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1 **Disability, Social Functioning and School Inclusion Among Older Children**  
2 **and Adolescents Living with HIV In Zimbabwe**  
3

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21 Short heading: Disability and social functioning in HIV-infected children

22 Key words: disability, adolescents, children, Africa, HIV, social functioning  
23

24 **Abstract**

25 **Objective** Increasing numbers of children with HIV are surviving to adolescence and  
26 encountering multiple clinical and social consequences of longstanding HIV infection. We  
27 aimed to investigate the association between HIV and disability, social functioning and school  
28 inclusion among 6 to 16-year olds in Zimbabwe.

29 **Methods** HIV-infected children receiving antiretroviral therapy from a public-sector HIV  
30 clinic, and HIV-uninfected children attending primary care clinics in the same catchment area  
31 were recruited. Standardised questionnaires were used to collect sociodemographic, social  
32 functioning and disability data. Multivariable logistic regression was used to assess the  
33 relationship between HIV status and disability and social functioning.

34 **Results** We recruited 202 HIV-infected and 285 HIV-uninfected children. There was no  
35 difference in age and gender between the two groups, but a higher proportion of HIV-infected  
36 children were orphaned. The prevalence of any disability was higher in HIV-infected than  
37 uninfected children (37.6% vs. 18.5%,  $p < 0.001$ ). HIV-infected children were more likely to  
38 report anxiety (adjusted odds ratio (aOR) 4.4; 95% CI 2.4, 8.1), low mood (aOR 4.2; 2.1, 8.4)  
39 and difficulty forming friendships (aOR 14.8; 1.9, 116.6) than uninfected children. Children  
40 with HIV also reported more missed school days, repeating a school year and social exclusion  
41 in class. These associations remained apparent when comparing children with HIV and  
42 disability to those with HIV but no disabilities.

43 **Conclusions** Children with HIV commonly experience disabilities, and these are associated  
44 with social and educational exclusion. Rehabilitation and support services are needed to  
45 facilitate educational attainment and social participation in this population.

## 46 **Introduction**

47 In 2016, worldwide approximately 160,000 children were newly infected with HIV (1). Of the  
48 estimated 2.1 million children aged under 15 years living with HIV, nearly 90% live in Sub-  
49 Saharan Africa (SSA) (1). The global scale-up of antiretroviral therapy (ART) programmes  
50 has meant that increasing numbers of children with HIV who would previously have died in  
51 infancy without treatment are now surviving to older childhood and adolescence. However,  
52 there is increasing evidence that childhood HIV infection is associated with chronic multi-  
53 system complications, resulting in hearing, cognitive, mobility and visual impairments (2, 3).

54 HIV may lead to impairments through a variety of mechanisms. For example, HIV-mediated  
55 immunosuppression may lead to opportunistic infections such as CMV that can cause visual  
56 impairment (4). The risk of impairments is increased if initiation of ART is delayed, as is  
57 common in many resource-limited settings (5). ART itself may also contribute to impairment;  
58 for instance, nucleoside analogue reverse-transcriptase inhibitors (NRTI) commonly used at  
59 the time of ART roll out for children in SSA (*e.g.* stavudine and lamuvidine) is linked to hearing  
60 loss (6, 7). Zidovudine has been independently linked to myopathy (8), which may lead to  
61 physical impairments. Once established, impairments may not be completely reversed by ART  
62 (9) and negatively impact on social functioning and schooling (3, 10). In other words, HIV or  
63 its treatment may lead to disability, which is defined as the restriction of participation in society  
64 of an individual due to an underlying impairment in combination with attitudinal and  
65 environmental and other barriers (11). Socio-economic deprivation, often associated with HIV  
66 infection (12), potentially exacerbates disability by further restricting participation in society.  
67 To optimise the quality of life and long-term care amongst those living with HIV and their  
68 families, HIV programmes need to broaden their focus and address longer-term consequences  
69 of HIV infection, including the impact on schooling and social inclusion. Even in the absence  
70 of HIV, education and schooling are a major global concern for children and adolescents with

71 disabilities, who are substantially less likely to be enrolled in school and, even when enrolled,  
72 lag behind their peers in educational attainment (13). HIV is likely to magnify these issues  
73 among children due to poverty resulting from parental ill health, food insecurity and  
74 unemployment (14).

75 We therefore conducted a cross-sectional study to investigate the association between HIV and  
76 disability, social functioning and school inclusion among HIV-infected children compared to  
77 uninfected peers in Zimbabwe.

## 78 **Methods**

### 79 *Study setting and participants*

80 HIV-infected children aged 6 to 16 years and receiving either first or second line ART for at  
81 least six months were consecutively recruited from Harare Central Hospital (HCH); this is the  
82 largest public-sector hospital in Harare, providing HIV care for more than 3,000 children. This  
83 age range was selected because it represents children of school going age. Recruitment was  
84 restricted to the first five eligible participants a day for logistical ease. Exclusion criteria were  
85 being acutely ill i.e. having a respiratory tract or other acute infection or tuberculosis, not  
86 residing in Harare and no guardian consent and/or participant assent.

87

88 A comparison group of HIV-uninfected children aged 6-16 years was recruited from primary  
89 health care clinics (PHC) in seven high-density communities from the same catchment area  
90 served by the clinic from which the HIV-infected participants were enrolled. Provider initiated  
91 HIV testing and counselling was offered by the PHCs to all children attending for acute care  
92 regardless of the reason for presentation, and those who tested HIV-negative were invited to  
93 participate and attend pre-booked appointments for assessments. The same exclusion criteria  
94 were applied to HIV-uninfected children.

95 *Data collection*

96 Socio-demographic data including age, sex and orphan status were recorded. Trained research  
97 nurses administered standardised questionnaires to collect data on disability, education and  
98 social functioning. The Washington Group/UNICEF Child Functioning and Disability 21  
99 Question Set was administered jointly to all children and caregivers by a research nurse to  
100 assess disability (15). This question set is validated for children aged 2-17 years. Self-reported  
101 functional difficulties were defined as binary variables in the following domains: vision,  
102 hearing, walking, speech, learning, memory, self-care, anxiety, low mood, difficulty  
103 controlling behaviour, dealing with change, forming friendships and concentration. Disability  
104 was defined as reported difficulties in any of the functional domains. Additional information  
105 on school and social functioning was collected, including the following: school enrolment,  
106 school attendance, repeated school year, problems getting help from teachers and friends,  
107 interaction with other children (leadership, play, bullying) and inclusion in lessons and school  
108 activities. Caregivers of HIV-infected children were asked additional questions relating to HIV  
109 diagnosis, testing, ART history, and children's awareness of diagnosis. At the time of  
110 enrolment, CD4 count was determined using an Alere PIMA CD4<sup>+</sup> (Waltham, Massachusetts,  
111 USA) and HIV viral load was measured using COBAS Ampliprep/Taqman 48 Version 2.0  
112 (Roche, Rotkreuz, Switzerland).

113 *Ethics*

114 Ethical approval was obtained from the Medical Research Council of Zimbabwe  
115 (MRCZ/A/1856), the Biomedical Research and Training Institute (AP125) Institutional  
116 Review Board, Harare Hospital Ethics Committee and the London School of Hygiene and  
117 Tropical Medicine (LSHTM) Ethics Committee (8263). All guardians gave written consent,  
118 and participants gave assent to participate in the study.

119 *Data management and analysis*

120 Data were collected using paper forms and entered into a Microsoft Access database using  
121 optical mark recognition software (Cardiff TELEFORM Intelligent Character, Version 10.7),  
122 which has inbuilt quality control checks. Paper forms were manually checked for missing data  
123 and inconsistencies before being captured. Further internal and external consistency checks  
124 were carried out using database queries.

125 Data completeness was assessed by summary and descriptive statistics. There was a low  
126 proportion of missing data (<6%) in HIV-infected and uninfected children for demographic,  
127 clinical, disability and school functioning and social inclusion data. The prevalence of  
128 functional difficulties and disability was summarised as frequencies and percentages for each  
129 variable by HIV status. Continuous variables were summarised as mean and standard deviation  
130 (SD) when normally distributed and median and interquartile range (IQR) when not.  
131 Univariable logistic regression analysis was used to compare functional, school and social  
132 outcomes between HIV-infected and uninfected children. Multivariable logistic regression was  
133 used to adjust each functional outcome of interest for a priori defined variables of age and sex.  
134 Orphan status and previous infection/co-morbidity did not significantly affect the fit of the  
135 model ( $p < 0.05$ ) on likelihood ratio testing and therefore were excluded. Hence, the final model  
136 was adjusted for age and sex alone. All statistical analyses were carried out using Stata v13.0  
137 (College Station, Texas: StataCorp LP).

138

139 **Results**

140 *Baseline characteristics of participants*

141 We recruited 202 HIV-infected children (median age 11 years [IQR 8-13]; 48.0% female) and  
142 285 uninfected children (median age 10 years [IQR 8-13]; 48.8% female). There were no  
143 significant differences in age or sex between the two groups, but HIV-infected children were

144 more likely to be orphaned ( $p < 0.001$ ) (Table 1). Among HIV-infected children, the median age  
145 at HIV diagnosis was 5 years [IQR 3-7] and the median CD4 count was 726 cells/ $\mu$ l [IQR 476-  
146 941]. The median duration of ART was 2 years [IQR 1-5] and the median age of ART initiation  
147 was 8 years [IQR 5-10].

148

#### 149 *Functioning and disability*

150 The prevalence of any self-reported difficulties in functioning (*i.e.* disability) was higher in  
151 HIV-infected children compared to uninfected children (37.6% compared to 18.8%  $p < 0.001$ )  
152 (Table 2). Amongst those with HIV, the most common types of disability were learning  
153 (reported by 23.2%) and memory difficulties (reported by 17.8%). Difficulties with seeing  
154 (7.7%), hearing (4.8%) and walking (2.5%) were also reported more commonly amongst HIV  
155 infected children.

156 After adjustment for age and sex, the odds of any disability were 2.8 times higher in HIV-  
157 infected than HIV-uninfected children (95% CI 1.8, 4.2  $p < 0.001$ ). HIV-infected children were  
158 significantly more likely to report visual (aOR 3.0; 1.3, 6.9), hearing (aOR 3.4; 1.0, 10.5),  
159 speech (aOR 3.8; 1.1, 13.9), learning (aOR 3.9; 1.4, 3.4) and memory problems (aOR 3.5; 2.0,  
160 6.6) (Table 2). In addition, HIV-infected children were more likely to report anxiety (aOR 4.4;  
161 2.4, 8.1), low mood (aOR 4.2; 2.1, 8.4) and difficulty forming friendships (aOR 14.8; 1.9,  
162 116.6) compared to their uninfected peers. There was no significant association between age  
163 at HIV diagnosis, age of ART initiation, CD4 count, viral load, ART duration or previous  
164 comorbidity and disability among HIV-infected children (Table 3).

165



## 166 *Schooling and social inclusion*

167 School enrolment rates were high among all children (96.0% in both HIV-infected and  
168 uninfected groups). However, children living with HIV were more likely to have repeated a  
169 school year (aOR 3.2; 1.6, 3.8) and on average, missed more days of school in the preceding  
170 month (mean 0.9 days (range 0-15 days) vs. 0.3 days (range 0-7 days). HIV-infected children  
171 more frequently reported not receiving help from teachers (aOR 2.1; 1.2, 3.8) or friends (aOR  
172 3.0; 2.0, 4.5) at school. They were more likely to feel excluded in lessons and activities (aOR  
173 4.7; 2.7, 8.3) and more likely to be physically and verbally bullied by other children (aOR 3.7;  
174 2.2, 6.0). Among children with HIV, those with disabilities were less likely to be enrolled in  
175 the same school grade as their age peers (aOR 3.3; 1.7, 6.1) and more likely to repeat a school  
176 year (aOR 1.9; 1.0, 3.6) compared to HIV-infected peers without disability. They were also  
177 more likely to report that their peers did not look up to them as leaders (aOR 2.1; 1.4, 3.4) and  
178 that they experienced violence from their peers (aOR 2.5; 1.3, 4.8) (Table 4). Amongst children  
179 with disability, those with HIV were less likely to be enrolled in school, more likely to have  
180 needed to repeat a school year and much more likely to have been physically or verbally bullied  
181 than disabled children without HIV (Supplementary Table 5).

## 182 **Discussion**

183 This study demonstrates a high prevalence of physical and cognitive functional difficulties  
184 among HIV-infected children compared to their uninfected peers. Children with HIV were  
185 more likely to report low mood, anxiety, difficulty forming friendships, repeating a school year  
186 and to experience poor social support at school, particularly when HIV and disability co-  
187 existed.

188 Other studies have reported increased physical, sensory and cognitive difficulties in HIV-  
189 infected children compared to those uninfected (3,16-22). Developmental delay is strongly

190 associated with HIV in SSA (2), affecting up to 78% of children (22). Fortunately, in the post-  
191 ART era, severe forms of cognitive impairment in children appear to be decreasing; however,  
192 the prevalence of mild impairment remains largely unchanged and may even be increasing  
193 (23). A number of studies have assessed the prevalence of cognitive (18, 22, 24, 26-29) and  
194 motor (18, 19, 21, 23-29) impairments among HIV-infected and uninfected children; however,  
195 to date these have largely focused on infants and younger children before school age. Our study  
196 highlights both the increased prevalence of learning difficulties among HIV-infected school-  
197 age children, but also shows that learning difficulties are common in uninfected children in  
198 Zimbabwe.

199 This study further demonstrates the additional burden of low mood and anxiety amongst HIV-  
200 infected children. There is evidence of a strong bidirectional association between mental health  
201 and educational attainment with mood and anxiety disorders having a direct effect on early  
202 school leaving, substance misuse and disruptive behavioural disorders (30). Mental health  
203 issues impact negatively on treatment compliance and retention in social care and school  
204 through the fear of disclosing HIV status and social ostracism (31). Socialising and making  
205 friends at school are key protective factors for psychosocial wellbeing in children with HIV,  
206 whereas negative peer interactions such as lack of friends, bullying and being beaten by friends  
207 have been identified as risks (32). Therefore, school peer support interventions should be  
208 adopted as they have been shown to reduce psychological distress, depression, anxiety and  
209 anger in children with HIV (33, 34).

210 Similar to our findings, a recent Malawian cross-sectional study found that a high proportion  
211 of HIV-infected school children had hearing impairment identified by extensive audiological  
212 testing (10). These children were less likely to attend school and had poorer emotional and  
213 school functioning than HIV-infected children without hearing loss. Furthermore, only 40% of

214 caregivers accurately perceived their child's hearing loss, and few had sought treatment,  
215 implying that routine screening may be necessary as disability may be underreported (10).

216 Our study found no significant association between HIV disease severity or treatment factors  
217 and disability. However, previous studies have shown a relationship between CD4 count, viral  
218 load at enrolment, ART duration and disability (2,10). The Malawian study mentioned above  
219 (10) found hearing loss to be significantly associated with HIV WHO Stage 3 or 4 disease, but  
220 not duration of ART or CD4 count. A recent systematic review of disability and HIV in SSA  
221 found a significant dose-response relationship between indicators of disease progression (CD4  
222 or WHO stage) and disability in 48% of studies (2). The evidence suggests that earlier ART  
223 initiation in children may reduce the risk of impairments and consequent disability, but once  
224 established, ART alone may not be sufficient to enable children with HIV to lead healthy lives  
225 (2).

226 Given the high prevalence of physical and sensory impairments amongst children living with  
227 HIV, our study underlines the need for increased availability of rehabilitation services to  
228 support school age children and adolescents with HIV. Currently, the few existing services are  
229 mainly located in urban areas or private health facilities which limits access for many (35).  
230 Greater support for children with learning difficulties is required in schools to facilitate social  
231 inclusion and educational attainment (36) as learning, remembering, and concentration appear  
232 to be common in HIV-infected and uninfected children.

233 Although incorporating disability inclusive approaches into HIV treatment and care is likely to  
234 increase the social participation and school functioning of children with HIV (37), so far only  
235 5 of 18 countries (27%) in Eastern and Southern Africa have recognised the need for specific  
236 support services and interventions for people with disabilities in their national strategic  
237 responses to HIV and AIDS (38). Although Zimbabwe is one of these countries, the findings

238 of this study suggest that further work is required to extend services to support school age  
239 children with HIV.

240 To our knowledge, this is the first study to estimate the prevalence of disability and its  
241 association with school and social functioning in HIV-infected and uninfected older children  
242 in a Sub-Saharan African population. Study limitations include the potential selection bias  
243 from non-probability based sampling: selecting the first five children attending the HIV clinic  
244 may have led to under-reported disability if children with physical or behavioral disabilities  
245 were more likely to attend at clinic later. Alternatively, children with disabilities may have  
246 been less likely to go to school and thus be the first to attend. Furthermore, misclassification  
247 and/or recall bias from the use of self-reported functional difficulties and disability without  
248 contemporaneous clinical measures of the impairments or their cause, coupled with the fact  
249 that carers may not accurately perceive their children's functional difficulties, may have also  
250 led to under-reported disability.

251 Unfortunately, socioeconomic data such as household income and size, asset ownership,  
252 caregiver education and food security were not available which meant that analyses could not  
253 be adjusted for socio-economic status. This is important as poverty and disability are likely to  
254 reinforce each other, leading to vulnerability and exclusion. Children who are poor are more  
255 likely to become disabled through poor healthcare, malnutrition, or dangerous living  
256 conditions. Once disabled, they are more likely to be denied basic resources that would mitigate  
257 deepening poverty (39). There is evidence that poverty is a major contributor to poor treatment  
258 adherence among in HIV-infected children. (40). Furthermore, evidence from a large cross-  
259 sectional study of South African adolescents from deprived urban areas showed that  
260 orphanhood by AIDS was significantly related to childhood depression, peer problems, post-  
261 traumatic stress and behavioural problems; however, adjusting for poverty indicators in this

262 study attenuated the association between AIDS-orphanhood and these psychological problems  
263 (41).

264 Although it is evident that disability is common in HIV-infected children and has a major  
265 impact on their lives, further research to understand the aetiology of different impairments is  
266 needed to inform the design of effective interventions and appropriate rehabilitation services.  
267 Examples of the type of interventions for HIV-infected children that could be introduced  
268 include: 1) routine screening for impairments 2) linking HIV care to rehabilitation and  
269 additional clinical services (*e.g.* ENT in the case of hearing impairment) 3) interventions to  
270 promote school inclusion and social acceptance among children with HIV (*e.g.* through training  
271 of parents, teachers and peers).

272 In conclusion, this study suggests physical and cognitive functional difficulties are common  
273 among children with HIV. These difficulties are associated with school exclusion, including  
274 impaired educational progress, difficulty forming friendships and reduced ability to participate  
275 in lessons and activities. Further work is required to develop tools to better detect and  
276 understand the need for rehabilitation and support services within paediatric HIV programmes.

#### 277 **Competing interests**

278 The authors have no competing interests to declare.

#### 279 **Authors' contributions**

280 RAF and HK designed the study. RR performed the statistical analysis and drafted the report.

281 All authors provided feedback on the draft manuscript and approved the final manuscript.

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**Table 1. Baseline Characteristics of HIV-infected and HIV-uninfected Children in Zimbabwe**

<b>Characteristic</b>	<b>HIV+ n=202 n (%)<sup>a</sup></b>	<b>HIV- n=285 n (%)</b>	<b>p value</b>
<b>Age</b>			
6 -11 years	132 (65.4)	165 (57.9)	0.06 <sup>b</sup>
12 -16 years	70 (34.6)	32 (42.1)	
<i>Median (IQR) years</i>	<i>11 (8, 13)</i>	<i>10 (8, 13)</i>	0.61 <sup>c</sup>
<b>Sex</b>			
Female	97 (48.0)	139 (48.8)	0.11 <sup>b</sup>
<b>Orphan status</b>			
Single orphan	69 (34.2)	25 (8.8)	<0.001 <sup>b</sup>
Double orphan	28 (13.9)	7 (2.5)	
Not orphaned	98 (48.5)	245 (85.9)	
<b>Age at HIV diagnosis</b>			
<i>Median (IQR) years</i>	<i>5 (3, 7)</i>		
<b>Age at ART initiation</b>			
<i>Median (IQR) years</i>	<i>8 (5, 10)</i>		
<b>ART duration</b>			
<1 years	75 (37.1)		
1-5 years	97 (48.0)		
>5 years	30 (14.9)		
<b>CD4</b>			
<200 cells/ $\mu$ l	9 (4.5)		
200-500 cells/ $\mu$ l	47 (23.2)		
>500 cells/ $\mu$ l	144 (71.3)		
<i>Median (IQR) cells/<math>\mu</math>l</i>	<i>726 (476, 941)</i>		
<b>Viral load</b>			
<400 copies/ml	152 (75.2)		
400-5000 copies/ml	14 (7.0)		
>5000 copies/ml	32 (15.8)		
<i>Median (IQR) copies/ml</i>	<i>19 (19, 250)</i>		

**Abbreviations:** HIV+ HIV-infected, HIV- HIV-uninfected, SD standard deviation, IQR inter quartile range

a) n (%) shown, except for median and IQR shown in italics

b) p value from  $\chi^2$  test

c) p value from Mann-Whitney U test

431 **Table 2. Domains of Disability and Functioning in HIV-infected and HIV-uninfected Children**  
 432 **in Zimbabwe**  
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<b>Outcome</b>	<b>HIV+ n=202 n (%)</b>	<b>HIV- n=285 n (%)</b>	<b>Crude OR (95% CI)</b>	<b>p value<sup>a</sup></b>	<b>aOR (95% CI)</b>	<b>p value<sup>a</sup></b>
Any disability	76 (37.6)	53 (18.8)	2.3 (1.6, 5.3)	<0.001	2.8 (1.8, 4.2)	<0.001
Seeing	16 (7.7)	9 (3.1)	2.7 (1.2, 6.0)	0.009	3.0 (1.3, 6.9)	0.009
Hearing	10 (4.8)	4 (1.4)	3.4 (1.1, 10.6)	0.031	3.4 (1.0, 10.5)	0.036
Walking	5 (2.5)	1 (0.4)	7.4 (0.9, 63.5)	0.065	7.4 (0.9, 63.5)	0.055
Speaking	9 (4.3)	3 (1.1)	4.0 (1.1, 14.5)	0.042	3.8 (1.1, 13.9)	0.042
Learning	48 (23.2)	33 (11.6)	2.1 (1.3, 3.2)	0.002	3.9 (1.4, 3.4)	0.001
Memory	37 (17.8)	16 (5.6)	3.6 (2.0, 6.6)	<0.001	3.5 (2.0, 6.6)	<0.001
Self-caring	3 (1.5)	1 (0.4)	1.7 (0.4, 8.0)	0.072	1.6 (0.4, 7.8)	0.524
Anxiety	42 (20.3)	14 (5.6)	4.6 (2.4, 8.2)	0.000	4.4 (2.4, 8.1)	<0.001
Depression	32 (15.5)	12 (4.2)	4.2 (2.1, 8.5)	0.010	4.2 (2.1, 8.4)	0.010
Controlling behaviour	3 (1.5)	1 (0.4)	4.0 (0.4, 39.4)	<0.001	4.0 (0.4, 39.3)	0.003
Concentration	2 (1.0)	6 (2.1)	0.4 (0.1, 2.2)	0.478	0.4 (0.1, 2.2)	0.311
Accepting change	39 (10.9)	36 (12.6)	1.6 (0.9, 2.6)	0.085	1.5 (1.0, 2.5)	0.075
Making friends	10 (4.8)	1 (0.4)	14.6 (1.9, 115.2)	0.001	14.8 (1.9, 116.6)	0.011

**Abbreviations:** **HIV+** HIV-infected, **HIV-** HIV-uninfected, **OR** odds ratio, **aOR** age, sex adjusted odds ratio.  
 a) p value from  $\chi^2$  test

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435 **Table 3. Difference in HIV Characteristics Amongst HIV-infected Children With and Without**  
 436 **Disability in Zimbabwe**  
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Characteristic	HIV+ with disability: n <sup>a</sup> =76	HIV+ without disability: n=126	p value	
<b>Age</b> <i>Median (IQR) years</i>	<i>10.9 (2.6)</i>	<i>10.3 (2.6)</i>		
6-9 years	24 (31.6)	48 (38.1)	0.77	-
10-12 years	31 (40.8)	50 (39.7)		
13-14 years	15 (19.7)	20 (15.9)		
15-16 years	6 (7.9)	8 (6.4)		
<b>Age at diagnosis</b>				
<i>Median (IQR) years</i>	<i>5.0 (3.0)</i>	<i>5.1 (2.9)</i>		-
<b>Age of ART initiation</b>				
<i>Median (IQR) years</i>	<i>8 (6, 11)</i>	<i>7 (5, 10)</i>	0.78	
<b>Sex</b>				
Female	35 (46.0)	62 (49.2)	0.66	
<b>aOR (95% CI)</b>				
<b>CD4 count</b>				
<i>Median (IQR) cells/uL</i>	<i>736 (513, 914)</i>	<i>720 (459, 910)</i>		
<200 cells/uL	3 (4.0)	6 (4.7)	0.78	1.0
200-500 cells/uL	15 (19.7)	32 (25.4)		1.4 (0.8, 2.5)
>500 cells/uL	57 (75.0)	87 (69.1)		
<b>Viral load</b>				
<i>Median (IQR) copies/ml</i>	<i>19 (19, 190)</i>	<i>19 (19, 343)</i>		
<400 copies/ml	57 (75.0)	95 (75.4)	0.16	1.0
400-5000 copies/ml	2 (2.6)	12 (9.5)		1.1 (0.7, 1.6)
>5000 copies/ml	14 (18.4)	18 (14.3)		
<b>ART duration</b>				
<i>Median (IQR) years</i>	<i>2 (1, 5)</i>	<i>1 (0, 4)</i>		
<1 years	24 (31.6)	51 (40.5)	0.21	1.0
1-5 years	39 (51.3)	58 (46.0)		1.2 (0.8, 1.9)
>5 years	13 (17.1)	17 (13.5)		
<b>No of hospital admissions in 12 months</b>				
>1	5 (6.6)	5 (4.0)		1.9 (0.6, 6.1)
<b>Past history of TB</b>	29 (38.2)	50 (39.7)	0.94	0.9 (0.5, 1.6)

**Abbreviations** HIV+ HIV-infected, HIV- HIV Uninfected, **aOR** odds ratio adjusted for age and sex, **ART** antiretroviral therapy, **TB** tuberculosis, **IQR** inter quartile range.

a) n shown, except for median and IQR shown in italics

**Table 4. School and Social Inclusion at School in HIV-infected and HIV-uninfected Children and in HIV-infected Children with and Without Disability**

<b>Characteristic</b>	<b>HIV+ n=202 n (%)</b>	<b>HIV- n=285 n (%)</b>	<b>aOR (95% CI)</b>	<b>HIV+ with disability n=76 n (%)</b>	<b>HIV+ without disability n=126 n (%)</b>	<b>aOR (95% CI)</b>
<b>School inclusion as reported by children and their carers</b>						
Currently enrolled in school	194 (96.0)	273 (96.0)	0.98 (0.4, 2.5)	71 (93.4)	123 (97.6)	0.3 (0.1, 1.5)
Enrolled in the same grade as peers	102 (50.5)	197 (69.1)	2.4 (1.6, 3.6)	24 (31.6)	78 (61.9)	3.3 (1.7, 6.1)
Ever repeated a year at school	68 (33.7)	53 (18.6)	2.5 (1.6, 3.8)	32 (42.1)	36 (28.6)	1.9 (1.0, 3.6)
<b>Social inclusion at school as reported by children and their carers</b>						
No help from teachers, if problem at school	4 (2.0)	2 (0.7)	2.1 (1.2, 3.8)	2 (2.6)	2 (1.6)	1.7 (0.9, 3.2)
No help from friends, if problem at school	15 (7.4)	3 (1.1)	3.0 (2.0, 4.5)	11(14.5)	4 (3.2)	1.5 (0.9, 2.4)
Child has no friends to play with	2 (1.0)	1 (0.4)	1.8 (0.7, 5.0)	2 (2.6)	1 (0.8)	1.7 (0.8, 5.7)
Friends look up to child as a leader	108 (53.5)	147 (51.6)	1.1 (0.8, 1.6)	44 (57.9)	41 (32.5)	2.1 (1.4, 3.4)
Other children hit, hurt /say nasty things to child	58 (28.7)	28 (9.8)	3.7 (2.2, 6.0)	30 (39.5)	28 (22.2)	2.5 (1.3, 4.8)
Child does not feel included in lessons and activities	6 (3.0)	2 (0.7)	4.7 (2.7, 8.3)	3 (4.0)	3 (2.4)	0.6 (0.1, 3.0)

**Abbreviations** HIV+ HIV-infected, HIV- HIV Uninfected, aOR odds ratio adjusted for age and sex.

**Supplementary Table 5. School and Social Inclusion at School in Disabled Children With and Without HIV-infection**

Characteristic	HIV+ with disability n=76 n (%)	HIV- with disability n=53 n (%)	aOR (95% CI)
<b>School inclusion as reported by children and their carers</b>			
Currently enrolled in school	71 (93.4)	52 (98.1)	1.1 (0.3, 4.5)
Enrolled in the same grade as peers	24 (31.6)	32 (57.1)	0.3 (0.1, 0.6)
Ever repeated a year at school	32 (42.1)	12 (21.4)	3.3 (1.4, 8.0)
<b>Social inclusion as reported by children and their carers</b>			
No help from teachers, if problem at school	2 (2.6)	1 (1.8)	0.1 (0.1, 8.1)
No help from friends, if problem at school	11 (14.5)	1 (1.8)	0.5 (0.0, 0.9)
Child has no friends to play with	2 (2.6)	0 (0.0)	-
Friends look up to child as a leader	26 (34.2)	27 (48.2)	0.5 (0.3, 1.1)
Other children physically or verbally bully	30 (39.5)	3 (5.4)	11.3 (3.9, 39.8)
Child excluded in lessons and activities	3 (4.0)	1 (1.8)	0.4 (0.0, 4.4)
<b>Abbreviations HIV+</b> HIV-infected, <b>HIV-</b> HIV Uninfected, <b>aOR</b> odds ratio adjusted for age and sex.			