Lower Size-Adjusted Bone Density and Muscle Function in Zimbabwean Children with HIV

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BACKGROUND

- Stunting and pubertal delay are common in children with HIV (CWH).
- Pubertal timing and musculoskeletal development are closely linked and CWH may be at higher risk of reduced bone density and impaired muscle function.
- This study aims to determine the effect of HIV on size-adjusted bone density (important in the context of small stature) and muscle function in peri-pubertal children on antiretroviral therapy (ART).

METHODS

- 8-16 year olds were recruited into the IMpact of Vertical HIV infection on child and Adolescent SKeletal development (IMVASK) study in Harare, Zimbabwe[1].
- CWH, established on ART for ≥2 years, from two public sector HIV clinics, frequency matched by age and sex with uninfected children from schools serving the same catchment area.
- Musculoskeletal assessments included grip strength, standing long jump and dual-energy X-ray absorptiometry (DXA).
- Total-body less-head (TBLH) bone mineral content (BMC) adjusted for lean body mass (LBM) and height (TBLH BMC^{LBM}) and lumbar spine bone mineral apparent density (LS BMAD) values and Z-Scores were calculated[2].
- Differences by HIV status, and risk factors for impaired musculoskeletal measures were determined using linear regression.



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Figure 1. Lumbar spine DXA of study participant

Children with HIV were more likely to have pubertal delay, stunting and be underweight.

Children with HIV had significantly lower muscle mass, muscle strength, TBLH BMC^{LBM} and LS BMAD compared to the uninfected children.

RESULTS

Table 1. Characteristics of Children With and Without HIV

	HIV + (n=278)	HIV – (n=292)	p value[a]
Mean age[b], years (SD)	12.4 (2.5)	12.5 (2.5)	0.569
Sex[b], female, N (%)	136 (48.9)	149 (51.0)	0.615
Pubertal delay (Tanner stage)[c], N (%)	7 (7.3)	0 (0.0)	0.020
HIV characteristics			
Mean age at HIV diagnosis[b], years (SD)	3.8 (3.2)	-	-
Mean ART duration[b], years (SD)	7.6 (2.8)		
Viral load at enrolment <1,000 copies/ml), N (%)	198 (78.9)	-	-
Tenofovir current use[b], N (%)	54 (21.6)	-	-
Anthropometry			
Stunted (height-for-age Z-score <-2)[3], N (%)	89 (32.2)	23 (8.0)	<0.001
Underweight (weight-for-age Z-score <-2)[3], N (%)	74 (26.9)	25 (8.6)	<0.001
Risk factors for musculoskeletal disease			
Mean calcium intake mg/day (SD)	214 (127)	216 (119)	0.836
Mean vitamin D intake mcg/day (SD)	5.1 (1.9)	5.3 (1.7)	0.133
Low physical activity, <600 METmin/week, N (%)	134 (48.2)	109 (37.5)	0.010

a) t test for continuous data and $\chi 2$ or Fisher's exact test for categorical data b)variables with no missing data c)pubertal delay defined here as <Tanner stage 2 in girls ≥13 years and boys ≥ 14 years. The denominator for pubertal delay is 109 (45 boys and 64 girls) in CWH and 118 (51 boys and 67 girls) in children without HIV

Figure 2. TBLH BMC^{LBM} and LS BMAD by HIV status and sex

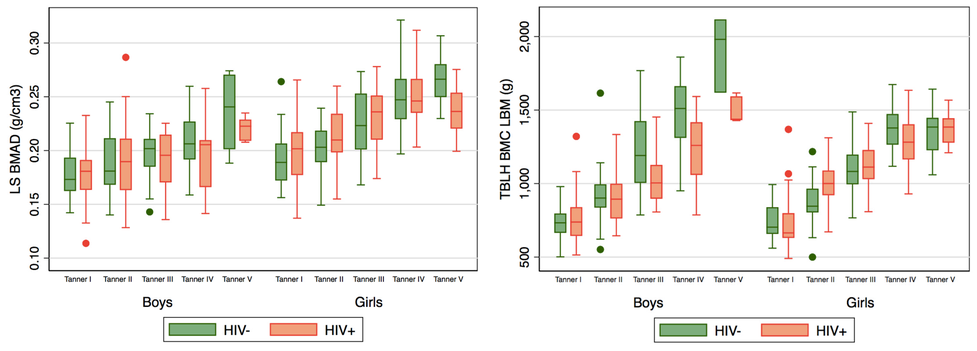


Table 2. Bone and Muscle Outcomes of Children With and Without HIV

	HIV + (n=278)	HIV – (n=292)	p value[a]
Muscle mass and function			
Mean total body muscle (lean) mass, kg (SD)	26.1 (6.8)	29.6 (8.2)	<0.001
Mean hand grip strength, kg (SD)	20.1 (7.3)	25.5 (9.2)	<0.001
Mean long jump distance, cm (SD)	125 (26)	133 (25)	<0.001
Bone outcomes			
Mean absolute TBLH BMC^{LBM}	949.6 (272.5)	1090.0 (334.8)	<0.001
Mean TBLH BMC^{LBM} Z-score (SD)	-0.606 (1.08)	-0.406 (1.00)	0.022
Low TBLH BMC^{LBM} (Z-score <-2)[4], N (%)	29 (10.4)	19 (6.6)	0.027
Mean absolute LS BMAD g/cm^3	0.202 (0.035)	0.210 (0.036)	0.010
Mean LS BMAD Z-score[6] (SD)	-0.517 (1.31)	-0.243 (1.20)	0.013
Low LS BMAD (Z-score <-2)[4], N (%)	40 (14.4)	17 (5.8)	<0.001

a) t test for continuous data and $\chi 2$ or Fisher's exact test for categorical data
LS BMAD - lumbar spine bone mineral apparent density; TBLH BMC^{LBM} - total body less head bone mineral content for lean mass adjusted for height

RESULTS

- CWH were more likely to have pubertal delay (7.3% vs 0%), stunting and be underweight than children without HIV (Table 1).
- CWH had significantly lower TBLH BMC^{LBM}, LS BMAD, muscle mass, and muscle strength compared to uninfected children (Table 2).
- In post pubertal children, the difference in TBLH BMC^{LBM} between boys with HIV and without is large, but not in girls (figure 2).
- Calcium and vitamin D intake were not significantly different between groups.

CONCLUSIONS

- HIV has a profound effect on muscle function and bone mass.
- Pubertal delay may account for these differences.
- The effect of HIV on musculoskeletal health may result in future fracture risk and long-term disability.

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