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Is it Feasible to Use Students' Self-reported Step Data in a Local School Policy Process?

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Objective: We examined students' self-reported step data and discussed the feasibility of using these data in a local school policy process. Methods: For 5 days during school hours, 281 students from grades 5–7 participating in a health education program, measured their steps using a pedometer. Results: The mean steps/school day of 5½ hours was 5215; 6072 steps for boys and 4317 for girls, representing 43% and 38% of daily recommendations, respectively. Independent of grade level, boys walked more than girls by 1798 steps. Steps declined with increasing grade level for both sexes. Conclusions: Student-collected data showed similar patterns as reported in the literature, and therefore, a feasible perspective could be to use students' self-reported step data in a local school policy process.

***Key words*: physical activity; pedometer; step-data; self-measuring, school, policy**
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Daily physical activity is important for health at any age. However, a worldwide review reported that 80% of individuals 13–15 years old from 102 countries did not meet the public health guidelines for recommended levels of daily physical activity.[1] Other tendencies across countries, as evidenced by accelerometer studies, show that boys are more active than girls and physical activity declines as children reach adolescence.[2,3] Studies employing pedometers show similar trends.[4,5]

As children spend many hours in school each day, this setting is important to promote present and future physical activity of children.[6] However, the results of school interventions and policies are inconclusive and ambiguous. Regarding interventions, reviews of school-based studies from many countries show varying degrees of effects on different outcomes, including physical activity, sedentary time, body mass index (BMI), and fitness knowledge.[7-9] Regarding policies, research from 24 European countries show that despite the availability of tools to promote school health policies at the national and local levels, policy implementation is faced with barriers and problems.[10]

Pedometers can be used effectively as measuring tools[11] and motivational tools to increase physical activity among youth.[12] In most school-based pedometer studies, the intervention was extra-curricular, and the data collection process was researcher-driven.[13] Only a few studies have included pedometers as part of the curriculum,[14,15] requiring the students themselves to record the number of steps taken at the end of the day.[16] Thus, the knowledge base regarding participatory curriculum-integrated methods and student-produced data is limited. Several topics remain under-explored. Could the data collected by this method have applications beyond individual learning and motivation? Do the students' self-collected data show patterns of physical activity that are consistent with findings from large scientific studies?" Would it be feasible for schools to use this inexpensive student-driven method to measure physical activity, independently of researchers, and apply this knowledge in a health policy process? These are all pertinent issues, as measurement of health behavior is one of the recommended steps in the health policy process.[17,18]

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Therefore, the objective of our study was to examine students' self-reported step data and discuss the feasibility of using this data in a local school policy process. The data in the present study were derived from research on a health education program integrated into math, where students measured their steps with pedometers during school hours for one week. The aims of the program included development of student understanding of physical activity as an important part of daily life and enhancement of their knowledge of applied statistics. The program was developed in several phases, in collaboration with school representatives from Copenhagen, Denmark. First, an exploratory study identified that participation in step-counting and visualization of the data in a diagram promoted student insight and the ability to reflect on physical activity in daily life.[19] Secondly, the educational program "IMOVE" was developed.[20] IMOVE is easily accessible and can be used by any math teacher in English-speaking countries, as the material has been translated to English from the original Danish, and remains accessible at www.imove.zone. With IMOVE, students measure their steps with pedometers during school hours for one week. During the following week, they analyze the step data during 5 lessons, guided by a math and health education assignment. Thirdly, IMOVE was promoted in schools in Copenhagen, and an observational classroom study was conducted. This study showed that IMOVE contributed to the development of physical activity-related health literacy in students.[21] The present study examined the step data collected by the students who took part in the classroom observational study.

METHODS

Participants

The target group included students from grades 5-7. These are 10-14-year-olds in the Danish school system. Schools with math teachers who showed interest in participating in the IMOVE program were recruited during the 2013–2014 school term. The schools were recruited consecutively until 12 classes comprising 4 classes from each of the 3 grade levels were included. The 12 classes were from 4 schools. The schools were recruited purposefully by a coordinator from Copenhagen, with homogeneity regarding the type of public school and cultural and socioeconomic backgrounds of the students as selection criteria. This was done to maintain similarity among the schools and justify treatment of the data as one school population with 3 grade levels.

Instrumentation

We chose pedometers for the IMOVE program instead of accelerometers, and thus, also for this study, because we wanted an instrument that was economically accessible for schools and technically manageable for practitioners, including children. A pedometer is a feasible choice for widespread use, when the desired outcome measure is a cumulative record of steps taken over the course of the day.[22] The pedometer mark "Select" by Select Sports A/S was chosen because it was the winner in a Danish test,[23] as reasonably accurate and economically accessible, as it was neither the cheapest nor the most expensive. This choice was supported by an evaluation of commercial pedometers recommending avoiding the cheapest because their accuracy is unacceptable; conversely, moderately priced pedometers are acceptable for practice and public health use as they provide a reasonable approximation of daily physical activity.[24]

Procedure

Prior to starting the measuring week, one of the authors visited each class to introduce the IMOVE program and deliver the pedometers. The pedometers were unsealed, as the students themselves had to read and record the number of steps taken daily during school hours. The daily average was 5½ hours. The aim was to collect data reflecting a typical week. To allow the students to use and familiarize themselves with the device, the pedometers were worn for 3 days before measurements were recorded, thereby also reducing the chance for any 'novelty value' to be reflected in the data, ie, students walking and running more than usual. Following these probationary days, for one week, students measured the number of steps taken during school hours. A group of 4 students from each class was selected as 'IMOVE managers' and were responsible for organizing the data collection process. The managers distributed the pedometers each morning and collected them each afternoon. They ensured that everyone noted their step counts

in the afternoon on a poster in the classroom and entered the step counts for each day into an Excel spreadsheet. Thus, the step data collection was handled by students with little or no support from teachers. This procedure produced student ownership[21] and made the data collection feasible in a school setting, where the class had different teachers during the day, and students often started and ended their school day in different classrooms.

Table 1
Participating Students (Classes) by School and Grade

	Grade			
	5	6	7	Total
School				
A	19 (1)	42 (2)		61 (3)
B	81 (3)			81 (3)
C		19 (1)	43 (2)	62 (3)
D		25 (1)	52 (2)	77 (3)
	100 (4)	86 (4)	95 (4)	281 (12)

School * grade: p < .001

Data Analysis

Each of the 12 classes provided the research group with the poster and the Excel spreadsheet showing their daily step counts. Data from students with step counts for only one of the 5 days were omitted from the statistical analysis. Two counting days were considered acceptable for a mean step, as several studies have done separate calculations for 2-3 weekdays and 2 weekend days.[25,26] In addition, step counts numbering fewer than 800 in one school day were omitted. This cut-off point was chosen because other studies that have measured steps over the entire day generally omit counts below 1000.[27] Ultimately, data from 270 students were analyzed using SPSS version 20 software.

We first investigated differences in the mean steps by sex, class, and grade level, using descriptive statistics. We then investigated differences in the mean steps by sex and grade level, using linear regression analysis and adjusting for the other variable. We further tested for a modifying effect of grade level on sex (interaction) and vice versa in the associations between the numbers of steps.

To compare the student-collected step data with public health recommendations on the daily number of steps for children, we searched the international literature, as there are no national recommendations on the daily number of steps for children or adults in Denmark. The most recent recommendation on the daily number of steps that are sufficient for children was derived from a review of 17 studies from 7 countries. This review concluded that for primary school children to meet the recommended 60 minutes/day of moderate-to-vigorous physical activity, girls and boys should walk 11,000-12,000 and 13,000-15,000 steps/day, respectively.[5] Therefore, we selected 11,500 steps for girls and 14,000 steps for boys as the daily norms. We reported the students' mean steps during school hours as a percentage of the recommended daily number of steps.

RESULTS

The study included 281 students (138 girls and 143 boys) in grades 5-7 (ages 10-14 years) from 12 classes in 4 schools. Of the 281 students, 270 (96%) had complete step counts for at least 2 days.

Table 2
Number (Percentage) of Participating Students by Sex and Grade, Mean age (SD)

	Grade			
	5	6	7	Total
Sex				
Boys	53 (53%)	39 (45%)	51 (54%)	143 (51%)
Girls	47 (47%)	47 (55%)	44 (46%)	138 (49%)
Mean age (SD)	11.1 (0.48)	12.2 (0.52)	13.3 (0.51)	12.2 (1.06)

Sex*grade: p = .938. Sex * school (not shown) p = .904

Table 3
Mean Steps/Day (SD) during School Hours by Grade, Sex and All Students

	Sex		
	Boys mean steps (SD)	Girls mean steps (SD)	Total mean steps (SD)
Grade			
5	7020 (2127)	5272 (1413)	6163 (2012)
6	6322 (2379)	4526 /1717)	5370 (2233)
7	4908 (1304)	3055 (872)	4053 (1455)
Total	6072 (2148)	4317 (1654)	5215 (2111)

p < .001 for sex difference in each grade, and for difference between grades.

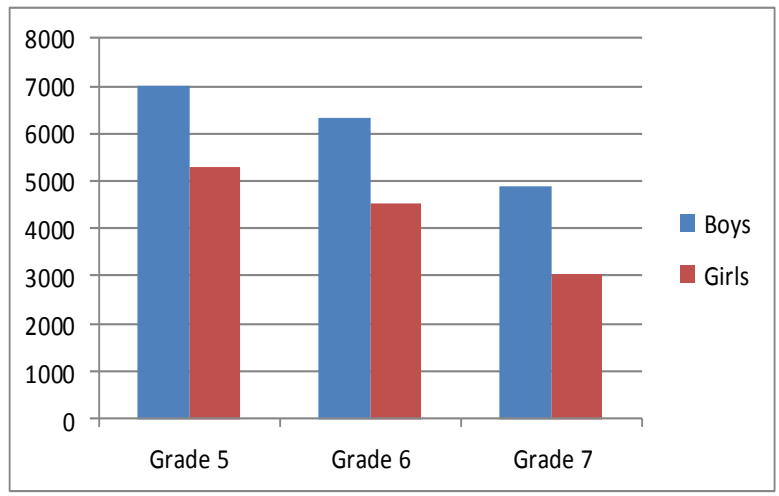
Analysis for sex * grade interaction not significant: p = .982

The mean number of counting days was 4.36 (SD = 0.89) and this number did not differ significantly by sex, grade level, or school.

The distribution of classes and students per grade level among the various schools was significantly different (p < .001), as one school participated with only grade 5, and the other schools with either grades 5 and 6, or grades 6 and 7 (Table 1). The distribution by sex within classes, between grade levels, and between schools was not statistically significant. The mean age was 11, 12, and 13 years in grade 5, 6, and 7 respectively (Table 2).

The mean steps/day observed in the study population was 5215 with large variation (SD = 2111), including 6072 steps/day for boys and 4317 steps/day for girls. The regression analysis showed that independent of grade level, boys had taken a significantly greater number of steps than girls (1798 steps more (95% CI 1395-2201)), and the mean steps/day declined with increasing grade level (p < .001). The mean steps/grade was 6163, 5370, and 4053 for grades 5, 6, and 7, respectively. Boys were signif-

Figure 1
Mean Steps/Day during School Hours by Grade and Sex



Note.
N = 270. The difference by grade and sex is statistically significant (p < .001).

icantly more active than girls were at all grade levels ($p < .001$) (Table 3 and Figure 1). Linear regression analysis did not reveal any statistically significant interactions between grade levels and sexes ($p = .978$).

Only one male student reached the recommended daily number of steps during the measuring period, which was school hours only (an average of 5½ hours a day). In comparison to established recommendations, the mean steps for boys during school hours were 6072, or 43% of the recommended 14,000 steps/day; and the mean steps for girls was 4317, or 38% of the recommended 11,500 steps/day.

DISCUSSION

In the present study, we evaluated the data collected by students in grades 5-7, as part of a math and health education program in 12 classes over 5 days. The average number of counting days was 4.36 without any statistically significant differences between grade levels, sexes, or schools. The overall results revealed a physical activity pattern with 2 trends:

- Boys were more physically active than girls in each grade level.
- Physical activity declined with increasing grade and age.

These trends are in keeping with both findings from large international studies, which used accelerometers[2] as well as studies that measured with sealed pedometers[5,25,26,28]. In these studies, researchers recorded the steps, thus not requiring children to self-report their step counts. Two of the studies compared physical activity of children from various countries. Children from Australia, Sweden, and the United States (US) were compared in one study[28] and those from Australia, Belgium, Brazil, Denmark, Estonia, Norway, Portugal, Switzerland, the United Kingdom, and the US were compared in another.[2] In addition to the 2 trends observed in the present study, those studies reported large inter-country variations in the activity level, magnitude of sex differences, and activity decline with age, as well as in the proportion of children complying with public health recommendations. The inter-country variations were ascribed to true differences in physical activity levels reflecting different environmental and sociocultural contexts.[2]

We found no other Danish pedometer studies with a similar age group to that of the present study (ages 10-14); however, a similar study utilizing accelerometers was conducted in American children in 2 age groups: 6–11-year-olds and 12–15-year-olds.[29] This study observed a larger sex difference in the older age group, in comparison to that of the younger, and a decline in physical activity with age that was larger for girls than for boys. In our study, there was no significant interaction between grade and sex; however, we compared children with only one year of difference, and thus, a much smaller age difference between comparison groups than in the American study.

Two similar Danish studies utilized accelerometers for measurement.[30,31] The former study[30] was conducted in a younger age group than that of the present study. The latter study,[31] conducted in a similar age group (11-16 years), reported a sex difference of 36%, a value that is consistent with that observed in the present study.

The findings from the student-collected data showed physical activity patterns that were consistent with those of the literature, thereby suggesting that this method could be feasible to use for practitioners for obtaining data of physical activity patterns at school level. However, there are weaknesses to be considered; some are related to the students as data collectors using inexpensive pedometers, whereas others are limitations in the study design.

The open recording procedure might have led participants to compete among themselves by walking more than they usually would on an average day, thereby resulting in over-reporting of the number of steps.[22] This might have occurred in the present study, and might have even exaggerated the sex differences observed, as boys might be more competitive than the girls, who might have followed the instructions to maintain their usual level of activity during the week of measurement.

The quality of the selected pedometer was another limiting factor. Selecting a pedometer is a compromise between price and accuracy. According to some public health researchers,[32] a 10% margin of error is acceptable for general use, whereas other researchers regard this level as unacceptable.[24] An imprecise measuring instrument can be mislead-

ing at the individual level; for example, a student might exhibit an inexplicably low step count one day and lose motivation, which is a risk associated with an inexpensive pedometer.[24] However, in a relatively large dataset, the uncertainty of imprecise measurement becomes randomly distributed and is, therefore, leveled. Thus, as evidenced in the present study, the student-measured data showed trends in physical activity that were consistent with those reported in the literature.

One limitation in the design of the present study was the measurement of steps only during school hours. This meant that the proportion of study participants who complied with the recommended daily number of steps could not be estimated. One Danish study reported large variations in the distribution of physical activity in children between school hours and leisure time.[31] However, disclosure of a low level of physical activity during school hours may serve a health education purpose for the participating students, and may motivate policymakers to create the conditions for more physical activity during school hours.[13]

Another limitation of the present study was the lack of analysis of class and school clustering or seasonal variation. One study of 7 schools in New Zealand showed that the number of permanent play facilities in schools was positively associated with all measures of physical activity.[33] The data in the present study were collected consecutively, school-by-school, during the school term in fall and winter, respectively. Thus, seasonal variation might have influenced the results. Another study reported differences in physical activity between summer and winter by as much as 25%.[34] However, it is difficult to imagine that accounting statistically for these contextual factors would change the trends that form the main findings of the present study, as the literature strongly supports them.

Beyond examining students' self-reported step data, the objective was to discuss the feasibility of using this data in a local school policy process. One precedent for its feasibility considers that the student-collected step data, self-measured with an open inexpensive pedometer, show a similar pattern of physical activity to that reported in a large body of scientific literature measured by researchers with sealed pedometers; that is, boys are more active than girls at all ages and physical activity declines with increasing age. The literature reveals large inter-country variations in the level and magnitude of sex and age differences. This indicates the necessity to measure physical activity locally. Furthermore, the authors of a large pedometer study in Canada concluded that self-measurement with relatively inexpensive pedometers is a viable method to monitor the physical activity of young people.[4] These factors support the feasibility of progressing from the use of self-reported data for monitoring and individual learning and motivation, to its use in a local health promoting school policy process, provided that the aforementioned limitations are considered acceptable.

IMPLICATIONS FOR HEALTH BEHAVIOR OR POLICY

A feasible perspective of this study for policy and practice could be to use this student-driven method in a local school policy process. Converting policy to practice is often a challenge at the national level,[35] as well as at the local school level.[36] Hunt et al[17] proposed a 10-step systematic process to help schools and districts convert the whole school approach for health and education outcomes into practice. Measuring health behavior, for instance physical activity, was included in 2 of the 10 steps: In the needs assessment (step 2), students' own step counting could be used to identify subgroups with low levels of physical activity, and guide the setting of targets for change. At the conclusion of an action plan, students could count steps again, and their self-reported data could be used to monitor the implementation and outcomes of local intervention (step 9). In this way, having students measure their own physical activity might contribute to more extensive use of local measuring and the conversion of health policy into practice at the local school level.

The students in the present study collected their step data in conjunction with the health education program IMOVE. With this program, self-monitored data collection can be incorporated easily into formal classroom teaching, allowing health measurements to become an integrated part of teaching, as recommended by other researchers.[15, 35]

Conclusion

The student-collected data showed similar patterns to those reported in the literature – indepen-

dent of grade level, boys were significantly more active than girls, and steps declined as grade level rose. A feasible perspective of this study for policy and practice could be to use this student-driven method, and the data generated for a local school health policy process.

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Human Subjects Approval Statement

Conducting this type of research project required no formal ethical approval in Denmark. Parents were informed about the study by the students' math teachers and could opt out. The students were informed about the study in the classroom. They were informed that by completing the questionnaire, they were giving the research team permission for confidential use of data for research purposes.

Conflict of Interest Disclosure Statement

The authors of this article declare they have no conflicts of interest.

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