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Place of residence, physical activity, use of electronic devices and health consequences in girls with scoliosis

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Abstract

Introduction and objective. Physical activity has been reduced in the 21st century and is a phenomenon which is now an important problem. The study focuses on the reasons for this lack of physical activity in adolescent girls diagnosed with scoliosis, and the possibility of preventing and effectively promoting a healthy lifestyle. The aim of the study is to investigate the relationship between place of residence (rural and urban) and physical activity in girls with scoliosis.

Materials and method. A group of 43 girls aged 16–18 years (x = 16.97 ± 0.88) with AIS (mean Cobb angle = 16.32 ± 3.55) who were rural inhabitants were examined. The control group included 39 young girls in the same age group and AIS who were living in towns (mean Cobb angle = 18.53 ± 4.3). BMI was calculated in percentiles and the IPAQ (*International Physical Activity Questionnaires*) was administered.

Results. The results showed decreased physical activity and a reduction in total sedentary time each week, which was higher in girls living in the countryside than in those living in towns ($P<.001$). Electronic devices were commonly used in both groups of girls.

Conclusion. The global weekly physical activity in girls living in the countryside was higher than that in girls living in the towns. A lower level of physical activity was noted in the girls exempted from PE at school. Body acceptance and fewer body image issues were noted in girls living in the countryside.

Key words

physical activity, scoliosis, IPAQ, electronic devices, sedentary behaviour

Abbreviations

AIS – Adolescent Idiopathic Scoliosis; **IPAQ** – International Physical Activity Questionnaire; **BMI** – Body Mass Index; **PCs** – Personal Computers; **PE** – Physical Education Classes; **MET** – Metabolic Equivalent of Work; **W** = Walk; **M** = Moderate; **V** = Vigorous

INTRODUCTION

Health is important for and inseparable from successful school performance [1], a good quality of life and good economic wellbeing. One's health shapes pro-health behaviours and enables the development of patterns over subsequent years [2]. Health is particularly important when adolescent and typical physical indolence are manifested in the general reluctance to participate in any physical activity [3], especially in girls. Physical education plays a particularly important role in shaping pro-health behaviours [4]. According to Leischik et al. [5], physical education should be defined as a 'health factory', in which fitness and physical efficacy are its products.

Physical activity is one of the main factors that influences the quality of life [6]. It is essential for maintaining a healthy lifestyle, and an insufficient amount of physical activity may result in a decrease in physical efficiency [7], overweight, obesity [8, 9], cardiovascular system disorders [10] and orthopedic problems, such as discopathy and repetitive strain injury [11]. According to Bodys-Cupak et al. [12], an optimal amount of physical activity is essential, especially for children and adolescents, and may guarantee optimal psychomotor and social development in young people. Children and young individuals of subsequently avoid performing physical activity in adulthood. These individuals may be less able to cope with stressful situations, and more cases of kinesiophobia [13] are noted among them. The effects of insufficient physical activity are well known, and it has previously been stated that physical activity should be chosen in accordance with individual abilitie, and that the consideration of individual contra-indications is necessary [14]. The way in which one spends free time is a significant lifestyle determinant. The development of civilization in the 21st century facilitates life at school and at home for children and young individuals. Electronic devices are commonly

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used for homework, but unfortunately, the increased usage of electronic devices has negative effects, such as a reduction in physical activity [10, 15, 16].

Articles about physiotherapy in young individuals living in the countryside and urban areas have been published [17, 18, 19]; however, there is a lack of analyses on this problem in girls with scoliosis living in different areas – rural and urban. The author's experience in therapy for children and young individuals with bad posture prompted the performance of a real assessment of this situation. The research questions posed focus on the reasons for the lack of physical activity in adolescent girls, and the possibility of preventing and effectively promoting a healthy lifestyle. Reduced physical activity is a very important problem that emerged while the hypothesis for this study was being created. Although the problem has been identifie, it has not yet been solved. The research presented in the study is part of a large scientific project.

OBJECTIVE

The aim of this study was to evaluate the level of physical activity among girls. The study also investigates the relationship between place of residence (urban/rural) and level of physical activity.

MATERIALS AND METHOD

Participants. A group of 43 young girls (group A) aged 16–18 years (x=16.97±0.88) who, on the basis of a medical examination and X-rays, were diagnosed with idiopathic adolescent scoliosis (AIS) were examined. The Cobb angle of the primary curvature ranged from 11° – 25° (x= 16.32±3.55; 95CI: 15.23–17.42), and the secondary curvature ranged from 8° – 25° (x=12.03±4.21; 95CI: 10.48–13.58). Girls from group A lived in the countryside in the Silesian province. The control group (group B) included 39 young girls from Silesian towns ere aged 16–18 years (x=16.82±0.72), diagnosed with idiopathic adolescent scoliosis on the basis of the same criteria. The Cobb angle of the primary curvature ranged from 11° – 24° (x= 18.53±4.3; 95CI: 17.14–18.93), and that of the secondary curvature ranged from 10° – 23° (x=14.7±2.23; 95CI: 13.83–15.63).

Instrumentation. For body posture assessment and classification, classic tools and tests were used (plumb line, scoliometer, digital inclinometer). Body weight was assessed by medical gravity, and growth measured as an increase in height. Length of arm span was determined and compared with growth. There was no difference in body weight and growth ($P>.05$) between the two group. Spirometry was therefore used to measure pulmonary function. Based on these parameters, BMI (*Body Mass Index*) was calculated. In children and adolescents, BMI is given in percentiles [20, 21]. Girls from both groups performed corrective exercises (most frequently) in the form of training sessions which included stations. The characteristics of the examined groups are shown in Table 1.

Additionally, the long form of the seven-day International Physical Activity Questionnaire was administered [22]. The questions included in the survey considered physical activity in relation to professional work, school activities, housework and garden activities, related to transport and free-time activities. The activities listed in the IPAQ are categorized as follows: low intensity, mainly including walking – energy output value 3.3 MET *(Metabolic Equivalent of Work),* as indicated by the letter W (Walk); moderate intensity – 4.0 MET, indicated by M (Moderate); and high intensity – 8.0 MET, indicated by V (Vigorous). By multiplying the number of days per week in which an activity was performed by the intensity or kind of activity described by the girls in a particular domain, the level of physical activity of the respondents was determined in MET – min. The fifth domain concerns the time spent in a sedentary position and is expressed in minutes. Based on the IPAQ, the level of physical activity of the girls who underwent the tests was calculated (low, moderate, high) in all of the above-mentioned domains.

The questions in the questionnaire developed by the author involved the use of mobile devices, tablets, PCs (Personal Computers) and computer games, at home and at school during weekdays and weekends. The reported individual time (in minutes) referred to the amount of time that participants spent with each electronic device, separately and in total.

Exclusion criteria. The girls who had proper body posture or were aged below 16 or above 18 years, were excluded, although the IPAQ questionnaire can be administered in individuals above the age of 16 [22]. Other exclusion criteria were smoking, chronic diseases (present and past), e.g., allergic diseases, viral infections, cardiac diseases, playing a wind instrument, exemption from physical education classes because of frequent infections, orthopedic injuries, or experiencing a 'growth spurt'.

Table 1. Characteristics of the examined groups.

	Cobb Angle (degree)	Age (year)	Height (meter)	ARMS' WIDTH (meter)	WEIGHT (kilogram)	BMI (percentile)
SUBGROUP (N)	Average (Range)	Average (Range)	Average (Range)	Average (Range)	Average (Range)	Average (Range)
A (43)	16.32±3.55* (11–22)	16.82±0.72 (16–19)	1.56±0.06 (1.44–1.7)	1.55±0.07 (1.42–1.7)	52.95±4.09 (41.9– 61.6)	52.67±24.79 (10–90)
	12.03±4.21** (8 – 19)					
B (39)	18.53±4.36* (11–24)	16.82±0.72 (16–19)	1.57±0.09 (1.41– 1.7)	1.56±0.09 (1.36– 1.8)	52.48±5.12 (42.7– 60.3)	47.612 ±26.3 (3 –90)1
	14.7±2.23** (10–19)					

* Cobb angle of the primary curvature; ** Cobb angle of the secondary curvature

Statistics. The Smirnov–Kolmogorov test was used to assess the normality of data. The following statistical methods were used for data analysis: Mann-Whitney U test for continuous variables with non-normal distribution, and Student's t test for continuous variables with normal distributions to assess relationships between examinations, and the non-parametric $\chi 2$ test and Spearman's rank test. The relationships between the parameters were evaluated with the Pearson correlation coefficient, r, and the χ^2 test was used for the non-parametric characteristics. Statistical significance was indicated when $P < .05$.

Ethics. This study was approved by the Ethics Committee of the Medical University of Silesia in Katowice (Resolution No. KNW-2–046/10 and KNW/0022/KB200/16), and performed in conformity with the Declaration of Helsinki. All patients and their parents/guardians provided written informed consent prior to the study, including the enrollment and data collection processes.

Validity. The weighted kappa statistic was used as a measure of intra-observer reliability, and intra-class correlation coefficients were used as a measure of interobserver reliability for each method. A method comparison analysis was performed to determine the 95% limits of agreement for all examiners. To prevent intertester variation, the same tester carried out all tests for each participant.

Randomization. The presented research is part of a large scientific project being conducted by the author. The project involves over 1,300 children from the Silesian Region of Poland. According to Pokrywka et al. [23], the prevalence of posture disorders is 38–39% in Polish children, 5% of whom suffer from bad body posture and severe deformities of the spine, such as scoliosis or Scheuremann's disease [24]. In the current study, the sample size was calculated using the sample size calculation for proportions. A margin of error of 6% with a confidence level of 95% was used for a population size of 200 girls with scoliosis, to yield a sample size of 115 individuals [25]. The response rate to the distribution of the place of residence was 50% [25]. After the exclusion criteria were taken into considered, a total of 92 girls were included in the final calculations (Fig. 1).

RESULTS

Physical activity level. Regarding the physical activity in both groups, discrepancies between them were expected; however, there were other results. The physical activity level was moderate in 63.16% of the girls in group B, the majority of the group, and it was moderate in only 34.88% of the girls in group A, the examined group. A high AF level was noted in 48.84% of the girls in group, and in only 13.16% of the girls in group B. The level of physical activity depended on the place of residence (X^2=11.9; P=.02, df=2). Table 2 shows the level of physical activity corresponding to particular domains in the IPAQ for the examined group.

Inter-group differences with no significance were observed in the domains 'Leisure/Free time' (z=0.36; P=.73) and transportation (z=1.25; P=.21). The physical activity level did not depend on age (P=.48) or the BMI coefficient in either of the examined groups (P=.66).

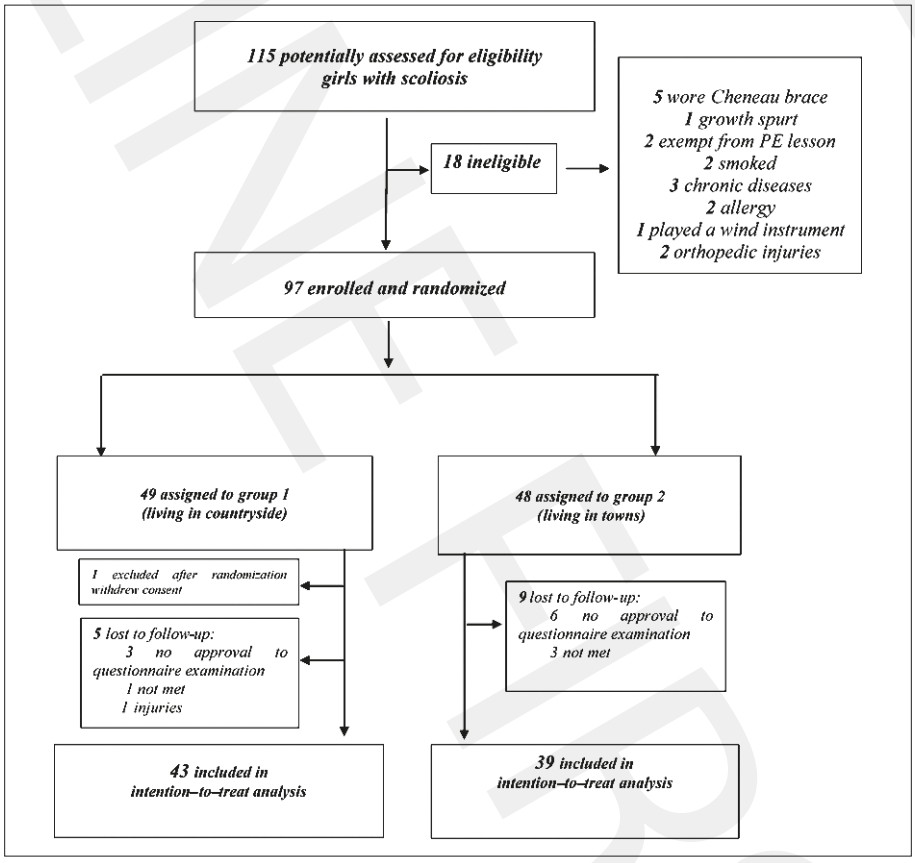

Figure 1. Visual insight into the selection procedure of participants (flow diagram)

Table 2. Level of physical activity of the examined grous in particular domains included in the IPAQ.

	Main – A (43)			Control – B (39)			P Value
	Average±SD (Range)	Me	95 CI	Average±SD (Range)	Me	95 CI	
JOB RELATED (MET-min/week)	7277.76±8740.79 (0–29400)	6000	4587.75–9967.79	3884.7±5992.4 (0–24360)	1476	1886.72–5882.68	.041
HOUSEWORK (MET-min/week)	2207.55±2026.36 (0–8055)	1500	1583.93–2831.18	1714.86±1795.43 (0–8055)	1260	1124.71–2305.01	.252
TRANSPORTATION (MET-min/week)	1924.53±1207.9 (0–4752)	1980	1552.79–2206.28	1586.59±1364.54 (0–4752)	1188	1131.63–2041.55	.211
LEISURE TIME (MET-min/week)	1486.14±1994.24 (0–6799)	636	872.4–2099.88	1054.68±1256.67 (0–6132)	792	641.62–1467.74	.731
TOTAL TIME SITTING (min/week)	1772.09±763.45 (510–3300)	1920	1537.13–2007.05	2753.68±1219.16 (630–5640)	2340	2352.95–3154.41	.000032
AVERAGE TOTAL TIME SITTING (min/week)	253.15±109.406 (72–471)	274.29	219.59–286.72	393.38±174.16 (90–850)	334.29	336.14–450.63	.000032
MET/min/week	12841.3±9518.25 (82–22 334)	10188	9912.02–15770.59	8096.86±6525.55 (70–18 790)	6251.5	5951.97–1024.77	.012
MET/min/day	1834.47±1359.75 (82–3018)	1455.43	1416–2252.94	1156.69±932.22 (70–2075)	893.07	850.28–1463.34	.012

Data are the mean ± SD – standard deviation and range; *P – value according to [1]Mann-Whitney U test for continuous variables with nonnormal distributions,[2]Student's t-test for continuous variables with normal distributions; A – main group living in the countryside; B – control group living in the urban areas; IPAQ – International Physical Activity Questionnaire; MET – metabolic equivalent of work

Sedentary Lifestyle. Additionally, it was noted that the girls in both groups spent time in a sitting position on average from 72–805 minutes per day (x=318.94±158.84). However, girls in the main group spent x=1020.93±601.13 minutes during each of the five work days and from 240–1,440 minutes during each of the free days (x=751.16±352.84) in a sitting position, whereas the girls in the control group spent, on average, x=2053.42±1106.38 minutes (t=5.3; *P*=.001) in a sitting position during each of the work days. During the free days, there were no significant differences in the time spent in a sitting position (x=700.26±298.39). During locomotion (when moving from one place to another), a moderate level of physical activity was noted in 90.70% of examinees in group A, and in 72.97% of those in the control group. A total of 53.85% of group B and only 6.98% of group A travelled mostly by car from 30–270 minutes a day (x=103.88±58.74 during 1–7 days a week). In total, 83.72% of girls living in rural areas and 17.45% of girls living in towns, on average, walked for 2–4 h a day.

Physical education classes (PE). Girls who were exempt from PE classes at school exhibited lower MET/min/week values. Overall, the individual's place of residence was associated with whether she was exempt from PE (X^2=13.89; *P*<.007, df=4). Girls living in urban areas were more often exempted from PE classes and significantly more likely to have negative attitudes toward their PE teachers. Compared with the girls living in towns, the girls living in the countryside exhibited a higher level of physical activity (*P*<.001) (Tab. 2). PE exemption depended on a willingness to participate in PE (X^2=10.7; *P*=.03, df=4 for group A; and X^2=23.64; *P* <.001, df=4 for group B). A total of 41.38% of the girls who were exempt from PE and living in urban areas reported that they did not like PE, whereas 41.86% of the girls from the countryside reported that they liked PE and attended classes regularly. A total of 27.91% of girls in group A who were not exempt from PE were classified into the high physical activity category. Girls with scoliosis were not ashamed during PE; they accepted their bodies, and a few girls had mental or emotional difficulties regarding their body image (Tab. 3).

A total of 83.72% of the girls in group A and 52.38% of the girls in group B participated in other activities. A total of 8.54% of the girls living in urban areas reported that they spent their free time in shopping centres. Girls from the countryside frequently participated in physical activities between15:00–17:00, whereas girls from cities frequently participated in physical activities between14:00–20:00. More sleep disorders were noted in the girls living in urban areas, and were dependent on the end time of the activities in this group (X^2=9.57; *P*<.001, df=1). In both groups, age, BMI and Cobb angle were not dependent on the present level of physical activity. BMI and Cobb angle were associated with each other (R= -0.37; *P*<.01) in the main group only.

Time spent with electronic devices in both groups. The examined girls in both groups reported using electronic devices regularly each day. There were no significant differences between the girls living in towns and the countryside (t=0.08; *P*=.92). The usage time of electronic devices ranged between three and six days per week. The number of hours in front of a TV, computer, tablet or mobile device was neutral for girls in both groups, and ranged between five and 1,290 minutes per week (95%CI_A: 349.78–522.77 and 95%CI_B: 405.38–593.84). There was no significant difference between the girls living in rural areas and towns (*P*=.32). This tendency did not depend on age in group A (*P*=.03) or group B (*P*=0.48).

The time spent watching TV (z=0.75; *P*>0.45; 95%CI_A: 61.84–140.01 and 95%CI_B: 74.96–188.27), using a computer (z=0.6;, *P*=.53; 95%CI_A: 191.67–284.6 and 95%CI_B: 198.16–310.98), using a tablet (z=1.64; *P*=.15, 95%CI_A: 27.78–129.10 and 95%CI_B: 39.16–152.51), and using the internet (z=0.87; *P*=.37; 95%CI_A: 214.71–293.7 and 95%CI_B: 194.32–291.55) affected both groups regardless of their place of residence. Differences between groups were shown only in the time

Table 3. Characteristics of the examined groups.

Category		Main – A (43)		Control – B (39)		P Values*
		n	(%)	n	(%)	
PE – exemption	*Partial*	11	(25.58)	6	(15.38)	0.25
connected with scoliosis	*Total*	9	(20.93)	13	(33.33)	0.2
PE – ashamed	*Yes*	9	(20.93)	18	(46.15)	0.01
	No	30	(69.77)	14	(35.90)	0.02
	No opinion	4	(9.30)	7	(17.95)	0.25
PE – teacher acceptance/like	*Yes*	31	(72.09)	11	(28.21)	<0.00001
	No	7	(16.28)	20	(51.28)	0.0007
	No opinion	5	(11.63)	8	(20.51)	0.27
Body acceptance	*Yes*	32	(74.42)	9	(23.08)	<0.00001
	No	2	(4.65)	12	(30.77)	0.001
	No opinion	9	(20.93)	18	(46.15)	0.01
Complexes	*Yes*	6	(13.95)	18	(46.15)	0.001
	No	27	(62.79)	2	(5.13)	<0.00001
	No opinion	10	(23.26)	19	(48.72)	0.01
	YES	36	(83.72)	22	(52.38)	0.006
Extra activities	*At school*	21	(58.33)	6	(27.27)	0.001
	in the community center	9	(25.0)	1	(4.55)	0.01
	at fitness club/sport club	6	(16.66)	15	(68.18)	0.01
Sleep disorders	YES	10	(23.26)	17	(43.58)	=0.05
Time of extra activities	*Before 5 pm*	26	(72.22)	7	(31.82)	0.00009
	After 5 pm	10	(27.77)	15	(68.18)	0.13
Getting to the school	*Walking*	36	(83.72%)	7	(17.95)	<0.00001
	by Bus	4	(9.30%)	11	(28.2)	0.02
	by Car	3	(6.98%)	21	(53.85)	0.00001

*P-values according to the test between the two components of the structure.

spent on a mobile device (z=2.07; *P*<.03). It was surprising that the girls in rural areas used a mobile device more than their urban counterparts (95%CI_A: 120.47–302.46 and 95%CI_B: 131.39–238.6).

DISCUSSION

The lack of motivation for and consistency in performing necessary exercises is an important problem in girls diagnosed with scoliosis. There are several reasons for this situation. First, misused exemptions from PE lessons result in the lack of systematic effort towards maintaining a level of physical activity that matches that of other children. Changing clothes in the dressing room can cause body image issues, which lead to a reluctance to show one's postural deformities, which may also be accompanied by a lack of acceptance by their peers. A Polish study [12] has shown that 40% of examined girlsid not participate willingly in PE classes and that 7% of girls are exempted from these lessons. According to a previous study by the author, more than 50% of examinees were not exempted from PE at school in either group (53.48 in group A and 51.28 in group B). Girls with scoliosis, no matter where they live, were similarly exempted from PE lessons due to their spinal deformities. In the countryside, the exemptions were more often related to specific exercises (below above 25%?), whereas in cities they were more often completely exempted (above 30%). The reason for this may be the lack of sufficient knowledge of physical education teachers about modifying exercises in this group of girls. In addition, when parents are overprotective, their children are restricted from participating in almost all activities because of the fear of scoliosis progression. The results of numerous studies [5, 10, 26, 27, 28] show that the factors helpful in performing physical activity every day are as follows: inner motivation connected with positive feelings after performing exercises and a daily routine that simultaneously leads physical activity becoming a habit

Currently, in the 21st century, physical activity may be a beneficial way to spend one's free time and may provide an opportunity to meet other people. According to the current study, the level of AF was moderate but insufficiently satisfactory in girls from towns. A definitely higher level, especially in the 'Vigour category' was presented by girls living in rural areas. This group also spent less time in a sitting position during the week and thus more time on homework activities. During the weekends, the results in both groups were comparable. Girls in towns and cities were more likely to travel in their parents' car, while girls living in villages were more likely to walk, which translated into results in the domain 'Transport'. Such a distribution may show slightly worse results of body posture in the sagittal plane in girls from the countryside, resulting from them carrying heavy school bags on their way to and from school. However, this was not the aim of this study because disorders in the sagittal plane are a typical dysfunction in scoliosis biomechanics. The lack of intergroup differences in the use of electronic devices also had no major impact on the results in this respect. A particular level of physical activity is required in order to perform some forms of physical activity, as described in detail by physiologists. A total of 30 minutes daily of physical activity of moderate intensity is sufficient, regardless of the individual's stage of physical developmental [22]. It may be that the physical activity level of girls is highly dependent on the physical activities of their families, as well as the engagement of their PE teachers. PE teachers support, engage and encourage young people to undertake physical activities. Girls living in urban areas are more often exempted from PE classes and are significantly more likely to have negative attitudes toward their PE teachers.

Physical effort has a positive impact on sleep regulation unless it is performed after 17:00. The girls from the countryside much more frequently participated in physical activities between 15:00–15:00, whereas the girls from cities more frequently participated in physical activity between 18:00–20:00. This is probably the cause of the bigger sleep disorders observed in the control group.

Schools should be the centres of local community development and inspire the development of lifelong learning attitudes. They should hold meetings for adolescents, adults and whole families and be a place for the early education of children and their parents, facilitate pre-school education and education beyond pre-school, and hold extracurricular activities for teenagers and educational activities for adults. Rural schools should be places for leisure and sport activities (gyms, school playground). The extra activities that were performed in group A were most frequently performed in school or in a community centre. The activities mainly included dancing, group games, or music and movement classes. Girls from urban areas chose fitness clubs, albeit rarely; these girls and their peer groups also preferred visiting shopping malls. In the girls performing sport activities regularly, a higher level of self-estimated wellbeing was also observed. In the girls in group A, a higher level of physical activity was observed as well as a higher level of self-esteem and felt more at ease with their deformities. This may be evidenced by shorter hair or, in the case of longer hair, more frequently worn ponytails revealing the back, compared to girls living in urban areas. This group wore almost always (except for the PE lessons) undid the hair covering the back.

It can be concluded that sedentary life is the main cause of an inactive lifestyle [29]. Increased usage of electronic devices also has negative effects, such as a reduction in physical activity [10, 15, 30], increased body weight, obesity [7, 8, 9], and bad body posture habits [31, 32, 33, 34]. Scoliosis is among the consequences of these body postures [35, 36, 37, 38, 39]. To date, some threats exist in rural areas, and a similar number of potential threats exist also in urban areas. These threats result from a sedentary lifestyle being noted more frequently in urban areas than in the countryside which, regarding posture disorders, may be a risk factor for the progression of these disorders.

CONCLUSIONS

A reduction in physical activity, especially in 'job-related' domains, was noted in girls living in urban areas, but a reduction in the total time spent sitting each week and in the average time spent sitting each day was noted in girls living in the countryside. The global physical activity (MET/min/week) in girls living in the countryside was higher than that in girls living in the towns. In the girls exempted from PE at school, a lower level of physical activity was noted. Body acceptance and fewer body image issues were noted in girls living in the countryside.

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