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Determining gender differences in adolescent physical activity levels using IPAQ long form and pedometers

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Abstract

The need to overcome gender differences in physical activity (PA) is an essential part of health and education policy. Adolescent girls display less PA than boys. The aim of the presented research was to determine whether 4-week monitoring with pedometers can influence differences between the level of PA amongst adolescent girls and boys. Four-week interventions using pedometers, motivational brochures and the International Physical Activity Questionnaire (IPAQ), long version, and the possibility of using an Internet programme were carried out at 14 randomly selected schools. In total, 275 girls (15.8±0.9 years) and 220 boys (15.8±0.8 years) participated in the study, which was divided into intervention and control groups. The IPAQ questionnaire was applied in the pre-test as part of the ANEWS questionnaire. The IPAQ was solely used in the post-test. Significant differences in average daily steps were not observed in the intervention group for girls and boys ($F=3.79$; $p<.05$; $\omega^2=.011$), nor were differences in girls' average number of steps in school vs. weekend days observed ($p=.82$). The lowest amount of PA in boys was observed on Sunday (n=10,390±3,728 steps•day^{-1}), while overall, boys had a larger amount of steps on school days than at weekends ($p<.01$). In contrast, girls walked more during the week following the intervention. The four-week intervention eliminated the difference in the overall PA of adolescent girls and boys, together with the difference between school and weekends among girls. The use of pedometers, motivational recording brochures and an Internet programme for maintaining PA for a longer period, supported the continuance for movement of an active and healthy lifestyle among girls significantly more than their use among boys.

Key words

physical activity; steps; education; monitoring; healthy lifestyle

INTRODUCTION

The majority of the research on this topic confirms that boys are more physically active than girls [1, 2, 3, 4, 5, 6]. In the school setting, it is apparent that the largest difference in PA between girls and boys is during free time [7, 8, 9], when boys, particularly in the afternoon, are less sedentary than girls [10]. Gender differences in PA are connected with the activities offered in school physical education (PE), and also with the respective educational needs, interests and abilities of girls and boys [11]. The stronger inclination of boys towards sports, conditioning or competition-focused PA [12] and of girls towards "girls' interests", such as aerobics or keeping fit [13], is one of the main causes in differences in vigorous PA [7]. Differences in activity preferences, as well as such factors as environmental and social obstacles and logistical issues, are additional barriers for girls in relation to PA participation at higher rates than boys [14]. Armstrong and Welsman [15], in an overview of contemporary research, also state that European boys are more active than European girls, particularly in terms of vigorous PA. Canadian authors [16] also emphasise the need to promote PA, particularly among girls, both outside school hours and at weekends.

The differences in PA amongst girls and boys are confirmed in both school and at weekends [1, 8]. For girls, weekend PA decreases with age significantly more than PA on school days [17]. The school has a responsibility for creating balanced conditions for PA among girls and boys on school days. Negative experiences during school PE classes were the strongest factor discouraging participation by teenage girls [18].

Girls do not have a lower interest in PA than boys [19]. The specific character has to be respected with adolescent girls in terms of lifestyle evaluation spheres, preferences, inclinations, condition bases and other gender differences.

School PE plays a significant role in creating habits for regular PA and acquiring a healthy lifestyle in the lives of children and young people [20, 21, 22]. In addition to PA at home, the school environment is central to forming PA habits and participating in daily PA. Change in the "school regime" is particularly valid at present, including for everyday PA [23] and in the character of recess [19]. Active transport to and from school is also important in supporting regular PA [17, 24] with the greatest factor being the linking of school PA with free time PA.

It has been demonstrated that simple pedometers are appropriate monitoring tools under school conditions for motivating students towards increased PA as a part of physical education, in addition to daily movement activity [25, 26, 27, 28]. Pedometers can support effective self-reflexes, realistic evaluation of lifestyles, satisfaction in reaching small goals through changes in movement behaviour, and expanding awareness of the role of PA in lifestyles. The positive influence of pedometers for aiding change in movement behaviours

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among adolescents has also been confirmed by various intervention programmes [26, 29]. Although differences exist between boys and girls regarding average levels of PA, the usage of pedometers can help eliminate these differences. In Central Europe, one study found that wearing pedometers positively influences physical activity in girls [30]. The motivation potential of pedometers, particularly for increasing walking activity, is emphasised by Zhu [31] and Welk [32], while Chan and Tudor-Locke [33] stress its feedback effect.

We assume that using pedometers in Polish schools, which have 3 – 4 hours of PE per week, can significantly support increased PA amongst students, particularly girls. Our assumption is grounded in the self-determination theory [34], where intrinsic motives for physical activities facilitate long-term adherence. Adolescents may strive to better their own PA with the use of pedometers because it may increase their self-awareness regarding their own PA level.

OBJECTIVE

The aim of the research was to determine whether 4-week monitoring with pedometers can influence differences between the levels of PA amongst adolescents. We worked with 2 groups, a control group and an intervention group. Each group began the study with different starting data gathered from the IPAQ long form; the differences between girls and boys in each group varied. We were interested in learning if using pedometers would initiate positive changes in the amount of physical activity in which students participated, and eliminate gender differences in the intervention group. The intervention group was involved in a 4-week, self-monitoring, physical activity and educative programme. From the pedometers, the average number of steps for particular days (school vs. weekend) and weeks were determined, and these values were compared from the perspective of gender. Finally, from the IPAQ long form, we determined the amounts of particular types of movement activity and compared them between the intervention and control groups from the perspective of gender.

MATERIAL AND METHODS

Participants. In total, 275 girls and 220 boys (Tab. 1) participated in the study at 14 randomly chosen schools in the Katowice region of Silesia south-western Poland. 7 intervention and 7 control groups were chosen in randomly selected classes (2 classes at each school). Participants and their parents consented to participate in the research project (8 boys and 2 girls refused participation). There was no pressure placed on the participants, and they had the opportunity to end the PA monitoring at any time; no incentives were used.

Methods of monitoring physical activity. The Polish version of the International Physical Activity Questionnaire – long form (IPAQ), which is part of the ANEWS (Abbreviated Neighbourhood Walkability Scale), was completed by students at school and used to estimate weekly PA prior to the intervention period. Students completed the IPAQ again during the post-test period [35], which took place a week after the intervention was completed. The Polish version of the questionnaire underwent the standard translate and back-translate procedure [36]. According to Craig *et al.* [35], the IPAQ questionnaires produce repeatable data with Spearman's coefficient at approximately 0.8.

Table 1. Baseline characteristics of intervention and control groups.

Characteristics	Intervention group				Control group			
	Girls (n=154)		Boys (n=104)		Girls (n=121)		Boys (n=116)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Age (years)	15.68	0.79	15.63	0.84	15.97	0.92	15.66	0.83
Height (cm)	165.47	6.74	175.86	7.87	165.83	6.04	174.31	7.87
Weight (kg)	54.68	7.59	66.89	11.15	56.79	8.97	66.01	12.06
BMI (kg·m^{-2})	19.96	2.50	21.58	2.99	20.63	2.89	21.63	3.07
PA (MET-min·week^{-1})	9,190	6,719	11,789	7,694	8,510	6,030	10,835	7,402
Organised PA (count·week^{-1})	2.46	2.25	2.98	2.09	2.11	1.47	2.41	1.85
Sedentary activity (min·day^{-1})	297	120	289	132	320	130	292	154

Note: M – mean, SD – standard deviation

Daily PA was monitored with Digi-Walker SW-700 (Yamax Co., Yasama Corp., Tokyo, Japan) pedometers, which underwent a standard pre-intervention calibration. Although this type of pedometer has some limitations, it is regarded as the most appropriate pedometer and has been useful as a behaviour modification tool [37].

After completing the IPAQ at the beginning of the intervention, the students were instructed on how to wear the pedometers (at the hip bone on the right side of the waist) and when to take them off (swimming, showering, sleeping). Each student recorded his/her achieved number of steps each evening, converting the distance when moving (km) and the active energy expenditure (kcal), into personal brochures. The participants were instructed to reset the pedometer to zero for the start of each day. The motivational recording brochures contained the following: record tables for data from the pedometer, the possibility of graphic expression of the daily number of steps, record tables for movement inactivity, suggestions for changes to movement behaviour, general recommendations for PA, a table for the energy values for selected foodstuffs, and a table for energy expenditure for selected PA [38]. The participants also had the opportunity to mark out their smaller goals in the motivational recording brochures and to record the results of the PE lessons, the exercise and training units or the chosen individual PA. Introductory and concluding investigations included completing a questionnaire regarding awareness of health and PA, although the results of these are not included in this study.

The online data recording system, Indares [39], was provided to students for record-keeping, analysis and immediate feedback for the obtained data from the pedometer as well as the recorded PA.

Study variables. 29 participants were eliminated from the original collection for technical reasons (missing information of a personal character, e.g., weight or height) or for an insufficient number of records (missing more than 3 consequent day-data), when the results from the pedometers were processed (intervention group: n=287). The data were

then screened for extreme values; data for any single day indicating less than 1,000 steps was removed, and values of more than 30,000 steps on any single day (73 values means 1.0%) were truncated [40]. From the 7,224 total data records (258 students recorded steps for 28 days), records from 145 (2.0%) pedometers were missing data regarding daily steps, which were supplemented separately for individual days, and for girls and boys with average values of steps for a particular day. For analysis of the IPAQ questionnaires, only data for 178 students from the intervention group who had completed both IPAQ questionnaires, before and after monitoring, were used. Also included were the questionnaires from the control group (n=317) for statistical processing. Thus, 495 pre-test and post-test IPAQs were processed.

The results of the IPAQ questionnaire were processed in accordance with the officially recommended "Guidelines for data processing and analysis of the international physical activity questionnaire" [41]. In contrast to the IPAQ manual, vigorous PA was evaluated on the 6 METs level because original classification of PA does not meet the requirement for countries with a higher level of PA in its citizens [42].

Statistical analysis. Basic statistical calculations were employed for data processing in the Statistica CZ 9 and the SPSS 19.0 programmes. To calculate the differences between the individual types of PA from IPAQ between girls and boys, the Mann-Whitney U test was used with a level of statistical significance of p=.05. The statistically significant differences were determined between the possibility of steps in individual days and weeks with the use of repeated ANOVA and Scheffe *post hoc* tests. To estimate which factors (independent variables) determined from the ANEWS questionnaire have an influence on overall PA (dependent variable), use was made of binary logistic regression analysis. The dependent variable was categorised in accordance with the median of the collection (8,442 MET-min/week) for a group of students who had an overall PA below this border (category 0) and above this border (category 1). Independent variables included age (15, 16 and 17 years of age), group (control and intervention), BMI (personality, normal weight, overweight), place of residence (city, town, small town, village), smoking (non-smoker, smoker), dog ownership, frequency of participation in organised PA (no participation, 1–2 x per week, 3 and more times per week), voluntary participation in PA (yes, no), and the presence of the following infrastructure in the area of residence within a 10 minute walk (yes, no): a park, recreation centre, gym, overall walking accessibility to services. Use was also made of "effect size" ω^2 [43], d [44] and η^2 [45] coefficients for evaluation of the statistical significance. Of the daily number of steps, 2,000 steps were established as the logically significant difference (approximately one PE lesson [46]).

RESULTS

Pedometer monitoring. Through the use of monitored pedometers over a period of 4 weeks, it was found that the average number of steps for girls (n=154) during school days was 12,356±2,838 steps, and during weekends 12,567±3,511 steps. This difference is not particularly significant, but it slightly favours weekends. In the case of boys (n=104), average step values for school days were 12,006±2,924 steps and for the weekend 11,014±3,511 steps.

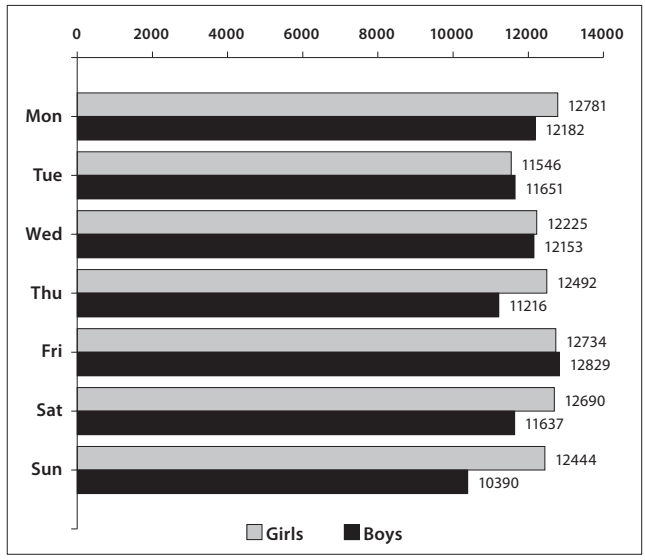

Figure 1. Average daily number of steps for girls (n=154) and boys (n=104) in single days (steps•day^{-1}).
Note: *p<.05; **p<.01

Significant differences (F=7.80; p<.01; ω^2=.14) were determined between particular days in the week with a higher average number of steps occurring on Monday and Friday, in contrast to Sunday and Tuesday (Fig. 1). Statistically significant differences (F=5.55; p<.01; ω^2=.08) were also recorded in the interaction between days x gender in addition to logically meaningful differences in the daily number of steps/results meaningfulness (n≥2,000 steps). For boys, the lowest average daily number of steps was recorded on Sunday (M=10,390±3,728 steps•day^{-1}). The average number of steps (p<.01; d=.63) was significantly different between Friday (M=12,829±3,848 steps•day^{-1}) and Sunday (M=10,390±3,728 steps•day^{-1}) for boys. Girls showed no significant differences in steps taken between particular days in the week. They did, however, reach a significantly higher average daily amount of steps on Monday (p<.05; d=.63), Friday (p<.05; d=.65) and Saturday (p<.05; d=.65), compared with the average number of steps for boys on Sunday. All differences found between boys and girls were not significant (F=3.79; p<.05; ω^2=.01).

Significant differences (F=5.46; p<.01; ω^2=.01) were determined between school and weekend days in particular weeks, but not specifically for girls and boys (Fig. 2). Looking at the interaction of days x gender (F=3.64; p<.01; ω^2=.06) in the final week, girls had a significantly higher average number of steps on the final weekend days than boys had on weekend days for weeks one (p<.01; d=.64) and two (p<.05; d=.57).

Significant differences were observed in the overall average number of weekly steps, without regard to gender, between the fourth week and the first week (F=8.15; p<.01; ω^2=.08) (Fig. 3). Including gender in this analysis shows that the final week differed significantly from the first week for girls (p<.05; d=.50). The average values in the fourth week for girls differed from the average values in the first week for boys (p<.05; d=.20).

IPAQ questionnaires. Boys compared to girls declared more vigorous PA (intervention group: Z=3.35; p<.01; η^2=.013; resp. control group: Z=2.15; p<.05; η^2=.009), moderate PA

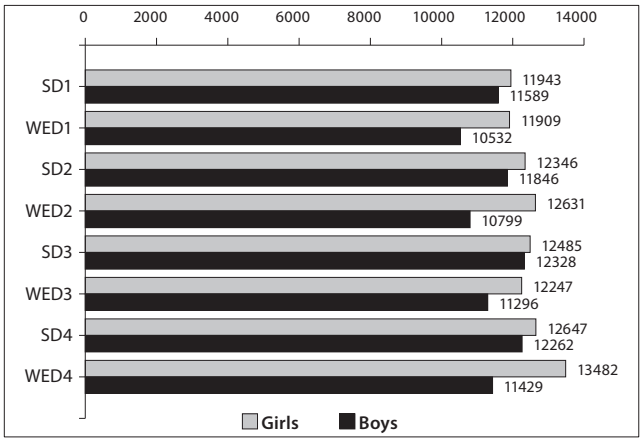

Figure 2. Average daily number of steps in girls and boys on school days (SD) and weekend days (WED) in single weeks (1-4) (steps•day^{-1}).
Note: **p<.01, *p<.05

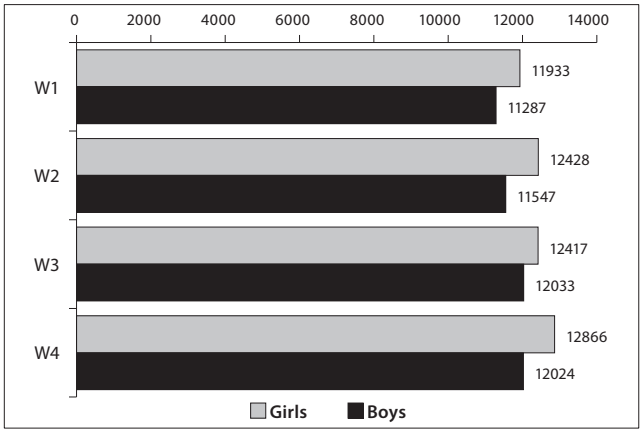

Figure 3. Average weekly number of steps for girls (n=154) and boys (n=104) in particular weeks.
Note: *p<.05

(intervention group: Z=3.08; p<.01; η^2=.012; resp. control group: Z=3.44; p<.01; η^2=.015) and total PA (intervention group: Z=2.83; p<.01; η^2=.011; resp. control group: Z=2.44; p<.01; η^2=.010) (Table 2) in the week before initiating the intervention.

In the week following the intervention, the boys in the intervention group had more PA than girls only in terms of vigorous PA (Z=2.61; p<.01; η^2=.01), and in contrast, girls demonstrated more walking (Z=3.13; p<.01; η^2=.012). Differences in overall PA in that week were not recorded among girls and boys (Tab. 3). The boys compared to girls in the control group again demonstrated more vigorous PA (Z=3.73; p<.01; η^2=.016), moderate PA (Z=3.85; p<.01; η^2=.016) and overall weekly PA (Z=3.15; p<.01; η^2=.013).

The results of the binary logistic regression analysis confirm gender as a factor (OR=2.64; CI= 1.33 – 4.39; p<.01) of influence on total PA (having more than 8,442 MET-minutes per week). Increased involvement in organised PA (OR= 4.00; CI= 2.00 – 8.01; p<.01), accessibility to recreational facilities (OR= 2.64; CI= 1.12 – 6.21; p<.05), and declaration of carrying out voluntary PA over the course of the year (OR= 2.27; CI= 1.00 – 4.68; p<.01) were shown to affect total weekly PA and were also verified as additional correlates associated with overall PA. The influence of the group factor (intervention and control), BMI or additional socio-demographic factors (location, type of living, dog ownership, houses in close neighbourhood, park accessibility, shops accessibility, fitness centre accessibility, neighbourhood walkability) was not observed.

Table 2. Weekly PA (MET-min•week-1) of girls and boys at the baseline (IPAQ)

Domain/ Intensity PA	Groups	Girls I (n=154) C (n=121)		Boys I (n=104) C (n=116)		Z	p	η^2
		Mdn	IQR	Mdn	IQR			
Work/school	I	2790	5187	3692	5082	**2.14***	**.032**	.008
	C	2826	4410	3324	4914	0.70	.484	-
Transportation	I	1152	2310	1400	2183	1.22	.223	-
	C	840	2309	1400	2394	1.45	.148	-
Domestic and garden	I	960	1730	1510	2956	**2.20***	**.027**	.009
	C	900	1530	1440	2630	1.69	.090	-
Leisure-time	I	1379	2472	2379	4205	**2.83****	**.005**	**.011**[b]
	C	1320	2289	1953	3472	**2.21***	**.027**	.009
Vigorous	I	1485	3300	3165	4410	**3.35*****	**.000**	**.013**[b]
	C	1200	2880	2160	4155	**2.15***	**.032**	.009
Moderate	I	2648	3910	3890	4998	**3.08****	**.002**	**.012**[b]
	C	2445	3180	3750	4883	**3.44****	**.001**	**.015**[c]
Walking	I	2706	3366	3053	3317	0.13	.894	-
	C	2574	3515	2063	2731	1.59	.113	-
Total PA	I	8317	8826	9779	9062	**2.83****	**.005**	**.011**[b]
	C	7440	7203	8816	10304	**2.44***	**.015**	**.010**[a]

Note: I – intervention group; C – control group; Mdn – median; IQR – interquartile range; Z – Mann-Whitney U test; *p≤.05; **p≤.01; ***p≤.001; η^2: [a]0.01≤η^2<0.06 = small effect size; [b]0.06≤η^2<0.14 = medium effect size; [c]0.14≤η^2 = large effect size

Table 3. Weekly PA (MET-min•week-1) in girls and boys in the post-test (IPAQ)

Domain/ Intensity PA	Groups	Girls I (n=154) C (n=121)		Boys I (n=104) C (n=116)		Z	p	η^2
		Mdn	IQR	Mdn	IQR			
Work/school	I	2505	6084	3354	4805	1.09	.276	-
	C	2640	5772	3837	5018	**2.35***	**.019**	**.010**[b]
Trans-portation	I	1944	2673	1080	2634	1.57	.117	-
	C	1188	1998	1400	2411	1.06	.289	-
Domestic and Garden	I	1260	2385	1087	2700	0.34	.730	-
	C	1140	1923	1590	2940	**2.05***	**.040**	.009
Leisure-time	I	2091	3024	2337	3081	0.72	.471	-
	C	1584	2403	2380	4146	**2.07***	**.038**	.009
Vigorous	I	1350	4200	2580	2940	**2.61****	**.009**	**.010**[b]
	C	1440	2580	2880	4170	**3.73*****	**.000**	**.016**[c]
Moderate	I	3000	4500	3225	5930	1.39	.166	-
	C	2460	3820	4638	6315	**3.85*****	**.000**	**.016**[c]
Walking	I	3514	4653	2285	2821	**3.13****	**.002**	**.012**[b]
	C	2970	3564	2376	3135	**2.12***	**.034**	.009
Total PA	I	9175	10101	8781	10895	0.48	.631	-
	C	6970	8467	11796	10882	**3.15****	**.002**	**.013**[b]

Note: I – intervention group; C – control group; Mdn – median; IQR – interquartile range; Z – Mann-Whitney U test; *p≤.05; **p≤.01; ***p≤.001; η^2: [a]0.01≤η^2<0.06 = small effect size; [b]0.06≤η^2<0.14 = medium effect size; [c]0.14≤η^2 = large effect size

DISCUSSION

The research was focused on 4-week interventions into the movement behaviour of adolescents. Findings suggested that this type of intervention could eliminate differences in PA among girls and boys.

Of note is the fact that the declared participation in physical education classes (school days x gender x participation in PE: F=1.79; p=.13) did not have an influence on the average daily number of steps taken for girls or boys. On days with recorded PE lessons (n=126), girls achieved an average of 12,058±2,788 steps•day^{-1} and boys an average of 12,330±2,761 steps•day^{-1}. From the data (n=42) listed in the recording brochure, which included the number of steps taken in PE lessons, the average number of steps was calculated as 2,017±860 steps per PE lesson (girls: 2,118±795 steps; boys: 1,883±947 steps). This calculation, however, is influenced by the small number of respondents, the non-representative collection, and in particular, the content of the PE lesson.

The use of pedometers over the 4-week intervention period evoked positive responses and attitudes (51.8 % boys and 76.4 % girls) and encouraged the subsequent use of the pedometers by students in the control groups on the basis of their own initiative.

Results of the pedometers on school and weekend days. In all 4 weeks, boys' PA levels were noticeably different between school and weekends. For girls, these differences were minimal in the first 3 weeks, and in the 4th week, a higher average number of steps was observed for the weekend. Gavarry et al. [1] found no evidence of differences between overall PA and moderate-to-vigorous PA (MVPA) on school and weekend days (70 min/day on average) for girls of approximately the same age as in the presented study. Certain studies [17, 24, 47] on younger children confirmed the higher amount of PA for boys monitored with pedometers, compared to girls, both on school days and weekends, with the number of steps at weekends being lower than on school days without regard to gender. Daily responsibilities on school days, active transport and the amount of free-time activities also increased the amount of steps significantly for Polish adolescents, in comparison with the weekend programme, which was dedicated more to rest (more than 33 % of the time) [48], watching television, visiting relatives and friends, and also preparing for school responsibilities. Due to the lack of available time needed for other activities, 46% of Polish people do not engage in PA [49]. Watching television and (123 min/day) sitting at the computer (117 min/day) were among the other activities Polish adolescents dedicated a significant amount of time to. These values were not determined from all of the probands of the intervention group, but only from those (20.1%) who recorded the data in the recording brochures. In a survey of the most common free-time activities in Central Europe [50], watching TV, DVDs and videos predominated, followed by listening to music and spending time at the computer; movement activity was in 6th place for daily operations. Jago, Anderson, Baranowski and Watson [10] argue that adolescent boys spend the most time at the weekend participating in electronic recreation and sport, while adolescent girls spend more time on personal care.

Results of the pedometers for particular weeks. Girls demonstrated growth in the number of steps taken over the course of the 4-week monitoring; this finding is evident both on school and weekend days (the difference between the 1st and 4th week is almost 1,000). The number of steps taken by boys also increased with the length of the measuring, although the difference is not substantial. Studies that may serve as a comparison for the results from this type of adolescent pedometer monitoring study for a particular time frame are not common, or are focused on comparisons of other parameters in connection with different age groups; for example, 3-week measuring with a pedometer and comparisons with body composition of adults [51]. Growth in the number of steps per day with the length of measurement has also been found with sedentary workers [52]. The authors came to the conclusion that sustainable behaviour change was achieved by approximately 4 weeks in a 12-week intervention with 106 participants. The changes were no longer significant in the following weeks.

Pedometer instruments. According to the results of the experiments and experiences at primary schools [53], pedometers can encourage pupils to engage in increased movement activity and can also serve as a significant motivational tool in physical education classes [28, 54]. Certain studies [55] call directly for longer lasting monitoring with pedometers because this will enable students to understand better their individual physical activity levels and patterns, and allow them to carry out self-assessments of PA. Intervention studies with the use of pedometers [52, 56, 57] are successful not only in support of PA [58], but also in terms of healthy eating habits among adolescent boys and girls [29]. The fact that girls respond more positively to the use of pedometers can significantly contribute to balancing opportunities for movement activity during free time when combined with additional encouragement measures.

IPAQ questionnaires. The IPAQ questionnaire, when applied as a pre-test, indicated that girls participated in a significantly lower amount of vigorous and moderate PA, compared to boys, which also had an influence on differences in overall PA. After 4 weeks of monitoring with a pedometer, the difference between the genders only remained with regard to vigorous PA. From the IPAQ data, it may be assumed that girls using pedometers enhanced the amount of PA for the transportation domain, and thus for walking in summary (intervention group: differences +792 MET-min/week for transportation and +808 MET-min/week for walking). Gender differences were also confirmed in studies of PA with the use of monitoring of heart frequency [1]. According to Sallise et al. [59], differences in PA between genders mainly start appearing at 16 years of age. Moderate PA and total PA in boys decreased in the post-test and gender differences were eliminated. A question remains: what caused the significant decrease in the amount of PA with boys in the post-test? Gavarry et al. [1], who observed 182 French children and teenagers aged 6–20 years old, monitored heart frequency and found similar results. The overall movement activity in boys over the course of school days decreased with age by 69 % in his study, while in the case of girls, the decrease was only 36 %. The decline in total PA was associated with a reduction in both moderate PA and vigorous PA. He explained this observation in relation to the great inter-individual variability of total PA existing in the French population.

Motivation recording brochures. Recording of data from pedometers was performed by all participants. The records determined that only 20.1% of the students were motivated to think more seriously about changes in lifestyle, establishing new goals, monitoring additional PA, and further possible use of the motivation recording brochures.

A significant contribution can also be expected in the area of awareness of one's lifestyle, more qualified approaches to changes in movement behaviour, deeper understanding of connections between movement activity and nutrition, and overall support for physical literacy among pupils.

Despite critical comments on the necessity of recording the number of steps (although this was voiced by only 3 students), recording activity and its evaluation is beneficial particularly for awareness of the sizes and types of movement activity, the influence of movement activity on energy exertion, the relationship between movement activity and eating and additional factors of a healthy lifestyle.

Strengths and limitations. The most positive contribution of the research is confirmation that the use of pedometers, during the period of use, can eliminate differences in PA among girls and boys as well as differences between school and weekends. A further contribution of the results is the length of monitoring of such an extensive group of adolescents. Some research among adolescents [60] does demonstrate monitoring longer than 4 weeks, but an insufficient amount of participants does not allow for generalisation of the results.

The design of the research aimed at preserving the most natural conditions possible. The individual effect of the pedometers, the motivation recording brochures and the INDARES Internet programme cannot be exactly determined in this intervention. The demanding school programmes also made it difficult to monitor repeated permanence of changes in movement behaviour. The technical limit of the research came from the use of the pedometers, which objectively monitor typical locomotion PA, but are less objective concerning other PA and are irrelevant for PA of a static character or activity in a water environment.

Linked research should focus on verifying whether the changes observed in the movement behaviour of girls in various socio-economic and cultural environments is permanent. There should be a further research focus on creating and verifying additional supporting motivational and educational means for increasing adolescent PA, including the use of Internet programmes which increase the benefits of pedometer use.

CONCLUSIONS

The results of the presented study demonstrate that the use of pedometers can decrease the differences in PA among adolescent girls and boys, as well as on school and weekend days. A significant finding is that PA levels did not decrease over the 4 weeks when pedometers were worn. Pedometers support an awareness of lifestyle amongst students under school conditions and are well-accepted by girls. An intervention incorporating PA monitoring using pedometers was successful in promoting PA in adolescent boys and girls. The results of the research serve to encourage physical education teachers to create school PE and extra-curricular PA programmes that extensively use pedometers, given their positive influence on PA, particularly in the case of girls.

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