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Do Overweight Girls Overreport Physical Activity?

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Abstract

Objective—To determine if overweight adolescent girls are more likely to overreport physical activity compared to normal-weight girls.

Methods—Participation in physical activities and perceived intensity of activities were assessed from the previous day physical activity recall (PDPAR) in 1021 girls aged 11-14 years old (37% overweight). Daily minutes of moderate to vigorous physical activity (MVPA) were measured using accelerometery.

Results—Girls in the “at-risk for overweight” and “overweight” categories had 17.7% and 19.4% fewer minutes of MVPA per block reported on the PDPAR compared to normal-weight girls ($P<0.05$).

Conclusions—Overweight adolescent girls tend to overreport their total amount of physical activity.

Keywords

adolescents; accelerometry; exercise

Childhood obesity is a growing problem throughout the world,[1-3] and one factor believed to contribute to obesity is insufficient physical activity. Studies report that physical activity levels of youth are declining,[4] particularly during adolescence.[5,6] The relationship between the decline in physical activity and excess weight gain is potentially an iterative loop. Less physical activity may cause weight gain, resulting from a positive energy balance; and weight gain may contribute to real and perceived barriers to being active, resulting in additional weight gain.

Some studies examining the relationship between weight status and physical activity levels in adults and adolescents report no significant relationship between physical activity and body fat.[7,8] Another report, however, found an association between fat mass and physical activity levels in boys, but not girls.[9] A recent study in adults showed that as body fat increases, physical activity objectively measured by accelerometry, decreases.[10] One reason for this discrepancy may be the differing choices of physical activity assessment tools. Klesges et al reported that

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surveys overestimate physical activity compared to accelerometry.[11] Furthermore, overweight and obese adults may overreport physical activity levels compared with normal-weight individuals,[12] although not all studies have observed this relationship.[13]

The literature regarding how weight status may influence perceptions of exertion during activity is ambiguous. Epstein et al suggest that overweight children drop out of exercise programs that are perceived to be too strenuous.[14] Other studies have noted a direct relationship between rating of perceived exertion (RPE) during exercise and body fat or BMI.[15,16] Evidence also suggests that when overweight youth are exposed to a standard exercise bout, they rate exertion levels higher than normal-weight youth do,[16,17] particularly at higher levels of intensities of exercise.[18] If overweight children perceive a given intensity of physical activity to be more strenuous than normal-weight children do, this perception could contribute to lower likelihood of participation in physical activity and, thus, additional weight gain.

To our knowledge, the relationship between weight status and intensity of physical activity, assessed by both objective monitoring and self-report, has not been critically evaluated in adolescent girls. Adolescence is a critical period for girls because their activity levels appear to precipitously decline and because there appears to be a stronger relationship between their activity levels and weight status than there is for boys.[19,20] Therefore, the purpose of this study was 2-fold: first, to determine if overweight adolescent girls overreport moderate to vigorous physical activity levels and, second, to determine if overweight girls report, or perceive, specific activities at higher intensity than do normal-weight girls.

METHODS

Subjects

The data were obtained as part of the baseline measurements (Spring 2003) for Trial of Activity for Adolescent Girls (TAAG) study. TAAG was a randomized controlled trial designed to test an intervention to reduce the decline of physical activity levels in middle-school-aged girls.[21] Field sites included 6 middle schools in each of the following states for a total of 36 schools: Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina. The study was coordinated by the University of North Carolina at Chapel Hill and the NHLBI project office. A representative sample of sixth-grade girls was selected to participate in the measurement protocol. Field sites provided the coordinating center (UNC-Chapel Hill) with class lists, which were placed in random order, and the first 60 girls from the list were targeted for recruitment. For the current study we obtained 1021 girls from the overall sample that had both accelerometry and self-report of physical activity data. This report focuses on those 1021 girls.

Instrumentation

Participation in specific types of physical activity and perceived intensity of exertion during the activity were estimated using the self-report 3-day physical activity recall (3DPAR), which required the girl to recall the activities performed over the previous 3 days.[22,23] The 3DPAR provides a list of 70 activities and divides each day into 30-minute segments, or blocks. The respondent inserts the “main activity” performed during each time period and her subjective rating of intensity. Intensity is determined from a 1 to 4 Likert scale using the following descriptors: (1) Light: slow breathing and little or no movement, (2) Moderate: normal breathing and some movement, (3) Hard: increased breathing and moderate movement, and (4) Very Hard: hard breathing and quick movement. Participants are provided with illustrations depicting activities typical of each intensity level. Pate et al found that the 3DPAR was moderately correlated with accelerometry counts (r = 0.28-0.46).[22] McMurray et al reported a correlation of ~0.31 between blocks of moderate to vigorous physical activity (MVPA) obtained from the 3DPAR and accelerometry counts in adolescent girls.[23] For this analysis, only data from the previous day were used (referred to as the previous day's physical activity record: PDPAR) because the accuracy of recall declined for the second or third day prior to completion of the survey: correlation day one = 0.54, day 2 = 0.16, day 3 = 0.22.[23]

The objective measure of physical activity used for this study was the Actigraph accelerometer (MTI, Ft Walton Beach, FL). Physical activity was measured in 30-second intervals. The Actigraph is the most widely used accelerometer for physical activity in youth and adolescents.[23-26] In previous studies, correlations between Actigraph counts and measured energy expenditure were found to be high for treadmill ambulation: r = 0.87.[26] However, in uncontrolled, free-living conditions, the correlations between Actigraph counts and heart rate monitoring or direct observation were somewhat lower: r = 0.45 to 0.85.[24,27-29] Nonetheless, Welk et al recommend accelerometry as the most appropriate criterion against which to validate self-report instruments.[30]

Procedures

All assessments occurred at the student's school, and all procedures were approved by institutional review boards. Height and body mass were measured with the participant dressed, but not wearing shoes. Body mass index (BMI) was calculated (kg/m^2). Each participant was given an accelerometer, instructed on its use and care, and told to remove it only for sleep, for activities in which it could get wet, or when competitive sports required its removal. Participants were instructed to wear the monitor for 6 consecutive days. Monitors were returned, and the data were downloaded and transferred to the coordinating center for data reduction and analysis. At this return visit, the participant completed the 3DPAR under the supervision of a trained research assistant.

Accelerometry data were examined, and girls were deemed compliant if they wore the monitor 80% of the time available in a given block of time; blocks represented before school, during school, after school, early evening, and evening.[31] If the girl was compliant for a block, we used the data provided. If not compliant, we used an expectation maximization algorithm to impute the missing data for that block.[31] This resulted in an18-hour day of data for each girl, 6 AM to midnight. Evaluation of our imputation procedure indicated that it provided valid results, even when data were not missing at random.

Analyses

Participants were classified in to 3 categories based on weight status, using age and gender-specific CDC norms: (1) normal with BMI<85th percentile, (2) at risk for overweight with BMI ≥85 & <95th percentile, and (3) overweight with BMI ≥95th percentile. Using the results of the PD-PAR, the 8 most frequently recalled activities were analyzed for self-reported intensities. Although a number of activities were reported by the girls, 8 activities were found to be in common to all BMI status groups.

Statistical analyses were conducted using SAS version 8.02 (SAS Institute, Cary, NC). Unadjusted means and frequencies of participants' descriptive characteristics were calculated. The Mantel-Haenszel chi-square statistic was used to determine differences in reported intensities of activity by BMI status. Multivariate associations between MVPA from accelerometer and self-report and BMI status were examined using general linear mixed model regression analyses. Mixed models were used to reflect the hierarchical design of the TAAG study. Field site and school were included in all models as random effects, with girls nested within schools and schools nested within field sites, to account for the correlation in responses among girls within schools and schools within field sites. All independent variables were treated as fixed effects. In all mixed models, race/ethnicity and day of the week activity occurred (weekday/weekend) were included as covariates. Initially, separate models were used to test for group differences in mean levels of accelerometer and self-reported MVPA (dependent variables) by BMI status (independent variable). In another mixed model we tested the interaction between BMI status and self-reported MVPA, with the dependent variable being accelerometer-measured MVPA. A significant interaction term in this model would suggest that the association between objectively measured MVPA and self-reported MVPA varies by BMI status. Finally, a variable consisting of the ratio of MVPA from accelerometer counts to blocks of MVPA from the PDPAR (accelerometer counts/blocks reported by PD-PAR: Cts:B ratio) was derived and used as the dependent variable with BMI status as the independent variable. A lower ratio would be suggestive of overreporting activity on the PD-PAR. A log transformation was applied to the Cts:B ratio to obtain a near-normal distribution. In order to be included in the ratio analysis, the girls needed to report at least one block of MVPA on the PD-PAR. Potential differences in weight status, race/ethnicity, and SES between those girls included in the ratio analysis and those removed were examined using Mantel-Haenszel chi-square statistics.

RESULTS

Complete accelerometry and PDPAR data were obtained on 1021 girls. However, 330 reported no bouts of MVPA on the PD-PAR. No differences in racial representation (P=0.403), socioeconomic status as indicated by participation in school lunch program (P=0.226), and BMI category (P=0.715) were found between those reporting no MVPA and those girls reporting MVPA. The girls ranged in age from 11 to 14 years. Of this sample 63% had BMI <85th percentile, and 19% had BMI between the 85th and 95th percentile, whereas 18% girls were above the 95th percentile. The general characteristics of the participants are shown in Table 1.

The 8 most frequently reported activities for all 3 BMI categories, their estimated MET values from the Compendium of Physical Activity,[32] and the mean±SD intensity scores are presented in Table 2. Most activities were reported to be in the moderate- to hard- intensity categories (2-3 range). There were no significant differences in the intensity ratings across the 3 BMI categories. Because 8 analyses are reported in Table 2, a Bonferroni correction indicated that P<0.0063 was the standard for statistical significance.

Adjusted means for accelerometry minutes of MVPA and blocks of MVPA for combined weekday and weekend days are presented in Figure 1. A significant trend for lower mean MVPA minutes assessed from the accelerometer at higher BMI categories was found (P=0.01). The normal group averaged 25.3±1.1 min MVPA/day whereas the overweight group averaged 20.8±1.5 min/day. The number of 30-minute blocks of MVPA assessed from the PDPAR did not differ across BMI categories. All 3 groups reported a mean of 2.1 to 2.3 blocks of MVPA per day. No interaction was found between reported blocks of MVPA and BMI status (P=0.85) for accelerometer-measured MVPA.

Table 3 presents results of the Cts:B ratio analysis. Of the 1021 girls, 330 reported no bouts of MVPA on the PD-PAR. Thus the regression analyses were based on 691 girls. The regression model resulted in exponentiated coefficients indicating a percent change rather than an absolute change for each unit increase in the independent variable. In addition to the exponentiated coefficient estimates, Table 3 presents the effect size of the coefficient and the average Cts:B ratio for normal-weight girls. For example, participants in the at-risk for overweight category, on average, obtained 17.7% fewer minutes of MVPA per block (11.4 minutes/block) compared to normal-weight category (13.9 minutes/block). The overweight category obtained 19.4% fewer minutes of MVPA per block (11.2 minutes/block) compared to normal-weight girls.

DISCUSSION

The results of this study include 2 novel findings. First, girls who are at risk for being overweight or overweight, reported similar perceptions of exercise intensities for a given activity compared to normal-weight girls. Second, overweight girls and girls at risk for being overweight reported similar levels of MVPA using a questionnaire; however, when comparing the ratio of accelerometer counts to blocks of self-report data from the PD-PAR, girls at risk for overweight and overweight girls obtained fewer minutes of MVPA per self-reported block of MVPA than normal-weight girls, suggesting that these girls over-estimated their MVPA levels to a greater extent.

We hypothesized that overweight girls would rate exertion levels for participation in specific physical activities as more intense than normal-weight girls, similar to previous findings. However, we failed to find this, even during high intensity exercises. Our results can be interpreted several ways. One way is that overweight adolescent girls and normal-weight girls participating in the same activity have similar physiologic responses. If so, then physical activity intensity coding (light to very hard) would be the same for a given activity across the 3 weight categories. A second possible explanation is that the girls liked to exercise within a comfort zone. Therefore, to maintain this comfort zone the overweight girls lowered their level of exertion to compensate. Perceptions of exercise effort appear to be focused on lactic acid, ventilation and heart rate responses[33] and research has shown that the heart rate and ventilatory responses of obese girls is greater at a given speed of ambulation than for normal-weight girls.[34] Therefore, to maintain an intensity of exercise within their perceived comfort zone the overweight girls simply did the exercise at a lower absolute intensity. This interpretation is consistent with other studies that have clearly shown that overweight individuals rate exercise as more intense and at a lower level of affect.[15-17] Thus, although the normal and overweight girls may perceive the exercise at the same intensity, the absolute amount of work during free-living activity may be less for the overweight girls. Alternatively, although perceived intensity for the activity was the same, the overweight girls may actually be expending more energy for a given activity, because their absolute energy use may be greater than normal-weight girls. In support, Maffeis et al[34] has shown that the absolute energy expenditures at any speed of ambulation are higher for overweight girls than normal-weight girls.

Another attractive premise is that the overweight girls could be feeling more fatigued by a given amount of exercise than normal-weight girls and end up accomplishing less MVPA over a given amount of time. Ward et al has shown that the higher perceptions of exertion reflect lower fitness.[18] Lower fitness would result in earlier onset of fatigue and therefore less exercise. The fact that our overweight girls had fewer minutes of MVPA as measured by accelerometry, tends to support this contention. Because we do not have objective monitoring of exertion levels during the specific activities, we cannot verify which interpretation is more plausible. Nevertheless, the interpretation that self-selected exercise level is reduced at a given perception of exertion is congruent with research in adults.[16] Finally, the differences may be related to the methodology. Accelerometer measures actual minutes, PDPAR measures in 30-minute blocks. The normal-weight girls might spend more time within each block of activity in MVPA (ie, 14 min/block vs 11 min/block) that could account for the difference.

The normal-weight girls had a Cts:B ratio of 13.9 min MVPA/block of MVPA (Table 3), whereas the overweight girls had a Cts:B ratio of 11.2 min/block. The reduction in actual minutes of MVPA compared to reported minutes of MVPA implies that overweight girls tend to overreport MVPA when surveyed. From our results we cannot determine the cause of the over-reporting; however, Klesges et al have suggested that overreporting may be related to social desirability issues.[11] The results are consistent with other findings in girls,[11] children in general,[8,35] and adults[10,12] suggesting that overweight individuals, whether adolescents or adults respond similarly.

The results of this study suggest one possible reason why overweight girls either gain or have difficulty losing weight. Although they perceive themselves as doing as much or more exercise than normal-weight girls, they may, in reality, be moving less. Although our mean data from accelerometry suggest that the difference is only about 5 minutes per day (Table 3), that amounts to 35 minutes, or approximately 150 caloric per week. In addition, it appears that many of the overweight girls are not participating in sufficient MVPA (<20 min/d) to gain other health benefits.

This study has some important strengths and limitations. One strength of the study was the large number of subjects from 6 sites across the United States providing good external validity to other populations of early adolescent girls. In addition, the range of accelerometry-measured minutes of MVPA obtained from the sample and the distribution of normal and overweight girls were similar to the overall sample of 1721 girls that participated in the TAAG study.[36] The use of accelerometry to obtain MVPA and the use of girl-specific cut-points for MVPA are strengths of this study as well. Conversely, the PDPAR does not estimate minutes of MVPA, thus potentially clouding the relationship between the accelerometer counts and self-report. The overweight girls may not be over reporting their activity, but a limitation of the PDPAR may be the explanation. Interestingly, 32% of the girls did not report any MVPA using the PDPAR, yet these girls had an average of 21 minutes of MVPA measured by accelerometry. Accelerometry information was obtained in 30-second epochs, allowing the collection of incidental physical activity, such as climbing a set of stairs or running to the car. These girls may have forgotten to report these non-specific physical activities, or it could be a fault of the PDPAR itself, which asks participants to report activities in 30-min time segments. This highlights a significant limitation of the PDPAR instrument.

In conclusion, our study suggests that overweight adolescent girls report exertion intensities similar to normal-weight girls. In addition, overweight adolescent girls tend to overreport activity levels but this association was only seen when a ratio of accelerometer counts and PDPAR was calculated. This finding has implications for other studies hoping to examine relationships between PA and weight status in girls. Because the overweight population appears to be increasing, the overreporting of PA in overweight girls needs to be taken into consideration when selecting measurement strategies in PA research (stressing electronic counts or direct observation over self-report), and when designing exercise programs for overweight adolescent girls. Also, the overreporting of PA and the fewer minutes of MVPA assessed by accelerometry in overweight girls may contribute to potential problems with weight loss. Health care workers may perceive that the overweight girls' PA level are adequate, but in reality they could be less than adequate; eg, they report 30 min of basketball but are actually playing much less. Thus, the findings of this study have both research and clinical implications.

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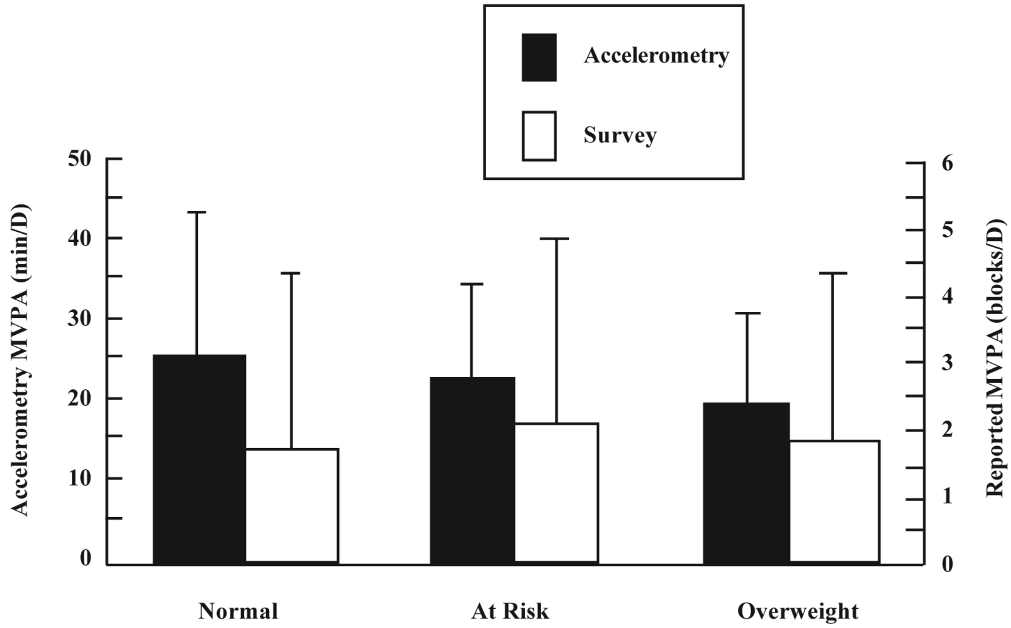

Figure 1. Adjusted Mean±se Minutes of MVPA Using Accelerometry and Blocks of MVPA as Reported by the PDPAR, Presented by Weight Group

Note.

Linear mixed model: Minutes/day or Blocks/day = BMI status + race/ethnicity + day of week; with field site and school within field site as random effects. * $P < 0.01$ for BMI categories.

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Table 1

Mean ±SD or Proportions of the Subject Characteristics Presented by Weight Group

Characteristic	**Normal (BMI<85th) n=645**	**At Risk (BMI 85th-95th) n=192**	**Overweight (BMI>95th) n=184**
Age (yr)	11.96 (0.50)	11.97 (0.47)	12.01 (0.57)
Height (cm)	151.46 (7.49)	154.23 (6.72)	156.37 (6.82)
Body Mass (kg)	42.07 (6.97)	55.55 (5.82)	72.24 (13.60)
BMI (kg/m^2)	18.24 (2.00)	23.30 (1.17)	29.41 (4.38)
Race/Ethnicity (%)			
White	47.12	35.94	24.46
AfricanAmerican	17.88	29.69	33.70
Other	35.00	34.47	41.84

Table 2

Estimated MET Levels[a] and Reported Intensities[b] of the 8 Activities Commonly Reported by the Girls in the Normal, At-Risk, and Overweight BMI Categories (n=1021)

	Estimated METs*	Normal	At Risk	Overweight
Playing with Children	3.0	2.07±0.78	2.34±0.94	2.02±0.48
Walking (Travel)	3.0	2.15±0.41	2.16±0.49	2.02±0.09
House Chores	3.5	2.29±0.57	2.27±0.53	2.29±0.48
Walking (Exercise)	4.0	2.05±0.75	2.18±0.76	1.98±0.86
Dance	4.5	2.52±0.90	2.57±0.66	2.41±0.88
Basketball	6.0	2.86±0.82	3.06±0.78	3.02±0.63
PE Class	6.0	2.59±0.67	2.60±0.62	2.57±0.68
Running/jogging	7.0	2.98±0.78	2.97±0.77	3.02±0.99

Note.

[a] METs from the Compendium of Physical Activity[32]

[b] Intensity: 1 = light, 2 = moderate, 3 = hard, 4 = very hard

Table 3

Analysis of Log Transformed Ratio of Measured Accelerometer Counts to Reported Blocks of Activity (Cts:B ratio)

BMI Categories	Coefficent Estimate (%)	Average Cts:B ratio (minutes/block)
Normal Weight (n=437)	reference	13.88
At Risk for Overweight (n=126)	-17.7*	11.43
Overweight (n=128)	-19.4*	11.19

Note.

Model includes BMI status, race, and weekday/weekend as fixed effects, and site and school within site as random effects.

* $P < 0.05$ compared to normal BMI group.