Decreased Vigorous Physical Activity in School-Aged Children with Human Immunodeficiency Virus in Johannesburg, South Africa

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Objective To describe physical activity in South African children with and without HIV.

Study design Study measurements were obtained in 218 children with perinatal HIV and 180 children without HIV aged 5-9 years in a study conducted in Johannesburg, South Africa. Weight-for-age *z*-score, height-for-age *z*-score, frequency and duration of moderate and vigorous physical activity, and sedentary behaviors were obtained. These measurements were compared between children with and without HIV.

Results Weight-for-age *z*-score and height-for-age *z*-score were significantly lower for children with HIV compared with those without HIV. Among children who attended school, fewer children with HIV than children without HIV participated in physical education (41% vs 64%; $P = .0003$) and organized after-school sports (38% vs 64%; $P < .001$). The proportion of children in both groups meeting World Health Organization recommendations for physical activity was similar (84% overall); however, girls with HIV spent less time in vigorous physical activity than girls without HIV (420 vs 780 minutes/week; $P = .001$). This difference remained significant even when girls with a medical condition with the potential to limit physical activity were excluded, and after adjusting for age. Time spent in sedentary behaviors did not differ significantly between the two groups.

Conclusion Although children with HIV with well-controlled disease after initiating antiretroviral therapy early in life achieve high levels of physical activity, vigorous physical activity is lower in girls with HIV than in healthy controls. This finding may reflect lower participation in school-based physical education and organized after-school physical activity. *(J Pediatr 2016;172:103-9)*.

Access to antiretroviral therapy (ART) for children with HIV has increased survival through adolescence and adulthood, making the optimization of long-term health outcomes an important goal. There is evidence of increased endothelial dysfunction, carotid artery intima-media thickening, inflammatory biomarkers, and redistribution of body fat in adults, adolescents, and children with HIV.[1-6] In addition, time spent in sedentary behavior is independently associated with cardiovascular mortality and diabetes incidence in adults.[7] Screen time (eg, television) is associated with cardiovascular risk factors in adolescents.[8] In South Africa, a country with a high burden of HIV and a growing epidemic of cardiovascular disease, 1 in 3 adolescents watch more than 3 hours of television daily, and inactivity and obesity are increasing.[9-13]

Physical activity provides long-term benefits for a number of outcomes, including blood pressure, bone density, and anthropometric markers such as waist circumference, in children and adolescents.[14-20] In South Africa, school-aged children spend 20 minutes per day in moderate or vigorous physical activity[9-13]; however, no studies describe physical activity or sedentary behaviors among children with HIV, who may have a greater lifetime risk for cardiovascular disease owing to cumulative lifetime exposure to HIV and ART.

Given the increasing prevalence of noncommunicable disease in South Africa, and the growing body of literature reporting adverse metabolic, bone, and cardiovascular outcomes in those living with HIV on lifelong ART, it is important to understand patterns of physical activity in this population. The present study describes patterns of physical activity in a cohort of school-aged South African children with HIV who have been well controlled with ART since early in life, compared with children without HIV of similar age.

ART	Antiretroviral therapy
BAZ	Body mass index–for-age *z*-score
FFM	Fat-free mass
MET	Metabolic equivalent
WAZ	Weight-for-age *z*-score
WHO	World Health Organization

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Funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Human Development (R01-HD073977 and HD073952). M.W. is supported by the National Institute of Allergy and Infectious Disease (T32-AI100852). The authors declare no conflicts of interest.

http://dx.doi.org/10.1016/j.jpeds.2016.01.034

Methods

Data were obtained during the baseline visits of the CHANGES (Childhood HAART Alterations in Normal Growth, Genes, and Aging Evaluation Study) Bone Study, a longitudinal observational cohort study of children with perinatal HIV and controls conducted at the Empilweni Service and Research Unit at Rahima Moosa Mother and Child Hospital in Johannesburg, South Africa, and approved by the Institutional Review Boards of Columbia University and the University of Witwatersrand. Prepubertal children with HIV aged 5-9 years who were initiated early in life and maintained on ART were included in the study. These children were recruited after completion of previous clinical trials at the study site.[21-23] Uninfected prepubertal controls aged 5-9 years were recruited without matching to children with HIV, from household members of children with HIV or healthy children attending preventative health services at the study site. Children with a chronic medical condition or lack of documented HIV-negative test results were excluded. The mother or legal guardian provided written informed consent and assent was obtained from children aged ≥7 years.

Caregiver demographic and household characteristics were obtained by questionnaire. Weight (to the nearest 0.1 kg) was measured with a digital scale, and height (to the nearest 0.1 cm) was measured with a stadiometer. Weight-for-age *z*-score (WAZ), height-for-age *z*-score, and body mass index–for-age *z*-score (BAZ) were calculated using World Health Organization (WHO) standards.[24] Overweight and obesity were defined as having a BAZ >1 SD and >2 SD, respectively, above the WHO growth standard median.[24] Fat-free mass (FFM) percentage of total body mass was estimated by single-frequency bioimpedance analysis (Quantum II; RJL Systems, Clinton, Michigan) using an equation derived and validated by Horlick et al[25] based on dual X-ray absorptiometry in children and adolescents that included children with HIV, as follows:

$$\mathrm{FFM} = \left[3.474 + 0.459\ \mathrm{height}^2/\mathrm{resistance} + 0.064 * \mathrm{weight}\right]/\left[0.769 - 0.009 * \mathrm{age} - 0.01 * \mathrm{sex}\right],$$

where male = 1 and female = 0.

A questionnaire quantifying total physical activity, sedentary behaviors, and time spent sleeping during the previous week was administered by a trained interviewer in the presence of both the child and the caregiver. This questionnaire had been used previously and validated by accelerometry in an urban South African cohort at age 9 years.[18,26] Additional activities were included in the questionnaire to reflect the most common activities in our sample from a younger, Johannesburg-based, urban population (eg, playground activities such as playing tag and skipping rope, active household chores). Activities were evaluated in 5 domains: physical education at school, informal activities at school (eg, during recess), organized after-school activities (eg, extramural or club sports), informal after-school activities, and activities of daily living (eg, walking for transportation and chores). The frequency and duration of all physical activities, sedentary behaviors, and time spent sleeping in the previous week were recorded. The metabolic equivalent (MET; defined as the energy expenditure for sitting quietly, or approximately 3.5 mL of oxygen/kg body weight/minute in an average adult) of each physical activity reported by the participant was determined according to the Compendium of Energy Expenditures for Youth.[27] Vigorous physical activities were defined as those associated with ≥7 METs, consistent with the South African literature, and included running, soccer, netball, skipping rope, tennis, and rugby. Moderate physical activities (3-6.9 METs) included playground activities, bicycling, walking, active chores, dancing, swimming, volleyball, cricket, and high jumping. Moderate-vigorous physical activity included both moderate and vigorous physical activities. The WHO recommends 60 minutes of moderate or vigorous physical activity daily, and vigorous activity at least 3 times weekly for children aged 5-17 years.[28] Screen time was defined as time spent on activities that involved viewing a screen, and included time spent watching television or playing games on a computer or cellular phone. Medical diagnoses were assessed based on caregiver report and physical examination performed by a physician. CD4 percentage and HIV-1 RNA concentration (COBAS TaqMan HIV-1 Test; Roche Molecular Diagnostics, Pleasanton, California) were measured in all subjects with HIV.

Statistical Analyses

Only children attending school (n = 258) were included in the analysis for physical education, informal activity at school, and organized after-school activities. Time spent in all physical activity domains was calculated in minutes/week, and to provide a context for each activity domain, also as a proportion of total time spent in all reported physical activities. All time reported in moderate physical activity, vigorous physical activity, sedentary behaviors, and time spent sleeping was calculated in minutes/week. The proportion of children meeting the WHO recommendations for physical activity was determined. To assess for confounding, any significant findings were reanalyzed excluding children who had a medical diagnosis with the potential to limit physical activity.

The data do not have a normal distribution, and thus are presented as median (IQR) for continuous data and as frequency for categorical data. Outcomes were compared between groups using Wilcoxon tests for continuous variables and the χ^2 or Fisher exact test for categorical variables. Linear regression was used to evaluate the relationships among FFM, BAZ, and WAZ and physical activity and sedentary behaviors. Logistic regression was used to evaluate the relationships between overweight and obesity and physical activity and sedentary behaviors. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, North Carolina).