

Physical activity of Polish adolescents and young adults according to IPAQ: a population based study

Józef Bergier¹, Lucyna Kapka-Skrzypczak^{2,3}, Przemysław Biliński^{4,5}, Piotr Paprzycki⁶, Andrzej Wojtyła⁷

¹ John Paul II State Higher Vocational School, Biała Podlaska, Poland

² Independent Laboratory of Molecular Biology, Institute of Rural Health, Lublin, Poland

³ Department of Public Health, University of Information Technology and Management, Rzeszow, Poland

⁴ Chief Sanitary Inspectorate, Warsaw, Poland

⁵ Institute of Haematology and Transfusion Medicine, Warsaw, Poland

⁶ Department of Functional Research, Institute of Rural Health, Lublin, Poland

⁷ Department of Health Promotion, Food and Nutrition, Institute of Rural Health, Lublin, Poland

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Abstract

The alarming problem of a decline in physical activity among children and adolescents and its detrimental effects on public health has been well recognised worldwide. Low physical activity is responsible for 6% of deaths worldwide and 5-10% of deaths in the countries of the WHO European Region, according to country. Within the last decade, many initiatives have been launched to counteract this phenomenon. The objective of presented study was analysis of the level of physical activity among adolescents and young adults in Poland, according to the IPAQ questionnaire. The study group covered 7,716 adolescents: 5,086 children attending high school and secondary schools and 2,630 university students. Low physical activity was noted among 57% of schoolchildren and 20.84% of students. Analysis of the level of physical activity according to the IPAQ indicated that it was lower among girls, compared to boys. An additional analysis, with the consideration of the place of residence, showed that the highest percentage of the population with low physical activity was noted in the rural areas (29.30%), while among the urban inhabitants of cities with a population above 100,000 it was on the level of 23.69% and 20.57%. Median for weekly physical activity by respondents' gender was on the level of 1,554.00 MET*min. weekly among females, and 2,611.00 MET*min. weekly among males ($p < 0.000$). The highest weekly physical activity expressed in MET*min. was observed among the inhabitants of towns with a population less than 100,000, whereas among the rural population and inhabitants of large cities with a population of over 100,000 the weekly physical activity was on a similar level (1,830.50 and 1,962.00 respectively). An extended analysis of respondents' physical activity showed that during the day students spend significantly more time in a sedentary position, compared to schoolchildren. The presented results of studies indicate the necessity to continue and intensify actions to promote various forms of physical activity among students and schoolchildren. A constant decrease in physical activity observed among children and adolescents suggests that it is necessary to pay greater attention to this social group while developing health programmes.

Key words

physical activity, Polish adolescents, young adults, social environment, metabolic equivalent (MET), public health

INTRODUCTION

Physical activity, in combination with healthy nutrition, is the precondition for the preservation and strengthening of health throughout the entire lifetime. An adequate level of activity stimulates the physical, motor and psychosocial development of children and adolescents. Physical activity reduces the risk of the majority of chronic diseases, especially those concerning the cardiovascular system, overweight and obesity, and type 2 diabetes [1,2,3]. Many studies indicate that there is a positive correlation between low physical activity and the risk of cancer [4]. In addition, physical activity strengthens the skeletal system and improves the state of

mental health. Physical activity in childhood and adolescence performs 4 functions:

- 1) stimulation and supporting physical, mental and social development;
- 2) adaptation to stimuli and changes of the physical and social environment (toughening up);
- 3) compensation for excessive immobilization associated with school education, doing lessons, watching TV, work with a computer;
- 4) correction and therapy of many disorders, including especially, obesity, diabetes, and cerebral palsy [5].

Insufficient physical activity is an important, though still underestimated factor affecting the state of health, morbidity and mortality. In the majority of highly developed countries, for more than 20 years one may even speak about an epidemic of 'mobility laziness' [6]. Low physical activity is responsible for 6% of deaths worldwide [7] and 5-10% of deaths in the countries of the WHO European Region, according to

Address for correspondence: Andrzej Wojtyła, Institute of Rural Health, Jaczewskiego 2, 20-090 Lublin, Poland.
E-mail: a.wojtyla@imw.lublin.pl

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country [8]. It was estimated with the use of the disability adjusted lifeyears (DALY) index, that every year in the WHO European Region over 8 million of the population experience a decline in health (lose years of life) as a result of too low physical activity, while about a million deaths annually are directly associated with lack of physical activity [7]. On the one hand, this is the effect of blessings brought about by civilization and the related changes in life style; on the other hand, the negative aspect is the lack of knowledge concerning the importance of physical effort for human health. The latest studies indicate that 50–60% of adult Poles are characterized by low physical activity [9]. This especially concerns females, inhabitants of large urban agglomerations, and the population with low socio-economic status. Insufficient physical activity among children and adolescents is an increasing public health problem: more than 50% of girls and approximately 33% of boys in Poland show too low physical activity [10].

The observations of changes in physical activity among Polish adolescents, which have been performed since the end of the 1990s, allow the presumption that the level of this activity decreases with age, and is constantly lower than that recommended. [11] The World Health Organization, European Platform for Action on Diet, Physical Activity and Health, among others, have announced recommendations concerning an acceptable level of physical activity for individual age groups [1]. According to the recent recommendations, children at school age should perform exercises of a moderate or high intensity for at least for 60 minutes daily, in a form adjusted to the stage of their development, which is varied, and would be a source of satisfaction for them [12].

Physical activity cannot be measured by a single parameter because this phenomenon is multi-dimensional and complex. The most important elements of PE which can be evaluated are: volume of effort, understood as a product of the frequency of effort sessions and duration of a single session, or, in other words, the sum of individual sessions (minutes, hours), and intensity of effort, understood as energy expenditure; for example, during a single effort session, daily, weekly (kilograms, kilojoules), or as an absolute exercise load (kilometres per hour, meters per second, watts), or as a relative exercise load (percentage of maximum intensity expressed as a maximum heart rate or maximum oxygen uptake, or in METs units). METs (*Metabolic Equivalent*) – the amount of oxygen consumed by the body from inhaled air in rest conditions (VO₂), also described as a basal metabolic rate – BMR. METs is also applied as a way of expressing energy cost of effort, as a multiplied resting value. It has been adopted that 1METs is approximately equal to 3.5 ml O₂/kg/min [13].

The level of physical activity is most frequently evaluated by means of a screening test developed by American researchers for the needs of primary health care of adolescents [14]. The measure of physical activity is an index of Moderate-to-Vigorous Physical Activity (MVPA). This is the number of days in a week devoted by the respondents to various forms of physical activity for at least 60 minutes daily. It has been assumed that the number of these days – at least 5, means the recommended level of physical activity, i.e. the level which satisfies the basic need of a young man.

A basic and cheapest method of evaluation of physical activity is the survey system. This system consists in monitoring all activities performed during the day (diaries) or training notes (logs, logbooks), which register activities performed during single exercise sessions within one week

(recall surveys) or one year (retrospective quantitative history) [15]. The survey system allows evaluation of the volume of effort, and also, indirectly, its intensity. Retrospective methods are obviously burdened with errors associated with forgetting and over-interpretation. The methods using electronic appliances for current monitoring are also a way of assessing physical activity. In everyday practice, wireless, wearable heart rate monitors (sport-testers) are most often applied [16]. In comprehensive epidemiological studies, the survey system is commonly used. In population studies, it is recommended that the International Physical Activity Questionnaire (IPAQ) should be applied, which has been validated in many countries worldwide, including Poland [17, 18, 19, 20]. It is recommended that information concerning physical activity should be collected for a period of the last 7 days within a month. Two versions of the questionnaire are available: long and brief. Despite the reported comments concerning overestimation of physical activity by the respondents, this is a good instrument for measuring physical activity in large populations.

OBJECTIVE

The objective of the study was investigation of the level of physical activity of Polish adolescents and young adults according to the short IPAQ questionnaire.

MATERIAL AND METHODS

Characteristics of the study population

Analyses of the study population were performed based on questionnaire forms collected among a randomly selected, representative group of adolescents attending high schools, secondary schools and university students in Poland in October 2011. Completed questionnaires, which were used for further analyses, were obtained from 53.17% of the initial number of respondents, which was 14,511, i.e. 10,083 schoolchildren, and 4,428 students. The study group covered 7,716 adolescents: 5, 086 children attending high schools and secondary schools and 2,630 university students (4,064 female and 3,652 male).

Sample selection – schoolchildren

The sampling frame was the database of the Ministry of National Education, especially 'Identification data concerning schools and educational facilities according to the data by Educational Information System of 30 September 2010' (No. 2010.09.30/01). Schools were sampled with the use of Statistica and SPSS software. For the purpose of conducting the survey among schoolchildren attending high and secondary schools, two-stage sampling was applied: at the first stage, a school was selected by stratified sampling; at the second stage – a class for the study. Cluster sampling was used: in the class selected for the study all the schoolchildren who were present were qualified for the study. The sample covered 569 schools from 379 provinces in Poland.

Sample selection – students

Students were investigated by means of a questionnaire in electronic form, available on a specified university website. The survey was anonymous; however, additional data was collected concerning the university and place of respondents'



residence (commune). This served the stratification of the sample obtained during analysis, and allowed a detailed correction of the composition of individual groups of students within the group. Correction procedure was performed in two ways. Firstly, by so-called random removal of excessively analysed respondents, and elimination of questionnaires containing mistakes and repetitions, i.e. structural correction of the sample. Secondly, all-Polish additional data enabled the ascribing of ranks to individual questionnaire forms, and the standardization of the sample according to additional variables.

Methods of assessment of physical activity

In order to determine the level of physical activity among adolescents at this age, the International Physical Activity Questionnaire (IPAQ) was used. IPAQ describes physical activity in energy expenditure units – minutes per week (MET). Metabolic equivalent of task (MET) is used to estimate the metabolic cost (energy expenditure as reflected by oxygen consumption) of physical activity – resting metabolic rate. According to scientific reports, one MET is equal to approx. 3.5 ml oxygen kg⁻¹ body weight per min⁻¹. It was determined that the cost of an intensive physical effort is 8 MET per minute, a moderate effort – 4 MET, walking (march, quick walking) – 3.3 MET. The energy cost of the physical activity is calculated as the MET level multiplied by the standard resting metabolic rate (1.0 kcal/kg/h). Selected items from the survey were used in the study concerning adolescents' physical activity, which is reflected the short version of the IPAQ. The survey contains 7 questions covering all types of physical activity:

- physical activity associated with the occupation performed, or at school;
- physical activity at home and around the house;
- moving to various places and mobility during free time devoted to recreation, playing games, sports, tourism, or other muscular work.

Only the physical activity lasting longer than 10 minutes was estimated, without rest breaks, and within the last 7 days. During the study, an average number of hours of the respondent's remaining in a sitting position daily was noted.

During the study, an average number of hours of the respondent's remaining in a sitting position daily was noted. The following was recorded in the study: frequency, duration and intensity of physical activity (assuming that a moderate physical activity means physical effort with slightly accelerated – with respect to resting – respiration, and slightly accelerated heart rate, an intensive physical activity is a hard physical effort which forces strongly intensified respiration and considerably accelerated heart rate), frequency and duration of walking, and average duration of remaining in a sitting position daily. The respondents' height and body weight were also recorded to calculate the BMI index, and the form of physical activity while performing occupational activity or at school, and also during free time. Demographic data and information concerning the type of occupation performed by the respondent was also collected. Weekly physical activity was calculated by summing-up the MET obtained during intense and moderate physical activity, and while walking during the entire week. In the methodology of the assessment of the level of weekly physical activity by means of the IPAQ, the following 3 categories were selected:

1. Insufficient (LOW) physical activity – when the total energy expenditure does not reach 600 MET min/week.

2. Sufficient (MIDDLE) physical activity – when the total energy expenditure ranges within 600-1,500 MET min/week, assuming that this expenditure is the effect of 3 or more days of intense physical activity for a minimum of 20 minutes daily; 5 or more days of moderate physical activity or marching-walking for at least 30 minutes; combinations of intensive or moderate physical activity jointly burning more than 600 MET min/week.
3. High physical activity (HIGH) – when the total energy expenditure exceeds 1,500 MET min/week, and results from at least 3 days of intensive effort of approx. 30 minutes daily, or practically an everyday half-an-hour moderate physical activity or walking.

STATISTICAL ANALYSIS

Statistical analysis was performed by means of the statistical software package Statistica 8.1 PL. Compilation of variables distribution was presented by means of frequency tables, descriptive statistics and contingency tables. In order to investigate the characteristics expressed in a nominal scale, contingency tables and Pearson chi-square test were applied. For analysis of the relationships between the variables expressed in continuous measurement scales, the ANOVA test was used, or in the case of the lack of fulfilment of conditions of a parametric test, the Kruskal-Wallis rank ANOVA test.

RESULTS

The results of the survey showed that physical activity among schoolchildren and students varies significantly. Low physical activity was observed among 57% of schoolchildren and 20.84% of students (Fig. 1). Analysis of physical activity

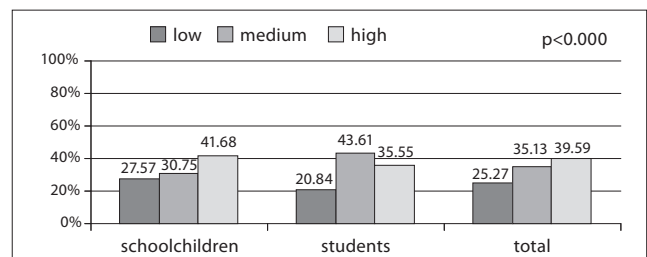


Figure 1. Physical activity acc. to short IPAQ questionnaire, by place of education

according to the 3 above-mentioned IPAQ categories showed that an increasingly larger number of males show a high physical activity, compared to females (48.77% vs. 31.35%), (Fig. 2). Additional analysis, with the consideration of the

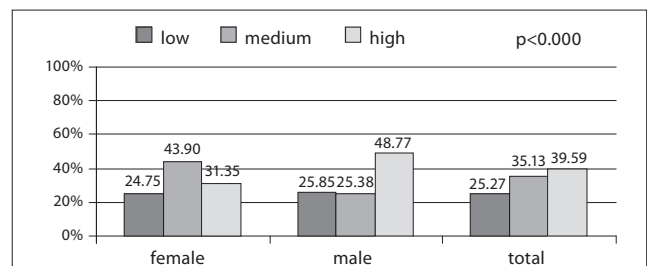


Figure 2. Physical activity acc. to short IPAQ questionnaire, by respondents' gender

place of residence, indicated that the highest percentage of the population with low physical activity was observed among the urban inhabitants (29.30%), while among the inhabitants of cities with a population above 100,000 remained on the level of 23.69% and 20.57%, respectively (Fig. 3).

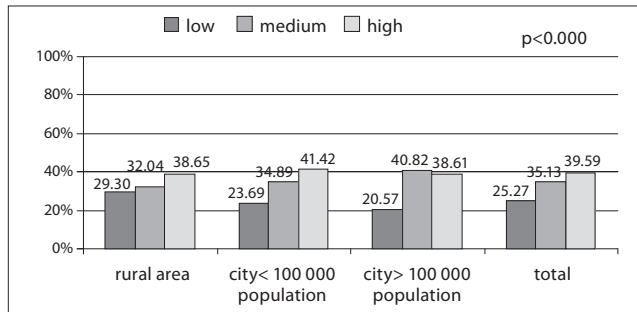


Figure 3. Physical activity acc. to short IPAQ questionnaire, by place of residence

The respondents' physical activity was also expressed as MET min. In this analysis, a statistically significant result was obtained according to the respondents' gender and place of residence (Fig. 4-5). Median for weekly physical activity by respondents' gender was on the level of 1,554.00 MET*min. among females, and 2,611.00 MET*min. weekly among males (p<0.000). Analysis by e place of residence indicated that the highest weekly physical activity expressed in MET*min. was noted among the inhabitants of cities with a population below 100,000; the inhabitants of rural areas and cities with a population of over 100,000 showed weekly physical activity on a similar level (1,830.50 and 1,962.00, respectively).

A comprehensive analysis of respondents' physical activity, with consideration of time spent by them in a sedentary position, showed that students spent significantly more time in a sedentary position during the day, compared to

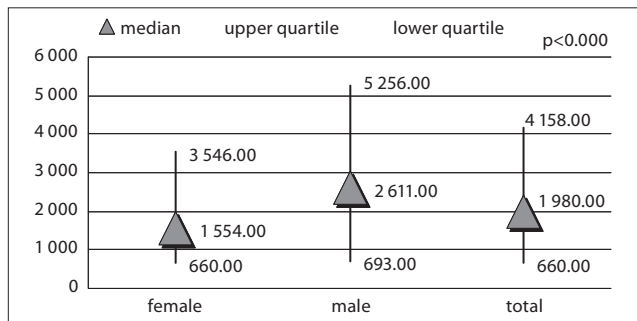


Figure 4. Weekly physical activity in MET*min. acc. to short IPAQ questionnaire, by respondents' gender

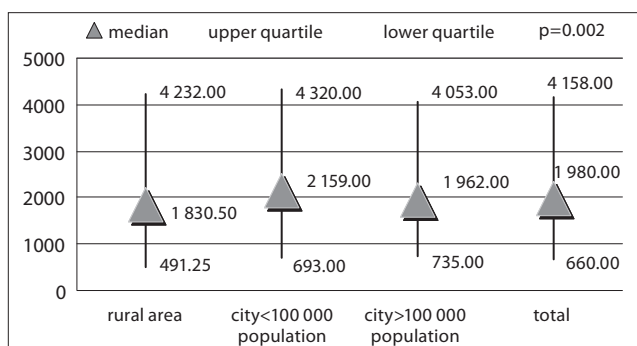


Figure 5. Weekly physical activity in MET*min. acc. to short IPAQ questionnaire, by respondents' place of residence

schoolchildren. Median for the number of hours spent in a sedentary position during the day was on the level of 300.00 for students, while for schoolchildren this value was 120.00 (Fig. 6). No statistically significant differences were observed

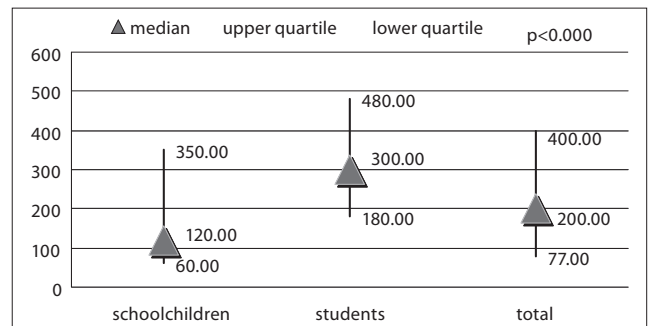


Figure 6. Minutes daily in a sitting position acc. to short IPAQ questionnaire, by place of education

when this analysis was performed with the consideration of gender. The results of the survey showed that the rural inhabitants spent twice as much time in a sedentary position as the inhabitants of small and large cities (Fig. 7).

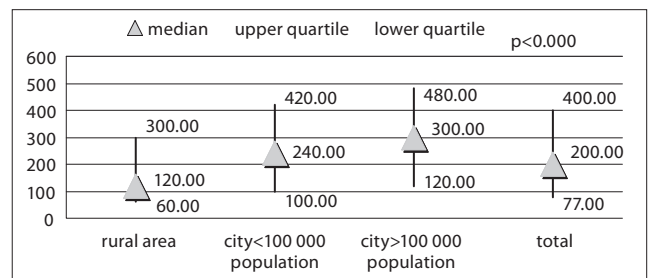


Figure 7. Minutes daily in a sitting position acc. to short IPAQ questionnaire, by respondents' place of residence

Analysis of the mean values for physical activity expressed in MET*min./weekly showed that the physical activity of girls gradually decreases with age, while among boys the lowest physical activity is observed at junior high school, and the highest at secondary school age. The highest mean physical activity was noted among boys living in the rural areas or in small towns, while among girls – those living in large cities with a population of over 100,000. Girls showed a similar level of the mean physical activity, irrespective of body weight. The highest physical activity was observed among boys who had a normal body structure. It is interesting that the highest mean physical activity was observed in obese inhabitants of small towns with a population below 100,000, or children and adolescents who were overweight, irrespective of the place of residence. In individual age groups, the highest mean physical activity was noted among schoolchildren who attended junior high and secondary schools (irrespective of body weight), and students who were overweight.

DISCUSSION

The results of the HBSC study indicate that in the countries of the European Union, including Poland, approximately 2/3 of adolescents do not attain the recommended level of physical activity [21]. This creates a serious health risk, including the development of an epidemic of obesity. In order to counteract



this phenomenon, in many countries, groups of experts develop recommendations concerning an optimum level of physical activity. The World Health Organization divided the recommendations concerning physical activity into 3 age-dependent groups: 5-17, 18-64 and over 65 [1]. Age groups were selected with consideration of evidence-based research concerning health benefits resulting from physical activity. Simultaneously, these recommendations clearly showed that children aged under 5 years should lead an active life style in accordance with their temper. The WHO recommends that children and adolescents aged 5-17 years should practice moderate to intense physical activity for 60 minutes daily [2, 22, 23]. At the same time, the WHO defines a moderate-intensity physical activity as the intensity 3.0-5.9 times higher than the activity related with rest, while vigorous-intensity physical activity as an activity 6 times higher than at rest in the case of adults, and 7 times higher than at rest in the case of children and adolescents. The recommendations concerning the physical activity of children and adolescents indicate that a moderate or high motor activity is beneficial when undertaken every day for an hour, while the minimum activity is half-an-hour daily [24]. For the population aged 18-64, the WHO recommends 150 minutes of moderate weekly physical activity, equally distributed during individual days, or 75 minutes of intensive physical activity weekly, or an equivalent volume of intensive and moderate physical activity weekly. A minimum of 10 minutes of aerobic physical activity is also recommended during each training session. At the same time, in the above-mentioned recommendations it is emphasized that in this age interval physical activity includes recreational activity, activity related with transport and relocation, occupational activity, household activities and sports [25].

In children and adolescents an adequate level of physical activity is of crucial importance for physical, motor, mental and social development, and through the 'transfer' of patterns and behaviours – conditions physical activity in the future. The results of studies conducted during the period 1979-1999, which covered very large groups of Polish children and adolescents aged 7.5-19.5, confirmed a clear regression in physical efficacy and capacity among adolescents [26]. The majority of Polish adolescents (59% of boys and 71% of girls) did not reach the recommended level of physical activity (60 min. daily for 5 days a week). This is the group at an elevated risk of disorders related with insufficient motor activity [27]. In every fourth adolescent with very low physical activity this risk is especially high. During the period of puberty, in both genders, physical activity decreases with age. There is a disproportion between the time devoted by adolescents to motor and sedentary activity to the benefit of the latter: on schooldays, 54% of adolescents devote at least 2 hours daily to doing homework, 76% to watching TV, 32% use a computer. The concern is that together with the number of families possessing a computer (in 2002 40% of families possessed a computer) the percentage of adolescents' sedentary behaviours during free time will increase. Girls are less physically active, compared to boys, and devote more time to doing homework, and less time to watching TV or using a computer [28].

The results of the studies obtained indicate a lower physical activity among girls than boys, as well as a decrease in the level of this activity with the age of the girls in the study are consistent with the tendencies generally observed in Poland

and worldwide [29]. A passive type of leisure is preferred by junior high and secondary school children, as well as by students, and the most popular forms of spending time are: watching television, playing on a computer and reviewing the Internet resources, i.e. sedentary activities [30].

The results of the HBSC study conducted during the school year 2001-2002 confirmed that the mean time of physical activity among adolescents was 3.8 hours weekly. At that time, the highest level of activity was noted in Austria, England, Ireland and Lithuania, whereas the lowest level – in Belgium, France, Italy and Portugal. Boys were characterized by higher physical activity than girls. Approximately 34% of the adolescents examined did not perform the recommended at least 60 minutes of a moderate effort for 5 or more days weekly. Among those who performed the recommendations there were 40% of boys and 27% of girls. This percentage decreased with age, especially among girls [31]. Similar tendencies are also observed among Polish adolescents. It is estimated that every fourth schoolchild shows deviations from the normal state of health, and the risk factors of non-contagious diseases occur at an increasingly younger age [32].

Despite health benefits resulting from regular physical activity, the majority of societies in the developed countries, including Europe and the USA, are characterized by an insufficient physical activity [33, 34, 35]. The majority of studies carried out in the developed countries, mainly in Europe, USA and Australia, focus on the differences in the levels of physical activity between the inhabitants of large cities and rural areas. According to the data from literature, the level of physical activity depends, among other things, on infrastructure which enables the transportation of inhabitants by foot, so-called walkable neighbourhoods [36, 37]. There are many studies, mainly in the USA, which confirm positive relationships between physical activity of the inhabitants, and the possibility of transportation by walking or by bicycle [38, 39]. It is postulated that the lower physical activity of the rural inhabitants of the developed countries is due to their greater dependence on vehicle transport (mainly by own car) caused by a lower density of population in these regions, and less road density [40, 41]. In addition, a lower socioeconomic status of the rural inhabitants results in their lower physical activity [42, 43]. Only few observations concerning this problem have been performed in Europe [44, 45]. Reports from West European countries indicate that the differences in the level of physical activity between the rural and urban populations were lower than in the USA and Australia, due to a denser population in these regions in Europe, and a greater amount of recreation areas where physical activity may be practiced [42]. Studies carried out in Island did not show any significant difference between physical activity among the younger part of the population living in the rural and urban areas, whereas Belgian researchers observed a slightly higher physical activity among the urban than rural inhabitants [42]. Studies conducted among Polish adolescents showed a higher level of physical activity among urban than rural adolescents during time free from work and education [46]. Turkish reports indicated a higher physical activity among adolescents living in the rural areas [47]. In African countries, e.g., in Cameroon, physical activity was twice as high among the rural than urban adolescents, which was explained by a greater work load associated with work on farms [48]. Physical activity of the rural population, including children and adolescents, during the time free from work



and education, results from a worse access to sports facilities, lower social status, and lower education level among this population. However, work load related with performing household activities may be higher, which compensates for low physical activity during free time [49, 50].

The differences between studies conducted among the rural and urban inhabitants in the USA, Australia, and European countries, may results from the methodology of research. For example, in Belgium, physical activity was measured by recording steps over a distance by means of a pedometer, whereas in the USA and Australia the studies were based on International Physical Activity Questionnaire (IPAQ) completed by respondents [51]. It seems that a greater physical work load at home may be the cause of slight differences between physical activity among the population living in the rural and urban areas of Europe [52]. In the presented studies, a significantly higher level of physical activity was observed among adolescents and students living in the rural areas.

Chinese reports confirm a dramatic decrease in physical activity among all age groups. This decrease concerns both the reduction in physical activity associated with occupational activity and transport, and the activity related with household work [53]. This is due to an accelerated economic development of this country. According to the data, in China, only within one decade between 1990-2000, physical activity related with occupational activity decreased by 22% among males, and by 24% among females [54]. This is linearly related with an increase in the percentage of obese and overweight population [55]. Similarly, physical activity connected with performing housework activities decreased by 57% in males, and by 51% in females [53]. Similar observations concern the activity related with transport [53]. In China, urban inhabitants are characterized by a higher physical activity than the rural population. However, higher dynamics in the reduction in physical activity have been noted among the rural than urban population [56, 57]. Studies carried out in Poland show that in recent years the percentage of obesity has been higher among the population living in the rural than urban areas [46, 58]. The results of the presented study correlate with these reports and confirm a direct relationship between low physical activity of the rural inhabitants and an increase of obese or overweight among the population living in the rural areas.

SUMMARY

Sedentary life style and lack of everyday systematic physical effort becomes an increasingly greater social health problem. Initially, the negative effects of the decrease in motor activity for physical condition and health concerned mainly adults. This was associated with the progressing mechanization of work and daily life facilities. At present, this problem also covers children and adolescents, who have exchanged outdoor activity for so-called sedentary activities.

The level of physical activity among children and adolescents in Poland is unsatisfactory. This activity decreases with age, which has been confirmed by the results of the presented study based on the number of minutes spent in a sedentary position by schoolchildren and students. There are differences in the level of physical activity between the rural and urban adolescents. The results of these studies and observations performed in other European countries show that children

and adolescents living in cities show a higher level of physical activity, compared to the rural inhabitants. The lower level of physical activity among girls than boys, is also alarming.

An insufficient level of physical activity noted among children and adolescents suggests that it is necessary to pay greater attention to this social group while developing health programmes. Parents' knowledge, motivation and activity also exert a great effect on the physical activity of children. By providing a positive example and organization of family, recreation sports activities and participation in these activities together with their children, as well as by encouraging physical activity at home, at school and with friends, parents shape health promoting attitudes and train children to the habit of active leisure [59]. The results of the studies presented indicate that it is necessary to continue and intensify actions in the area of promotion of various forms of physical activity among schoolchildren and adolescents.

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