Overestimation of physical activity by long IPAQ in a Polish nationwide study

Przeszacowania aktywności fizycznej ocenianej za pomocą długiej wersji IPAQ – na podstawie ogólnopolskich badań

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Wprowadzenie. Praca wpisuje się w nurt rozwiązywania problemów metodycznych związanych ze stosowaniem długiego Międzynarodowego Kwestionariusza Aktywności Fizycznej (IPAQ; International Physical Activity Questionnaire).

Cel. Analiza czynników (domen aktywności fizycznej, rodzaju wysiłku, cech socjo-demograficznych) mogących mieć związek z przeszacowaniami aktywności fizycznej Polaków.

Materiały i metody. Z reprezentatywnej próby Polaków w wieku 15-69 lat (n=1765) wyłoniono grupę 132 osób, które przekraczały graniczną wartość aktywności fizycznej 16 godz./dobę. Aktywność fizyczną mierzono długą wersją IPAQ. Analizę danych przeprowadzono przy użyciu pakietu statystycznego R (licencja: GNU GPL). Wnioskowanie statystyczne przeprowadzono korzystając z testów Wilcoxona (U Manna Whitneya), Kruskala-Wallisa, Chi-kwadrat zależności oraz Chi-kwadrat zgodności na poziomie istotności 0,05.

Wyniki. Problem przeszacowań aktywności fizycznej odnotowano głównie w pracy zawodowej oraz w/wokół domu. Średni maksymalny czas aktywności fizycznej w pracy zawodowej wynosi 723,1±439,9 (840) min./dobę, a w/wokół domu 295,5±294,9 (180) min./dobę. Największy udział w przeszacowaniach miały w tym przypadku wysiłki umiarkowane (87,5%).

Wnioski. Sugerujemy zwrócenie uwagi na wyjaśnienie respondentom istoty pomiarów, szczególnie w dwóch domenach: pracy zawodowej i w/wokół domu. Dotyczy to zwłaszcza pytań dotyczących chodzenia w pracy zawodowej oraz wysiłków umiarkowanych w/wokół domu. Jest wysoce prawdopodobne, że problemu przeszacowań związanych z długim IPAQ można uniknąć zwracając specjalną uwagę właśnie na te pytania w kwestionariuszu oraz na wyszczególnione w pracy grupy osób potencjalnie najbardziej podatne na przeszacowania.

Słowa kluczowe: *aktywność fizyczna, IPAQ, przeszacowania, populacja polska*

Introduction. The current investigation fits into a trend of solving the methodological issues related to the use of a long version of International Physical Activity Questionnaire (IPAQ).

Aim. To identify factors (for example, physical activity domains, type of activity, and socio-demographic characteristics) that influence the overestimations of physical activity among the Polish population.

Material & Method. Based on an algorithm for a sample of population (n=1765) aged 15-69 years through the stratified-quota sampling, a group of people (n=132) who reported physical activity above 16 h per day was selected. PA was measured by the IPAQ long version. The statistical analysis was performed using the R language (licenced to: GNU GPL). The difference between the variables was tested with a non-parametric tests: Wilcoxon and Kruskal-Wallis, with the significance level of 0.05.

Results. Overestimations of PA were observed mainly in the occupational and household domains. The average maximum PA was 723.1±439.9 (840) min/day for occupational and 295.5±294.9 (180) min/day for household. Moderate PA was the major reason for overestimations (87.5%).

Conclusion. We suggest a more detailed explanation of the measurement nature, especially regarding the occupational and household domains. The interpretation of the results in the occupational and household domains, particularly walking at work, moderate physical activity and activity in the house/garden, is of great importance. It is highly probable that the problem of overestimation in the long IPAQ version could be avoided by focusing on those questions in the questionnaire and on the groups potentially most susceptible to overestimation.

Key words: *physical activity, IPAQ, overestimation, Polish population*

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Introduction

A low level of physical activity, as suspected at first, is now known to be an important risk factor for a variety of disorders including cardiovascular disease, cancer, high blood pressure, depression, obesity and diabetes [1]. Current knowledge on the level of physical activity across different cultures is mainly based on results of questionnaires [2]. One questionnaire widely used in several countries [3] is the International Physical Activity Questionnaire (IPAQ) which is available in two versions: short [4] and long [5]. The former version estimates the activities undertaken and the level of physical activity. The latter is more detailed and, apart from the level of physical activity, also rigorously measures the activities in specific domains (i.e. occupational and leisure time). It defines the total weekly energy expenditure and energy cost during walking, moderate and vigorous activity. Both versions of the IPAQ test take into account sedentary time; however, the short version only analyses weekdays, whereas the long version includes the weekend. Given such a wide scope of capabilities, the IPAQ is thought to be one of the most advanced international questionnaires to measure physical activity (frequency, duration, and intensity of an activity) across different populations (in both developed and developing countries) [6].

However, the scientists point out that there are significant issues arising from the way the questionnaire is completed. They most frequently result from the techniques employed to conduct the research (collecting data via phone or completing the questionnaires without assistance, e.g. via email) [7, 8], incorrect interpretation of the questions [9] or lack of understanding of the terminology used [10]. Estimating the duration of an activity, defining the type of activity, and classifying it into a specific domain also prove difficult [11]. As the result of problems introduced above, the researchers are encountering either underestimations or overestimations of physical activity of the participants [12]. Bergier surmises that these problems are, to a large extent, attributable to a general overestimation of one's own activity, particularly with regard to the duration of exercise (time interval no shorter (continuous) than 10 minutes), and self-reported intensity [13]. Rzewnicki et al. [7] emphasize that more than 40% of the respondents overestimated vigorous and moderate exercise, while two-thirds overestimated the duration of walking, This results in 74% of participants overrating total weekly activity. Polish studies in this respect also demonstrate substantial differences in results. The total weekly physical activity ranges from 700-800 MET-min/week [14] to 13.700 MET-min/week [15]. Biernat et al. [8] demonstrate that over 33% of the studied men and over 24% of the women declared activity exceeding 6000 MET-min/week. Furthermore, they point to the differences in average values of physical activity among the respondents who completed the questionnaire on their own (1386 MET-min/week) and those who were interviewed (320 MET-min/week). Similar discrepancies were observed in other European countries. For instance, in the studies by Rutten and Abu-Omar conducted in the form of face-to-face interviews [16], the values of MET-min/week ranged from 693 (Northern Ireland) and 1119 (Sweden) to 2060 (Germany) and 2336 (the Netherlands). The same instrument (IPAQ), which was used in the EU-PASS project (telephone surveys) [16], demonstrated that the median of the total physical activity ranged from 1653 MET-min/week (United Kingdom) and 2360 MET-min/week (Spain) to 4212 MET-min/week (Finland) and 5070 MET-min/week (Germany). The median (MET-min/week) for Poles that had been computed based on data gathered during face-to-face interviews (240-360 MET-min/week) were also significantly different from those computed using the data from questionnaires completed by the respondents themselves (1440-2772 MET-min/week) [8]. It is also clear that moderate activities were significantly ($p<0.001$) more frequently declared by the directly interviewed respondents than by self-completion (90 and 59% respectively) which suggests underestimation of such activities by the latter category of respondents, who may instead classify them as vigorous ones. Vigorous activities were, in turn, significantly ($p<0.01$) overestimated by self-reporting respondents, especially by men and women with higher education [8]. Poor understanding of the importance of moderate activities seems to be relatively low compared with mis-evaluation of the duration of a given activity, as the overestimation pertains mainly to duration. Self-reporting respondents declared significantly longer durations of all activities as compared to the directly interviewed respondents, the respective values amounting to 9.6 h/week and 3.4 h/week for walking, 4.0 h/week and 1.7 h/week for moderate, and 5.1 h/week and 0.3 h/week for vigorous activities. The known advantages of IPAQ justify further investigations on potential sources of errors. The exposure of these sources would increase the credibility of collected data [10] and, consequently, its usability in other countries [7]. This investigation corresponds with the current trend in finding solutions to methodological issues related to the use of the long IPAQ version. The aim of this work is to identify factors (for example, physical activity domains, type of activity, and socio-demographic characteristics) that influence the overestimations of physical activity among the Polish population.

Aim

Identify factors (for example, physical activity domains, type of activity, and socio-demographic characteristics) that influence the overestimations of physical activity among the Polish population.

Material and method

The surveys were conducted between 10 October 2012[1] and 14 November 2012 via Computer-Assisted Telephone Interviews (CATI). The interviews were administered by qualified and supervised surveyors who delivered the questions in a way that was equally easy to comprehend for all respondents. The research tool for the current investigation was the Polish long version of International Physical Activity Questionnaire (IPAQ) which allowed for the analysis of physical activity in specific domains (i.e., occupational, transportation, household, sports and leisure) and types of activity (i.e. vigorous PA, moderate PA and walking) [5].

The investigated sample consisted of 1765 Polish citizens (age range 15-69 years). They were selected through the stratified-quota sampling method, with demographic variables such as age, gender, education, and the place of residence as strata. The quotas were established proportionally, based on data made accessible to the researchers by the Central Statistical Office. Furthermore, in order to increase the sample representativeness the data-weighting procedure was used for the variables listed above. The quotas were proportionally assessed based on the data provided by the Central Statistical Office (data sources: National Census of Population and Local Data Bank).

Out of the sample (n=1765), 132 participants who reported physical activity greater than 16 h per day were selected.

In accordance with the IPAQ methodology, any observations in which the total daily physical activity exceeds 16 h should by default be considered an overestimation [18]. Since IPAQ enables computing only the weekly (and not daily) physical activity (i.e. either minutes/week spent on physical activity in every domain, or minutes/week for each type of exercise), an appropriate algorithm in the R statistical package (under the GNU GPL license) was implemented in order to determine the possible longest duration of total daily activity. For instance, in the case of a respondent who declares engaging in occupational physical activity for five days per week, household physical activity for seven days, and sports and leisure time activity for one day, the exercise they undertake covers at least two of these domains for at least one day. However, the example given above allows three different interpretations. First, the exercise can be undertaken for five days (both occupational and household); second, it can be undertaken for one day (occupational and during sports practice/leisure time); third, it can be undertaken for one day in all three domains.

The data gathered by means of IPAQ make it impossible to determine which of the aforementioned cases is most plausible. Hence, in theory, each of the three variants is equally plausible although none of them provides the same information about the potential occurrence of overestimation. If we assume the variant number one – whereas the variant three is true –the overestimation may not be detected. Therefore, the combined duration of PA in the variant three is higher than in variant one or two. Hence, a safe assumption was adopted that the algorithm should determine the maximum duration of total daily activity. It means that in the above example the variant three was quoted as the total daily duration of physical exercise. It appears that this approach did not significantly increase the percentage of overestimations in the researched population.

In the present study, in addition to the maximum total daily physical activity, maximum daily PAs were determined for individual domains (occupational, household, transportation, and leisure time) and particular types of exercise (vigorous, moderate and walking). Basic descriptive statistics were characterized (mean, standard deviation, median, limit values and lower and upper quartiles).

Having identified the cases where excessive overestimation of physical activity occurred it was possible to assign each of them to the domain and the type of exercise showing the highest values for the daily activity. Thus, a percentage share of particular domains and types of exercise in overestimated observations was obtained. Moreover, relationships between individual domains and particular types of exercise with the longest duration of daily activity (chi-square test of independence) were studied as were the relationships between the maximum daily physical activity in each of the domains, each type of exercise, and socio-demographic characteristics, as shown in Table I {Spearman's rank correlation coefficient (rho)}. The Wilcoxon and Kruskal-Wallis tests were used to analyze the differences between averages of maximum daily physical activities in the particular domains and the types of exercise as well as socio-demographic characteristics.

[1] Data collection excluded All Saints' Day (national holiday in Poland) due to increased physical activity caused by frequent cemetery visits

Table I. Spearman's rank correlation coefficient for maximum duration of total daily physical activity (in minutes/day) relative to domain and socio-demographic characteristics of analyzed sample (n=132)
Tabela I. Współczynnik korelacji rang Spearmana dla maksymalnego czasu całkowitej dziennej aktywności fizycznej (w min/dobę) w stosunku do domeny i społeczno-demograficznej charakterystyki badanej grupy (n=132)

Factors /Czynniki	Occupational /Praca zawodowa	Transportation /Przemieszczanie się	Household work /Praca w/wokół domu	Leisure time /Czas wolny
Age /Wiek	0.010	0.076	0.189*	0.067
Education /Wykształcenie	0.075	-0.104	-0.165	-0.130
Place od residence /Miejsce zamieszkania	0.154	-0.011	-0.026	-0.012
Income /Dochód	0.057	-0.005	-0.032	0.083

*Statistically significant p<0.05 /Statystycznie istotne p<0,05

Results

Socio-demographic characteristics of the persons who overestimated their physical activity level (n = 132; 53.8% men and 46.2% women) were as follows: 4.5% of the sample were 15-19-year-olds, 20.5%, 12.9%, 17.4%, 15.2%, 24.2% and 5.3% – respectively 20-24, 25-29, 30-39, 40-49, 50-59 and 60-69-year-olds. Primary education was reported by 24.2%, secondary by 56.8% and higher by 19.0%. 29.5% of the respondents lived in the countryside, in the city depending on the population to 20 thous. – 15.9%, 21-50 thous. – 21.2%, 51-100 thous. – 15.9%, 101-200 thous. – 3.8%, 201-500 thous. – 6.1% and >500 thous. – 7.6%. The monthly household income (net per person) <1000 PLN was declared by 9.8% of the sample, 1000-1999 PLN – 22.7%, 2000-2999 PLN – 21.2%, 3000-3999 PLN – 12.1%, 4000-4999 PLN – 9.8%, 5000 -5999 PLN – 3.8%, ⩾6000 PLN – 7.6%. However, in this case, due to the lack of data resulting from the refusal to answer the percentage of respondents did not add up to 100%.

The statistical analysis confirmed that there was a significant difference in reported durations of physical activities in different domains (χ^2=184.4; df=3; p<0.01) and types of activity (χ^2=23.4; df=2; p<0.01). The respondents were more likely to overestimate their physical activity in the occupational domain (75%) rather than in household work (18.2%), transportation (6.1%), and leisure time (0.8%). As far as the analysis of different types of activities, walking and moderate physical activity (MPA) had a similar number of overestimations (45.5 and 40.9%, respectively) whereas a vigorous activity fell lower (13.6%) on the scale.

A relationship (χ^2=35.6; df=6; p<0.001) was confirmed between the domains and types of exercise where the highest daily physical activities of the respondents were observed. The most common was the tendency to overestimate the duration of walking (36.4%), occupational MPA (25.0%), and household MPA (15.9%). The people who excessively overrated their occupational physical activity declared lower exercise in the remaining domains as compared to other individuals who also overestimated their activity. In particular, they reported lower household activities (the Wilcoxon test; W=338, p<0.001). Conversely, nearly all individuals who overestimated their household activity reported zero occupational activity. Such marked tendencies cannot be observed among people overestimating their transport-related activity or their leisure time physical activity. According to 75% of the respondents, their activity in occupational domain was a minimum of 420 min per day and according to over 50% (56.8%) of the respondents the minimum duration was 840 min per day (Me=14 h/24 h). Additionally, 25% of the participants in this domain estimated the longest durations of the physical activity reaching at least 960 min/day, which means that one out every four persons (regardless of gender) estimated their total physical activity only in the occupational domain. The second domain with the highest rates of overestimations of physical activity duration was household work (including housework and looking after the family). In this domain 11.4% the women and 6.8% the men overestimated their physical activity duration. It must be noted that 25% of the respondents were active for at least 60 min/day; 75%, at least 420 min/day. The overestimations in the remaining two domains (transportation and leisure time) were much lower. Only 2.3% of the men and 3.8% of the women reported that the longest duration of their physical activity was a result of transportation. Approximately 25% of the respondents were active for at least 60 min/day; 75%, for at least 360 min/day. The average duration of physical activity in this domain was 206.5±212.9 (120) min/day {208±216.0 (120) for men and 204.7±210.9 (120) for women}. As for leisure physical activity, only 0.7% of the men (0% of the women) overestimated their physical activity. Thus, the problem with overestimating was marginal in this domain. Approximately 25% of the respondents were active for at least 10 min/day. The maximum average duration of physical activity was 111.3±128.2 (60) min/day {116.5±121.9 (60) for the men and 105.2±135.9 (60) for the women}. No statistical relationships between the declared time of activity

and socio-demographic variables were found in either domain (transportation and leisure time). Given that the majority of physical activity overestimations were observed in the occupational and household domains, further analysis only included socio-demographic factors within those two domains. The gender-based analysis demonstrated that men (58.6%) declared the highest daily occupational physical activity significantly more frequently (χ^2=5.17; df=1; p<0.05) than women (41.4%). A similar pattern was observed among adults aged 50-59 years (25.2%) and 20-24 years (23.2%) relative to other age groups (χ^2=1.73; df=1; p=0.1889). Furthermore, the chief contributors to occupational overestimations were the people with secondary education (54.5%; χ^2=0.5043; df=1; p=0.4776), villagers (29.3%), small town residents (16.2% for towns with up to 20,000 inhabitants, and 21.2% for towns with 20-50,000 inhabitants; χ^2=0; df=1; p=1) as well as people with gross income of 1000-2999 PLN (47.5%; χ^2=1.4762; df=1; p=0.2244). No statistically significant relationship between the analyzed occupational physical activity and gender, age, education, or monthly gross income per capita in household was reported (Table I). The average maximum daily duration of this activity in the analyzed group totaled 723.1±439.9 (840) min/day and was not significantly different between the men {751.2±396.4 (840) min/day} and the women {690.5±486.9 (840) min/day}.

The inverse was observed in the household domain, since the difference in the proportion of women (62.5%) and men (37.5%) where the highest duration was confirmed was statistically significant at p=0.07. Considering the age variable, the highest daily duration of the total household physical activity was reported mainly among adults aged 30-59 years (62.5%; χ^2=0.1548; df=1; p=0.694). People with secondary education (75.0%) (χ^2=3.0984; df=1; p=0.07837) as well as villagers (29.2%) and residents of towns with up to 20,000 inhabitants and between 21-50,000 inhabitants (16.7 and 25.0%, respectively) (χ^2=0.6425; df=1; p=0.4228) also contributed to overestimations. The highest household physical activity was also reported by the people with the gross income of €278-476 (25.0%; χ^2=0.0006; df=1; p=0.9805). The average daily maximum duration of household exercise declared overall totaled 295.5±294.9 (180) min/day. In the men {237.7±224.1 (180) min/day} it was significantly shorter (the Wilcoxon test; W=1765.5; p=0.067) as compared to the women {362.8±350.3 (240) min/day}. Similarly to the occupational domain, no relationship was observed between the duration values of daily activity and gender, education, place of residence, and monthly gross income. The Spearman's rank correlation coefficient however demonstrated a significant dependence on the age of respondents (rho=0.189; p<0.05; Table I). The highest household physical activity {555.0±409.2 (540) min/day} was declared by seniors (60-69 years of age; the Kruskal-Wallis test, χ^2=11.3, df=6, p=0.078). Considerations of the problem of overestimations in the context of undertaken activities (vigorous, moderate, and walking) revealed that regardless of the domain there was a relationship between the respondents' gender and MPA (rho=-0.180; p<0.05) (Table II). The daily duration of this activity in the women {585.5±317.2 (540.0) min} was significantly higher (the Wilcoxon test; W=1757.5; p=0.063) than in the men {476.5±240.8 (480) min}. Likewise, no gender dependent differences were proven in the VPA duration in the men {274.2±225.4 (300.0) min/day} and the women {268.5±235.4 (240.0) min/day} as well as in the duration of walking in the men {576.5±294.3 (540.0) min/day} and the women {501.9±310.9 (480.0) min/day}.

What was proven, however, was the relationship between the MPA duration and the age of respondents (rho=0.206; p<0.05). It is interesting to observe that while seniors aged 60-69 years declared both the highest MPAs {771.4±280.2 (840.0) min/day} and the lowest VPAs {147.1±139.8 (120.0) min/day}, young people aged 15-19 years reported both the lowest MPAs {415.0±193.9 (405.0) min/day} and the highest VPAs {370.0±183.6 (390.0) min/day}. A statistical relationship between gross income and maximum VPA (rho=-0.213; p<0.05) was observed. The highest VPAs were declared by the individuals with the gross income of €476-713 {315.5±232.9 (330.0) min/day} as well as the people from the lowest {<€237; 300.0±231.1 (360.0) min/day} and the highest income group {⩾€1427; 300.0±201.8 (360.0) min/day}. Education was not a factor differentiating the duration of specific types of exercise (Table II); nevertheless, the respondents

Table II. Spearman's rank correlation coefficient for maximum total daily physical activity (in minutes/day) depending on type of exercise and socio-demographic characteristics of participants (n=132)
Tabela II. Współczynnik korelacji rang Spearmana dla maksymalnej całkowitej dziennej aktywności fizycznej (w min/dzień) w zależności od rodzaju ćwiczeń i społeczno-demograficznych cech uczestników (n=132)

Factors /Czynniki	Vigorous PA /Intensywna AF	Moderate PA /Umiarkowana AF	Walking /Chodzenie
Age /Wiek	-0.067	0.206*	-0.034
Education /Wykształcenie	0.077	-0.023	-0.097
Place of residence /Miejsce zamieszkania	-0.025	0.003	0.080
Income /Dochód	-0.213*	-0.009	0.080

*Statistically significant p<0.05 /Statystycznie istotne p<0,05

in all levels of education declared the highest daily walking activity.

Discussion

Current research suggests that using the long IPAQ version presents several issues such as difficulties in understanding the questions [9], differentiating between vigorous physical activity (VPA) and moderate physical activity (MPA) [7], defining the frequency and duration of physical activity [5, 12] and their classification within the domains [12]. There is a clear relationship between overestimating or underestimating physical activity and socio-demographic factors (e.g. age) [12]. Recognizing these factors could provide an interesting source of knowledge on behavior of a population and contribute to broadening our understanding of the reasons underpinning the low physical activity within this population. It is therefore the aim of the current investigation to identify factors that influence overestimations of physical activity.

Both males and females were equally well represented in the sample group (n=1765). The respondents fell in the age group between 15 and 69 years (40.4±14.9) and were a representative sample in terms of gender, place of residence, education, and gross income. With the use of bespoke algorithm, 132 (7.5%) participants who overestimated physical activity (per IPAQ methodology [17]) were selected for further analysis.

The results show that when using the long IPAQ version attention should be drawn to the occupational and domestic domain in particular. The majority of overestimations of physical activity are observed within these domains. This has been confirmed by Spanish [18], Swedish [19], and Chinese [20] researchers.

In the current investigation, as many as 75% of the respondents whose total physical activity duration was over 16 h per day highly overestimated their physical activity in the occupational domain. In some cases, the reported duration of physical activity was over 16 h per day in this domain alone. The average total time of physical activity duration in this area was longer than 12 h/day (723.1 min/day) which is rather surprising given that we devote the average of 8 h out of 24 h to sleeping. This, in turn, significantly limits our abilities to undertake prolonged physical activity in other domains in our lives (i.e., domestic, leisure time, and commuting). Sebastião et al. [21] also question the physical activity estimation in this domain. They argue that the high average physical activity duration in occupational domain observed in Brazilian males (1564.7 min per week) and females (1157.1 min per week) was rather unrealistic. This observation was also supported by Ford et al. [22] and Hallal et al. [23].

The analysis of the respondents, focusing on their socio-demographic characteristics, demonstrated that the Polish males (58.6%) significantly more frequently declared the highest occupational daily physical activity as compared to the females (41.4%). Although it is true that no significant relationship was ascertained between the maximum duration of this activity and gender, however, it was observed that the men {751.2±396.4 (840.0) min/day} reported longer average duration of such exercise than the women {690.5±486.9 (840.0) min/day}. Swedish researchers observed a similar relationship. According to Kwak, Hagströmer and Sjöström [19], the men (94.2±141.3 min/day) overrated their MPA at work far more considerably than the women (78.3±132.7 min/day). In the case of Poland, overestimations occurred mainly in the walking domain (36.4%) and MPA (25.0%).

Occupational physical activity was most frequently overestimated by the individuals aged 50-59 years and 20-24 years. This high share in the group of 50-59-year-olds – nearly equally distributed among the women (14 females) and the men (11 males) – can suggest a growing loss of interest in work, or job burnout, related to the approach of retirement age. What is quite puzzling, however, is that a staggering 85.2% of young people (aged 20-24 years) estimated their occupational physical activity so highly. As most of them were students it is fair to surmise that by occupational activity they meant participating in physical education classes, having a part-time job, undergoing training or doing an internship, which was also quite surprising. What is even more baffling is that young people aged 15-19 years declared similarly high occupational activity (83.3%). This can either testify to their lack of understanding of the intention behind the survey questions or their conviction that physical activity at school lasted so long, which – as we all know – is highly unlikely. Hallal et al. draw similar conclusions [23]. On the other hand, Klesges et al. claimed that young people displayed a tendency to report in questionnaires a higher physical activity than really existing [24]. We note that previous findings indicated that some younger adults had difficulties in understanding the IPAQ questions [6, 7, 9] or over-reported their activities on IPAQ [6, 7, 25-27], the findings consistent with those presented here. It appears that in Poland not only individuals who study but also people who work (e.g. provide childcare at home) identify their activity with prolonged exercise that is tantamount to the time spent at work or college.

Hence, 'by default' they declared 8 h of physical activity.

What is quite striking is that the proportion of seniors (aged 60-69 years) who overestimated their occupational activity {386.6±460.1 (0) min/day} was noticeably lower (5.3%) than of other people. It is a common knowledge that elderly people – due to problems with structuralizing their everyday physical activity and difficulty memorizing it – tend to excessively overrate their physical activity [11]. We did not observe the occurrence of such a phenomenon in our research. Nevertheless, one could raise a valid point that using the same questionnaire for all age categories may not be entirely authoritative.

The Spearman's correlation did not demonstrate a significant relationship between the average maximum occupational physical activity and education. What was observed, however, was that the median duration of this activity increased with the level of education (primary – 780 min/day; secondary – 840 min/day; and higher – 960 min/day), but decreased in another area where excessive PA reporting by Polish people (18.2%) was quite noticeable: namely the household domain (240.0 min/day, 180.0 min/day, and 120.0 min/day, respectively). This implies that overestimating exercise may to some degree be influenced by education and the associated conviction about the importance of one's work. On the one hand, highly educated Poles convinced of their high occupational activity, confuse physical exercise with engagement, mental fatigue, responsibility, and time spent in the workplace. On the other hand, individuals with primary education more frequently overrate their domestic activity. Therefore it seems that as in Belgium [7] it is necessary to develop more detailed instructions whereby more specific examples of occupational physical activity at varied levels of intensity are provided.

A high share of overestimations within the household domain was reported mainly among the women (62.5 vs. 37.5%). The average maximum declared duration of exercise totaled 362.8±350.3 (240) min/day. It was significantly shorter in the men and equaled 237.7±224.1 (180) min/day. This may result from the fact that for the women performing domestic chores is usually tantamount to doing professional work (as a housewife or raising children), which makes them overrate their self-reported physical activity. This can be partly confirmed by the fact that household physical activity was overestimated particularly by the respondents aged 30-59 years (62.5%) – namely adults who performed family roles. However, this phenomenon is not exclusive to Poland. Researchers from all over the world draw attention to a similar problem [20-22]. During our research we also observed that among all respondents overestimating their household physical activity, the highest average values of maximum duration of such activities {555.0±409.2 (540) min/day} was relatively more frequently reported by people aged 60-69 years. Perhaps a reason for it is the problem alluded to above where seniors have problems with structuring everyday physical activity or difficulty memorizing the duration of undertaken exercise. Alternatively, it may also be that because these tasks involve heavy exercise, the respondents tend to emphasize them more. This would, however, indicate the necessity (not only for the sake of elderly people) to introduce into the questionnaire a time limit to enable marking off the duration of declared activities on a 24-hour scale and exclude sleeping time.

The analysis of specific types of exercise proved there was a relationship between gender and MPA. While it is true that the proportion of women (44.3%) exceeding 16 h per day of MPA (regardless of the domain) was not significantly different (χ^2=0.30; df=1; p=0.58) from the men (38.0%), the women still tended to declare relatively higher maximum MPAs {585.5±317.2 (540.0) min/day} than the men {476.5±240.8 (480.0) min/day}. In the Polish population women hardly engage in the occupational or household VPA. Hence, it is quite natural they tend to overestimate MPA. However, it is not a circumstance that would explain the reason for these overestimations. It is therefore more likely that they stem from a lack of comprehension of the survey questions [5, 12]. Incidentally, Japanese researchers argue that IPAQ can only roughly estimate the respondents' MPA [28].

An existing relationship between MPA and the age of respondents was also proven. It was observed that while people aged 60-69 years declared both the highest MPAs {771.4±280.2 (840.0) min/day} and the lowest VPAs {147.1±139.8 (120.0) min/day}, young people aged 15–19 reported both the lowest MPAs {415.0±193.9 (405.0) min/day} and the highest VPAs {370.0±183.6 (390.0) min/day}. Harada et al. [11] argued that while the participation of senior people in more vigorous/intensive activities was less frequent, their recollection of moderate activity was more difficult, which could result in a subsequent erroneous estimation of their physical activity.

A relationship between gross income and the maximum VPA was observed. The highest VPAs were declared by the individuals with the income of 2000-2999 PLN {315.5±232.9 (330.0) min/day} as well as adults in the lowest {<1000 PLN; 300.0±231.1 (360.0) min/day} and the

highest income group (⩾6000 PLN; 300.0±201.8 (360.0) min/day}. Ensuring reliable and accurate measurements is particularly important in countries with low and average gross income, where these two areas (professional and domestic work) constitute significant components of the total physical activity [23]. Therefore, it seems justified to draw attention to the observation made earlier whereby highly educated Poles tend to confuse engagement, professional responsibility, and mental fatigue with physical exercise.

Conclusion

The accurate measures of physical activity are crucial for identifying trends in the levels of physical activity and, subsequently, health benefits of physical activity. Unreliable and unstable measures can occlude important phenomena, relationships or effects in this area of research. Estimating physical activity is momentarily a pivotal point for health professionals in establishing further directions within the public health sector. For this reason, it is extremely important to obtain reliable measures of physical activity. This would further aid the development of intervention strategies across the entire population. The current investigation highlights the necessity of a cautious approach when using the long IPAQ version. We suggest that particular attention should be drawn to the clear explanations of occupational and domestic domain by the surveyors. This is specifically the case when delivering questions about walking in the occupational domain and moderate physical activity in the household domain. The majority of errors were observed in a group of people with secondary education, aged 50-59 years or aged 20-24 years, and people living in villages and small towns. These errors can be reduced by drawing particular attention to the groups listed above.

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