Physical Activity and Sedentary Behavior in Obese Youth

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Objective To determine whether directly measured physical activity and sedentary behavior patterns of obese children presenting to a weight-management clinic differs from nationally representative samples of obese and normal-weight children.

Study design A cross-sectional comparison study of 3 groups of boys and girls between 8 and 18 years (mean, 13.4 years) was performed. A clinical group (n = 56) seeking specialized care for obesity was compared with 2 nationally representative samples of children from the Canadian Health Measures Survey (CHMS): (1) body mass index >95th percentile (n = 143); and (2) body mass index <85th percentile (n = 958).

Results Obese clinical and obese CHMS boys did not differ in daily moderate-to-vigorous physical activity (MVPA). Both obese groups engaged in less MVPA than normal-weight boys in the CHMS ($P < .0006$). Compared with normal-weight boys, obese boys had fewer days in which they accrued 60 or 30 minutes of MVPA ($P = .006$ and .01, respectively). Daily MVPA did not differ among the 3 groups of girls. Light activity in clinical boys was lower than in the normal weight CHMS boys, whereas clinical girls engaged in less light activity than both CHMS comparators. No differences were observed between groups for sedentary behavior.

Conclusions Obese youth, whether in clinic or the community, were not more sedentary than their normal-weight CHMS comparators. Although obese youth were less active, overall MVPA was low in all groups. This finding highlights the need for health professionals to target both physical activity and sedentary behavior in all children, rather than focusing on only children with obesity. *(J Pediatr 2015;166:1270-5)*.

Sedentary behavior, a form of waking behavior defined by many as expending <1.5 metabolic equivalents in a sitting or reclining position[1] and unique from inactivity (ie, accruing insufficient amounts of moderate-to-vigorous physical activity [MVPA]), has been shown to be independently associated with poorer cardiometabolic health (ie, lower fitness, greater body fat, poorer metabolic profile) in children and youth.[2] There is evidence to suggest that overweight and obese children and youth are less active than their leaner counterparts,[3-7] and it is thought that an overall decrease in energy expenditure may have contributed to the current childhood obesity epidemic. It is unclear, however, whether reduced physical activity (PA) and increased sedentary behavior are a result, or the cause of obesity.

There is overwhelming evidence to support the health benefits (eg, improved adiposity, musculoskeletal health, fitness, cardiometabolic health, mental health) of PA for children, regardless of weight status.[8] PA is a complex behavior, and an accurate assessment of PA in children and adolescents is needed. Yet, the accurate measurement of PA is challenging, especially in children, given their complex and multidimensional activity patterns.[9] Many studies in the pediatric population have relied on self-reported PA or sedentary behavior, which can be unreliable because of recall difficulties, and may be less accurate in children and adolescents who feel compelled to respond in a socially desirable manner. Thus, objective measures, such as accelerometry, are believed to offer more robust estimates of PA and/or sedentary time and remove the issues of recall and response bias.[10]

The objective of this study was to determine whether the PA and sedentary behavior of children who are seeking treatment for their obesity are any different than those from a representative sample of Canadian children (either obese or normal weight). It is hypothesized that the children referred to clinical treatment programs for obesity, whose severity of condition is presumably greater, will have lower levels of PA and greater levels of sedentary time compared with obese as well as normal-weight children from a representative Canadian sample.

Methods

The study protocol was approved by the Children's Hospital of Eastern Ontario (CHEO) Research Ethics Board. Informed consent (≥16 years) or parental consent and assent (<16 years) was obtained. Patients between 8 and 18 years of age

BMI	Body mass index
CHEO	Children's Hospital of Eastern Ontario
CHMS	Canadian Health Measures Survey
MVPA	Moderate-to-vigorous physical activity
PA	Physical activity

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were recruited through the CHEO endocrinology clinic between 2007 and 2012. Those with a body mass index (BMI) greater than the 95th percentile (Centers for Disease Control and Prevention)[11] who were being seen for their obesity were eligible. Of the 112 patients approached, 62 participants provided informed consent or assent and included patients who participated in the Physiological and Psychological Predictors and Determinants of Metabolic Complications of Pediatric Obesity study, or who are being assessed by CHEO's Centre of Healthy Active Living weight-management program. All participants visited the Healthy Active Living and Obesity laboratory at the CHEO Research Institute for comprehensive baseline measurements before they received any clinical treatment.

The nationally representative data sample for this study was drawn from the Canadian Health Measures Survey (CHMS); cycle 1 (2007-2009). The CHMS is a comprehensive, direct health measures survey. The data were collected from a sample of the Canadian population ages 6-79 years living in private households at the time of the survey. These data, collected at 15 sites across Canada between 2007 and 2009, represent approximately 96% of Canadians.[12] Participation was voluntary; respondents could opt out of any part of the survey at any time. Of the 1409 children recruited, 97% (186 obese; BMI >95th percentile, and 1181 nonoverweight/obese; BMI <85th percentile) wore the accelerometer. The comparison group of 143 obese CHMS and 958 nonoverweight/obese, referred herein as "normal weight," included all respondents ages 8-18 years with 4 or more valid days of accelerometer data.[13,14] More extensive details of the CHMS are available elsewhere.[15]

Both sets of children were asked to wear an Actical accelerometer (Mini Mitter Company, Inc, Blend, Oregon) over the right side of their hip on an elasticized belt during waking hours for 7 consecutive days. The Actical device measures and records time-stamped movement in all directions and provides an assessment of PA level.

Accelerometer signals also are recorded as steps per minute. Data were processed with the use of standardized quality control and data reduction procedures in SAS version 9.3 (SAS Institute, Cary, North Carolina).[14] The Actical accelerometer has been validated to measure PA[16,17] as well as step counts in children.[18] Published guidelines were followed to identify and remove days with incomplete (invalid) accelerometer wear time.[14,19] A valid day was defined as 10+ hours of wear time. Wear time was determined by subtracting nonwear time from 24 hours. Nonwear time was defined as at least 60 consecutive minutes of zero counts, allowing for 2 minutes of counts between 0 and 100. For each minute, the level of movement intensity (sedentary, light, and MVPA) was based on the available published cut-points for the Actical accelerometer: sedentary = cpm less than 100[20]; light = cpm 100 to less than 1500; MVPA = cpm 1500 or greater.[17] For an individual participant, minutes at each intensity level were summed for each day and averaged across their valid days. Further details of how the MVPA and sedentary behavior cut-offs were derived from the accelerometers can be found elsewhere.[14,21] To ensure consistency, the data reduction and analysis for the clinical population were harmonized with the CHMS approach.[14,21,22]

Statistical Analyses

All descriptive statistics for the obese clinical sample were obtained using IBM SPSS Statistics version 19 software (IBM Institute, Armonk, New York) and SAS version 9.3 for the CHMS sample. The χ^2 and Mann-Whitney *U* tests were used to analyze potential differences in the categorical sociodemographic characteristics.

Comparisons between the clinical sample and the CHMS weighted data sample were conducted using Welch unpaired *t* tests with the degrees of freedom of the CHMS SE fixed at 11 (15 primary sampling units minus 4 strata)[23] in the Welch-Satterthwaite approximation, custom coded in Microsoft Excel 2003 (Microsoft, Redmond, Washington). The Welch test does not require an assumption of equal variance in the clinical and CHMS samples, which is applicable to this case, given the differences between the sampling methodologies. Pairwise Mann-Whitney *U* tests were used to investigate potential differences in meeting PA guidelines (eg, proportion of the sample that was active on average 60 min/day, reported as a percentage) between the 3 groups of interest. Obese clinical children were compared with obese CHMS and normal weight CHMS separately by sex. Sex differences were only tested between like samples, specifically: (1) obese clinical boys vs obese clinical girls; (2) obese CHMS boys vs obese CHMS girls; and (3) normal-weight boys vs normal-weight girls.

Data in the tables and figures are presented as the estimate of the mean ± SEM or 95% CI. To account for multiple comparisons, the Holm (Bonferroni step-down) correction method[24] was used, and a 2-sided $P < .05$ was considered statistically significant after the correction. Specifically, 3 group comparisons ([1] obese clinical vs obese CHMS; [2] obese clinical vs normal weight CHMS; and [3] obese CHMS vs normal-weight CHMS) across 4 descriptive data variables (age, height, weight, BMI) were performed, for a total of 12 comparisons. Similarly, 3 group comparisons across 4 outcome data variables were evaluated; measured sedentary time, light activity, MVPA, and steps/day. Finally, we performed comparisons by sex in each of the 3 groups when investigating the 4 descriptive data variables and the 4 outcome data variables, for a total of 12 comparisons each respectively.

Results

Valid accelerometer data were available for 28 girls and 28 boys from the obese clinical sample; 62 girls and 81 boys from the obese CHMS sample and 504 girls and 454 boys from the normal-weight CHMS sample. Descriptive data are shown in **Table I** and indicate that the clinical samples of boys and girls were significantly more obese than their CHMS comparators. There were no demographic