



## Research Article

# Self-Perceived and Objectively Measured Physical Activity in Children

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## Abstract

**Background:** Guidelines suggest children obtain 60 minutes of moderate intensity physical activity (or 12,000 steps) each day. Low physical activity may result when children mistakenly perceive they are more physically active than they actually are. **Aim:** This study compared the self-perceptions and objective measures of physical activity in 264 children in grades 3 to 6 (ages 8 to 12 years). **Materials and Methods:** Children's self-perceptions of physical activity were interpreted from their responses to: (1) How many days in the past week did you obtain at least 60 minutes of moderate intensity physical activity? And (2) Compared to other children your age, how active are you? Physical activity was objectively assessed from seven valid days of pedometer data. **Results:** Over half of the children (54.9%) overestimated the number of days they met the physical activity guidelines, while 43.8% of children overestimated their physical activity in comparison to other children of the same age. In both cases, children who overestimated their physical activities took significantly fewer steps than those who accurately or underestimated their physical activities. **Discussion and Conclusion:** The discrepancy between children's self-perceived and objective measures of physical activity may influence their decision to be physically active, and physical activity promotion efforts should be designed accordingly.

**Keywords:** Daily steps; Pedometers; Perceptions; Self-report

## Introduction

The 24-hour movement guidelines recommend that children ages 5 to 17 years obtain a minimum of 60 minutes of moderate-to-vigorous physical activity (MVPA) each day [1]. Sixty min of MVPA roughly equates to 12,000 steps per day [2]. Using these guidelines, 35% of children ages 5 to 17 years obtained an average of 60 minutes of MVPA per day over the week [3], and 9% of boys and 4% of girls obtained at least 12,000 steps on at least six days per week [4].

Various correlates of physical activity in children and youth have been examined to better understand children's participation or lack thereof in physical activity. These include age, sex, ethnicity, opportunities for physical activity, physical activity preferences, intention to be physically active, perceived physical activity competence, previous physical activity, time spent outdoors, program/facility access, depression, community sports, sensation seeking, parent support, support from others, and more [5]. Further, several barriers to physical activity have been examined, including access and availability to parks and outdoor spaces in which children can move and play, financial support for registration fees, equipment, and travel for various sport programs [3]. Despite the known influences on physical activity – positive and negative, and even though many have been addressed in various physical activity promotion efforts, a considerable portion of children and youth remain physically inactive [3,4].

Another potential explanation for children's lower levels of physical activity – at least for some, may relate to their self-perceptions of the amount and intensity of their physical activity.

If children think the physical activity they do is intense enough to contribute to the guidelines and/or think they spend more time being physical activity than they really do, they may think physical activity promotional efforts are not directed at them and there is no need to increase their physical activity. This is particularly true for people who overestimated their physical activity as they are less likely to change their physical activity behaviors [6]. Further, almost half of the people who overestimated their physical activity were also likely to consider themselves as equally physically active or more physically active than others [7]. Other groups at risk of misinterpreting their need for and level of physical activity are individuals who think their weight was 'right' or those who had a lower body mass index (BMI) [7]. It is possible when individuals perceive little or no personal relevance to the threat of physical inactivity – because they think they are sufficiently physically active and/or are thin enough, they do not attempt to change their level of physical activity.

Support of this potential explanation for lower levels of physical activity has also been shown in research with children [8,9]. For example, of the 30.9% of 1892 British children classified as physically inactive (<60 minutes per day of MVPA), 40% overestimated their level of physical activity [8]. Interestingly 80% of the parents/guardians of these children also overestimated their children's physical activity. Further, a direct negative correlation with perceived physical activity and children's fat mass index (i.e., fat mass obtained from bioelectrical impedance divided by height squared) also exists [8]. Specifically, the lower the children's

fat mass index, the more likely they overestimated their physical activity level. It is possible that children who overestimated their physical activity made this assumption in part because they had a favorable body composition. Given this overestimation, it would be likely these children did not think there was a need to engage in more physical activity, supporting the ideas of Van Sluijs et al. [6] and Lechner et al. [7].

Further support for this notion is found in research of 306 children's self-perceptions of their own level of physical activity to the physical activity of friends of their age, as measured using the Physical Activity Questionnaire – Children or PAQ-C [9]. Although 85% of this sample of 8 to 15-year-old children thought they were physically active (active, more active and much more active than friends their age), only 13.4% were classified as active according to their results from the PAQ-C indicating a clear discrepancy in how children view themselves regarding their physical activity [9]. Therefore, similar to adults, if children do not perceive their physical activity accurately – and in particular if they overestimate how physically active they are, they may not consider the various physical activity promotional efforts as relevant and make no changes to their participation in physical activity. This, in turn, could jeopardize children's health and wellbeing and may be an important avenue of research.

## **Aim**

Thus, the purpose of this study was to explore children's self-perceived level of physical activity and compare this self-perception to what is objectively measured.

## **Materials and Methods**

### **Research ethics approval**

Data examined in this study were collected as part of a larger research project, the Canadian Assessment of Physical Literacy (CAPL) [10]. Approval for the CAPL project came from the Research Ethics Boards of the Children's Hospital of Eastern Ontario, and the local university and public school.

### **Participants**

During classroom visits, 1065 boys and girls in grades 3 through 6 (8-12 years) were invited to participate in the CAPL. The students were given a letter of invitation and informed consent form to take home for their parents/guardians to complete along with a health-screening tool. Only children who returned the signed consent form, completed health forms, and provided verbal assent on the day of data collection participated in the CAPL.

### **Self-perception of physical activity**

Children's self-perception of their physical activity was determined from their responses to two questions of the physical activity questionnaire designed for the CAPL project [11]. The first question was 'Compared to other kids of your age, how active are you?' and the children were asked to

indicate their response using a Likert scale from 1 to 10, with 1 being 'a lot less active', 5 or 6 being the 'same', and 10 being 'a lot more active'. The second question asked 'During the past week (7 days), on how many days were you physically active for a total of at least 60 minutes per day? (all the time you spent in activities that increased your heart rate and made you breathe hard)'. For their response to this question, the children were asked to circle a number between 0 and 7 to indicate the number of days for the past week.

### **Objective measure of physical activity**

For the objective measure of physical activity, the children wore a Piezo RX Steps Count pedometer for seven consecutive days following the day of distribution from when they woke in the morning until they went to bed at night. These children also completed a pedometer log to record the time the pedometer was put on and taken off each day and if they did not wear the pedometer for any length of time during the day and the reason for not wearing it. On the day of CAPL data collection, a trained research assistant showed the participants how to attach the pedometer to their waistband over their right hip. Participants were told the pedometer could not be worn in water but was safe to wear during other sporting activities such as hockey, soccer, dance, basketball, etc. Similar instructions were sent via email to the children's parents/guardians to assist with compliance.

### **Data management**

The number of steps recorded for each day was downloaded from the pedometers as soon as they were returned. Using the established CAPL protocols, valid days of pedometer data were determined for each participant [12]. First, the total step count for the day must have been between 1000 and 30,000 steps [13, 14]. Second, the participant must have self-reported wearing the pedometer for at least 10 hours each day (total time worn minus the time taken off) [15, 16]. Finally, to be included in the analyses in this study, each child must have had seven days of pedometer measurements meeting the requirements above.

### **Data organization**

Average daily steps were determined for the children according to grade. Using these values and each child's average steps for their seven days of data collection, children were individually classified as more, less, or equally active than children their age. If a child's average steps were more than one standard deviation below the average steps for his/her grade, then he/she was considered less physically active than others his/her age. If a child's average steps were greater than one standard deviation above the grade average, then he/she was classified as more physically active than others his/her age. If the child's average daily step count was within one standard deviation of the mean, he/she was considered equally physically active as other children his/her age. Using their classification (more active, less active, or equally active) and the children's responses to 'Compared to other kids your age, how active are you?' children were then

labelled individually as underestimating, accurately estimating, or overestimating their physical activity. Table 1 illustrates the nine theoretical possibilities for these classifications. Finally, using these classifications (i.e., underestimating, accurately estimating, or overestimating), the

percentage of children that accurately reported their level of physical activity compared to others their age was determined where 1-3 = less active, 4-7 = equally active and 8-10 = more active on the Likert Scale.

Participant	Grade-Specific Average Steps/Day	Participant's Average Steps/Day	Self-Reported Physical Activity	Estimation
1	10,000	6000	1-3	Accurate
2	10,000	6000	4-7	+ Over
3	10,000	6000	8-10	+ Over
4	10,000	10,000	1-3	- Under
5	10,000	10,000	4-7	Accurate
6	10,000	10,000	8-10	+ Over
7	10,000	14,000	1-3	- Under
8	10,000	14,000	4-7	- Under
9	10,000	14,000	8-10	Accurate

**Table 1:** Nine possible classifications of children regarding self-reporting of their level of physical activity compared to others their age.

Daily steps were examined to determine if the children met the physical activity guidelines of 12,000 steps each day. The number of days each child met the criteria were summed resulting in a value between 0 and 7 days per week. This value (an objective determination of physical activity) was then compared to the child's response to 'During the past week (7 days), on how many days were you physically active for a total of at least 60 minutes per day?' From here, the percentage of children that accurately reported the same days per week was determined. These self-reports of meeting the physical activity guidelines were considered accurate if the child reported within one day of the number of days they accumulated 12,000 steps. For example, if a child had at least 12,000 steps on six of the seven days and he/she reported that he/she was physically active seven days of the past week, this was considered an accurate perception. If a child reported two or more days above or below their objective number of days obtaining 12,000 steps, this was considered an over or underestimation, respectively. In this way, the percentage of participants that over, accurately, and underreported their daily physical activity was determined.

**Statistical analysis**

Analysis of Variance were used to determine if differences existed among the children according to grade for steps, pedometer wear time, and questionnaire responses. Significance was accepted at  $p < 0.05$ .

**Results**

Of the 1064 children who participated in the local data collection site, 909 (85.4%) provided some pedometer data, and only 249 (23.4%) provided seven valid days (i.e.,  $\geq 10$  self-reported hours of wear time and daily steps between 1000 and 30,000). Seven valid pedometer days were needed for these analyses to make a comparison to the children's response to the question 'During the past week (7 days), on how many days were you physically active for a total of at least 60 minutes per day?'

	Grade 3	Grade 4	Grade 5	Grade 6
Number of children	29	102	56	61
Age (years)	8.5 ± 0.38	9.6 ± 0.41	10.7 ± 0.44	11.8 ± 0.37
Steps (per day)	13662 ± 2889*	12257 ± 3335	11845 ± 3032	11434 ± 3058*
Wear time (hours)	12.9 ± 0.60*	13.0 ± 0.76*	13.4 ± 0.72*	13.2 ± 0.80
Compared to other kids your age, how active are you? (scale of 1-10)	7.6 ± 2.3	7.4 ± 1.9	6.8 ± 2.1	6.8 ± 1.8
In the past week, how many days were you active for at least 60 minutes? (scale of 0-7)	4.7 ± 2.3	5.3 ± 2.0	5.5 ± 1.5	5.3 ± 1.4

\*indicates significant difference at  $p < 0.05$

**Table 2:** Average (±SD) age, steps/day, wear time, and questionnaire responses for children in grades 3, 4, 5 & 6.

Table 2 presents the number of participants according to grade, their average age, steps/day, pedometer wear time, and their responses to each of the two self-perception questions. Although it appears that fewer steps are accumulated by older compared to younger children, only children in grade 3 obtained significantly more steps ( $p=0.010$ ) than children in grade 6. In terms of pedometer wear time, children in grade 5 wore the pedometer significantly longer than children in

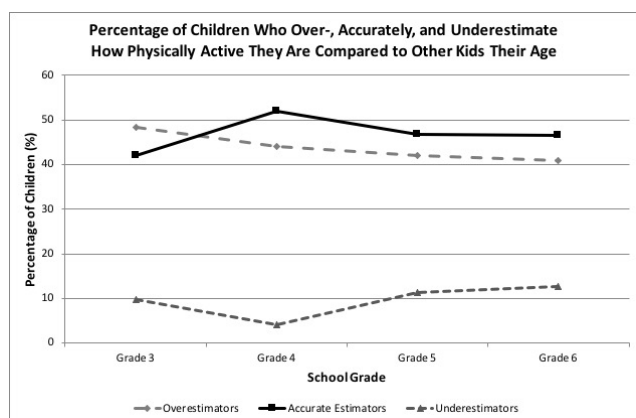
grades 3 ( $=0.013$ ) and 4 ( $p=0.004$ ). Children in grade 6 also wore the pedometer significantly longer than children in grade 4 ( $p=0.039$ ). On average, children in grades 3 through 6 considered themselves as active as other children their age, with no significant differences among the grades. Similarly, there were no significant differences in the number of days children in grades 3, 4, 5, and 6 self-reported being physically active for at least 60 minutes per day.

Compared to other kids your age, how active are you?	Grade 3	Grade 4	Grade 5	Grade 6
Less active (1-3)	2 (6.9%)	0	2 (3.3%)	1 (1.6%)
As active (4-7)	9 (31.0%)	51 (51.0%)	34 (56.7%)	39 (63.9%)
More active (8-10)	18 (62.1%)	49 (49.0%)	20 (33.3%)	21 (34.4%)

**Table 3:** Number (and percentage) of children according to grade who self-reported as less (1-3), equally (4-7), or more active (8-10) than other kids their age.

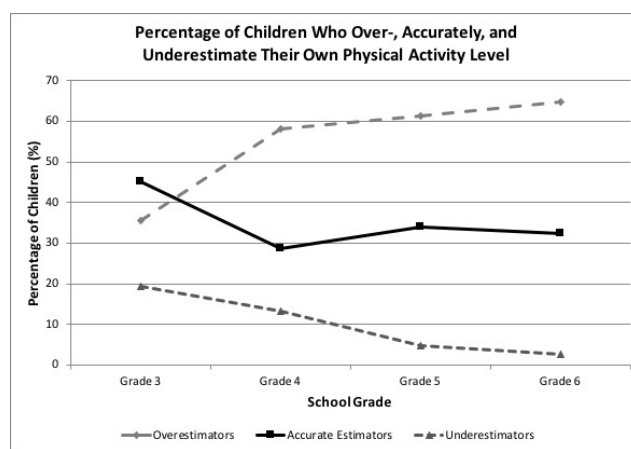
The data presented in Table 3 shows the percentage of students according to grade who considered themselves less, equally, or more active than other children their age. Most children in grades 4, 5 and 6 identified themselves as equally physically active as other children their age. Children in grade 3 most often identified themselves as more physically active than other children their age. Only five participants identified themselves as less active than others their age.

The data presented in Figure 1 shows the results of the children’s responses to “Compared to children your age, how active are you?” using the terminology and examples presented in Table 1. Overall, a similar percentage of children in each grade accurately identified their level of physical activity compared to others their age. Few children underestimated their level of physical activity, while a relatively larger number overestimated their level of physical activity. The children in grade 4 most accurately reported their physical activity on this question (52%) and had the lowest percentage of children who underestimated their level of physical activity (4%).



**Figure 1:** Percentage of children in grades 3 to 6 who over-, accurately, and underestimate how physically active they are compared to other kids their age.

The data presented in Figure 2 represents the percentage of children in each grade who over, under, and correctly identified the number of days in the past week they were physically active for at least 60 minutes. About 30% of children in grades 4, 5, and 6 were accurate in this estimation. Most children in these grades (~ 60%) overestimated the days they were active for at least 60 minutes. Overall, few children underestimated their physical activity.



**Figure 2:** Percentage of children in grades 3 to 6 who over-, accurately, and underestimate their own physical activity level.

The average steps of the children classified as over, under or accurate estimators of their physical activity compared to others their age were examined using ANOVA and Tukey’s post hoc analyses. Children who overestimated their physical activity took significantly fewer steps ( $10612 \pm 2350$ ) than children who underestimated ( $15201 \pm 2580$ ;  $p<0.000$ ) and accurately estimated ( $13862 \pm 3010$ ;  $p<0.000$ ) their physical activity. There were no significant differences in average steps per day between the children classified as accurate estimators and those who underestimated their level of physical activity compared to others their age ( $p=0.069$ ). Similarly, the average steps of the children classified as over,

under or accurate estimators of their physical activity according to the number of days per week they reported obtaining at least 60 minutes of moderate or more intense physical activity were examined using ANOVA and Tukey's post hoc analyses. Children who overestimated the number of days per week they were active obtained significantly fewer steps ( $11075 \pm 2846$ ) than the children who accurately estimated ( $12401 \pm 3096$ ;  $p=0.001$ ) and the children who underestimated the days they were active ( $15711 \pm 1673$ ;  $p<0.000$ ). Further, the children who accurately estimated the days per week they engaged in at least 60 minutes of moderate or more intense physical activity obtained significantly fewer steps than the children who underestimated their days per week ( $p<0.000$ ).

## Discussion

The purpose of this study was to compare self-perceived and objectively measured physical activity in children. This was done in two ways. First, children's self-reported level of physical activity relative to other children their age was compared to an objective measure of their physical activity (i.e., steps obtained from seven days of pedometer wear time) relative to the average steps for children their age. Second, children's responses to how many days per week they obtained at least 60 minutes of moderate or more intense physical activity were compared to the number of days they obtained at least 12,000 steps over the seven days of pedometer data collection. The results indicated that overall 46.8% of the children in grades 3, 4, 5, and 6 accurately estimated their physical activity when comparing themselves to others their age. Further, 35.0% of children accurately estimated the number of days per week they obtained the equivalent of 60 minutes of moderate or more intense physical activity. These results suggest the majority of children have difficulty recognizing their physical activity in comparison to others their age as well as difficulty estimating the time and intensity of their physical activity.

Of the children, 43.8% in grades 3 to 6 reported they were more active than their age-matched peers despite being equally or less active. Similarly, more than half (51.6%) of all children in grades 3 to 5 and almost 65% of the grade 6 participants overestimated the days per week they met the physical activity recommendations. In other words, a large percentage of the children in this study thought they were more active than other children their age and self-reported more days per week of meeting the physical activity requirements than what their objective physical activity data showed.

The results of this study are similar to the findings of Greca et al. [9] where 84.6% of the children studied perceived themselves as being physically active even though they were classified as physically inactive. Together these findings provide support for the contention that children's perceptions of their physical activity may not relate to their actual level of physical activity. For instance, the present study found significant differences between the average steps of children who overestimated, accurately estimated, and underestimated their level of physical activity. Children who overestimated their level of physical activity took fewer steps than children

who accurately or underestimated their physical activity, whether the overestimation was in comparison to other children their age or in reporting the number of days per week with at least 60 minutes of moderate or more intense physical activity.

Overall the results of this study suggest a relatively strong and important relationship between children's actual level of physical activity and how they think about their physical activity. Children who underestimated their physical activity may not think that they are obtaining adequate levels of physical activity and engage in more as a result. Those who overestimated their physical activity might think they are already getting enough physical activity and subsequently do not make efforts to be more physically active. As a consequence, the children who overestimate their physical activity do not meet the recommended 12,000 daily steps each day. If these assumptions are reasonable, then an overestimation of physical activity is a potential barrier in physical activity promotion for children. It is reasonable to assume that when individuals over-perceive their physical activity levels they are less likely to listen to physical activity promotion messages, as they would not see personal relevance or implication.

One limitation of this study may relate to how the self-reported physical activity data were collected. In terms of comparing children's physical activity level to their peers, it may have been a difficult question for the children because it asked for two perceptions of physical activity, their own, and that of their peers. There also may have been limitations regarding the comparison of the self-reported data regarding how many days per week the children reported meeting the physical activity guidelines and the objective measure collected. Participants reported number of days in the past week they obtained at least 60 minutes of physical activity while pedometers were most often distributed to the participants on the same day they completed the questionnaire. Consequently, the objective physical activity measurements were obtained for the week following the self-reported estimate of physical activity. In other words, the self-reported level of physical activity used in this study to compare to the pedometer measurements assessing the children's accuracy of perception were not measuring physical activity for the same week. This discrepancy in timing only applies to this comparison and not when children were asked to compare their level of physical activity to other children their age. It should be pointed out that it would not have been practical to have the children wear the pedometers for a week and then ask them to self-report their level of physical activity simply because they had access to the number of steps obtained during the week they wore the pedometers. That said, it is generally assumed that children's physical activity levels do not fluctuate greatly from week to week.

Although the questionnaire designed for this study has established validity and reliability [12], it is recommended that further research should consider the cognitive development of children and their ability to recall not only their own physical activity, but also that of others. One suggestion would be to ask questions that do not involve the estimation of time. Children may have a less accurate ability

to recollect time-based activities because parents, teachers and schools often schedule their days [17].

## Conclusion

The results of this study showed that children in grades 3 to 6 were more likely to overestimate their physical activity and less likely to underestimate their physical activity. Therefore, efforts at promoting physical activity to children should be done early with cognizance of the potential to overestimate personal physical activity. Children who overestimated their physical activity took significantly fewer steps on average than those who accurately estimated or underestimated their physical activity. This discrepancy in physical activity has implications in that children's perceptions of their level of physical activity may influence their intended and actual physical activity. Further, misperceptions around physical activity may make promotion efforts difficult if the target audience for these efforts do not pay attention to them. These results strongly suggest a renewed outlook on physical activity education, such that children understand the extent of their daily habits.

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