeria: out of 18 HIV-positive children, only one (5.6%) had a mother who was also HIV-positive [25]. The existence of discordant mother-child pairs in cross-sectional surveys is, however, not documented evidence of horizontal transmission, as it is possible that children have misreported their adopted (HIV-negative) mother as their biological mother. This phenomenon is known as the adoption effect and is common in African countries where a father remarries and his new wife takes on the role of the child's mother [26,27]. Despite studies suggesting the existence of horizontal HIV infection among African children, the lack of biological evidence confirming maternity makes it hard to determine the true extent and modes of horizontal HIV transmission in Africa [23].

Despite the limited research into sources of horizontal HIV infection and the problem of confirmed transmission events, proposed risk factors do exist: sexual abuse, nosocomial routes, scarification, and caring for HIV-positive relatives. In Africa, epidemiologists have begun to try to identify the possible routes of horizontal transmission by investigating correlates of HIV infection in children who have HIV-negative mothers. A 2007-2008 case-control study in Kenya examined 11 children (aged 4-10) with suspected horizontally-

acquired HIV and their uninfected siblings [23]. Children with HIV had greater iatrogenic exposures than their uninfected siblings, particularly punctures related to health care for malaria, injections while hospitalised, and dental surgery [23]. The conclusion that blood exposures are the primary route of horizontal transmission should not be immediately accepted, however, as there are several weaknesses not fully addressed in the study. The first concern is the low sample size (11 cases), making it impossible to draw any robust statistical conclusions that could be extrapolated to a larger population. Additionally, recall bias may have played a role in the findings. Although the authors concluded that iatrogenic exposure was the most likely source of infection, they failed to accurately take into account the possibility of sexual transmission. The authors assumed that children had never engaged in sexual intercourse and that there was a low likelihood of child sexual abuse; however, Reza *et al.* (2007) have shown that over half of all instances of child sexual abuse remain unreported, despite a third of all women sampled having experienced sexual abuse as a child [28]. Additionally, face-to-face interviews with the mothers were used to collect the data, and it is possible that the mothers were either unaware of, or unwilling to disclose, cases of sexual abuse [29]. An additional limitation is that the seeking of health care (leading to iatrogenic exposures) could be because of the HIV infection, and not the cause of it, so the direction of causation is therefore unclear [13,30,31].

Research into nosocomial HIV transmission suggests that children have contracted HIV through failure to implement adequate infection control practices in hospitals and clinics, such as using sterile implements and not reusing needles [24]. Much debate currently centres around medically and nosocomially acquired HIV infections, particularly as few rigorous studies have been designed specifically to assess the link between poor infection control procedures and the risk of HIV exposure [24]. Poor infection control can be a problem in many developing countries. A probability sample of public and private hospitals in South Africa in 2003 found that 65% did not have adequate sterilizing equipment available on a regular basis, suggesting that patients and healthcare workers were at risk of HIV infection due to an

inadequate infection-control programme and poor implementation of standard precautions [32]. A study conducted in 2004 in South Africa by Shisana *et al*. recruited 3471 children and their biological mothers from clinics in the Free State Province to assess nosocomial HIV infection [24]. Nurses collected blood samples for HIV testing and asked questions on the history of exposure to HIV transmission factors. In total, seven HIV-positive children had HIV-negative mothers, and, among them, transmission was significantly associated with dental injections (OR: 31.5; 95%CI: 4.5-189.4), dental visits (OR: 26.9; 95%CI: 4.4-283.5), being breastfed by a non-biological mother (OR: 437; 95%CI: 53-5020), and being fed breast milk from a milk room (OR: 37.6; 95%CI: 6.2-259.0) [24]. While the study was designed to be able to accurately assess exposure routes, due to the small number of children who acquired HIV horizontally, the results cannot definitively exclude nosocomial infections as a source of HIV in children.

Little research has been conducted into the proportion of children infected with HIV through sexual abuse, even though sexual abuse has been reported to be common in South Africa [33,34]. Even less research has been conducted on traditional scarification practices that might expose children to HIV through the reuse of unsterilized implements. In Zimbabwe, researchers found that the risk of HIV infection was greater among those who had undergone scarification than those who had not [35], but, in South Africa, the 2005 national HIV survey indicated that HIV incidence was not significantly different between those who had reported undergoing scarification in the past 12 months and those who had not [24]. Other traditional practices, such as the removal of "abnormal" or "false" teeth in infants to treat an acute illness may also expose children to HIV [36,37]. Parents who have taken part in the practice, which is common in several areas of eastern Africa, have noted that the cutting implements used are often contaminated with blood and reused without sterilization or any other form of cleaning [36,37].

All of these associations remain speculative, however, due to the low number of horizontally infected children in each study. Moreover, all of the above prevalence values also assume

perfect sensitivity and specificity in the testing, which is unlikely to be a valid assumption under field conditions. Sensitivity and specificity of HIV tests are high (generally >99%), but the positive predictive value of the test decreases with decreasing HIV prevalence and can drop to below 85% for a test with 99% specificity when HIV prevalence is 5%, implying that several of the observed serodiscordant relationships may be false [38].

Given the possible different sources of HIV infection in children, more information is needed to clarify the extent and magnitude of how children acquire HIV. Most child HIV infections are likely mother-to-child in nature, although horizontal infections do appear possible, with some plausible sources of exposure having been investigated. Despite this, there is uncertainty around what the magnitude of the horizontal contribution could be, and current evidence is circumstantial and incomplete, with studies conducted only in select populations. Solid epidemiological data is therefore needed about risk factors for paediatric infection from well formulated studies and samples.

1.3 HIV-related vulnerability in children

Having discussed how children might acquire HIV, I will now move on to covering the literature on how HIV/AIDS might affect children's lives, a topic that I investigate in depth in chapters four and five. The trauma and hardship inflicted upon children affected by HIV/AIDS affects many facets of a child's life including their family, physical and mental health, social standing and interactions, and future outlook. Children affected by AIDS, even those who are HIV-negative, can suffer from depression, malnutrition, decreased wellbeing, poor health, reduced access to education, and a greater chance of acquiring HIV themselves [39]. As parents and other family members become ill or die, children may be forced to take on more responsibility in the home and outside of it. Responsibilities can include caring for ill family members, producing food, and earning an income [1,40]. In these situations, work falls most often to girls and older children, who take on expanded adult roles, to help maintain the

household [41]. Children orphaned by AIDS, of which there are more in Africa than in any other part of the world, are usually cared for by the extended family or, less frequently, live in child-headed households [1].

Therefore, within the context of HIV/AIDS, it is not only HIV-positive children who can be considered vulnerable, as many children face considerable obstacles due to HIV-related stigma, illness, and death within their families/household and communities [42]. Based on focus group interviews in South Africa, Zimbabwe, and Botswana, Skinner *et al*. [43] developed a definition of orphans and vulnerable children (OVC) that included children less than 18 years of age who had lost one or more parents or who were at risk of long-term damage. They found that vulnerability included three dimensions: material, emotional, and social problems. Condensed into easily measured indicators, they proposed that children be considered vulnerable if their parent(s) had died, if their parent(s) were chronically ill, if the child themselves was disabled or chronically ill (*e.g*. HIV-positive), or if the family was very poor. Other studies in SSA have also suggested including children who are required to care for an ill relative as vulnerable [44,45], although this has been disputed, with the suggestion that young-carers can actually be empowered by their caring experiences in certain contexts [46]. Operationalising these measures based on available data, for most of the analyses in this thesis, unless otherwise specified, I considered those children who were orphans, HIV-positive, had an HIV-positive parent, or were young-carers to be vulnerable. A young-carer is a child or youth under the age of 18 who looks after an ill family member. I did not include those children in the poorest households as vulnerable in my analyses as I wanted to control for the effect of socio-economic status (SES), which I would not have been able to do if I had included them.

In many countries, income in households where one or both parents has died of AIDS has been found to be 20–30% lower than in households where both parents are still alive [42]. Even if both parents remain alive, households where a family member has AIDS can expect

to see their income decrease by as much as 60%, their expenditure on health care quadruple and their food consumption decrease by 40% [42,47]. The decrease in household income, coupled with potentially increased expenses for treatment, funerals and transport can push families into poverty [48]. Such poverty can have negative impacts on children in terms of nutrition, health, education, and emotional wellbeing [48]. In fact, one of the most important effects of HIV/AIDS on children is emotional. Should one or both of their parents be HIV-positive, children can endure stress and exhaustion from worry and the additional work required of them, insecurity regarding their own future should one or both of their parents die, fear that they too are HIV-positive, and stigmatisation if it is assumed that they are HIV-positive or that their family has been disgraced by the disease [41,49-51]. Due to the silence surrounding HIV and AIDS in many parts of Africa, children often internalise these events, leading to anxiety, depression, and withdrawal [49-51]. Because of the potentially extreme impact of the HIV/AIDS epidemic on children in developing countries, research in this field is growing [52,53].

In the same study population that I will be investigating in Manicaland, Zimbabwe, previous studies have found OVC to be more likely to suffer from chronic malnutrition, diarrhoea, early sexual debut, teenage pregnancy, HIV infection, and secondary school drop-out than non-vulnerable youth [54,55]. These associations remained after adjusting for SES, suggesting these effects are not explained by economic vulnerability alone. It is important to continue to study the vulnerabilities experienced by OVC, to investigate the causal pathways through which these vulnerabilities appear, and to evaluate possible interventions to support OVC on an individual and societal level.

1.3.1 *Vulnerability and substance use*

Substance use, including alcohol, cigarettes, and illegal drugs, has become a major health concern for youth in SSA, where it is on the rise [56]. Substance use among adolescents is a

public health concern because of its association with other risk-taking behaviours such as risky sexual activity, crime, and delinquency [57]. Furthermore, substance use is a major cause of death among young people [58].

In SSA, estimates of the prevalence of different forms of substance use vary by the type of substance. Data on tobacco use are typically collected in Demographic Health Surveys; the 2012 Zimbabwean survey found 0.2% of females and 4.5% of males aged 15-19 to smoke, and 0.1% of females and 19.2% of males aged 20-24 to smoke [59]. Alcohol use is common in youth from urban areas of SSA, with between 63% and 67% of male and 33% and 48% of female high school students in Cape Town and Durban, South Africa reporting having ever drunk alcohol [56] and roughly 38% of adolescents aged 12-18 reporting having drunk alcohol in Lagos, Nigeria [60]. Marijuana use was also common, with up to 32% of males and 13% of females having smoked it in South Africa and 6% of males and 3% of females in Lagos. The use of other illicit substances in these populations was less frequent than marijuana use at up to 16% and 5% for males and females, respectively, in South Africa, and 4.5% and 3% for males and females in Lagos.

Adolescence is a period of increasing independence, but is also a time of increased risk taking. All adolescents are prone to high risk behaviour, related to their life stage, but vulnerable youth may be at increased risk compared to their non-vulnerable counterparts as parental death often results in loss of protective structures and increased stress. This may leave orphaned adolescents particularly vulnerable to substance use, and to associated morbidities [61]. The potential for increased vulnerability of orphans to engaging in risky behaviour, including substance use, has been documented for some time [61], as parental death often leaves youth with loss of a protective structure and altered physical, financial, and emotional resources [62]. Stress, anxiety, feelings of isolation, lack of support, and the absence of role models, all of which may occur with the loss of a parent [63], influence risk behaviours in adolescents [64,65]. A small number of studies have looked at alcohol and drug

use amongst adolescents and young adults in sub-Saharan Africa [60,62,66,67], but, to my knowledge, there are no published findings from Zimbabwe on this topic and work is needed to investigate correlations between vulnerability and substance use in adolescents in this population.

1.3.2 *Vulnerability and education*

In SSA, evidence about the impact of the HIV epidemic on children's education continues to emerge. In Africa, there are many barriers to school attendance and one of the most visible effects of the HIV epidemic is a decline in school enrolment. The majority of children affected by HIV are of school-going age and live in countries where education is not compulsory and school fees exist [68,69], including Zimbabwe, where primary school fees were introduced in 1991 and have risen steadily since [70].

Many households affected by AIDS can no longer afford school fees due to the cost of medicine, and households where the primary caretaker has died of AIDS often struggle to generate income [1]. Indeed, the primary reason for children not to be in school was lack of money, a problem that was more pronounced in children coming from households affected by AIDS [39]. Furthermore, the stigma associated with AIDS may prompt children to avoid school, rather than face ridicule or exclusion from their teachers and peers [47,71]. In addition to the financial and social barriers, children may stop attending school because they have to care for sick family members, or may themselves be HIV-positive. Indeed, in the Central African Republic and Swaziland, AIDS caused school enrolment to fall by 25-30% at the beginning of the millennium [72] and, in a high-density community in Zimbabwe, when matched for age, nearly 72% of children affected by AIDS were not in school, compared to just 29% of children not affected by AIDS [39].

At the individual level, it has been shown that a child's education can be negatively impacted by either the loss of a parent or having an HIV-positive parent. Interestingly, maternal and paternal deaths have different impacts on children's education, with the death of a father generally being less severe [73]. Loss of a father may result in children dropping out of school [74], while maternal death has been associated with children not enrolling in school, delaying school attendance, lower educational attainment, being at a lower grade for their age, and worse performance in school [73,75-78]. Children with sick parents have also been shown to be at a lower grade for their age due to interruptions caused by parental illness, as they were required to look after their ailing parent(s) [75,79].

Even though an increasing number of studies have examined the effects of parental loss and illness on education outcomes in SSA, a review by Guo *et al.* in 2012 noted that only 23 peer-reviewed studies on the effects of HIV/AIDS on children's education outcomes had been published from 1999 to 2010 and that no studies had directly examined the effects of children being HIV-positive themselves [80]. Adolescents who are long-term survivors of MTCT, as previous evidence would suggest them to be [14,15], would most likely be experiencing AIDS-related illnesses by this point, and such illness might negatively impact on both school attendance and performance.

1.4 Education and HIV

The relationship between AIDS and education is reinforcing: as the epidemic worsens, the education sector suffers, which, in turn, is likely to increase the incidence of HIV. Although there are numerous ways in which AIDS can affect education, education may also have a role in the fight against HIV. The degree to which schools are able to continue functioning in the face HIV/AIDS will influence how well societies will be able to cope with, and recover from, the epidemic [1,40].

Decreased school attendance may hinder HIV prevention efforts, as a good, basic education is one of the most effective and cost-effective means of preventing HIV [81,82]. People who grow up with little education can be up to two times as likely to contract HIV as young adults who have completed primary school [83]. In this context, the decrease in school attendance caused by AIDS is of particular concern as it may perpetuate a negative cycle.

AIDS is also having a devastating effect on the already inadequate supply of teachers in African countries. A South African study found that 21% of teachers aged 25-34 were living with HIV [84]. Teachers affected by AIDS are more likely to take time off work, whether it is for personal health reasons, to care for sick or dying relatives, or to attend funerals. Teachers may also take time off to cope with the psychological effects of the HIV epidemic, particularly if they teach in a community that has been greatly impacted by AIDS [81]. The death or illness of a teacher in rural areas can be especially devastating as schools in these areas often depend heavily on just one or two teachers, and skilled teachers are not easily replaced [84]. In Tanzania, in 2006, it was estimated that an additional 45,000 teachers were needed to make up for those that were lost due to AIDS [84].

Conversely, education can play a vital role not only in preventing HIV infection, but also in supporting children affected by HIV/AIDS. School education has been shown to significantly improve accurate knowledge of HIV transmission routes and prevention strategies [85]. Furthermore, formal education serves as a protective factor against HIV infection, but this has not always been the case. Early research in SSA on the effect of education on HIV suggested the opposite – that more educated people were more likely to be HIV-positive [86-98]. This finding was unexpected as, typically, when an individual's education level increases, their health outcomes improve compared to less educated people [99]; but, until the mid-1990s, less educated Africans had a lower risk of becoming infected with HIV than Africans with more education. Studies reported that more educated people, particularly men, were

more likely to have unsafe sex and multiple sexual partners, increasing their risk of contracting HIV [96,100-102]. These findings were supported by a 2002 systematic review of the effect of education on HIV risk in SSA, which found that prior to 1996 educated men and women had higher risks of contracting HIV than their less educated peers [103,104]. This caused education to be classified as a risk factor for HIV in SSA at the start of the pandemic.

Theories on why education was a risk factor for HIV centred on the material and social resources that education provided. Some researchers theorised that the higher SES and greater mobility of the more educated facilitated sexual relations with a larger range and number of partners, thereby increasing their HIV risk [104]. Indeed, a 1995 study found that educated heterosexual males from SSA were more frequently sexually-active, with more partners than less educated men [105]. Even a small amount of education gave men more disposable income, higher status, more free time, greater mobility, and access to transactional sex, all of which acted to increase their sexual activity with multiple partners, increasing their HIV risk and also their risk of spreading HIV to their partners [90,92,94,103,106-109]. Similar risk behaviours were also observed in women: more educated women had more sexual partners and changed partners more frequently [110,111]. Contraceptive use also differed by education level: while educated women were more likely to use contraception overall, among women using contraception, educated women were more likely to use a method of contraception that did not protect against HIV, such as the oral contraceptive pill [112].

Further increasing HIV risk in SSA was the lack of readily available information on HIV and its risk factors until the early 1990s. A major way in which education protects against infection and acts as a 'social vaccine' is through its enhancement of an individual's ability to understand, assimilate and use the information provided to them to change their behaviour. The lack of accurate information on HIV risk factors, combined with the spread of misinformation and the disease's long incubation time caused the positive impact of education to be delayed. Instead, the indirect effect of education - acting through social

status and material wealth - was seen to increase risky sexual behaviours and HIV risk in SSA [105,113].

More recent studies have shown that the positive correlation between education and HIV risk in SSA during the early stages of the epidemic dissipated as the epidemic matured [114-119]. As the epidemic advanced and the public health response to HIV grew in SSA, the speculation was that the most educated people would be better able to absorb new knowledge and skills and would be the first to adopt protective behaviours, reducing their risk to HIV [102,103,120]. Formal education provides biological knowledge and an understanding of causality into which information on HIV risk factors can be integrated. In this way, education allows youth to understand the connection between risk behaviours, such as unprotected sex, and the potential outcome of HIV infection [121]. Indeed, an examination of data from demographic and health surveys in 11 African countries found that, in young adults who matured after the misconceptions about HIV risk factors were reduced, higher levels of education were linked with a lower HIV infection risk [112].

Education can also provide young people with motivation to want to avoid HIV infection and pregnancy, reducing the chance that they will have unprotected sex [121]. Indeed, a Zimbabwean study found that women with secondary education were more likely to have a delayed sexual debut and to report having used a condom at last sex than women without secondary education [116]. A study of four African cities in Benin, Cameroon, Kenya, and Zambia also found that greater levels of education increased condom use, while also decreasing casual sex, and decreasing transactional sex amongst women [115]. Furthermore, since HIV campaigns are often presented in schools, more years of schooling can increase exposure to health-promotion messages, potentially reducing HIV risk [122,123].

In studies where longitudinal data are available, HIV prevalence decreases more consistently over time in people with high levels of education than in people with less

education. A longitudinal survey in the rural areas of Uganda compared the association between HIV prevalence and education level in a population-based cohort between 1989/1990 and 1999/2000 [124]. In 1989/1990, education level was not significantly associated with HIV prevalence after adjustment for age, but, by 1999/2000, higher levels of education were significantly associated with lower HIV prevalence among women. The rate of the prevalence decline was also faster for people with secondary education than lower levels of education, and people with primary education also had a greater decline in prevalence than people with no education [124].

Several limitations exist when investigating the link between education levels and HIV infection risk. Population-level studies may be subject to ecologic fallacy, where the assumption is made that education trends true at the population level are also true at the individual level. The causal role of education can also be difficult to determine due to the logistical and ethical difficulties of conducting randomised control trials of education provision. Even though cross-sectional studies have shown that higher levels of education are associated with greater HIV risk in early stages of an epidemic, but with less risk in later stages [114-119], and longitudinal studies have shown that people with more education are less likely to contract HIV over time [124], the causal role of education cannot be determined with certainty, and, instead, these studies only show an association between education level and HIV risk. Despite this, the findings from these studies suggest that, as the HIV epidemic progressed in SSA throughout the 1990s and into the 2000s, the effect of education on the risk of HIV has reversed, and new infections are now occurring more amongst the least educated segments of society in SSA.

1.5 HIV-competent schools

Based on the knowledge that education can improve the outcomes of OVC, there has been a move towards schools providing more holistic support to their pupils. Developed on the

concept of HIV-competent communities outlined by Campbell *et al.* (2007), HIV-competent schools are an environment in which people work together to reduce stigma, promote positive behaviour change, and support the care and treatment of people infected or affected by HIV [125]. Such communities facilitate access to health-based knowledge and life skills, instil a sense of confidence in an individual's ability to ensure their own health and wellbeing, provide safe spaces in which to discuss and debate how to translate knowledge and skills into action, encourage strong and supportive relationships within the community, and bridge access to additional support networks in the public or NGO sector [52,125,126]. An HIV-competent school would attempt to provide the same resources, but tailored to the school environment and supporting children.

How exactly an HIV-competent school would operate remains to be seen though, as limited research has been conducted into how youth would like to learn not only in general, but also about HIV/AIDS. In South Africa, secondary school children expressed a desire for HIV/AIDS programmes to be conducted in small, gender-specific groups that incorporate outside presenters and involve parents/caregivers [127]. They wanted a greater variety in the programme format, with more information presented on HIV/AIDS care, support and treatment. The programmes should address values and life skills, while also using fear-provoking real-life images and stories to instil caution [127]. Among Zimbabwean adolescents, there exists a demand for an environment in which they can safely ask questions about sex and learn how to communicate effectively, showing the feasibility and acceptability of HIV prevention programs [128]. Schools are well placed to provide such a forum and an intervention trial in 36 schools found that properly trained teachers can provide adolescents with the skills necessary to make informed decisions about their sexual behaviour [129].

Research has also found several key areas in which education systems in Africa can improve their delivery methods. A 2004 review of school-based prevention programmes in Africa found that, while knowledge and attitudes towards HIV/AIDS are easiest to change, behaviour change remains a challenge [130]. The review highlighted the need for additional

research to identify the factors that drive successful school-based HIV/AIDS programmes in Africa. The research I conduct herein into HIV-competent schools aims to at least partially fill this gap. Moreover, current education models do not take into account gender roles in Zimbabwean society, which reinforce that girls must be "feminine" and boys must be "masculine" [131]. By not addressing these gender stereotypes, current education programmes will not increase gender equity, which is a key factor in reducing the spread of HIV [40]. Beyond gender, past and current education models in many African countries have created and maintained disparities and inequities along lines of class, ethnicity, religion, language, and culture [132]. As such, currently, there is a search for education options or alternatives in Africa that would instead increase equality. In Ghana, there was a comprehensive, coordinated investigation into the needs of learners, parents, teachers, and policy-makers, but no such investigation has been undertaken in Zimbabwe [132]. By investigating the role that schools play in supporting children affected by AIDS in chapter six, I hope to elucidate if it is possible that HIV-competent schools could not only help to determine how to support children coping with AIDS, but also how to create a more inclusive school environment.

1.6 Data sources and definitions

1.6.1 *Study setting*

The data used in this thesis was collected in Manicaland, which is the easternmost province of Zimbabwe, with a population of approximately 1.7 million people. It is a primarily rural location with only 17% of the population found in urban centres [133]. The population is relatively young, with 44% of the population below the age of 15 and just 3% aged 65 years or older. Partly due to the age distribution, a quarter of the population has never been married, although females tend to marry at younger ages than males [133].

Manicaland, and Zimbabwe as a whole, is characterised by strong marriage and extended family systems. In Shona culture, of which most people in Zimbabwe are a part, a nuclear family structure (mother, father, and children) is uncommon and instead people relate to all their relatives as members of one large family [134]. It is common for multiple generations to live together and uncles and aunts may be addressed as fathers and mothers, and cousins may be referred to as brothers or sisters [134]. Families are typically patrilineal and, when a man marries, his wife will come to live with him and his family. These close family structures are maintained even when a woman's husband dies: often she will remarry to a member of her deceased husband's family, typically a younger brother [135].

Within Zimbabwe there exist numerous different churches that vary greatly in terms of their religious beliefs, practices involving marriage, sexual behaviour, and healthcare. In Manicaland, most people belong to Christian churches, with Spiritual churches being the second most common, followed by atheism and Traditional religion [136]. Members of Traditionalist churches ascribe to beliefs founded on Ancestral spirits and witchcraft, and often ascribe illness to these causes, rather than to medical explanations of illness. In both Traditional and Spiritual churches, polygyny is widely accepted and encouraged, which could potentially increase HIV risk in these groups [136]. Spiritualists also believe in the power of faith healing, and shun modern medicine for religious reasons. In contrast, Christian churches promote Western medicine and beliefs, are often closely involved in HIV control programmes, and shun extra- and pre- marital sex. Therefore, it is plausible that religion may play a role in the HIV profile of the region [136].

As with the rest of Zimbabwe, Manicaland is a highly educated province (96% literacy rate [133]) and this may by one reason that HIV declined earlier and to a greater degree than in neighbouring countries. HIV prevalence increased rapidly in the 1990s, before plateauing in the late 1990s (peak prevalence of almost 30% in 1997 [137]), and declining after 2000. HIV incidence peaked around 1991 and declined gradually thereafter [138]. In the late 1990s and

early 2000s, incidence decline accelerated, possibly corresponding to reduced levels of risky sexual behaviour [137,138]. Around this time there were marked declines in concurrent partnerships and men paying for sex, increases in the frequency and consistency of condom use, and high levels of personal exposure to AIDS deaths resulting in fear of contracting the virus, all of which likely played a role in the reduction of HIV incidence [137-140]. Other countries, such as Malawi and Zambia, had similarly high levels of HIV mortality and HIV prevention programmes, but did not see the same levels of HIV reduction as Zimbabwe. One reason for this could be the high levels of education and marriage in Zimbabwe. The combination of these two factors allowed for a clearer understanding (and acceptance) of how HIV is transmitted [123] and a greater ability to act upon the prevention messages ("be faithful"), given the strong marriage pattern [141-143].

1.6.2 *Manicaland cohort study*

The Manicaland HIV/STD Prevention Project, a partnership between the Harare-based Biomedical Research and Training Institute (BRTI) and the Imperial College School of Public Health, began in the early 1990s. The main study is a population-based, open cohort survey of approximately 10,000 adults that investigates the dynamics and impacts of HIV transmission in 12 sites in the Manicaland Province of eastern Zimbabwe. Each round of the survey involves a census of all households in the 12 study sites (4 subsistence farming areas; 4 large-scale commercial estates; 2 small towns; and 2 roadside trading centres), followed by interviews with individual household members about socio-demographic characteristics, sexual behaviours and other HIV risk factors; collection of dried blood spot samples for HIV testing; and verbal autopsy interviews with caregivers of past participants who have died since the previous round. Informal confidential voting is used to collect data on sensitive subjects, such as sexual behaviours, to reduce social desirability bias [144]. Data are collected in a phased manner (one site at a time), and each round of the survey takes

approximately two years to complete. Five rounds of data collected between 1998 through 2011 were available for analysis for this thesis.

The baseline survey was conducted from July 1998 to February 2000 and included male (17-54) and female (15-44) regular residents of households in the study areas. From the second round (2001-2003) onwards, all initial interviewees plus those originally too young to participate but now old enough, and people who did not meet the original residence criteria were eligible for interview. For the third survey round (2003-2005) and all subsequent rounds, the age restriction was widened, and all men and women aged 15-54 were eligible for interview. The household questionnaire collects data on physical household characteristics, household composition and socio-economic factors. Individual participants are interviewed using a structured questionnaire. Households that reported deaths of participants since the previous round are asked to complete a verbal autopsy questionnaire. These are conducted with the caregiver(s) of the deceased to ascertain the cause of death.

As part of the fifth round (2009-2011) of the Manicaland survey, an investigation of HIV prevalence amongst children in Zimbabwe was undertaken. A random sample of 4065 2-17 year-olds in existing households was interviewed. The overall response rate for the child survey was 77.6% (4065/5235); response rates for the adult surveys were approximately 80% in each round [140]. Children who did not complete the survey did not have significantly different age or gender distributions, and their household of residence did not have significantly different mean SESs, than those who completed the questionnaire. Reasons given for non-response included: away from home for work (9.2%), away from home for school (19.2%), another reason for being away from home (61.7%), whereabouts unknown (0.4%), refused (6.6%), and other (2.9%). Questions asked varied depending on the child's age. All children were interviewed on their welfare, health and healthcare, with children under seven answering with assistance from their primary caregiver. The primary caregiver

was also asked to answer questions on any external support that the child and/or household receives. Questions on HIV testing and knowledge of HIV status were addressed to the child's primary caregiver in the presence of the child if he or she was over the age of seven. Additionally, the questionnaire was administered by a nurse who had HIV Testing and Counselling certificates, which include training in how to respond if a child becomes distressed. Questions of a more sensitive nature were asked only of older children and were answered without their primary caregiver being present: children 7-14 were asked questions on sexual abuse, children 7-17 were asked questions on psychological health, and children 12-17 were asked questions on lifestyle factors such as alcohol and drug use and sexual behaviour. If a child reported abuse then the interviewer notified the supervising nurse who would subsequently investigate in the company of a social worker. The information from the supervisor and social worker was then fed back to the local Child Protection Committee.

Along with individual questionnaires, dried blood spot samples were collected for HIV testing. The results of this test were not made available to participants, but participants and their families were provided with free access to HIV testing and counselling should they desire it. Blood samples were collected on filter paper and air-dried before transport to the BRTI laboratory in Harare where they were tested for HIV. For the baseline study, samples were tested for antibodies to HIV using a dipstick dot enzyme immunoassay [140]. The following rounds used a similar protocol, but only samples from participants recorded as being HIV-negative in the previous round were tested. If seroconversion was found, then the stored sample from the previous round was retested to confirm the original negative result. All personnel remained blind to the HIV status of individual participants.

To measure the impact of the scaling-up of national HIV/AIDS programme activities on trends in the HIV epidemic at the local level in rural Zimbabwe, an monitoring and evaluation (M&E) survey of facilities (including schools) providing HIV/AIDS services was undertaken in

two districts in Manicaland. The facilities are drawn from a baseline census of all HIV/AIDS-related service providers and facilities in Manicaland Study areas. The initial survey was conducted in May 2010 and is updated every 6-12 months. Surveys are conducted using a structured questionnaire with questions tailored to the type of service(s) provided by the organisation. The questionnaire has sections for facilities offering services in behaviour change, VCT and PMTCT, biomedical services, care and support services, and education. The questionnaire for the fourth M&E survey round (February 2012 - March 2012) was expanded to include questions on key criteria for HIV-competent schools (e.g. teaching quality, AIDS policy, affordability, HIV awareness, supportive environment, links with other organisations). All facilities are asked about their personnel resources and access to utilities.

Ethical approval for the Manicaland HIV/STD Prevention Project was obtained from the Research Council of Zimbabwe (Number 02187), the Biomedical Research and Training Institute Zimbabwe's institutional review board (Number AP6/97), and the Imperial College London Research Ethics Committee (Number ICREC 9_3_13). Written informed consent was obtained for participation in each round of the survey. For the child survey, written informed consent was obtained prior to survey participation from each child's primary caregiver. In addition, children aged 7-14 years provided verbal or written assent, respectively. Participants and guardians were informed that, at any point, they could refuse to answer a question or decline to continue the interview.

The Manicaland HIV/STD Prevention Project is supported by a grant from the Wellcome Trust (grant 050517/z/97abc). Funding for research into the role of schools helping African children to cope with the impacts of disease and poverty was provided by the Economic and Social Research Council (agreement reference ES/1033459/1). The work into substance use among adolescents was directly supported through a grant from RIATT-ESA (Interagency Task Team on Children and AIDS) under Grant AFR100. I was provided with funding for my

PhD through a Doctoral Foreign Study Award from the Canadian Institutes of Health Research (CIHR).

1.6.3 *Vulnerability definitions*

As I discussed in section 1.3, the definition of what constitutes vulnerability in children is broad and stretches beyond children who have been orphaned. Although much existing research focuses on the detrimental effects of orphanhood, for this thesis I wanted to move beyond the idea that it is only orphans who are made vulnerable by HIV. Orphans are not automatically the most vulnerable children in a population, and children with living parents can still be vulnerable and that vulnerability can result from a wide range of causes [145]. This idea forms the central principle of the concept of the Most Vulnerable Child (MVC), a term that seeks to deemphasise orphanhood as being the only category of vulnerability and also remove the stigma that can be attached to the word "orphan" [145]. Therefore, although I use the term OVC in this thesis, the definition of OVC I use incorporates not just orphans, but other forms of vulnerability as well. In doing so, I have attempted to incorporate the principles of the MVC concept into my work.

As I discussed in section 1.3, I have chosen to include those children who are HIV-positive, have lost one or more parents, have an HIV-positive parent, or who care for an ill relative as being vulnerable. One other common category of vulnerability that I have not included in my thesis is that of children living in the poorest households. I have omitted this group from my definition of vulnerability not because I do not believe that they could be vulnerable, but because I wished to control for SES in my analyses and would not have been able to do so due to the inherent correlation.

Throughout this thesis, unless otherwise stated, the following definitions for vulnerability have been used:

- Non-orphan: both biological parents are alive
- Maternal orphan: biological mother deceased
- Paternal orphan: biological father deceased
- Double orphan: both biological parents deceased
- Orphan: biological mother, father, or both deceased
- Child-carer/young-carer: a child or youth under the age of 18 who looks after an ill family member
- Vulnerable: child/youth who is HIV-positive, has an HIV-positive parent, is a young-carer, and/or is an orphan

1.6.4 *Education indicators*

In this thesis I spend much of my time discussing various aspects of education and therefore it is important to clarify how I am measuring education. There exist a variety of ways in which education can be measured, and different education indicators represent different facets of the education system. For the purposes of this thesis I have divided education indicators into those that measure outcomes, access, quality, and cognition (Table 1-3).

Measures of outcomes are those indicators that are concerned with end results of education, for example completion of primary school or literacy. I have included as an outcome indicator having obtained five or more 'O' level passes. 'O' levels are the final year high school exams in Zimbabwe and five 'O' level passes is considered to be a "complete" education and is the requirement for formal sector employment or attending university in Zimbabwe. Thus, five or more 'O' level passes is an outcome indicator for an individual's potential to achieve a higher level of employment.

Table 1-3 Education indicators

	Data collection	Age range of respondents	Chapters where indicator appears
Outcome indicators			
Primary completion	Round 1-5 adult survey Round 5 child survey	15-54 13-17	Chapters 3 & 4
Secondary or greater education	Round 1-5 adult survey Round 5 child survey	15-54 13-17	Chapter 3
Literacy	Round 1-5 adult survey Round 5 child survey	15-54 6-17	Chapter 3
5+ 'O' levels	Round 2-5 adult survey Round 5 child survey	16-54 16-17	Chapters 3 & 4
Access indicators			
Enrolment	Round 1-5 adult survey Round 5 child survey	15-18 8-17	Chapters 3 & 5
Attendance	Round 5 child survey	6-17	Chapters 3, 4, 5, & 6
Quality indicators			
Correct grade-for-age	Round 1-5 adult survey Round 5 child survey	15-18 8-17	Chapters 3, 4, & 6
Contact teaching time	Not collected	N/A	None
Cognition indicators			
Numeracy and literacy tests	Not collected	N/A	Discussed in chapter 4
IQ tests (or other cognitive measures)	Not collected	N/A	Discussed in chapter 4

Access indicators relate to an individual of school-going age having access to education (*i.e.* if they are enrolled and attend school regularly). Attendance data was collected in the round five child survey and was measured as the number of days out of the last 20 school days that a child had missed. From this I created a binary variable where regular attendance was defined as attending at least 80% of the last 20 school days. Children not enrolled in school were coded as not attending regularly.

Indicators of education quality are slightly harder to measures, but are interested in measuring whether or not the time a child spends at school is worthwhile. One such measure is children being able to progress normally in school, otherwise known as being in the correct grade for their age. In Zimbabwe, children should start primary school if they have turned six before August of the previous year (the school year in Zimbabwe runs from

January to December). Each year children should progress to the subsequent grade, entering secondary school after the successful completion of grade 7, ideally when they are 13 years of age, and completing secondary school by the age of 18. By comparing how children are actually progressing with the ideal situation, I was able to determine if children were in the correct year of school or if they had fallen behind. Grade progression can be measured as either a continuous (number of years behind in school) or a categorical (behind in school: yes or no?) variable and I chose to measure it as a categorical variable for several reasons. By using a categorical variable I was able to include children who are ahead of their normative grade-for-age and was also able to include a one year grace period in the measure. In Zimbabwe, many children start school at the age of seven, making them one year behind the normative grade for their age, and I was unconvinced that this truly disadvantaged them compared to their peers. Therefore, children were deemed to be behind in school if they were two or more years behind where they should be. The use of a categorical variable also reduced the measurement error as compared to a continuous variable.

Finally, cognition indicators measure a child's intelligence or skill in a particular subject, such as reading or mathematics. Various tests exist to measure cognition and differ by subject and the age at which the child takes them, which is why I have not listed any specific tests in Table 1-3. Although cognition tests, which measure a child's metal abilities, are a valuable tool in education research, they can be time-consuming to conduct and were not included as part of the Manicaland questionnaire. For this reason, although I discuss them in Chapter 4 of this thesis, I was not able to include them as a measure in my own work.

1.7 Thesis objectives

The main aim of this thesis is to provide a comprehensive, holistic picture of the relationship between education and HIV in eastern Zimbabwe and to examine whether education can be

beneficial to children affected by the HIV epidemic (Figure 1.1). Based on the review of background literature information presented here and the gaps it identified, the specific research objectives of this thesis were to:

- Provide a reliable, direct estimate of HIV prevalence in children in Zimbabwe (Chapter 2).

- Determine if horizontal transmission was a possible source of HIV infection in children from this population (Chapter 2).

- Examine the health consequences of HIV infection and the levels of ART coverage in children (Chapter 2).

- Describe the education trends over time in Zimbabwe and if they related to major economic and/or social events (Chapter 3).

- Determine if parental education was an indicator of child education and, if so, whether in the face of economic turmoil, highly educated parents would be more likely to prioritise their children's education than less educated parents (Chapter 3).

- Provide data on the relationship between education and HIV prevalence and incidence in the setting of a mature HIV epidemic (Chapter 3).

- Assess if HIV-positive children, in addition to children made vulnerable by HIV in other ways, are more likely to experience educational disadvantages than children unaffected by the HIV epidemic (Chapter 4).

- Describe the relationship between vulnerability, lost education, substance use, and sexual risk behaviours in an effort to help elucidate the pathway between lower education and increased HIV risk that has been described previously (Chapter 5).

- Contribute to the development of, and conduct a quantitative assessment of, a model of high quality schools (HIV competent schools) that can help to improve the education outcomes and the wellbeing of not only vulnerable children, but children overall (Chapter 6).

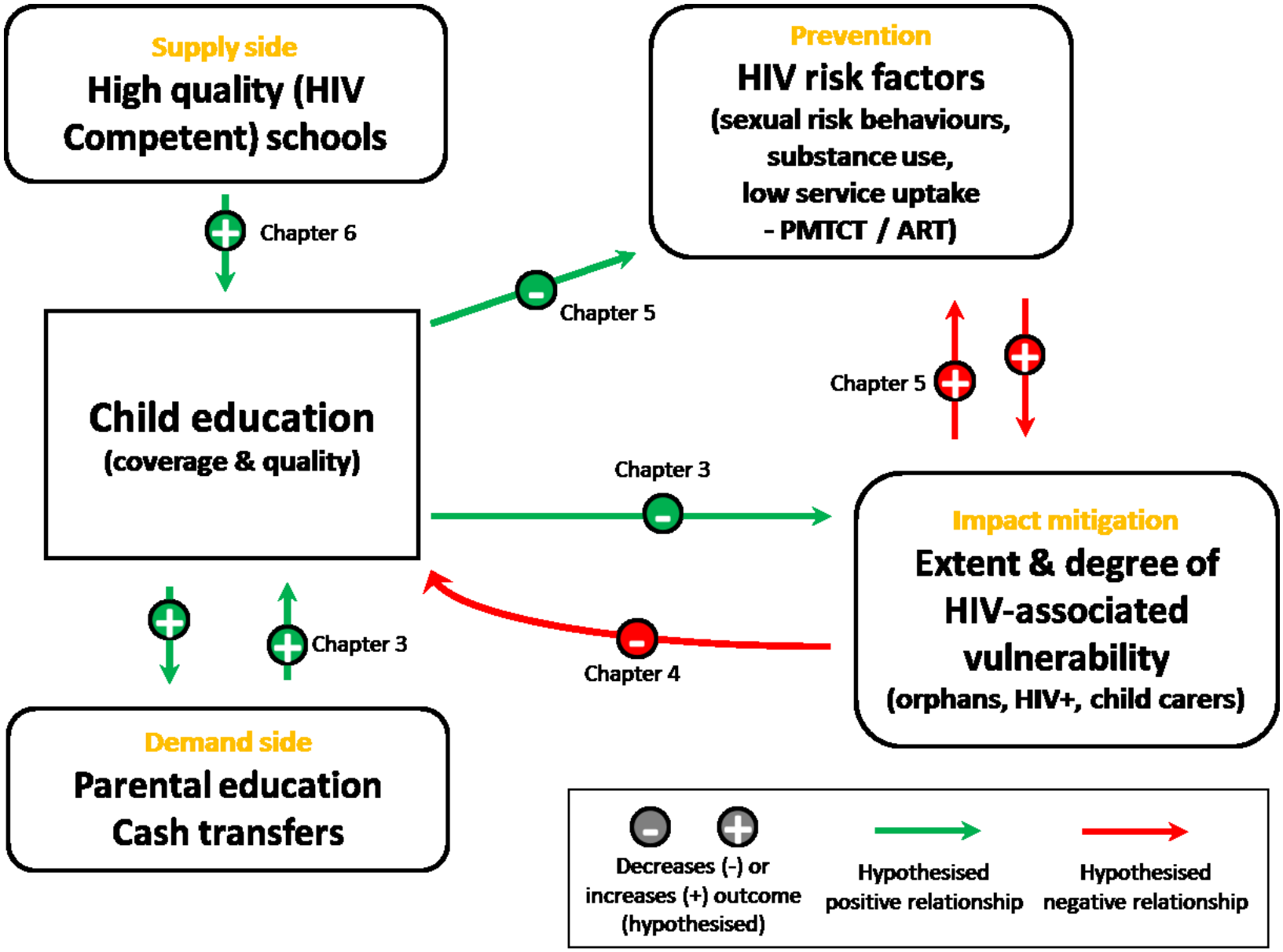

Figure 1-1 Theoretical framework for the cyclic relationship between education and HIV reduction.

1.8 Thesis outline

Chapter 2 presents HIV prevalence, socio-demographic correlates, infection sources, and health consequences in children aged 2-17 years in Manicaland, eastern Zimbabwe, between 2009 and 2011, using data from one round of a population-based cohort study.

Chapter 3 describes the education and HIV trends in the Manicaland cohort between 1998 and 2011, using data from five survey rounds. I use these trends to investigate whether associations between educational attainment and HIV prevalence and incidence have changed over time in this population.

Chapter 4 investigates associations between vulnerability and several measures of educational success in children aged 6-17 from 2009 to 2011, using logistic regression models to test the hypothesis that vulnerable children are less likely to succeed in school as compared to those children unaffected by HIV.

Chapter 5 uses data from adolescents and youth aged 15-24 years to investigate the relationship between HIV-related vulnerability, substance use, and education. These associations are used to speculate on the possible mechanisms through which increased school enrolment/attendance may avert HIV infection.

In Chapter 6, I present an evaluation of general and HIV-specific school quality and an index of child wellbeing. I used these, in conjunction with education data from previous chapters, to determine if higher quality schools were associated with higher wellbeing and better education outcomes in vulnerable children and children overall.

Chapter 7 concludes with a summary of the overall findings, the main limitations of the study, and a discussion of their implications for future work and policy; in particular I discuss the

consequences of my findings with regards to their implications for the education system and the design of interventions to assist OVCs.

Three appendices contain published papers (from Chapters 2, 4, and 6) based on work from this thesis.

1.9 Contribution to thesis

I determined the overall content of this project in consultation with my supervisors Simon Gregson, Laura Robertson, and Jeff Eaton. The overall study design for the HIV competent schools project was developed by Cathy Campbell and Morten Skovdal from the London School of Economics and Political Science (LSE), and Simon Gregson, before the start of my PhD. I designed and executed the detailed quantitative data analysis plan in consultation with them, Laura Robertson, and Jeff Eaton.

There are three main data sources used in this work: the main Manicaland HIV/STD survey, the Manicaland child survey, and the facility Monitoring and Evaluation (M&E) survey. Design of the questionnaires and data collection for the main and child surveys were conducted by others prior to the start of my PhD. Development of the M&E survey questions on school resources was conducted by myself and Morten Skovdal in consultation with Simon Gregson, Laura Robertson and Cathy Campbell. Data cleaning and quality checks were conducted by me, Nadine Schur, Jeff Eaton, and Albert Takaruza.

I planned and conducted all of the analyses presented in this thesis. The work comparing the HIV prevalence estimates from Spectrum to the Manicaland data was conducted in conjunction with Jeff Eaton, who extracted the necessary data (single-year age estimates of HIV prevalence) from the Zimbabwe national HIV estimates using the Spectrum software. I would also like to thank Janet Dzangare and Elizabeth Gonese (Zimbabwe Ministry of Health

and Child Welfare) and Mary Mahy (UNAIDS) for assistance with obtaining the Zimbabwe Spectrum file and John Stover for advice regarding the calculation of HIV prevalence estimates from the Spectrum software. The qualitative work mentioned in Chapter 6 was conducted by Louise Andersen in conjunction with Cathy Campbell, Morten Skovdal, Alice Mutsikiwa, and Claudius Madanhire. The principal components analysis (PCA) used to construct the child index of wellbeing described in Chapter 6 was conducted under the guidance of Dr. Thibaut Jombart.

All work was reviewed and influenced by discussions with my supervisors and colleagues in the Department of Infectious Disease Epidemiology, Imperial College London. In addition, the work on HIV competent schools in Chapter 6 was discussed with, and reviewed by, Cathy Campbell and Morten Skovdal at LSE.

2 HIV in children in a general population sample in eastern Zimbabwe: prevalence, causes and effects

2.1 Introduction

In 2012, it was estimated that over 85% of children who became infected with HIV were living in SSA [1]. Most infected children are believed to have acquired HIV perinatally from their HIV-positive mothers. Untreated HIV infection in infants is typically characterised by rapid disease progression and death at a median of two years of age or less, with survival depending on the stage (*e.g.* perinatally, breastfeeding) when an infant becomes vertically infected [146], but it is estimated that perhaps up to a third of vertically infected children survive into adolescence [14,147,148]. Clinical reports [15,149-151] and studies in non-representative samples from highly localised areas [23,24,35] suggest that non-sexually acquired infections may occur in children and adolescents. However, debate continues as to whether or not these children are actually long-term survivors of MTCT or have acquired HIV horizontally [14,15,149,150].

Currently, although clinical data exist, there are few empirical data on the epidemiology and the health and nutrition effects of HIV infection in children in general population samples from SSA. The most common sources of data about HIV prevalence in SSA in adults, Demographic and Health Surveys (DHS) and community-based cohort studies, typically include only persons over age 15 years. As a result, estimates for HIV in children are generally extrapolated from data about pregnant women using mathematical models [59]. In Zimbabwe, UNAIDS estimated that 2.8% (95% CI: 1.6-3.7%) of children 0-14 were HIV-positive in 2012 [59,152]. Direct empirical data about the epidemiology, sources and impacts of HIV in children will improve confidence in estimates and ensure that health and social care systems are able to meet the needs of infected children.

The objectives of this chapter are to:

1) Describe patterns of HIV prevalence in a representative general population sample of children aged 2-17 years in a large-scale generalised HIV epidemic in rural areas of eastern Zimbabwe from 2009-2011

2) Investigate the likely extent and possible sources of horizontal HIV transmission in childhood

3) Assess whether the observed age-pattern of HIV-positive children is consistent with that expected from survival of children infected from MTCT (given recent trends in adult prevalence and PMTCT programme scale-up)

4) Assess the impact of HIV on children's mental and physical health and nutritional status

5) Investigate the levels and determinants of ART coverage in children

2.2 Methods

2.2.1 Study population and data collection

Included in this chapter are data from children and adolescents aged 2-17 who participated in the child survey in round five (2009-2011) of the Manicaland HIV/STD Prevention Project. In addition to data from the child survey, those adolescents aged 15-17 who completed the adult survey, but not the child survey, were also included in the analysis. Due to slightly different content in the two surveys, data on certain non-sexual horizontal HIV risk factors (*i.e.* blood transfusions, caring for an ill relative, being breastfed by a non-biological mother,

and vaccination record) were not collected for adult survey respondents. An overview of the study population and data collection methods is given in section 1.6.

Children under seven answered with assistance from their primary caregiver. More sensitive questions were asked only of older children and were answered without their caregiver being present: children aged 7-17 years were asked questions on sexual abuse and on psychological health. Questions on HIV testing and knowledge of HIV status were addressed to the child's primary caregiver in the presence of the child if he or she was over the age of seven. Additionally, the questionnaire was administered by a nurse who had HIV Testing and Counselling certificates, which include training in how to respond if a child becomes distressed.

All maternal data (religion and HIV status) were collected in the general (adult) survey and linked to child data based on children reporting who their biological mother was, and confirmed through fertility histories and the household roster. In cases where a link could not be made, or if the child was a maternal orphan, maternal data was coded as missing.

Dried blood spot samples were collected and tested for HIV in an offsite laboratory using the COMBAIDS-RS HIV 1+2 Immunodot Assay (Span Diagnostics, India); for cases in which the child tested HIV-positive but had an uninfected mother or the test result did not match the self-reported HIV status, the HIV test results were confirmed using Vironostika HIV Uni-form II Plus O (Biomérieux, France) ELISA tests.

2.2.2 Data analysis

In this analysis of children aged 2-17 years old, I tested for associations between HIV infection and socio-demographic characteristics (sex, age-group, household SES, community type, and mother's religion) using logistic regression. Socio-economic status was

measured using a summed asset-based wealth index developed for the study population in Manicaland [153]. The mother's self-reported religious affiliation was classified into "Christian", "Traditional", "Spiritual", "Other", or "none", as in previous analyses of Manicaland data [136].

To test the hypothesis that HIV infection in children occurs primarily through MTCT, where available, I examined maternal survival/infection status (deceased, alive and HIV-negative, alive and HIV-positive, alive with unknown HIV status) by child HIV status to establish the plausibility of mother-to-child HIV transmission. The odds ratios of being a maternal orphan and of being a maternal orphan or having an HIV-positive mother amongst infected and uninfected children were evaluated using a one-sided Fisher's exact test. This follows the procedure that Eaton *et al.* used in work on adolescents in the same population from 2006-2008 [15]. I tested for associations between HIV infection and risk factors for horizontal HIV transmission, which included blood transfusion, vaccination, non-vaccination medical injections, breastfed by a non-biological mother, cared for a sick relative, sexual abuse, and sexual activity (ages 15-17 only).

To assess whether the observed age-pattern of HIV prevalence in children was consistent with that which would be expected in Zimbabwe if infections were due to MTCT, I compared the age-specific HIV prevalence data to national estimates of child HIV prevalence reported by UNAIDS [1]. These estimates are derived using the Spectrum model [154,155], which assumes MTCT is the source of paediatric HIV and reflects the declining trends in HIV prevalence recorded in pregnant women, rates of mother-to-child transmission, patterns of paediatric survival depending on whether infection occurred perinatally or through breastfeeding, national data on PMTCT and anti-retroviral therapy (ART) scale-up, and effectiveness of PMTCT regimens [146]. Single year age estimates for HIV prevalence are not provided directly in the Spectrum file and were calculated by Dr. Jeff Eaton based on advice from John Stover. The 2013 Spectrum file that I used in this analysis can be downloaded from http://apps.unaids.org/spectrum/.

The impacts of HIV on measures of physical and mental health were evaluated using linear (continuous outcomes) or logistic (binary outcomes) regression, adjusting for age. Z-scores for height- and weight-for-age and weight-for-height were calculated using WHO child growth standards [156,157]. Z-scores below -2 were considered to indicate stunting (low height-for-age), being underweight (low weight-for-age) and wasting (low weight-for-height), as per the WHO standards [156,157]. Comparisons were made for stunting (ages 2-14), being underweight (ages 2-10), and wasting (ages 2-5), based on the ages for which reference data were available [156]. Psychological wellbeing scores were calculated in children aged 7-17 years using principal components analysis (PCA) of psychological distress measures as described by Nyamukapa *et al*., 2010 [63]. A more in-depth explanation of the calculation of psychological wellbeing is given in Chapter 6. All analyses were conducted in Stata/SE version 12.1 (StataCorp LP, USA).

2.3 Results

2.3.1 Demographic profile of infected children

Seven thousand six hundred and forty children aged 2–17 years were enumerated in an initial household census and selected for inclusion in the study, of whom 5505 (72.1%) completed the child and/or adult survey and gave a dried blood spot for HIV testing. Children who did not complete the survey did not have significantly different age or gender distributions and their household of residence did not have significantly different mean SESs than those who completed the questionnaire. Reasons given for non-response included: away from home for work (7.4%), away from home for school (7.0%), another reason for being away from home (67.1%), whereabouts unknown (1.1%), refused (12.3%), and other (5.0%).

One hundred and fourteen children (2.1%, 95% CI: 1.7-2.4%) were HIV-positive. By age, HIV prevalence was 1.6% (11/688), 2.5% (33/1296), 1.9% (25/1405), and 1.9% (41/2116) among children aged 2–4 years, 5–9 years, 10–14 years, and 15-17 years, respectively. Demographic characteristics of children aged 2-17 years by HIV status are presented in Table 2-1. HIV prevalence did not differ significantly ($p<0.05$) by sex, age-group, or any other demographic characteristics (household SES, community type, and maternal religion), although orphaned children were more likely to be HIV-positive than non-orphaned children ($p<0.001$).

Table 2-1 Association between demographic characteristics and HIV infection in children

	HIV+ (%)	N	OR (95% CI)[†]	*p*-value[‡]
Gender				
Male	2.14%	2710	Referent	0.72
Female	2.00%	2795	0.93 (0.65-1.35)	
Age Group				
2-4	1.60%	688	Referent	0.32
5-9	2.20%	1296	1.71 (0.86-3.38)	
10-14	1.92%	1405	1.21 (0.59-2.45)	
15-17	1.94%	2116	1.22 (0.62-2.38)	
Household SES				
Poorest quintile	1.70%	1059	Referent	0.27
Second quintile	1.87%	1066	1.11 (0.58-2.10)	
Middle quintile	0.85%	236	0.49 (0.11-2.14)	
Fourth quintile	2.57%	1750	1.53 (0.88-2.65)	
Least poor quintile	2.10%	1378	1.24 (0.69-2.25)	
Community type				
Subsistence farming	2.46%	2280	Referent	0.38
Roadside trading	1.82%	1153	0.79 (0.41-1.50)	
Agricultural estate	1.20%	1245	0.54 (0.27-1.08)	
Commercial centre	2.66%	827	0.87 (0.44-1.73)	
Mother's religion [a]				
Christian	1.25%	1517	Referent	0.97
Traditional	0%	18	N/A	
Spiritual	1.36%	1248	1.09 (0.56-2.10)	
Other	1.35%	446	1.08 (0.43-2.71)	
None	0%	89	N/A	
Orphanhood				
Non-orphan	0.9%	3499	Referent	<0.001
Maternal orphan	6.1%	261	7.08 (3.83-13.1)	
Paternal orphan	2.4%	984	2.71 (1.59-4.62)	
Double orphan	7.5%	491	8.79 (5.42-14.3)	

[†]Unadjusted odds ratio [‡]Fisher's exact test for difference of proportions

[a] Total respondents (n=3318) lower than other categories due to maternal orphans (n=752 including double orphans), unlinked records (n=857) and question non-response (n=578).

2.3.2 Sources of HIV infection

Ninety-one of the 114 HIV-positive participants were either maternal orphans or had an HIV-positive surviving mother; 21 of the remaining mothers had an unknown HIV status and the other 2 were HIV-negative. This is consistent with the primary source of childhood infection being MTCT (Table 2-2). These two individuals (one male child aged 3 and one female adolescent aged 15) did not report risk factors for non-sexual horizontal transmission (blood transfusions, breastfeeding by a non-biological mother, caring for a sick relative, or child abuse); however, the adolescent reported having had sex. The three year-old male child lived in a roadside trading centre, was reported to be living with his biological parents, with his mother being reported as his primary caregiver. HIV-positive children were significantly more likely to be a maternal orphan (OR: 6.00, 95% CI: 4.09-8.80) and/or have an HIV-positive mother (OR: 59.56, 95% CI: 18.82-188.5)) than HIV-negative children. Among HIV-positive children, the likelihood of being a maternal orphan as compared to having an HIV-positive mother increased with age (p=0.01, Figure 2-1). Although the overall trend was significant, there were a small number of children of each age (minimum of 2 and maximum of 18) and the confidence intervals for each age were very wide and are not shown on the graph. Note that the percentages for each age do not add up to 100 as HIV+ children with HIV-negative mothers or mothers of unknown HIV status (n=23) are not included on the graph.

Overall, 29.1% (1191/4092) of participants who answered the survey questions reported at least one of the selected risk factors for horizontal HIV transmission (Table 2-3), excluding vaccination-related injections, of which 99.7% (3992/4005) of children reported having had. HIV-positive children were significantly more likely to report non-vaccination injections than HIV-negative children (56.1% vs. 45.9%, p=0.04). Otherwise, no significant differences in reporting of risk factors (blood transfusions, breastfeeding by a non-biological mother, caring

for a sick relative, child abuse, or sexual activity) were found between HIV-positive and uninfected children.

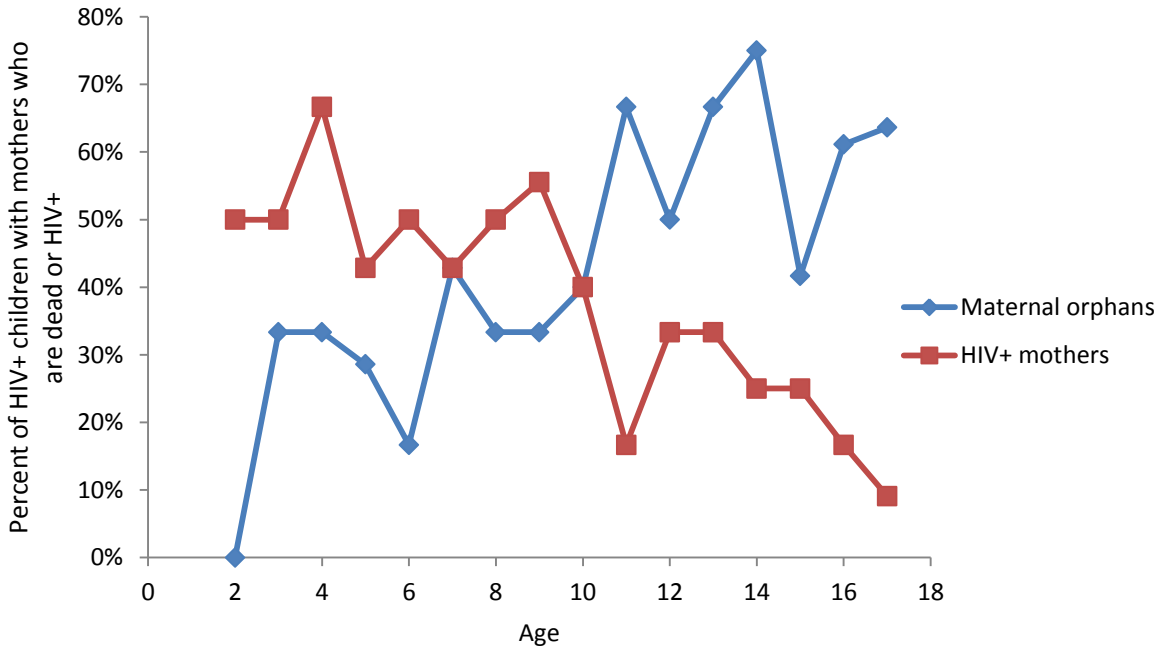

Figure 2-1 Comparison of maternal status in HIV-positive children by child age

Table 2-2 Maternal mortality and HIV status in children

Maternal status	**Child HIV status**	
	HIV- (N=5391)	**HIV+ (N=114)**
Mother deceased	701 (13.00%)	53 (46.49%)
Mother alive, HIV+	620 (11.50%)	38 (33.33%)
Mother alive, HIV-	2639 (48.95%)	2 (1.75%)
Mother alive, unknown HIV status	1431 (26.54%)	21 (18.42%)

Table 2-3 Association between HIV status and potential horizontal risk factors for HIV

Horizontal risk factors	N	HIV+ (%)	AOR (95% CI) [†]	*p*-value[‡]
Ever had a blood transfusion				
No	3988	2.01%	Referent	0.17
Yes	9	11.1%	6.11 (0.75-49.4)	
Lifetime number of non-vaccination injections				
0	2968	1.68%	Referent	0.04
>0	2537	2.53%	1.5 (1.04-2.19)	
Received tuberculosis, polio, measles, and/or diphtheria vaccination				
No	13	0%	Referent	0.77
Yes	3992	1.98%	N/A	
Breastfed by non-biological mother				
No	3991	2.00%	Referent	1.00
Yes	17	0%	N/A	
Cared for a sick relative (ages 6-17)				
No	2731	2.09%	Referent	0.42
Yes	85	0%	N/A	
Ever been sexually abused (ages 7-17)				
No	3517	1.93%	Referent	1.00
Yes	4	0%	N/A	
Ever had sex (ages 15-17)				
No	1980	1.97%	Referent	0.68
Yes	136	1.47%	0.74 (0.18-3.11)	

[†] Adjusted odds ratio; adjusted for age, gender, SES, and site type

[‡]Fisher's exact test for difference of proportions NB: Different Ns due to different question non-response rates and certain questions only being asked in the child survey

2.3.3 *Comparison of observed age-specific HIV prevalence with national estimates from the UNAIDS Spectrum model*

HIV prevalence in children aged 2-17 observed in Manicaland (2009-2011) was lower than the national estimates for Zimbabwe as a whole for 2010 estimated by the Spectrum model (3.5%). However, the age-pattern of HIV prevalence amongst children observed in the data was consistent with the model estimates (Figure 2-2). This suggests that the age-patterns of HIV in Manicaland are in line with what would be expected if MTCT were the main source of child infections, accounting for the declining trend in adult HIV prevalence and the scale-up of PMTCT programmes in Zimbabwe.

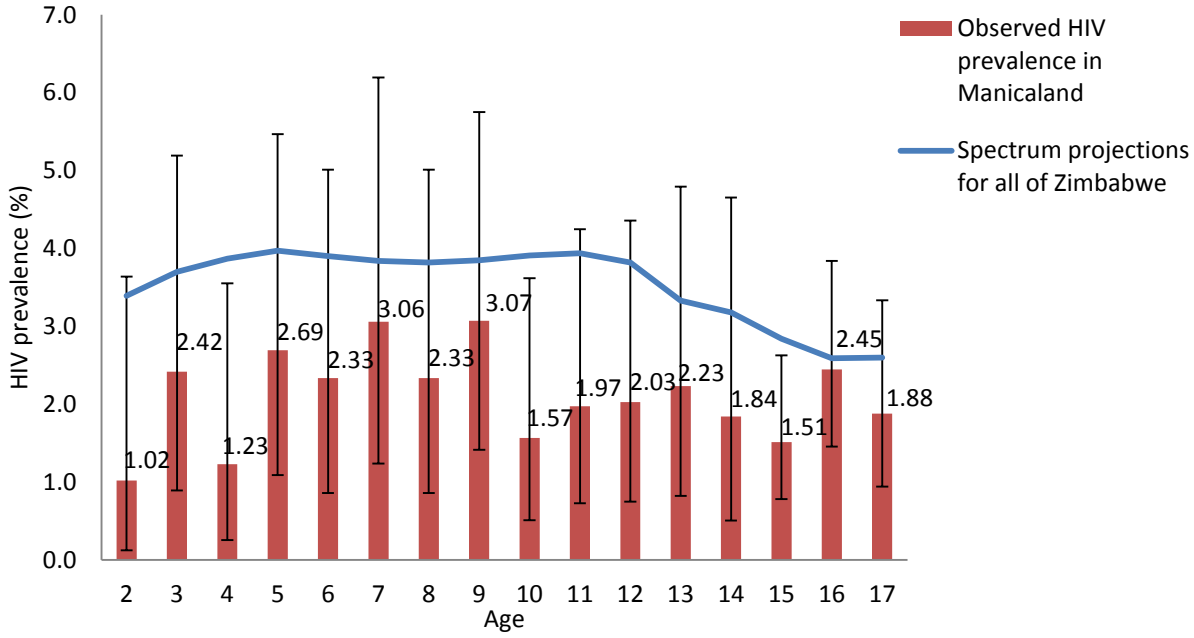

Figure 2-2 Comparison of observed HIV prevalence by age in Manicaland, with 95% confidence intervals, to the Zimbabwe national HIV estimates from UNAIDS and the Zimbabwe Ministry of Health and Child Welfare

2.3.4 HIV status and child health

HIV-positive children were significantly more likely to be underweight (low weight-for-age) (AOR: 2.20; 95% CI: 1.08-4.47), stunted (AOR: 1.69; 95% CI: 1.02-2.81), and to report a recent illness (AOR: 1.99; 95% CI: 1.22-3.23) than HIV-negative children, but were not more likely to be wasted (low weight-for-height) (AOR: 0.43; 95% CI: 0.05-3.34) (Table 2-4). When the analysis for illness was divided up into ages 2-14 and 15-17, there was no association in the younger group (AOR: 1.31; 95% CI: 0.64-2.66), but there was a significant association in adolescents aged 15-17 years (AOR: 3.32; 95% CI: 1.59-6.96). HIV status was also not associated with psychological wellbeing (coefficient: -0.31; 95% CI: -4.32 – +3.71) (Table 2-4).

Of the 114 HIV-positive children, 23.7% (27/114) reported that they knew their HIV status. Of the HIV-negative children, 332/5391 (6.2%) had had an HIV test, significantly lower than reported testing prevalence in HIV-positive children ($p<0.001$). Children of mothers who reported that they knew they were HIV-positive had 3.40 times higher odds (95% CI: 1.88-6.13) of having had an HIV test and to know the result than children of mothers who self-reported as HIV-negative. Knowledge of HIV status (either by the child or their guardian) was not associated with psychological wellbeing score for HIV-positive children (change in psychological wellbeing score: -0.04; 95% CI: -0.30 – +0.21). All but three of the children (24/27) who were aware of their HIV-positive status reported taking drugs that stop HIV from causing AIDS (presumed to be on ART). Despite high ART coverage when HIV status is known, overall, less than a quarter (21.1%, 24/114) of HIV-positive children were receiving ART.

The HIV test results reported here did not perfectly agree with the self-reported results from the survey (Table 2-5). Among those children who had been tested (n=351), 9 (2.6%) reported an HIV status that did not match the study results: 5 were false negatives (self-

identify as negative when tested positive) and 4 were false positives (self-identify as positive when tested negative). The five false negatives were aged 16 (3/5) or 17 (2/5); four were male and one was female; none had mothers who were HIV-positive; three were maternal orphans; and one reported having had sex. The four false positives were aged 4, 15, 16, and 17; two were male and two were female; none had mothers who were HIV-positive; one was a maternal orphan; one reported having engaged in sexual activity; and two reported being on ART. In all cases where the test results did not match the self-reported HIV status, the collected blood samples were retested using an ELISA assay, as described in the methods.

Table 2-4 Effects of HIV status on physical and mental health outcomes in children and adolescents

Health outcome	**N**	**%**	**AOR (95% CI)**[†]	***p-value***
Ill in last two weeks				
HIV-	5390	9.92%	Referent	0.006
HIV+	114	18.4%	1.99 (1.22-3.23)	
Low height-for-age (ages 2-14)				
HIV-	3222	30.60%	Referent	0.04
HIV+	69	39.13%	1.69 (1.02-2.81)	
Low weight-for-age (ages 2-10)				
HIV-	2225	9.97%	Referent	0.03
HIV+	51	19.61%	2.20 (1.08-4.47)	
Low weight-for-height[‡] (ages 2-5)				
HIV-	833	11.64%	Referent	0.42
HIV+	16	6.25%	0.43 (0.05-3.34)	
Psychological wellbeing score (ages 6-17)[a]				
HIV-	2976	16.31	Referent	0.88
HIV+	96	16.00	-0.31 (-4.32 - +3.71)	

[†]Adjusted odds ratio; adjusted for age, gender, SES, and community type
[a] Mean and change in score between HIV- and HIV

Table 2-5 Comparison of self-reported HIV status (among those who reported having undergone an HIV test) and HIV test results from the study

	Test HIV-	Test HIV+
Self-report HIV-	315	5
Self-report HIV+	4	27

2.4 Discussion

This chapter described the prevalence of HIV in children and young adults aged 2 to 17 in eastern Zimbabwe and additionally investigated the sources and health consequences of HIV in this population. The work in this chapter provides much of the background data and context for the work in chapters four through six and, to a smaller degree, chapter three. Addressing the objectives of this chapter:

1) 2.1% (114/5505) of children aged 2-17 years in this sample from rural eastern Zimbabwe were HIV-positive. HIV status did not differ by any measured socio-demographic factors.

2) Paediatric HIV was not associated with reported risk factors for horizontal transmission in this population, although there was one case of non-MTCT that could not be explained by any measured source of horizontal HIV infection.

3) The observed age pattern of HIV-positive children is consistent with that expected from survival of children infected through MTCT. The overall child prevalence in Manicaland was lower than that predicted by Spectrum for the national population.

4) HIV negatively impacts on child development, increasing the odds of stunting, being underweight, and reporting a recent illness, though not wasting.

5) ART coverage in HIV-positive children is low overall (21%), but increases substantially when HIV status is known (88.9%).

2.4.1 HIV demographics

In this chapter I have provided the first data-based population-level estimate of HIV in children from Zimbabwe. Previous estimates exist, but they are based on mathematical models that use maternal data [10]; studies with small, non-representative, samples [158]; or studies with a limited age range and geographical coverage [159]. Here, in eastern Zimbabwe, from 2009-2011, I found that 2.1% (95% CI: 1.7-2.4%) of children aged 2-17 years tested positive for HIV, at a time when HIV prevalence was 11% and 17% amongst male and female adults (15-54 years), respectively, in the same population. This estimate, from a representative general-population sample, is lower than those from a sample of children in 2005 in Chimanimani district in southern Manicaland, where HIV prevalence was 3.6% (57/1591) in children aged 2-18 years [158]. Such a reduction between 2005 and 2010 is expected based on the decline in adult HIV prevalence and the increase in PMTCT coverage since 2005. A study conducted with 4,386 primary school children in urban areas in Harare in 2010 found an HIV prevalence of 2.7% (95% CI: 2.2-3.1%) in children aged 6-13 years [159], which is close to the prevalence of 2.3% (95% CI: 1.7-2.9%) found in this study for the same age-group, albeit in a different region. As was the case in the Chimanimani study [158] and in studies in similar age-groups elsewhere in SSA [160-162], including a large national population survey in South Africa conducted in 2008 [163], I found no significant differences in HIV prevalence with respect to sex or age. This is important because it highlights that any programmes for HIV treatment and care in children must target all ages and should not assume that maternally infected children do not live beyond their early years.

2.4.2 HIV transmission routes

The finding of a relatively even pattern of HIV prevalence by age is consistent with official national estimates derived from the Spectrum model, which are based on the assumption that child HIV prevalence results from MTCT alone. Survival data for children infected with

HIV through MTCT suggest high mortality [14] and, in a stable epidemic with little non-MTCT and no PMTCT intervention, HIV prevalence will decline steadily with age; however, the decline in HIV prevalence in pregnant women since the late 1990s (from 25.7% in 2002 to 16.1% 2009 [164]) and the scale-up of PMTCT services from the mid-2000s, explain the similar prevalence levels in younger and older children observed in the current study.

Although the age pattern of HIV prevalence in children reported here is similar to that reported in Spectrum, the overall prevalence is lower in the Manicaland data. This discrepancy may be because Spectrum represents a different population (all of Zimbabwe), due to differences in HIV prevalence in pregnant women in Manicaland vs. nationally, differences in MTCT programme uptake in Manicaland vs. nationally, the low numbers of HIV-positive children from the study in each age band, or the imprecision of the Spectrum estimates. To note is that although low numbers might explain the variability in the Manicaland estimates by single year of age, this is less likely the case for overall prevalence, for which the Manicaland estimate is based on a large overall sample of children. Currently, Spectrum estimates child HIV prevalence based on the number of HIV-positive women of reproductive age, fertility rates irrespective of ART, peripartum and breastfeeding transmission rates, infant feeding practices, the number of children receiving cotrimoxazole and ART, and how long children on and off ART will survive [165]. Although the age-specific HIV prevalence reported here may be imprecise due to the small overall population of HIV-positive children, neither should the Spectrum estimates be taken as the gold standard. The Spectrum team at UNAIDS has acknowledged the potential weaknesses in the model and are currently in the process of updating Spectrum to incorporate the time of ART initiation during pregnancy, age stratification of treatment initiation for children, fertility rates on and off ART, variations in breastfeeding practices/duration, retention and adherence on ARVs for pregnant women, and revising Spectrum to include a compartmental model to produce survival patterns for children on and off ART [166]. By working with the Spectrum team and

feeding my results back to them, I have helped to strengthen the Spectrum model, because a model can only be as good as the data that go into it.

The results of this study support the belief that MTCT is the primary mode of HIV transmission in children in eastern Zimbabwe [15]. Mothers of HIV-infected children were significantly more likely than mothers of uninfected children to be deceased or HIV-positive. One child, for whom I could not identify a plausible source of infection, did not report any maternal, sexual, or other non-mother-to-child risk factors for transmission. Exposure to potential modes of transmission may have been under-reported and data were not collected on all possible sources of infection, such as scarification and hospital and dental visits, which have previously been identified as sources of HIV in children [23,24,35]. Sexual abuse has also been identified as a potential mode of HIV acquisition in select cases in children [167-172]; however, little research has been conducted into the proportion of children infected with HIV through sexual abuse, even though sexual abuse has been reported to be common in South Africa [33,34]. Sexual abuse was also measured in this study, but was likely to be underreported, with only four children aged six and up (0.11%) reporting it. While I cannot be certain about the accuracy of reporting about the child's biological mother without biological tests [27], for which this study did not have consent, the identification of the biological mother was consistent with information reported on the household roster and the child was named on the mother's fertility history.

I did find that HIV-positive children were significantly more likely to report non-vaccination medical injections than HIV-negative individuals, but this may be because HIV-positive children are more likely to seek healthcare for managing their infection or to treat HIV-associated illnesses [151]. Thus, this association should not be misconstrued as evidence for medical injections as a source of horizontal transmission, particularly as 27 of the 30 (90%) of the HIV-positive children who reported having had medical injections also reported being a maternal orphan or having a mother who was HIV-positive. In the introduction to this

thesis, I discussed in detail the evidence for and against horizontal transmission and the theory that injections may have a substantial contribution to paediatric HIV. The findings in this chapter suggest that, although horizontal infections may be possible, they are unlikely to be the main source of HIV infection in children.

By identifying MTCT as the most likely route of HIV transmission in this population, I have strengthened the arguments for causality that I make later in this thesis (*i.e.* in chapters four and five). Because HIV infection likely occurs around the time of birth in youth who are under the age of 18 from 2009-2011, I am able to argue that HIV infection has occurred before any of the negative outcomes that I investigate, providing a temporal link.

2.4.3 Health implications of HIV infection

The need to understand HIV infection in children is particularly important given that HIV is increasingly becoming a cause of hospitalisation amongst adolescents in SSA[151] and this trend is likely to continue as more HIV-positive children age into adolescence. Indeed, the data suggest that it is older adolescents who are more likely to experience illness, supporting the theory that HIV-positive children aging out of childhood will continue to place an increased burden on health systems in SSA [151]. However, HIV-related health concerns are not confined exclusively to adolescents, as I found HIV-positive children to be significantly more likely to be underweight and stunted, indicative of the long-term harm of HIV infection on health and nutritional status. Perhaps unsurprisingly, I did not find a significant relationship with wasting, which measures recent severe weight loss, often associated with acute starvation and severe disease, and therefore not a condition necessarily expected to be associated with HIV infection. These indicators of malnourishment are also present in the national population, with 3%, 10%, and 32% of children under age 5 found to be wasted, stunted, and underweight, respectively, in the 2010-2011 Zimbabwe Demographic Health Survey (conducted from September 2010 to March 2011) [59]. These numbers are similar to

those seen here among all children, bar wasting, with 11.5%, 9.9%, and 30.8% of all children being wasted, stunted, and underweight, respectively. Wasting may have been lower in the Manicaland data due to some study areas being more fertile and having more regular rainfall than the country as a whole. Also, the DHS survey period is concentrated within the pre-harvest period whereas the Manicaland data were collected over the whole year. Unfortunately, the DHS does not collect HIV status for children, but stunting and being underweight in HIV-positive children, as well as wasting, have been reported previously in SSA [151,173,174].

There are few data from SSA on the psychological manifestations of HIV infection in children, although studies from developed countries report significantly higher incidence of psychiatric admissions for HIV-positive children than HIV-negative children, with knowledge of HIV status increasing the risk of admission [175]. A previous study in Zimbabwe found that 56% of HIV-positive adolescents reported psychosocial problems, but that these problems were not common in younger children [176]. These data, however, were collected from children and adolescents visiting facilities offering HIV care services, and many respondents were already presenting with AIDS-related illnesses. Because the results were from a clinical study and were not compared to an HIV-negative population, it was not possible to conclude that there was a significant difference in psychosocial distress based on HIV status. Although I found no significant association between HIV status or knowledge of HIV status and psychological wellbeing, the lack of data from SSA in this area and the findings of Ferrand *et al*. (2010) [176] suggest that this is an important topic for future investigation.

These health-related issues, both physical and psychological, could have other negative consequences for children affected by HIV. Among other issues, children affected by HIV may be less able to attend school, or may be more prone to substance use, both of which are issues that I will explore later in this thesis.

2.4.4 Knowledge of HIV status and ART coverage

Only a quarter of HIV-positive children and/or their guardians were aware of their HIV status. Across southern and eastern Africa, ART coverage among children is a major problem and is a high priority for many governments as it continues to lag behind adult coverage (33% versus 65% in the 22 priority countries, of which 21 are in Africa) [177]. So long as they remain undiagnosed, and therefore untreated, HIV-positive children are at higher risk for AIDS-related illnesses and early mortality. In the longer term, knowledge of HIV status is important to mitigate the risk of passing the infection on to sexual partners.

Despite the low coverage of HIV testing, I found that if children or their guardians were aware of the child's HIV-positive status there was an almost 90% chance that the child would be on ART. This suggests that, despite the fear, potential stigma and associated costs, a positive diagnosis does result in the initiation of treatment. One way to help increase treatment amongst children might be to increase HIV-testing of women, as I found that when a mother knew herself to be HIV-positive, her child was significantly more likely to have had an HIV test themselves – suggesting that getting more mothers diagnosed will improve child testing. Increases in maternal and infant testing are likely already underway due to the scaling up of PMTCT programmes, which test infants if their mothers have tested positive for HIV. Beyond PMTCT programmes, which will not benefit older children, one possible way to increase diagnosis of HIV in this population is point-of-care testing. Point-of-care testing has been shown to increase the likelihood of having a CD4 test and to reduce the time to being tested both in SSA and other settings, which could increase the number of eligible patients initiating ART [178]. New point-of-care tests that are being developed could also increase infant diagnosis of HIV as, currently, many infants go undiagnosed due to the long turnaround times or poor infrastructure associated with dried blood spot sample testing [179]. New tests include a rapid p24 antigen test and a nucleic-acid amplification test, both of which can be performed in under half an hour [180]. Early diagnosis of HIV infection is important, as the high

ART coverage when children are aware of their status implies that lack of knowledge of HIV status is a contributing factor to the low coverage of ART in children that has been noted in Zimbabwe (39.5% according to the 2011 national estimates [181]) and more broadly in most of SSA [182].

An increase in HIV testing would, however, come with its own potential issues. I found here that 2.6% (9/351) of tested children had results that did not match those of the survey. The five false negatives may have been due to sexual infections that occurred after they had been tested for HIV as all five were aged 16 or 17 years, despite only one of them reporting having been sexually active. Such lack of disclosure is common when asking respondents about questions of a sensitive nature, in this case sexual activity, and would not be surprising [183-186]. Alternatively, these adolescents may have been aware of their status and were simply not comfortable disclosing it to the interviewer. Also worryingly, are the 4/32 (12.5%) of children who were false positives. A contributing factor to this might be incorrect diagnoses in routine PMTCT testing. A 2014 report found that, in pregnant Zimbabwean women, 8% of those found HIV-negative and 2% of those found HIV-positive were, in fact, misdiagnosed [187]. Misclassification error in routine HIV testing based on rapid tests is a growing area of interest and future work in the Manicaland study will include investigations of this. Regardless of the reasons for the misdiagnosis, unwarranted ART is a potential issue. A child placed on ARVs despite not needing them may suffer needless drug-induced side effects, stigma, and psychological distress, in addition to the financial burden that treatment can place on the family. Although treatment is free in this population, many families in rural areas do not live near clinics and the time and costs of getting to the clinic are not insignificant. This is not to say by any means that testing should not be scaled up, as it appears, at least in this population, to be the main barrier to getting HIV-positive children on treatment; however, care must be taken to recognise the potential negative side effects of incorrect test results.

The key findings and conclusions of this chapter are:

1) MTCT is the main source of HIV infection in children in southern Africa and current initiatives to increase the availability and effectiveness of PMTCT should result in reductions in HIV prevalence in children over time.

2) Age-specific HIV patterns matched those predicted by Spectrum, albeit at rather lower overall levels, consistent with childhood HIV infection being driven by MTCT. The discrepancies in the prevalence estimates may be due to discrepancies with the national population, the small number of HIV-positive children of each age, or the lack of precision in the Spectrum estimates.

3) HIV-positive children and adolescents experience more adverse health outcomes than their HIV-negative counterparts, suggesting the potential for them to place a burden on the health system as their infection continues to progress, although this could be avoided by increased ART coverage.

4) Effort should be made to encourage HIV testing in children because, despite low overall ART coverage, children who are aware of their HIV status were highly likely to be on treatment.

5) Maternal HIV testing, whether through PMTCT programmes or other means, may be a way to increase child HIV testing because when a mother knew herself to be HIV-positive, her child was significantly more likely to have had an HIV test.

In the next chapter I will examine education trends in Manicaland over time as well as the direct associations between education and HIV prevalence and incidence. In the following

chapters I will look at the negative impacts of HIV on education by examining the links between HIV-related vulnerability and poorer education.

3 Education and HIV trends in eastern Zimbabwe from 1998 to 2011

3.1 Introduction

The associations between education and HIV are complex and reinforcing: as the epidemic worsens, the education sector suffers, which in turn is likely to increase HIV incidence. This is applicable in many countries in SSA, but the Zimbabwean context contains an extra layer of complexity due to the volatile history of education in the country. In Zimbabwe, education was the purview of missionary schools until Independence in 1980, at which time primary education became mandatory for all children [70]. Primary education was made free of charge, several new schools were built, additional teachers were trained, and universal primary education was achieved in the late 1980s [188]. However, primary school fees were re-introduced in 1991 and have risen steadily since then [70]. In addition to rising school fees, larger social and economic forces have also had an impact on the education system. The Zimbabwean economy began to decline in the early- to mid-1990s, although, at this time, there was a national 'O' level pass rate of approximately 70%, with 23% of students passing five or more subjects [189]. 'O' levels are the final year high school exams and five 'O' level passes is considered to be a "complete" education and is the requirement for formal sector employment in Zimbabwe.

The economy continued to decline in the late 1990s, particularly following the ending of the World Bank / IMF supported Economic Structural Adjustment Programme (ESAP). However, the land redistribution programme, starting in 2000, is viewed as the main catalyst for the economic and social crisis that would define much of the 2000s in Zimbabwe [190]. Agricultural production was disrupted due to farms being sub-divided and changing hands, and manufacturing declined due largely to a shortage of foreign currency to import both

materials and machinery [190]. This decline in productivity led to a decline in employment and disposable income, which, coupled with rising primary school fees, meant that many families, particularly those in rural areas, were either unable to afford school fees, or needed their children to help out at home earning money, which forced children to drop out of school. In the early- to mid-2000s, over 30% of all children who enrolled in primary school are believed to have dropped out before finishing their final year [191]. Hyperinflation reached a peak of almost 500 billion percent in December 2008 [188,190], but severe problems in the education system were apparent before then. In 2007, the 'O' level pass rate fell to 11%, well below the 72% reported in the mid-1990s and, in 2008, the school year was severely disrupted due to teachers striking over low salaries (<£6/month) and poor working conditions [192]. The education sector in Zimbabwe has started to improve since the adoption of a multi-currency system (based primarily on the US dollar) in early 2009, with schools reopening and large investments being made by UNICEF, other international donors, and the Government of Zimbabwe's Basic Education Assistance Module (BEAM) programme, which aims to offset education costs for OVCs. Other challenges still face the education system in Zimbabwe, including the lower proportion of females receiving education as compared to males [190].

Despite the turbulent history of education in Zimbabwe, it remains one of the most educated countries in Africa, with an adult literacy rate of between 83% [193] and 91% [194], depending on the source. Given the number of national-level events that have influenced the education system in Zimbabwe, it is useful to describe how education outcomes have changed over time in Manicaland and the extent to which they coincide with macro-economic and political forces.

Although economic and social changes can influence education outcomes for individuals, they do not provide the entire story. In other settings, it has been shown that better educated parents are more likely to educate their children. Parental literacy, years of schooling, and

education level have been found to correlate with child education measures in developed countries [195-198], with paternal education potentially being more influential than maternal education [199]. With the legacy of high education levels in Zimbabwe, it could be possible that, even in times of economic crisis, educated Zimbabwean parents prioritise their children's education over other expenditures. Thus, I hypothesise that the economic crisis will have had a larger detrimental effect on child education for those with less educated parents, because higher educated parents will have placed a higher priority on education.

At the same time as Zimbabwe was experiencing this economic and social upheaval, the HIV/AIDS epidemic was also underway. HIV prevalence peaked in Zimbabwe in the late 1990s, with adult AIDS mortality peaking in the early- to mid-2000s, and orphan levels rising until at least the mid-2000s [4]. The national response to the epidemic took off during this time, with the introduction of PMTCT in 2003 and ART from 2005. It is possible that these events might also have had an underlying influence on trends in education indicators. Thus, because of these underlying trends and the relationship between education and HIV in SSA, it is important to understand the education trends in Zimbabwe. The introduction to this thesis described in greater detail the associations between HIV and education in SSA and how they have changed over time (section 1.4). Briefly, in Africa up until the mid-1990s it appeared that education was a risk factor for HIV due to the higher mobility and SES that it afforded, facilitating a larger range and number of partners; but, as information about HIV prevention became more widely available, those with education were better able to absorb and actualise these messages, and the association appears to have reversed itself in recent years [102,103,120,124].

The remainder of this thesis will examine the ways in which education interacts with both HIV risk factors and the downstream effects of the HIV epidemic, while this chapter describes the education trends over time, the associations between parental education and

children's education, and the relationships between education level and both HIV prevalence and incidence. Therefore, the objectives of this chapter are:

1) To examine education trends in Zimbabwe over time and if those patterns are correlated with economic and social events in the country (*e.g.* Independence in 1980 and the economic crash in the 2000s)

2) To determine whether children of more educated parents are more likely to be educated themselves

3) To assess if, even in times of economic turbulence, children with more educated parents are more likely to be in education (*i.e.* Can parental education buffer the effects of an economic crash?)

4) To determine the associations between school education and HIV incidence and prevalence, and whether these changed over time.

3.2 Methods

3.2.1 Study population and data collection

This chapter includes data from adults aged 15-54 from all five survey rounds (1998-2011) and from children and adolescents aged 6-17 who participated in the child survey in round 5 (2009-2011) of the Manicaland HIV/STD Prevention Project. In rounds 1 and 2, data were only collected from males aged 17 and above and from females aged under 45, limiting the age-ranges analysed in these rounds. The Manicaland survey rounds correspond roughly to the different stages of the economic collapse and so will be used as proxies for different stages of the economic collapse in this chapter: Round 2 (2001-2003) corresponds to the time of the land redistribution programme and the start of the economic collapse; round 3

(2003-2005) corresponds to the period of rapidly accelerating inflation and growing shortages; round 4 (2006-2008) corresponds to the period of hyperinflation, culminating in economic collapse; and round 5 (2009-2011) corresponds to the adoption of a multi-currency system and the beginning of the economic recovery. A full description of the study population and data collection methods is given in section 1.6.

3.2.2 Education measures

Three measures of education were used for youth of school-going age (*i.e.* ages 6-18): enrolment, regular attendance, and being in the correct grade-for-age. School enrolment was measured through self-report in children and adolescents of school-going age who responded to the child survey in round 5 (ages 6-17) and who were aged 15 to 18 years and responded to the adult survey in rounds 1 through 5. School attendance data was only collected in the round 5 child survey and therefore was only available in 2009-2011 for youth up to the age of 17. Regular attendance was defined as attending at least 80% of the last 20 school days. Children not enrolled in school were coded as not attending regularly. Being in the correct grade-for-age was used to measure progress in school. Respondents were deemed to be in the correct grade for their age if they were less than two years behind in school [200]. This leeway was given to account for the differing ages when children start school (*i.e.* either age 6 or 7), and children aged 15-18 (for all rounds) or aged 8-17 (for round 5 child survey data) were included in the analysis.

Three additional measures of education were used for participants aged 15 and over: having secondary or greater education, literacy, and having five or more 'O' level passes. Participants were deemed to have secondary or greater education if they had completed at least one year of secondary school. All participants (aged 15 and above) could have been expected to have done this as the normal age to start secondary school in Zimbabwe is 13. As part of the survey design, literacy was assumed in those individuals who had completed

at least some secondary schooling and for those who had not, they were coded as literate if they could read a newspaper or short letter that was provided to them in either Shona or English. I used 5 'O' level passes as an education measure because, in Zimbabwe, 'O' level exams are typically written starting at the age of 16, and having at least 5 'O' level passes is the minimum requirement for formal sector employment. Data on 'O' level passes were only collected in the Manicaland study from round two onwards.

Parental education measures considered were maternal and paternal literacy and secondary or greater education, which were defined in the same way as for children (*i.e.* as described above).

3.2.3 Measures of HIV prevalence and incidence

HIV prevalence was measured in each of the five rounds and was defined in each round as the percentage of people who tested HIV positive. HIV incidence was measured between successive rounds (*i.e.* from round 1 to round 2, from round 2 to round 3, etc.) as the rate of seroconversions per 1000 HIV negative person years of risk.

3.2.4 Data analysis

All analyses were stratified by gender and conducted in Stata/SE 12.1. Previous work in Manicaland has shown that HIV risk differs not only between men and women, but also over time [140,201], so analyses assessing HIV were stratified by gender and survey round.

To examine education trends over time, panel data regression models were fit with individual random effects to account for the same individuals being present in multiple rounds and, therefore, that the data were not independent. Temporal trends in education trends for school enrolment (ages 15-18 and 17-18), progression in school (ages 15-18), and literacy

(ages 15-54) were smoothed using quadratic B-spline functions with knots set at 1998, mid-2005, and 2011. Trends in primary school completion (ages 15-54) were assessed based on the year an individual turned six (and should therefore have started primary school), with knots at 1960, 1975, 1990, and 2002. Trends in 'O' level passes (ages 16-54) were assessed based on the year an individual turned 16, with knots at 1970, 1985, 2000, and 2011. Trends in the relationship between maternal and paternal education levels and child education levels, as well as parental education levels on their own, were assessed as above, with knots set at 1998, mid-2005, and 2011.

To assess the associations between parental education outcomes and child education outcomes, data were combined over all rounds and analysed using logistic regression with random effects to account for repeated measurements. Parental literacy and secondary or greater education was measured against their children being enrolled in school (ages 15-18), being in the correct grade-for-age (ages 15-18), having completed primary school (ages 15-24), being literate (ages 15-24), and having five or more 'O' level passes (ages 16-24) over rounds 2 to 5 of the Manicaland survey. All regressions were adjusted for age, community type (town, estate, roadside settlement or subsistence farming), SES (measured using a previously described index [153]), and round. The regressions were also estimated with an interaction term between survey round and the parental education measure to determine if the effect of parental education changed over time. This was done to assess if parental education could buffer the negative effects of the economic instability on child education in Zimbabwe. Parental data were not linked to child data in the first survey round (1998-2000), so round 1 was excluded from these analyses.

In round 5 (2009-2011), adjusting for variables as above, logistic regression was used to assess the associations between parental education levels and their children attending primary (ages 6-12) and secondary (ages 13-18) school regularly, and being in the correct grade-for-age (ages 8-18). Paternal data were not linked to data from the child survey and

therefore associations between paternal education levels and child education measures were not assessed in children under the age of 15.

Finally, I used multivariable logistic regression models adjusting for age-group, religion, SES, and community type to determine if education level (none/primary vs. secondary or higher) was associated with HIV prevalence over all survey rounds in youth aged 15-24. The religious affiliation of all participants was based on their self-reported religion and was included because previous work in Manicaland has shown religion to be associated with HIV prevalence and incidence [136]. Socioeconomic data were not collected in round 2 (2001-2003), and therefore could not be adjusted for in analyses covering this time period. The models were also fit without adjusting for SES to help assess whether the observed relationships (or lack thereof) were actually due to education status or to the increased SES that can result from higher education levels. I used Poisson regression adjusting for variables as above, with time at risk for HIV infection as the exposure time, to assess the relationship between education level and HIV incidence between survey rounds. Differences in HIV prevalence between in- and out-of-school youth were assessed among adolescents aged 15-18 in each survey round using Fisher's exact test.

3.3 Results

3.3.1 Education trends in Zimbabwe

The education levels of male and female study participants over time are presented in Figure 3-1 and show a general pattern of increasing education. For most education indicators, males outperform females, except when looking at adolescents being in the correct grade-for-age (Figure 3-1c). Vertical lines on the graphs correspond to major events in Zimbabwe (independence and education reform in 1980, introduction of primary school fees in 1988, land redistribution in 2000, and height of hyperinflation and the adoption of a multi-currency system at end of 2008/start of 2009). These events appear to correspond more to changes

in short-term indicators (*e.g.* enrolment and grade-for-age, Figures 3-1a to 3-1c) than in indicators that are fixed (*e.g.* literacy and primary school completion, Figures 3-1d and 3-1e). The potential wider effect of the Zimbabwean context is particularly noticeable in the number of people with five or more 'O' level passes: increased steadily from 1980 onwards, dropped off starting with the land redistribution in the early 2000s and the economic crash, which peaked in the late 2000s (Figure 3-1f). To allow for delays in students achieving five or more 'O' levels, I also produced estimates based on the year individuals turned 18, and found the same decrease in the 2000s (Figure 3-2). Levels of parental education have also increased over time, with mothers and fathers of children under the age of 25 showing a steady increase in levels of secondary school completion (Figure 3-3).

In the most recent survey round (2009-2011), education levels remained high (Table 3-1), with enrolment and literacy greater than 90% and secondary education and regular attendance greater than 80%, albeit with males more likely to be educated than females (all $p<0.001$). Enrolment decreased between primary and secondary school, with 99.4% (944/950) of girls and 98.8% (941/952) of boys enrolled in primary school as compared to 80.3% (1091/1359) of girls and 87.6% (1097/1253) of boys in secondary school. 'O' level pass rates were low, with less than 15% of people aged 16 or over having passed 5 or more. The percentage of people with secondary education and five or more 'O' levels increased with increasing SES, although direction of causality cannot be determined from the cross-sectional data. A more detailed analysis and discussion of education measures in children aged 6-17 from round 5 (2009-2011) is presented in Chapter 4.

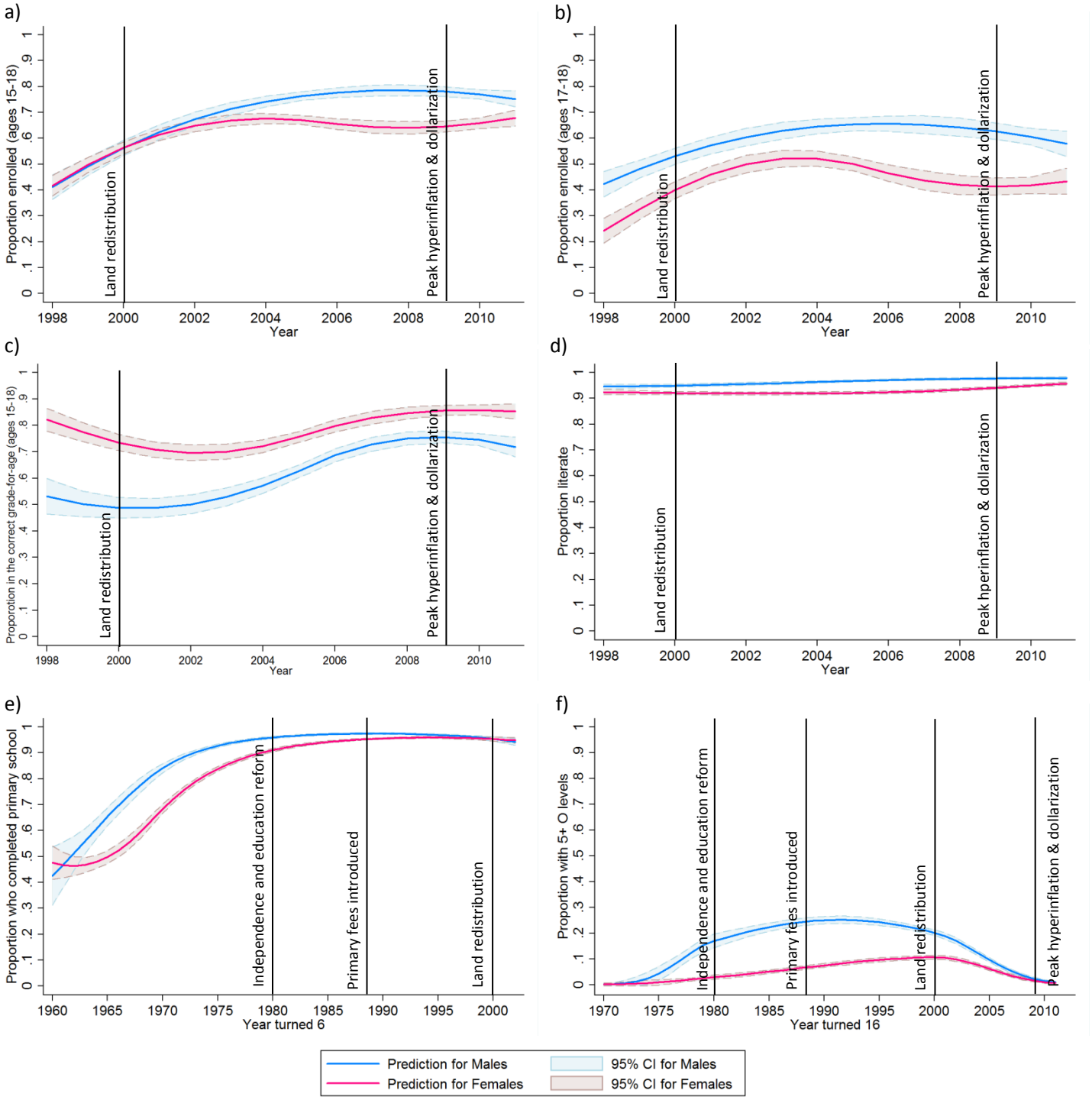

Figure 3-1 Proportion of males and females a) aged 15-18 enrolled in school; b) aged 17-18 enrolled in school; c) aged 15-18 in the correct grade-for-age; d) who are literate; e) who completed primary school (based on the year they turned 6); and f) who have at least five O level passes (based on the year they turned 16), over time. Ages included are 15-54 unless otherwise noted. Labelled black lines indicate major events in Zimbabwe.

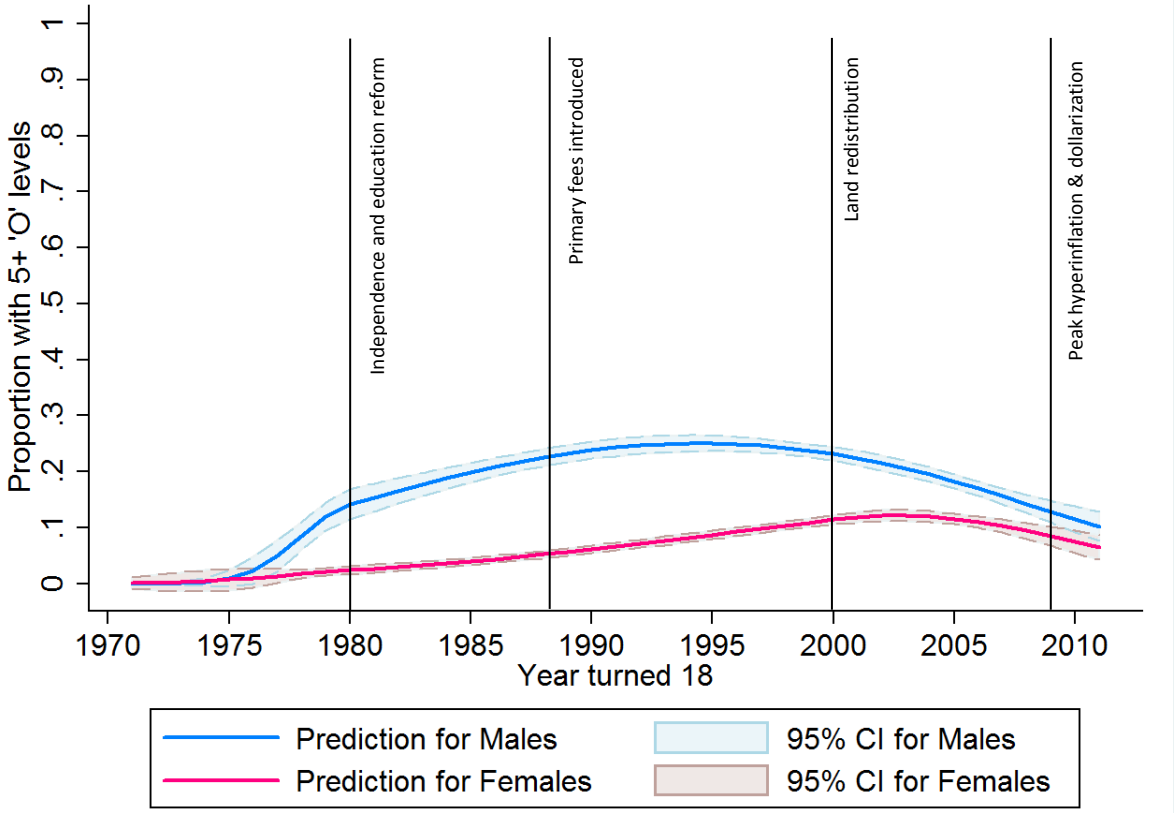

Figure 3-2 Proportion of males and females aged 18-54 who have at least five O level passes (based on the year they turned 18, as opposed to 16 as seen in Figure 3-1f), over time. Labelled black lines indicate major events in Zimbabwe.

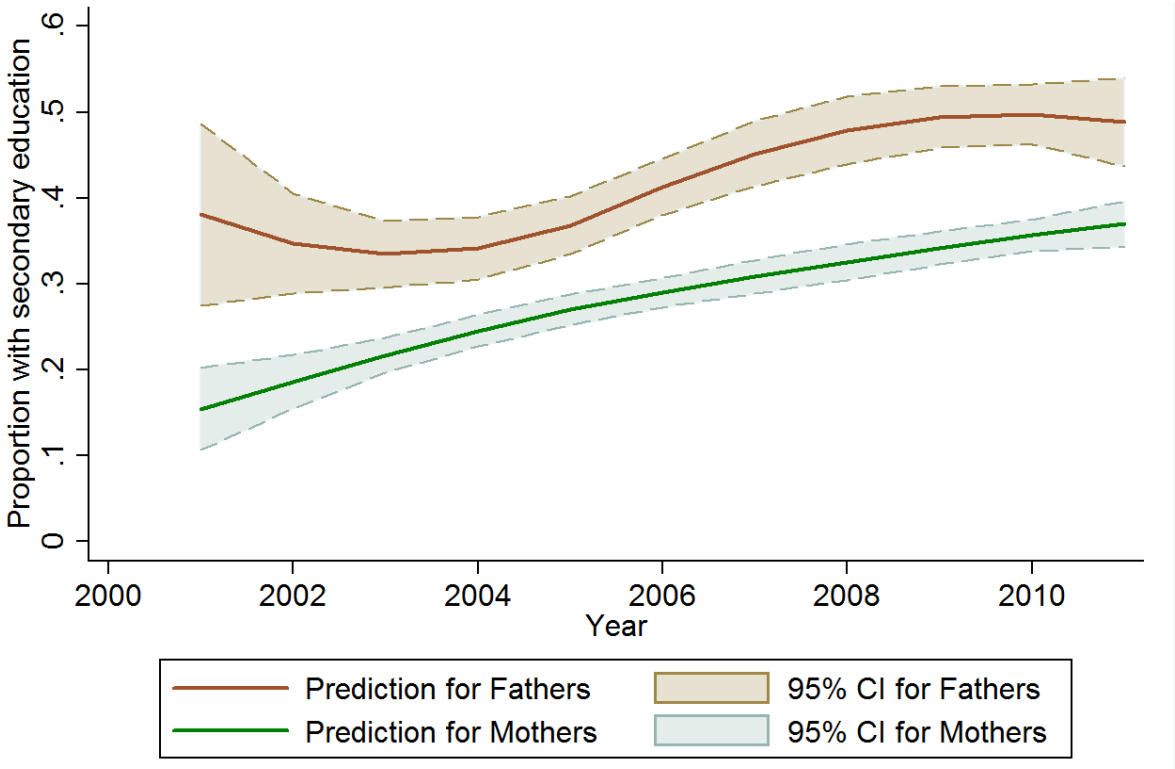

Figure 3-3 Proportion of identified biological mothers and fathers of youth aged 24 and under who have at least some secondary education, over time.

Table 3-1 Educational status of Zimbabwean children and adults from Manicaland in 2009-2011

	Enrolled in school (ages 6-17)		Regular attendance (ages 6-17)		Literate (ages 15-54)		Secondary or greater education (ages 15-54)		5 or more 'O' level passes (ages 16-54)	
	n/N	%	n/N	%	n/N	%	n/N	%	n/N	%
Gender										
Male	2038/2205	92.4%	1386/1663	83.3%	4625/4735	97.7%	4109/4739	86.7%	733/4346	16.9%
Female	2035/2309	88.1%	1359/1736	78.3%	6403/6742	95.0%	5284/6763	78.1%	450/6355	7.1%
Age										
6-12	1885/1902	99.1%	1785/1953	91.4%	-	-	-	-	-	-
13-17	2188/2612	83.8%	960/1446	66.4%	2048/2096	97.7%	1865/2102	88.7%	14/1322	1.1%
18-24	-	-	-	-	3045/3123	97.5%	2744/3128	87.7%	356/3120	11.4%
25-34	-	-	-	-	3536/3699	95.6%	2916/3705	78.7%	511/3697	13.8%
35+	-	-	-	-	3907/4436	88.1%	2296/4454	51.5%	373/4440	8.4%
Community type										
Town	624/674	92.6%	409/491	83.3%	2185/2281	95.8%	1734/2292	75.7%	347/2168	16.0%
Commercial estate	906/1000	90.6%	640/801	79.9%	3223/3444	93.6%	2394/3451	69.4%	350/3264	10.7%
Roadside trading centre	851/964	88.3%	554/712	77.8%	2534/2735	92.7%	2088/2743	76.1%	251/2574	9.8%
Subsistence farming	1692/1876	90.2%	1142/1395	81.9%	4610/4904	94.0%	3621/4914	73.7%	308/4577	6.7%
Socio-economic status										
Poorest quintile	776/876	88.6%	536/687	78.0%	2327/2515	92.5%	1607/2524	63.7%	99/2369	4.2%
Second quintile	818/917	89.2%	534/681	78.4%	2467/2643	93.3%	1875/2651	70.7%	147/2472	5.9%
Middle quintile	778/867	89.7%	493/617	79.9%	2474/2657	93.1%	1959/2665	73.5%	192/2498	7.7%
Fourth quintile	628/691	90.9%	442/548	80.7%	2625/2782	94.4%	2089/2787	75.0%	261/2617	10.0%
Least poor quintile	1059/1149	92.2%	730/856	85.3%	2659/2767	96.1%	2307/2772	83.2%	557/2627	21.2%

3.3.2 Associations of parental education with child education

The associations between parental education levels and education outcomes in their children ages 15 to 24 over survey rounds 2 to 5 are presented in Table 3-2. Associations between parental education and child education were inconsistent. Maternal education measures were more frequently associated with better child education outcomes than were paternal education measures. Maternal literacy and secondary education were consistently associated with better education outcomes in both males and females. Paternal literacy was associated with primary school completion in males and females, and paternal secondary education was associated with primary school completion in females. The trends in association between parental and child education levels are presented in Figure 3-4 and show that higher levels of both maternal and paternal education have associations with the education level of their daughters over time, though not necessarily their sons.

In round five, participants in the child survey and adolescents aged 15-17 had consistently better education outcomes if their mother had secondary or higher education (Table 3-3). Female children, but not males, were also more likely to be in the correct grade-for-age if their mother was literate than if she was not. The only significant association with paternal education was that females whose fathers were literate were more likely to attend secondary school regularly than if their father was illiterate.

To investigate potential biases between linked and unlinked children, I tested for differences in demographic and education characteristics between youth who were and were not linked to one or both of their parents and found no differences between them (all $p>0.05$).

Table 3-2 Associations between parental education and child education outcomes, aggregated over rounds two to five

	School enrolment [a]			Correct grade-for-age [a]			Primary completion [b]			Literacy [b]			5 or more 'O' levels [c]		
	N	%	AOR†	N	%	AOR†	N	%	AOR†	N	%	AOR†	N	%	AOR†
Males															
Maternal Literacy															
Illiterate	458	76.4%	1	323	61.3%	1	676	93.8%	1	672	96.7%	1	571	8.8%	1
Literate	1433	85.2%	**1.8 (1.2-2.5)****	1179	72.9%	1.3 (0.95-1.8)	1867	98.0%	**3.0 (1.8-5.1)*****	1861	99.0%	**2.2 (1.1-4.4)***	1481	11.0%	**1.6 (1.1-2.4)***
Paternal Literacy															
Illiterate	67	74.6%	1	49	53.1%	1	94	90.4%	1	94	94.7%	1	79	5.1%	1
Literate	535	84.5%	2.7 (0.48-15)	431	67.7%	1.9 (0.91-4.1)	690	96.5%	**2.5 (1.1-5.6)***	688	98.3%	3.4 (0.99-12)	544	8.5%	3.6 (0.99-13)
Maternal Education															
Less than secondary	1189	81.1%	1	919	65.6%	1	1659	97.0%	1	1651	98.6%	1	1375	10.1%	1
Secondary or more	595	89.2%	**1.7 (1.2-2.5)****	518	78.2%	**1.6 (1.2-2.2)****	730	98.8%	**2.9 (1.3-6.8)***	728	99.3%	1.5 (0.57-4.1)	554	12.1%	**1.6 (1.1-2.3)***
Paternal Education															
Less than secondary	335	82.7%	1	261	61.3%	1	457	95.0%	1	456	97.6%	1	371	7.5%	1
Secondary or more	257	85.6%	1.1 (0.34-3.8)	214	71.5%	1.2 (0.77-1.9)	306	97.7%	1.7 (0.75-3.8)	305	99.0%	2.5 (0.65-9.7)	231	9.1%	1.5 (0.83-2.8)
Females															
Maternal Literacy															
Illiterate	456	70.0%	1	300	74.7%	1	619	93.4%	1	614	96.1%	1	480	4.6%	1
Literate	1403	81.6%	**1.9 (1.4-2.7)*****	1099	83.2%	**1.7 (1.2-2.5)****	1726	98.1%	**3.4 (1.7-6.7)*****	1719	99.1%	**4.6 (1.9-11)****	1257	7.2%	**2.1 (1.3-3.4)****
Paternal Literacy															
Illiterate	77	62.3%	1	43	93.0%	1	97	87.6%	1	96	93.8%	1	74	0.0%	1
Literate	500	78.6%	2.4 (0.98-6.0)	371	79.2%	0.53 (0.18-1.5)	602	96.0%	**5.5 (1.1-29)***	601	98.0%	2.5 (0.94-6.4)	417	6.2%	N/A
Maternal Education															
Less than secondary	1105	77.7%	1	821	79.5%	1	1433	96.8%	1	1426	98.1%	1	1100	6.5%	1
Secondary or more	621	84.4%	**1.6 (1.1-2.2)****	502	86.7%	**1.5 (1.1-2.2)***	726	98.5%	1.8 (0.92-3.6)	721	99.3%	2.6 (0.94-7.3)	500	7.6%	1.5 (0.97-2.3)
Paternal Education															
Less than secondary	287	73.2%	1	189	77.8%	1	346	91.6%	1	345	95.9%	1	253	3.2%	1
Secondary or more	268	81.7%	1.8 (0.97-3.3)	215	82.3%	1.2 (0.68-2.2)	325	98.5%	**6.8 (1.3-37)***	324	98.8%	2.5 (0.81-8.0)	218	8.3%	1.9 (0.92-3.9)

†Adjusted for age, SES, round, and community type, with ID as random effect to account for repeat observations *, **, *** Significant at p<0.05, <0.01, <0.01

[a] Ages 15-18 [b] Ages 15-24 [c] Ages 16-24 NB: No parental data were collected in round 1 %: Percent of children with education outcome

N/A: Insufficient numbers in each category to run analysis

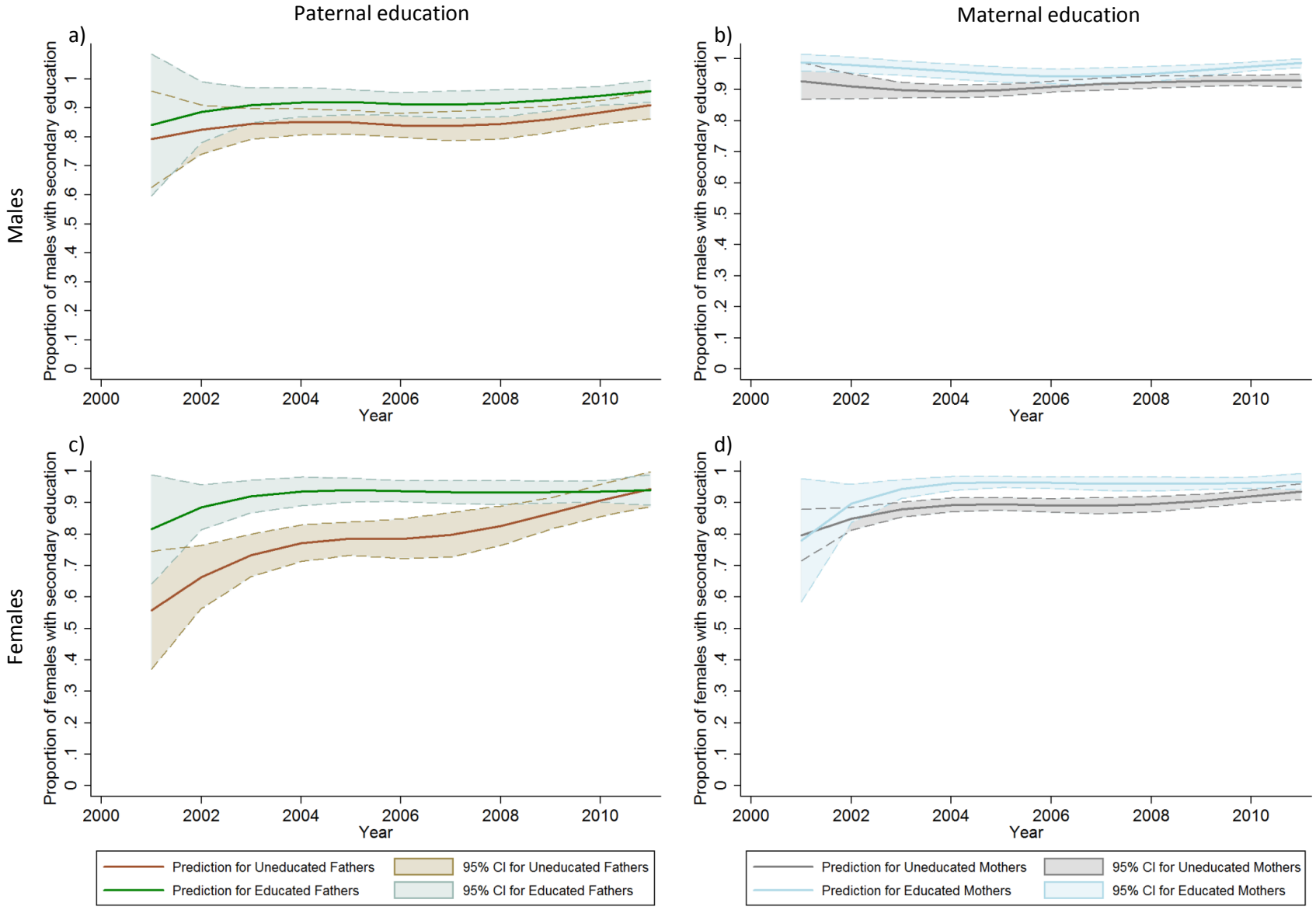

Figure 3-4 Relationship between paternal (a & c) and maternal (b & d) education levels and education levels of their sons (a & b) and daughters (c & d) aged 15-24 years, over time.

Table 3-3 Effect of parental education on education outcomes among male and female children aged 6-17 from 2009-2011

	Regular primary attendance (ages 6-12)			Regular secondary attendance (ages 13-17)			Correct grade-for-age (ages 8-17)		
	N	%	AOR†	N	%	AOR†	N	%	AOR†
Males - Maternal education									
Secondary education									
Less than secondary	202	84.2	1	191	70.7	1	462	69.7	1
Secondary or greater	378	92.6	**2.5 (1.4-4.4)****	150	83.3	1.6 (0.88-2.9)	471	81.5	**2.0 (1.3-3.3)****
Literacy									
Illiterate	83	86.7	1	83	66.3	1	258	67.5	1
Literate	527	90.1	1.4 (0.67-3.0)	285	77.2	1.9 (0.74-4.9)	824	78.1	1.6 (0.93-2.7)
Males - Paternal education									
Secondary education									
Less than secondary	-	-	-	36	69.4	1	41	73.1	1
Secondary or greater	-	-	-	37	75.7	1.4 (0.38-5.1)	127	77.8	1.2 (0.54-2.8)
Literacy									
Illiterate	-	-	-	5	80.0	1	43	46.1	1
Literate	-	-	-	70	70.0	0.47 (0.04-5.8)	131	77.6	3.5 (0.86-13.8)
Females - Maternal education									
Secondary education									
Less than secondary	225	88.4	1	191	65.4	1	492	81.5	1
Secondary or greater	341	95.3	**2.7 (1.3-5.8)***	161	78.9	**1.8 (1.05-3.3)***	484	88.0	**1.7 (1.07-2.6)***
Literacy									
Illiterate	82	90.2	1	94	59.6	1	185	76.1	1
Literate	507	92.3	1.2 (0.49-2.9)	290	73.4	3.9 (0.50-29.9)	928	85.1	**1.8 (1.1-2.9)***
Females - Paternal education									
Secondary education									
Less than secondary	-	-	-	27	48.1	1	28	77.4	1
Secondary or greater	-	-	-	41	68.3	2.7 (0.74-9.8)	125	84.6	1.2 (0.48-3.0)
Literacy									
Illiterate	-	-	-	6	16.7	1	29	81.3	1
Literate	-	-	-	63	63.5	**18.0 (1.3-243)***	130	81.8	0.98 (0.22-4.4)

†Adjusted for age, SES, and community type *, ** Significant at p<0.05, p<0.01

%: Percent of children with education outcome N/A: Insufficient observations in the comparison group to run the analysis

NB: No data available for paternal education outcomes for children under the age of 15

3.3.3 Changes in the relationship between parental education and child education over time

Models presented in Table 3-2 were estimated including an interaction term between the parental education measure and round to determine if these associations changed over time. The interaction terms were only statistically significant in two cases - the association between maternal literacy and enrolment and 'O' level passes in females. For enrolment, the positive relationship between maternal secondary education and their daughters being enrolled in school appeared to dissipate over time, but the reverse was true for 'O' level passes, with maternal literacy having a greater association with increased 'O' level passes in the later survey rounds (Figure 3-5). Data on the education outcomes of offspring in the different survey rounds by parental education measures are presented in Tables 3-4 to 3-8. Although the relationships are harder to interpret than those presented in Figure 3-5, the magnitude of associations, or lack thereof, do not change significantly (all $p>0.05$) between the different survey rounds (excepting the two discussed above).

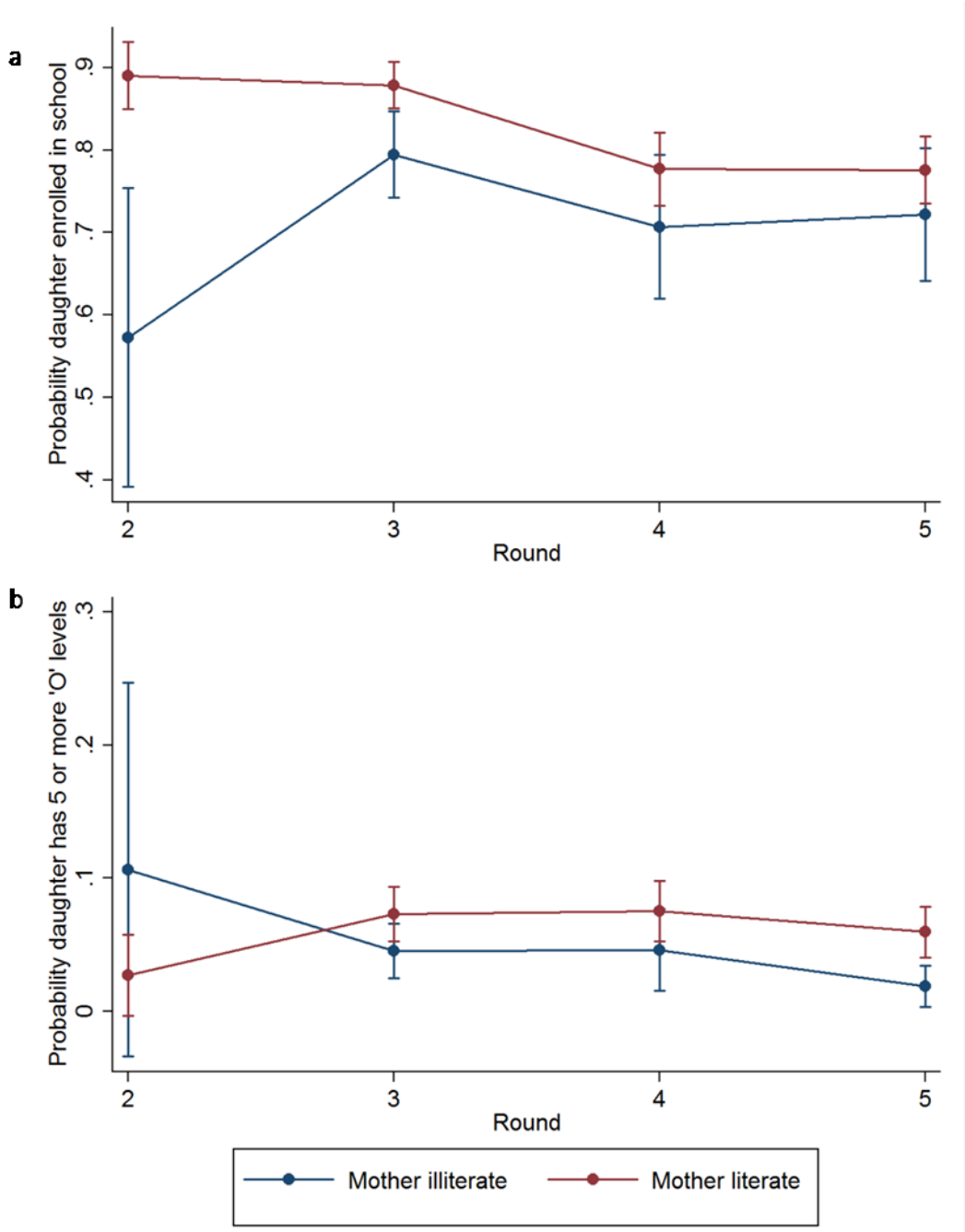

Figure 3-5 Relationship between maternal literacy and the enrolment (a) and 'O' level passes (b) of their daughters by survey round

Table 3-4 Proportion of adolescent males and females aged 15-18 enrolled in school in the different survey rounds by parental education measures

	Round 2 (2000-2002)		Round 3 (2003-2005)		Round 4 (2006-2008)		Round 5 (2009-2011)	
	N	%	N	%	N	%	N	%
Males								
Maternal Literacy								
Illiterate	16	81.3%	224	73.7%	116	77.6%	145	73.1%
Literate	94	84.0%	476	83.4%	446	84.1%	558	81.0%
Paternal Literacy								
Illiterate	6	16.7%	33	81.8%	14	64.3%	18	77.8%
Literate	32	81.3%	182	79.7%	159	84.9%	209	84.7%
Maternal Secondary Education								
Less than secondary	86	79.1%	490	77.8%	348	83.9%	387	75.7%
Secondary or greater	21	100%	165	87.3%	185	85.9%	274	86.5%
Paternal Secondary Education								
Less than secondary	23	65.2%	137	80.3%	99	80.8%	103	83.5%
Secondary or greater	15	86.7%	74	81.1%	77	85.7%	115	86.1%
Females								
Maternal Literacy								
Illiterate	36	52.8%	232	69.4%	124	62.9%	148	69.6%
Literate	216	85.6%	478	80.5%	423	75.7%	498	75.7%
Paternal Literacy								
Illiterate	10	40.0%	37	56.8%	22	77.3%	19	63.2%
Literate	64	75.0%	187	79.7%	153	71.2%	170	77.1%
Maternal Secondary Education								
Less than secondary	203	78.8%	443	77.0%	313	70.9%	337	71.8%
Secondary or greater	45	91.1%	190	84.2%	200	79.5%	267	79.4%
Paternal Secondary Education								
Less than secondary	44	63.6%	131	74.0%	83	68.7%	77	67.5%
Secondary or greater	28	78.6%	79	83.5%	87	75.9%	106	81.1%

NB: No parental data were collected in round 1 %: Percent enrolled in school

Table 3-5 Proportion of adolescent males and females aged 15-18 in the correct grade-for-age in the different survey rounds by parental education measures

	Round 2 (2000-2002)		Round 3 (2003-2005)		Round 4 (2006-2008)		Round 5 (2009-2011)	
	N	%	N	%	N	%	N	%
Males								
Maternal Literacy								
Illiterate	12	58.3%	153	48.4%	87	67.8%	95	80.0%
Literate	79	50.6%	386	65.0%	365	80.8%	431	73.3%
Paternal Literacy								
Illiterate	1	0%	27	55.6%	9	55.6%	13	46.2%
Literate	26	42.3%	137	59.1%	129	73.6%	170	71.2%
Maternal Secondary Education								
Less than secondary	67	49.3%	364	56.6%	285	74.7%	263	68.9%
Secondary or greater	21	52.4%	143	69.2%	153	83.7%	231	80.1%
Paternal Secondary Education								
Less than secondary	15	33.3%	104	52.9%	75	70.7%	81	67.9%
Secondary or greater	13	46.2%	58	65.5%	65	75.4%	96	71.9%
Females								
Maternal Literacy								
Illiterate	18	61.1%	154	64.9%	71	77.5%	99	83.8%
Literate	179	72.1%	374	74.9%	301	88.0%	364	87.6%
Paternal Literacy								
Illiterate	3	100%	19	68.4%	15	93.3%	12	100%
Literate	45	64.4%	139	71.9%	101	82.2%	128	84.4%
Maternal Secondary Education								
Less than secondary	153	69.3%	328	71.6%	208	81.7%	237	87.8%
Secondary or greater	41	75.6%	156	77.6%	149	93.3%	202	88.1%
Paternal Secondary Education								
Less than secondary	24	62.5%	86	70.9%	53	80.8%	51	82.4%
Secondary or greater	22	68.2%	65	73.8%	63	85.7%	84	86.9%

NB: No parental data were collected in round 1 %: Percent in the correct grade-for-age

Table 3-6 Proportion of adolescent males and females aged 15-24 who have completed primary school in the different survey rounds by parental education measures

	Round 2 (2000-2002)		Round 3 (2003-2005)		Round 4 (2006-2008)		Round 5 (2009-2011)	
	N	%	N	%	N	%	N	%
Males								
Maternal Literacy								
Illiterate	18	94.4%	389	95.9%	214	94.9%	273	93.8%
Literate	105	99.0%	777	98.2%	703	98.7%	841	98.2%
Paternal Literacy								
Illiterate	6	66.7%	55	94.5%	22	86.4%	32	90.6%
Literate	35	100%	294	95.9%	262	97.3%	311	97.4%
Maternal Secondary Education								
Less than secondary	96	97.9%	844	97.3%	588	98.6%	657	97.3%
Secondary or greater	23	100%	252	99.6%	267	98.1%	378	99.2%
Paternal Secondary Education								
Less than secondary	26	96.2%	230	95.7%	166	94.6%	178	96.6%
Secondary or greater	15	100%	107	95.3%	120	99.2%	152	98.0%
Females								
Maternal Literacy								
Illiterate	39	92.3%	370	94.9%	180	92.2%	231	95.7%
Literate	224	97.8%	693	98.3%	628	98.1%	698	98.6%
Paternal Literacy								
Illiterate	11	81.8%	57	89.5%	29	82.8%	28	92.9%
Literate	66	93.9%	257	96.5%	221	95.5%	249	98.8%
Maternal Secondary Education								
Less than secondary	212	96.2%	700	97.3%	487	98.2%	508	97.4%
Secondary or greater	47	100%	251	99.2%	269	97.0%	339	99.1%
Paternal Secondary Education								
Less than secondary	45	86.7%	187	93.0%	116	89.7%	120	98.3%
Secondary or greater	30	100%	108	99.1%	128	98.4%	147	98.6%

NB: No parental data were collected in round 1 %: Percent completed primary school

Table 3-7 Proportion of adolescent males and females aged 15-24 who are literate in the different survey rounds by parental education measures

	Round 2 (2000-2002)		Round 3 (2003-2005)		Round 4 (2006-2008)		Round 5 (2009-2011)	
	N	%	N	%	N	%	N	%
Males								
Maternal Literacy								
Illiterate	17	100%	388	97.4%	213	96.7%	272	97.1%
Literate	104	99.0%	776	98.7%	699	99.1%	841	99.3%
Paternal Literacy								
Illiterate	6	66.7%	55	98.2%	22	95.5%	32	90.6%
Literate	35	100%	293	98.6%	260	98.1%	311	98.4%
Maternal Secondary Education								
Less than secondary	94	98.9%	842	98.2%	585	99.3%	656	98.8%
Secondary or greater	23	100%	252	99.2%	265	98.9%	378	99.7%
Paternal Secondary Education								
Less than secondary	26	96.2%	230	98.3%	165	96.4%	178	97.8%
Secondary or greater	15	100%	106	99.1%	119	100%	152	98.7%
Females								
Maternal Literacy								
Illiterate	39	97.4%	369	96.5%	178	94.4%	229	97.8%
Literate	224	99.6%	689	99.3%	624	98.9%	698	99.1%
Paternal Literacy								
Illiterate	11	100%	57	91.2%	28	92.9%	28	92.9%
Literate	66	100%	256	97.7%	221	98.2%	249	98.8%
Maternal Secondary Education								
Less than secondary	212	99.1%	697	98.1%	485	97.9%	506	99.0%
Secondary or greater	47	100%	249	99.6%	265	99.2%	339	99.1%
Paternal Secondary Education								
Less than secondary	45	100%	187	95.2%	115	95.7%	120	97.5%
Secondary or greater	30	100%	107	98.1%	128	99.2%	147	99.3%

NB: No parental data were collected in round 1 %: Percent literate

Table 3-8 Proportion of adolescent males and females aged 16-24 who have 5 or more 'O' level passes in the different survey rounds by parental education measures

	Round 2 (2000-2002)		Round 3 (2003-2005)		Round 4 (2006-2008)		Round 5 (2009-2011)	
	N	%	N	%	N	%	N	%
Males								
Maternal Literacy								
Illiterate	17	0%	357	11.2%	184	9.8%	228	10.5%
Literate	100	6.0%	695	14.2%	564	16.7%	676	10.4%
Paternal Literacy								
Illiterate	6	0%	50	6.0%	17	5.9%	27	0%
Literate	34	5.9%	260	11.5%	216	15.3%	242	7.9%
Maternal Secondary Education								
Less than secondary	90	4.4%	770	13.2%	482	13.9%	556	10.1%
Secondary or greater	23	8.7%	223	15.2%	211	19.0%	285	11.2%
Paternal Secondary Education								
Less than secondary	25	4.0%	205	10.7%	142	11.3%	141	6.4%
Secondary or greater	14	7.1%	94	10.6%	93	20.4%	115	8.7%
Females								
Maternal Literacy								
Illiterate	30	6.7%	329	6.7%	140	7.1%	179	3.4%
Literate	156	1.9%	603	10.8%	463	11.7%	540	9.1%
Paternal Literacy								
Illiterate	7	0%	51	2.0%	22	0%	21	0%
Literate	46	8.7%	209	9.6%	153	13.1%	192	9.4%
Maternal Secondary Education								
Less than secondary	151	2.6%	626	9.3%	388	10.8%	403	6.5%
Secondary or greater	31	3.2%	210	11.0%	180	10.6%	252	10.7%
Paternal Secondary Education								
Less than secondary	32	0%	155	5.2%	84	8.3%	101	6.9%
Secondary or greater	20	20.0%	88	13.6%	87	14.9%	106	10.4%

NB: No parental data were collected in round 1 %: Percent with 5+ 'O' levels

3.3.4 Associations of education levels with HIV prevalence

In males aged 15-24, having attained secondary or higher education was significantly associated with lower HIV prevalence in rounds 1 and 2 in univariable models, but these associations did not remain significant after adjustment for age, SES, religion, and community type, although all odds ratios were below one (Table 3-9). In female youth, education was consistently associated with lower HIV prevalence before and after adjustment for other variables. For both males and females, the analyses were also fit without adjusting for SES and religion and there were no significant changes to the effect size or significance of secondary or higher education.

I also examined the differences in HIV prevalence between in- and out-of-school youth over the different survey rounds (Table 3-10). In males aged 15-18, there were no differences in HIV prevalence in any of the rounds; however, in females, HIV prevalence was significantly lower in in-school youth in rounds 1, 2, 3, and in 17-18 year-olds in round 5. Out-of-school youth had a higher HIV prevalence in round four, but the difference was not significant at $p<0.05$.

Table 3-9 Associations between HIV status and education level in youth aged 15-24 from 1998-2011.

	Prevalence	Unadjusted OR	Adjusted OR
Males			
Round 1			
None/primary	27/399 (6.8%)	1	1
Secondary/higher	71/1668 (4.3%)	**0.61 (0.39-0.97)***	0.65 (0.38-1.11)
Round 2			
None/primary	11/167 (6.6%)	1	1
Secondary/higher	30/1230 (2.4%)	**0.35 (0.17-0.72)****	0.56 (0.23-1.32)
Round 3			
None/primary	11/395 (2.8%)	1	1
Secondary/higher	71/2619 (2.7%)	0.97 (0.51-1.85)	0.90 (0.44-1.84)
Round 4			
None/primary	11/239 (4.6%)	1	1
Secondary/higher	73/2156 (3.4%)	0.73 (0.38-1.39)	0.73 (0.37-1.45)
Round 5			
None/primary	7/246 (2.8%)	1	1
Secondary/higher	55/2152 (2.6%)	0.90 (0.40-1.99)	0.81 (0.35-1.91)
Females			
Round 1			
None/primary	141/578 (24.4%)	1	1
Secondary/higher	206/1611 (12.8%)	**0.45 (0.36-0.58)*****	**0.54 (0.39-0.75)*****
Round 2			
None/primary	60/380 (15.8%)	1	1
Secondary/higher	98/1484 (6.6%)	**0.38 (0.27-0.53)*****	**0.42 (0.27-0.66)****
Round 3			
None/primary	107/687 (15.6%)	1	1
Secondary/higher	191/2940 (6.5%)	**0.38 (0.29-0.49)*****	**0.60 (0.44-0.84)****
Round 4			
None/primary	60/417 (14.4%)	1	1
Secondary/higher	142/2317 (6.1%)	**0.39 (0.28-0.54)*****	**0.43 (0.31-0.61)*****
Round 5			
None/primary	29/375 (7.7%)	1	1
Secondary/higher	110/2466 (4.5%)	**0.56 (0.36-0.85)****	**0.57 (0.37-0.90)***

†Adjusted for age, SES, religion, and community type *Significant at p<0.05, p<0.01, p<0.001

NB: No SES data were collected in round 2

Table 3-10 Difference in HIV prevalence between enrolled and out-of-school youth in Manicaland over all survey rounds

	Round 1 (1998-200)				Round 2 (2000-2002)				Round 3 (2003-2005)				Round 4 (2006-2008)				Round 5 (2009-2011)			
	Enrolled		Out-of-school		Enrolled		Out-of-school		Enrolled		Out-of-school		Enrolled		Out-of-school		Enrolled		Out-of-school	
	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n
Male																				
15-16	-	-	-	-	-	-	-	-	1.0%	493	2.3%	43	1.9%	574	0%	60	1.8%	665	0%	69
17-18	0.4%	276	0.8%	382	1.1%	183	1.4%	71	1.1%	520	1.2%	277	3.2%	374	2.6%	232	2.1%	378	0.8%	244
15-18	-	-	-	-	-	-	-	-	1.1%	1013	1.3%	320	2.4%	948	2.1%	292	1.9%	1043	0.6%	313
Female																				
15-16	1.5%	291	**8.5%***	184	1.3%	304	5.3%	38	0.9%	572	**3.6%***	112	2.8%	570	4.4%	114	2.7%	663	0.8%	123
17-18	1.0%	137	**4.3%****	352	0.9%	115	5.2%	135	1.9%	483	**4.8%***	398	0.8%	220	4.1%	325	0.8%	260	**4.1%***	365
15-18	1.2%	428	**7.1%*****	536	1.2%	419	**5.2%****	173	1.3%	1055	**4.5%*****	510	2.2%	790	3.3%	439	2.2%	923	3.3%	488

*, **, *** Difference between enrolled and out-of-school youth significant at p<0.05, p<0.01, p<0.001 using Fisher's exact test

NB: No data were collected in males under the age of 17 in round 1

3.3.5 Associations of education levels with HIV incidence

Overall there were relatively few seroconversions in the 15-24 age group (124 over all survey rounds), limiting the ability to make strong statistical conclusions. Despite this, among both male and female youth aged 15-24 there was a consistent trend for having more than primary education to be associated with a decreased HIV incidence rate; however, only among females in round 4 was the adjusted relative risk significant (Table 3-11). As with the associations between HIV prevalence and education, these models were also fit without adjusting for SES and religion and no significant differences were found between the models.

Due to the small number of seroconversions in each round I also attempted to fit exact Poisson regression models, which do not depend on asymptotic results and offer more exact results for small sample sizes as compared to maximum-likelihood-based regression models. I was able to fit the unadjusted, but not the fully adjusted, regression models. Although there were no differences in the results for females, for males from round 4 to round 5, the unadjusted relative risk of 0.06 remained the same, but was no longer significant (95% CI: 0.001-4.79; p=0.22). Pooling the data over all rounds, adjusted as in Table 3-11 with the addition of survey round, both the unadjusted (RR=0.47; 95% CI: 0.19-1.14) and adjusted (RR=0.97; 95% CI: 0.34-2.77) risks for males were insignificant. In females, the unadjusted risk (RR=0.52; 95% CI: 0.32-0.85) was significant, although the adjusted one (RR=0.61; 95% CI: 0.35-1.07) was not.

Table 3-11 Associations between HIV incidence rate and education level in youth aged 15-24 from 1998-2011.

	Seroconversions/ person years at risk	Rate [a]	Unadjusted RR	Adjusted RR [b]
Males				
Round 1 – Round 2				
None/primary	4/230	17.3	1	1
Secondary/higher	14/1416	9.9	0.45 (0.14-1.43)	0.88 (0.19-3.95)
Round 2 – Round 3				
None/primary	0/119	0	1	1
Secondary/higher	7/915	7.7	N/A	N/A
Round 3 – Round 4				
None/primary	1/133	76.9	1	1
Secondary/higher	8/1532	5.2	0.71 (0.09-5.70)	0.59 (0.06-5.78)
Round 4 – Round 5				
None/primary	1/112	8.9	1	1
Secondary/higher	1/1841	0.5	**0.06 (0.004-0.98)***	N/A
Females				
Round 1 – Round 2				
None/primary	8/417	19.2	1	1
Secondary/higher	34/1409	24.1	1.11 (0.51-2.43)	1.08 (0.42-2.78)
Round 2 – Round 3				
None/primary	4/197	20.3	1	1
Secondary/higher	11/1228	9.0	0.40 (0.12-1.26)	0.80 (0.17-3.82)
Round 3 – Round 4				
None/primary	8/225	35.6	1	1
Secondary/higher	15/1547	9.7	**0.27 (0.11-0.63)****	**0.31 (0.12-0.78)***
Round 4 – Round 5				
None/primary	2/191	10.5	1	1
Secondary/higher	6/1283	4.7	0.45 (0.09-2.22)	0.34 (0.06-2.12)

*, **, *** Significant at p<0.05, p<0.01, p<0.001

[a] Per 1000 person years at risk

[b] Adjusted for age, SES, site type, and religion

N/A: Too few seroconversions to run the analysis

3.4 Discussion

In this chapter, I have described the education trends in Zimbabwe over time and have related parental education levels to education outcomes, and education outcomes to HIV incidence and prevalence in young people. By doing so I have provided not only the educational context for the remainder of the thesis, but have also addressed the question of the degree to which the education system in Zimbabwe was affected by the economic collapse, which, prior to this, had only been discussed anecdotally [192]. Addressing the objectives of this chapter:

1) Education has increased over time in Manicaland, but some less fixed education measures (*i.e.* 'O' level passes, enrolment, and being in the correct grade-for-age, as opposed to literacy) appear to have decreased during the economic crisis.

2) Children of educated parents were more educated themselves, with maternal education measures having more significant effects than paternal ones.

3) With only two changes in the associations between parental education and child education seen over the rounds, parental education does not appear to have offset the effects of the economic crash on their children's education.

4) Secondary education was associated with lower HIV prevalence in females, but not in males, over all survey rounds. Secondary education was only associated with lower HIV incidence between rounds three and four in females.

3.4.1 Education trends over time in Zimbabwe

Generally, education has increased over time in Manicaland. Primary school completion rates were high and increased in the 1960-1975 cohorts. This may be because it was more common in those days for people to complete late and/or to re-enrol in school, especially after free primary education was introduced in 1980. Encouragingly, as of 2011, over 90% of people have completed primary school, and over 90% of both men and women are able to read.

Three major political events, in particular, may have had an influence on the long-term trend towards improvements in most education outcomes: Independence in 1980, the land redistribution process in the early 2000s, and the economic collapse from the mid-2000s to early 2009. As one might expect, these events generally show more effect on short-term indicators (*e.g.* enrolment for girls) than on indicators that cumulate over a child's life-course (*e.g.* literacy). The potential effect of the wider Zimbabwean context is particularly noticeable in the number of people with five or more 'O' level passes, which increased steadily from 1980 onwards, but dropped-off starting with the land redistribution in the early 2000s followed by the economic crash in the late 2000s. Despite the apparent influence of these events, the steep drop-off in recent years for 'O' levels could have been due to censoring, with, for example, those who turned 16 in 2010 having had less time than earlier cohorts to take and pass their exams. To account for this potential censoring I also fit the models based on the age that individuals turned 18, to provide extra time for them to have passed more 'O' levels, and found the same pattern, suggesting that censoring does not fully explain the drop in 'O' level passes. The greater sensitivity of 'O' levels to events like the land redistribution exercise and the 2008 economic crisis might also partly reflect migration between different types of areas, with more educated people leaving the rural province of Manicaland to go to more urban areas of Zimbabwe, or even to other countries.

For most education indicators, males have outperformed females over time, the exception being female adolescents being more likely to be in the correct grade-for-age. School enrolment shows a particularly stark divide between the education of males and females during the economic collapse. Before the early to mid-2000s, males and females either had the same levels of enrolment (ages 15-18) or females were rapidly catching up with males (ages 17-18); however, when the effects of the economic collapse were first starting to be felt around 2003 [190], female school enrolment dropped off sharply, while that of males remained fairly steady. The potential effects of the improved economic climate from 2009 onwards can also be noted in female enrolment, which has increased since 2009 and is again nearing the same levels as that of males.

Interestingly, from the education trends that I have observed, it appears to be that remaining in school is the main barrier to educational success in females. High enrolment levels in primary school for girls (>99%) in the most recent survey round imply that it is not initial enrolment in school that is the problem, but retention in school is, particularly once girls move to secondary school. Consistently over time, despite having lower enrolment levels, a higher proportion of females than males enrolled in school were in the correct grade-for-age. Although the reasons behind this are unknown, several possibilities exist: It may be that those girls who are enrolled come from families that value education highly, or those girls who remain in school are highly driven and motivated to succeed, or simply that females perform better than males in school. In addition, there could perhaps be a form of selection effect occurring, with parents keeping girls in school if they are performing well, more so than they do for boys.

Despite the economic turmoil and differences between males and females, education levels in Zimbabwe are typically higher than those in many other sub-Saharan African countries. From 2005-2011, youth literacy (ages 15-24) was over 90% in Zimbabwe, as compared to just 64% in SSA as a whole [202]. Although the survey used a measure of literacy that included

having completed at least some secondary school as proxy for literacy, the levels of literacy I found in the study population are close to those cited in a 2006 UNESCO report, which reported a literacy rate of 97.6% in youth aged 15-24 [203]. Of the Southern African Development Community (SADC) countries included in the report, Zimbabwe was the second most literate, following closely behind Seychelles (99.1%), with the next closest being South Africa at 91.8%, although the report claimed South Africa's reported level of literacy to be a "fanciful" estimation. In terms of primary school enrolment, there was a net enrolment ratio of just 77% in SSA in 2011, while over 99% of primary school-aged children in the Manicaland study were enrolled in school from 2009-2011. This is despite the rising tuition fees and economic uncertainty that Zimbabwe has experienced, showing that the legacy of "education for all" [188] begun with independence continues to today.

3.4.2 The associations of parental education with the education of their children

The high education levels I observed may very well be a legacy of the parents of today's youth receiving education when Zimbabwe first gained independence. Over time, children with educated parents were consistently more likely to be educated themselves. There were associations between parental education and all the measures of child schooling that I investigated, suggesting that parental literacy and secondary education can holistically support the education outcomes of children and are not confined to improving just one outcome. My analysis of parental and child education in round five, where data for children under the age of 15 was available, continued to show that children with more educated parents have stronger educational outcomes. All of this is consistent with previous research that has found the education of parents to be one of the most important determinants of child education [195-198,204]. One potential caveat to the associations I describe between parental education and child education is that children who were linked to their parents could have in some way been different from children who were not linked to their parents. To account for this potential bias I tested for differences in demographic and education characteristics

between youth 15-24 who were and were not linked to one or both of their parents and found no differences between them, suggesting that such bias was not an issue here.

If these positive relationships between parental and child education can be maintained in the future, it bodes well for both the educational and economic outlook of Zimbabwe. In Manicaland, there has been a consistent trend for increasing levels of parental education during the 2000s (Figure 3-3), and, if this continues, it implies that there will be an increasing population of educated children. This educated population will then join the workforce, likely earning more than if they were less educated, and therefore hopefully increasing the economic output of Zimbabwe. Obviously though, this depends too on the supply of available jobs, and it might be that instead of generating more jobs an educated population would instead migrate to more economically successful countries.

3.4.3 Parental education, the economic crisis, and child education

I had hypothesised that higher parental education would be able to mitigate the effects of the economic crash on their children's education, but this does not appear to have been the case. Although educated parents continued to afford their children higher levels of education during the worst of the economic crisis, this effect was no greater than during the start of the economic recovery (2009-2011) or before the worst of the crisis began (2001-2003). The one exception to this is the association between maternal literacy and their daughters having five or more 'O' levels. Why this one indicator should be significant but not others is uncertain, but it may reflect educated women believing that the way to ensure their daughters having a bright future in times of economic struggle is to become educated enough to qualify for higher paying jobs.

Although my hypothesis was that parental education could somehow offset the negative effects of larger societal forces on education, it is not entirely surprising that this was not the

case. During the worst of the economic crisis, many schools were closed or, if they were open, many teachers would not show up because they were not being paid [192]; these are not things which parents putting a premium on education could offset. Although more educated parents were not able to provide an additional buffer against the economic crash for their children, neither did the economic and social turbulence erode the ability of parental education to buoy up child education outcomes.

Despite the economic crisis, education has increased over time in Zimbabwe and shorter-term education indicators that were lower during the crisis appear to be recovering to pre-economic crash levels. Thus, although economic shocks may destabilise education in the short term, the system does appear to be recovering in line with the economy. Encouragingly, during times of economic crisis, parents with greater levels of education can help to buffer the effects of the economic shocks. These buffering effects are particularly important for females, who are more likely to see their education suffer in times of economic difficulty. There is therefore a strong rationale for public investments in female education: the intergenerational effects of such programmes will lead to a more highly educated population overall. Zimbabwe remains one of the most highly educated countries in Africa and continued investment in the education system will ensure that future generations can reap the benefits of a good education, as their parents have.

3.4.4 The relationship between parental education and SES as a limitation of the work

A potential limitation of the work in this chapter is the possibility that it was the higher SES afforded by greater parental education that increased child education, and not the parent's education *per se*. Indeed, there are established positive links between SES and child education [205,206], and parental education and SES [197]. McLoyd has also documented the relationship of low SES to a range of negative child outcomes, including educational achievement, in two reviews [207,208]. But despite the fact that parental education is linked to

SES and SES is linked to child education, research suggests that parental education is in fact an independent predictor of child education. In an analysis of data from several large-scale developmental studies, Duncan and Brooks-Gunn [209] found maternal education to be linked to children's intellectual outcomes even after controlling for a variety of other socio-economic indicators. Additionally, Davis-Kean [210] found direct effects of parental education, but not SES, on children's standardized achievement scores, and data from a 40 year cohort study showed the positive effects of parental education on child education to be independent of parental SES [197]. Moreover, the extent to which education works through higher SES might have been expected to be eroded during the economic crisis due to rising unemployment and reduced earnings amongst even the most educated. My analysis adjusted for SES using an asset-based wealth index, and so I conclude that my findings are consistent with this existing literature: positive associations between parental and child education were not explained by household SES, but suggest a true causal effect between parental education and child education.

3.4.5 Education and HIV incidence and prevalence

The trends in education that I have described in this chapter are important for many reasons, including the proposed associations of education with HIV prevalence and incidence. Cross-sectional studies have shown that higher levels of education are associated with greater HIV risk in early stages of an epidemic, but less risk in later stages, and longitudinal studies have shown that people with more education are less likely to contract HIV over time [102,103,120,124].

In this work, I have found higher education levels to be consistently associated with lower HIV prevalence in young women aged 15-24, but not men, regardless of survey round. Additionally, although the adjusted odds ratios were not significant in men, they were all below one. These findings are, unfortunately, unable to address the hypothesis that early on in an epidemic education is a risk factor for HIV. The HIV epidemic in Zimbabwe began to

take off before the 1990s (incidence peaked in 1991 [4]) and as such even data from the earliest survey round (1998-2001) reflects a relatively mature HIV epidemic, particularly when the 1998-2001 period covers the time of peak HIV prevalence [4]. Moreover, this is prevalence data and the timing of HIV infection cannot be accurately established, preventing inferences into causality. I focused on adults under the age of 25 for this analysis as previous work in Manicaland has found there to be a changing direction of association between education and HIV among older adults (*i.e.* education in older adults more likely to increase HIV risk) [153,211]. This is related to the changing associations between education and HIV that were experienced in the earlier stages of the epidemic, which I have described in section 1.4 of the Introduction.

Also supporting the protective association between education and HIV are data on HIV prevalence in in- and out-of-school youth from Manicaland. Up until round four, young women out of school aged 15-18 were consistently more likely to have HIV than their counterparts who remained enrolled. Beginning with round four, one would start to expect to see long-term survivors of MTCT entering the analysis and therefore potentially diluting the associations between school enrolment and HIV prevalence, which I observed. That being said, it is not possible to interpret a causal direction in the data, as youth may not be in school because they are ill, as opposed to becoming infected because lack of schooling increases their HIV risk. I comment further on the associations between school enrolment and HIV risk in Chapter 5.

In terms of HIV incidence, only between rounds three and four did I find education to have a significant protective effect in young women. The lack of significant associations may have been due to the relatively low number of incident infections observed in the data (124) causing the analyses to be underpowered. Although the associations are not significant, the incident trend in women does appear to support the hypothesis of education changing its direction of effect as time progresses in the epidemic, with a higher incidence rate in more

educated young women between rounds one and two than in those women without secondary education. I am unable to comment on the HIV incidence rates in young men due to the very low numbers of seroconversions observed in the data.

All of the above results suggest that education has a somewhat protective effect against HIV infection, even if a causal association cannot be definitively asserted due to the underpowered analyses. Investigating the underlying behavioural and other mechanisms through which school education has a protective effect was beyond the scope of my analysis, but previous work by Gregson *et al.* [102] and Lopman *et al.* [153] in Zimbabwe has suggested that education encourages safer sexual practices including later sexual debut [102] and that the higher SES associated with higher education levels is associated with lower HIV prevalence and incidence and also safer sexual practices [153].

3.4.6 The gender gap in education

Although Zimbabwe has made great strides in increasing the education of its population, it still appears that there is a gender gap. Despite the trends indicating that females' education is catching up to that of males, much work remains to be done. From 2009 to 2011, females were universally less likely to report successful educational measures than males, a common theme from SSA [212] and the SADC [203]. Of the 53 countries with a Gender Parity Index (GPI) below 0.95, 31 are in Africa and Benin, Côte d'Ivoire, Ethiopia, Guinea, Mali, and Togo, all had fewer than 60 girls per 100 boys entering secondary education in 2008 [213]. Zimbabwe fared better, with a GPI of 0.89 for secondary education, but that remains below the threshold of 0.95 that is considered to be "on course" to achieving equal education for males and females [213]. Data from SSA consistently suggest that girls are less likely to achieve positive educational outcomes than boys [213,214], a finding which was highlighted in a 2007 UNICEF report [215]. Recent data still support this, suggesting that although the gap is narrowing, a divide still exists [212]. The continued disparities in education outcomes between

males and females are a worrisome phenomenon. Less educated women are more likely to die in childbirth, more likely to marry young, more likely to give birth at a young age, less likely to participate in politics, and, perhaps most importantly, less likely to send their own children to school [215]. Gender gaps in education are a concern not only for the individuals involved, but also for society as a whole. Education gaps can have an effect on economic growth, with a 2009 paper suggesting the inequality can reduce growth by as much as 1.7% as compared to regions where education and employment gaps are far smaller [216].

Although I was unable to examine the reasons for the lower education levels of females in my study population, a wide range of reasons have been identified previously and include international aid priorities, national economic policies, societal norms (including views that girls should marry early and spend more time on household chores and caring duties than boys), a lack of schools for girls to attend, and family-level economic decisions [213,215]. Future qualitative studies into parental decisions on education would be beneficial to understand the complex, real-life, situation that leads to female children being less likely to enter education than their male counterparts.

The gender gap in education is not only present at the child level, but also at the parental level. Although maternal education has been steadily increasing over time, still fewer mothers are educated beyond primary school than fathers. This disparity is worrisome given that it appears as if it is the mother's education, as opposed to the father's, which has the greater influence on a child's schooling. Although there were fewer fathers than mothers with low education in the comparison groups for the analyses thereby reducing power, the consistent significant results for maternal education cannot be ignored. Therefore, if the gender gap in education is to be closed and if child education is to continue to increase, then a way must be found to increase female education, not just to benefit girls in school today, but also all children in the next generation.

The key findings and conclusions of this chapter are:

1) Despite the economic crisis, education had increased over time in Manicaland and shorter-term education indicators that were lower during the crisis appear to be recovering to pre-economic crash levels.

2) Although higher levels of parental education were not able to offset the negative effects of the economic crash, neither did the crisis eliminate the positive associations between parental education and child education.

3) Because a mother's education has a greater impact on a child's schooling than the father's, there is a strong rationale for public investments in female education: the intergenerational effects of such programmes will lead to a more highly educated population overall.

4) The data suggest a strong link between higher education in women and lower HIV levels. This is yet another reason to promote the education of women and to strive towards eliminating the gender gap that still exists.

5) Zimbabwe remains one of the most highly educated countries in Africa and continued investment in the education system will ensure that future generations can reap the benefits of a good education, as their parents have.

Having documented the education trends in Zimbabwe and the potential link between education lower HIV prevalence, in the next chapter, I will examine the issue from the other side and investigate the associations between HIV-related vulnerability and childhood education outcomes.

4 The impact of HIV on children's education in eastern Zimbabwe

4.1 Introduction

Chapter 3 examined the associations between achieving education and contracting HIV. In this chapter I will investigate the converse relationship—assessing the ways in which HIV could affect children's education, both through the health consequences of being infected themselves and being affected by orphanhood or having an HIV-positive parent. This is a particularly important question given that the majority of children affected by HIV are of school-going age and live in African countries where education is not compulsory and school fees exist [68,69]. School fees are especially problematic for children from families impacted by HIV due to lost income from sick or deceased adult relatives and the high costs of medicines [48]. In addition to financial reasons, children may suffer educational setbacks because they have to care for sick family members, are suffering psychological distress, or may themselves be HIV-positive. Orphans or HIV-positive children placed with a foster family may experience reduced investment in their long-term school or wellbeing [75]. The effects of the HIV epidemic on education in SSA are clearly visible: in the Central African Republic and Swaziland, AIDS caused school enrolment to fall by 25-30% at the beginning of the millennium [72] and, in a high-density community in Zimbabwe, nearly 72% of children affected by AIDS were not in school, compared to just 29% of children not affected by AIDS [39].

Recently, an increasing number of studies have examined the effects of parental loss and illness on education outcomes in SSA. On an individual level, it has been shown that a child's education can be negatively impacted by either the loss of a parent or having an HIV-positive parent. Loss of a father may result in children dropping out of school [74], while maternal death has been associated with children not enrolling in school, delaying school attendance, lower educational attainment, being at a lower grade for their age, and worse performance in school [73,75-78]. Children with sick parents have also been shown to be at a

lower grade for their age due to interruptions caused by looking after their ailing parent(s) [75,79]. Moreover, carers may be educationally disadvantaged due to the time constraints and high burden placed on them in caring for ailing relatives or younger siblings after a parent has died [217]. On the other hand, some qualitative research has suggested that those children responsible for caring for their family members may not be disadvantaged and instead feel empowered by their caring duties [46]. Despite the qualitative findings in this area, little quantitative data exist to either support or refute this hypothesis, a gap which I aim to partially address in this chapter.

Even though there is increased interest in the effects of the HIV epidemic on children's education, a 2012 review by Guo *et al.* noted that, of the 23 peer-reviewed studies on the effects of HIV/AIDS on children's education outcomes published between 1999 and 2010, none had directly examined the effects of children themselves being HIV-positive [80]. The review called for research to be done into the direct relationship between HIV and education, as AIDS-related illness experienced by HIV-positive children and adolescents could be expected to impact negatively on attendance and, therefore, on grade progression [159]; a gap that I aim to address here. Research suggests that perinatal HIV infection can cause developmental delay and impact cognitive development at a young age [218-221], which could have negative consequences for school performance in both primary and secondary school children.

Although there is a general consensus that HIV and its downstream impacts have negative consequences for education outcomes, the type and magnitude of those effects can vary dramatically by country. Differences between countries in traditional customs and socio-cultural, economic, policy, and political situations influence the barriers and opportunities for education among vulnerable children [80,222-224]. The effect of orphanhood on enrolment and attendance varies with age, gender, religion, and household composition [75,225]; all potential

moderating factors in the relationship between orphanhood and school attendance/enrolment [76,226,227].

In SSA, Zimbabwe provides an ideal setting in which to study education outcomes because, although primary school fees were introduced in 1991 and have risen steadily since [70], literacy rates remain among the highest in Africa, with education being a clear priority in many families. I investigated the impact of a range of HIV-related effects on children's and adolescents' education outcomes in the Manicaland province of Zimbabwe, using pooled data for adolescents from five survey rounds conducted from 1998–2011 and data for children from the dedicated child survey (2009–2011). High levels of school enrolment in the study population (over 90% in 2009-2011) allowed me to examine the effects of HIV not only on school attendance but also on quality of education.

The objectives of this chapter are to:

1) Determine if HIV infection status has an association with education outcomes in children aged 6-17 from 2009-2011 and/or in adolescents aged 15-17 from 2006-2011.

2) Investigate the associations between HIV-related vulnerability (having an HIV-positive or AIDS-sick parent; being a maternal, paternal, or double orphan; and being a young-carer) and education outcomes in children aged 6-17 from 2009-2011 and youth aged 15-24 from 1998-2011.

3) To compare the education outcomes of young-carers to those of other vulnerable children.

4.2 Methods

4.2.1 Study population

Included in this chapter are data from youth aged 15-24 from all five adult survey rounds (1998-2011) and from children and adolescents aged 6-17 who participated in the child survey in round five (2009-2011) of the Manicaland HIV/STD Prevention Project. A full description of the study population and data collection methods is given in section 1.6.

4.2.2 Education variables

Educational outcomes were measured using different variables in the adult and child surveys due to different questions being asked in the two surveys. From the adult survey, data were pooled over all rounds and educational outcomes were completion of primary school (ages 15-24), having at least five 'O' level passes (the minimum requirement for formal sector employment) (ages 16-24), and being in the correct grade-for-age (ages 15-19). From the child survey, educational outcomes were being in the correct grade-for-age, and regular attendance in primary and secondary school. Data on O level passes were not collected in round 1 (1998-2000) and therefore the pooled analyses for 'O' level passes begin only at round 2. Being in the correct grade-for-age was used to measure progress in schooling and participants were deemed to be in the correct grade for their age if they were less than two years behind in school [200]. This leeway was given to account for the differing ages when children start school (*i.e.* either age 6 or 7) and children aged 8-19 (for all rounds) or aged 8-17 (for round five child survey data) were included in the analysis as these were the age ranges for which children had the potential to be both progressing normally or behind in school. Regular attendance was defined as having attended at least 80% of the last 20 school days.

4.2.3 Data analysis

Logistic regression was used to determine associations between the education outcomes described above and HIV/AIDS-related vulnerability: through being HIV-positive; being a young-carer; having an HIV-positive parent; or being a maternal, paternal, or double orphan. Parental data were not linked to child data in the first survey round (1998-2000) and paternal data were not linked to the child survey in round five (2009-2011), meaning that analyses dependent on parental data (orphan status and parental HIV status) do not include these data. Unless stated otherwise, the comparison group in all analyses was individuals who were unaffected by HIV/AIDS.

Models were adjusted for age (linearly), household socio-economic status (SES, measured using a previously described index [153]), community type (subsistence farming, roadside settlement, town, or estate), and round of data collection (if applicable). Household random effects were included to account for residual correlation between youth residing in the same household. Analysis of the association between being HIV-positive and education outcomes for young adults were limited to only persons aged 15–17 in rounds 4 and 5, of whom, HIV-positive persons were most likely long-term survivors of mother-to-child transmission (MTCT) [15]. This was done to avoid reverse causality where poor education outcomes contributed to subsequent risk of HIV infection, which could be more likely for older young adults (aged 18–24 years). In cases where orphanhood was significantly associated with an education outcome, I tested whether age of orphanhood had an impact on that outcome.

In addition to comparing young-carers to non-vulnerable children, I also compared their outcomes to those of other types of vulnerable children. This analysis w the same procedure as above, except that the comparison group was children/adolescents with any other form vulnerability (*i.e.* orphan, HIV-positive, HIV-positive parent) as opposed to non-vulnerable children.

All of the above regressions were stratified by gender and were conducted in Stata/SE 12.1.

4.3 Results

4.3.1 Participant characteristics

Table 4-1 presents characteristics of vulnerable and non-vulnerable children in 2009-2011 (round five of the survey). A total of 4,574 individuals were included, of whom 2,958 (45.0%) had some form of HIV-related vulnerability. There were no significant differences in characteristics between the different types of vulnerable children, except for young-carers being older than other vulnerable and non-vulnerable children (mean age: 14.4 years vs. 10.8 years; $p<0.01$). Households with vulnerable children were more likely to be receiving external assistance than households that did not have vulnerable children (all p-values<0.05). Additionally, young-carers were significantly more likely to come from households receiving schooling support than other categories of vulnerable children (14.0% vs. 3.6%, $p<0.01$). When comparing children receiving external support to those not, although the numbers are small (n=91), orphans from households receiving support for schooling were significantly more likely (76.7% vs. 50.0%, $p=0.03$) to be in the correct grade-for-age than orphans not receiving support.

Demographic data on respondents aged 15-24 years pooled over all survey rounds are presented in Table 4-2. To characterise all entries in the analyses, individuals present in more than one survey round have been included only in the first round that they were present for in the survey. Over all rounds, a total of 20,262 unique observations were recorded. The only significant difference in the demographic characteristics of the respondents, when the same age categories were used, was that youth who had an HIV-positive parent who was ill were more likely to live in households with a lower average SES ($p=0.01$).

Table 4-1 Characteristics of vulnerable and non-vulnerable children (ages 6-17) in round five (2009-2011) of the Manicaland survey

	Non-vulnerable (n=2516, 55.0%)	HIV+ child (n=96, 2.1%)	HIV+ parent (not ill) (n=408, 8.9%)	HIV+ parent (ill) (n=178, 3.9%)	Young-carer (n=86, 1.9%)	Maternal orphan (n=731, 16.0%)	Paternal orphan (n=1414, 30.9%)	Double orphan (n=487, 10.6%)
Mean age	12.4	12.5	12.7	12.8	14.4	13.6	13.4	13.9
Percent female	50.8%	49.0%	51.0%	50.0%	58.1%	51.4%	50.2%	49.5%
Site type								
Town	13.9%	18.1%	17.6%	19.1%	15.1%	18.0%	15.7%	17.2%
Commercial estate	23.9%	11.7%	25.0%	22.5%	27.9%	17.1%	18.4%	15.9%
Subsistence farming	42.4%	50%	35.6%	36.0%	39.5%	39.3%	42.0%	42.7%
Roadside trading centre	19.8%	20.2%	21.9%	22.5%	17.4%	25.6%	23.8%	24.2%
SES								
Poorest quintile	18.0%	14.6%	20.8%	27.0%	17.4%	18.3%	20.9%	18.7%
Second quintile	20.0%	18.8%	21.1%	13.5%	30.2%	20.8%	22.6%	22.6%
Middle quintile	17.5%	19.8%	17.9%	20.8%	23.3%	22.7%	22.7%	23.0%
Fourth quintile	15.4%	18.8%	13.2%	18.0%	12.8%	15.5%	16.3%	15.4%
Least poor quintile	28.7%	28.1%	26.5%	20.8%	16.3%	22.4%	17.4%	20.1%
Receiving external support								
Any form	10.5%	17.0%	15.2%	16.3%	23.3%	14.4%	14.4%	14.7%
Education support	1.1%	4.3%	4.4%	7.3%	14.0%	4.4%	4.6%	4.6%
Enrolled								
Overall	89.3%	94.8%	90.7%	95.5%	84.9%	87.3%	88.3%	86.9%
Primary school	95.6%	95.4%	94.1%	100%	100%	98.3%	97.8%	98.6%
Secondary school	83.7%	94.3%	87.8%	92.2%	81.7%	82.3%	83.2%	82.2%
Attending ≥80% of the time								
Overall	61.6%	60.4%	61.8%	61.2%	73.3%	54.7%	55.9%	50.7%
Primary school	90.7%	93.0%	88.7%	88.0%	93.3%	94.7%	92.4%	94.2%
Secondary school	35.5%	34.0%	39.2%	41.8%	69.0%	36.6%	35.9%	33.3%
Correct grade-for-age[†]	78.1%	75.0%	79.4%	69.1%	70.9%	71.4%	72.8%	71.6%

N.B.: Percentages of vulnerable and non-vulnerable children do not add up to 100% as some children are in more than one category of vulnerability

[†]Ages 8-17

Table 4-2 Characteristics of vulnerable and non-vulnerable children (ages 15-24 unless otherwise stated) over five rounds (1998-2011) of the Manicaland survey

	Non-vulnerable (n=10203)	HIV+ youth (ages 15-17, n=93)†	HIV+ parent, not ill (n=782)‡	HIV+ parent, ill (n=476)‡	Young-carer (ages 15-17, n=873)	Maternal orphan (n=1010)‡	Paternal orphan (n=3619)‡	Double orphan (n=2115)‡
Mean age	18.7	16.0	17.1	17.2	16.2	18.6	18.5	18.5
Percent female	52.8%	53.8%	46.7%	52.5%	62.1%	57.3%	55.2%	55.6%
Site type								
Town	14.4%	19.7%	18.1%	16.6%	12.1%	18.5%	16.5%	17.5%
Commercial estate	28.9%	19.7%	23.7%	22.7%	21.8%	20.0%	21.0%	19.6%
Subsistence farming	37.2%	39.9%	36.2%	37.8%	44.7%	39.6%	39.9%	41.9%
Roadside trading centre	19.5%	20.8%	22.0%	22.9%	21.4%	21.9%	22.7%	21.1%
SES [a]								
Poorest quintile	17.6%	23.6%	18.7%	26.8%	17.7%	18.0%	18.2%	17.9%
Second quintile	15.4%	10.3%	17.0%	12.0%	13.1%	15.3%	16.2%	15.8%
Middle quintile	20.6%	21.8%	20.5%	25.6%	25.9%	24.8%	25.8%	24.7%
Fourth quintile	21.7%	20.6%	20.9%	15.9%	21.5%	20.6%	19.4%	20.0%
Least poor quintile	22.7%	21.8%	21.3%	16.3%	20.1%	19.9%	18.3%	20.1%
Completed primary	95.4%	95.7%	96.7%	95.2%	95.5%	93.2%	94.8%	93.5%
5+ O level passes (ages 16-24) [b]	9.9%	0.0%[c]	8.7%	7.5%	1.6%[c]	8.6%	9.2%	7.9%
Correct grade-for-age (ages 15-19)	69.4%	87.1%[c]	77.7%	69.8%	82.2%[c]	70.4%	72.2%	70.4%

N.B.: Percentages of vulnerable and non-vulnerable children do not add up to 100% as some children are in more than one category of vulnerability. Additionally, youth present in more than one survey round have a record for only the first round they were present in.

† Rounds 4 and 5 only ‡Parental data not available in round 1 [a] SES data not available in round 2 [b] Data not available in round 1

[c] Not significantly different from non-vulnerable children aged 15-17 years in rounds 4 and 5 (1.6% with 5+ 'O' levels; 85.9% in the correct grade-for-age)

4.3.2 Associations between vulnerability and education outcomes

Being HIV positive was not associated with differences in any education outcomes (Tables 4-3 to 4-6). Young-carers and children with HIV positive parents did not have worse educational outcomes than non-vulnerable children (Tables 4-3 & 4-4). Similarly, educational outcomes were not significantly different between male orphans compared and non-vulnerable children (Tables 4-3 & 4-5).

Female maternal, paternal, and double orphans were all less likely to be in the in the correct grade-for-age than non-vulnerable children aged 8-17 years surveyed from 2009-2011 (Table 4-4; maternal: AOR: 0.52, $p<0.01$; paternal: AOR: 0.68, $p=0.02$; double: AOR: 0.56, $p=0.02$). Female youth aged 15-24 years, pooled over all rounds, were less likely to have completed primary school if they were maternal (95.0% vs. 92.6%, AOR: 0.52, $p<0.001$), paternal (95.0% vs. 95.6%, AOR: 0.68, $p<0.01$), or double (95.0% vs. 93.4%, AOR: 0.56, $p<0.01$) orphans thank non-vulnerable children (Table 4-6). However, the effect of orphanhood was not cumulative: female double orphans were no more likely than maternal or paternal orphans to suffer educational setbacks after adjusting for covariates (Figure 4-1). Orphanhood was not associated with primary or secondary school attendance or with 'O' level passes in either males or females. Age at orphanhood was not significantly associated with any education outcomes.

Table 4-3 Associations between measures of childhood vulnerability and education outcomes in males in the most recent survey round (2009-2011)

	Correct grade for age (ages 8-17)			Primary attendance (ages 6-12)			Secondary attendance (ages 13-17)		
	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI)[†]	N	%	AOR (95% CI)[†]
HIV+ youth[‡]									
HIV-	1884	75.3%	1	957	91.0%	1	666	71.8%	1
HIV+	41	80.5%	0.82 (0.29-2.38)	24	95.8%	1.79 (0.23-14.0)	11	90.9%	2.47 (0.14-43.2)
HIV+ parent [a]									
Parent HIV-	558	78.1%	1	491	90.2%	1	155	85.8%	1
Parent not ill	166	76.5%	1.19 (0.64-2.23)	85	85.9%	0.88 (0.29-2.66)	59	74.6%	0.87 (0.31-2.40)
Parent ill	75	66.7%	0.66 (0.25-1.71)	36	88.9%	0.99 (0.22-4.44)	34	79.4%	1.06 (0.37-3.00)
Young-carer									
Non-carer	683	79.4%	1	607	91.1%	1	272	84.2%	1
Carer	35	60.0%	0.67 (0.21-2.18)	5	100.0%	N/A	31	71.0%	0.33 (0.08-1.39)
Orphanhood									
Non-orphan	974	78.7%	1	607	91.1%	1	301	74.1%	1
Maternal orphan	250	71.6%	**0.63 (0.40-0.99)**[*]	119	90.8%	1.52 (0.58-4.03)	108	75.0%	1.00 (0.57-1.76)
Paternal orphan	404	72.0%	0.73 (0.50-1.05)	186	90.3%	0.97 (0.56-1.69)	150	74.0%	0.98 (0.59-1.63)
Double orphan	233	72.1%	0.82 (0.52-1.30)	71	94.4%	1.35 (0.47-3.93)	96	68.8%	0.86 (0.42-1.76)

[†]Odds ratios are adjusted for age, SES, and site type, with household random effects. N/A: No children in comparison group who do not attend school regularly

NB: N differs for each analysis due to different response rates for the questions on the vulnerability categories [a] Maternal data only for ages 6-14

[*] Significant at $p<0.05$

Table 4-4 Associations between measures of childhood vulnerability and education outcomes in females in the most recent survey round (2009-2011)

	Correct grade for age (ages 8-17)			Primary attendance (ages 6-12)			Secondary attendance (ages 13-17)		
	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI)[†]	N	%	AOR (95% CI)[†]
HIV+ youth[‡]									
HIV-	2003	80.5%	1	950	91.7%	1	753	61.2%	1
HIV+	40	75.0%	0.54 (0.20-1.45)	19	89.5%	0.65 (0.10-4.39)	12	66.7%	2.81 (0.17-46.7)
HIV+ parent									
Parent HIV-	543	82.1%	1	457	92.1%	1	168	81.5%	1
Parent not ill	179	88.3%	1.86 (0.94-3.67)	98	93.9%	0.78 (0.17-3.62)	59	72.9%	1.76 (0.72-4.32)
Parent ill	80	77.5%	0.80 (0.38-1.70)	39	87.2%	0.22 (0.04-1.20)	21	76.2%	1.83 (0.49-6.81)
Young-carer									
Non-carer	679	82.5%	1	579	90.7%	1	285	84.9%	1
Carer	50	80.0%	1.18 (0.50-2.80)	10	90.0%	0.66 (0.05-8.27)	40	67.5%	0.45 (0.17-1.16)
Orphanhood									
Non-orphan	1,017	83.4%	**1**	578	90.7%	1	352	67.0%	1
Maternal orphan	293	79.9%	**0.52 (0.35-0.78)**[**]	147	93.2%	1.77 (0.59-5.33)	113	68.1%	0.53 (0.23-1.21)
Paternal orphan	428	79.7%	**0.68 (0.47-0.97)**[*]	175	93.1%	1.46 (0.64-3.36)	163	62.0%	0.65 (0.34-1.25)
Double orphan	229	74.2%	**0.56 (0.35-0.89)**[*]	68	94.1%	1.67 (0.39-7.12)	89	56.2%	0.57 (0.22-1.49)

[†]Odds ratios are adjusted for age, SES, and site type, with household random effects. N/A: No children in comparison group who do not attend school regularly

NB: N differs for each analysis due to different response rates for the questions on the vulnerability categories [*], [**] Significant at p<0.05, p<0.01

Table 4-5 Associations between measures of childhood vulnerability and education outcomes in male youth (ages 15-24 years), pooled over five survey rounds (1998-2011)

	Correct grade-for-age (ages 15-19)			Completed primary (ages 15-24)			5+ 'O' level passes (ages 16-24)		
	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI) [†]
HIV+ youth [‡]									
HIV-	672	82.3%	1	821	94.9%	1	507	1.6%	1
HIV+	32	84.4%	1.57 (0.54-4.56)	41	95.1%	0.76 (0.17-3.43)	26	0.0%	N/A
HIV+ parent									
Parent HIV-	1816	60.5%	1	4809	96.2%	1	2689	13.6%	1
Parent not ill	287	73.9%	1.26 (0.86-1.85)	416	96.2%	1.19 (0.59-2.41)	324	9.6%	1.46 (0.72-2.97)
Parent ill	137	61.3%	0.88 (0.50-1.54)	226	94.7%	0.98 (0.44-2.18)	190	11.1%	2.24 (0.89-5.64)
Young-carer [a]									
Non-carer	521	73.3%	1	667	96.9%	1	397	1.5%	1
Carer	258	74.8%	1.17 (0.79-1.72)	331	94.9%	0.39 (0.09-1.63)	224	1.3%	N/A
Orphanhood									
Non-orphan	1816	60.5%	1	4809	96.2%	1	2689	13.6%	1
Maternal orphan	163	60.7%	0.85 (0.66-1.10)	393	95.2%	0.75 (0.51-1.11)	349	13.2%	0.77 (0.58-1.04)
Paternal orphan	748	68.9%	1.02 (0.82-1.25)	1626	96.2%	0.92 (0.66-1.27)	1405	13.2%	0.93 (0.74-1.18)
Double orphan	427	63.0%	0.86 (0.66-1.13)	931	95.6%	0.77 (0.52-1.16)	785	9.3%	0.70 (0.51-0.97)

[†] Odds ratios are adjusted for age, round, SES, and site type, with household (to account for youth living in the same household) random effects

[‡] Ages 15-17, rounds 4 and 5 only [a] Ages 15-17 only

N/A: Insufficient individuals (<5) in comparison group with/without outcome of interest

NB: N differs for each analysis due to different response rates for the questions on the vulnerability categories

Table 4-6 Associations between measures of childhood vulnerability and education outcomes in female youth (ages 15-24 years), pooled over five survey rounds (1998-2011)

	Correct grade-for-age (ages 15-19)			Completed primary (ages 15-24)			5+ 'O' level passes (ages 16-24)		
	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI)[†]	N	%	AOR (95% CI)[†]
HIV+ youth[‡]									
HIV-	617	90.1%	1	823	95.6%	1	493	0.8%	1
HIV+	34	88.2%	N/A	48	95.8%	N/A	29	0.0%	N/A
HIV+ parent									
Parent HIV-	1879	77.9%	1	5374	95.0%	1	3156	7.1%	1
Parent not ill	225	82.7%	1.35 (0.78-2.33)	364	97.8%	2.55 (0.98-6.65)	263	8.0%	1.95 (0.78-4.86)
Parent ill	161	77.0%	0.75 (0.43-1.31)	250	95.6%	1.15 (0.50-2.65)	182	3.8%	0.75 (0.29-1.95)
Young-carer [a]									
Non-carer	802	84.8%	1	1164	96.0%	1	595	1.1%	1
Carer	381	87.1%	1.52 (0.78-2.96)	542	95.9%	1.00 (0.55-1.82)	332	1.8%	N/A
Orphanhood									
Non-orphan	1879	77.9%	1	5374	95.0%	1	3156	7.1%	1
Maternal orphan	189	78.8%	0.92 (0.64-1.32)	606	92.6%	**0.50 (0.37-0.67)*****	514	6.4%	0.89 (0.67-1.18)
Paternal orphan	733	77.8%	0.91 (0.69-1.23)	1,979	95.6%	**0.65 (0.49-0.86)****	1691	7.4%	1.02 (0.80-1.30)
Double orphan	379	78.6%	0.86 (0.58-1.28)	1,164	93.4%	**0.61 (0.44-0.83)****	994	7.2%	0.98 (0.72-1.34)

[†] Odds ratios are adjusted for age, round, SES, and site type, with household (to account for youth living in the same household) random effects

[‡]Ages 15-17, rounds 4 and 5 only [a] Ages 15-17 only **, *** Significant at p<0.01, p<0.001

NB: N differs for each analysis due to different response rates for the questions on the vulnerability categories

N/A: Insufficient individuals (<5) in comparison group with/without outcome of interest

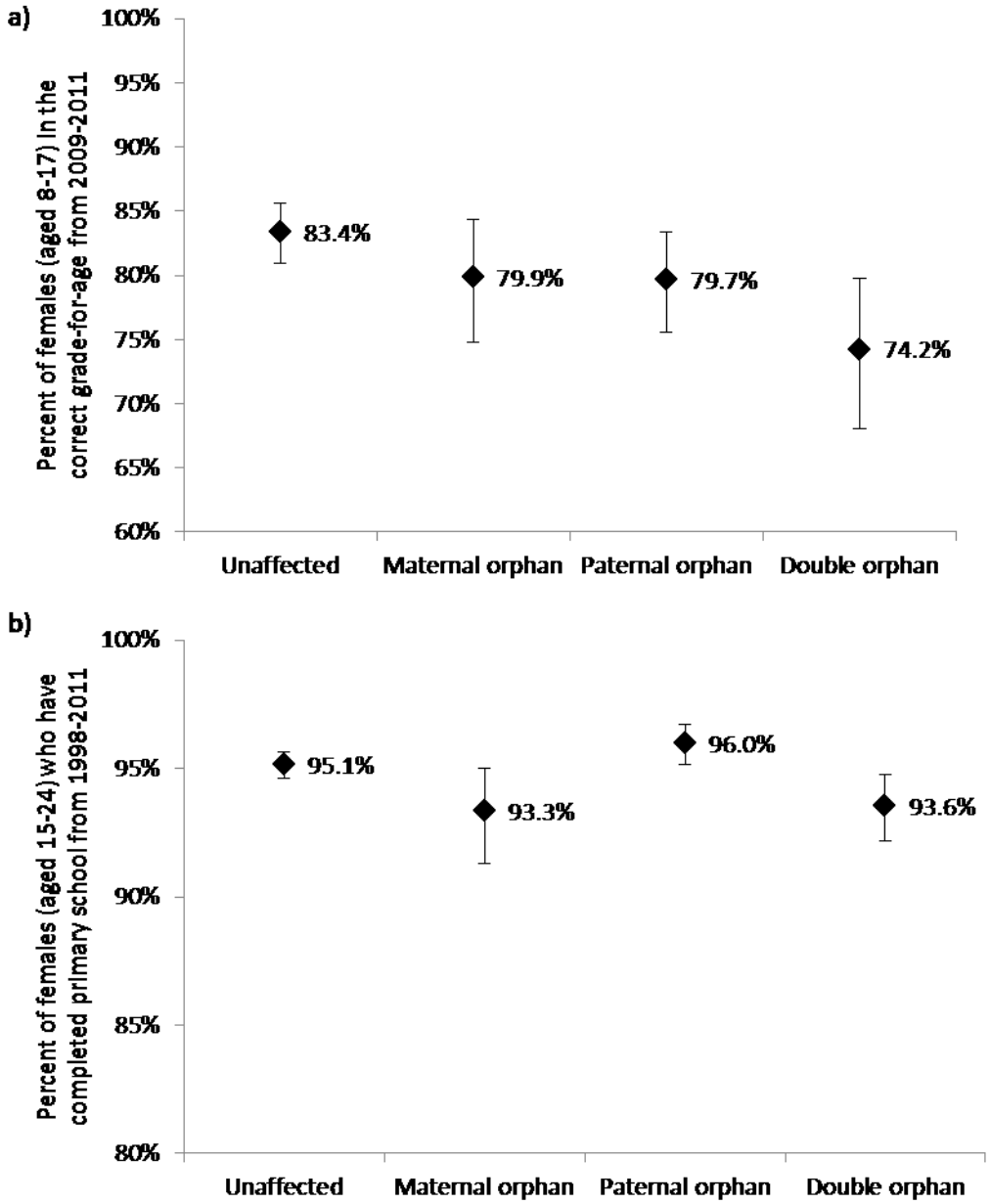

Figure 4-1 Unadjusted differences in percentage of children who are in the correct grade for age (1a) and who have completed primary school (1b) as a function of orphanhood status, compared to children unaffected by the HIV-epidemic

4.3.3 Comparison of young-carers to other vulnerable children

From 2009-2011 as compared to non-vulnerable children, both male and female young-carers were not less likely to attend regularly than other vulnerable children (Table 4-7). Over all survey rounds, female young-carers were more likely to be in the correct grade-for-than all other forms of vulnerable children (Table 4-8); no other significant relationships were seen.

In case the lack of associations were due to carers having additional OVC traits (*e.g.* orphanhood) all analyses were rerun comparing youth who were only carers to all other vulnerable children and no associations changed noticeably from their original values.

4.3.4 Antiretroviral therapy and education outcomes in HIV-positive children

Data on ART coverage were collected in the child survey in round five (a more detailed discussion of ART is given in Chapter 2), and of the 68 HIV-positive children included here, 20 (29.4%) reported taking ARVs. These numbers do not provide adequate power to statistically evaluate whether ART affected education outcomes, but I will describe the data here, with data for males and females combined. Children who were HIV-positive and on ARVs were not more likely to be in the correct grade-for-age than HIV-positive children not on ARVs (76.5% vs 79.4%), or to attend primary (88.9% vs 94.1%) or secondary school (57.1% vs 87.5%) regularly.

In rounds 4 and 5 of the survey, 93 HIV-positive adolescents were present and data on ARV use was available for 18 (19.4%) of them. Of those for whom ART data were present, 7 (38.9%) reported taking ARVs. Again, these numbers are too low to perform a meaningful statistical analysis on, but descriptively: 85.7% vs 80.0% of HIV-positive children on ARVs

were in the correct grade-for-age compared to 81.8% those not on ARVs, 100% vs 90.9% had completed primary school, and no adolescents had more than five ‘O’ level passes.

Table 4-7 Comparison of education outcomes for young-carers to those of other vulnerable children in the most recent survey round (2009-2011)

	Correct grade for age (ages 8-17)			Primary attendance (ages 6-12)			Secondary attendance (ages 13-17)		
	N	%	AOR (95% CI [†]	N		AOR (95% CI)[†]	N	%	AOR (95% CI)[†]
Males									
Vulnerable	861	72.4%	1	371	91.1%	1	327	73.1%	1
Young-carer	35	60.0%	0.58 (0.22-1.48)	5	100%	N/A	31	71.0%	2.12 (0.95-4.70)
Females									
Vulnerable	909	78.3%	1	381	93.2%	1	328	61.3%	1
Young-carer	50	80.0%	1.28 (0.49-3.35)	10	90.0%	0.80 (0.09-6.89)	40	67.5%	0.70 (0.20-2.44)

[†]Odds ratios are adjusted for age, sex, SES, and site type, with household random effects.

N/A: No children in comparison group who do not attend school regularly

Table 4-8 Comparison of education outcomes for young-carers to those of other vulnerable children in data from youth (ages 15-17 years) pooled over five survey rounds (1998-2011)

	Correct grade for age (ages 15-17)			Completed primary (ages 15-17)			5+ O level passes (ages 16-17)		
	N	%	AOR (95% CI) [†]	N	%	AOR (95% CI)[†]	N	%	AOR (95% CI)[†]
Males									
Vulnerable	1142	75.8%	1	1446	95.2%	1	1013	1.9%	1
Young-carer	145	72.4%	1.22 (0.75-1.99)	188	95.7%	1.29 (0.43-3.90)	109	2.8%	1.79 (0.48-6.75)
Females									
Vulnerable	1204	84.0%	1	1689	94.7%	1	1122	1.3%	1
Young-carer	210	87.1%	**2.47 (1.21-5.05)**[**]	318	96.9%	1.54 (0.70-3.41)	179	1.7%	1.87 (0.50-7.06)

[†]Odds ratios are adjusted for age, SES, round, and site type, with household random effects.

[**], [***] Significant at p<0.01, p<0.001

4.4 Discussion

In this chapter I investigated the associations between vulnerable children and education outcomes both in the round five child survey and in youth aged 15-24 over all survey rounds. Addressing the objectives of this chapter:

1) HIV infection status did not have an association with any of the education outcomes investigated in either males or females.

2) Orphanhood had a negative effect on educational attainment in females, but not in males.

3) Female, but not male, young-carers were more likely to be in the correct grade-for-age than all other forms of vulnerable children.

4.4.1 HIV status and education outcomes

I did not find any evidence that HIV status affects children's education outcomes in the study population. The lack of effect of HIV status on education outcomes in younger children could be because HIV-positive children who have survived to primary school age have experienced slower disease progression, have exhibited few signs of infection, and/or are unaware that they are infected. Although it has been found that perinatal HIV infection can impact cognitive development at a young age [218,219], our data did not find any evidence of HIV status affecting children's educational attendance or attainment. This may be because these studies used tools such as IQ tests to measure child development and did not directly assess their performance in school, whereas cognitive tests were not part of the Manicaland study. In 2013, Bandason *et al*. found an association between HIV status and being less likely to be in the correct grade-for-age in primary school children in Harare, which was

attributable to illness [159]. However, they did not adjust for potential confounders, such as orphanhood, a possible alternative explanation for poorer educational outcomes, as is suggested by my analyses.

Negative associations between HIV and education outcomes amongst adolescents might have been expected considering other evidence that HIV-positive adolescents experience AIDS-related illnesses [15,151] that could impact negatively on school attendance and performance. I saw no evidence of this, perhaps due to the small number of HIV-positive children of school-going age in the sample. Also possible is bias in the survey if sick children and adolescents were less likely to participate than healthy children. However, only 0.65% (5/768) of non-respondents in the child survey cited illness as the reason, suggesting that healthy user bias was unlikely.

It is possible that taking ARV medication may have allowed HIV-positive children to attend school more, but my data were unable to support this hypothesis. Data on ART coverage were collected in the child survey in round five (a more detailed discussion of ART is given in Chapter 2), and of the 68 HIV-positive children included here, 20 (29.4%) reported taking ARVs. I lacked adequate power to statistically evaluate whether ART affected education outcomes but, examining the data, there was no indication that taking ARVs was associated with improved education outcomes in children aged 6-17 from 2009-2011. The findings were the same in rounds four and five of the general survey (2006-2011), with no indication that ARVs were associated with any education outcomes. This is not to say that taking ARVs does not allow HIV-positive children to more fully participate in school, but simply that the numbers available for analysis in this study were too small to make any meaningful conclusions. It is also possible that one would not expect improved education outcomes among this group, but rather that ART uptake amongst those who have become sick is offsetting what would otherwise be poorer education outcomes in HIV-positive children.

4.4.2 Orphanhood and education outcomes

Although a child's HIV infection status did not affect their education outcomes, orphanhood had negative associations with education outcomes in females only. Orphanhood was associated with significantly reduced odds of females being in the correct grade for their age and completing primary school. Previous studies, summarised in a review by Guo *et al.*, also found orphaned children to be educationally disadvantaged as compared to their peers, with vulnerable girls often more likely to be disadvantaged than boys [80]. Most commonly, studies reported that orphaned children were less likely to be enrolled in school or to attend regularly [73,74,228]. However, other studies [76,226,227,229] found, as I did, that orphanhood had no effect on enrolment or attendance. In addition to the effects of orphanhood varying by country, due to differences in potential cofactors (*e.g.* age, gender, religion, household composition, and societal norms) [80], the lack of effect I saw could also have been due to orphaned children being relocated to live with more well-off relatives [78], who were willing and able to provide for their education.

Although the numbers were low (n=91), I found that orphaned children living in households that reported receiving external support were more likely to be in the correct age-for-grade than those not receiving support. External support received by vulnerable households could have increased education levels by permitting families to send their children to school on a regular basis. This possibility is supported by recent findings from the study population that both conditional and unconditional cash transfers to households increased school attendance amongst vulnerable children [230]; findings which echo those from other settings [231]. I will discuss cash transfers and their benefits in greater detail in Chapters 5 and 6.

The few studies that have examined the gap in schooling found, as I did, that children who lost either or both of their parents to AIDS were less likely to be in the correct grade for their age due to the interruption in studies caused by parental illness preceding death [75,214].

Although I did not find any associations with parental illness and education, this may be because there were too few instances to detect an effect or because the measure of parental illness is a crude one, assessing only illnesses in the last two weeks and does not distinguish between a chance cold and the chronic illnesses associated with HIV. Additionally, parental illness may not be the underlying cause as some studies have found that it is not atypical for households where one or more parents have died of AIDS to prioritise the enrolment of older children while delaying enrolling the younger ones [80].

Interestingly, all forms of orphans showed negative associations with females being in the correct grade-for-age (2009-2011) and having completed primary school (1998-2011). The reasons for why orphanhood may hinder educational attainment and success are varied and complex and the mechanisms and circumstances behind observed associations may be different for paternal and maternal loss. In a previous study using data from the first two rounds of the survey in Manicaland (1998-2003), all types of orphans were less likely to have completed primary school than their unaffected counterparts, with the suggestion that this was due to lack of external support and gaps in the arrangements made for caring for orphans [78]. Maternal orphans were particularly vulnerable due to a lack of support from their fathers and stepmothers, in addition to being ineligible for financial assistance due to residing in a household of higher SES [78]. Other studies have found that orphanhood can hinder general educational attainment due to the interruption of parental illness and death [75,214]. Moreover, children orphaned by AIDS have been reported to be less confident and more impulsive, anxious, and aggressive in school than other children [232]. This disruptive behaviour, along with the potential psycho-social impacts of AIDS orphanhood [63,233], could account for the poor school performance of orphaned children.

4.4.3 The education outcomes of young-carers

There has been a debate about whether or not young-carers experience adverse education outcomes. As Cluver describes, carers may be educationally disadvantaged due to the time constraints and high burden placed on them in caring for ailing relatives or younger siblings after a parent has died [217]. Others [46], however, suggest that carers, instead of being disadvantaged, may instead be resilient and empowered to cope with both the burdens of school and home life. Although I found no evidence to suggest that carers are better able to succeed in education as compared to children unaffected by HIV, I then compared carers to other vulnerable children in an effort to determine if their education outcomes differed in any way. I found no significant effect when comparing carers to other vulnerable children in the round five child survey (possibly due to the low number of carers included), but when the education outcomes of young-carers were compared to those of other vulnerable adolescents over all rounds, a different picture emerged. Over all rounds, female young-carers had significantly higher odds of being in the correct grade-for-age than other vulnerable children. Qualitative work in Kenya has shown that carers can cope with their burdens by accessing social support, constructing positive identities for themselves and their caring activities, and by generating income [46]. All of the children in the Kenyan study were enrolled in school and, despite instances of stigma, frequently cited schools as a source of support, allowing them to have hope for the future. I will return to the idea of schools as sources of support for children in Chapter 6 of my thesis, where I will examine this concept in depth. Such positive attitudes towards school, along with the resilience and skills that young-carers demonstrated, may account, at least partially, for the higher levels of educational achievement we saw in young-carers as opposed to other vulnerable children. This is a heartening finding as it suggests that although carers may experience educational disadvantage in the short term (*i.e.* through decreased attendance due to their caring duties as suggested by Cluver [217]), it does not preclude them from fulfilling their educational goals in the long run.

4.4.4 The relationship between gender and education

Even when unaffected by HIV, females are more likely to have worse education outcomes than their male counterparts [213]. Here, I found that orphanhood disproportionately affects the education outcomes of females over males, with only associations in females being significantly negative. That being said, the odds ratios for males were all less than one, implying a trend towards negative associations despite their lack of significance. Indeed, the levels of primary education were high enough in the sample that I may have lacked the power to detect small differences, particularly in males who had higher primary education levels than females to begin with.

Although I did not investigate the reasons behind the disparities in the effects of orphanhood in males and females, it may be linked to my work in Chapter 3, where it appeared as if male education was valued over that of females', a finding not uncommon in Africa and other parts of the world [213,215]. Moreover, participants in qualitative work from Manicaland noted that mothers were more willing to make sacrifices to keep their children in school than fathers were [78]. This factor also potentially helps to explain why females were affected by orphanhood, but males were not: fathers are more likely to prioritise the education of their sons, whilst mothers may make education for all her children a priority. When a parent dies it is also often the extended family of this parent who arranges to help pay for the education of the children, and again the gender bias may come into play, with family members exhibiting a preference to educate male over female offspring, as money earned by males is more likely to come back into the family whereas once a woman marries her income, if any exists, is expected to go towards her husband's family.

4.4.5 Limitations and strengths of the work

Although I disaggregated the data on orphans by which of their parents they had lost, this may still be a relatively simplistic view of the complex situations that children who have lost one or more of their parents experience. Firstly, I was unable to identify the cause of parental death and therefore grouped AIDS orphans and children orphaned for other reasons together. Because AIDS orphans can experience greater degrees of psychological distress and stigma than children orphaned for other reasons [234], Orkin *et al.* have suggested that it is children orphaned by HIV, as opposed to those orphaned for other reasons, who are more likely to experience poorer educational outcomes [235]; however, in his work he saw no effect of orphanhood until the data were disaggregated by orphan type, an issue which was not present here.

Although I tested to see if duration of orphanhood had an effect on education outcomes, I did not explicitly take into account the sequence of events (*e.g.* was the child orphaned before or after they were of an age to complete primary school). Due to the education situation in Zimbabwe this would have been difficult to do, as interruptions to schooling are frequent and it is not uncommon for people to leave school only to return after a few years. This was particularly problematic during the economic crash, when schools, especially those in rural areas such as Manicaland, were frequently closed. Because of these complications, I included time since orphanhood as a proxy to account for the timing of orphanhood in relation to education outcomes as best I could.

Conversely, a strength of this work comes from the knowledge that HIV infection in children from this population almost certainly precedes school enrolment and therefore all measures that I have assessed here. Based on my findings in Chapter 2 and previous work by Eaton *et al.* [15], it appears as if the vast majority of HIV infections in this population are due to MTCT,

meaning that although I do not have incidence data, I am still able to assume the sequence of events.

Another issue surrounding orphans is that often the time just before orphanhood, when the child's parent is ill and dying, can be critically difficult. These spells of illness that proceed death due to HIV can decrease children's school attendance even above those of orphans [75], although I found no evidence for this here. The situation that orphans find themselves in after orphanhood could also be associated with their education outcomes. Orphaned children from wealthier households, or those who are fostered with economically better-off family members, may find themselves buffered from some of the negative economic effects typically associated with orphanhood, and which have been shown to have negative associations with education [225].

Despite the wide variety of emotional, material, and family situations that orphans can experience, I was still able to detect an association between orphanhood and education outcomes in this population. This suggests either that, regardless of individual experiences, orphanhood is associated with negative education outcomes or that the other factors I controlled for in my analysis were sufficient to account for the variability in orphan experiences and allow me to detect the underlying association.

Another potential weakness of this work is that I aggregated the data for youth aged 15-24 over all survey rounds. As shown in Chapter 3, education has generally increased over time in the Manicaland study population. Although I presented a detailed analysis of these patterns in Chapter 3, here I condensed the data over all rounds to get an overall view of the associations between vulnerability and education. Such aggregation of the data will, of course, lose some of the nuanced patterns seen over time. However, due to the low number of observations in certain categories of vulnerability, I combined the data over the rounds

and controlled for any potential changes in vulnerability or education over time by controlling for survey round in my analyses.

4.4.6 The implications of lost education

I found that the percentage of children behind in school in Manicaland (from 2009-2011) increases from 17.4% (95% CI: 15.8%-19.0%) overall to 23.1% (95% CI: 20.2%-26.0%) for paternal orphans and 25.4% (95% CI: 19.7%-31.1%) for maternal orphans. This is particularly worrisome given the continued high levels of orphanhood in Zimbabwe [181]. The lower education levels experienced by orphans compared to other children have potentially severe negative consequences for childhood development and life outcomes considering that children who miss out on education often struggle as adults to find employment, and, when they do find a job, typically earn less than their educated counterparts [236]. Exacerbating this problem is the economic situation of Zimbabwe. As discussed in Chapter 3, after Independence in 1980, Zimbabwe's primary education was free of charge, but fees were introduced in 1991 [70]. Fees have risen steadily since then, and, with the economic crash in the late 2000s, many families, particularly in rural areas, were either unable to afford school fees, or needed their children to help out at home earning money [190]. For children who grow up in rural areas, such as those in the Manicaland study areas, education enables them to make better use of the resources available, whether by teaching them how to increase the productivity of their land, how best to sell excess produce, or how to manage their household budget [236]. Without the skills that proper education imparts, children already disadvantaged by the loss of a parent may continue to fall further behind their more educated peers.

In addition to the economic consequences of lost education, for those children who are HIV-negative, decreased school attendance can have a dramatic impact on HIV prevention, as a good, basic education is one of the most effective and cost-effective means of preventing

HIV [81]. Education is notably important for women, who are more likely to delay their sexual debut, use a condom, and avoid transactional sex if they have secondary school education [115,116]. Children who grow up with little education can be up to two times as likely to contract HIV as children who have completed primary school [83] and orphans also have increased HIV risk, with lower school education as a possible mediating factor [54]. In this context, the lower levels of primary school completion among orphans, and female orphans in particular, is of concern as it may perpetuate a vicious cycle of HIV infection, orphanhood, and reduced education.

The key findings and conclusions in this chapter are:

1) Despite evidence from previous studies suggesting that HIV-positive children can have cognitive impairments, I found no evidence that HIV status has any association with education outcomes.

2) Girls who come from families impacted by the HIV epidemic, particularly orphans, are less likely to succeed in school than those children who have escaped the effects of AIDS. Therefore, it is critical to direct resources towards supporting children affected by AIDS, particularly girls, either through cash transfer programmes or by helping schools to support vulnerable children.

3) Young-carers are as likely to succeed as non-vulnerable children and are in fact more likely to succeed in education than children who have been made vulnerable in other ways.

4) Generally, female orphans experience poorer educational outcomes than unaffected children more frequently than male orphans, perpetuating a gap that already exists

between male and female education. It is important therefore to focus on programmes that continue to reduce the education gap between males and females.

Poor education outcomes are not the only way in which the effects of the HIV epidemic, and orphanhood in particular, can impact on child outcomes. In the next chapter I will investigate how orphanhood is related to substance use, risky sexual behaviours, and if education can offset any increased risk they may experience.

5 The associations between orphanhood, education, substance use, and HIV risk behaviours

5.1 Introduction

Having now established the associations between education and decreased HIV risk (Chapter 3) and orphanhood and lower education levels (Chapter 4), I will use this chapter to examine substance use as a potential factor on the causal pathway between orphanhood, education, and HIV risk. I hypothesise that orphans are at increased risk of substance use and that substance use increases HIV risk by increasing risky sexual behaviours. Moreover, I believe that school education will decrease both substance use and sexual risk behaviours (Figure 5-1).

As discussed previously, the HIV epidemic in sub-Saharan Africa has increased the numbers of orphans and other children made vulnerable by HIV-related illness, stigma and death within their families and communities [181]. Orphans and children made vulnerable by HIV (OVC) are at an increased risk of exploitation [237,238], abuse [237,238], psychosocial distress [239], poverty [240], lower school attendance [241,242], and acquiring sexually transmitted diseases [243]. Research from Manicaland province, Zimbabwe supports these associations, with OVC more likely to have HIV infection, early sexual activity, teenage pregnancy, and secondary school drop-out than non-orphaned, non-vulnerable children [54]. These associations remained after adjusting for SES, suggesting the effects are not explained by economic vulnerability alone. Prevalence of orphanhood remains high in Manicaland, with 33.2% of children aged 2-17 having lost one or both of their parents (see Chapter 2). Attention has turned to understanding the causal pathways through which these vulnerabilities relate to HIV status, and to evaluating possible interventions to support OVC within their families and communities, as a part of a comprehensive response to HIV epidemics.

Although there is a protective effect of education on HIV risk (Chapter 3 and [112,123,244]), the exact mechanisms by which schooling decreases HIV risk are unclear. School education may decrease risk directly through delayed sexual debut, and by decreasing other sexual risk behaviours (*e.g.* entering into relationships with older partners, higher numbers of non-regular partners, and engaging in transactional sex) however, substance use has also been shown to be associated with increased sexual risk behaviours [61-63,153,245] and may be an important mediating factor that has previously been neglected.

Despite the link between substance use and HIV risk behaviours, only a small number of epidemiological studies have looked at alcohol and drug use amongst adolescents in SSA [60,66,67], with none published from Zimbabwe. Building on the work of Chapter 4 where I found links between orphanhood and decreased education, in this chapter, I will investigate linkages between vulnerability, substance use, sexual risk behaviours, and education. Figure 5-1 outlines the proposed relationships that I will be investigating. The objectives of this chapter are:

1) To describe levels and patterns of substance use in adolescents aged 15-19 in eastern Zimbabwe between 2009 and 2011.

2) To test the hypothesis that substance use is on the causal pathway between parental loss and increased HIV risk behaviour for orphaned adolescents by:
    a. Testing if orphaned adolescents report more sexual risk behaviours than non-vulnerable adolescents
    b. Investigating whether orphaned adolescents have higher levels of substance use than non-vulnerable adolescents
    c. Examining if adolescents practicing substance use have greater sexual risk behaviours

3) To test the hypothesis that school enrolment and/or regular attendance is associated with reduced substance use in adolescents (orphaned and not), thereby potentially reducing HIV risk behaviours.

4) To determine the relationship between education (school enrolment and regular attendance) and sexual risk behaviours, and to ascertain if that relationship is mediated by substance use.

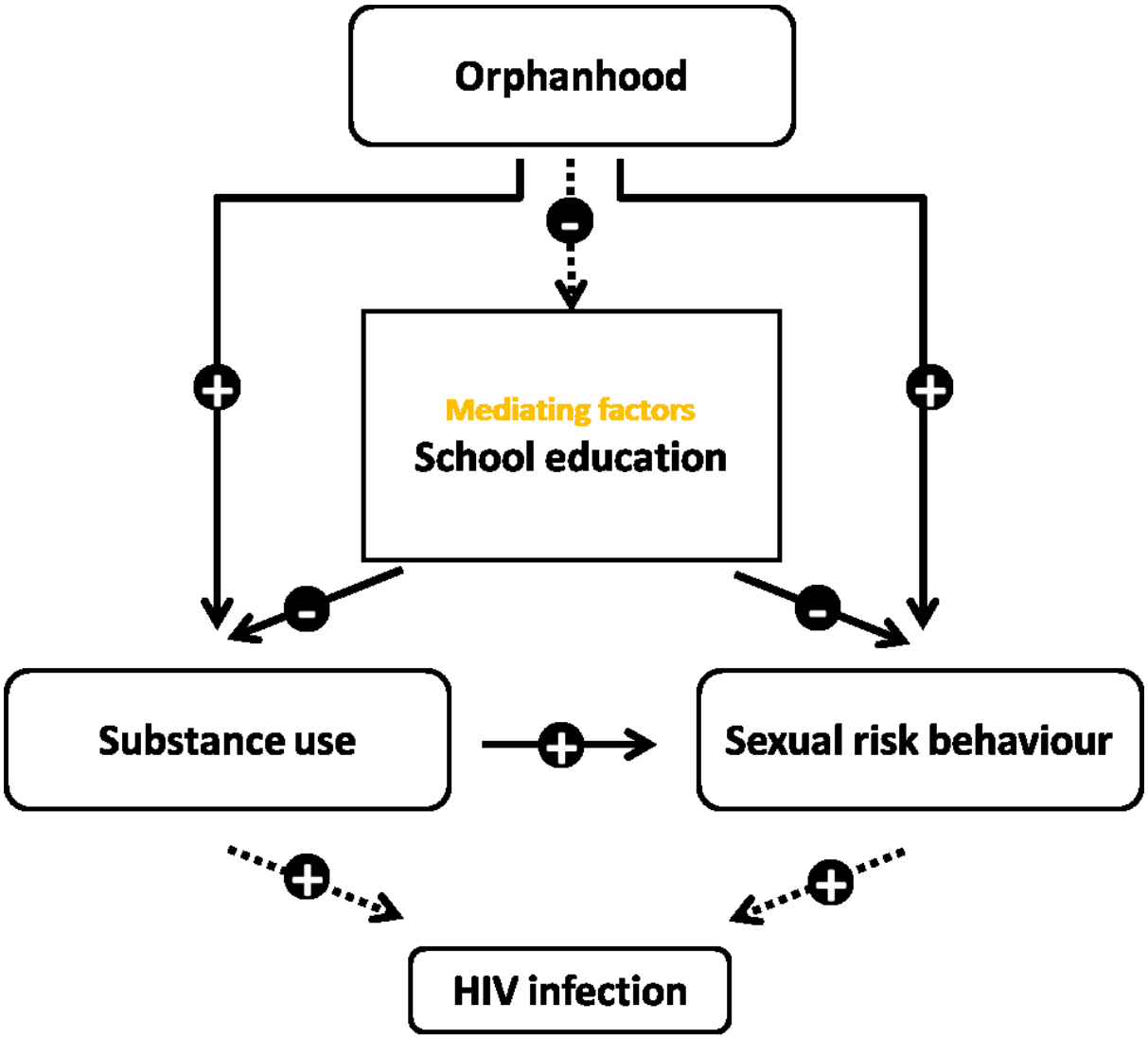

Figure 5-1 The proposed relationships between orphanhood, substance use, education, and HIV risk behaviours that I will investigate in this chapter. Dashed lines represent associations not investigated in this chapter.

5.2 Methods

5.2.1 Study population and data collection

Included in this chapter are data from participants aged 15-19 years in both the child (ages 15-17 only) and adult (ages 15-19) surveys of round five (2009-2011) of the Manicaland HIV/STD Prevention Project. A full description of the study population and data collection methods is given in section 1.6.

5.2.2 Exposure measures

School enrolment was measured through self-report in adolescents of school-going age (taken as ages 15-18 years). Regular attendance was defined as attending at least 80% of the last 20 school days. If a child was not enrolled in school, then they were coded as not attending regularly. School attendance data were only collected in the child survey and therefore were only available for adolescents aged 15-17. Orphans were classified as maternal, paternal and double orphans (described in section 1.6.3).

5.2.3 Outcome measures

Information on adolescents' substance use was self-reported and included use of cigarettes, alcohol, and recreational drugs (primarily marijuana (*Mbanje*) in the study populations; injecting drugs being little used due to the high costs). A summary variable to assess if adolescents had ever used any of the three substances was also created from the responses to these three questions. For the child survey, questions on substance use were asked without the primary caregiver being present to encourage full disclosure. Sexual behaviour outcomes were ever having had sex, having had sex before the age of 15 (early sexual debut), number of non-regular partners in the last 30 days, engaging in transactional sex, and using condoms at the last sexual encounter.

5.2.4 Data analysis

Logistic regression, adjusting for linear age only, was used to determine associations between demographic factors, parental loss, and the various forms of substance use. Multivariable linear and logistic regression models adjusting for age, gender, SES (measured using a previously described index [153]), religion, and community type (town, estate, roadside settlement or subsistence farming) were used to determine if orphanhood was associated with higher levels of substance use. Similar models were used to assess whether substance use, orphanhood (before and after adjusting for substance use), and education (before and after adjusting for substance use) were associated with higher levels of sexual risk behaviours. The religious affiliation of all participants was based on their own self-reported religion and not that of their mother, as was used in Chapter 2. Finally, I assessed whether, among all adolescents and orphaned adolescents specifically, school enrolment was associated with lower levels of substance use. Variables significant at $p<0.2$ in age-adjusted models were included in the fully-adjusted multivariable regression models. All analyses were stratified by gender.

5.3 Results

To guide the results, I have updated Figure 5-1 to reflect the general trend of associations that I found evidence for in this chapter (Figure 5-2). Figure 5-2 does not reflect many of the nuances in the data and instead aims to provide an overall summary of what I found. I will discuss the subtler intricacies of my findings in proper detail throughout the discussion.

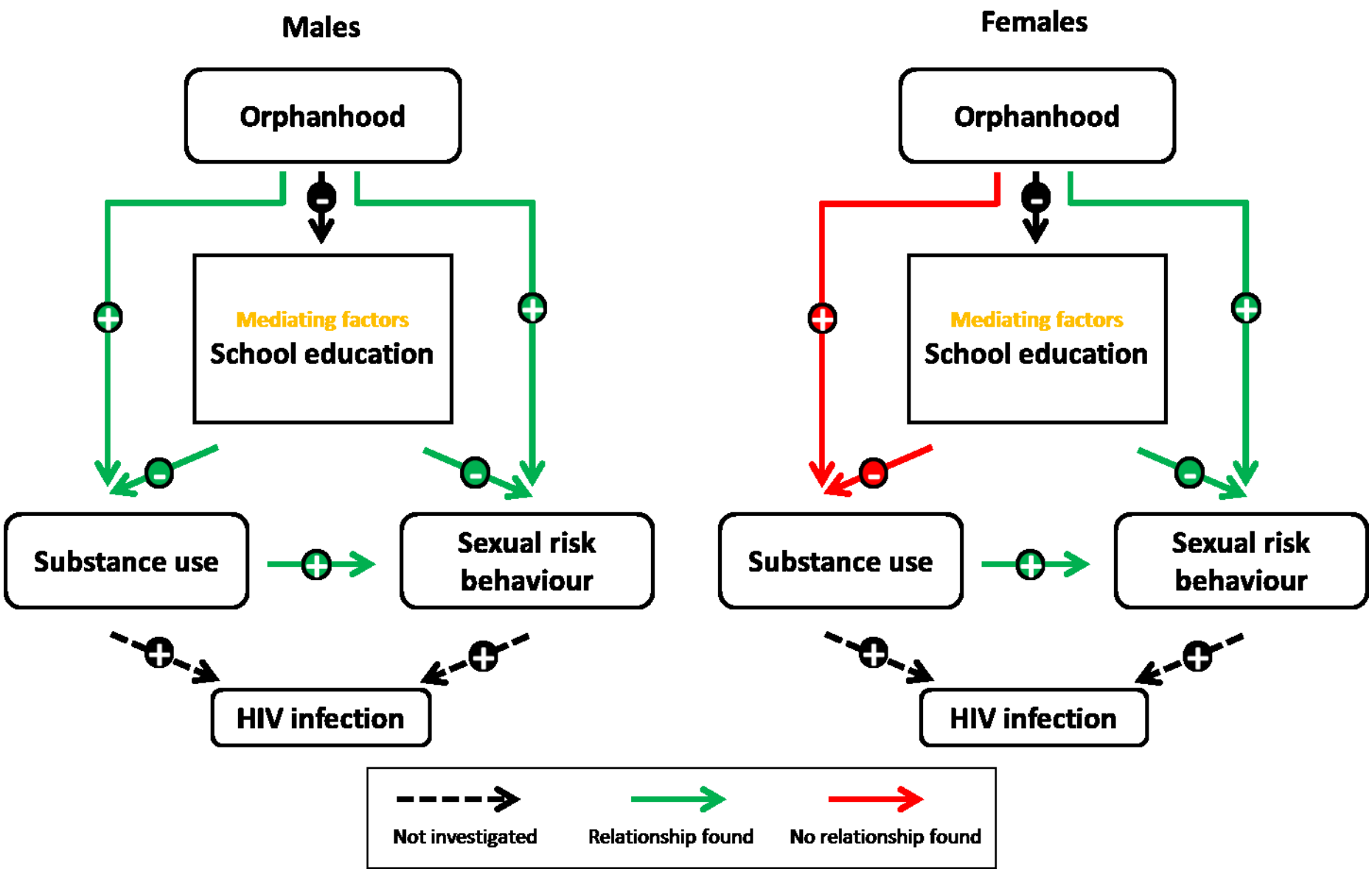

Figure 5-2 The observed relationships between orphanhood, substance use, education, and HIV risk behaviours investigated in this chapter.

5.3.1 Participant characteristics

A total of 9,147 young adults aged 15-19 years were enumerated, of which 4,722 were randomly selected for inclusion in the study, of which 3,274 participated, giving a response rate of 69.3%, similar to the 72.1% response rate for the child survey (Section 2.3.1). Of those who did not complete the survey only 6 (0.4%) were due to refusal. Fifty-one percent of the study population was female and demographic characteristics were generally evenly distributed between the genders (Table 5-1). Overall levels of any substance use (cigarettes, drugs, or alcohol) were relatively low (3.8%, 123/3273) and were higher in males (6.7%, 108/1609) than in females (0.9%, 15/1664). Males were more likely than females to report ever using cigarettes (0.9% vs 0.1%), drugs (3.2% vs 0.4%), and alcohol (6.4% vs 0.7%) (all $p<0.01$). In contrast to substance use, adolescent females were more likely than males to report having started sex (24.4% vs 6.4%; $p<0.01$), to be married or in a long-term partnership (20.4% vs. 0.7%, $p<0.001$), and to have had an early sexual debut before the age of 15 (2.8% vs. 0.5%, $p<0.001$), but, among those who were sexually active, females were less likely than males to have engaged in transactional sex (2.5% vs 4.9%, $p<0.01$). Conversely, males were more likely than females to have used condoms at their last sexual encounter (70.9% vs. 9.7%, $p<0.01$), and also reported fewer partners in the last month (0.2 vs. 2.0, $p<0.001$).

Of those people in a long-term partnership (N=350), females had a significantly larger mean age gap between themselves and their partner than males (6.5 years younger vs. 1.3 years older, $p<0.001$). Additionally, condom use was strongly related to marital status, with those in a long-term partnership being significantly less likely to have used condoms at their last sexual encounter (all $p<0.001$, Table 5-2). When condom use was stratified by marital status, females remained significantly less likely to use condoms than males if they were single (age-adjusted OR: 0.17; 95% CI: 0.08-0.37), but condom usage was similarly low among both married males and females (age-adjusted OR: 0.36; 95% CI: 0.07-1.84). Among

women, those who are married form the great majority of those who have already had sex, with only 3.5% (46/1300) of unmarried women having had sex compared to 100% (N=334) of married women; meaning that, out of those women who are sexually active, only 12.1% are unmarried. In contrast, fewer men are married (N=12) and, although pre-marital sex is more common among males (5.8%, 92/1593), those who are married are still more likely to be sexually active (11/12, 91.7%). The differences in early sexual debut are also likely due to more women being married, with 8.7% of those who are married reporting sex before the age of 15, as compared to 0.3% of unmarried women, making up 80.6% of the women reporting early sexual debut.

Table 5-1 Characteristics of adolescents aged 15-19 years included in the analyses for this chapter

	All (N=3274) Mean [IQR] or % (95% CI)	Males (n=1609) Mean [IQR] or % (95% CI)	Females (n=1665) Mean [IQR] or % (95% CI)
Mean age	16.8 [16-18]	16.8 [16-18]	16.7 [16-18]
Community type			
Town	15.5% (14.2-16.7)	15.2% (13.5-17.0)	15.7% (14.0-17.5)
Commercial estate	20.9% (19.5-22.3)	20.9% (18.9-22.9)	20.8% (18.9-22.8)
Roadside trading centre	22.4% (21.0-23.8)	22.7% (20.7-24.8)	22.1% (20.1-24.1)
Subsistence farming	41.2% (39.5-42.9)	41.1% (38.7-43.5)	41.3% (40.0-43.7)
Religion			
Christian	54.2% (52.5-55.9)	54.2% (51.7-56.6)	54.3% (51.9-56.7)
Traditional	0.2% (0.1-0.4)	0.2% (0.0-0.5)	0.2% (0.0-0.4)
Spiritual	27.7% (26.2-29.3)	25.6% (23.5-27.8)	29.8% (27.6-32.0)
Other	14.5% (13.4-15.8)	14.4% (12.7-16.1)	14.7% (13.0-16.4)
None	3.2% (2.6-3.9)	5.5% (4.4-6.7)	1.0% (0.5-1.5)
Orphanhood			
Non-orphan	51.1% (49.4-52.9)	51.0% (48.5-53.5)	51.3% (48.9-53.7)
Maternal	5.8% (5.0-6.7)	5.3% (4.2-6.4)	6.4% (5.2-7.6)
Paternal	26.4% (24.9-27.9)	26.2% (24.1-28.4)	26.6% (24.5-28.8)
Double	16.6% (15.3-17.9)	17.5% (15.7-19.4)	15.7% (13.9-17.4)
Enrolled in school[†]	71.0% (69.3-72.7)	76.7% (74.5-79.0)	65.5% (63.0-67.9)
Regular school attendance[‡]	53.9% (50.8-57.1)	61.2% (56.5-65.8)	48.0% (43.7-52.3)
Substance use			
Smoking	0.5% (0.3-0.8)	0.9% (0.5-1.4)	0.1% (0.0-0.3)
Drug use	1.7% (1.3-2.2)	3.2% (2.3-4.0)	0.4% (0.0-0.6)
Alcohol consumption	3.5% (2.9-4.1)	6.4% (5.2-7.6)	0.7% (0.3-1.1)
Any form of substance use	3.8% (3.1-4.4)	6.7% (5.5-7.9)	0.9% (0.4-1.4)
Sexually active	15.6% (14.3-16.8)	6.4% (5.2-7.6)	24.4% (22.3-26.5)
Married or in a long-term partnership	10.7% (9.6-11.7)	0.7% (0.3-1.2)	20.4% (18.5-22.4)
HIV risk behaviours			
Sexual debut before age 15	1.3% (1.0-1.7)	0.5% (0.2-0.8)	2.8% (1.5-2.9)
Condom use at last sexual encounter	22.1% (18.5-25.7)	70.9% (62.0-79.7)	9.7% (6.8-12.5)
Engaged in transactional sex[a]	3.0% (1.5-4.4)	4.9% (0.7-9.0)	2.5% (1.0-4.0)
Mean number of non-regular partners in the last 30 days[a]	0.6 [0-1]	2.0 [1-2]	0.2 [0-0]
Age difference with partner[b]	6.2 [4-8]	-1.3 [-3 – -1]	6.5 [4-8]

[†]Ages 15-18 [‡]Ages 15-17 [a] Among those who have had sexual debut
[b] Among those who are married or in a long-term partnership

Table 5-2 Relationship between marital status and condom use at last sexual encounter

		Did not use condoms	Used condoms	Odds ratio (95% CI)
All participants	Not married	50	87	0.03 (0.02-0.07)
	Married	324	21	
Males	Not married	21	71	0.07 (0.02-0.30)
	Married	9	2	
Females	Not married	29	16	0.11 (0.05-0.23)
	Married	315	19	

5.3.2 Socio-demographic factors, orphanhood, and substance use

Age-adjusted associations between socio-demographic factors (including orphanhood and education) and substance use for males are presented in Table 5-3; fully adjusted models are presented in Table 5-5. As described above, for females, overall levels of substance use were very low (<1%, Table 5-1) and therefore there were insufficient data to investigate differences in substance use between the different categories of socio-demographic factors, including orphanhood and education.

For males, maternal orphans (4.9%, 18/364) and double orphans (5.4%, 15/280) were more likely to take drugs for pleasure than non-orphans (2.8%, 28/781), before (Table 5-3) and after (Table 5-4) adjusting for socio-demographic factors ($p<0.05$). A higher percentage of maternal and double orphans also reported alcohol consumption and smoking, but the differences were not statistically significant. Substance use was higher in agricultural areas than in towns, and all forms were less common in Spiritual churches. No differences were found between socio-economic sub-groups.

The associations between education and substance use in Table 5-4 will be discussed in section 5.3.6.

Table 5-3 Socio-demographic determinants of substance use in male adolescents aged 15-19 years

	N	Smoking cigarettes		Recreational drugs		Alcohol		Any substance use	
		%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)
Orphanhood									
Non-orphan	789	0.9%	1	2.8%	1	6.6%	1	6.6%	1
Maternal	364	1.4%	1.67 (0.56-4.94)	4.9%	**1.89 (1.04-3.46)***	7.8%	1.30 (0.82-2.07)	8.5%	1.38 (0.88-2.16)
Paternal	699	0.9%	0.77 (0.27-2.18)	3.6%	1.17 (0.66-2.07)	5.9%	0.80 (0.52-1.22)	6.6%	0.89 (0.59-1.34)
Double	280	1.1%	1.09 (0.30-3.89)	5.4%	**1.95 (1.04-3.69)***	7.6%	1.19 (0.72-2.01)	8.6%	1.33 (0.81-2.17)
Community type									
Town	245	0.8%	1	0.4%	1	3.7%	1	3.7%	1
Commercial estate	336	1.2%	1.54 (0.28-8.53)	2.7%	7.18 (0.89-57.6)	7.1%	2.17 (0.97-4.84)	7.7%	**2.41 (1.09-5.33)***
Roadside settlement	366	0.5%	0.61 (0.09-4.41)	4.4%	**10.5 (1.37-80.5)***	6.0%	1.56 (0.69-3.50)	6.6%	1.73 (0.78-3.85)
Subsistence farming	662	1.1%	1.35 (0.28-6.61)	3.8%	**10.5 (1.40-78.6)***	7.1%	**2.13 (1.01-4.48)***	7.4%	**2.25 (1.1-4.72)***
SES									
Poorest quintile	293	1.4%	1	2.0%	1	4.8%	1	4.8%	1
Second quintile	361	0.8%	0.56 (0.12-2.55)	4.2%	1.93 (0.73-5.20)	6.4%	1.28 (0.64-2.58)	7.5%	1.54 (0.78-3.05)
Middle quintile	329	0.9%	0.48 (0.10-2.19)	4.0%	1.35 (0.50-3.68)	7.6%	1.20 (0.60-2.40)	7.9%	1.26 (0.63-2.51)
Fourth quintile	338	0.3%	0.17 (0.02-1.51)	3.0%	1.11 (0.39-3.14)	6.0%	1.00 (0.49-2.05)	6.2%	1.05 (0.51-2.14)
Least poor quintile	286	1.3%	0.75 (0.18-3.10)	2.4%	0.83 (0.27-2.55)	7.0%	1.13 (0.55-2.32)	7.0%	1.12 (0.54-2.31)
Religion									
Christian	869	1.0%	1	3.7%	1	7.4%	1	7.5%	1
Traditional	4	0%	N/A	0%	N/A	0%	N/A	0%	N/A
Spiritual	411	0.5%	0.48 (0.10-2.26)	1.2%	**0.33 (0.10-0.86)***	4.1%	**0.55 (0.30-0.96)***	4.1%	**0.54 (0.30-0.95)***
Other	231	0.9%	0.87 (0.19-4.08)	3.0%	0.86 (0.37-2.00)	5.7%	0.78 (0.41-1.46)	6.5%	0.89 (0.49-1.62)
None	89	2.2%	1.97 (0.41-9.38)	7.9%	2.02 (0.83-4.87)	9.1%	1.11 (0.50-2.46)	12.4%	1.60 (0.79-3.25)
School enrolment†									
Not enrolled	320	1.9%	1	5.3%	1	9.7%	1	10.6%	1
Enrolled	1055	0.3%	0.24 (0.05-1.05)	0.9%	**0.27 (0.10-0.64)***	2.6%	**0.37 (0.20-0.70)****	2.7%	**0.34 (0.20-0.60)****
School attendance‡									
Does not attend regularly	167	0.6%	1	2.4%	1	6.0%	1	6.6%	1
Attends regularly	263	0.4%	0.98 (0.05-18.0)	1.5%	0.77 (0.17-3.38)	3.4%	0.84 (0.32-2.23)	3.8%	0.81 (0.32-2.06)

AOR, age-adjusted odds ratio †Ages 15-18 years ‡ Ages 15-17 years N/A: No observations in comparison group *, **Significant at p<0.05, p<0.01

Table 5-4 Effects of parental loss and school enrolment on substance use in male adolescents aged 15-19 years

	N	Smoking cigarettes		Recreational drugs		Alcohol		Any substance use	
		%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)
Orphanhood									
Non-orphan	789	0.9%	1	2.8%	1	6.6%	1	6.6%	1
Maternal orphan	364	1.4%	1.7 (0.56-4.9)	4.9%	**1.9 (1.01-3.4)***	7.8%	1.2 (0.77-2.0)	8.5%	1.3 (0.84-2.1)
Paternal orphan	699	0.9%	0.77 (0.27-2.2)	3.6%	1.2 (0.64-2.1)	5.9%	0.77 (0.50-1.2)	6.6%	0.86 (0.57-1.3)
Double orphan	280	1.1%	1.1 (0.30-3.9)	5.4%	**2.0 (1.04-3.8)***	7.6%	1.1 (0.67-1.9)	8.6%	1.2 (0.76-2.0)
School enrolment†									
– All adolescents									
Not enrolled	320	1.9%	1	5.3%	1	9.7%	1	10.6%	1
Enrolled	1055	0.3%	0.25 (0.06-1.1)	0.9%	**0.26 (0.11-0.63)****	2.6%	**0.32 (0.18-0.57)*****	2.7%	**0.30 (0.17-0.53)*****
– Maternal orphans									
Not enrolled	89	2.2%	1	10.1%	1	11.5%	1	13.5%	1
Enrolled	226	0%	N/A	0.9%	**0.13 (0.02-0.72)***	3.1%	**0.30 (0.09-0.97)***	3.1%	**0.30 (0.10-0.91)***
– Paternal orphans									
Not enrolled	161	2.5%	1	8.1%	1	9.4%	1	11.2%	1
Enrolled	431	0%	N/A	0.7%	**0.15 (0.04-0.60)****	2.3%	**0.36 (0.15-0.90)***	2.3%	**0.32 (0.13-0.78)***
– Double orphans									
Not enrolled	71	1.4%	1	11.3%	1	11.4%	1	14.1%	1
Enrolled	169	0%	N/A	1.2%	**0.17 (0.03-0.95)***	3.6%	0.33 (0.09-1.2)	3.6%	0.32 (0.09-1.1)
School attendance‡									
– All adolescents									
Does not attend regularly	167	0.6%	1	2.4%	1	6.0%	1	6.6%	1
Attends regularly	263	0.4%	1.46 (0.11-18.8)	1.5%	0.56 (0.12-2.54)	3.4%	0.56 (0.23-1.34)	3.8%	0.52 (0.23-1.20)
– Maternal orphans									
Does not attend regularly	43	2.3%	1	7.0%	1	7.0%	1	9.3%	1
Attends regularly	55	0%	N/A	1.8%	0.78 (0.03-18.8)	5.5%	2.83 (0.25-31.5)	5.5%	2.34 (0.25-22.3)
– Paternal orphans									
Does not attend regularly	73	0%	1	2.7%	1	5.5%	1	6.8%	1
Attends regularly	104	0%	N/A	1.0%	0.46 (0.03-6.51)	3.8%	0.88 (0.18-4.26)	3.8%	0.81 (0.18-3.74)
– Double orphans									
Does not attend regularly	33	0%	1	6.1%	1	6.1%	1	9.1%	1
Attends regularly	35	0%	N/A	2.9%	0.60 (0.04-8.88)	8.6%	2.21 (0.21-23.8)	8.6%	1.89 (0.21-17.0)

AOR: odds ratios adjusted for age, site type, SES, and religion † Ages 15-18 years ‡ Ages 15-17 years N/A: No observations in comparison group
*, **, *** Significant at p<0.05, p<0.01, p<0.001

5.3.3 Orphanhood and HIV risk behaviours

For adolescent males, orphanhood was not associated with having started sex, early sexual debut, engaging in transactional sex, or condom use, but each form of orphanhood was associated with significantly higher numbers of non-regular partners in the last 30 days (Table 5-5). This effect was not statistically significant after adjusting for substance use. For females, maternal and paternal orphanhood was associated with increased odds of ever having had sex, and paternal orphans were more likely to report condom use at the last sexual encounter (Table 5-6). All effects remained after adjusting for substance use.

5.3.4 Substance use and HIV risk behaviours

Among adolescent men, I found positive associations between substance use and ever having had sex, early sexual debut, number of non-regular partners, and engaging in transactional sex (Table 5-5). No form of substance use was significantly associated with condom use. In females, recreational drug use was associated with a higher number of partners in the last month, while consuming alcohol and any form of substance use were associated with increased reporting of condom use (Table 5-6). The condom use findings are qualitatively different from the previous findings in that they are associations of substance use with protective behaviours as compared to substance use being associated with more risk. Care should be taken in this interpretation though, as condom use could be a marker of women who engage in transactional sex.

Table 5-5 Associations between orphanhood, substance use, school enrolment and sexual risk behaviours in male adolescents aged 15-19

	N	Condom use [a]		Number of partners [a]	Transactional sex [a]		Sex before the age of 15		Ever had sex	
		%	AOR (95% CI)	Change (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95%CI)
Smoking										
Non-smoker	1594	69.9%	1	0	3.2%	1	0.4%	1	5.9%	1
Smoker	15	80.0%	1.6 (0.24-10.4)	+1.2 (-1.2 – +3.7)	20.0%	**7.6 (1.1-52.3)***	6.7%	**11.5 (1.19-110)***	66.7%	**23.6 (7.0-79.3)*****
Drug use										
Does not use drugs	1555	68.4%	1	0	1.4%	1	0.4%	1	5.1%	1
Uses drugs	51	79.2%	1.4 (0.39-4.7)	+0.67 (-1.1 – +2.4)	16.7%	**18.6 (1.8-197)***	3.9%	5.07 (0.85-30.2)	47.1%	**8.0 (4.2-15.3)*****
Alcohol										
Does not drink	1502	64.5%	1	0	1.6%	1	0.2%	1	4.1%	1
Drinks	102	80.5%	2.9 (0.87-9.6)	**+1.6 (0.01-3.1)***	9.8%	6.6 (0.58-73.9)	4.9%	**17.4 (3.44-87.8)****	40.2%	**8.7 (5.2-14.5)*****
Any form of substance use										
No substance use	1501	64.5%	1	0	1.6%	1	0.2%	1	4.1%	1
Substance use	108	80.5%	2.9 (0.87-9.6)	**+1.6 (0.01-3.1)***	9.8%	6.6 (0.58-73.9)	4.6%	**16.2 (3.23-81.5)****	38.0%	**8.0 (4.8-13.4)*****
Orphanhood										
Non-orphan	789	71.1%	1	0	2.2%	1	0.5%	1	5.7%	1
Maternal orphan	364	73.1%	0.81 (0.25-2.6)	**+1.4 (0.50-4.4)***	11.5%	5.4 (0.69-42.3)	0.5%	1.04 (0.21-5.24)	7.1%	1.1 (0.70-1.9)
Paternal orphan	699	67.3%	0.73 (0.27-2.0)	**+1.9 (0.01-3.7)***	5.8%	1.0 (0.15-6.8)	0.6%	1.06 (0.26-4.28)	7.4%	1.3 (0.82-2.0)
Double orphan	280	68.1%	0.50 (0.14-1.8)	**+2.5 (0.51-4.6)***	9.1%	2.3 (0.26-20.6)	0.7%	1.39 (0.28-7.01)	7.9%	1.3 (0.76-2.2)
School enrolment[†]										
Not enrolled	320	82.8%	1	0	2.9%	1	0.6%	1	11.0%	1
Enrolled	1055	61.9%	0.30 (0.06-1.57)	-1.20 (-3.32 – +0.9)	4.8%	1.08 (0.05-22.0)	0.3%	0.93 (0.13-6.52)	2.0%	**0.35 (0.19-0.64)*****
School attendance[‡]										
Does not attend regularly	167	77.7%	1	0	0%	1	1.2%	1	5.5%	1
Attends regularly	263	0%	N/A	+1.50 (-48.9 – +51.2)	0%	N/A	0.4%	0.74 (0.05-10.5)	0.4%	0.13 (0.01-1.23)
After additional adjustment for substance use										
Orphanhood										
Non-orphan	789	71.1%	1	0	2.2%	1	0.5%	1	5.7%	1
Maternal orphan	364	73.1%	0.67 (0.19-2.3)	+1.3 (-0.37 – +3.0)	11.5%	4.3 (0.54-34.0)	0.5%	0.95 (0.18-5.08)	7.1%	1.0 (0.61-1.7)
Paternal orphan	699	67.3%	0.85 (0.31-2.4)	-0.1 (-1.5 – +1.4)	5.8%	1.2 (0.16-8.5)	0.6%	1.20 (0.29-5.04)	7.4%	1.4 (0.87-2.2)
Double orphan	280	68.1%	0.45 (0.12-1.7)	+1.7 (-0.08 – +3.5)	9.1%	1.7 (0.2-14.7)	0.7%	1.32 (0.24-7.36)	7.9%	1.3 (0.72-2.2)
School enrolment[†]										
Not enrolled	320	82.8%	1	0	2.9%	1	0.6%	1	11.0%	1
Enrolled	1055	61.9%	0.31 (0.06-1.63)	-1.15 (-3.02 – +0.90)	4.8%	1.33 (0.05-32.2)	0.3%	1.97 (0.23-16.6)	2.0%	**0.45 (0.24-0.86)***
School attendance[‡]										
Does not attend regularly	167	77.7%	1	0	0%	1	1.2%	1	5.5%	1
Attends regularly	263	0%	N/A	+5.50 (-57.7 – +58.7)	0%	N/A	0.4%	0.79 (0.04-17.0)	0.4%	0.10 (0.01-1.03)

AOR: Odds ratios adjusted for age, gender, community type, SES, and religion [†] Ages 15-18 years [‡] Ages 15-17 years

[a] Among sexually active adolescents (N=103) *, **, *** significant at p<0.05, p<0.01, p<0.001

Table 5-6 Associations between orphanhood, substance use, school enrolment and sexual risk behaviours in female adolescents aged 15-19

	N	Condom use [a]		Number of partners [a]	Transactional sex [a]		Sex before the age of 15		Ever had sex	
		%	AOR (95% CI)	Change (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95%CI)
Smoking										
Non-smoker	1662	9.7%	1	0	2.5%	1	2.2%	1	24.4%	1
Smoker	2	0%	N/A	+0.75 (-0.22 – +1.72)	0%	N/A	0%	N/A	50%	7.27 (0.45-118)
Drug use										
Does not use drugs	1656	9.5%	1	0	2.5%	1	2.2%	1	24.3%	1
Uses drugs	6	50.0%	8.47 (0.48-151)	**+0.79 (0.11-1.48)***	0%	N/A	0%	N/A	33.3%	3.69 (0.52-26.4)
Alcohol										
Does not drink	1643	9.3%	1	0	2.5%	1	2.2%	1	24.3%	1
Drinks	12	50.0%	**16.2 (1.80-146)***	+0.06 (-0.44 – +0.55)	0%	N/A	0%	N/A	33.3%	1.70 (0.43-6.69)
Any form of substance use										
No substance use	1649	9.3%	1	0	2.5%	1	2.2%	1	24.3%	1
Substance use	15	40.0%	**8.71 (1.20-63.2)***	+0.19 (-0.25 – +0.64)	0%	N/A	0%	N/A	33.3%	2.18 (0.63-7.53)
Orphanhood										
Non-orphan	818	6.5%	1	0	1.8%	1	2.0%	1	20.7%	1
Maternal orphan	365	8.9%	0.90 (0.40-2.00)	-0.04 (-0.15 – +0.07)	0%	N/A	2.7%	1.45 (0.68-3.09)	27.7%	**1.41 (1.03-1.94)***
Paternal orphan	699	12.2%	**2.23 (1.07-4.67)***	-0.03 (-0.12 – +0.07)	3.6%	2.60 (0.62-10.9)	2.1%	1.03 (0.52-2.05)	28.0%	**1.36 (1.03-1.78)***
Double orphan	259	12.1%	1.45 (0.61-3.44)	-0.01 (-0.13 – +0.13)	0%	N/A	2.3%	1.14 (0.46-2.81)	25.5%	1.06 (0.73-1.53)
School enrolment [†]										
Not enrolled	493	8.2%	1	0	3.3%	1	5.7%	1	49.1%	1
Enrolled	934	22.2%	3.19 (0.57-17.7)	+0.20 (-0.08- +0.48)	10.0%	4.38 (0.38-50.3)	0.1%	**0.01 (0.001-0.05)*****	1.1%	**0.02 (0.01-0.03)*****
School attendance [‡]										
Does not attend regularly	272	7.8%	1	0	3.5%	1	8.1%	1	42.3%	1
Attends regularly	251	0%	N/A	+0.64 (-0.33 – +1.62)	0%	N/A	0%	N/A	0.4%	**0.01 (0.001-0.05)*****
After additional adjustment for substance use										
Orphanhood										
Non-orphan	818	6.5%	1	0	1.8%	1	2.0%	1	20.7%	1
Maternal orphan	365	8.9%	0.93 (0.41-2.06)	-0.04 (-0.15 –+0.07)	0%	N/A [b]	2.7%	N/A [b]	27.7%	**1.42 (1.03-1.95)***
Paternal orphan	699	12.2%	**2.24 (1.10-4.96)***	-0.03 (-0.12 – +0.07)	3.6%	N/A [b]	2.1%	N/A [b]	28.0%	**1.36 (1.03-1.78)***
Double orphan	259	12.1%	1.47 (0.61-3.51)	-0.01 (-0.13 – +0.12)	0%	N/A [b]	2.3%	N/A [b]	25.5%	1.06 (0.74-1.54)
School enrolment [†]										
Not enrolled	493	8.2%	1	0	3.3%	1	5.7%	1	49.1%	1
Enrolled	934	22.2%	3.18 (0.57-17.7)	+0.20 (-0.08- +0.48)	10.0%	N/A [b]	0.1%	N/A [b]	1.1%	**0.02 (0.01-0.03)*****
School attendance [‡]										
Does not attend regularly	272	7.8%	1	0	3.5%	1	8.1%	1	42.3%	1
Attends regularly	251	0%	N/A	+0.64 (-0.34 – +1.62)	0%	N/A	0%	N/A	0.4%	**0.01 (0.001-0.05)*****

AOR: Odds ratios adjusted for age, gender, community type, SES, and religion [†] Ages 15-18 years [‡] Ages 15-18 years [a] Among sexually active adolescents (N=405)

*, **, *** significant at p<0.05, p<0.01, p<0.001 [b] No participants who reported substance use had the outcome, making it impossible to adjust for substance use

5.3.5 Substance use and HIV risk behaviours among orphans

There were only 60 orphans who reported any form of HIV risk behaviour and therefore when testing to determine if there were any associations between substance use, education and sexual risk behaviours among orphans, I did not stratify the analyses by orphanhood type or the different types of substance use.

Among male orphans, substance use was associated with increased odds of early sexual debut and ever having had sex, but not transactional sex, condom use, or the number of partners in the last month (Table 5-7). In female orphans, substance use was not associated with any sexual risk behaviours (Table 5-8), although in all females adolescents substance use was associated with increased odds of condom use (Table 5-6).

Table 5-7 Associations between substance use, school enrolment and sexual risk behaviours in male orphans aged 15-19

	N	Condom use [a]		Number of partners [a]	Transactional sex [a]		Sex before the age of 15		Ever had sex	
		%	AOR (95% CI)	Change (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95%CI)
Any form of substance use										
No substance use	730	60.0%	1	0	0%	1	0.3%	1	4.8%	1
Substance use	53	85.7%	3.69 (0.70-19.5)	+1.35 (-0.55 – +3.25)	19.0%	N/A	3.8%	**12.9 (1.25-133)***	39.6%	**6.97 (3.40-14.3)*****
School enrolment [†]										
Not enrolled	179	87.5%	1	0	4.2%	1	1.1%	1	13.5%	1
Enrolled	488	37.5%	**0.03 (0.01-0.63)***	-0.39 (-4.33 – +3.57)	0%	N/A	0.2%	0.20 (0.01-2.74)	1.6%	**0.18 (0.07-0.45)*****
School attendance [‡]										
Does not attend regularly	83	77.8%	1	0	0%	1	2.4%	1	11.0%	1
Attends regularly	124	0%	N/A	-0.29 (-3.85 – +3.28)	0%	N/A	0.8%	0.33 (0.03-3.65)	0.8%	**0.08 (0.01-0.87)***
After additional adjustment for substance use										
School enrolment [†]										
Not enrolled	179	87.5%	1	0	4.2%	1	1.1%	1	13.5%	1
Enrolled	488	37.5%	**0.11 (0.01-0.76)***	-0.15 (-4.08 – +3.78)	0%	N/A	0.2%	0.43 (0.02-7.63)	1.6%	**0.21 (0.08-0.54)****
School attendance [‡]										
Does not attend regularly	83	77.8%	1	0	0%	1	2.4%	1	11.0%	1
Attends regularly	124	0%	N/A	-0.01 (-4.53 – +4.53)	0%	N/A	0.8%	0.51 (0.04-6.67)	0.8%	**0.07 (0.01-0.89)***

AOR: Odds ratios adjusted for age, gender, community type, and SES [†] Ages 15-18 years [‡] Ages 15-17 years

[a] Among sexually active orphaned adolescents (N=56) *, **, *** significant at p<0.05, p<0.01, p<0.001

Table 5-8 Associations between substance use, school enrolment and sexual risk behaviours in female orphans aged 15-19

	N	Condom use [a]		Number of partners [a]	Transactional sex [a]		Sex before the age of 15		Ever had sex	
		%	AOR (95% CI)	Change (95% CI)	%	AOR (95% CI)	%	AOR (95% CI)	%	AOR (95%CI)
Any form of substance use										
No substance use	798	10.5%	1	0	3.1%	1	2.4%	1	28.7%	1
Substance use	7	50.0%	17.7 (0.76-412)	+0.34 (-0.37 – +1.04)	0%	N/A	0%	N/A	28.6%	1.46 (0.21-10.0)
School enrolment [†]										
Not enrolled	262	9.0%	1	0	3.5%	1	6.1%	1	55.0%	1
Enrolled	422	50.0%	9.33 (0.97-90.0)	+0.06 (-0.39 – +0.51)	25.0%	8.95 (0.64-125)	0%	N/A	0.9%	**0.01 (0.003-0.03)** ***
School attendance [‡]										
Does not attend regularly	141	5.8%	N/A	N/A	5.8%	N/A	8.5%	1	48.9%	1
Attends regularly	104	0%			0%		0%	N/A	0%	N/A
After additional adjustment for substance use										
School enrolment [†]										
Not enrolled	262	9.0%	1	0	3.5%	1	6.1%	1	55.0%	1
Enrolled	422	50.0%	9.33 (0.97-90.0)	+0.06 (-0.38 – +0.51)	25.0%	N/A [b]	0%	N/A	0.9%	**0.01 (0.003-0.03)** ***
School attendance [‡]										
Does not attend regularly	141	5.8%	N/A	N/A	5.8%	N/A	8.5%	1	48.9%	1
Attends regularly	104	0%			0%		0%	N/A	0%	N/A

AOR: Odds ratios adjusted for age, gender, community type, and SES [†] Ages 15-18 years [‡] Ages 15-18 years *** significant at p<0.001

[a] Among sexually active orphaned adolescents (N=231)

[b] No participants who reported substance use had the outcome, making it impossible to adjust for substance use

5.3.6 Education and substance use

Adolescent males who were enrolled in school were less likely to report taking recreational drugs (OR: 0.27; 95% CI: 0.1-0.64), drinking alcohol (OR 0.37; 95% CI: 0.2-0.7), and engaging in any sexual risk behaviour (OR 0.34; 95% CI: 0.2-0.6) (Table 5-3) than unenrolled males when adjusting for age. These associations remained after adjusting for socio-demographic factors (Table 5-4). Additionally, school enrolment was associated with significantly lower levels of overall substance use for male orphans (AOR=0.32, 95% CI, 0.14-0.75) and for each individual form of orphanhood (Table 5-4). Similar patterns of effects were found for recreational drugs and for alcohol (Table 5-4 & Figure 5-3) but not for smoking cigarettes. Regular attendance had no significant associations with any forms of substance either for males overall or for male orphans. Due to the low levels of substance use among females (<1%), I was unable to examine associations between either school enrolment or attendance and the different forms of substance use in females.

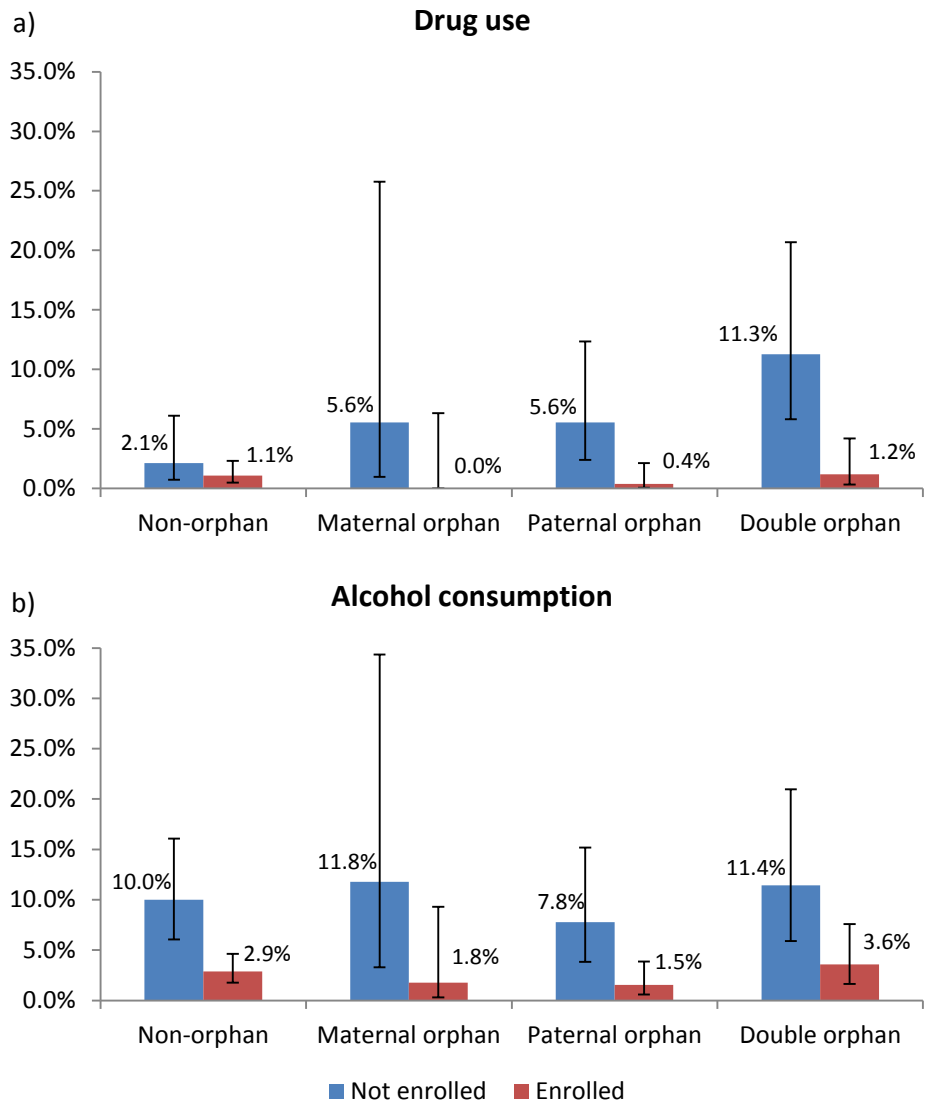

Figure 5-3 Drug use (a) and alcohol consumption (b) in male orphans and non-orphans under age 19 by school enrolment status.

5.3.7 Education and sexual risk behaviours

For males, school enrolment, but not regular attendance, was negatively associated with ever having had sex. The statistical significance of this association decreased ($p<0.001$ vs $p=0.02$) after adjusting for substance use, although the effect size did not differ greatly (Table 5-5). The associations between school enrolment and starting sex also held true among male orphans (before adjustment for substance use: 0.18, 95% CI: 0.07-0.45, $p<0.001$; after adjustment: 0.21, 95% CI: 0.08-0.54, $p<0.01$, Table 5-7). Additionally, school enrolment was associated with decreased odds of condom use in male orphans, but this analysis included only 28 observations due to the low number of male orphans aged 15-18 who had ever had sex (N=32) and, as such, the analysis is underpowered. No such association was observed in the analysis including all males.

Among females, school enrolment was associated with decreased odds of early sexual debut and ever having had sex, and this relationship did not change after adjusting for substance use (Table 5-6). Similarly, regular school attendance was negatively associated with ever having had sex and again that association did not change after adjusting for substance use (Table 5-6). Due to the low numbers of female orphans who had had sex or reported substance use, it was only possible to detect an association between school enrolment and ever having had sex (Table 5-8).

5.4 Discussion

In this chapter I have characterised substance use among adolescents aged 15-19 years in eastern Zimbabwe, a context in which the HIV epidemic has increased the levels of orphanhood and social vulnerability [54,55,140,181], and investigated whether reductions in substance use might partially explain the relationship between school enrolment and reduced HIV risk. Addressing the objectives of this chapter:

1) In Zimbabwe, substance use is more common among male than female adolescents (6.7% vs. 0.9%), with the most common form being alcohol (3.5%) followed by recreational drugs (1.7%), and cigarettes (0.5%).

2)

   i. In males, all forms of orphanhood were associated with a higher average number of partners in the last month. In females, maternal and paternal orphans were more likely to report ever having had sex.

   ii. Female orphans were not more likely to report substance use than non-vulnerable children, but male maternal and double orphans were more likely to report recreational drug use.

   iii. In males, various forms of substance use were associated with a number of sexual risk behaviours. In females, the associations were fewer and only recreational drug use was associated with a higher number of partners, while alcohol use and overall substance use were associated with an increased likelihood of condom use.

3) In males, school enrolment was associated with lower levels of recreational drug use, alcohol use, and substance use overall in all adolescents as well as maternal and paternal orphans. Among females there were no significant associations between school enrolment and any form of substance use. There were no significant associations between attendance and substance use in males or females.

4) In males, school enrolment was associated with ever having had sex, and this association decreased in significance after adjusting for substance use, suggesting a potential mediating effect, even if the effect size did not change significantly. In

females, school enrolment and regular attendance were associated with decreased odds of early sexual debut and ever having had sex, but this relationship did not appear to be mediated by substance use.

5.4.1 Demographic profile of substance use

I found that substance use was almost exclusively confined to young men (6.7% in males vs. 0.9% in females, p<0.001). In both males and females, alcohol consumption was the most common form of substance use (6.4% and 0.7%), followed by recreational drugs (3.2% and 0.4%), and smoking cigarettes (0.9% and 0.1%). These patterns are similar to those reported in a study of 15 year-old in-school adolescents in Harare, Bulawayo and Manicaland, conducted in 2003 – alcohol use was most common (males 18.1% and females 14.5%), followed by drugs (15.4% and 11.1%), and then smoking (14.5% and 5.6%) [245]. Despite the similar pattern, these results were very different in terms of substance use being observed in both men and women, as compared to substance use in Manicaland being almost exclusively in males. Higher levels of substance use found in the earlier study may be due to the inclusion of large cities, reductions in substance use over time, the economic crisis affecting the availability and affordability of illicit drugs, or differences in reporting.

It is encouraging that levels of substance use are relatively low in this population, well below 10% overall, and less than 1% in women. In addition to the implications of substance use that I am exploring in this chapter, substance use has also been linked with psychological issues [246] and medical problems (*e.g.* liver failure and lung cancer, among many others), making it encouraging that the prevalence is so low here. Substance use is also known to be less common in women, possibly because they are less prone to risk-seeking behaviours than men or because it is more of a social taboo [247]. The social taboo is particularly common in Zimbabwe in regards to alcohol, where it is generally only men who will go out and drink at beer halls, with a frequent assumption being that women in beer halls are sex workers [248].

Regardless of the reasons for the low prevalence of substance use, and the encouraging implications that is has, there still remains a need to investigate what the correlates and consequences of substance use are in this population.

5.4.2 Orphanhood and increased odds of substance use

Male maternal and double orphans were more likely than non-orphans to take recreational drugs. To my knowledge, this is the first study to document an enhanced risk of drug use among orphans in Zimbabwe. The findings are roughly consistent with data from South Africa, where males who were paternal or double orphans were more likely to have consumed alcohol, and females who were paternal orphans were more likely to have taken drugs[62]. Orphans may be more likely than other adolescents to engage in substance use because parental death often leaves them with fewer physical, financial, and emotional resources [39,42,62]. Stress, anxiety, feelings of isolation, lack of support, and absence of role models, may all occur with the loss of a parent [63], and can influence risk behaviours in adolescents [64,65]. Although it is not clear why there were differing risks between male and female orphans, these differences are not unprecedented, with similar results having been reported in South Africa [62]. A likely possibility is that due to the fact that very few women (<1%) reported any substance use behaviours, the study did not have sufficient power to detect a difference between sub-groups of women.

5.4.3 Factors associated with increased sexual risk behaviours

My findings of associations between substance use and increased HIV risk behaviours, such as sexual debut, multiple sexual partners, and unprotected sex [248-255], are consistent with studies from the USA, the UK, and Asia [256-259]; however, data from populations in SSA are scarce, with most studies focusing on associations with alcohol use [260,261] and few studies of adolescents. In other settings, research suggests that substance use may lead to increased sexual risk behaviours for HIV infection due to the social context and consequences of

substance use which facilitate unprotected sex. Physiological effects of substance use on decision-making [262-264], altered expectations of condom use when using substances [265,266], and certain personality types being more likely to engage in all forms of risky behaviours [267-269] may increase the likelihood of risky sex and therefore HIV infection.

My results also suggest that substance use could be on the causal pathway between orphanhood and increased risk of HIV acquisition for male adolescents (see Figure 5-3 for proposed pathway). The statistically significant association between orphanhood and higher numbers of sexual partners disappeared after adjusting for substance use, implying that substance use may be a mediating factor in the relationship between orphanhood and sexual risk behaviours in males. Contrary to the findings in males, it does not appear that substance use is a mediating factor between orphanhood and HIV risk behaviours in females, as the relationship between orphanhood and sexual risk behaviours did not change after adjusting for substance use. It is almost certain that this is due to the low prevalence of substance use in females in the study.

Understanding what behaviours and vulnerabilities are associated with different sexual practices is important because there is consistent evidence for certain sexual risk behaviours (*e.g.* early sexual debut [270,271]) having an association with HIV acquisition. More important, however, is understanding ways in which these vulnerabilities can be mitigated and the risk of HIV infection decreased.

5.4.4 The potential mediating role of education

My results indicate that school enrolment may mediate the relationship between parental loss, substance use, and sexual risk behaviours for HIV infection. Among male adolescent orphans, I found that school enrolment was negatively associated with taking drugs, drinking alcohol, and a combined measure that represented any form of substance use. These

results are consistent with studies in the United States [272] and in South Africa [62,273] and are plausible because school enrolment increases connectedness in the form of bonds with teachers and peers [273,274], whilst not being enrolled in school can alter how and where peer relationships are formed, with friendships coming from higher-risk groups and settings rather than from within a protective school environment [62]. However, I also found that, whilst school enrolment was associated with decreased likelihood of sexual debut, this effect weakened (from $p<0.001$ to $p=0.02$) when substance use was adjusted for, providing evidence that substance use is on the causal pathway between education and sexual risk behaviour. Thus, I have elucidated, at least for males, a possible mechanism through which school enrolment could reduce risky sexual behaviour in this population. Although this is cross-sectional data, previous randomised trials in similar settings (Kenya and Malawi) have identified a causal link between education and risky sex, supporting the inferences I make here [275,276].

5.4.5 Marriage as an underlying factor of condom use in females

Although I have discussed the gender disparities in my analyses as I have gone along, I have not yet discussed the implications of higher marital rates in females versus males. In this population, females aged 15-19 were over 34 times as likely as males to be married or in a long-term partnership (20.4% vs. 0.7%). The gender disparity in marriage is not unexpected as it common for women to marry at an earlier age than men, with the average at marriage being 19.7 for women versus 24.7 for men in Zimbabwe [59].

The gender disparity in marriage also accounts for a large part of the gender disparity in other measures of sexual behaviour that I have discussed. On the surface it appeared as if young women were engaging in greater HIV risk behaviours than their male counterparts, but much of these disparities are due to marital status. Among women, those who were married formed the great majority of those who had already had sex, who had early sexual debut, and who did not use condoms. It is well established that individuals in stable

monogamous partnerships are less likely to use condoms [277,278] and my data conforms to this assumption with condom use among people in stable partnerships being far lower than for those who were single. Furthermore, when I examined condom use in married individuals, there was no significant difference between males and females.

These associations of marriage and condom use are important as I found alcohol and overall substance use to be associated with an increased likelihood of condom use in females. Although perhaps counterintuitive at first inspection, the increase in condom use may be due to an increase in casual sexual partnerships that single women form. Single women, possibly sex workers [248], may also be more likely to frequent beer halls than married women, although I could not say this from the data due to the low reporting of substance use in women. If these two factors are the case then it would imply that although single women drink more, they are also, to some extent, being sexually responsible and protecting themselves during sexual encounters with non-regular partners [279].

5.4.6 Correlation vs. causation and other limitations of the work

The study is limited by the use of cross-sectional data, limiting the causal inferences that can be drawn from the observed associations. Although previous work has examined the effect of substance use on educational attainment [280-282], a literature review on pathways to substance use in adolescents in Canada highlighted academic underachievement and poor attendance as two factors leading to substance use in teenagers [283], supporting the causal hypothesis that I propose here. Moreover, much of the work examining the effects of substance use on educational attainment was done in college students [281], or has focussed on an early age at first drinking, both of which are age-related factors that could reverse the true causality [280,282]. Further supporting the case for substance use influencing sexual behaviour and not the reverse is previous work showing that substance use is typically initiated before sexual debut occurs [258].

Another weakness of this work is the reliance on self-reported measures, which may have been subject to social desirability bias and could have resulted in under-reporting of both substance use and sexual risk behaviours. Under-reporting of sensitive information is common [183], but it is unlikely that there would be a directional effect that would have influenced the relationships I observed.

In the causal pathway diagram (Figure 5-1), I have included a (potential) direct link between substance use and HIV infection because injecting drug use is an important HIV risk in some populations and could be influenced by orphanhood and education, among other factors. Because of the low injecting drug use in Manicaland, coupled with the finding of overall low prevalence of drug use, it is unlikely to be a major factor in rural eastern Zimbabwe.

Finally, the study was limited by the low prevalence of certain risk behaviours (*e.g.* smoking), particularly among women, making it difficult to properly assess associations in these groups. I have noted and discussed the low prevalence of substance use in women throughout this chapter and although it is encouraging that substance use is so uncommon, it has limited my ability to draw meaningful conclusions in women.

5.4.7 Implications for interventions that affect school attendance

Currently, there is growing interest in providing cash transfers (CTs) to at-risk population groups, including OVCs, as a tool for HIV prevention [284]. In particular, the focus has been on using CTs to keep adolescents in school, acting as a form of 'social vaccine' against HIV infection [112]. Cash transfer programmes have been shown to have positive effects on a range of education and health outcomes [285,286], including HIV risk and poor school attendance amongst adolescents [112,244,275]. A randomized controlled trial of CTs to girls in Malawi that were conditional on school enrolment found a decrease in the prevalence of HIV and HSV-2 [275]. Much of the focus of these CT programmes has been on their effects in

females, with less attention paid to males [112,244,275,284-287]. Although girls are typically viewed to be educationally disadvantaged as compared to boys [81], there is no reason why boys could not benefit from CTs and the protective effects of education on HIV.

The work conducted in this chapter provides interesting suggestions towards a potential mechanism through which CTs might decrease the risk of HIV in vulnerable adolescents. Trials examining the effects of CTs, have shown an increase in various education measures [230,275,288] and reductions in sexual risk behaviour including decreases in ages of sexual debut [270] and marriage [288], decreased frequency of sexual activity [275,287], a smaller age gap between the participants and their sexual partners [275,287], and decreased likelihood of being infected with HIV and HSV-2 [275]. Despite these linkages, no previous studies have explicitly made the connection between education, substance use, and sexual risk behaviours, as I have done here. Therefore I propose a potential mechanism through which schooling can decrease risky sexual behaviours in males: by reducing alcohol and drug use, which has, in turn, been tied to risky sexual behaviours.

Future work should build on these findings and investigate the role of education and schools as a protective factor not only against HIV infection, but also against substance use. Moreover, although the focus of CT trials has been on their positive effects for women, I have shown here that there is no reason that CTs that can effectively increase education outcomes among men cannot also decrease their HIV risk.

Interestingly, I did not find the same associations for women as I did for men, suggesting that substance use might not be the mechanism through which CTs decrease HIV risk in females. Exactly how CTs, and other interventions that increase education, work is unknown, but previous work into education and HIV risk has suggested that education provides females with a sense of agency and that the financial benefits of education make them less reliant on male partners [117,244,270].

Overall, and in males, I found school enrolment to be significantly associated with lower substance use, and substance use to be associated with higher HIV risk behaviours. This suggests that, at least in males, the effect of CTs on school enrolment and HIV risk could be partially explained by lower levels of substance use. Much of the research about CTs and HIV has been focussed on adolescent women [112,244,275,284-287], who reported low levels of substance use here, but my work suggests that CTs could also have a positive impact for adolescent men.

The key findings and conclusions of this chapter are:

1) Overall levels of substance use are low in adolescents aged 15-19 living in eastern Zimbabwe, although levels in males are much higher than those in females.

2) Male orphans were more likely to report using recreational drugs and had a higher number of sexual partners in the last month than non-orphans, suggesting an increased vulnerability in this group.

3) School enrolment was consistently associated with lower levels of substance use in males, which, regardless of any associations with HIV risk, is an encouraging finding that may indicate another way in which education is beneficial.

4) School enrolment was also associated with decreased odds of ever having had sex among males. When this association was adjusted for substance use, the relationship weakened, suggesting that the decreases in substance use associated with education are partially, but not wholly, responsible for the negative association of education with sexual activity.

5) Among females, levels of substance use were very low; however, school enrolment and attendance were associated with decreased odds of early sexual debut. Although substance use was not identified as a mediating factor in this analysis, the finding that education can protect girls from risky sexual behaviours is a welcome one and reinforces earlier work from SSA.

6) HIV prevention programmes for adolescents should recognize that substance use may be an important indicator of HIV risk in male orphans due to its association with risky sexual behaviours.

Having established the potential link between education and decreased risk factors for HIV, it is important to understand ways in which education can be improved for children in general, but also specifically for vulnerable children living in high HIV prevalence settings. Recent studies have shown that CT programmes, in particular, can be an effective means of promoting education [230,231]. However, cash transfer programmes may not be the only option for supporting the educational outcomes of vulnerable children. In Chapter 6, I will examine and discuss how schools may be able to support children made vulnerable by HIV/AIDS.

6 School quality and the wellbeing of children affected by HIV

6.1 Introduction

Children affected by HIV (orphaned children, children with HIV-positive parents, and HIV-positive children) can be particularly vulnerable to stigma, abuse, poor nutrition, poor mental and physical health, and poverty [39,48]. Households affected by AIDS are economically disadvantaged by the cost of medical care and the loss of income from ill or deceased adult members [48]. All of these factors form barriers to education for children. One of the most visible effects of the HIV epidemic has been a decline in school enrolment, attendance, and academic progress [79,289], which I have reported in my thesis, particularly among females. Education is a vital pillar of socio-economic development, with previous research suggesting that it helps to support children by buffering the impacts of poverty, trauma, abuse, social isolation and discrimination on children's mental and physical health [104,145,290-293], rendering it important to support children's education in any way possible.

In this chapter, I therefore wish to examine the possibility of schools supporting vulnerable children by assessing the relationship between school quality, education outcomes, and child wellbeing. The role of schools in supporting children, and HIV-affected children in particular, is reminiscent of Jonathan Mann's insistence on a human rights approach to tackling HIV. As seen through a public health lens, Mann proposes that human rights provide a better guide for identifying, analysing and responding to societal conditions than biomedical frameworks, a point that may be lost somewhat amid the current focus on biomedical approaches to HIV prevention such as ART and male circumcision [294]. Thus, promoting and protecting health depends not only upon the biomedical, but also upon the promotion and protection of human rights and dignity [294]. Schools, with their direct and sustained contact with children during their formative years, are ideally placed to fulfil this

role for children. Indeed, previous work has shown that a holistic, rights-based approach to education can successfully promote education in OVC [145]. To test the theory that 'HIV competent schools' can improve wellbeing requires a measure of child wellbeing. Recently, there has been growing interest in monitoring wellbeing among children and adolescents as an important part of national wellbeing programmes. This has brought on an increasing awareness that separate measures of wellbeing are required for children and adolescents as compared to adults, which need to incorporate the perspectives of youth themselves. This approach reflects the fundamental rights of children by giving them ownership of their own lives and may allow for better informed policymaking and child advocacy [295-297].

The United Nations Convention on the Rights of the Child (UNCRC) stated that "the primary consideration in all actions concerning children must be in their best interest and their views must be taken into account" [298]. From a policy and development perspective, this shifted thinking towards treating youth as social actors rather than merely objects of policy making or research subjects. The UNCRC also signalled a move towards incorporating measures of wellbeing that could capture young people's own perspectives and views on wellbeing, rather than those of their guardians. This has paralleled a broader shift beyond focusing on basic needs and survival indicators for children, to trying to capture quality of life issues that incorporate more positive measures [296].

In this new paradigm of child wellbeing, schools seem well placed to improve the wellbeing of children, and vulnerable children in particular, as they can play a general social development role by buffering the inter-linked impacts of poverty, abuse, trauma, time poverty (due to household responsibilities, particularly for girls), social isolation, and discrimination on children's mental and physical health [104,145,290-293]. It is therefore important to understand to what extent schools can play a role in child wellbeing.

Little is known on how exactly schools may influence child wellbeing, but it is possible that they operate, even unknowingly, under the framework of 'HIV-competence', which was first outlined by Campbell *et al.* (2007) [126] and Nhamo, Campbell, and Gregson (2010) [125,299]. The framework of HIV-competence theorises that even in conditions of poverty, communities have 'portfolios of assets', such as labour (*e.g.* women working), housing (*e.g.* renting out rooms and home-based enterprises), informal credit arrangements (*e.g.* borrowing money from friends and neighbours), and household relations (*e.g.* increased reliance on family support networks). These assets also include social capital in the form of community networks [300,301], of which schools are one. HIV-competent communities are theorised as an environment in which people work collectively to reduce stigma, promote positive behaviour change and support the care and treatment of people infected or affected by HIV [125,299]. An HIV-competent community is a context that facilitates access to health-based knowledge and life skills, instils a sense of confidence in an individual's ability to ensure their own health and wellbeing, provides safe spaces in which to discuss and debate how to translate knowledge and skills into action, encourages strong and supportive relationships within the community, and bridges access to additional support networks in the public or non-governmental organisation (NGO) sector [52,125,126]. It is possible for schools to provide these same resources, but tailored to their environment and geared towards supporting children and their wellbeing. Thus, the concept of HIV-competent schools fits well with a child/human rights approach to health.

The objectives of this chapter are to:

1) Develop an index of child wellbeing using data from responses collected in the child questionnaire from round five of the Manicaland Survey

2) Evaluate whether regular school attendance is associated with higher child wellbeing.

3) Develop two composite indicators of school quality (based on the concept of HIV-competence developed in the work of Campbell *et al.* [125,299] in South African communities) – one measuring general school characteristics (physical infrastructure, staffing and teaching, fee support), and one measuring HIV-specific characteristics (HIV policies, awareness, and curriculum).

4) Investigate how these indices of school quality are related to education outcomes in all vulnerable children and in orphans in particular.

5) Determine if school quality is associated with child wellbeing and whether school quality provides particular benefit for children affected by HIV/AIDS and for orphans in particular.

6.2 Methods

6.2.1 Data Sources

For this chapter, I analysed individual data collected from children aged 6 to 17 years in round five (2009-2011) of the Manicaland Survey. In parallel to round five (2009-2011) of the main study, a monitoring and evaluation (M&E) facility survey collected information about health facilities and schools in each community, including 28 primary schools and 18 secondary schools. Information was collected during a face-to-face interview with the school headmaster using a structured questionnaire. The survey included questions on physical infrastructure, number of staff and students, fees, HIV policies, teaching methods, student engagement, and community links. The number of children from each village in the school's catchment area was also collected.

6.2.2 Measuring child wellbeing

Individual child wellbeing was calculated using a relative objective micro-level index based on existing indices of wellbeing [302-307] and using data available from round five of the Manicaland HIV/STD Prevention Project survey. Previously developed indices could not be used to measure wellbeing as I was constrained to using questions already present in the Manicaland questionnaire, and although many domains overlapped, identical questions were not present. Moreover, domains were selected based on factors that schooling could potentially impact. For example, missing breakfast was included as some schools offer school feeding programmes, which provide breakfast to either all of their pupils or to those who come from vulnerable households [308-312]. Not all items included in the indices were those that schools were likely to impact positively; factors such as common infections are more likely to occur among children attending school as this exposes them to more pathogens [313-316]. Certain items common to other indices (*e.g.* household SES, housing, and parental unemployment) were excluded as they were unlikely to be things on which school could have an influence. HIV status was also excluded as it was one of the forms of vulnerability for which wellbeing was compared. Education is a common component of existing wellbeing indices [296,302-306], but as I was investigating the relationship between education and wellbeing, I omitted it from my index. In choosing the domains and elements that I did, I sought to include direct rather than indirect measures of wellbeing; to make the child, rather than their family or household, the unit of interest, and to use indicators of present rather than future wellbeing.

The final index contains multiple domains to capture overall quality of life, because wellbeing seeks to represent an overall measure of quality of life, which is reliant on multiple factors [303,304,306]. Therefore, the developed index seeks to represent multiple complementary domains of children's lives. Domains included in the index for primary school children were

health behaviours, physical health, risk and safety, psychological health, and household resources (Figure 6-1). Domains for secondary school-age children were the same as primary school-age children, with the addition of a social wellbeing domain, for which no data was collected in younger children (Figure 6-1). Principal components analysis, a type of factor analysis, was used to integrate the variables in each domain together to obtain a score for each child in that domain. The final score, which centres on a mean of zero and theoretically ranges from negative one to plus one, is a weighted average of the different components that takes into account the variability and dependencies in the data [317,318]. The ade4 package in R was used to conduct this analysis. The output of this analysis was exported into Stata, where the scores for each domain were averaged to create an overall wellbeing score for each child, which was then scaled to be between 0 and 100 for ease of interpretation.

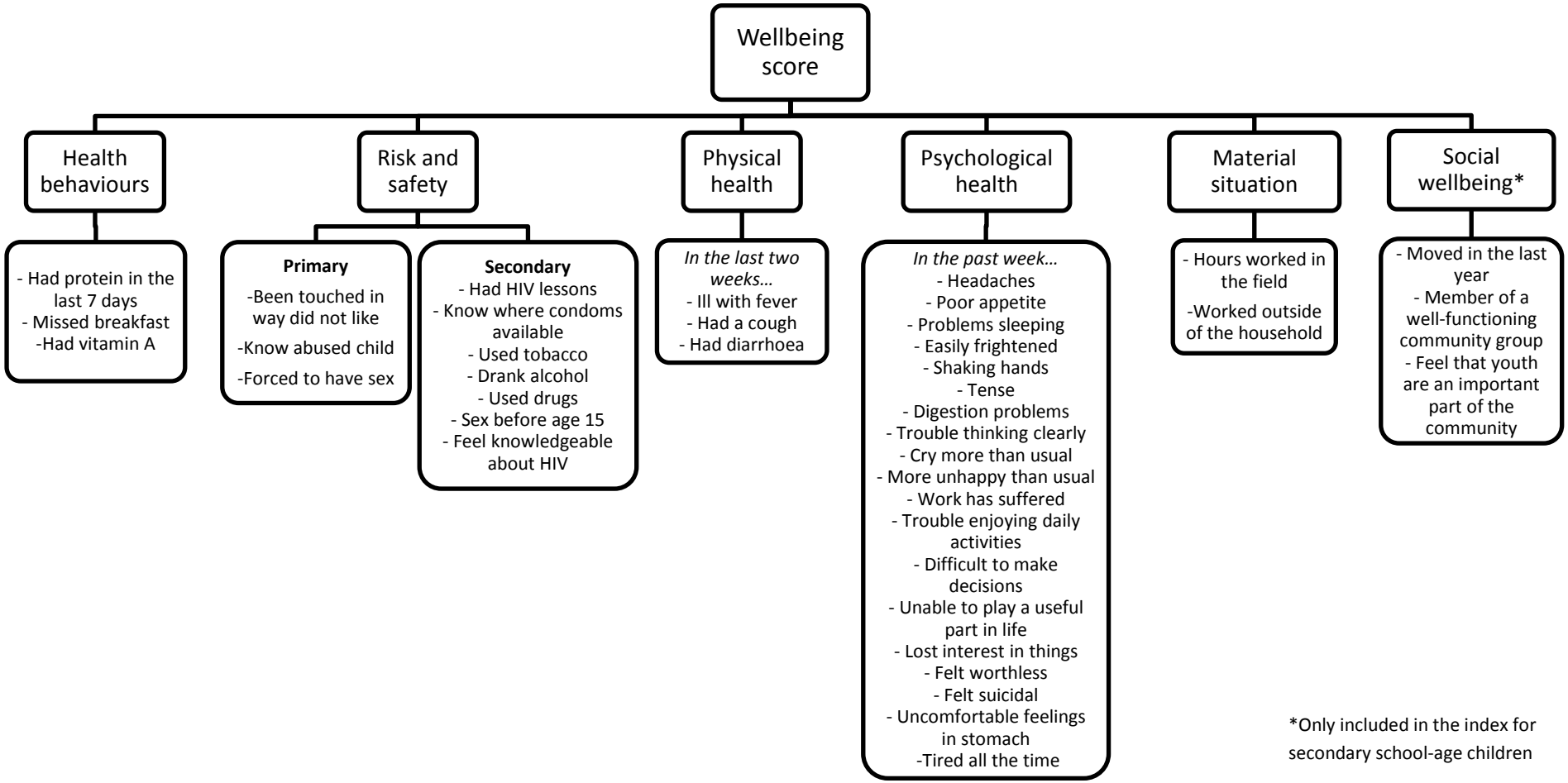

Figure 6-1 Components making up the domains of the primary and secondary wellbeing indices

6.2.3 Measuring school quality

General and HIV-specific school quality scores were calculated from data collected in the M&E facility survey. Two separate scores were created to test whether it is the HIV-specific characteristics of a school or its general quality that provides benefits for vulnerable children.

Research from South Africa [125,319], Zimbabwe [126], and Kenya [52] proposes that measures of HIV competence include access to health knowledge and life skills; welcoming, non-judgemental social spaces for open dialogue; promoting a sense of confidence and ownership over health and wellbeing; strong and supportive relationships; and bridging access to other support networks, such as NGOs. Adapting this to the school environment, factors included in the general quality score were physical infrastructure, inclusive teaching methods, fee structure and support, community links, student initiatives, and extracurricular activities (Figure 6-2a). Factors in the HIV-specific score included HIV policies, teaching of HIV-related subjects, HIV/AIDS-related clubs and initiatives, and community links (Figure 6-2b). Questions measuring school quality were developed by me and Morten Skovdal for the M&E survey using the proposed characteristics of HIV-competent communities developed by Campbell *et al.* [125] and based on qualitative interviews with school officials, teachers, and community members (work done by Louise Buhl-Anderson, Morten Skovdal, and Catherine Campbell). By basing the questions in the M&E survey on qualitative research conducted in the same geographical area, I was able to ensure that the included questions are a good representation of what the community and the schools themselves consider to be the characteristics of high quality schools.

When constructing the indices, each component was given a score between zero and one (either as proportions or binary variables), summed, and the average taken for each school. For yes/no binary outcomes (*e.g.* does the facility have electricity, are communication skills taught, are there links with churches to provide psychological support, etc.), a value of 1 was

assigned to a positive answer and a value of 0 was assigned to a negative answer. In cases where a binary outcome was not present (*e.g.* cost of school fees, number of cases of bullying), the value for each school was taken and divided by the largest value in that category to get a number between 0 and 1, which was then used in the calculation of the HIV competence score. In cases where a lower number was better (*e.g.* student to teacher ratio, cost of school fees), one minus the original value was used for calculating the overall score. Each overall score (general and HIV-specific) was categorised into binary variables for analysis using equal frequency grouping intervals.

6.2.4 Child vulnerability and educational outcomes

For this chapter, vulnerable children were defined as children who were HIV-positive; were a maternal, paternal, or double orphan; or had an HIV-positive parent. Individual educational outcomes were regular attendance in primary (ages 6-12) and secondary (ages 13-17) school-age children and being in the correct grade-for-age (ages 8-17). Regular attendance was defined as having attended at least 80% of the last 20 school days and children not enrolled in school were included with those not attending regularly. Educational attainment was measured through being in the correct grade-for-age. Children were deemed to be in the correct grade for their age if they were no more than one year behind the normative grade for age [200]. For example, to be at the appropriate grade-for-age in year one of primary school, children would have to be either six or seven years old.

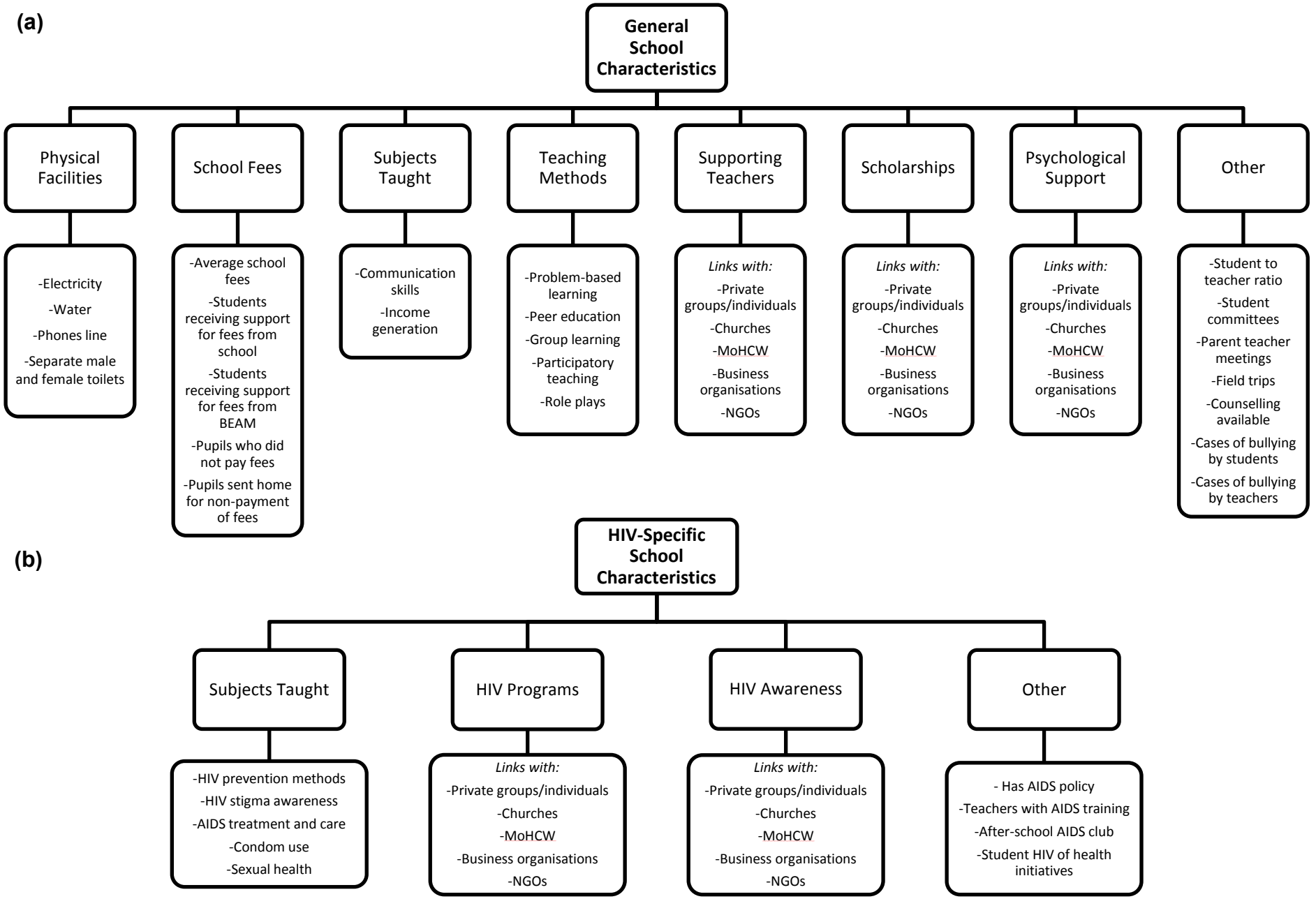

Figure 6-2 Components of the general (a) and HIV-specific (b) school quality indices.

6.2.5 Data analysis

To determine if regular attendance of vulnerable children of primary and secondary school age was associated with higher levels of wellbeing, multivariable logistic regression models adjusting for age, gender, household SES (measured using a previously-validated wealth index [153]), and community type (town, roadside settlement, estate, or subsistence farming area (SFA)) were used. Household of residence was included as a random effect to account for household-level effects attributable to children residing in the same household. This analysis was also split by gender and run just for those children who were orphans.

Logistic regression was used to assess what factors were associated with vulnerable children (and orphans specifically) of primary or secondary school age attending regularly and being in the correct grade-for-age. Logistic regression models included the school quality scores and community characteristics, adjusting for age, gender, household SES, and community type. Again, household-level random effects were included in the models to account for correlated outcomes for multiple children residing in the same household. Community characteristics included unemployment levels, community SES, HIV prevalence in adults aged 15-54 years, and local community group participation. Community group participation was defined as those respondents who were members of one or more well-functioning community groups, including church groups, women's groups, co-operatives, farmers' groups, burial societies, savings clubs, AIDS groups, and political groups [320-322].

Separate models evaluated first the effect of the general school score on outcomes of interest, and then the additional effect of the HIV-specific score. This was done to assess if HIV-related school qualities had an effect over and above that of general school quality. Where a village was in the catchment area for more than one school, children were assigned a school score as the average of the two schools serving that village, weighted according to the number of students from that village reported by each school.

Using multivariable regression, I first tested for the effects of general and HIV-specific school quality on overall and psychological wellbeing for all children and then tested for an interaction between child vulnerability and general school quality to determine whether school quality differentially affected the wellbeing of vulnerable versus non-vulnerable children. Psychological wellbeing was analysed separately from overall wellbeing due to previous work in Manicaland (using the same psychological wellbeing index) finding that orphans experienced more psychosocial distress than non-orphans [233]. All analyses were additionally split by gender and, where vulnerability was involved, run just for those children who were orphans. Community characteristics were also included in the models, along with demographic factors and household of residence as above.

All analyses were conducted in Stata/SE 12.1 unless otherwise stated.

6.3 Results

6.3.1 Child and school characteristics

A total of 4,577 children aged 6-17 were included in the study, of whom 2341 (51.1%) were linked to schools in the study area. Nine hundred and ninety-three children of primary school age (50.6%) and 1348 secondary school age children (51.6%) were linked to schools. Children were not linked to schools because some schools just outside the study site boundaries were not included in the M&E survey (so children in villages in their catchment areas couldn't be matched to a school) and because some villages in the study areas were erroneously not reported by schools as lying within their catchment areas. Children not linked to schools did not differ from those linked in terms of gender, age, SES, enrolment, attendance, grade progression, wellbeing scores, and vulnerability status (all $p>0.05$). Linked children were, however, less likely to live in subsistence farming areas than children who were not linked ($p<0.001$).

The characteristics of all children, not just those linked to schools, are presented in Table 6-1. Overall, 40.1% of primary school-aged children and 53.1% of secondary school-aged children were classified as vulnerable. Whether or not a child was vulnerable did not differ by gender ($p=0.78$), but older children were more likely to be vulnerable ($p<0.001$). In secondary school children, vulnerability status did not differ by age ($p=0.37$) or gender ($p=0.68$). Vulnerable children were less likely to be in the correct grade for age in secondary school ($p<0.001$), but not in primary school ($p=0.31$). Vulnerability had no association with school attendance in primary ($p=0.91$) or secondary ($p=0.05$) school-age children.

Tables 6-2 and 6-3 describe the factors contributing to schools' general (Table 6-2) and HIV-related (Table 6-3) quality scores. In primary schools, the mean score for general quality was 0.47 (range: 0.36 to 0.64); the mean for HIV-related quality was 0.42, and ranged from 0.22 to 0.65. In secondary schools, the mean score for general quality was 0.52 (range: 0.38 to 0.71); the mean for HIV-quality was 0.42 and ranged from 0.32 to 0.69. Among both primary and secondary schools certain factors, such as teaching methods and the teaching of HIV-related subjects, were universally well implemented (all above 85%), while links with outside organisations were less frequently reported (all less than 45%, and three quarters of links reported in less than 25% of schools), except for links with NGOs for HIV programmes and HIV awareness. Schools that consistently reported outside links for psychological support, scholarships, HIV awareness, and HIV programmes had the highest levels of general and HIV-related quality (all $p<0.05$).

Table 6-1 Characteristics of children and adolescents included in study

	Primary school-age children (age 6–12 years, n=1964)	Secondary school-age children (age 13–17 years, n= 2613)
Percent vulnerable[†]		
All types	40.1% (37.9-42.3%)	53.1% (51.1-55.1%)
Maternal orphan	11.7% (10.3-13.2%)	20.3% (18.7-21.9%)
Paternal orphan	26.3% (24.4-28.3%)	38.1% (36.2-40.1%)
HIV+	2.1% (1.5-2.7%)	2.0% (1.5-2.6%)
HIV+ parent	13.3% (11.6-14.6%)	12.5% (11.2-13.8%)
Mean age[‡]		
Overall	9.17 (8, 11)	15.43 (15, 16)
Non-vulnerable children	8.93 (7, 11)	15.35 (15, 16)
Vulnerable children	9.53 (8, 11)	15.43 (15, 16)
Percent female[†]		
Overall	49.5% (47.3-51.8%)	51.9% (50.0-53.9%)
Non-vulnerable children	49.2% (46.3-52.1%)	52.5% (49.6-55.4%)
Vulnerable children	50.6% (47.0-53.1%)	51.5% (48.7-54.2%)
Correct grade-for-age[†]		
Overall	46.6% (44.0-49.1%)	49.3% (47.4-51.2%)
Non-vulnerable children	47.4% (43.9-50.8%)	52.6% (49.7-55.5%)
Vulnerable children	45.9% (42.0-49.8%)	45.7% (43.0-48.5%)
Attending at least 80% of the time[†]		
Overall	91.2% (90.0-93.4%)	68.6% (65.3-71.9%)
Non-vulnerable children	91.2% (89.5-94.0%)	75.4% (70.7-80.2%)
Vulnerable children	92.1% (89.5-94.8%)	68.7% (64.1-73.4%)
Average wellbeing score[‡]		
Overall	45.8 [37.5, 52.2]	45.8 [36.3, 54.0]
Non-vulnerable children	47.1 [37.5, 53.9]	45.9 [36.9, 53.6]
Vulnerable children	43.9 [37.5, 50.4]	45.7 [36.5, 54.2]
Average psychological wellbeing score[‡]		
Overall	16.3 [1.7, 22.6]	16.3 [1.2, 24.1]
Non-vulnerable children	16.7 [3.3, 22.7]	15.3 [1.2, 22.7]
Vulnerable children	15.7 [0.5, 22.1]	17.1 [1.2, 25.3]

[†]Mean (95% CI) [‡]Mean [IQR]

Table 6-2 General characteristics of schools included in study

	Primary schools (n=28)	Secondary schools (n=18)
Facilities available[a]		
Electricity	12 (42.9%)	12 (66.7%)
Water	12 (42.9%)	11 (61.1%)
Phone line	2 (7.1%)	2 (11.1%)
Separate male & female toilets	28 (100%)	18 (100%)
Student to teacher ratio[b, c, d]	31.4 (29, 35.5)	20.4 (18.4, 22.5)
Student committee[a]	18 (64.3%)	13 (72.2%)
Parent teacher meetings[a]	28 (100%)	18 (100%)
Field trips[a]	17 (60.7%)	14 (77.8%)
Counselling available[a]	28 (100%)	18 100%
Number of cases of bullying by students[b, c, d]	3.4 (0, 10)	1.6 (0, 3)
Number of cases of bullying by teachers[b, c, d]	0.04 (0, 0; max: 1)	0.06 (0, 0; max: 1)
Subjects taught[a]		
Communication skills	28 (100%)	16 (88.9%)
Income generation	22 (78.6%)	17 (94.4%)
Teaching methods[a]		
Problem-based learning	26 (92.9%)	18 (100%)
Peer education	25 (89.3%)	17 (94.4%)
Group learning	28 (100%)	18 (100%)
Participatory teaching	28 (100%)	18 (100%)
Role plays	28 (100%)	18 (100%)
Average school fees[b, c, d]	$53.36 ($45, $60)	$341.33 ($105, $894)
Students receiving support for school fees[b]		
School – direct	0.9% (0%, 1.0%)	2.0% (0%, 2.5%)
Other – *e.g.* BEAM	16.5% (11.1%, 19.3%)	16.3% (4.1%, 28.6%)
Pupils who did not pay fees[b, d]	26.0% (11.4%, 33.0%)	34.0% (17.9%, 49.0%)
Pupils sent home for non-payment of fees[b, d]	65.4% (0%, 100%)	69.1% (14.3%, 100%)
Supporting teachers[a]		
Links with private groups/individuals	12 (42.9%)	7 (38.9%)
Links with churches	2 (7.1%)	2 (11.1%)
Links with the MoHCW	0 (0%)	0 (0%)
Links with business organisations	0 (0%)	0 (0%)
Links with NGOs	0 (0%)	0 (0%)
Scholarships[a]		
Links with private groups/individuals	9 (32.1%)	6 (33.3%)
Links with churches	3 (10.7%)	1 (5.6%)
Links with the MoHCW	0 (0%)	0 (0%)
Links with business organisations	0 (0%)	0 (0%)
Links with NGOs	6 (21.4%)	6 (33.3%)
Psychological support[a]		
Links with private groups/individuals	0 (0%)	2 (11.1%)
Links with churches	2 (7.1%)	2 (11.1%)
Links with the MoHCW	5 (17.9%)	3 (16.7%)
Links with business organisations	4 (14.3%)	0 (0%)
Links with NGOs	10 (35.7%)	5 (27.8%)
Overall competence score[b]	0.47 (0.36, 0.64)	0.52 (0.38, 0.71)

[a] n (percent) [b] Mean (IQR) [c] The value for each school was taken and divided by the largest value in each category to get a value between 0 and 1, which was then used in the calculation of the HIV competence score.
[d] Lower values were taken to be more competent

Table 6-3 HIV-competence characteristics of schools included in study

	Primary schools (n=28)	Secondary schools (n=18)
Teachers with AIDS training[b]	6.3% (0%, 14.3%)	6.5% (0%, 11.1%)
School has an AIDS policy[a]	7 (25.0%)	6 (33.3%)
After-school AIDS club[a]	20 (71.4%)	16 (88.9%)
Student HIV or health initiatives[a]	8 (28.6%)	5 (27.8%)
Subjects taught[a]		
HIV prevention methods	27 (96.4%)	18 (100%)
HIV stigma awareness	28 (100%)	16 (88.9%)
AIDS treatment & care	26 (92.9%)	17 (94.4%)
Condom use	10 (35.7%)	6 (33.3%)
Sexual health	28 (100%)	18 (100%)
HIV programs[a]		
Links with private groups/individuals	0 (0%)	0 (0%)
Links with churches	0 (0%)	2 (11.1%)
Links with the MoHCW	7 (25.0%)	2 (11.1%)
Links with business organisations	0 (0%)	0 (0%)
Links with NGOs	22 (78.6%)	14 (77.8%)
HIV awareness[a]		
Links with private groups/individuals	0 (0%)	2 (11.1%)
Links with churches	1 (3.6%)	4 (22.2%)
Links with the MoHCW	8 (28.6%)	3 (16.7%)
Links with business organisations	2 (7.1%)	2 (11.1%)
Links with NGOs	16 (57.1%)	10 (55.6%)
Overall HIV competence score[b]	0.42 (0.22, 0.65)	0.42 (0.32, 0.69)

[a] n (percent) [b] Mean (IQR)

6.3.2 Wellbeing index

Wellbeing scores, scaled to range between 0 and 100, had an inter-quartile range (IQR) of 37.5 to 52.2 in primary school-aged children and 36.5 to 54.0 in secondary school-aged children (Table 6-1, Figure 6-3). Wellbeing score distributions did not differ between children linked to schools and those not linked (Figure 6-4). Although the overall index was normally distributed (Figure 6-3), this was not case for the scores of the individual domains (Figure 6-5). The different domains of the index had contrasting degrees of variability, with those domains that had the most components (*e.g.* psychological wellbeing) contributing the highest degree of variability. Physical health had the lowest average score of all domains, with many children reporting all three symptoms of illness (Figure 6-1) in the last two weeks.

When comparing the wellbeing scores by vulnerability status (Table 6-1), the average wellbeing score for primary school-age children was significantly lower for vulnerable compared to non-vulnerable children (43.9 vs. 47.1, $p<0.001$) and for orphans compared to non-orphans (43.4 vs 46.8, $p<0.001$), but there was no difference for secondary school-aged children (45.7 vs. 45.9, $p=0.50$ for vulnerable children; 45.3 vs 46.2, $p=0.24$ for orphans). Psychological wellbeing scores were not significantly lowered in vulnerable versus non-vulnerable children in primary (15.7 vs. 16.7, $p=0.19$) or secondary (17.1 vs. 15.3, $p=0.08$) school, with the same being true for orphans: 15.7 vs. 16.5 ($p=0.26$) in primary school and 16.9 vs. 16.0 ($p=0.39$) in secondary school.

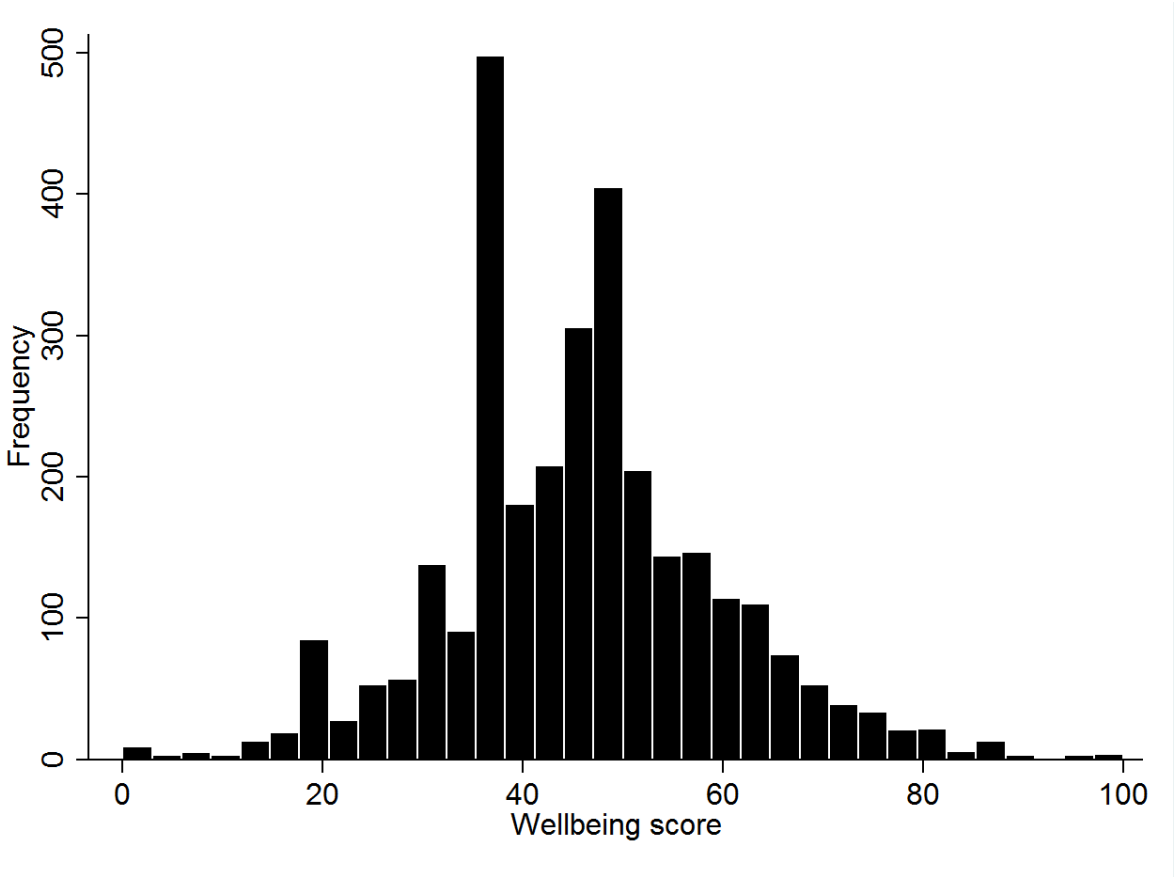

Figure 6-3 Distribution of wellbeing scores among all children (n=3,095)

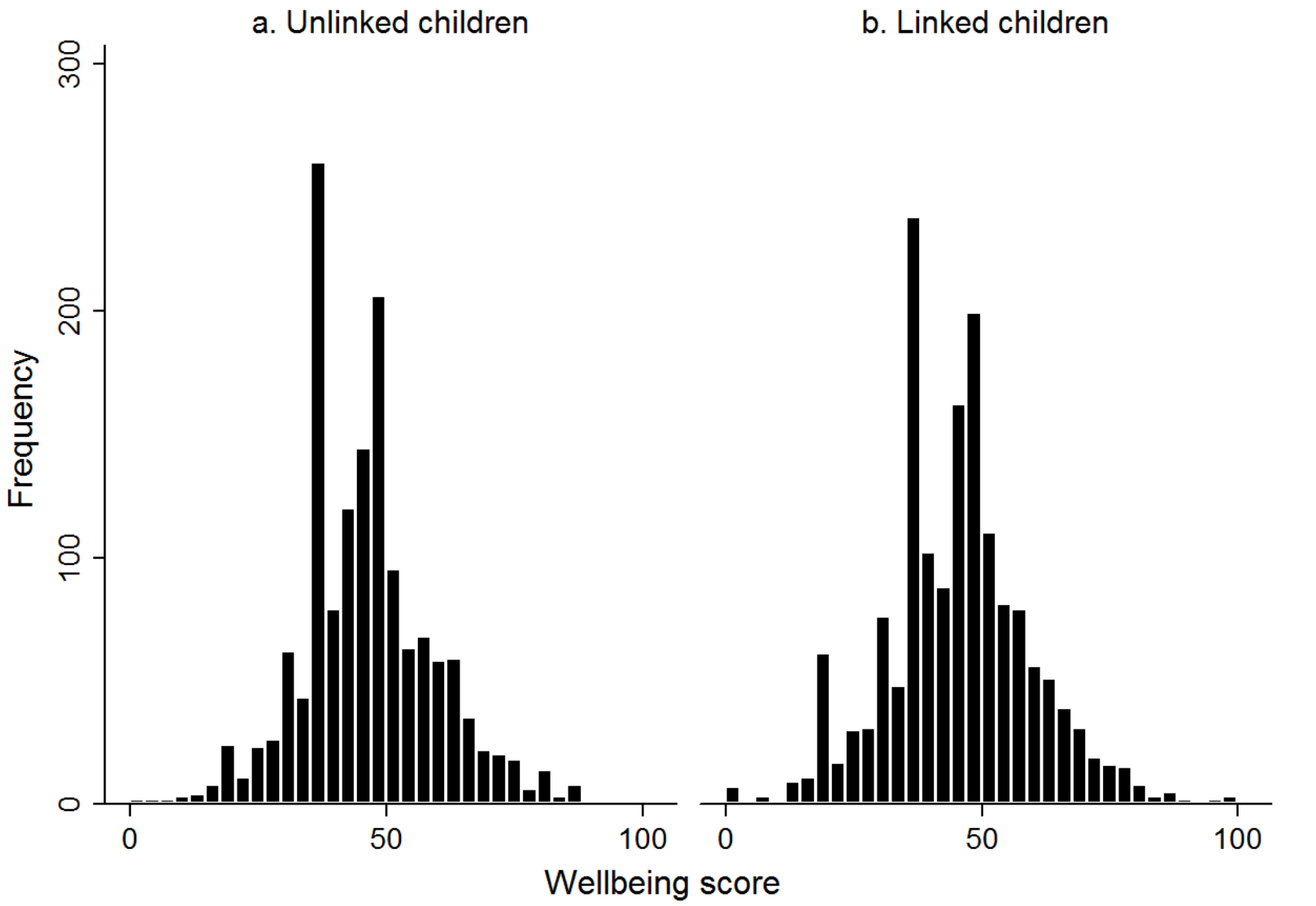

Figure 6-4 Distribution of wellbeing scores among children who were a) unlinked (n=1491) and b) linked (n=1604) to schools

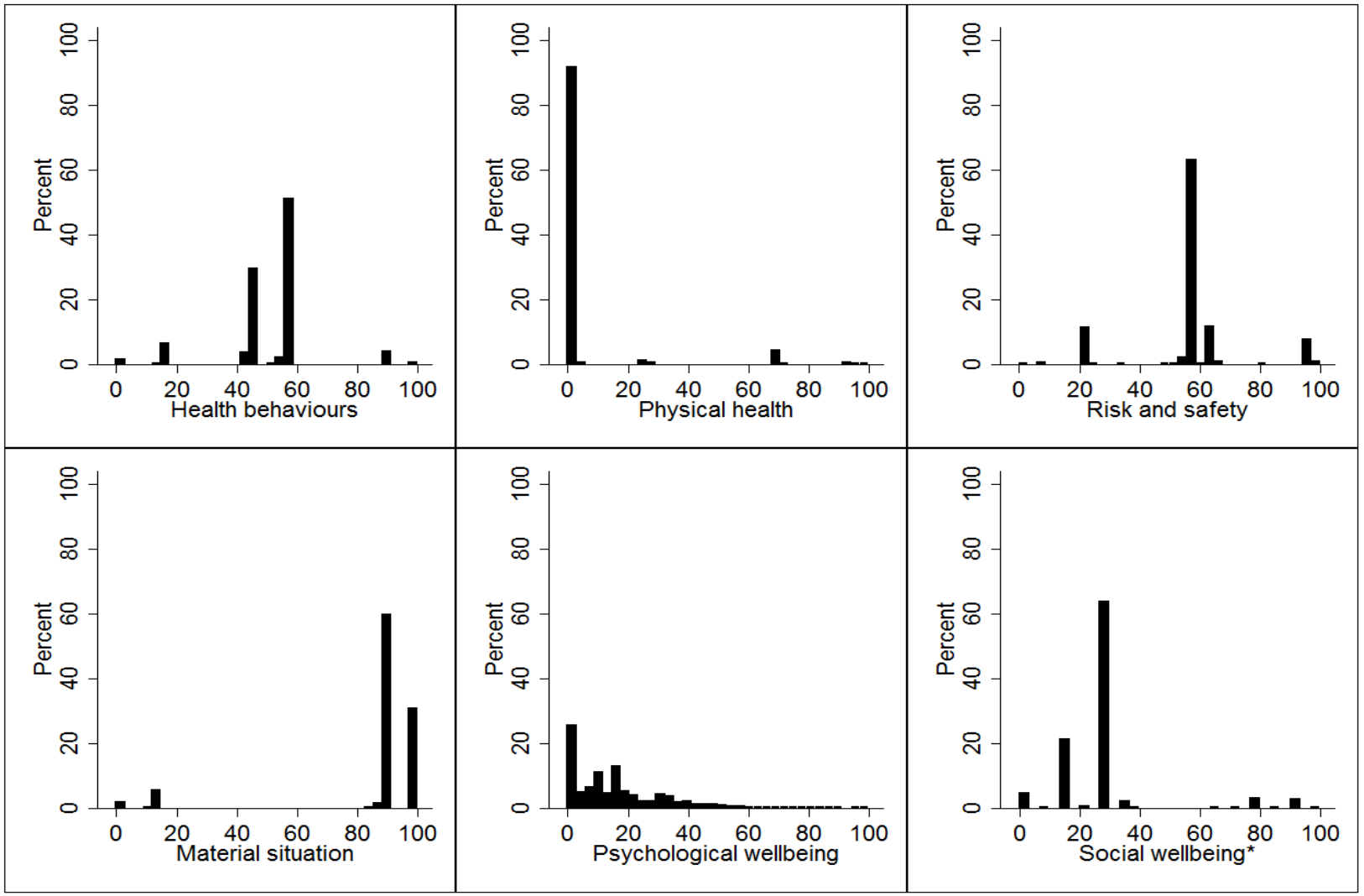

Figure 6-5 Distributions of scores for the individual domains of the wellbeing index.
*Only included in the secondary school index

6.3.3 Regular attendance and wellbeing in vulnerable children

Regular attendance was not significantly associated with higher wellbeing among vulnerable children in primary or secondary school, but was associated with higher wellbeing in orphans (overall, male, and female) of primary school age (Table 6-4). In primary school children, increasing age was associated with lower wellbeing for all models in Table 6-4, while children living in roadside trading centres had greater wellbeing than children living in towns (data not shown in table). In secondary school children, increasing age was associated with higher wellbeing for all models in Table 6-4, but no other factors had a significant association (data not shown in table).

Table 6-4 Association between regular attendance and wellbeing among vulnerable children

	Primary school			Secondary school		
	N	Change in wellbeing score (95% CI)[†]	Change in psychological wellbeing score (95% CI)[†]	N	Change in wellbeing score (95% CI)[†]	Change in psychological wellbeing score (95% CI)[†]
Regular attendance in:						
Vulnerable children	718	3.08 (-1.54 – +7.71)	-2.07 (-6.96 – +2.83)	491	-2.89 (-8.18 – +2.40)	-2.55 (-9.05 – +3.95)
Vulnerable males	349	4.34 (-3.03 – +11.7)	1.73 (-5.54 – +9.00)	261	-1.64 (-8.77 – +5.49)	-6.21 (-14.9 – +2.45)
Vulnerable females	369	2.57 (-3.35 – +8.48)	-4.38 (-10.8 – +2.01)	230	-4.37 (-12.3 – +3.56)	3.35 (-6.38 – +13.1)
Orphans	550	**8.60 (2.64-14.6)****	3.95 (-2.15 – +10.0)	399	-3.64 (-9.76 – +2.48)	0.74 (-6.99 – +8.47)
Male orphans	271	**10.3 (1.28-19.3)***	7.21 (-1.29 – +15.7)	216	-1.27 (-10.1 – +7.55)	-3.82 (-15.4 – +7.81)
Female orphans	279	**7.94 (0.20-15.7)***	3.77 (-4.15 – +11.7)	183	-5.53 (-13.7 – +2.66)	5.65 (-4.69 – +16.0)

[†]Adjusted for age, gender (for non-gender specific analyses), household SES, community type, and external support *, ** Significant at p<0.05, 0.01

6.3.4 School quality and schooling outcomes in vulnerable children

Higher scores on the general school quality measure were significantly associated with vulnerable children being more likely to be in the correct grade-for-age, but not with regular attendance in either primary or secondary school-aged vulnerable children (Table 6-5). HIV-related school quality did not have a significant additional effect on attendance or grade progression. By gender, there was a significant association between school quality and education outcomes in females, but not in males (Table 6-6). Among orphans, the effect of school quality was significant overall, but only when HIV quality was included in the model, and not when sub-divided by gender (Table 6-6). All other variables had similar levels of effect as in Table 6-5 and the significance of the effects did not change.

6.3.5 School quality and child wellbeing

Schools with greater general quality were significantly associated with higher wellbeing in primary school-aged children as a whole, both before and after adding the HIV-specific school score to the model (Table 6-7). HIV-specific school quality was also significantly associated with higher wellbeing in primary school. In secondary school-age children, neither general school quality nor HIV-specific school quality were significantly associated with higher wellbeing in the models, although there was a positive trend for general school quality (Table 6-7). The level of general school quality was associated with higher wellbeing of children overall, but the interaction between school quality and child vulnerability was not significant in the models for primary ($p=0.19$) or secondary ($p=0.44$) school, indicating that schools do not preferentially improve the wellbeing of vulnerable children over that of non-vulnerable children (Table 6-8). When the analysis was split by gender, general school quality remained significant for males and females in primary school, although HIV-specific school quality was only significant for females (Table 6-9). Additionally, males who were vulnerable, but not females, had significantly lower wellbeing than their non-vulnerable

counterparts. In orphans, the same patterns held true. As with all vulnerable children, none of the interactions between vulnerability and school quality were significant (Table 6-8).

The above analyses were also run for psychological wellbeing with the same general pattern of results as seen for overall wellbeing (Tables 6-10 and 6-11). However, external support was associated with higher psychological wellbeing in primary school-age children, while higher SES in the local community was associated with significantly lower psychological wellbeing (Table 6-10). It was also vulnerable females of primary school age, and not males, who had significantly lower psychological wellbeing than non-vulnerable children.

Across all models in secondary school children, higher HIV prevalence in the school catchment area was associated with lower wellbeing. No other community-level factors had a significant effect.

Table 6-5 Association between various factors, including school quality, and education outcomes among children made vulnerable by HIV

	Primary attendance (n=388)		Secondary attendance (n=219)		Correct grade for age (n=575)	
	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	0.63 (0.11-3.44)	0.69 (0.12-3.96)	1.03 (0.20-5.26)	2.39 (0.18-31.6)	**2.05 (1.18-3.54)**[*]	**2.11 (1.22-3.67)**[*]
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	1.48 (0.26-8.32)	—	0.04 (0.00-1.98)	—	0.65 (0.36-1.17)
HIV in school area	0.95 (0.76-1.19)	0.93 (0.74-1.18)	1.15 (0.89-1.49)	1.34 (0.98-1.78)	0.95 (0.87-1.03)	0.96 (0.85-1.05)
Unemployment in area	0.98 (0.89-1.07)	0.97 (0.89-1.07)	0.94 (0.82-1.07)	1.03 (0.87-1.23)	0.99 (0.96-1.02)	1.00 (0.95-1.03)
CG participation in area	0.99 (0.85- 1.14)	0.99 (0.86-1.14)	1.06 (0.90-1.24)	1.02 (0.82-1.26)	0.99 (0.94-1.05)	1.00 (0.97-1.05)
Worked outside home	6.90 (0.33-145)	7.19 (0.34-154)	1.57 (0.25-9.85)	1.15 (0.18-7.53)	0.74 (0.37-1.52)	0.71 (0.35-1.48)
Had breakfast	0.77 (0.09-6.38)	0.76 (0.09-6.33)	N/A[‡]	N/A[‡]	0.98 (0.41-2.32)	0.95 (0.44-2.26)
Protein in last week	**14.5 (2.40-87.8)**[**]	**14.9 (2.44-91.2)**[**]	2.90 (0.59-14.3)	3.04 (0.60-15.3)	0.89 (0.47-1.70)	0.91 (0.44-1.73)
Ill in last two weeks	0.65 (0.07-6.11)	0.67 (0.07-6.28)	0.54 (0.04-6.56)	0.50 (0.04-5.92)	0.70 (0.30-1.65)	0.70 (0.30-1.64)
Hours worked in field	1.40 (0.77-2.51)	1.41 (0.78-2.56)	0.95 (0.80-1.12)	0.97 (0.82-1.15)	1.04 (0.95-1.14)	1.05 (0.93-1.15)
External support	N/A[‡]	N/A[‡]	0.56 (0.10-3.02)	0.68 (0.13-3.61)	0.97 (0.55-1.70)	0.99 (0.53-1.75)
Age	0.70 (0.47-1.03)	0.70 (0.47-1.02)	0.76 (0.45-1.29)	0.77 (0.44-1.35)	**0.86 (0.78-0.96)**[*]	**0.86 (0.84-0.95)**[*]
Gender (female vs. male)	0.90 (0.28-2.89)	0.91 (0.28-2.90)	0.79 (0.20-3.16)	0.80 (0.19-3.45)	**2.61 (1.62-4.23)**[**]	**2.61 (1.56-4.21)**[**]
Household SES						
Poorest quintile	1	1	1	1	1	1
Second quintile	1.29 (0.18-9.45)	1.25 (0.17-9.18)	0.76 (0.11-5.45)	0.56 (0.07-4.62)	1.32 (0.62-2.84)	1.34 (0.65-2.87)
Middle quintile	2.66 (0.33-21.2)	2.62 (0.33-20.6)	0.64 (0.07-5.48)	0.46 (0.05-4.63)	**2.77 (1.33-5.78)**	**2.85 (1.42-5.95)**
Fourth quintile	0.83 (0.13-5.48)	0.83 (0.13-5.50)	0.40 (0.04-3.65)	0.23 (0.02-2.52)	1.47 (0.66-3.28)	1.43 (0.65-3.21)
Highest quintile	6.88 (0.54-87.6)	6.82 (0.54-86.8)	1.45 (0.11-19.8)	0.89 (0.06-14.4)	1.72 (0.81-3.64)	1.68 (0.89-3.55)
Community type						
Town	1	1	1	1	1	1
Agricultural estate	0.74 (0.04-12.6)	0.99 (0.04-22.1)	3.65 (0.33-40.2)	2.06 (0.16-26.3)	**3.42 (1.30-8.99)**[*]	2.79 (0.92-7.58)
SFA	2.11 (0.09-48.5)	2.30 (0.10-51.5)	2.29 (0.21-24.8)	2.94 (0.17-50.8)	**5.06 (1.81-14.2)**[*]	**4.85 (1.26-13.5)**[*]
Roadside settlement	0.95 (0.05-18.0)	1.14 (0.06-23.5)	11.69 (0.49-279)	9.11 (0.11-736)	**3.44 (1.20-9.85)**[*]	2.76 (0.74-8.16)

[‡]Not included because too few observations were present [†]Adjusted for all other variables in the table *, ** significant at p<0.05, 0.01

Table 6-6 Associations between school quality and education outcomes 1) stratified by gender for vulnerable children, 2) among orphans, and 3) stratified by gender for orphans

	Primary attendance		Secondary attendance		Correct grade for age	
	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]	Model 1 AOR (95% CI)[†]	Model 2 AOR (95% CI)[†]
Vulnerable males	n=214		n=137		n=303	
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	1.08 (0.17-6.99)	1.24 (0.19-8.27)	0.43 (0.03-6.97)	0.17 (0.01-54.4)	2.07 (0.77-5.56)	2.24 (0.83-6.09)
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	2.48 (0.34-18.0)	—	0.01 (0.00-5.47)	—	0.50 (0.17-1.48)
Vulnerable females	n=174		n=129		n=272	
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	0.25 (0.04-1.84)	0.23 (0.03-1.99)	0.23 (0.01-4.97)	0.28 (0.01-10.1)	**1.18 (1.01-3.31)**[*]	**1.82 (1.04-3.33)**[*]
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	0.79 (0.10-5.95)	—	N/A[‡]	—	0.83 (0.42-1.64)
Orphans	n=304		n=223		n=475	
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	1.27 (0.23-6.89)	1.69 (0.31-9.14)	0.53 (0.08-3.49)	0.58 (0.07-4.54)	1.89 (1.00-3.60)	**1.93 (1.01-3.70)**[*]
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	2.62 (0.49-13.9)	—	0.06 (0.01-1.34)	—	0.80 (0.41-1.59)
Male Orphans	n=166		n=118		n=256	
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	3.92 (0.52-2.98)	6.79 (0.77-59.4)	0.03 (0.00-58.5)	0.01 (0.00-3226)	2.86 (0.60-13.6)	2.92 (0.65-13.2)
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	6.46 (0.69-60.9)	—	0.03 (0.00-83.6)	—	0.63 (0.14-2.77)
Female Orphans	n=138		n=108		n=219	
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	0.15 (0.01-3.02)	0.11 (0.01-3.00)	0.42 (0.01-20.1)	0.24 (0.01-21.8)	1.67 (0.83-3.37)	1.64 (0.81-3.33)
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	0.45 (0.02-8.06)	—	N/A[‡]	—	1.20 (0.56-2.57)

[‡]Not included because too few observations were present [†]Adjusted for all variables as in Table 6-5 *, ** significant at p<0.05, p<0.01

Table 6-7 Associations between school quality, community factors, and child wellbeing

	Primary School (n=929)		Secondary school (n=558)	
	Model 1 Change in wellbeing score†	Model 2 Change in wellbeing score†	Model 1 Change in wellbeing score†	Model 2 Change in wellbeing score†
Vulnerable child	-1.55 (-3.49 - +0.38)	-1.49 (-3,43 - +0.44)	-2.00 (-4.28 - +0.29)	-1.96 (-4.25 - +0.33)
School quality index				
Lower quality	1	1	1	1
Higher quality	**4.00 (+1.53 - +6.46)****	**5.06 (+2.45 - +7.68)*****	1.80 (-1.29 - +4.89)	1.99 (-1.20 - +5.19)
HIV-related school quality index				
Lower quality	—	1	—	1
Higher quality	—	**3.02 (+0.43 - +5.62)***	—	-0.90 (-4.66 - +2.87)
HIV in school area	0.09 (-0.29 - +0.47)	-0.01 (-0.40 - +0.38)	**-0.75 (-1.34 - -0.17*)**	**-0.69 (-1.33 - -0.06)***
Unemployment in school area	-0.10 (-0.24 - +0.03)	-0.10 (-0.24 - +0.03)	-0.11 (-0.28 - +0.07)	-0.10 (-0.27- +0.08)
CG participation in school area	-0.04 (-0.27 - +0.19)	0.06 (-0.28 - +0.17)	0.12 (-0.22 - +0.49)	0.14 (-0.21 - +0.50)
SES in school area	-16.2 (-54.5 - +22.0)	-11.0 (-49.3 - +27.3)	-44.1 (-94.8 - +6.69)	-47.1 (-99.4 - +5.21)
External support	1.53 (-0.93 - +4.00)	1.18 (-1.30 - +3.66)	-0.22 (-3.28 - +2.85)	-0.14 (-3.22 - +2.94)
Age	**-0.58 (-0.98 - -0.19)****	**-0.59 (-0.99 - -0.20)****	**2.13 (+1.34 - +2.93)*****	**2.14 (+1.34 - +2.94)*****
Gender (female vs. male)	0.15 (-1.48 - +1.79)	0.21 (-1.43 - +1.84)	0.67 (-1.55 - +2.90)	0.68 (-1.55 - +2.90)
Household SES				
Poorest quintile	1	1	1	1
Second quintile	1.48 (-1.72 - +4.68)	1.41 (-1.77 - +4.59)	-0.58 (-4.35 - +3.19)	-0.56 (-4.32 - +3.21)
Middle quintile	0.68 (-2.40 - +3.76)	0.63 (-2.43 - +3.69)	1.49 (-2.13 - +5.11)	1.58 (-2.05 - +5.22)
Fourth quintile	0.60 (-2.89 - +4.10)	0.25 (-3.24 - +3.74)	-1.41 (-5.51 - +2.69)	-1.44 (-5.54 - +2.67)
Highest quintile	0.83 (-2.32 - +3.99)	0.73 (-2.41 - +3.86)	-0.50 (-4.07 - +3.07)	-0.45 (-4.03 - +3.12)
Community type				
Town	1	1	1	1
Agricultural estate	4.11 (-0.64 - +8.86)	**7.12 (+1.73- +12.5)***	-1.67 (-6.13 - +2.79)	-2.04 (-6.76 - +2.68)
SFA	2.64 (-1.84 - +7.12)	3.91 (-0.68 - +8.50)	-2.50 (-7.42 - +2.42)	-2.65 (-7.60 - +2.32)
Roadside settlement	**9.36 (+4.85 - +13.9)*****	**10.9 (+6.24 - +15.6)*****	0.38 (-5.47 - +6.24)	-0.13(-6.36- +6.11)

†Adjusted for all other variables in the table CG: community group SES: socio-economic status *, **, *** significant at p<0.05, 0.01, 0.001

Table 6-8 Significance of the interaction term between child vulnerability and general school quality in the models from tables 6-6, 6-7, and 6-9

	Primary school	Secondary school
	Change in wellbeing score (95% CI)†	Change in wellbeing score (95% CI)†
Overall wellbeing		
All vulnerable children	-2.52 (-3.01 – +2.54)	1.78 (-2.79 – +6.39)
Vulnerable males	-1.24 (-6.64 – +4.16)	4.51 (-1.96 – +11.0)
Vulnerable females	-4.82 (-9.79 – +0.14)	-0.36 (-6.85 – +6.13)
All orphans	-2.04 (-5.99 – +1.90)	1.63 (-2.91 – +6.16)
Male orphans	-0.62 (-6.23 – +4.99)	1.65 (-4.76 – +8.06)
Female orphans	-4.57 (-9.89 – +0.75)	2.33 (-4.15 – +8.82)
Psychological wellbeing		
All vulnerable children	-3.40 (-7.42 – +0.63)	3.02 (-2.24 – +8.28)
Vulnerable males	-3.19 (-8.67 – +2.29)	5.74 (-1.33 – +12.8)
Vulnerable females	-4.10 (-9.66 – +1.44)	0.77 (-6.95 – +8.49)
All orphans	-3.09 (-7.31 – +1.14)	3.28 (-1.93 – +8.48)
Male orphans	-2.44 (-8.16 – +3.29)	3.76 (-3.21 – +10.7)
Female orphans	-4.29 (-10.2 – +1.65)	3.55 (-4.15 – +11.2)

†: All values adjusted for as in their original models

Table 6-9 Associations between school quality and child wellbeing in males, females, and orphans

	Primary School		Secondary school	
	Model 1 Change in wellbeing score[†]	Model 2 Change in wellbeing score[†]	Model 1 Change in wellbeing score[†]	Model 2 Change in wellbeing score[†]
Males	(n=470)		(n=279)	
Vulnerable male	**-2.86 (-5.67 – -0.05)**[*]	**-2.82 (-5.63 – -0.01)**[*]	**-3.75 (-6.92 – -0.58)**[*]	**-3.77 (-6..95 – -0.59)**[*]
School quality index (higher vs. lower quality)	**4.06 (0.63-7.49)**[*]	**4.30 (0.69-7.90)**[*]	1.96 (-2.18 – +6.10)	1.87 (-2.45 – +6.19)
HIV-related school quality index (higher vs. lower quality)	—	0.75 (-2.80 – +4.32)	—	0.39 (-4.96 – +5.74)
Females	(n=459)		(n=279)	
Vulnerable female	-1.86 (-4.39 – +0.67)	-1.77 (-4.27 – +0.73)	-0.65 (-3.93 – +2.62)	-0.58 (-3.85 – +2.69)
School quality index (higher vs. lower quality)	**4.24 (1.18-7.30)**[**]	**6.24 (3.00-9.49)**[***]	0.52 (-3.87 – +4.92)	0.97 (-3.55 – +5.50)
HIV-related school quality index (higher vs. lower quality)	—	**5.33 (2.15-8.52)**[**]	—	-2.02 (-7.28 – +3.24)
Orphans	(n=948)		(n=567)	
Orphan	-1.58 (-3.61 – +0.46)	-1.54 (-3.57 – +0.49)	-1.10 (-3.35 – +1.15)	-1.08 (-3.33 – +1.17)
School quality index (higher vs. lower quality)	**4.07 (1.62-6.52)**[**]	**5.07 (2.47-7.67)**[***]	1.86 (-1.20 – +4.90)	2.14 (-1.01 – +5.30)
HIV-related school quality index (higher vs. lower quality)	—	**2.86 (0.29-5.43)**[*]	—	-1.32 (-5.04 – +2.39)
Male orphans	(n=480)		(n=283)	
Male orphan	**-3.20 (-6.14 – -0.24)**[*]	**-3.17 (-6.12 – -0.21)**[*]	-1.78 (-4.96 – +1.39)	-1.77 (-4.95 – +1.41)
School quality index (higher vs. lower quality)	**4.14 (0.74-7.54)**[*]	**4.27 (0.69-7.86)**[*]	2.12 (-2.05 – +6.30)	2.21 (-2.16 – +6.57)
HIV-related school quality index (higher vs. lower quality)	—	0.42 (-3.07 – +3.92)	—	-0.35 (-5.71 – +5.01)
Female orphans	(n=468)		(n=284)	
Female orphan	-1.96 (-4.68 – +0.77)	-1.91 (-4.61 – +0.78)	-0.59 (-3.79 – +2.60)	-0.62 (-3.81 – +2.58)
School quality index (higher vs. lower quality)	**4.02 (0.96-7.08)**[*]	**5.95 (2.72-9.18)**[***]	0.48 (-3.79 – +4.76)	1.04 (-3.36 – +5.44)
HIV-related school quality index (higher vs. lower quality)	—	**5.27 (2.11-8.43)**[**]	—	-2.42 (-7.58 – +2.74)

[†]Adjusted for variables as in Table 6-6 *, **, *** significant at p<0.05, 0.01, 0.001

Table 6-10 Associations between school quality, community factors, and child psychological wellbeing

	Primary School (n=929)		Secondary school (n=558)	
	Model 1 Change in psychological wellbeing score[†]	Model 2 Change in psychological wellbeing score[†]	Model 1 Change in psychological wellbeing score[†]	Model 2 Change in psychological wellbeing score[†]
Vulnerable child	-1.35 (-3.42 – +0.72)	-1.24 (-3.30 – +0.81)	1.06 (-1.56 – +3.68)	1.07 (-1.56 – +3.69)
School quality index				
Lower quality	1	1	1	1
Higher quality	**2.58 (0.01-5.16)***	**4.28 (1.56-6.99)****	2.66 (-0.89 – +6.21)	2.70 (-0.97 – +6.34)
HIV-related school quality index				
Lower quality	—	1	—	1
Higher quality	—	**4.86 (2.17-7.56)*****	—	-0.18 (-4.50 – +4.14)
HIV in school area	-0.08 (-0.48 – +0.32)	-0.24 (-0.65 – +0.16)	-0.65 (-1.32 – +0.03)	-0.63 (-1.36 – +0.09)
Unemployment in school area	-0.08 (-0.22 – +0.06)	-0.08 (-0.22 – +0.06)	-0.12 (-0.32 – +0.08)	-0.11 (-0.32 – +0.09
CG participation in school area	-0.03 (-0.27 – +0.20)	-0.06 (-0.30 – +0.17)	0.04 (-0.37 – +0.44)	0.04 (-0.37 – +0.45)
SES in school area	-33.8 (-73.8 – +6.26)	-25.3 (-65.1 – +14.6)	**-60.6 (-119 – -2.34)***	**-61.2 (-121 – -1.15)***
External support	**5.09 (2.45-7.72)*****	**4.51 (1.87-7.16)****	0.31 (-3.20 – +3.83)	0.33 (-3.21 – +3.86)
Age	-0.27 (-0.72 – +0.17)	-0.29 (-0.73 – +0.16)	**-1.04 (-1.95 – -0.13)***	**-1.03 (-1.95 – 0.12)***
Gender (female vs. male)	-0.29 (-2.09 – +1.52)	-0.20 (-2.00 – +1.61)	1.41 (-1.14 – +3.96)	1.41 (-1.13 – +3.96)
Household SES				
Poorest quintile	1	1	1	1
Second quintile	-0.19 (-3.53 – +3.15)	-0.28 (-3.58 – +3.02)	1.17 (-3.16 – +5.50)	1.17 (-3.16 – +5.51)
Middle quintile	-2.18 (-3.53 – +3.15)	-2.25 (-5.42 – +0.92)	0.62 (-3.54 – +4.77)	0.63 (-3.54 – +4.81)
Fourth quintile	-1.43 (-5.39 – +1.03)	-1.98 (-5.59 – +1.63)	-2.72 (-7.43 – +2.00)	-2.72 (-7.44 – +1.99)
Highest quintile	-2.02 (-5.07 – +2.21)	-2.18 (-5.43 – +1.08)	-3.78 (-7.89 – +0.32)	-3.77 (-7.89 – +0.34)
Community type				
Town	1	1	1	1
Agricultural estate	0.99 (-3.96 – +5.59)	**5.82 (0.22-11.4)***	-3.01 (-8.14 – +2.11)	-3.08 (-8.51 – +2.34)
SFA	-2.85 (-7.54 – +1.85)	-0.82 (-5.60 – +3.95)	-4.81 (-10.5 – +0.84)	-4.84 (-10.5 – +0.85)
Roadside settlement	**8.33 (7.97-63.8)*****	**10.9 (5.39-60.7)*****	0.87 (-5.85 – +7.60)	0.77 (-6.39 – +7.93)

[†]Adjusted for all other variables in the table CG: community group SES: socio-economic status *, **, *** significant at p<0.05, 0.01, 0.001

Table 6-11 Associations between school quality and child psychological wellbeing in males, females, and orphans

	Primary School		Secondary school	
	Model 1 Change in wellbeing score[†]	Model 2 Change in wellbeing score[†]	Model 1 Change in wellbeing score[†]	Model 2 Change in wellbeing score[†]
Males	(n=470)		(n=279)	
Vulnerable male	-0.54 (-3.40 – +2.31)	-0.32 (-3.16 – +2.53)	-0.63 (-4.10 – +2.84)	-0.62 (-4.09 – +2.86)
School quality index (higher vs. lower quality)	2.60 (-0.87 – +6.08)	**3.92 (0.28-7.56)**[*]	4.37 (-0.17 – +8.91)	4.45 (-0.28 – +9.18)
HIV-related school quality index (higher vs. lower quality)	—	**4.16 (0.56-7.76)**[*]	—	-0.33 (-6.19 – +5.54)
Females	(n=459)		(n=279)	
Vulnerable female	**-3.16 (-6.00 – -0.32)**[*]	**-3.05 (-5.86 – -0.25)**[*]	1.80 (-2.10 – +5.70)	1.78 (-2.12 – +5.68)
School quality index (higher vs. lower quality)	2.23 (-1.13 – +5.60)	**4.44 (0.87-8.02)**[*]	-0.80 (-6.06 – +4.46)	-0.94 (-6.37 – +4.50)
HIV-related school quality index (higher vs. lower quality)	—	**5.87 (2.37-9.37)**[**]	—	0.55 (-5.80 – +6.91)
Orphans	(n=948)		(n=567)	
Orphan	-0.86 (-3.04 – +1.33)	-0.79 (-2.96 – +1.39)	1.75 (-0.84 – +4.34)	1.76 (-0.83-4.35)
School quality index (higher vs. lower quality)	**2.61 (0.05-5.17)**[*]	**4.15 (1.45-6.85)**[**]	2.16 (-1.34 – +5.66)	2.25 (-1.37 – +5.88)
HIV-related school quality index (higher vs. lower quality)	—	**4.48 (1.82-7.15)**[**]	—	-0.42 (-4.68 – +3.85)
Male orphans	(n=480)		(n=283)	
Male orphan	-0.17 (03.18 – +2.85)	0.05 (-2.95 – +3.06)	0.75 (-2.71 – +4.21)	0.80 (-2.66 – +4.27)
School quality index (higher vs. lower quality)	2.67 (-0.78 – +6.13)	**3.87 (0.24-7.49)**[*]	3.87 (-0.68 – +8.42)	4.15 (-0.61 – +8.91)
HIV-related school quality index (higher vs. lower quality)	—	**3.71 (0.17-7.26)**[*]	—	-1.11 (-6.95 – +4.73)
Female orphans	(n=468)		(n=284)	
Female orphan	-2.90 (-5.95 – +0.15)	-2.85 (-5.86 – +0.16)	2.71 (-1.10 – +6.51)	2.73 (-1.07 – +6.53)
School quality index (higher vs. lower quality)	1.85 (-1.51 – +5.21)	**3.90 (0.35** – +7.46)[*]	-1.59 (-6.72 – +3.54)	-1.85 (-7.15– +3.45)
HIV-related school quality index (higher vs. lower quality)	—	**5.62 (2.15-9.09)**[**]	—	0.96 (-5.31 – +7.23)

[†]Adjusted for variables as in Table 6-6 *, **, *** Significant at p<0.05, 0.01, 0.001

6.4 Discussion

In this chapter, I have considered how schools might act to help improve child outcomes. I have used the concept of 'HIV-competence' in schools as a framework for addressing this question by taking a human rights approach to tackling HIV and its effects in children. Using indicators based largely on information children have provided themselves, I have directly incorporated the youth perspective into this work. Addressing the objectives of this chapter:

1. A wellbeing index for children was developed using data largely provided by children themselves to create indicators that directly relate to the child, and do not treat children as merely an extension of their parents' situation.

2. I found that regular school attendance was associated with higher overall wellbeing in orphans of primary school age, but there were no significant associations in secondary school-aged children.

3. Two composite indicators of school quality (one general, one HIV-specific) were created based on the characteristics of HIV-competent communities and qualitative interviews conducted by colleagues.

4. General school quality was found to be associated with children being in the correct grade-for-age, but not regular attendance. HIV-specific school quality had no additional effect beyond that of general quality.

5. General and HIV-specific school quality was positively associated with wellbeing in primary school children, but not secondary school children. In neither case was school quality preferentially associated with the wellbeing of vulnerable children.

There is a long tradition of monitoring wellbeing in adult populations, which is now extending into the younger ages. Such monitoring is important because well-measured, consistent indicators provide a useful way of assessing the condition of society that goes beyond simple deprivation indices [323]. The information that wellbeing measures provide can be used to inform important issues of policy and to guide strategic approaches to social development. By describing the condition of children and tracking child outcomes, indicators of wellbeing allow researchers, policymakers, advocacy groups, and service providers to set goals for improving the lives of children [323].

6.4.1 School attendance and wellbeing

It is this context of wellbeing, and the potential for schools to affect it, that drove the analyses in this chapter. When looking at the associations between regular school attendance and wellbeing, I found that, although regular attendance had no association with wellbeing in vulnerable children overall, it did have a positive association with wellbeing in orphans (overall, male, and female) of primary school age. The composite variable for vulnerable children included those children who were HIV-positive themselves and children who had HIV-positive parents, in addition to orphans. Although causality cannot be assessed due to the cross-sectional nature of the data, it is possible that orphans derive more value from regular school attendance than other children affected by HIV. Many schools have programmes in place to support orphans and the poorest children, but these programmes may not include other vulnerable children, making them potentially less likely to benefit from attending school [288,324]. On the other hand, it may be the case that it is those orphans who already have greater wellbeing that are choosing to attend school. I would argue, however, that this is the less likely of the two options, because no effect was seen in vulnerable children overall. If it was truly those children who had greater wellbeing who were more likely to attend school, then one would expect this effect to be true for all vulnerable children, not

just for orphans. However, because many schools, including those in the study area [325], have programmes in place that support orphans and impoverished children, but not those who are vulnerable in other ways, it would be a very large coincidence that it is the children specifically supported by schools that have higher wellbeing.

6.4.2 School quality and education outcomes

I found an association between school quality and progression in schooling (*i.e.* children being in the correct grade-for-age); however, no association was seen between school quality and regular attendance. The implication of this is perhaps that school quality is not enough on its own to encourage children to attend regularly, but that once children are in school, there are tools in place to help them progress at a normal pace. This, of course, assumes that the observed associations are not due to external confounding factors (*e.g.* community characteristics). To minimise such confounding, all analyses included community level variables, including community type, average community SES, and HIV prevalence. Alternatively, it may be that because attendance is already very high (>90%) there is not much margin for improvement.

6.4.3 School quality and child wellbeing

The role of schools as social protection for children may go beyond improving education outcomes, and reach into helping to improve a child's overall wellbeing. Even though there was no differential association between vulnerable and non-vulnerable children, higher levels of school quality were associated with significantly higher levels of wellbeing among primary school-age children, suggesting that the effect of good quality schools may extend beyond vulnerable children to children overall. Vulnerable children still benefit from higher quality schools, just not more so than non-vulnerable children. This is a crucial point, because, although high quality schools may not preferentially help OVC, if a causal

relationship exists, my work reinforces the view that schools can go beyond merely dealing with education to improving the practical and emotional challenges faced by children. This is particularly important in areas of high poverty, where schools may be the only formal agency available to support children.

6.4.4 Schools supporting children

As Campbell *et al.* have discussed, the ability of communities (and schools) to support people affected by HIV is not just a measure of HIV-specific activities and policies, but is a composite of factors directly related to HIV, the ethos of the community, and other characteristics that are perceived to be supportive of vulnerable people (*e.g.* in the case of schools: infrastructure, teaching methods, and school fees) [125,299]. It is the combination of these factors that enables schools to support not just vulnerable children, but children overall. I did not find clear or strong effects of HIV-specific school policies on educational outcomes or wellbeing in our data, suggesting that it is not necessarily the HIV-specific factors that enable schools to support vulnerable children but, instead, the more general factors that provide a safety net.

Previous work investigating best practices for schools in SSA suggests the potential for schools to go beyond education, to also contribute to tackling practical, material, and emotional challenges faced by vulnerable children [290,326-328]. Bell and Murenha (2009) suggest that improving the conditions of schools and the process of teaching are keys to mitigating the effects of the HIV epidemic in SSA [290], a topic which I have discussed in greater detail in the introduction (section 1.4). Kelly (2002) also highlights this approach, focussing on participatory learning and school linkages with the community as ways of moving forward to support children and improve both their health and education outcomes [326]. These views are supported by my findings that general school quality (a measure that includes schools facilities, teaching methods, and community links) is associated with better

progress through school and child wellbeing, as opposed to the HIV-specific factors. Kelly argues that HIV/AIDS education programmes in SSA often lack contextual understanding and in some cases may in fact exacerbate the very problem they are trying to address [326]. As I did not assess the quality or content of the HIV-related activities and programmes in the schools in the study it is impossible to say if this is the case in the study population, though it is a potential reason for why I only found associations with the HIV-based quality index in one of the analyses.

6.4.5 The community context

When examining the associations of schools with education outcomes and wellbeing, it is not possible to ignore the potential effects that the community could have. It may be that better off communities have better schools and/or more resources to support child wellbeing and progression in school. By accounting for both the community type and other community level characteristics in my analyses, hopefully most of the confounding effects at the community level should have been accounted for and therefore the associations seen between school quality and education outcomes and wellbeing are true. Despite this, it is likely that it is a combination of community and school factors that influence child wellbeing and education outcomes. Indeed, I found that associations with child wellbeing extend beyond the role that schools can play on their own, as the community context of the schools was significantly associated with wellbeing. Even when accounting for a school's quality, a higher community prevalence of HIV was negatively associated with wellbeing in secondary school-aged children. This shows that schools do not operate in isolation, but are part of a wider context that cannot be ignored when considering their relationship with child wellbeing and education outcomes. One of the key properties of the concept of HIV-competence is the existence of links between communities, or schools, and outside agencies [299]. HIV competent schools are social entities that reflect interconnections and interactions (in both directions) between schools and the local communities that they serve, support, and draw

resources from. That is to say that it is a two-way process and the two are to some extent inseparable. Without engaging with the larger world and seeking outside links and sources of support, it is unlikely that schools will have the resources or skills to tackle a devastating social problem, such as the effects of the HIV epidemic [299,329]. The community context must also be taken into account when working with schools on the role they can play in the lives of vulnerable children, because the implementation of any intervention is constrained by poverty, social uncertainty and poor service delivery [330]. This is particularly important for social development interventions with a heavy psycho-social component, such as interventions centred on learning. These interventions are more likely to succeed when they resonate with communities' own understandings of their needs and interests, and build on pre-existing community strengths [52,331].

6.4.6 Gender

In addition to running the analyses in this chapter for children overall, I also divided the analyses by gender to examine if there was a differential effect between males and females. Previous work has shown that females often receive more benefits from school-based interventions, such as cash transfers, as compared to males [276,285]; and are also more likely to be the target of these interventions [244,275]. Here we found a similar relationship, with school quality having a significant positive association on females being in the correct grade-for-age, but not males. However, primary school quality was significantly associated with higher wellbeing in both males and females, though HIV-specific primary school quality only had a positive effect in females. This is not to say that school-based interventions are only helpful for girls, it is simply that girls are particularly vulnerable to early marriage, early sexual debut, pregnancy, and sexually transmitted infections, the risks for which can be reduced by remaining in school [54,112,243]. Boys can still incur benefits from interventions encouraging them to go to school: for example, a study in western Kenya found that an

intervention to provide school uniforms to children reduced dropout rates and early marriage for both boys and girls [276].

6.4.7 Secondary school children

Despite the associations in primary school-age children, I found no association between school quality and either education outcomes or wellbeing in children of secondary school age. Additionally, there were no associations between vulnerability and wellbeing in this population. One possible reason for this is, quite simply, that it may be that older children have become accustomed to their situation. If their parents(s) died when they were a young child, it could have conceivably been a decade or more since they were orphaned and they no longer feel the burden as heavily as they did when they were younger. Alternatively, it has been reported that adolescents made vulnerable by HIV show resilience in the face of their circumstances and develop coping strategies [46,332-335]. These can include income generating activities, social networking, and participating in the community and gaining support from it [46,332]. Such activities could conceivably have a positive effect on wellbeing, which, due to their age, are less accessible to primary school-aged children.

The lack of any wellbeing or education outcome associations with secondary school quality might imply that the school is no longer a key part of a child's primary support network, and instead that adolescents are more directly engaged with the community, either through taking on more responsibilities at home or working outside the home to earn money. Indeed, school attendance declines with age among secondary school children, suggesting that, as children become older, school no longer plays as central a role in their lives as it once did. An adolescent's reasons for leaving school could also interact with their wellbeing in several ways. For example, it may be those adolescents from disadvantaged backgrounds who no longer attend school due to financial reasons, or it may be that they leave school to get married or enter employment, or they may have been expelled or had insufficient exam

passes. However, without knowing why they left school, it is not possible to say the likely direction of the association with wellbeing.

6.4.8 Causality and other weaknesses

While the cross-sectional nature of the data limits my ability to draw firm causal conclusions about the role of school quality in determining improved educational outcomes of vulnerable children, I have adjusted for various contextual factors, including SES, to reduce the influence of outside resiliencies on the data and minimise confounding. Additionally, few of the components of the school quality indices could be influenced by children's wellbeing; therefore reverse causality seems implausible. There is the possibility for reverse causality in the association between regular attendance and wellbeing, but as discussed earlier, I find this to be unlikely.

The unique combination of individual, household, and community data sources available from the Manicaland Project allowed me to link school characteristics (including HIV-specific activities) to children's outcomes, but I may still have been limited by the small sample size due to the inability to link some children to their schools, potential imprecise classification of the school attended by some children, and lack of detail about schools' policies and implementation. The effectiveness and consequences of these policies should be an area for further quantitative and qualitative research, including more ephemeral measures, such as a sense of school community, that I was unable to measure.

6.4.9 Differing paradigms for improving education

Demonstrating the ability of strong institutions to affect child outcomes is important in light of previous work done in this population, which has shown that OVC are more susceptible to poor education outcomes than children unaffected by poverty and HIV [78,241]. In SSA, without

support, vulnerable children may drop out of school, fail to enrol, attend less frequently, have lower educational attainment, be at a lower grade for their age, and perform worse in school than their counterparts unaffected by the HIV epidemic [73,75-77,79,241]. The best way to address these issues remains a topic for debate with research espousing the merits of both social institutions and individual incentives like cash transfer programmes [230,275,336]. In the Manicaland community CT [230], there was a strong attempt to combine the two approaches with strong community participation in designing the CT programme and involvement (and strengthening) of community structures in its implementation. Such community buy-in has been shown to be beneficial for achieving positive health and education outcomes [337,338].

If quality schools are better able to support the educational attainment of vulnerable children, then it becomes critical to engage with schools and help them to recognise and mobilise their inherent resources for the benefit of their students. Investing in schools as community resources and a form of social support is a potential complementary approach to CTs, which provide direct financial resources to OVC. Previous research in Manicaland has found that both conditional and unconditional cash transfers to OVCs successfully increased regular attendance [230], and we found here that external support is associated with higher psychological wellbeing, but cash transfers often rely on outside sources of funding that may come and go as funding priorities change, although governments in SSA, including Zimbabwe, are beginning to offer cash transfer programmes themselves [339]. Instead, by helping schools to mobilise their inherent resources (those that exist outside of the funding provided by the government or aid agencies, such as teaching HIV awareness and providing an inclusive environment) and helping them engage with the community, schools can act as a form of social protection independent from outside aid. It is not reasonable to expect that this can occur without additional funding, but, unlike CTs, which must be given to each child/household, an investment in schools could potentially benefit all children. And once the programmes/practices are established, they would potentially require minimal funds, if any at all, to keep running.

Although CTs and HIV-competent schools appear to be contrasting paradigms that have massive implications for public policy making and expenditures, this may not be the case. HIV-competent schools, which suggests that making institutional changes are the approach to improving education and well-being, and CTs, in which it's suggested that individual incentives are the way to improve education and wellbeing, could in fact be used synergistically, especially if CT programmes engage community stakeholders. The use of inter-sectoral programming could be used effectively to improve the education outcomes and wellbeing of OVC, with education departments focusing on supporting schools by helping them to mobilise their inherent resources and engage with the community, and the social welfare or children's departments organising cash transfers.

The key findings and conclusions in this chapter are:

1) Vulnerable children in primary school have lower wellbeing than non-vulnerable children, indicating a need for them to receive support. Children in secondary school did not have differences in wellbeing by vulnerability status, possibly due to them having had time to adapt to their situation or their age conferring greater resilience.

2) Among orphans in primary school, regular attendance was associated with significantly higher wellbeing, but not in vulnerable children overall.

3) General school quality was associated with orphans being more likely to be in the correct grade-for-age, but not with attendance in primary or secondary school. HIV-related school quality had no additional effect in any of these analyses.

4) Both general and HIV-specific school quality are positively associated with higher overall and psychological wellbeing in primary school-age children, supporting the hypothesis that good quality schools can have a positive effect on children's lives.

5) School quality did not have a differential effect on wellbeing for vulnerable compared to non-vulnerable children, but because higher levels of school quality were associated with significantly higher levels of wellbeing among primary school-age children, this suggests that the effect of good quality schools may extend beyond vulnerable children to children overall.

6) The community context plays a part in a child's wellbeing and must be taken into account when looking at interventions to either increase schooling or improve wellbeing.

7) Females were more likely to see an association with school quality than males, but this was not universally true, suggesting that schools can play a role in improving wellbeing for both genders.

8) Acting as part of the larger community, schools can play an integral role in improving the future outlook of children, particularly at younger ages. If schools can mitigate the impact of poverty and disease on marginalised children and provide them with opportunities and relevant education, then they take an important step towards improving the future outlook of vulnerable children.

7 Discussion

7.1 Synthesis of findings

The HIV/AIDS epidemic in SSA has affected children in many ways beyond HIV infection itself, including through parental loss, increased burdens of care and work, and poorer education outcomes. The work in this thesis has focused on HIV-related vulnerability in children and youth from eastern Zimbabwe, an area of SSA highly affected by the HIV/AIDS epidemic, and how these vulnerabilities and HIV itself interact with education in a variety of ways. I have analysed data from an open cohort study in rural eastern Zimbabwe to determine exactly what these interactions might be, including how schools may be able to help improve the outcomes of vulnerable children. The main findings of my thesis, as they pertain to HIV-related vulnerability and education, are summarised in Figure 7-1, which is an updated version of Figure 1-1. In addition to the findings directly pertaining to HIV and education I have also described the epidemiology of HIV in children from eastern Zimbabwe (Chapter 2) and shown that although education has generally increased over time, that there were slight decreases during the height of the economic crash (Chapter 3). I have already discussed the detailed findings of the analyses at the end of the relevant chapters, and so, in this chapter, I will discuss the main conclusions of my thesis in combination with their broader implications, including on policy, for education and child wellbeing in the context of HIV/AIDS in Zimbabwe.

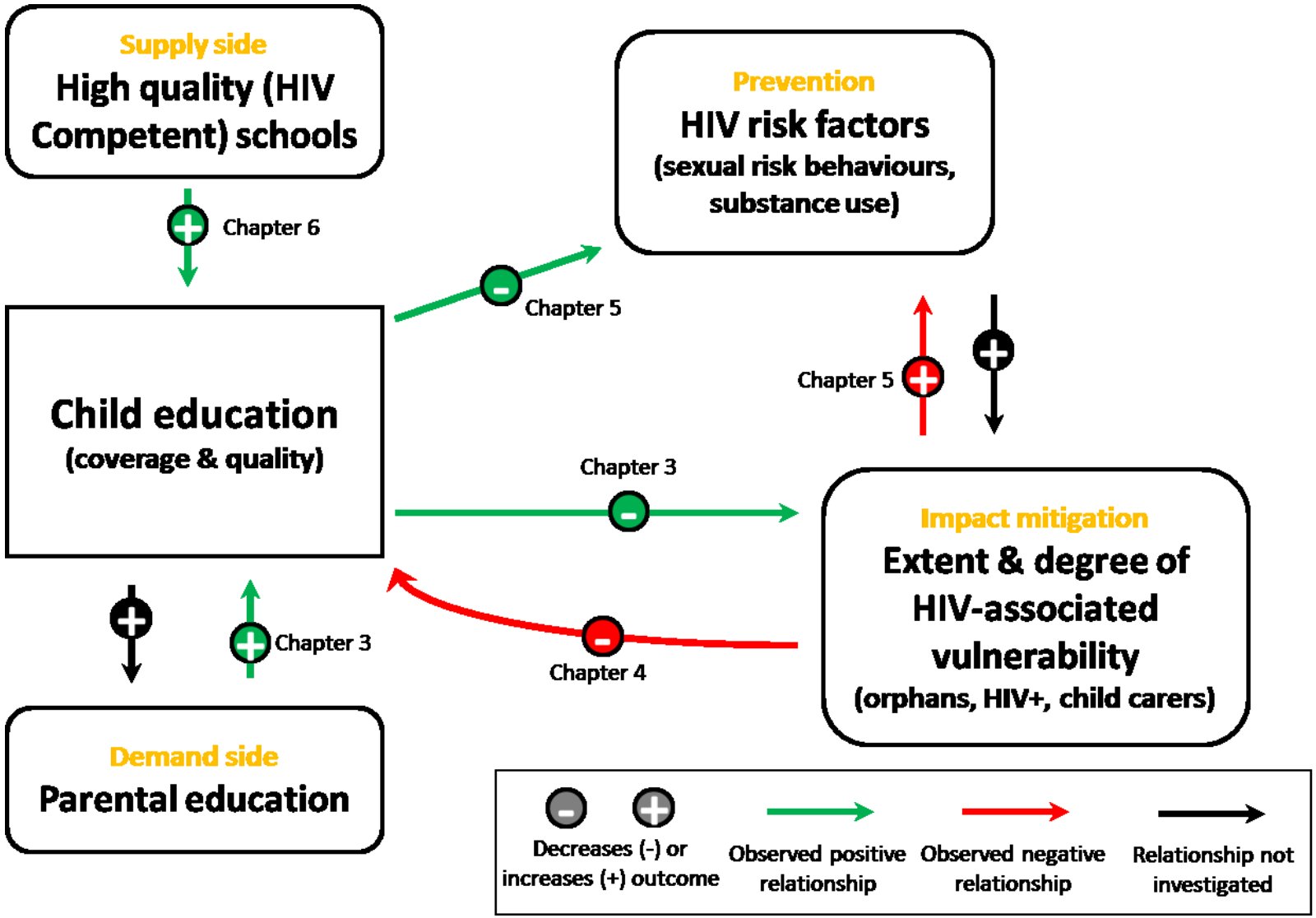

Figure 7-1 Updated theoretical framework for the synergistic relationship between education and HIV reduction, summarising the findings in this thesis.

HIV prevalence in children aged 2-17 from 2009-2011 was 2.1%, a value similar to that predicted by the UNAIDS Spectrum model [59,152]. The results from the analyses of maternal deaths and HIV status in comparison to their children's HIV status suggest that MTCT of HIV is the primary source of infection in this population, even among older adolescents. This supports previous mathematical models and findings from populations in SSA that suggest that some children infected through MTCT may live into at least early adulthood [14,147,148]. Despite a longer lifespan than was previously anticipated [340-343], HIV-positive children do still experience poorer health outcomes than HIV-negative children, including stunting and being underweight [151,173,174]. Additionally, HIV-positive adolescents were more likely to report episodes of recent illness, suggesting a potential progression to AIDS, and that adolescent long-term survivors of MTCT may place an increased burden on healthcare systems in the coming years [151] – although timely provision of ART may help to offset these demands.

Education outcomes have improved over the long-term in Manicaland, although more acute education indicators fell during the economic turbulence of the 2000s and males consistently outperformed females. Parental education, particularly that of mothers, was strongly associated with education outcomes among their children, implying that an educated female population is important for education among future generations. Moreover, females with secondary or higher education were less likely be infected with HIV than their less educated counterparts, a finding that supports education being protective against HIV in the later stages of the epidemic [102,103,120,124]. It is possible that high education levels contributed to the behaviour change and subsequent HIV decline in Zimbabwe [4,139]. All of these findings reiterate a familiar story in SSA, whereby it is often women who are less educated than men [203,212-215], despite the strong benefits that an educated female population bring not only to themselves [215], but to society as a whole [216].

Given the importance of education to an individual's future prospects, I wanted to determine whether or not vulnerability, including HIV infection, was associated with education

outcomes among children and adolescents. Although HIV status had no associations with any education outcomes, orphaned females were less likely to succeed in education than their non-vulnerable counterparts, supporting previous research in Manicaland and elsewhere that orphans have poorer education outcomes than non-orphans [73-75,80,214,228]. Conversely, young-carers had better educational outcomes than other vulnerable children, supporting the hypothesis that young-carers are empowered, as opposed to disadvantaged [46]. Although young-carers do not appear to do less well at school, the lower education levels experienced by orphans compared to other children have potentially severe negative consequences for childhood development and life outcomes, considering that children who miss out on education often struggle as adults to find employment, and, when they do find a job, typically earn less than their educated counterparts [236]. In addition to the economic consequences of lost education, for those children who are not infected perinatally, decreased school attendance can have a dramatic impact on HIV prevention, as a good, basic education is one of the most effective and cost-effective means of avoiding HIV infection [81].

Knowing that OVC are at increased risk for substance use, poor education outcomes, and HIV infection, I created a causal model for these relationships and showed that increases in substance use by orphans may be partially responsible for their increased HIV risk, and a decrease in substance use may be one way in which education reduces HIV risk in orphans. These findings are consistent with other studies from SSA and across the world looking at the associations between orphanhood and substance use [62], education and substance use [62,272,273], and substance use and sexual risk behaviours [248-259], although, to my knowledge, this is the first time that these concepts have been studied together to elucidate this part of the causal pathway between orphanhood and HIV risk.

Qualitative work from Manicaland and other countries in SSA suggest that schools can act as sources of support for vulnerable children [52,125,126,299], providing them with not only better

education outcomes, but also with greater overall wellbeing. Having established in my thesis the poor outcomes that children, both vulnerable and not, experience with reduced education, I felt it was important to move beyond the problems and attempt to investigate a way in which they could be addressed. Linking schools to children within the survey area showed that although vulnerable children had lower wellbeing (and the previously established poorer educational outcomes), that children, both vulnerable and not, in higher quality schools were more likely to have better grade progression and higher overall wellbeing. Interestingly, females more frequently saw an association with school quality than males, supporting the theme of the importance for education in women that runs throughout this thesis. My work here shows that, with the right tools and by taking the community context into consideration, schools can help to improve the wellbeing of children both vulnerable and not. Investments in schools may then be a complement to the current focus on CTs, which, while enormously beneficial to those who receive them, do not reach all children as schools have the potential to.

In summary, the main conclusions of my thesis are:

1) The prevalence of HIV in children in Zimbabwe is not higher than what would be expected through MTCT alone and additional data confirm that a substantial proportion of children infected through MTCT can live into their teenage years. This is important knowledge because finding, treating, and supporting these children can save a lot of health.

2) Coverage of ART remains low in children, and appears to be largely due to the child or their guardian being unaware of the child's HIV-positive status, but ART coverage was high among those who were diagnosed. The increase in PMTCT programmes that are already underway in Zimbabwe should help to prevent new HIV infections in

children, but there is also a need to increase the testing of children so that those children who are HIV-positive can be placed on treatment as soon as possible.

3) Education has been steadily increasing in Zimbabwe, despite the economic turmoil, with parental education being a strong indicator of a child's educational attainment. Moreover, secondary or higher education was consistently associated with lower HIV, reinforcing the importance of education as an HIV-prevention tool in this population.

4) Despite the benefits of education, those children who are already vulnerable remain at increased risk of poor education outcomes. This lower educational standard may increase their risk of substance use, which in turn may increase their risk of risky sexual behaviours that put them at risk of HIV infection.

5) Gender disparity continues to be a major limiting factor in achieving the self-defined goal of "education for all" in Zimbabwe. Girls continue to lag behind boys in their education outcomes and are more likely to suffer educational setbacks if they are orphans. Despite this, girls are also more likely to see the benefits of high quality schools, suggesting that directed investments in the education system could help to close the gap between male and female education.

6) Acting as part of the larger community, schools can play an integral role in improving the future outlook of children, particularly at younger ages. If schools can mitigate the impact of poverty and disease on marginalised children and provide them with opportunities and relevant education, then they take an important step towards improving the future outlook of vulnerable children.

7.2 Novelty and strengths of the work

This thesis provides a holistic and comprehensive assessment of the relationship between HIV and education and the role that schools, and school education, can play in combatting HIV and its effects in Zimbabwe and beyond.

In Chapter 2, I presented the first statistics on HIV in children from a large population-representative sample in Zimbabwe. This is also one of only a handful of studies to describe HIV in children at a population level in SSA, with the other studies coming from South Africa [160,163]. Because there have been so few studies in this area, child HIV data from a large sample is incredibly valuable for helping to characterise the HIV epidemic in rural African populations. In Zimbabwe, these data can be used to accurately inform programmatic approaches for HIV in children. Beyond their usefulness in Zimbabwe, the estimates from this work and from the work in South Africa, which present similar prevalence values [160,163], can be used to inform HIV monitoring and control programmes in other parts of Africa that have previously relied on estimates from mathematical models that had not been calibrated using data from children.

Chapter 3 quantified, for the first time, the negative impacts that the economic crash had on Zimbabwe's education system, which had previously been reported only in anecdotal press coverage [192]. Such historic data can be used as baseline information to help track the progress of the education system's recovery and examine if it is in-line with the economic recovery. In addition to the historic data on education, I conducted the first study into the direct effects of HIV infection on school attendance and progression in children from SSA. While HIV infection itself was not associated with poor school performance, it appears that the other vulnerabilities surrounding HIV (particularly orphanhood) disadvantage children.

In addition to the novelty of the individual analyses in this thesis, the holistic approach that I took to education and HIV highlighted the reinforcing aspects of the relationship between the two. This approach provided insight into the downstream benefits of investing in females (higher education in future generations), the obstacles to this (orphanhood), and how these might be overcome (HIV-competent schools). My comprehensive approach to HIV and education has also shown that mitigation can assist in prevention – by providing vulnerable adolescents with education, they are at a decreased risk of substance use, which, in addition to the inherent benefits that provides, is also linked to decreased risky sexual behaviours. By demonstrating both the ways in which education can improve outcomes and the consequences of this, I provide a compelling picture that highlights the importance of investment in the Zimbabwean concept of "education for all".

In addition to the important findings on education, I have also provided data that is being used to inform the refinement of Spectrum, which is the main UNAIDS tool that countries use to monitor, and plan their response to, the HIV epidemics. I highlighted that the Spectrum estimates for Manicaland were consistently higher than observed data and that applying Spectrum at a regional level requires taking into consideration the fact that regional-level realities may not match the national data. Based on these findings, the Manicaland Project was awarded a grant to validate Spectrum at the regional level, with preliminary results showing that the Spectrum age pattern of HIV prevalence in children now match the data [344].

My work in Zimbabwe also provides a good basis for work in the rest of SSA due to the advanced stage of the epidemic. Because Zimbabwe's epidemic is several years ahead of those in many southern African countries, it provides an excellent model for what works and does not work in terms of both HIV prevention and care for those people who are HIV-positive. Specific local contexts must always be taken into account though, and small pilot projects that engage the community and assess the feasibility and acceptability of any intervention, such as HIV-competent schools, should always be conducted.

7.3 Limitations of the work

When interpreting the results of the work presented here it is important to consider the limitations of the methods and data that were used. One of the main limitations of this thesis is the reliance on cross-sectional data for much of the analyses and that the timing of key events was not available, meaning that in many instances I was unable to assess causality. For instance, it was not possible to determine if adolescents commenced sexual activity before or after they began to partake in substance use. This reduces the strength of the conclusions that can be drawn, because the direction of causation in the established relationships cannot be established with certainty. That being said, previous research into the various relationships, even in different contexts, was examined and was used to inform the hypothesised timing of events in the data - *e.g.* previous research in Asia suggests that substance use typically precedes sexual HIV risk behaviours [258]. Moreover, by establishing in the first chapter that HIV infection in children and adolescents in this population is most likely from MTCT, I was able to analyse the associations of HIV infection on educational attainment confident in the direction of (potential) causation.

One limitation of a lot of education research is that it can be quite difficult to measure quality of education. Simply measuring the quantity of children who participate in education (*i.e.* who are enrolled in school) does not address whether or not any actual education occurred for these individuals [345]. Moreover, measures of achievement, such as standardised tests, are incomplete proxies for education quality. These tests provide no information on student values, capacities, or other non-cognitive skills that should also be part of a complete education [345]. It can also be difficult to assess changes in quality over time. For example, quality could have declined even while enrolment, attendance, and grade progression stayed high. Comparisons across time can, however, be made, as long as the measures of education remain internally consistent, are measured in the same age and education groups, and on a common scale [345], as I did in Chapter 3. Despite the weaknesses in the existing

measures of quality education, they do have their strengths as well. Even a measure of school enrolment can have benefits in a country, such as Zimbabwe, where school fees exist. Whether parents enrol and send their children to school can depend on how they view the quality of education provided as they must decide, particularly in resource-limited settings, if the time and cost of educating their child is worth the lost productivity that child could provide at home [345]. Despite the weaknesses of test scores and grade progression, they do serve as useful proxies for education quality. These measures provide information on how well the curriculum is being taught and understood, and exit exams, such as 'O' level passes, indicate how well students have done at the exit point of the education system, which helps employers and universities to select those individuals best qualified for employment and further education [345]. I have also addressed another facet of education quality in Chapter 6, by creating a school-based index of quality. This index of quality comprised both the physical resources of the school, in addition to teaching practices and methods. Given the known issues with measuring per-pupil spending as a measure of school resources [346], and because this data was not available to the study, I instead measured resources directly. Despite measuring resources such as student-to-teach ratio, after school programs, and teaching materials, I was not able to measure the quality of these resources, only whether or not they existed. To address this gap, I included measures of teaching based on what occurs in the classroom, which have been suggested as proxies for education quality [346].

An issue that arose several times in the analyses was small sample sizes impacting on my ability to either run the analyses or make meaningful conclusions from them. In many cases these small sample sizes were reasons for optimism - *e.g.* when too few adolescent women partook in substance use to be able to make any meaningful conclusions about the causes and consequence of substance use among them. Other examples of small sample sizes include too few HIV-positive children in each individual year of age to accurately compare the single-year prevalence values to Spectrum data and too few HIV seroconversions in

youth aged 15-24 over the survey rounds to make inferences on the effect of education on HIV incidence. If these questions are to be addressed in the future then studies will need to be purposefully designed to address them, with the appropriate sample size calculations conducted.

Another factor that may have limited my ability to detect differences between vulnerable and non-vulnerable children is the fact that, in populations with large HIV epidemics, almost all people, including children, are affected to at least some degree – *e.g.* if not by losing a parent then by losing other relatives, which may be felt more closely in African cultures that consider cousins as brothers and sisters. This is particularly important in SSA, where extended families are likely to be affected, but also provide support networks that help to share the burden. The pervasive effects of the HIV epidemic may contribute to the lacking or small differences between children included and not included in definitions of OVC, and may mean that comparison groups in analyses are not truly control groups. This was an additional reason that I looked at the benefits of good quality schools for all children in my final chapter.

Beyond potentially smaller differences in vulnerability between children I defined as vulnerable and not, the role and effects of external support may have contributed to there being fewer observed differences between OVC and non-OVC. In Chapter 4, I found that orphaned children were more likely than non-vulnerable children to live in a household receiving external support and those that did had improved education outcomes, although the coverage of these programmes was modest in the study population. The reporting on external support was likely an underestimation of what was received as only 256 of 5505 children (4.7%) reported living in households receiving cash transfers (CTs), despite there being a large ongoing CT trial in the study area during the fifth survey round [230]. Although I adjusted for the receipt of external support (whether through CTs or another source), I was only able to do this in data from the round five child survey (the only questionnaire in which

this data was collected) and, as I have said, this was likely a low estimate of the coverage of external support. This underestimation of external support may have impacted on my analyses, reducing the apparent difference in education outcomes between OVC and non-OVC.

7.4 Future research directions and policy implications of the work

The work in this thesis has brought to light several areas of further work that should be examined in the future. The first of these is the importance of monitoring the population of HIV-positive children who are now aging into adulthood. Much has been made by others, and here in this thesis, of the issues facing young children affected by HIV: How long will they live? What are their health outcomes? Do they suffer from psychological issues? Do they have poorer education outcomes? Do they experience stigma and discrimination? And, although these are important issues, far less attention has been paid to what happens to maternally infected children when they age out of childhood and adolescence and into adulthood. Beyond investigating the vulnerabilities and setbacks that these people face, we should also focus on the longer-term links between a childhood experienced through HIV and future development, health conditions, social participation, risk behaviours, emerging sexuality, and attitudes and approaches to starting a family. Long-term survivors of MTCT in Zimbabwe and elsewhere are now reaching early adulthood and it is becoming critically important to monitor their mental and physical health, behaviour patterns and survival, particularly as the ageing of the HIV epidemic and the longer survival times on ART mean that this population is steadily growing. It was originally believed that children infected through MTCT would not survive beyond the age of two [340-343], and even now we remain unsure of exactly how long they will live and what quality of life they will possess. Therefore, it is necessary to continue to follow those children infected with HIV in infancy so that we are able to understand their expected outcomes and if they can expect a similar sort of lifespan as those people infected as an adult. Studies are needed that can accurately identify youth

infected through MTCT and follow them forward into adulthood, with a matching cohort of HIV-negative youth, to accurately assess any differences that might or might not exist between these groups. Research into this area is needed not just in SSA, but all over the world where HIV-positive children are now reaching adulthood. Although we are striving towards an AIDS-free generation, it is important that we do not ignore those children who already have HIV and that we continue to monitor their progress and provide services for them as best we are able.

Following on from the above point, my thesis reemphasises the importance of using cohort data to track the timing of events so that a clear causal link can be established. I have discussed previously how this is useful in the timing of events such as substance use, education, and HIV infection, but it will also be important for monitoring incident HIV infections in children. Although I concluded that the majority of HIV infections in children were through MTCT, supporting much previous research [14,146-148,347-352], I did detect one HIV infection that could not be attributed to MTCT or sexual infection. If incident data from a cohort study were available, it would be possible to detect cases of horizontal transmission, which will become even more important as the scaling-up of PMTCT programmes continues. Currently there is a push to achieve an "AIDS-free generation" and the importance of identifying unknown sources of infection will increase lest people incorrectly assume that PMTCT programmes are failing to protect infants from HIV infection. Conversely, it remains important to screen out false cases of horizontal infection that arise, potentially due at least partly to the adoption effect. When children knowingly or unknowingly report their adopted mother as their biological mother, it increases the likelihood that a serodiscordant mother-child pair will be identified [27]. Such pairs may incorrectly lead to the assumption that horizontal transmission is a larger problem in young children than it actually is. Therefore, in the absence of incident data, it remains necessary to verify the biological mother's identity by whatever means available, including household rosters and fertility histories, which may be more practical to implement than the more accurate tools of maternity testing and comparing

viral sequences. Encouragingly, the Manicaland Project has noted the importance of cohort data among children and the child survey component was included in the round six questionnaire, allowing for an accurate determination of incident HIV infections in addition to all of the other benefits that arise from repeated measures in a population. Data from the sixth survey round will hopefully be available for analysis in early 2015.

Based on my research into education, substance use, and HIV risk behaviours, I suggest that the previous focus of most programmes on improving the education outcomes of females should be widened to include males as well. The work I have done here suggests that any initiatives that increase educational attainment in males, including CT programmes and supportive schools, may cause a decrease in both substance use and HIV risk behaviours. Obviously, these programmes should not be expanded at the expense of girls, particularly given their continuing education shortfalls as compared to boys, but neither should the potential benefits of education for young males be ignored. Despite the low number of young males who seroconverted during the course of the study, this is not a reason to avoid investment in protecting them from HIV. Other studies that have investigated HIV risk have shown that education reduces HIV risk not only immediately after being in secondary school, but also in the longer term [114,115,117,119] and that males in education are less likely to have HIV than males outside of education [117]. Simply because HIV prevalence in males is lower than in females, does not mean that males should be ignored. The simple fact remains that even if HIV prevalence is lower in males than in females that, in Manicaland, it was still over 10% from 2009 to 2011. Moreover, in a generalised (heterosexual) HIV epidemic, such as the one in Zimbabwe, high HIV prevalence in one sex will inevitably be passed on to the other.

It is important to develop integrated programmes and policies that incorporate multiple strategies for improving the outcomes of vulnerable children. If HIV-positive children are living longer than was originally believed, as my work suggests they are, and are now within

the school safety net, policies must now focus on how to strengthen the school as a platform for delivery and support. Recently, the focus in SSA has been on the use of CTs to improve the education and health outcomes of children, especially those who are vulnerable and female. Although CTs can and do have significant benefits for those children and households who receive them, by their nature, they reach only those classified as eligible, whatever those criteria might be (poorest quintile of households, orphans, etc.). And because many children are likely affected by the HIV epidemic in ways that are not immediately visible or easily classifiable (as discussed in section 7.3), there is a need to incorporate broader-reaching programmes into government policy as a way to complement the directed approach of CTs. One option would be for CTs to take on a more holistic approach than the previous siloed programmes targeted at either school attendance, or psychological wellbeing, or nutrition, although this would still not address the issue of targeting. Alternatively, structural interventions, such as HIV-competent schools, which I have discussed in Chapter 6, may be a broader method of improving child outcomes. Structural interventions have multi-sectoral benefits, which, when taken into account, provide excellent value for money [353]. The concept of HIV-competent schools is based on a human rights approach to health and wellbeing that treats the child as an actor in his or her own life, which provides a useful framework for helping schools to position themselves as a key positive force in children's lives. Additionally, because of the high enrolment rates in Zimbabwe, particularly for young children, schools would be able to reach the majority of the young population.

Finally, future work and policy development should focus on goals that centre on reducing the gender gap in education, which will have multifaceted benefits for women, including effects on HIV. Work in my thesis clearly shows that young women continue to experience systemic disadvantages in terms of their education outcomes. This issue crosscuts all of my work, reappearing again and again, and has been echoed by UNICEF and other researchers for many years [203,212-215]. Although we have been aware of these disparities in education for

many years and their negative consequences, progress in addressing them remains slow. More work is therefore needed to identify ways by which we can increase the educational success of girls. Cash transfers have been an excellent starting point for this, but may not be feasible in all settings and conditions, and almost certainly one strategy on its own will not be enough to address the problem. Therefore I propose that more research, beyond the groundwork that I have laid in my thesis, should be done into how schools themselves can encourage the attendance and success of female pupils. But beyond just identifying strategies to increase female education, there must also be a concerted effort by researchers to engage with governments and policy makers so that they understand the importance of the issue and what works and does not in addressing it, so that real and lasting progress can be made towards ensuring everyone receives the benefits that education provides.

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Appendices

Appendix I: Published paper (Chapter 2)

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PLOS ONE

HIV in Children in a General Population Sample in East Zimbabwe: Prevalence, Causes and Effects

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Abstract

Background: There are an estimated half-million children living with HIV in sub-Saharan Africa. The predominant source of infection is presumed to be perinatal mother-to-child transmission, but general population data about paediatric HIV are sparse. We characterise the epidemiology of HIV in children in sub-Saharan Africa by describing the prevalence, possible source of infection, and effects of paediatric HIV in a southern African population.

Methods: From 2009 to 2011, we conducted a household-based survey of 3389 children (aged 2–14 years) in Manicaland, eastern Zimbabwe (response rate: 73.5%). Data about socio-demographic correlates of HIV, risk factors for infection, and effects on child health were analysed using multi-variable logistic regression. To assess the plausibility of mother-to-child transmission, child HIV infection was linked to maternal survival and HIV status using data from a 12-year adult HIV cohort.

Results: HIV prevalence was (2.2%, 95% CI: 1.6–2.8%) and did not differ significantly by sex, socio-economic status, location, religion, or child age. Infected children were more likely to be underweight (19.6% versus 10.0%, p = 0.03) or stunted (39.1% versus 30.6%, p = 0.04) but did not report poorer physical or psychological ill-health. Where maternal data were available, reported mothers of 61/62 HIV-positive children were deceased or HIV-positive. Risk factors for other sources of infection were not associated with child HIV infection, including blood transfusion, vaccinations, caring for a sick relative, and sexual abuse. The observed flat age-pattern of HIV prevalence was consistent with UNAIDS estimates which assumes perinatal mother-to-child transmission, although modelled prevalence was higher than observed prevalence. Only 19/73 HIV-positive children (26.0%) were diagnosed, but, of these, 17 were on antiretroviral therapy.

Conclusions: Childhood HIV infection likely arises predominantly from mother-to-child transmission and is associated with poorer physical development. Overall antiretroviral therapy uptake was low, with the primary barrier to treatment appearing to be lack of diagnosis.

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Data Availability: The authors confirm that all data underlying the findings are fully available without restriction. All data used in the study are publicly available as part of the "core data file" found at http://www.manicalandhivproject.org/data.html for unrestricted download under license agreement terms as a tab delimited text file.

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Introduction

In 2012, it was estimated that over 85% of children who became infected with HIV were living in sub-Saharan Africa (SSA) [1]. However, general population data about epidemiology and health effects of paediatric HIV in SSA are sparse. The most common data about HIV prevalence in SSA, Demographic and Health Surveys (DHS) and community-based cohort studies, have typically only included persons over age 15 years. As a result, estimates for HIV in children are generally extrapolated from data about pregnant women using mathematical models [2]. In Zimbabwe, UNAIDS estimated that 2.8% (95% CI: 1.6 3.7%) of children 0 14 were HIV-positive in 2012 [2,3]. Direct empirical data about the epidemiology, sources and impacts of HIV in children will improve confidence in estimates and ensure that health and social care systems are able to meet the needs of infected children.

Most infected children are believed to have acquired HIV perinatally from their HIV-positive mothers. Untreated HIV infection in infants is typically characterised by rapid disease progression and death at a median of two years of age or less, with survival depending at what stage (*e.g.* perinatally, breastfeeding) the infant becomes vertically infected [4,5], but it is estimated that perhaps up to a third of vertically infected children survive into

adolescence [6 8] and clinical reports have provided evidence of non-sexually acquired infections in adolescents [9 12]. However, debate continues as to whether or not these children are actually long-term survivors of mother-to-child transmission (MTCT) or have acquired HIV horizontally. Other studies have reported instances of horizontal HIV transmission in children [13 15]; however, these studies used non-representative samples or were conducted in highly localised areas.

In this study, we aim to: (i) describe patterns of HIV infection in a representative general population sample of children aged 2 14 years in a large-scale generalised HIV epidemic in rural areas of eastern Zimbabwe; (ii) investigate possible sources of horizontal HIV transmission in childhood; (iii) assess whether the observed age-pattern of HIV-positive children is consistent with that expected from survival of children infected from MTCT (given recent trends in adult prevalence and prevention of mother-to-child transmission (PMTCT) program scale-up); (iv) assess the impact of HIV on children's mental and physical health and nutritional status; and (v) investigate the levels and determinants of antiretroviral treatment (ART) coverage in children.

Methods

Study Population and Data Collection

The Manicaland HIV/STD Prevention Project is a population-based, open cohort study in eastern Zimbabwe [16 18]. Each round of the survey involves a census of all households in the 12 study sites (4 subsistence farming areas; 4 large-scale commercial estates; 2 small towns; and 2 roadside settlements), followed by interviews with individual household members and collection of dried blood spot samples for HIV testing.

In the most recent round (2009 2011) of the Manicaland survey, all children (aged 2 14 years) in a randomly selected 1/3 of households were invited to participate in an investigation of HIV prevalence amongst children. Children were interviewed about their welfare, health, and healthcare using a structured questionnaire. Children under seven answered with assistance from their primary caregiver. Questions on HIV testing and knowledge of HIV status were addressed to the child's primary caregiver in the presence of the child if he or she was over the age of seven. Additionally, the questionnaire was administered by a nurse who had HIV Testing and Counselling certificates, which include training in how to respond if a child becomes distressed. More sensitive questions were asked only of older children and were answered without their caregiver being present: children aged 7 14 years were asked questions on sexual abuse and on psychological health. If a child reported abuse then the interviewer notified the supervising nurse who would subsequently investigate in the company of a social worker. The information from the supervisor and social worker was then fed back to the Child Protection committee in the study area. All maternal data (religion and HIV status) were collected in the general (adult) survey and linked to child data based on children reporting who their biological mother was, and confirmed through fertility histories and the household roster. In cases where a link could not be made, or if the child was a maternal orphan, maternal data was coded as missing. Dried blood spot samples were collected and tested for HIV in an offsite laboratory using the COMBAIDS-RS HIV 1+2 Immunodot Assay (Span Diagnostics, India); for cases in which the child tested HIV-positive but had an uninfected mother, the HIV test results were confirmed using Vironostika HIV Uni-form II Plus O (Biomérieux, France) ELISA tests. Data used in the manuscript are provided in the supporting information file Dataset S1.

Ethics Statement

Ethical approval for the Manicaland HIV/STD Prevention Project was obtained from the Research Council of Zimbabwe (Number 02187), the Biomedical Research and Training Institute Zimbabwe's institutional review board (Number AP6/97), and the Imperial College London Research Ethics Committee (Number ICREC 9_3_13). Written informed consent was obtained prior to survey participation from each child's primary caregiver. In addition, children aged 7 14 years provided verbal or written assent, respectively. Participants and guardians were informed that, at any point, they could refuse to answer a question or decline to continue the interview.

Data Analysis

In this analysis of children aged 2 14 years old, we tested for associations of HIV infection with socio-demographic characteristics (sex, age-group, household socio-economic status (SES), community type, and mother's religion) using logistic regression. Socio-economic status was measured using a summed asset-based wealth index developed for the study population in Manicaland [19]. The mother's self-reported religious affiliation was classified into "Christian", "Traditional", "Spiritual", "Other", or "none", as in previous analyses of Manicaland data [20].

To test the hypothesis that HIV infection in children occurs primarily through MTCT, where available, we examined maternal survival/infection status (deceased, alive and HIV-negative, alive and HIV-positive, alive with unknown HIV status) by child HIV status to establish the plausibility of vertical HIV transmission. The odds ratios of being a maternal orphan and of being a maternal orphan or having an HIV-positive mother amongst infected and uninfected children were evaluated using a one-sided Fisher's exact test. We tested for associations between HIV infection and risk factors for horizontal HIV transmission, which included blood transfusion, vaccination, non-vaccination medical injections, breastfed by a non-biological mother, cared for a sick relative, and sexual abuse.

To assess whether the observed age-pattern of HIV prevalence in children is consistent with that which would be expected in Zimbabwe if infections were due to mother-to-child transmission, we compared the age-specific HIV prevalence data to national estimates of child HIV prevalence reported by UNAIDS [1]. These estimates are derived using the Spectrum model [21 23], which assumes MTCT is the source of paediatric HIV and reflects the declining trends in HIV prevalence recorded in pregnant women, rates of mother-to-child transmission, patterns of paediatric survival by time of infection, national data on PMTCT and anti-retroviral therapy (ART) scale-up, and effectiveness of PMTCT regimens [4]. The Spectrum file that we used in this analysis can be downloaded from http://apps.unaids.org/spectrum/.

The impact of HIV on measures of physical and mental health was evaluated using linear (continuous outcomes) or logistic (binary outcomes) regression, adjusting for age. Z-scores for height- and weight-for-age and weight-for-height were calculated using WHO child growth standards [24,25]. Z-scores below -2 were considered to indicate stunting (low height-for-age), being underweight (low weight-for-age) and wasting (low weight-for-height). Comparisons were made for stunting and being underweight for all children, while wasting was only compared in children aged 2 5 years, as these were the ages for which reference data were available [24]. Psychological wellbeing scores were calculated in children aged 7 14 years using principal components analysis of psychological distress measures as described by

Nyamukapa *et al.*, 2010 [26]. All analyses were conducted in Stata version 12.1 (StataCorp LP, USA).

Results

Demographic Profile of Infected Children

Four thousand six hundred and eleven children aged 2 14 years were enumerated and selected for inclusion in the study, of which 3389 (73.5%) completed the survey and gave a dried blood spot for HIV testing. Children who did not complete the survey did not have significantly different age or gender distributions and their household of residence did not have significantly different mean SESs than those who completed the questionnaire (all p>0.05). Reasons given for non-response included: away from home for work (7.4%), away from home for school (7.0%), another reason for being away from home (67.1%), whereabouts unknown (1.1%), refused (12.3%), and other (5.0%). Seventy-three (2.2%, 95% CI: 1.7 2.6%) were HIV-positive. Prevalence was 1.6% (11/688), 2.5% (33/1296), and 1.8% (25/1405) among children aged 2 4 years, 5 9 years, and 10 14 years, respectively. Demographic characteristics of children aged 2 14 years by HIV status are presented in Table 1. HIV prevalence did not differ significantly (p<0.05) by sex, age-group, or any other demographic characteristics (household SES, community type, and maternal religion).

Sources of HIV Infection

All but one HIV-positive child were either maternal orphans or had an HIV-positive surviving mother, consistent with the primary source of childhood infection being MTCT (Table 2). HIV-positive children were significantly more likely to be a maternal orphan (OR: 6.56, 95% CI: 4.03 10.66) and/or have an HIV-positive mother (OR: 76.03, 95% CI: 18.54 311.79)) than HIV-negative children. The one child who was HIV-positive but for whom the woman identified as his biological mother was HIV-negative (Table 2) was a three year-old male reported to be living with both biological parents. He did not report any of the risk factors for non-sexual horizontal transmission (blood transfusions, non-medical injections, breastfeeding by a non-biological mother, caring for a sick relative, or child abuse). Overall, 26.9% (902/3360) of participants who answered the survey questions reported any of the selected risk factors for horizontal HIV transmission (Table 3), excluding vaccination-related injections, of which 99.7% (3364/3374) of children reported having had. Item non-response ranged from 0.1% (ever cared for a sick relative) to 27.1% (ever had a blood transfusion) and did not differ between HIV-negative and HIV-positive children (all p>0.05). HIV-positive children were significantly more likely to report non-vaccination injections than HIV-negative children (41.1% vs. 26.2%, p = 0.01). Otherwise, no significant differences in reporting of risk factors (blood transfusions, breastfeeding by a non-biological mother, caring for a sick relative, child abuse or sexual activity) were found between HIV-positive and uninfected children.

Comparison of Observed Age-Specific HIV Prevalence with National Estimates from the Spectrum Model

HIV prevalence in children aged 2 14 observed in Manicaland was lower than the national estimates for Zimbabwe as a whole in 2010 from the Spectrum model (3.6%). However, the age-pattern of HIV prevalence amongst children observed in the data was consistent with the model estimates (Figure 1). This suggests that the age-patterns of HIV in Manicaland are in line with what would be expected if MTCT were the main source of child

Table 1. Association between demographic characteristics and HIV infection in children.

Category	Sub-category	HIV+	N in Sub-category	OR (95% CI)†	*p*-value‡
Gender	Male	2.34%	1712	Referent	0.21
	Female	1.73%	1677	0.75 (0.46–1.21)	
Age Group	2–4	1.60%	688	Referent	0.27
	5–9	2.54%	1296	1.61 (0.81–3.20)	
	10–14	1.78%	1405	1.11 (0.55–2.28)	
Household SES	Poorest quintile	1.75%	688	Referent	0.33
	Second quintile	2.38%	632	1.37 (0.64–2.95)	
	Middle quintile	0.70%	143	0.40 (0.05–3.07)	
	Fourth quintile	2.70%	1063	1.58 (0.80–3.13)	
	Least poor quintile	1.85%	863	1.06 (0.50–2.26)	
Community type	Subsistence farming	2.44%	1391	Referent	0.38
	Roadside trading	1.93%	671	0.79 (0.41–1.50)	
	Agricultural estate	1.36%	811	0.54 (0.27–1.08)	
	Commercial centre	2.13%	516	0.87 (0.44–1.73)	
Mother's religion[a]	Christian	1.44%	967	Referent	0.95
	Traditional	0%	13	N/A	
	Spiritual	1.53%	849	1.02 (0.48–2.19)	
	Other	1.69%	301	1.15 (0.41–3.21)	
	None	0%	67	N/A	

†Unadjusted odds ratio.
‡Fisher's exact test for difference of proportions.
[a]Total respondents (N = 2206) is lower than other categories due to maternal orphans (n = 348), unlinked records (n = 722) and question non-response (n = 113).
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Table 2. Maternal mortality and HIV status in children.

	Child HIV status	
Maternal status	**HIV- (N = 3316)**	**HIV+ (N = 73)**
Mother deceased	318 (9.59%)	30 (41.09%)
Mother alive, HIV+	390 (11.76%)	31 (42.47%)
Mother alive, HIV-	1765 (53.23%)	1 (1.37%)
Mother alive, unknown HIV status	843 (25.42%)	11 (15.07%)

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infections, accounting for the declining trend in adult HIV prevalence and the scale-up of PMTCT programmes in Zimbabwe.

HIV Status and Child Health

HIV-positive children were significantly more likely to be underweight (low weight-for-age) (AOR: 2.20; 95% CI: 1.08 4.47) and stunted (AOR: 1.69; 95% CI: 1.02 2.81) than HIV-negative children, but were not more likely to be wasted (low weight-for-height) (AOR: 0.43; 95% CI: 0.05 3.34) or to report a recent illness (AOR: 1.31; 95% CI: 0.64 2.66) (Table 4). HIV status was also not associated with psychological wellbeing (Coefficient: −0.06; 95% CI: −0.21 +0.09) (Table 4).

Of the 73 HIV-positive children, 26.0% (19/73) reported that they knew their HIV status. Of the HIV-negative children, 114/3309 (3.5%) had had an HIV test, significantly less than reported testing prevalence in HIV-positive children ($p<0.001$). Children of mothers who reported that they knew they were HIV-positive were 5.17 times (95% CI: 2.27 11.76) more likely to have had an HIV test and know the result than children of mothers who self-reported as HIV-negative. Knowledge of HIV status was not associated with psychological wellbeing score for HIV-positive children (change in psychological wellbeing score: +0.01; 95% CI: −0.131 +0.33). All but two of the children (17/19) who were aware of their HIV-positive status reported taking drugs that stop HIV from causing AIDS (*i.e.* were on anti-retroviral therapy (ART)). Despite high ART coverage when HIV status is known, overall, less than a quarter (23.3%, 17/73) of the HIV-positive children was receiving ART.

Discussion

This study describes the prevalence and consequences of HIV in children living in a rural area of southern Africa. In eastern Zimbabwe, from 2009 2011, 2.2% (95% CI: 1.7 2.6%) of children aged 2 14 years tested positive for HIV, at a time when HIV prevalence was 11% and 17%, respectively, amongst male and female adults (15 54 years) in the same population. This estimate, from a representative general-population sample, is lower than those from a sample of children in 2005 in Chimanimani district in southern Manicaland, where HIV prevalence was 3.2% (41/1290) in children aged 2 14 years [27]. Such a reduction between 2005 and 2010 is expected based on the decline in adult HIV prevalence and the increase in PMTCT coverage since 2005. A study conducted with 4,386 primary school children in Harare in 2010 found an HIV prevalence of 2.7% (95% CI: 2.2 3.1%) in children aged 6 13 years [28], which is close to the prevalence of 2.2% found in our study for a slightly different age-group in a different region. As was the case in the Chimanimani study [27] and in studies in similar age-groups elsewhere in SSA [29 31], including a large national population survey in South Africa conducted in 2008 [32], we

Table 3. Association between HIV status and potential horizontal risk factors for HIV.

Horizontal risk factors	Exposure	N	HIV+%	AOR (95% CI) †	*p*-value‡
Ever had a blood transfusion	No	3,355	2.15%	Referent	0.14
	Yes	7	14.3%	6.51 (0.80–53.34)	
Lifetime number of non-vaccination injections	0	2491	1.73%	Referent	0.004
	>0	873	3.44%	2.19 (1.23–3.89)	
Received tuberculosis, polio, measles, and/or diphtheria vaccination	No	10	0%	Referent	0.81
	Yes	3364	2.11%	N/A	
Breastfed by non-biological mother	No	3359	2.14%	Referent	0.71
	Yes	16	0%	N/A	
Cared for a sick relative (ages 6–14)	No	2403	2.29%	Referent	0.45
	Yes	35	0%	N/A	
Ever been sexually abused (ages 7–14)	No	2180	2.25%	Referent	N/A
	Yes	4	0%	N/A	

†Adjusted odds ratio; adjusted for age, gender, SES, and site type.
‡Fisher's exact test for difference of proportions.
NB: Different Ns are due to different question non-response rates.
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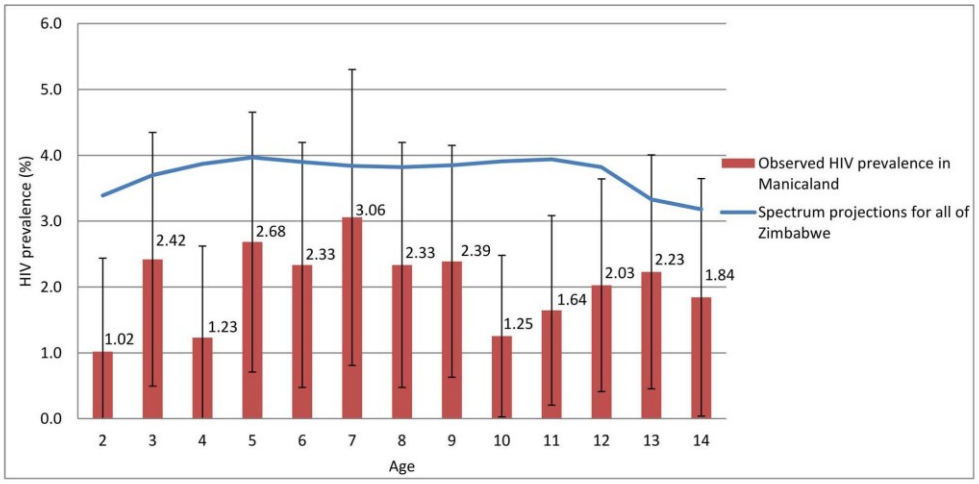

Figure 1. Comparison of observed HIV prevalence by age in Manicaland, with 95% confidence intervals, to the Zimbabwe national HIV estimates from UNAIDS and the Zimbabwe Ministry of Health and Child Welfare.
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found no significant differences in HIV prevalence with respect to sex or age.

Our finding of a relatively even pattern of HIV prevalence by age is consistent with official national estimates derived from the Spectrum model. Survival data for children infected with HIV through MTCT suggest high mortality [7] and, in a stable epidemic with little horizontal transmission and no PMTCT intervention, HIV prevalence will decline as children age into adolescence. However, the decline in HIV prevalence in pregnant women since the late 1990s (from 25.7% in 2002 to 16.1% 2009 [33]) and the scale-up of PMTCT services from the mid-2000s explain reduced prevalence in younger children to the levels observed in the current study. The pattern of HIV prevalence we saw with age is also consistent with that reported by Eaton et al. in 15–17 year-olds in the same population at different time points (2009–2011 here and 2006–2008 in Eaton et al.) [12]. That is, it supports the hypothesis that MTCT is the main source of HIV infection in children and adolescents in this population.

Our data further confirm the belief that MTCT is the primary mode of HIV transmission in children in eastern Zimbabwe [12]. Mothers of HIV-infected children were significantly more likely than mothers of uninfected children to be deceased or HIV-positive. One child, for whom we could not identify a plausible source of infection, did not report any vertical, sexual, or other horizontal risk factors for transmission. Exposure to potential modes of transmission may have been under-reported and data were not collected on all possible sources of infection, such as scarification and hospital and dental visits, which have previously

Table 4. Effects of HIV status on physical and mental health outcomes in children and adolescents.

Health outcome	HIV status	N	%	AOR (95% CI)[†]	*p-value*
Ill in last two weeks	HIV−	3320	11.55%	Referent	0.11
	HIV+	69	19.61%	1.31 (0.64–2.66)	
Low height-for-age	HIV−	3222	30.60%	Referent	0.04
	HIV+	69	39.13%	1.69 (1.02–2.81)	
Low weight-for-age	HIV−	2225	9.97%	Referent	0.03
	HIV+	51	19.61%	2.20 (1.08–4.47)	
Low weight-for-height[‡]	HIV−	833	11.64%	Referent	0.42
	HIV+	16	6.25%	0.43 (0.05–3.34)	
Psychological wellbeing score[a]	HIV−	2385	0.01	Referent	0.45
	HIV+	55	−0.05	−0.06 (−0.21–+0.09)	

[†]Adjusted odds ratio; adjusted for age, gender, SES, and community type.
[‡]Children 2–5 only.
[a]Mean and change in score between HIV− and HIV+; ages 6–14 only.
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been identified as sources of HIV in children [13 15]. Sexual abuse has also been identified as a potential mode of HIV acquisition in select cases in children [34 39], however, due to ethical reasons, little research has been conducted into the proportion of children infected with HIV through sexual abuse, even though sexual abuse has been reported to be common in South Africa [40,41]. While we cannot be certain about the accuracy of reporting about the child's biological mother, without biological tests, for which this study did not have consent, the identification of the biological mother was consistent with information reported on the household roster and the child was named on the mother's fertility history.

The need to understand HIV infection in children is particularly important given that HIV is increasingly becoming a cause of hospitalisation amongst adolescents in SSA [11] and this trend is likely to continue as more HIV-positive children age into adolescence. We found that HIV-positive children were significantly more likely to report non-vaccination medical injections than HIV-negative individuals, most likely because HIV-positive children are more likely to seek healthcare for managing their infection or to treat HIV-associated illnesses [11]. Thus, this association should therefore not be misconstrued as evidence for medical injections as a source of horizontal transmission, particularly as 27 of the 30 (90%) of the HIV-positive children who reported having had medical injections also reported being a maternal orphan or having a mother who was HIV-positive. Stunting and wasting in HIV-positive children, as well as being underweight, have been reported previously in SSA [11,42,43]. We found HIV-positive children to be significantly more likely to be underweight and stunted, indicative of the long-term harm of HIV infection on health and nutritional status. Perhaps unsurprisingly, we did not find a significant relationship with wasting, which measures recent severe weight loss, often associated with acute starvation and severe disease.

There are few data from SSA on the psychological manifestations of HIV infection in children, although studies from developed countries report significantly higher incidence of psychiatric admissions for HIV-positive children than HIV-negative children, with knowledge of HIV status increasing the risk of admission [44]. A previous study in Zimbabwe found that 56% of HIV-positive adolescents reported psychosocial problems, but that these problems were not common in younger children [45]. These data, however, were collected from children and adolescents visiting facilities offering HIV care services, and many respondents were already presenting with AIDS-related illnesses. Because the results were from a clinical study and were not compared to an HIV-negative population, it is not possible to conclude that there was a significant increase in psychosocial distress based on HIV status. Although we found no significant association between HIV status and psychological wellbeing, the lack of data from SSA in this area and the findings of Ferrand *et al.* (2010) [45] suggest that this is an important topic for future investigation.

Only a quarter of HIV-positive children in our study were aware of their HIV status. Across southern and eastern Africa, ART coverage among children is a major problem and high priority for many governments as it continues to lag behind adult coverage (33% versus 65% in the 22 priority countries, of which 21 are in Africa) [46]. So long as they remain undiagnosed, and therefore untreated, HIV-positive children are at higher risk for AIDS-related illnesses and early mortality. In the longer term, knowledge of HIV status is important to mitigate the risk of passing the infection on to sexual partners. Despite the low coverage of HIV testing, we found that if children or their guardians were aware of the child's HIV-positive status there was a 90% chance that the child would be on ART. This suggests that, despite the fear, potential stigma and associated costs, a positive diagnosis does result in the initiation of treatment. One way to help increase treatment amongst children might be to increase HIV-testing of women, as we found that when a mother knew herself to be HIV-positive, her child was significantly more likely to have had an HIV test themselves suggesting that getting more mothers diagnosed through PMTCT programs will improve child testing. Other possible ways to increase infant diagnosis of HIV in this population are the new point-of-care tests currently being developed. New tests include a rapid p24 antigen test and a nucleic-acid amplification test, both of which can be performed in under half an hour [47]. Currently, many infants go undiagnosed due to the long turnaround times or poor infrastructure associated with dried blood spot sample testing [48]. Early infant HIV diagnosis is important, as the high ART coverage when children are aware of their status implies that lack of knowledge of HIV status is a contributing factor to the low coverage of ART in children that has been noted in Zimbabwe (39.5% according to the 2011 national estimates [49]) and more broadly in most of sub-Saharan Africa.

Conclusion

These findings provide evidence that MTCT is the principal source of HIV infection in children in southern Africa and that current initiatives to increase the availability and effectiveness of PMTCT should result in reductions in HIV prevalence in children over time. Effort should be made to encourage HIV testing in children because, despite low overall ART coverage, children who are aware of their HIV status were highly likely to be on treatment.

Supporting Information

Dataset S1 (CSV)

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Author Contributions

Conceived and designed the experiments: ELP CN JWE SM LR SG. Analyzed the data: ELP JWE. Wrote the paper: ELP CN JWE RM LR SG SM GC. Organised the data collection: CN RM GC SG.

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Appendix II: Published paper (Chapter 4)

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The impact of HIV on children's education in eastern Zimbabwe

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Little is known about how HIV impacts directly and indirectly on receiving, or particularly succeeding in, education in sub-Saharan Africa. To address this gap, we used multivariable logistic regression to determine the correlation between education outcomes in youth (aged 15–24) (being in the correct grade-for-age, primary school completion and having at least five "O" level passes) and being HIV-positive; having an HIV-positive parent; being a young carer; or being a maternal, paternal or double orphan, in five rounds (1998–2011) of a general population survey from eastern Zimbabwe. The fifth survey round (2009–2011) included data on children aged 6–17, which were analysed for the impacts of the above risk factors on regular attendance in primary and secondary schools and being in the correct grade-for-age. For data pooled over all rounds, being HIV-positive had no association with primary school completion, "O" level passes, or being in the correct grade-for-age in adolescents aged 16–17 years. Additionally, HIV status had no significant association with any education outcomes in children aged 6–17 surveyed in 2009–2011. In 2009–2011, being a young carer was associated with lower attendance in secondary school (69% vs. 85%, AOR: 0.44; $p=0.02$), whilst being a maternal (75% vs. 83%, AOR: 0.67; $p<0.01$), paternal (76% vs. 83%, AOR: 0.67; $p=0.02$) or double (75% vs. 83%, AOR: 0.68; $p=0.02$) orphan was associated with decreased odds of being in the correct grade-for-age. All forms of orphanhood also significantly decreased the odds of primary school completion in youths surveyed from 1998 to 2011 (all $p<0.01$). We found no evidence that HIV status affects education but further evidence that orphans do experience worse education outcomes than other children. Combination approaches that provide incentives for children to attend school and equip schools with tools to support vulnerable children may be most effective in improving education outcomes and should be developed and evaluated.

Keywords: HIV; children; education; orphanhood; Zimbabwe

Introduction

In sub-Saharan Africa (SSA), the impact of the HIV epidemic on children's education is only now beginning to be properly understood. The majority of children affected by HIV are of school-going age and live in countries where education is not compulsory and school fees exist (Boerma, Urassa, Senkoro, Klokke, & Ngweshemi, 1999; UNAIDS, UNICEF, & USAID, 2004). School fees are particularly problematic for children from households impacted by HIV due to lost income from sick or deceased adult relatives and the high costs of medicines (Fenner et al., 2010). In addition to the financial barriers, children may stop attending school because they have to care for sick family members, or may themselves be HIV-positive. Indeed, in the Central African Republic and Swaziland, AIDS caused school enrolment to fall by 25–30% at the beginning of the millennium (UNAIDS, 2002) and, in a high-density community in Zimbabwe, nearly 72% of children affected by AIDS were not in school, compared to just 29% of children not affected by AIDS (Kembo, 2010).

On an individual level, it has been shown that a child's education can be negatively impacted by either the loss of a parent or having an HIV-positive parent. Loss of a father may result in children dropping out of school (Case, Paxson, & Ableidinger, 2004), while maternal death has been associated with children not enrolling in school, delaying school attendance, lower educational attainment, being at a lower grade for their age and worse performance in school (Ainsworth, Beegle, & Koda, 2005; Birdthistle et al., 2009; Case & Ardington, 2006; Evans & Miguel, 2007; Nyamukapa & Gregson, 2005). Children with sick parents have also been shown to be at a lower grade for their age due to interruptions caused by looking after their ailing parent (s) (Ainsworth et al., 2005; Kasirye & Hisali, 2010).

An increasing number of studies have examined the effects of parental loss and illness on education outcomes in SSA. A recent review noted that, of the 23 peer-reviewed

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studies on the effects of HIV/AIDS on children's education outcomes published between 1999 and 2010, none had directly examined the effects of children being HIV-positive themselves (Guo, Li, & Sherr, 2012). AIDS-related illness experienced by HIV-positive children and adolescents could be expected to impact negatively on attendance and, therefore, on grade progression (Bandason et al., 2013). Moreover, research suggests that perinatal HIV infection can cause developmental delay and impact cognitive development at a young age (Mayaux et al., 1996; McDonald et al., 2012; Puthanakit et al., 2013; Smith et al., 2000), which could have negative consequences for school performance in both primary and secondary school children.

Although there is a general consensus that HIV and its downstream impacts have negative consequences for education outcomes, the type and magnitude of those effects can vary dramatically by country. Differences between countries in traditional customs and socio-cultural, economic, policy and political situations influence the barriers and opportunities for education among vulnerable children (Atekyereza, 2001; Guo et al., 2012; Nyamukapa, Foster, & Gregson, 2003; Urassa et al., 1997). The effect of orphanhood on enrolment and attendance varies with age, gender, religion and household composition (Ainsworth et al., 2005; Ainsworth & Filmer, 2006), all potential cofactors in the relationship between orphanhood and school attendance/enrolment (Birdthistle et al., 2009; Kürzinger et al., 2008; Sharma, 2006).

In SSA, Zimbabwe provides an excellent setting in which to study education outcomes because, although primary school fees were introduced in 1991 and have risen steadily since (Kanyongo, 2005), literacy rates remain among the highest in Africa, with education being a clear priority in many families. We investigated the impact of a range of HIV-related effects on children's and adolescents' education outcomes in the Manicaland province of Zimbabwe, using pooled data for adolescents from five survey rounds conducted from 1998 to 2011 and data for children from a dedicated child survey (2009–2011). Dimensions of vulnerability to HIV investigated were (1) being HIV-positive; (2) having an HIV-positive or AIDS-sick parent; (3) being a maternal, paternal orphan or double orphan; and 4) being a young carer. High school enrolment in the study population (over 90% in 2009–2011) allowed us to examine the effects of HIV not only on school attendance but also on quality of education. Education outcomes considered were (1) regular attendance of primary or secondary school, (2) enrolment in the correct grade for age, (3) completion of primary school, and (4) having acquired at least five "O" level passes (final year examinations, of which five passes are the minimum requirement for formal sector employment).

Methods

Study population and data collection

The Manicaland HIV/STD Prevention Project is a population-based, open-cohort survey in the Manicaland province of eastern Zimbabwe. Five rounds of the survey were conducted between 1998 and 2011. Each round involves a census of all households in the 12 study sites (2 small towns; 2 roadside settlements; 4 subsistence farming areas; and 4 large-scale agricultural estates), followed by random sampling of individual household members aged 15–54 for interview, with roughly 10,000 individuals interviewed in each round. As part of the most recent round (2009–2011), a child survey component was added. A total of 5520 two- to seventeen-year-olds were interviewed from a random sample of households using a structured questionnaire similar to that employed in the adult survey. Dried blood spot samples were taken from all participants and tested for HIV in an offsite laboratory using the COMBAIDS-RS HIV 1+2 Immunodot Assay (Span Diagnostics, India); HIV positives were confirmed using Vironostika HIV Uni-form II Plus O (Biomérieux, France).

Ethical approval for the Manicaland HIV/STD Prevention Project was obtained from the Medical Research Council of Zimbabwe, the Biomedical Research and Training Institute Zimbabwe's institutional review board, and the Imperial College London Research Ethics Committee. Written informed consent was obtained prior to survey participation from the participant or their primary carer, if under the age of 18. In addition, children aged 7–12 and adolescents aged 13–17 years provided verbal or written assent, respectively. Participants and guardians were informed that, at any point, they could refuse to answer a question or decline to continue the interview.

Education variables

Educational outcomes were measured using different variables in the adult and child surveys. From the adult survey, data were pooled over all rounds and educational outcomes were completion of primary school (aged 15–24), having at least five "O" level passes (aged 16–24) and being in the correct grade-for-age (aged 15–20). Grade-for-age was used to measure progress in schooling and adolescents were deemed to be progressing normally if they were no more than two years behind in school (Miller, 2006). The two-year leeway allowed for the differing ages when children start school.

For the child survey, education outcomes were primary school completion (aged 13–17), being in the correct grade-for-age (aged 8–17) and regular attendance for both primary (aged 6–12) and secondary (aged 13–17) school. Regular attendance was defined as having attended at least 80% of the last 20 school days. Children

who were not enrolled in school were included in the analysis as children who did not attend regularly.

Data analysis

Logistic regression was used to determine associations between the education outcomes and children made vulnerable by AIDS, either through being HIV-positive; being a young-carer; having an HIV-positive parent; or being a maternal, paternal or double orphan. Comparison groups were individuals who were unaffected by HIV/AIDS. Models were adjusted for age (linearly, by single year of age), gender, socio-economic status (measured using a previously described index (Lopman et al., 2007)), community type (subsistence farming, roadside settlement, town or estate) and round of data collection (if applicable). Individual random effects were included to account for repeated measures of the same individuals in multiple survey rounds and household random effects were included to account for residual correlation between children residing in the same household. Analysis of the association between being HIV-positive and education outcomes for young adults included only persons aged 15–17 in rounds 4 and 5, of whom, HIV-positive persons were most likely long-term survivors of mother-to-child transmission (MTCT) (Eaton et al., 2013), to avoid the reverse causality that poor education outcomes contributed to subsequent risk of HIV infection. In cases where orphanhood was significantly associated with an education outcome, we tested whether age of orphanhood had an impact on that outcome.

Results

Table 1 presents characteristics of vulnerable and non-vulnerable children in 2009–2011 (round five of the survey). There were no significant differences between the different types of vulnerable children, except for young carers being older than other children (mean age: 14.4 years vs. 10.8 years; $p<0.01$). All categories of vulnerable children were more likely to come from households receiving external assistance than non-vulnerable children (all p values <0.05). Additionally, young carers were significantly more likely to come from households receiving schooling support than other categories of children (14.0% vs. 3.6%, $p<0.01$). When comparing children receiving external support to those not, although the numbers are small, orphans from households receiving support for schooling ($n=91$) were significantly more likely (76.7% vs. 50.0%, $p=0.03$) to be in the correct grade-for-age than orphans not receiving support.

Being HIV-positive was not significantly associated with any education measures in youth aged 15–17 years pooled from rounds 4 and 5 (Table 2) or in children aged 6–17 surveyed from 2009 to 2011 (Table 3). Young

Table 1. Characteristics of vulnerable and non-vulnerable children (aged 6–17) in round five (2009–2011) of the Manicaland survey.

	Non-vulnerable (n: 2518, 55.0%)	HIV+ child (n: 94, 2.1%)	HIV+ parent (not ill) (n: 585, 12.8%)	HIV+ parent (ill) (n: 178, 3.9%)	Young carer (n: 86, 1.9%)	Maternal orphan (n: 727, 15.9%)	Paternal orphan (n: 1406, 30.7%)	Double orphan (n: 483, 10.6%)
Average age	12.4	12.5	12.7	12.8	14.4	13.6	13.4	13.9
Percent male	49.3%	53.2%	48.6%	49.4%	41.9%	48.8%	49.6%	50.1%
Site type								
Town	13.9%	18.1%	17.6%	19.1%	15.1%	18.0%	15.7%	17.2%
Commercial estate	23.9%	11.7%	25.0%	22.5%	27.9%	17.1%	18.4%	15.9%
Subsistence farming	42.4%	50%	35.6%	36.0%	39.5%	39.3%	42.0%	42.7%
Roadside trading centre	19.8%	20.2%	21.9%	22.5%	17.4%	25.6%	23.8%	24.2%
Average SES	0.33	0.33	0.31	0.30	0.29	0.31	0.29	0.30
Percent receiving external support								
Any form of support	10.5%	17.0%	15.2%	16.3%	23.3%	14.4%	14.4%	14.7%
Education support	1.1%	4.3%	4.4%	7.3%	14.0%	4.4%	4.6%	4.6%

Note: Percentages of vulnerable and non-vulnerable children do not add up to 100% as some children are in more than one category of vulnerability.

Table 2. Associations between measures of childhood vulnerability and education outcomes in data from youth (aged 15–24 years) pooled over five survey rounds (1998–2011).

	Correct grade for age (ages 15–20)			Completed primary (ages 15–24)			5+ O level passes (ages 16–24)		
	n/N (%)	AOR (95% CI)	*p*	*n/N* (%)	AOR (95% CI)	*p*	*n/N* (%)	AOR (95% CI)	*p*
HIV+[a]	1177/1370 (85.9%)	0.87 (0.32–2.35)	0.78	1674/1754 (95.4%)	0.75 (0.12–4.56)	0.75	70/1,596 (4.4%)	0.48 (0.12–2.00)	0.32
HIV+ parent									
Parent not ill	892/1260 (70.8%)	1.23 (0.90–1.70)	0.20	1346/2137 (96.3%)	1.16 (0.55–2.44)	0.70	168/1,729 (9.7%)	1.45 (0.91–2.33)	0.12
Parent ill	946/1356 (69.8%)	0.88 (0.60–1.28)	0.67	2405/2505 (96.0%)	1.03 (0.57–1.86)	0.93	217/2,089 (10.4%)	1.42 (0.80–2.50)	0.23
Young carer	1448/2184 (66.3%)	1.25 (0.95–1.64)	0.10	7858/8160 (96.3%)	0.92 (0.59–1.44)	0.71	795/5,519 (14.4%)	1.11 (0.85–1.45)	0.46
Orphanhood[b]									
Maternal orphan	2483/3641 (68.2%)	0.83 (0.65–1.06)	0.14	6097/6351 (96.0%)	0.44 (0.29–0.67)	<0.01	418/5,468 (7.6%)	0.93 (0.66–1.31)	0.68
Paternal orphan	3155/4586 (68.8%)	0.99 (0.81–1.19)	0.90	8705/9042 (96.3%)	0.59 (0.40–0.86)	<0.01	522/6,914 (7.5%)	1.00 (0.74–1.34)	0.98
Double orphan	3034/4429 (68.5%)	0.85 (0.67–1.10)	0.22	7701/8015 (96.1%)	0.47 (0.31–0.71)	<0.01	510/6,740 (7.6%)	0.90 (0.62–1.32)	0.60

Note: Odds ratios are adjusted for age, sex, round, SES and site type, with household and individual (to account for repeat measurements) random effects.
n/N: number of youth who have attained the education outcome/total number of youth included in each analysis (**NB**: *N* differs for each analysis due to different response rates for the questions on the vulnerability categories).
[a]Ages 15–17, rounds 4 and 5 only.
[b]Ages 15–20.

Table 3. Associations between measures of childhood vulnerability and education outcomes in children in most recent survey round (2009–2011).

	Correct grade for age (ages 8–17)			Primary attendance (ages 6–12)			Secondary attendance (ages 13–17)		
	n/N (%)	AOR (95% CI)	*p*	*n/N* (%)	AOR (95% CI)	*p*	*n/N* (%)	AOR (95% CI)	*p*
HIV+	1632/1995 (81.8%)	0.77 (0.38–1.56)	0.47	1115/1216 (91.7%)	0.88 (0.14–5.53)	0.89	481/729 (66.0%)	1.67 (0.43–6.48)	0.46
HIV+ parent									
Parent not ill	544/684 (79.5%)	1.19 (0.73–1.93)	0.49		N/A[a]		184/259 (71.0%)	1.04 (0.56–1.95)	0.89
Parent ill	488/645 (75.6%)	0.75 (0.43–1.31)	0.32	173/194 (89.2%)	0.47 (0.05–4.73)	0.52	177/257 (68.9%)	1.23 (0.55–2.76)	0.61
Young carer	1044/1265 (82.5%)	0.83 (0.43–1.59)	0.57	1096/1195 (91.7%)	0.73 (0.06–9.56)	0.81	519/623 (83.3%)	0.47 (0.25–0.89)	0.02
Orphanhood									
Maternal orphan	1979/2453 (80.7%)	0.67 (0.51–0.88)	<0.01	1299/1409 (92.2%)	1.59 (0.53–4.75)	0.41	637/922 (69.1%)	0.77 (0.52–1.12)	0.17
Paternal orphan	2377/2967 (80.1%)	0.67 (0.60–0.96)	0.02	1514/1644 (92.1%)	1.16 (0.57–2.36)	0.68	769/1114 (69.0%)	0.80 (0.57–1.12)	0.19
Double orphan	2306/2890 (79.8%)	0.68 (0.49–0.93)	0.02	1487/1613 (92.2%)	1.63 (0.50–5.31)	0.42	744/1088 (68.4%)	0.73 (0.46–1.16)	0.18

Note: Odds ratios are adjusted for age, sex, SES and site type, with household random effects.
n/N: number of youth who have attained the education outcome/total number of youth included in each analysis (**NB**: *N* differs for each analysis due to different response rates for the questions on the vulnerability categories).
[a]No children in comparison group who do not attend school regularly.

carers were less likely to attend secondary school (69.0% vs. 85.2%, AOR: 0.44, $p=0.02$) from 2009 to 2011, a difference that was seen in both male and female young carers. However, being a young carer had no association with primary school attendance. Maternal (74.9% vs. 82.6%, AOR: 0.67, $p<0.01$), paternal (76.3% vs. 82.6%, AOR: 0.67, $p=0.02$) and double (75.0% vs. 80.6%, AOR: 0.68, $p=0.02$) orphans were all less likely to be in the correct grade-for-age amongst children aged 8–17 years surveyed from 2009 to 2011. Youth aged 15–20 years pooled over all rounds were less likely to have completed primary school if they were maternal (94.6% vs. 96.7%, AOR: 0.44, $p<0.01$), paternal (95.7% vs. 96.8%, AOR: 0.59, $p<0.01$) or double (94.4% vs. 96.4%, AOR: 0.47, $p<0.01$) orphans. However, the effect of orphanhood was not cumulative: double orphans were no more likely than maternal or paternal orphans to suffer educational setbacks (Figure 1) after adjusting for covariates, and orphanhood was not associated with primary or secondary school attendance or with "O" level passes. Age at orphanhood was not significantly associated with any of the education outcomes.

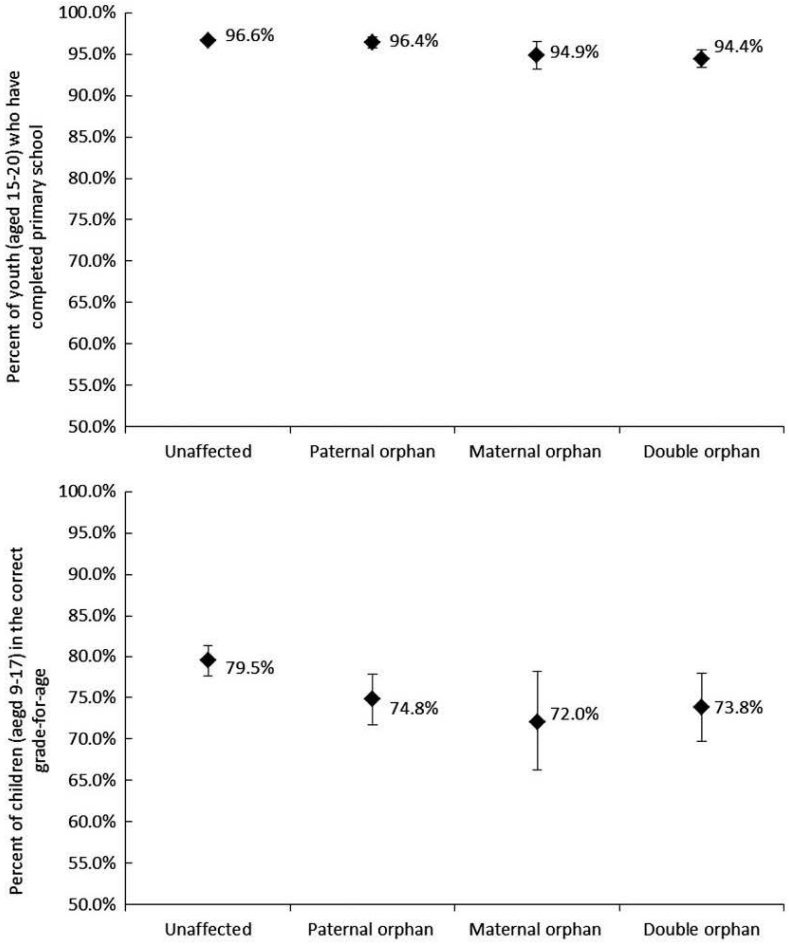

Figure 1. Unadjusted differences in percentage of children who have completed primary school (1a) and who are in the correct grade for age (1b) as a function of orphanhood status, compared to children unaffected by the HIV-epidemic.

Discussion

Our analysis did not find evidence that HIV status affects children's education outcomes in eastern Zimbabwe. The lack of effect of HIV status on education outcomes in younger children could be because HIV-positive children who have survived to primary school age have experienced slower disease progression, have exhibited few signs of infection and are unaware that they are infected. Bandason *et al.* found an association between HIV status and being in the correct grade-for-age in primary school children in Harare, which was attributable to illness (Bandason et al., 2013). However, they did not adjust for potential confounders, such as orphanhood, a possible alternative explanation for poorer educational outcomes, as is suggested in our analysis. Associations between HIV and education outcomes amongst adolescents might have been expected considering other evidence that HIV-positive adolescents experience AIDS-related illnesses (Eaton et al., 2013; Ferrand et al., 2010) which could impact negatively on school attendance and performance. We saw no evidence of this, perhaps due to the small number of HIV-positive children of school-going age in our sample. If sick children and adolescents were less likely to participate in the survey, our results could be subject to selection bias. However, only 0.65% (5/768) of non-respondents in our child survey were due to illness.

Although a child's HIV infection status did not affect their education outcomes, being a young-carer and orphanhood had negative impacts on education outcomes. Between 2009 and 2011, young carers were significantly less likely to attend school regularly than their unaffected peers. As Cluver describes, this is likely due to the time constraints and high burden placed on children who must care for ailing relatives or younger siblings after a parent has died (Cluver, Operario, Lane, & Kganakga, 2012).

Orphanhood significantly reduced the odds of children being in the correct grade for their age and completing primary school. Previous studies, summarised in a review by Guo *et al.* also found orphaned children to be educationally disadvantaged compared to their peers (Guo et al., 2012). Most commonly, studies reported that orphaned children were less likely to be enrolled in school or to attend regularly (Case et al., 2004; Evans & Miguel, 2007; Monasch & Boerma, 2004). However, other studies (Birdthistle et al., 2009; Kürzinger et al., 2008; Oladokun, Brown, Aiyetan, Ayodele, & Osinusi, 2009; Sharma, 2006) found, as we did, that orphanhood had no effect on enrolment or attendance. In addition to the effects of orphanhood varying by country, due to differences in potential cofactors (Guo et al., 2012), the lack of effect we saw could also have been due to orphaned children being relocated to live with more well-off relatives, who were willing and able to provide for their education. Although the numbers were low, we found that orphaned children living in households who reported receiving external support were more likely to be in the correct age-for-grade than those not receiving support. External support received by vulnerable households could have permitted families to send their children to school on a regular basis. This possibility is supported by recent findings from our study population that both conditional and unconditional cash transfers to households increased school attendance amongst vulnerable children (Robertson et al., 2013); findings which echo those from other settings (Kremer, Brannen, & Glennerster, 2013).

The few studies that have examined the gap in schooling found, as we did, that children who lost either or both of their parents to AIDS were less likely to be in the correct grade for their age due to the interruption in studies caused by parental illness preceding death (Ainsworth et al., 2005; Bicego, Rutstein, & Johnson, 2003). Some of these studies have found that it is not atypical for households where one or more parents have died of AIDS to prioritise the enrolment of older children while delaying enrolling the younger ones (Guo et al., 2012).

In a previous study using data from the first two rounds of the survey in Manicaland, all types of orphans were less likely to have completed primary school than their unaffected counterparts (Nyamukapa & Gregson, 2005). Other studies have found that orphanhood can hinder general educational attainment due to the interruption of parental illness and death (Ainsworth et al., 2005; Bicego et al., 2003). Moreover, children orphaned by AIDS have been reported to be less confident and more impulsive, anxious and aggressive in school than other children (Tu et al., 2009). This disruptive behaviour, along with the potential psycho-social impacts of AIDS orphanhood (Nyamukapa et al., 2008, 2010), could account for the poor school performance of orphaned children.

We found that the percentage of children behind in school in Manicaland (from 2009 to 2011) increases from 17.4% (95% CI: 15.8–19.0%) overall to 23.1% (95% CI: 20.2–26.0%) for paternal orphans and 25.4% (95% CI: 19.7–31.1%) for maternal orphans. This is particularly worrisome given the continued high levels of orphanhood in Zimbabwe (Zimbabwe Ministry of Health and Child Welfare, 2012). The lower education levels experienced by orphans compared to other children have potentially severe negative consequences for childhood development and life outcomes considering that children who miss out on education often struggle as adults to find employment, and, when they do find a job, typically earn less than their educated counterparts (Plan, 2008). Exacerbating this problem is the economic situation of Zimbabwe. Initially, after Independence in 1980,

Zimbabwe's primary education was free of charge, but fees were introduced in 1991 (Kanyongo, 2005). Fees have risen steadily since then, and, with the economic crash in the last 2000s, many families, particularly in rural areas, were either unable to afford school fees, or needed their children to help out at home earning money. For children who grow up in rural areas, such as those in Manicaland, education enables them to make better use of the resources available, whether by teaching them how to increase the productivity of their land, how best to sell excess produce and how to manage their household budget (Plan, 2008). Without the skills that proper education imparts, children already disadvantaged by the loss of a parent may continue to fall further behind their more educated peers.

Conclusions

Whilst we found no evidence that HIV-infected children suffered poorer educational outcomes in this population, our findings add to the body of knowledge which suggests that children from families impacted by the HIV epidemic, particularly orphaned children, are less likely to succeed in school than children less affected by AIDS. Orphaned children were more likely than non-vulnerable children to live in a household receiving external support and those that did had improved education outcomes, although the coverage of these programmes was modest in the study populations. Recent studies have shown that cash transfer programmes, in particular, can be an effective means of promoting education (Kremer et al., 2013; Robertson et al., 2013). However, for schools to be able to support children made vulnerable by HIV/AIDS, it is necessary that they remain accessible to as many children as possible, which can be a challenge due to the many barriers that exist at the individual and institutional levels (Schenker & Nyirenda, 2002). Therefore, a combination approach that provides incentives for children to attend school and also equips schools with the tools to support vulnerable children may be most effective in improving education outcomes.

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The contribution of schools to supporting the well being of children affected by HIV in eastern Zimbabwe

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Objectives: Schools are often cited as a source of support for orphans and children affected by HIV/AIDS in populations experiencing generalized HIV epidemics and severe poverty. Here we investigate the success of schools at including and supporting the well being of vulnerable children in rural Zimbabwe.

Design: Data from a cross-sectional household survey of 4577 children (aged 6–17 years), conducted between 2009 and 2011, were linked to data on the characteristics of 28 primary schools and 18 secondary schools from a parallel monitoring and evaluation facility survey.

Methods: We construct two measures of school quality (one general and one HIV-specific) and use multivariable regression to test whether these were associated with improved educational outcomes and well being for vulnerable children.

Results: School quality was not associated with primary or secondary school attendance, but was associated with children's being in the correct grade for age [adjusted odds ratio 2.0, 95% confidence interval (CI) 1.2–3.5, $P=0.01$]. General and HIV-specific school quality had significant positive effects on well being in the primary school-age children (coefficient 5.1, 95% CI 2.4–7.7, $P<0.01$ and coefficient 3.0, 95% CI 0.4–5.6, $P=0.02$, respectively), but not in the secondary school-age children ($P>0.2$). There was no evidence that school quality provided an additional benefit to the well being of vulnerable children. Community HIV prevalence was negatively associated with well being in the secondary school-age children (coefficient −0.7, 95% CI −1.3 to −0.1, $P=0.03$).

Conclusions: General and HIV-specific school quality may enhance the well being of primary school-age children in eastern Zimbabwe. Local community context also plays an important role in child well being.

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Keywords: AIDS, children, education, HIV, HIV competence, schools, well being, Zimbabwe

Introduction

Children affected by HIV (orphaned children, children with HIV-positive parents, and HIV-positive children) are particularly vulnerable to stigma; abuse; poor nutrition, mental and physical health; and poverty [1,2]. Households affected by AIDS are economically disadvantaged by the cost of medical care and the loss of income from ill or

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deceased adult members [2]. All of these factors form barriers to education for children. One of the most visible effects of the HIV epidemic has been a decline in school enrolment, attendance, and academic progress [3,4]. Education is a vital pillar of socio-economic development, helping to support HIV-affected children by buffering the impacts of poverty, trauma, abuse, social isolation and discrimination on children's mental and physical health [5–10], rendering it important to support children's education in any way possible.

Even in conditions of poverty, communities have 'portfolios of assets', including social capital in the form of community networks [11,12], of which schools are one. Developed based on the concepts outlined by Campbell *et al.* [13] and Nhamo *et al.* [14], 'HIV-competent communities' are theorized as an environment in which people work collectively to reduce stigma, promote positive behaviour change and support the care and treatment of people infected or affected by AIDS. HIV-competent communities facilitate access to health-based knowledge and life skills, instil a sense of confidence in an individual's ability to ensure their own health and well being, provide safe spaces in which to discuss and debate how to translate knowledge and skills into action, encourage strong and supportive relationships within the community, and bridge access to additional support networks in the public or non-governmental organisation sector [13,15,16]. It is possible for schools to provide these same resources, but tailored to their environment and geared towards supporting children.

Building on the work of Campbell *et al.* [13,14] in South African communities, we develop two composite indicators of school quality – one measuring general school characteristics (physical infrastructure, staffing and teaching, fee support), and one measuring HIV-specific characteristics (HIV policies, awareness, and curriculum). We investigate how these indices are related to child education and the overall well being in rural eastern Zimbabwe, and whether school characteristics provided particular benefit for children affected by HIV/AIDS.

Methods

Study population and data collection

The Manicaland HIV/STD Prevention Project is a population-based, open cohort study that has monitored HIV trends in adults living in 12 geographically distinct sites [2 small towns; 2 roadside settlements; 4 subsistence farming areas (SFAs); and 4 large-scale agricultural estates] in the Manicaland province of eastern Zimbabwe since 1998 [17]. From 2009 to 2011, a child survey, comprising an interview and test for HIV, was conducted among children aged 2–14 years in a randomly selected one-third of study households and among adolescents aged 15–17 years in two-thirds of study households. A total of 5520 2–17-year-olds participated. Dried blood spot samples were tested for HIV in an offsite laboratory using the COMBAIDS-RS HIV 1+2 Immunodot Assay (Span Diagnostics, India); HIV-positive tests were confirmed using Vironostika HIV Uni-form II Plus O (Biomérieux, France).

Ethical approval for the Manicaland HIV/STD Prevention Project was provided by the Research Council of Zimbabwe, the Biomedical Research and Training Institute Zimbabwe's institutional review board, and the Imperial College London Research Ethics Committee. Written informed consent was obtained prior to survey participation from each child's primary caregiver. In addition, children aged 7–12 and adolescents aged 13–17 years provided verbal or written assent, respectively.

In parallel, a monitoring and evaluation (M&E) facility survey collected information about health facilities and schools in each community, including 28 primary schools and 18 secondary schools. Information was collected during a face-to-face interview with the school headmaster using a structured questionnaire with questions on physical infrastructure, number of staff and students, fees, HIV policies, teaching methods, student engagement, and community links (see Appendix 1). The villages in each school's catchment area and the number of children from each village were also collected.

Measuring child well being and school competence

Individual child well being was calculated using a relative objective micro-level index based on existing indices of well being [18–23] and using data available from round five of the Manicaland HIV/STD Prevention Project survey. Domains included in the index for primary school-age children were health behaviours, physical health, risk and safety, psychological health, and household resources. Domains for secondary school-age children were the same as primary school-age children, with the addition of a social well being domain, for which no datum was collected in younger children (Fig. 1). Principal-components analysis was used to integrate the variables in each domain together to obtain a score for each child in each domain [24,25]. The scores for each domain were averaged to create an overall well being score for each child, which was then scaled to be between 0 and 100.

School general and HIV-specific quality scores were calculated from data collected in the M&E facility survey. Criteria were adapted from the proposed characteristics of HIV-competent communities developed by Campbell *et al.* [13] and based on qualitative interviews with school officials, teachers, and community members. Factors in the general quality score included the physical infrastructure, student to teacher ratio, fee structure and support, community links, teaching methods, and

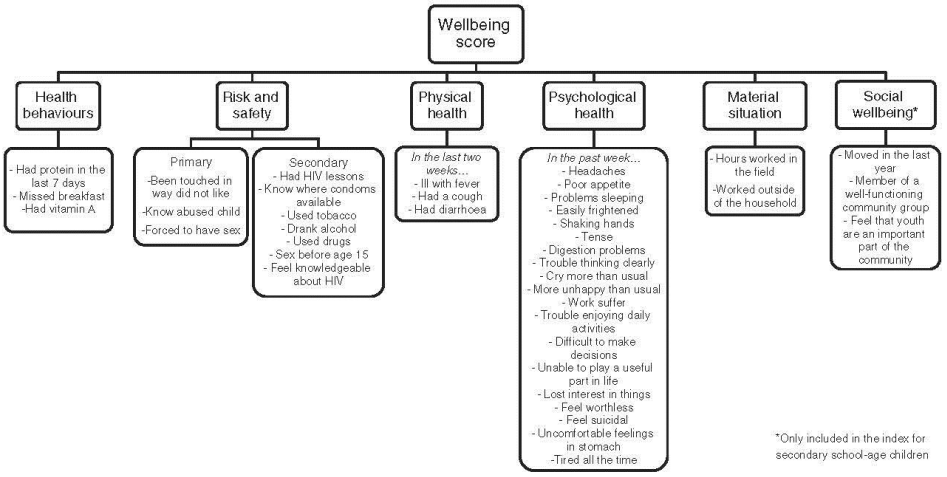

Fig. 1. Components of the primary and secondary wellbeing indices, divided into their different domains.

extracurricular activities. Factors in the HIV-specific score included HIV policies, teaching of HIV-related subjects, HIV/AIDS-related clubs and initiatives, and community links. Each component was given a score between zero and one (either as proportions or binary variables), summed, and the average taken for each school. Each score (general and HIV-specific) was categorized into binary variables for analysis.

Child vulnerability and educational outcomes

Vulnerable children were defined as children who were HIV-positive; were a maternal, paternal, or double orphan; or had an HIV-positive parent. Individual educational outcomes were regular attendance in primary (ages 6–12) and secondary (ages 13–17) school-age children and being in the correct grade for age (ages 8–17). Regular attendance was defined as having attended at least 80% of the last 20 school days. Educational attainment was measured through being in the correct grade for age. Children were deemed to be in the correct grade for their age if they were no more than 1 year behind the normative grade for age [26]. For example, to be at the appropriate grade for age in year 1 of primary school, children would have to be either 6 or 7 years old.

Data analysis

Logistic regression was used to assess whether factors were associated with vulnerable children of primary or secondary school age attending regularly and being in the correct grade for age. Regression models included the school quality scores and community characteristics, adjusting for age, sex, socio-economic status (SES, measured using a previously validated wealth index [27]), and community type (town, roadside settlement, agricultural estate, or SFA). Separate models evaluated first the effect of the general school score on outcomes of interest, and then the additional effect of the HIV-specific score. Where a village was in the catchment area for more than one school, children were assigned a school score as the average of the two schools serving that village, weighted according to the number of students from that village reported by each school. Community characteristics included unemployment levels, community SES, HIV prevalence (in adults aged 15–54 years), and local community group participation. Community group participation was defined as those respondents who were members of one or more well functioning community groups, such as church groups, savings clubs, youth groups, and so on [28–30]. Household-level random effects were included in the models to account for correlated outcomes for multiple children residing in the same household.

Using multivariable regression, we first tested for the effects of general and HIV-specific school quality on well being for all children, and then tested for an interaction between child vulnerability and general school quality to determine whether school quality differentially affected the well being of vulnerable vs. non-vulnerable children. Community characteristics were also included in the models, along with demographic factors and household of residence as above.

Results

Child and school characteristics

The demographic characteristics of children, including vulnerability, well being scores, and education outcomes are presented in Table 1. Overall, 45.5% of primary

Table 1. Characteristics of children and adolescents included in study.

	Primary school-age children (aged 6–12 years, $n-1964$)	Secondary school-age children (aged 13–17 years, $n-2613$)
Percentage vulnerable[a]		
All types	40.1% (37.9–42.3%)	53.1% (51.1–55.1%)
Maternal orphan	11.7% (10.3–13.2%)	20.3% (18.7–21.9%)
Paternal orphan	26.3% (24.4–28.3%)	38.1% (36.2–40.1%)
HIV+	2.1% (1.5–2.7%)	2.0% (1.5–2.6%)
HIV+ parent	13.3% (11.6–14.6%)	12.5% (11.2–13.8%)
Mean age[b]		
Overall	9.17 (8, 11)	15.43 (15, 16)
Non-vulnerable children	8.93 (7, 11)	15.35 (15, 16)
Vulnerable children	9.53 (8, 11)	15.43 (15, 16)
Percentage female[a]		
Overall	49.5% (47.3–51.8%)	51.9% (50.0–53.9%)
Non-vulnerable children	49.2% (46.3–52.1%)	52.5% (49.6–55.4%)
Vulnerable children	50.6% (47.0–53.1%)	51.5% (48.7–54.2%)
Correct grade for age[a]		
Overall	46.6% (44.0–49.1%)	49.3% (47.4–51.2%)
Non-vulnerable children	47.4% (43.9–50.8%)	52.6% (49.7–55.5%)
Vulnerable children	45.9% (42.0–49.8%)	45.7% (43.0–48.5%)
Attending at least 80% of the time[a]		
Overall	95.0% (94.0–96.0%)	94.3% (92.8–95.7%)
Non-vulnerable children	95.4% (94.1–96.6%)	93.8% (91.6–96.0%)
Vulnerable children	94.5% (92.9–96.2%)	94.5% (92.3–96.5%)
Average well being score[b]		
Overall	45.8 (37.5, 52.2)	45.8 (36.3, 54.0)
Non-vulnerable children	47.1 (37.5, 53.9)	45.9 (36.9, 53.6)
Vulnerable children	43.9 (37.5, 50.4)	45.7 (36.5, 54.2)

[a]Mean (95% confidence interval).
[b]Mean (interquartile range).

school-age children and 50.0% of secondary school-age children were classified as vulnerable. Whether or not a child was vulnerable did not differ by sex ($P=0.78$), but older children were more likely to be vulnerable ($P<0.001$). In adolescents, vulnerability status did not differ by age ($P=0.37$) or sex ($P=0.68$). Vulnerable children were less likely to be in the correct grade for age in secondary school-age children ($P<0.001$), but not in the primary school-age children ($P=0.31$). Vulnerability had no association with attendance in primary ($P=0.45$) or secondary ($P=0.68$) school-age children.

Well being scores, scaled to range between 0 and 100, had an interquartile range (IQR) of 37.5–52.2 in primary school-age children and 36.5–54.0 in secondary school-age children (Table 1, Fig. S1, http://links.lww.com/QAD/A530). When comparing the well being scores by vulnerability status, the average well being score for primary school-age children was significantly lower for vulnerable compared to non-vulnerable children (43.9 vs. 47.1; $P<0.001$), but there was no difference for secondary school-age children (45.7 vs. 45.9; $P=0.50$).

Table 2 describes the factors contributing to schools' general and HIV-related quality scores. The mean score for HIV-related quality in primary school was 0.42, and ranged from 0.22 to 0.65; the mean for general quality was 0.48 (range 0.36–0.64). In secondary school, mean HIV quality was 0.42 and ranged from 0.32 to 0.69. Among both primary and secondary schools, certain factors, such as teaching methods and the teaching of HIV-related subjects, were universally well implemented, whereas links with outside organizations were less frequently reported. Schools that consistently reported outside links for psychological support, scholarships, HIV awareness, and HIV programmes had the highest levels of general and HIV-related quality.

School quality and school attendance and grade progression in vulnerable children

These analyses were restricted to vulnerable children due to universally high attendance and vulnerable children being more likely to be behind in school compared to children unaffected by HIV (Table 1). Higher scores on the general quality school measure were significantly associated with vulnerable children being more likely to be in the correct grade for age, but not with regular attendance in either primary or secondary school-age vulnerable children (Table 3). The HIV-specific score quintile was not significantly associated with any of the measured education outcomes. Older children were less likely to be in the correct grade for age, but age was not associated with attendance in primary or secondary school. In primary school age, children were more likely to attend regularly if they reported eating protein in the past 2 weeks; no factors had a significant association with secondary school attendance. In addition to a school's quality, females were more likely to be in the correct grade for age compared to males, as were children living in all other community types compared to towns.

School quality and child well being

Schools in the top half of the general quality index were significantly associated with higher well being in primary

Table 2. General and HIV-competency characteristics of schools included in study.

	Primary schools ($n=28$)	Secondary schools ($n=18$)
General competency		
Facilities available[a]		
Electricity	12 (42.9%)	12 (66.7%)
Water	12 (42.9%)	11 (61.1%)
Phone line	2 (7.1%)	2 (11.1%)
Separate male and female toilets	28 (100%)	18 (100%)
Student to teacher ratio[b,c,d]	31.4 (29, 35.5)	20.4 (18.4, 22.5)
Student committee[a]	18 (64.3%)	13 (72.2%)
Parent teacher meetings[a]	28 (100%)	18 (100%)
Field trips[a]	17 (60.7%)	14 (77.8%)
Counselling available[a]	28 (100%)	18 (100%)
Number of cases of bullying by students[b,c,d]	3.4 (0, 10)	1.6 (0, 3)
Number of cases of bullying by teachers[b,c,d]	0.04 (0, 0; max: 1)	0.06 (0, 0; max: 1)
Subjects taught[a]		
Communication skills	28 (100%)	16 (88.9%)
Income generation	22 (78.6%)	17 (94.4%)
Teaching methods[a]		
Problem-based learning	26 (92.9%)	18 (100%)
Peer education	25 (89.3%)	17 (94.4%)
Group learning	28 (100%)	18 (100%)
Participatory teaching	28 (100%)	18 (100%)
Role plays	28 (100%)	18 (100%)
Average school fees (min, max)[b,c,d]	$53.36 ($45, $60)	$341.33 ($105, $270)
Students receiving support for school fees[d]		
School – direct	0.9% (0%, 1.0%)	2.0% (0%, 2.5%)
Other – e.g. BEAM	16.5% (11.1%, 19.3%)	16.3% (4.1%, 28.6%)
Pupils who did not pay fees[c,d]	26.0% (11.4%, 33.0%)	34.0% (17.9%, 49.0%)
Pupils sent home for non-payment of fees[c,d]	65.4% (0%, 100%)	69.1% (14.3%, 100%)
Supporting teachers[a]		
Links with private groups/individuals	12 (42.9%)	7 (38.9%)
Links with churches	2 (7.1%)	2 (11.1%)
Links with the MoHCW	0 (0%)	0 (0%)
Links with business organizations	0 (0%)	0 (0%)
Links with NGOs	0 (0%)	0 (0%)
Scholarships[a]		
Links with private groups/individuals	9 (32.1%)	6 (33.3%)
Links with churches	3 (10.7%)	1 (5.6%)
Links with the MoHCW	0 (0%)	0 (0%)
Links with business organizations	0 (0%)	0 (0%)
Links with NGOs	6 (21.4%)	6 (33.3%)
Psychological support[a]		
Links with private groups/individuals	0 (0%)	2 (11.1%)
Links with churches	2 (7.1%)	2 (11.1%)
Links with the MoHCW	5 (17.9%)	3 (16.7%)
Links with business organizations	4 (14.3%)	0 (0%)
Links with NGOs	10 (35.7%)	5 (27.8%)
Overall competency score[d]	0.47 (0.44, 0.50)	0.52 (0.43, 0.56)
HIV competency		
Teachers with AIDS training[d]	6.3% (0%, 14.3%)	6.5% (0%, 11.1%)
School has an AIDS policy[a]	7 (25.0%)	6 (33.3%)
After-school AIDS club[a]	20 (71.4%)	16 (88.9%)
Student HIV or health initiatives[a]	8 (28.6%)	5 (27.8%)
Subjects taught[a]		
HIV prevention methods	27 (96.4%)	18 (100%)
HIV stigma awareness	28 (100%)	16 (88.9%)
AIDS treatment and care	26 (92.9%)	17 (94.4%)
Condom use	10 (35.7%)	6 (33.3%)
Sexual health	28 (100%)	18 (100%)
HIV programmes[a]		
Links with private groups/individuals	0 (0%)	0 (0%)
Links with churches	0 (0%)	2 (11.1%)
Links with the MoHCW	7 (25.0%)	2 (11.1%)
Links with business organizations	0 (0%)	0 (0%)
Links with NGOs	22 (78.6%)	14 (77.8%)
HIV awareness[a]		
Links with private groups/individuals	0 (0%)	2 (11.1%)
Links with churches	1 (3.6%)	4 (22.2%)
Links with the MoHCW	8 (28.6%)	3 (16.7%)
Links with business organizations	2 (7.1%)	2 (11.1%)
Links with NGOs	16 (57.1%)	10 (55.6%)
Overall HIV competency score[d]	0.42 (0.32, 0.49)	0.42 (0.32, 0.49)

[a]*n* (percentage). [b]The value for each school was taken and divided by the largest value in each category to get a value between 0 and 1, which was then used in the calculation of the HIV competency score. [c]Lower values were taken to be more competent. [d]Mean (interquartile range). BEAM, Basic Education Assistance Module; MoHCW, Ministry of Health and Child Welfare; NGO, non-governmental organisation.

Table 3. Association between various factors, including school quality, and education outcomes among children made vulnerable by HIV.

	Primary attendance ($n=388$)		Secondary attendance ($n=219$)		Correct grade for age ($n=575$)	
	Model 1 AOR (95% CI)[b]	Model 2 AOR (95% CI)[b]	Model 1 AOR (95% CI)[b]	Model 2 AOR (95% CI)[b]	Model 1 AOR (95% CI)[b]	Model 2 AOR (95% CI)[b]
School quality index						
Lower quality	1	1	1	1	1	1
Higher quality	0.63 (0.11–3.44)	0.69 (0.12–3.96)	1.03 (0.20–5.26)	2.39 (0.18–31.58)	2.05 (1.18–3.54)	2.11 (1.22–3.67)
HIV-specific school quality index						
Lower quality	—	1	—	1	—	1
Higher quality	—	1.48 (0.26–8.32)	—	0.04 (0.00–1.98)	—	0.65 (0.36–1.17)
HIV in school area	0.95 (0.76–1.19)	0.93 (0.74–1.18)	1.15 (0.89–1.49)	1.34 (0.98–1.784)	0.95 (0.87–1.03)	0.96 (0.85–1.05)
Unemployment in area	0.98 (0.89–1.07)	0.97 (0.89–1.07)	0.94 (0.82–1.07)	1.03 (0.87–1.23)	0.99 (0.96–1.02)	1.00 (0.95–1.03)
CG participation in area	0.99 (0.85- 1.14)	0.99 (0.86–1.14)	1.06 (0.90–1.24)	1.02 (0.82–1.26)	0.99 (0.94–1.05)	1.00 (0.97–1.05)
Worked outside home	6.90 (0.33–145.2)	7.19 (0.34–153.94)	1.57 (0.25–9.85)	1.15 (0.18–7.53)	0.74 (0.37–1.52)	0.71 (0.35–1.48)
Had breakfast	0.77 (0.09–6.38)	0.76 (0.09–6.33)	N/A[a]	N/A[a]	0.98 (0.41–2.32)	0.95 (0.44–2.26)
Protein in past week	14.50 (2.40–87.81)	14.92 (2.44–91.22)	2.90 (0.59–14.26)	3.04 (0.60–15.33)	0.89 (0.47–1.70)	0.91 (0.44–1.73)
Ill in past 2 weeks	0.65 (0.07–6.11)	0.67 (0.07–6.28)	0.54 (0.04–6.56)	0.50 (0.04–5.92)	0.70 (0.30–1.65)	0.70 (0.30–1.64)
Hours worked in field	1.40 (0.77–2.51)	1.41 (0.78–2.56)	0.95 (0.80–1.12)	0.97 (0.82–1.15)	1.04 (0.95–1.14)	1.05 (0.93–1.15)
External support	N/A[a]	N/A[a]	0.56 (0.10–3.02)	0.68 (0.13–3.61)	0.97 (0.55–1.70)	0.99 (0.53–1.75)
Age	0.70 (0.47–1.03)	0.70 (0.47–1.02)	0.76 (0.45–1.29)	0.77 (0.44–1.35)	0.86 (0.78–0.96)	0.86 (0.84–0.95)
Sex (female vs. male)	0.90 (0.28–2.89)	0.91 (0.28–2.90)	0.79 (0.20–3.16)	0.80 (0.19–3.45)	2.61 (1.62–4.23)	2.61 (1.56–4.21)
Household SES						
Poorest quintile	1	1	1	1	1	1
Second quintile	1.29 (0.18–9.45)	1.25 (0.17–9.18)	0.76 (0.11–5.45)	0.56 (0.07–4.62)	1.32 (0.62–2.84)	1.34 (0.65–2.87)
Middle quintile	2.66 (0.33–21.22)	2.62 (0.33–20.61)	0.64 (0.07–5.48)	0.46 (0.05–4.63)	2.77 (1.33–5.78)	2.85 (1.42–5.95)
Fourth quintile	0.83 (0.13–5.48)	0.83 (0.13–5.50)	0.40 (0.04–3.65)	0.23 (0.02–2.52)	1.47 (0.66–3.28)	1.43 (0.65–3.21)
Highest quintile	6.88 (0.54–87.56)	6.82 (0.54–86.76)	1.45 (0.11–19.80)	0.89 (0.06–14.37)	1.72 (0.81–3.64)	1.68 (0.89–3.55)
Site type						
Town	1	1	1	1	1	1
Agricultural estate	0.74 (0.04–12.65)	0.99 (0.04–22.11)	3.65 (0.33–40.20)	2.06 (0.16–26.35)	3.42 (1.30–8.99)	2.79 (0.92–7.58)
SFA	2.11 (0.09–48.48)	2.30 (0.10–51.46)	2.29 (0.21–24.84)	2.94 (0.17–50.83)	5.06 (1.81–14.16)	4.85 (1.26–13.54)
Roadside settlement	0.95 (0.05–18.04)	1.14 (0.06–23.51)	11.69 (0.49–279.0)	9.11 (0.11–736.5)	3.44 (1.20–9.85)	2.76 (0.74–8.16)

AOR, adjusted odds ratio; CI, confidence interval; N/A, not applicable; SES, socio-economic status; SFA, subsistence farming area.
[a]Not included because too few observations were present.
[b]Adjusted for all other variables in the table.

school-age children, both before and after adding the HIV-specific quality index to the model (Table 4). HIV-specific school quality was also significantly associated with higher well being in primary school. In secondary school-age children, neither general school quality nor HIV-specific school quality was significantly associated with higher well being in the models (Table 4). Although the level of general school quality was associated with higher well being of children overall, this association was not significantly different between vulnerable and non-vulnerable children as the interaction term was not significant in the models for primary ($P=0.19$) or secondary ($P=0.44$) schools.

In primary school-age children, living in a roadside settlement compared to a town was associated with higher well being, and older age was associated with lower well being. In secondary school-age children, older age was associated with higher well being, and higher HIV prevalence in the school catchment area was associated with lower well being.

Discussion

Our findings suggest an association between a school's quality and progression in schooling; that is, children being in the correct grade for age. As Campbell *et al.* have discussed, the ability of communities (and schools) to support people affected by HIV is not just a measure of HIV-specific activities and policies, but is a composite of factors directly related to HIV, the ethos of the community, and other characteristics that are perceived to be supportive of vulnerable people (e.g. in the case of schools: infrastructure, teaching methods, and school fees) [13,14]. It is the combination of these factors that enables schools to support not just vulnerable children, but children overall. Indeed, from our analyses, it appears that it is not necessarily the HIV-specific factors that enable schools to support vulnerable children, but, instead, the more general factors that provide a safety net.

Previous work investigating best practices for schools in sub-Saharan Africa (SSA) suggests the potential for schools to go beyond education, to also contribute to tackling practical, material, and emotional challenges faced by vulnerable children [5,31–33]. Bell and Murenha [5] suggest that improving the conditions of schools and the process of teaching are keys to mitigating the effects of the HIV epidemic in SSA. Kelly [31] also highlights this approach, focussing on participatory learning and school linkages with the community as ways of moving forward to support children and improve both their health and education outcomes. These views are supported by our findings that general school quality (a measure that includes schools facilities, teaching methods, and community links) is associated with better progress through school and child well being, as opposed

Table 4. Associations between school quality, community factors, and child well being.

	Primary school ($n=929$)		Secondary school ($n=558$)	
	Model 1 Change in well being score†	Model 2 Change in well being score†	Model 1 Change in well being score†	Model 2 Change in well being score†
Vulnerable child	−1.55 (−3.49 to +0.38)	−1.49 (−3.43 to +0.44)	−2.00 (−4.28 to +0.29)	−1.96 (−4.25 to +0.33)
School quality index				
Lower quality	1	1	1	1
Higher quality	4.00 (+1.53 to +6.46)	5.06 (+2.45 to +7.68)	1.80 (−1.29 to +4.89)	1.99 (−1.20 to +5.19)
HIV-related school quality index				
Lower quality	—	1	—	1
Higher quality	—	3.02 (+0.43 to +5.62)	—	−0.90 (−4.66 to +2.87)
HIV in school area	0.09 (−0.29 to +0.47)	−0.01 (−0.40 to +0.38)	−0.75 (−1.34 to −0.17)	−0.69 (−1.33 to −0.06)
Unemployment in school area	−0.10 (−0.24 to +0.03)	−0.10 (−0.24 to +0.03)	−0.11 (−0.28 to +0.07)	−0.10 (−0.27 to +0.08)
CG participation in school area	−0.04 (−0.27 to +0.19)	0.06 (−0.28 to +0.17)	0.12 (−0.22 to +0.49)	0.14 (−0.21 to +0.50)
SES in school area	−16.17 (−54.55 to +22.00)	−11.01 (−49.34 to +27.31)	−44.06 (−94.81 to +6.69)	−47.09 (−99.40 to +5.21)
External support	1.53 (−0.93 to +4.00)	1.18 (−1.30 to +3.66)	−0.22 (−3.28 to +2.85)	−0.14 (−3.22 to +2.94)
Age	−0.58 (−0.98 to −0.19)	−0.59 (−0.99 to −0.20)	2.13 (+1.34 to +2.93)	2.14 (+1.34 to +2.94)
Gender (female vs. male)	0.15 (−1.48 to +1.79)	0.21 (−1.43 to +1.84)	0.67 (−1.55 to +2.90)	0.68 (−1.55 to +2.90)
Household SES				
Poorest quintile	1	1	1	1
Second quintile	1.48 (−1.72 to +4.68)	1.41 (−1.77 to +4.59)	−0.58 (−4.35 to +3.19)	−0.56 (−4.32 to +3.21)
Middle quintile	0.68 (−2.40 to +3.76)	0.63 (−2.43 to +3.69)	1.49 (−2.13 to +5.11)	1.58 (−2.05 to +5.22)
Fourth quintile	0.60 (−2.89 to +4.10)	0.25 (−3.24 to +3.74)	−1.41 (−5.51 to +2.69)	−1.44 (−5.54 to +2.67)
Highest quintile	0.83 (−2.32 to +3.99)	0.73 (−2.41 to +3.86)	−0.50 (−4.07 to +3.07)	−0.45 (−4.03 to +3.12)
Site type				
Town	1	1	1	1
Agricultural estate	4.11 (−0.64 to +8.86)	7.12 (+1.73 to +12.50)	−1.67 (−6.13 to +2.79)	−2.04 (−6.76 to +2.68)
SFA	2.64 (−1.84 to +7.12)	3.91 (−0.68 to +8.50)	−2.50 (−7.42 to +2.42)	−2.65 (−7.60 to +2.32)
Roadside settlement	9.36 (+4.85 to +13.87)	10.93 (+6.24 to +15.61)	0.38 (−5.47 to +6.24)	−0.13(−6.36 to +6.11)

CG, community group; SES, socioeconomic status; SFA, subsistence farming area.
†Adjusted for all other variables in the table.

to the HIV-specific factors. Indeed, Kelly [31] argues that HIV/AIDS education programmes in SSA often lack contextual understanding and in some cases may in fact exacerbate the very problem they are trying to address. As we did not assess the quality or content of the HIV-related activities and programmes in the schools in our study, it is impossible to say if this is the case in our study population, though it is a potential reason for why we only found associations with the HIV-based quality index in one of our analyses.

Demonstrating the ability of strong institutions to affect child outcomes is important in light of previous work done in this population, which has shown that orphans and vulnerable children (OVCs) are more susceptible to poor education outcomes than children unaffected by poverty and HIV [34]. In SSA, without support, vulnerable children may drop out of school, fail to enrol, attend less frequently, have lower educational attainment, be at a lower grade for their age, and perform worse in school than their counterparts unaffected by the HIV epidemic [4,34–39]. If quality schools are better able to support the educational attainment of vulnerable children then it becomes critical to engage with schools and help them to recognize and mobilize their inherent resources for the benefit of their students. Investing in schools as community resources and a form of social support is a potential complementary approach to cash transfers, which provide direct financial resources to OVCs. Previous research in Manicaland has found that both conditional and unconditional cash transfers to OVCs successfully increased regular attendance [40]. The use of inter-sectoral programming could be used effectively to improve the education outcomes and well being of OVC, with education departments focusing on supporting schools by helping them to mobilize their inherent resources and engage with the community and the social welfare or children's departments organizing cash transfers.

The role of schools as social protection for children extends beyond improving their education outcomes, into helping to improve a child's overall well being. Even though there was no differential association between vulnerable and non-vulnerable children, higher levels of school quality were associated with significantly higher levels of well being among primary school-age children, suggesting that the effect of good-quality schools may extend beyond vulnerable children to children overall. This is a crucial point because, although high-quality schools may not preferentially help OVCs, our work reinforces the view that schools can go beyond merely dealing with education to improving the practical and emotional challenges faced by children. This is particularly important in areas of high poverty, where schools may be the only formal agency available to support children.

We also found that influences on child well being extend beyond the role that schools can play on their own, as the community context of the schools was significantly associated with the well being. Even when accounting for a school's quality, a higher community prevalence of HIV was negatively associated with well being in secondary

school-age children. This shows that schools do not operate in isolation, but are part of a wider context that cannot be ignored when considering their relationship with child well being and education outcomes. One of the key properties of the concept of HIV competence is the existence of links between communities, or schools, and outside agencies [14]. Without engaging with the larger world and seeking outside links and sources of support, it is unlikely that schools will have the resources or skills to tackle a devastating social problem, such as the effects of the HIV epidemic [14,41]. The community context must also be taken into account when working with schools on the role they can play in the lives of vulnerable children, because the implementation of any intervention is constrained by poverty, social uncertainty and poor service delivery [42]. This is particularly important for social development interventions with a heavy psycho-social component, such as interventions centred on learning. These interventions are more likely to succeed when they resonate with communities' own understandings of their needs and interests, and build on pre-existing community strengths [16,43].

Whereas the cross-sectional nature of the data limits our ability to draw firm causal conclusions about the role of school quality in determining improved educational outcomes of vulnerable children, we have adjusted for various contextual factors, including SES, to reduce the influence of outside resiliencies on our data. Additionally, few of the components of the school-quality indices could be influenced by children's well being; therefore, reverse causality seems implausible and we cannot discount the possible influence of school quality on child well being. We did not find clear or strong effects of HIV-specific school policies on educational outcomes or well being in our data. The unique combination of individual, household, and community data sources available to the Manicaland Project allowed us to link school characteristics (including HIV-specific activities) to children's outcomes, but we may still have been limited by the sample size, potential imprecise classification of the school attended by some children, and lack of detail about schools' policies and implementation. The effectiveness and consequences of these policies should be an area for further quantitative and qualitative research, including more ephemeral measures, such as a sense of school community, that we were unable to measure.

Acting as part of the larger community, schools can play an integral role in improving the future outlook of children, particularly at younger ages. If schools can mitigate the impact of poverty and disease on marginalized children and provide them with opportunities and relevant education, then they take an important step in narrowing the divide between children of more privileged backgrounds and those affected by HIV, poverty and disability.

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Conflicts of interest

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