Physical Activity Awareness of British Adolescents

Kirsten Corder, PhD; Esther M. F. van Sluijs, PhD; Ian Goodyer, MD, FRCPsych; Charlotte L. Ridgway, PhD; Rebekah M. Steele, PhD; Diane Bamber, PhD; Valerie Dunn, BEd; Simon J. Griffin, MBBS, DM, FRCPG; Ulf Ekelund, PhD

Objectives: To assess adolescent physical activity (PA) awareness and to investigate associations with biologic and psychosocial factors.

Design: Cross-sectional study from November 1, 2005, through July 31, 2007 (the ROOTS study).

Setting: Population-based sample recruited from Cambridgeshire and Suffolk schools (United Kingdom).

Participants: Of 799 participants, 43.6% were male. The mean (SD) age was 14.5 (0.5) years.

Main Exposures: Self-rated PA perception, self-reported psychosocial factors, and measured anthropometry.

Main Outcome Measures: We measured PA with accelerometry for 5 days. Inactive was defined as less than 60 minutes per day of moderate and vigorous PA (MVPA) measured by accelerometry. Associations between awareness (agreement between self-rated and accelerometer-measured active/inactive) and potential correlates were investigated using multinomial logistic regression.

Results: Approximately 70.1% of adolescents were inactive (81.2% of girls and 55.8% of boys; odds ratio [OR], 3.41; 95% confidence interval [CI], 2.41-4.82). There were 52.6% of all girls (64.8% of inactive girls) and 33.6% of all boys (60.3% of inactive boys) who inaccurately rated themselves as active (overestimators). Compared with girls accurately describing themselves as inactive (28.6%), girl overestimators had lower fat mass (OR, 0.84; 95% CI, 0.70-0.99), higher socioeconomic status (high vs low OR, 2.38; 95% CI, 1.07-5.32), more parent support (OR, 1.57; 95% CI, 1.12-2.22), and better family relationships (OR, 0.25; 95% CI, 0.09-0.67). Among boys accurately describing themselves as inactive (22.1%), overestimators had lower fat mass (OR, 0.86; 95% CI, 0.77-0.96) and reported more peer support (OR, 1.75; 95% CI, 1.32-2.30) and less teasing (OR, 0.75; 95% CI, 0.61-0.92).

Conclusions: A substantial number of adolescents believe themselves to be more physically active than they really are. They may be unaware of potential health risks and unlikely to participate in PA promotion programs. Increasing information of PA health benefits beyond weight control might encourage behavior change.

Arch Pediatr Adolesc Med. 2011;165(7):603-609

NSUFFICIENT PHYSICAL ACTIVITY (PA) is a risk factor for obesity and related metabolic disorders in youth1 and is positively associated with poor mental health2 and poor bone development.3 Adolescence is an important period for promoting PA and preventing an age-related PA decrease.4-7 Recent reviews highlight the limited success of PA promotion in youth8-10, the reasons for this are largely unknown.

One hypothesis for the limited effectiveness of PA promotion is a lack of awareness of health behavior, such as a belief in being more healthy than is true.11 Previous studies have shown that this misperception is relatively common for PA.9,12,13 Possibly because PA is a complex behavior for which the threshold between healthy and unhealthy may be unclear.12 People may not be aware of what the healthy levels are, and changes in health recommendations may play a role. Even if people are aware of what constitutes sufficient PA, to accurately estimate their PA level they need to determine their activity intensity during different behaviors, quantify their activity of this intensity, and sum it over time.

Increased awareness may be a proximal effect of behavior change,11 but those who overestimate their PA may see no need to change their behavior12 and may not be susceptible to PA promotion. Improving PA awareness may therefore be a crucial initial component of promotion campaigns, although few interventions consider this.9,12,15 Associations between psychosocial, personal, and behavioral factors and PA awareness have been examined in adults12,16-18 and children13 but not adolescents. Most previous studies of PA awareness have focused on adults, and most have used questionnaires to assess true PA levels.12,16-18 These studies show
that from 46% to 61% of inactive adults overestimate their PA, and these overestimators also tended to have more favorable anthropometric characteristics than those realistic about their inactivity.16-18 A recent study of PA awareness using objectively measured PA in children indicated that 80% of parents of inactive children (those engaged in <60 min/d of moderate and vigorous PA [MVPA]) wrongly thought that their child was sufficiently active, and 40% of inactive children overestimated themselves.13 Compared with parents who accurately described their children as inactive, overestimators were more likely to have girls, to have children with a lower fat mass, and to have their children report more parent and peer support.13 Child overestimators reported receiving more peer support.13

We aimed to examine adolescents’ PA awareness using objectively assessed PA and to investigate associated biologic and psychosocial factors.

METHODS

PARTICIPANTS

Participants were 799 adolescents recruited to the ROOTS study, described previously,19 a longitudinal cohort study examining psychiatric disorders during adolescence. (ROOTS is not an initialism.) Adolescents were assessed at baseline (14 years old; T0) and at 18 (T2) and 36 (T3) months after baseline with repeated psychosocial measures. Physical activity and body composition were assessed 6 months after baseline (T1) between November 1, 2005, and July 31, 2009.

At T0, we approached 27 secondary schools from Cambridgeshire and Suffolk, United Kingdom, and 18 agreed to participate. Study information, invitation letters, and parent and student consent forms were sent to parents by means of the schools. Of the 1185 baseline participants, 998 adolescents and parents (84.2%) completed postal informed consent for the T1 PA assessment and 931 (93.3% of those consenting) attended a testing session at school. All procedures were explained, and participants could choose to decline all or any part of the study. The ROOTS study was approved by the Cambridge research ethics committee.

ANTHROPOMETRY

At T1, height (Leicester height measures; Chasmors Ltd, Leicester, United Kingdom), weight, and body composition (TBF–300A body composition analyzer; Tanita, Tokyo, Japan) were measured at school testing sessions. Validated and published equations were used to calculate fat mass from impediment.

Figure 1. Classification of 348 adolescent boys into 4 physical activity awareness groups by adolescent perception. MVPA indicates moderate and vigorous physical activity.

Figure 2. Classification of 451 adolescent girls into 4 physical activity awareness groups by adolescent perception. MVPA indicates moderate and vigorous physical activity.

OBJECTIVE PA MEASUREMENT

Physical activity was assessed using the validated Actiheart heart rate and movement sensor (CamNtech, Papworth, United Kingdom).22-24 The Actiheart was attached to the torso and recorded movement data in 30-second epochs. Volunteers were instructed to wear the monitor continuously, including during sleep and water-based activities, for the remainder of the testing day and then 4 consecutive days, including 2 weekend days. Participants returned the monitors to the school for collection.

To find an MVPA cut point comparable with the widely used Actigraph accelerometer, a comparison between the Actiheart and Actigraph 7164 (Actigraph, Pensacola, Florida) was performed in a separate group of adolescents who wore both a 7164 Actigraph and an Actiheart while walking and running on a treadmill under controlled conditions.23 The laboratory study suggested a conversion factor of 5 (Actigraph counts = Actiheart counts × 5), which was confirmed in a free-living study of 254 participants aged 12 to 17 years.25

After conversion, a custom program removed data recorded after 11 PM and before 6 AM, periods of 60 minutes or more with continuous zero activity counts, and days with less than 600 minutes of recording (the cutoff for a valid day). Participants with fewer than 3 valid days were excluded.26 Time (minutes per day) spent in MVPA was derived using 2000 (Actigraph) counts per minute as the lower threshold.27,28 Participants were then classified as active or inactive using a threshold of an average of 60 minutes per day of MVPA, according to British PA recommendations.29,30

SELF-RATED PA

Self-rated PA was assessed at the beginning of the PA measurement session, before any assessment of PA or body composition, as follows: “How physically active would you say you have been during this school term: very inactive, fairly inactive, not inactive/not active, fairly active, or very active?” Four PA awareness groups were derived using objective and self-rated PA (Figure 1 and Figure 2).

SOCIOECONOMIC STATUS

The ACORN index (A Classification Of Residential Neighborhoods) was used as a proxy for socioeconomic status (SES). The ACORN index is a postcode (zip code)–based system that categorizes United Kingdom postcodes into 5 categories using...
125 demographic and 287 lifestyle variables. Where SES data were unavailable, the category closest to the mean score for the school was used. Categories were combined to represent low, middle, and high SES.

PARENT AND PEER SUPPORT

Parent and peer support for PA were assessed by a questionnaire administered at T1. Responses were on a 5-point scale from “never” to “every day.” Composite peer and parent support scores were derived from 4 and 5 questions, respectively. Confirmatory principal-component factor analysis was used to determine internal consistency; the Cronbach α was used to confirm suitability of the groupings (parent: α = .80; and peer: α = .83). Peer teasing for not being good at PA and sports was assessed using 1 question, used in the original format.

MOODS AND FEELINGS

The Mood and Feelings Questionnaire, a 33-item self-report measure of depressed mood, was administered at T0 and has validity as a screen for adolescents with unipolar depression. Respondents rate their symptoms during the previous 2 weeks, and items are scored on a 3-point scale (mostly/sometimes/never). A summed score was used; higher Mood and Feelings Questionnaire scores indicate increased risk for depression. The internal consistency in this sample was high (Cronbach α = .96).

FRIENDSHIP

The friendship questionnaire completed at T0 assesses 8 items on current friendship satisfaction, such as happiness with number of friends. A higher value represents a more positive score. Confirmatory factor analysis confirmed the suitability of a single-factor model, and Cronbach α was used to confirm the suitability of the grouping (α = .74).

FAMILY FUNCTION

The short Family Assessment Device (FAD) is an adolescent-reported 12-item questionnaire measuring general family function, administered at T0. Items are scored on a 3-point scale (as described previously) and assess family well-being, such as feeling accepted. A higher value represents a negative score. Confirmatory factor analysis confirmed the suitability of a single-factor model, and the Cronbach α was used to confirm the suitability of the grouping (α = .88).

STATISTICAL ANALYSIS

Analyses were performed using Stata, version 11 (StataCorp, College Station, Texas). Characteristics of participants with missing data and between boys and girls were assessed using t tests or χ² tests. Analyses were performed separately for boys and girls because of sex differences in PA levels and psychosocial variables. All psychosocial variables were checked for collinearity; variance inflation factor statistics were less than 2.0. Multinomial logistic regression was used to examine differences between inactive adolescents (overestimators vs realistically inactive) and between active adolescents (underestimators vs realistically active) for all potential correlates separately. Multiple multinomial logistic regression was then used to assess the extent to which multiple factors influenced an adolescent’s PA awareness, with “realistically inactive” as the reference category; this analysis was also done with “realistically active” as the reference category. Variables significantly different in the simple models (including interaction terms) were included in adjusted models and subsequently removed if the P value was less than .05. If more than 1 variable met these criteria, variables were removed one at a time, starting with the variable with the highest P value. Analyses were adjusted for school-level clustering.

The main emphasis of this study involves differences between inactive adolescents (overestimators and realistically inactive) because they are most likely to be targeted in PA promotion, although all groups are included in the models.

RESULTS

Of the volunteers attending a testing session, 17 were not fully tested because of medical reasons or refusal to participate. Because of the late introduction of the perception questionnaire, 799 adolescents (85.8% of the 931 tested at T1) are included. No significant differences were found by sex (P = .69), weight (P = .80), FMI (P = .85), or MVPA (P = .27) between those with complete T1 data and the 132 with missing data; however, those of lower SES (P = .001) had more missing data.

Figures 1 and 2 show the classification of boys and girls into 4 PA awareness groups by objectively measured and self-rated PA. Among boys, 57.4% accurately reported their PA (22.1% realistically inactive and 35.3% realistically active). Of the 55.8% of boys who were inactive, 60.3% overestimated their PA (33.6% of all boys) (Figure 1). Among the girls, 41.5% accurately reported their PA level (28.6% realistically inactive and 12.9% realistically active). Of the 81.2% of girls who were inactive, 64.8% overestimated their PA (52.6% of all girls) (Figure 2). Compared with girls, boys were more likely to be realistically active (odds ratio, 3.50; 95% confidence interval, 2.26-5.42) and less likely to be realistically inactive (odds ratio, 0.29; 95% confidence interval, 0.18-0.44) or to overestimate their PA (odds ratio, 0.23; 95% confidence interval, 0.16-0.33).

Compared with realistically active boys, those underestimating their PA had lower body mass index (calculated as weight in kilograms divided by height in meters squared) and FMI and poorer mood (Table 1). Of the inactive boys, those overestimating their PA did more MVPA, had higher body mass index and FMI, reported higher peer and parent support, and reported lower teasing than those realistic about their inactivity. Of the active girls, those underestimating their PA were older, had higher FMI, and reported more teasing and lower peer and parent support than those who were realistically active (Table 2). Inactive girls overestimating their PA level had higher MVPA, SES, peer and parent support, and friendship scores and better mood and family scores, but lower FMI and teasing, than those realistically inactive. For girls, there were significant interactions between SES and peer support, FAD, friendship, and mood (interactions for the simple models shown in cTable 1; http://www.archpediatrics.com).

Table 3 shows the results of the final models of multiple correlates on PA awareness. For inactive boys, these results were similar to the simple models. Compared with girls who were realistic about being inactive, those overestimating their PA were more likely to be of higher SES, to report higher parent support, and to have a lower FMI and...
Physical activity levels were low; only 44.3% of boys and 18.8% of girls were meeting recommendations. This is less than the 81% of 15-year-old boys and the 60% of 15-year-old girls who were shown to be meeting these recommendations in a recent European study, yet these British adolescents appear to be more active than the 11% of US boys and 3% of US girls aged 12 to 15 years shown to be meeting these guidelines. Although this may indicate true differences, the results are not directly comparable because of different PA data preparation meth-
ods. The number of adolescents meeting PA guidelines depends on the cut points used to define MVPA.

This is the second study investigating PA awareness in youth, and the adolescents in this study appeared to be less aware than children aged 9 to 10 years in the previous study, in which 40% of inactive children perceived themselves as active. This could be due to social desirability bias, to being unaware of what constitutes PA, or to the fact that children in the previous study were more active. However, overestimation in these adolescents seems to be similar to the 46% to 61% of inactive adults overestimating their PA in previous studies. Girls were more likely to overestimate their PA than boys, possibly because social desirability bias may be more prevalent for girls, as seen with dietary reports. Compared with adolescents who were realistic about their inactivity, those overestimating their PA level had a lower FMI. This result supports previous evidence suggesting that overestimators may assume that they are sufficiently active because of their favorable body composition.

Adolescents who overestimated their PA level reported higher peer and parent support than those realistic about their inactivity, and boys overestimating their PA reported less teasing than those realistic about their inactivity. Although these adolescents appear to be receiving support for PA, they have still been classified as inactive, so this does not necessarily mean that this activity is at recommended levels. Although more support appears to be associated with a lack of awareness, this support could confer other benefits, such as reduced risk of depressive symptoms. For inactive girls, FAD and parent and peer support were positively associated with overestimation; this may be imitation of the familial and/or peer group pattern among relatively satisfied and well-adjusted teenagers. Although parent and peer support are positive correlates of PA, our findings suggest that they may be associated with a lack of PA awareness. Therefore, intervention components targeting PA awareness may need to use strategies different than those directly targeting PA.

Our proxy SES measure appears to be important in relation to awareness among girls but not boys. Significant interactions between SES/peer support and SES/FAD were included in the final model for girls, supporting previous research that girls and those of lower SES tend to have higher scores on measures of psychosocial difficulties. Within the realistically inactive group, peer support/FAD scores were more positive for girls of lower SES. Conversely for overestimators, peer support/FAD scores were more negative for girls of lower SES. Although unavailable, inclusion of individual SES indicators, such as parental educational level, would be useful to further explore this association between SES and PA awareness. Peer and parent support appear important in relation to awareness, and because these associations appear to differ by SES, interventions aiming to target PA awareness by means of support should perhaps tailor strategies by SES.

Education regarding the benefits of PA other than weight control may play an important role in PA promotion among adolescents because there are additional health outcomes, including features of the metabolic syndrome and bone health, that are associated with youth PA, and too much focus may have been given to the importance of PA for weight control relative to other benefits. Most inactive adolescents overestimate their PA level and may be less likely to want to increase their PA. Improving awareness could be an important component of adolescent PA promotion. Self-monitoring and feedback using pedometers may be effective to promote PA awareness. To determine the most effective types of feedback and their effect on awareness and PA, further research on changes in objectively measured PA behavior is needed. More work is also required on the ways that improving awareness helps to increase PA and whether it may improve intervention effectiveness.

We are unaware of any other studies assessing PA awareness in adolescents. This is especially important considering the PA decrease observed throughout adolescence, suggesting that adolescence is a valuable time for PA promotion. It is unknown how to best assess PA awareness, and the measure used here is the only one previously used in youth, it leaves interpretation to the participant. Although responses may be influenced by awareness and knowledge of PA guidelines, we consider this measure appropriate for this population. Our results

Table 3. Results of Multinomial Logistic Regression of Multiple Factors on Adolescent Physical Activity Awareness for 117 Boys and 237 Girls

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overestimators (Realistically Inactive)</th>
<th>Overestimators (Realistically Active)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Boys</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat mass indexd</td>
<td>0.86 (0.77-0.96)</td>
<td>0.97 (0.85-1.11)</td>
</tr>
<tr>
<td>Peer support</td>
<td>1.75 (1.32-2.30)</td>
<td>0.55 (0.40-0.76)</td>
</tr>
<tr>
<td>Teasing</td>
<td>0.75 (0.61-0.92)</td>
<td>1.31 (0.97-1.76)</td>
</tr>
<tr>
<td><strong>Girls</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Middle</td>
<td>2.28 (0.95-8.74)</td>
<td>3.76 (1.51-9.40)</td>
</tr>
<tr>
<td>High</td>
<td>2.38 (1.07-5.32)</td>
<td>5.16 (2.18-12.2)</td>
</tr>
<tr>
<td>Fat mass indexd</td>
<td>0.84 (0.70-0.99)</td>
<td>1.03 (0.89-1.21)</td>
</tr>
<tr>
<td>Parent support</td>
<td>1.57 (1.12-2.22)</td>
<td>0.86 (0.59-1.26)</td>
</tr>
<tr>
<td>Peer support</td>
<td>1.14 (0.61-2.14)</td>
<td>1.04 (0.43-2.50)</td>
</tr>
<tr>
<td>FAD</td>
<td>0.25 (0.09-0.67)</td>
<td>1.15 (0.59-2.24)</td>
</tr>
<tr>
<td>SES/FAD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Middle</td>
<td>2.50 (1.02-6.05)</td>
<td>0.88 (0.21-3.68)</td>
</tr>
<tr>
<td>High</td>
<td>1.41 (0.63-3.15)</td>
<td>0.84 (0.28-0.25)</td>
</tr>
<tr>
<td><strong>Teasing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1 [Reference]</td>
<td>1 [Reference]</td>
</tr>
<tr>
<td>Middle</td>
<td>3.67 (0.90-15.00)</td>
<td>0.82 (0.32-2.10)</td>
</tr>
<tr>
<td>High</td>
<td>4.04 (1.45-11.25)</td>
<td>0.63 (0.23-1.68)</td>
</tr>
</tbody>
</table>

Abbreviations: CI, confidence interval; FAD, Family Assessment Device; OR, odds ratio; SES, socioeconomic status.

a SES derived from home postcode (ACORN index [A Classification Of Residential Neighborhoods]) scored 1 for lowest to 3 for highest.

b Reference category for analysis is 77 boys and 129 girls.

c Reference category for analysis is 123 boys and 58 girls.

d Calculated as weight in kilograms divided by height in meters squared.
are somewhat dependent on the dichotomization of self-rated PA, specifically the classification of those answering “not active/not inactive” as “inactive” (12.1% of boys and 19.1% of girls). These adolescents were hypothesized to be ambivalent about their PA level and, because of reporting bias, more likely to be inactive than active in reality. Furthermore, because the average objectively measured PA level in this group was “inactive,” participants identifying themselves as similar to their peers were also most likely inactive. Study strengths include objective PA measurement to classify awareness. Objective data should represent true PA more accurately than a questionnaire and should overcome correlated error from 2 self-reported data sets. Our results rely on the thresholds used to determine active/inactive; however, results were similar when using 30 minutes per day of MVPA to define active/inactive (eTable 2).

This is a cross-sectional analysis, and we are unable to determine the direction of association and cannot infer causality. We must acknowledge the limitation that mood, FAD, and friendship were measured 6 months before PA, and they may have changed. There was some differential drop-out exacerbated by late introduction of the perception questionnaire, with lower-SES adolescents having more missing data, limiting generalizability. Cambridgeshire and Suffolk may not be representative of the whole United Kingdom, and this group had slightly lower levels of overweight than adolescents from the East of England.

In conclusion, most inactive adolescents wrongly consider themselves to be sufficiently active, and adolescents with a lower FMI inaccurately describe themselves as active. Physical activity awareness may be especially important when targeting PA promotion interventions for adolescent girls. Increasing awareness of PA health benefits beyond weight control might reverse misperceptions and encourage behavior change.

Accepted for Publication: January 6, 2011.

Correspondence: Kirsten Corder, PhD, Centre for Diet and Activity Research, Institute of Public Health, Forvie Site, Robinson Way, Cambridge CB2 0SR, United Kingdom (kc29@medschl.cam.ac.uk).

Author Contributions: Study concept and design: Corder, van Sluijs, Goodyer,Steel, Bamber, Dunn, Griffin, and Ekelund. Acquisition of data: Corder, van Sluijs, Goodyer, Ridgway, Steele, Bamber, Dunn, Griffin, and Ekelund. Analysis and interpretation of data: Corder, van Sluijs, Goodyer, Steel, Bamber, Dunn, Griffin, and Ekelund. Drafting of the manuscript: Corder. Critical revision of the manuscript for important intellectual content: Corder, van Sluijs, Goodyer, Ridgway, Steele, Bamber, Dunn, Griffin, and Ekelund. Statistical analysis: Corder. Obtained funding: Goodyer, Steel, and Dunn. Administrative, technical, and material support: Corder, Ridgway, and Steele. Study supervision: van Sluijs, Goodyer, Bamber, Dunn, Griffin, and Ekelund.

Financial Disclosure: None reported.

Funding/Support: The ROOTS data collection was supported by grant 074296/Z/04/Z from the Wellcome Trust and by the Medical Research Council Epidemiology Unit and Medical Research Council Human Nutrition Research.


Additional Contributions: We acknowledge all those who assisted with the ROOTS measurement sessions. We are also grateful to all schools and volunteers participating in the ROOTS study.

Additional Information: This research was completed within the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care for Cambridgeshire and Peterborough.

REFERENCES


