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Research article

VALIDITY OF THE INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE (IPAQ) FOR SERBIAN ADOLESCENTS IN URBAN AREAS

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Abstract. *Physical activity (PA) remains the most important modifiable risk factor in chronic diseases prevention. Instruments to assess physical activity, especially for youth, are needed for (inter)national monitoring systems and comparison. The aim of the present study was to test the validity of the International Physical Activity Questionnaire (IPAQ) in a group of urban Serbian adolescents. We hypothesized that the IPAQ has good validity compared with the objective standard (pedometry) in this population. Convenient sampling of secondary school students was employed in this study. For that purpose, twenty-nine (N=29) healthy adolescents (15-17 years old) from the city of Niš, Serbia voluntarily participated in the study. PA levels derived from the Serbian long version self-administered IPAQ were compared with pedometer-recorded data of step counts. PA was expressed as a metabolic equivalent-minute per week (MET-min/week) and classified as light, moderate, and vigorous. Then, the participants were asked to register pedometer-based step counts for seven consecutive days. Significant correlations were found between the IPAQ and the pedometer in all components, except light PA. Pedometer-based PA was strongly correlated with moderate and vigorous activity ($r = 0.746$, $p < 0.0001$), as well as with overall PA ($r = 0.998$, $p < 0.0001$). Comparing the four domains of IPAQ determined PA (leisure time physical activity, domestic and gardening activities, school-related physical activity and transport-related physical activity) and pedometry-based PA, significant correlations were found for three domains ($p < 0.0001$), excluding transport. The findings of this study provided support for the validity of the Serbian version of the IPAQ as an instrument for the assessment of habitual PA among adolescents.*

Key words: *physical activity, adolescents, IPAQ, pedometer*

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INTRODUCTION

Inadequate physical activity (PA), combined with an unhealthy diet, is a modifiable risk factor for many chronic diseases, including cardiovascular disease, type 2 diabetes, obesity, hypertension, some types of cancer and depression (Dimitri, Joshi, & Jones, 2020; Li et al., 2020; Nancy, Rahman, Kumar, Sofia, & Robins, 2022). The health benefits of adequate physical activity are independent of age, but it is especially important for young people. However, young people's levels of physical activity are declining, and the proportion of fat children is rising (Detels et al., 2022).

WHO guidelines and recommendations provide details for different age groups and specific population groups on how much physical activity is needed for good health (World Health Organization, 2018.). Although the optimal physical activity dose associated with improved health outcomes cannot be determined precisely, many of the benefits are observed with an average of 60 min of moderate-to-vigorous intensity physical activity daily.

The level of PA among children and adolescents is an important premise for their present and future health-promoting lifestyle, which is emphasized in many studies (Sampasa-Kanyinga et al., 2020; Kliziene, Cizauskas, Sipaviciene, Aleksandraviciene, & Zaicenkoviene, 2021; Groffik, Fromel, & Badura, 2020). Regular physical activity helps in the prevention and control of risk behaviors among young people such as smoking, alcohol consumption and abuse of psychoactive substances, has effects on one's diet and together with sports promotes psychological well-being and reduce stress, anxiety, depression, violence and loneliness (Lesjak & Stanojević-Jerković, 2015).

However, a recent worldwide survey revealed that large proportions of young people across different European countries did not meet PA recommendations and spent a lot of time sedentary (Marzi et al., 2022). Researchers and health professionals have been trying to develop adequate objective and/or subjective measurement tools to quantify the amount of PA, but questionnaires still remain the most widely used measurement tools (Cleland, Ferguson, Ellis, & Hunter, 2018; Quinn et al., 2017; Watson et al., 2017). Many PA questionnaires exist, but few can be used for intercountry comparisons, like the International Physical Activity Questionnaires (IPAQ) (IPAQ, 2010). Recently, more attention has been given to objective instruments used to assess PA, like accelerometers (Brady, Brown, Hillsdon, & Mielke, 2022) and pedometers (Pereira, Cliff, Sousa-Sá, Zhang, & Santos, 2019).

IPAQ, as an instrument for cross-national monitoring of physical activity, is also a comprehensive and reliable self-administered tool to determine the degree of PA during adolescence. It has been translated into numerous languages and validated for use in adult populations in various countries, but its validity for use in developing countries, where the changes in lifestyles are evident, and among adolescents needs further research. In addition, a valid IPAQ in the Serbian language is necessary for comparing data collected from adolescents in Serbia with data collected from other countries. The economic standard affects the possibilities of expensive measurements used to assess PA, which are more difficult to apply in countries in transition such as Serbia, while the IPAQ allows study of larger populations.

The aim of the study was to test the validity of the International Physical Activity Questionnaire (IPAQ) in a group of urban Serbian adolescents. We hypothesized that the long version of the long version of the IPAQ has good validity compared to the objective standard (pedometry) in the adolescent population.

METHOD

Participants

Convenient sampling of secondary school students was employed in this study. The study population was recruited from the central municipality of the city of Niš, Serbia. The participants, aged 15–16.99 years, were identified and randomly selected from two different schools. Participation in the study was voluntary.

Upon the obtained permission of the Ministry of Education, Republic of Serbia, the headmasters of the schools were informed about the research. The parents and pupils were informed about the purpose of the study and the participants had the opportunity to end the physical activity monitoring at any time.

Each participant signed a written consent and the parents of participants also signed the consent, in accordance with the Declaration of Helsinki and legal standards. Consent for the implementation of the population survey was given by the Ethics Committee of the Institute of Public Health Institute, Niš, Serbia (No. 12-3785/5).

A total of 100 adolescents were invited, and twenty-nine volunteers (n=29) participated in this study. The inclusion criteria for the study were the following: age between 15 and 16 years and the absence of chronic illnesses.

Measures

The first part of questionnaire contained questions meant to provide information on socio-demographic data (age, gender of the participants, place of residence etc.). The long version of the Physical Activity Questionnaire (IPAQ) was applied (IPAQ, 2010). Prior to the study, the IPAQ long version was translated from English to Serbian, checked through back translation and pre-tested in the classroom. The IPAQ is a self-administered questionnaire and originally developed for adults between 15-69 years, consisting of 27 questions that cover assessing the four domains of PA (leisure time physical activity, domestic and gardening activities, work-related physical activity and transport-related physical activity). To adapt the questionnaire to the young population, questions about PA at work were replaced by questions about PA at school. Furthermore, the items relating domestic and gardening PA were reduced to one question. All questions referred to the previous 7 days. The results of the IPAQ questionnaire were processed in accordance with the officially recommended "Guidelines for data processing and analysis of the international physical activity questionnaire" (IPAQ, 2005). The IPAQ data were presented as the total metabolic equivalent-minute per week (MET-min/week). The MET-min/week score of specific activity is the computed MET value of a particular activity with time spent performing the particular activity. Total PA score was calculated, as well as separate scores for each of the 4 domains. The MET values of PA levels were classified as light (< 600MET-min/week), moderate level of activity (600-1500MET/-min/week) and adequate –high (>1500 MET-min/week).

The pedometer Double Power DP-878 (Shenzen Double power Electronics Co, Ltd, Guangdong, China), which underwent a standard pre-intervention calibration, was used as the objective instruments to assess PA.

Procedures

All participants were visited at school by researchers and the distribution of the questionnaires and collection of the responses took place at school.

Then, the participants were asked to register pedometer-based step counts for seven consecutive days. They were instructed to wear the pedometer on their belt during walking hours. All the participants were asked to carry on their usual activities, to remove the pedometer only while swimming, bathing or showering. Based on procedures of Tudor-Lock (Tudor-Locke, Lind, Reis, Ainsworth, & Macera, 2004), the participants recorded the number of step counts at the end of each day of pedometer registration in a journal. Following established guidelines (De Cocker, Cardon, & De Bourdeaudhuij, 2007; Tudor-Locke, & Bassett, 2004), we used these indices to classify pedometer-determined physical activity in healthy adults: (a). <5000 steps/day - a 'sedentary lifestyle index' or light; (b). 5000-7499 steps/day -moderate; and (c). >or=7500-9999 steps/day - 'active' individuals.

Statistical analysis

Basic descriptive statistic data were calculated: frequencies and percentages for categorical characteristics and average (Mean) and Standard Deviation (SD) for continuous variables. The Spearmen rank correlation was used to test the association between IPAQ-based PA and the pedometer-based PA. The Chi-squared test was used for statistical analysis of categorical data, while the Mann-Whitney and Student's t-test for independent samples were also calculated. The level of significance was set at $p< 0.05$.

RESULTS

This study began with thirty volunteers, but only twenty-nine produced data that were acceptable. The study included 29 adolescents, 16 males (55.2%) and 13 females (44.8%) aged between 15-17 years.

The basic characteristics of the participants are shown in Table 1. The mean age of the participants was 16.5 ± 1. 9 years for boys and 16.7 ± 1.7 years for girls. The adolescents were homogeneously distributed by gender and grade (first grade – 27.6%, second grade – 34.5% and third grade – 37.9% in total).

Table 1 Characteristics of the participants

Characteristics	Boys	Girls	P
Gender	16 (55.2%)	13 (44.8%)	NS
Age (X±SD years)	16.5 ± 1.9	16.7 ± 1.7	NS
Body height in cm (X±SD)	183.1 ± 10.2	162.85 ± 6.6	P>0.0001
Body weight in kg (X±SD)	74.8 ± 24.3	59.9 ± 10.1	P>0.05
Body mass index in kg/m^2 (X±SD)	23.2 ± 6.1	22.6 ± 3.4	NS

NS – non significant, p>0.05

Table 2 Physical activity of the participants based on the IPAQ and pedometry

	PA level (MET-min/week)*				PA level (steps/day)#			
	Light	Moderate	Adequate -high	Very high	Sedentary	Low active	'Some-what active'-active	Very active
Male N (%)	3 (18.7)	3 (18.7)	6 (37.5)	4 (25.0)	4 (25.0)	5 (31.2)	3 (18.8)	4 (25.0)
Female N (%)	3 (23.1)	6 (46.2)	3 (23.1)	1 (7.7)	5 (38.5)	6 (46.1)	1 (7.7)	1 (7.7)
Total N (%)	6 (20.7)	9 (31.0)	9 (31.0)	5 (17.2)	9 (31.0)	11 (37.9)	4 (13.8)	5 (17.3)

*Pearson's $\chi 2=3,527$, $p=0,317$
#Pearson's $\chi 2=2,72$, $p=0,437$

According to the IPAQ PA estimates (Table 2), there were no significant differences between boys and girls on the IPAQ-based PA levels ($\chi 2=3,527$, $p>0.05$). In this sample, 20.7% of the participants had light physical activity, 31% of the participants had a moderate PA level, while only 17.2% participants had adequate-high PA and very high PA level . There were also no significant differences between boys and girls in pedometer-based PA level ($\chi^2=2,72$, $p=0.437$).

According to the pedometer-based PA (Table 2), almost one-third of the participants (31%) had sedentary physical activity (25.0% boys, 38.5% girls). Low active level of PA was noted for 37.9% of the participants (31.2% boys, 46.1% girls), 'somewhat active'-active PA for 13.8% (18.75% boys, 7.7% girls), and very active only for 17.3% of the participants (25% boys, 7.7% girls).

Table 3. presents Spearman's rank correlation that was computed to assess the relationship between the data acquired using the IPAQ and the pedometer data. Significant correlations were found between the IPAQ and the pedometer in all components, except light PA. Pedometer-based PA were strongly correlated with moderate and vigorous activity ($r = 0.746$, $p < 0.0001$), as well as with overall PA ($r = 0.998$, $p < 0.0001$).

Table 3 Non-parametric test of differences between IPAQ and pedometry-based PA estimates in the sample of Serbian adolescents

Pairs of PA estimates compared	Spearman ρ	P
Overall (IPAQ v. pedometer)	0.998	0.0001*
Light (IPAQ v. pedometer)	0.328	>0.05
Moderate (IPAQ v. pedometer)	0.746	0.0001*
Vigorous (IPAQ v. pedometer)	0.746	0.0001*

*significant correlation

The examined adolescents were physically very active in the leisure-time domain and in the domestic and garden domain as opposed to transportation (Table 4). The boys and girls in the study differed statistically ins all domains of PA, except transport.

Table 4 The level of PA of different domain

Domain	MET-min/week (mean±SD)	t	p
School (male/female)	209.0 ± 84.6 / 168.9 ± 96.8	4.400	< 0.0001*
Transport (male/female)	141.5 ± 89.3 / 149.1 ± 82.9	0.289	> 0.5
Domestic and garden (male/female)	755.2 ± 109.9 / 312.5 ± 97.09	5.298	< 0.0001*
Leisure-time (male/female)	1574.9 ± 966.2 / 848.4 ±807.1	4.674	< 0.0001*

*significant correlation

Comparing the four domains of IPAQ-determined PA (leisure time physical activity, domestic and gardening activities, school-related physical activity, and transport-related physical activity) and pedometry-based PA, significant correlations were found for three domains that are shown in Table 5.

Table 5 Non-parametric test of differences between IPAQ and pedometry-based PA according to domains in the sample of Serbian adolescents

PA	School		Transport		Domesting and gardening activities		Leisure time	
	r	p	r1	p1	r2	p2	r3	p3
IPAQ	0.479	< 0.05*	-0.191	> 0.05	0.574	< 0.005*	0.707	< 0.0001*
Pedometer	0.496	< 0.05*	-0.190	> 0.05	0.469	> 0.05	0.822	< 0.0001*

*significant correlation

DISCUSSION

The validity of the IPAQ in the examined population according to our results was significant and comparable to pedometry results used among adolescents. Questionnaires represent the most accessible instrument for usual physical activity evaluation, above all in epidemiological studies due to the easiness of being applied to large groups, low cost and for allowing information collection in relation to the type and context in which they are performed, which does not occur with other measurement resources. But sometimes, the questionnaires may present inconsistencies in the responses, and, when compared to other measurement resources, they demonstrate more difficulty in fulfilling the criteria associated with the reproducibility and validity of their results. To our knowledge, this seems to be the first study aimed at analyzing the IPAQ validity in Serbian adolescents.

In this sample of Serbian adolescents, we found significant and positive correlations between the Serbian version of the IPAQ-based PA and pedometer-determined PA. So, objectively measured step counts correlated positively with the subjectively reported PA levels according to the questionnaire data. A significant, positive association between step counts and questionnaire – based PA were also found in previous studies. The Arab Teens Lifestyle Study reports on the convergent validity of the physical activity questionnaire against an electronic pedometer. The participants were 39 males and 36 females randomly selected from secondary schools, with a mean age of 16.1 ± 1.1 years. The correlation of step counts with total time spent on all activities based on the questionnaire was 0.369. (Al-Hazzaa, Al-Sobayel, & Musaiger, 2011). Previous meta-analysis indicated moderate to

high reliability (rw = 0.59) and concurrent validity (rw = 0.55) of national language versions of single-item sedentary behaviour questions (Meh, Jurak, Sorić, Rocha, & Sember, 2021). Chinese authors (Gao et al., 2022) evaluated the validity of common subjective instruments in measuring PA and sedentary behaviour (SB) among college students and suggested that some questionnaires could achieve a moderate validity for PA compared with the accelerometer. Other results showed that the IPAQ short version for men has acceptable reliability and criterion validity for vigorous activity and sitting (Kurtze, Rangul, & Hustvedt, 2008).

Another study (Hagstromer, Oja, & Sjostrom, 2006) found also a positive relationship between the pedometer step counts and the IPAQ data for total PA and vigorous PA, but a weaker relationship was shown for moderate PA.

In the study of Regaigeg et al. (2016), strong relationships were observed between pedometer step count data and the IPAQ data for vigorous PA ($r = 0.57$, $p < 0.001$) and walking ($r = 0.61$, $p < 0.001$) and a weaker relationship for moderate PA among Tunisian overweight and obese youths ($r = 0.24$, $p < 0.05$).

The major advantages of this study are the methods used. The long version of the IPAQ allowed us to determine the level of physical activity in each of the four physical activity domains, which is very important in order to gain complete insight into the pattern of physical activity among adolescents. But if we want to compare this study with similar studies from other countries, we have to bear in mind that the many recent studies used the short version of the IPAQ.

Several study limitations must also be considered. Due to the small sample size of the validity study, an examination of how demographic factors such as age, gender or education affected the validity of the IPAQ was not considered. Therefore, further studies are needed on larger samples of participants and with longer follow-up observational periods. Although the pedometer is a reliable instrument and provides an objective estimate of the level of PA, it is not the best standard criterion for assessing habitual PA (Marsaux et al., 2016) because it cannot record the intensity of the PA. The IPAQ asked about the combination of PA in various domains, while the pedometer measured all activity throughout the day.

Measuring physical activity levels in children is also important for developing successful public health programs to increase PA levels and the valid measurement of physical activity has the potential to be a very useful tool in countering the obesity epidemic.

CONCLUSION

To conclude, the findings of the present study provided support for the acceptable validity of the IPAQ when used to assess the levels and patterns of PA in Serbian adolescents.

Additional efforts should be made to develop specific instruments to assess PA in overweight and obese youths.

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VALIDACIJA UPITNIKA ZA PROCENU FIZIČKE AKTIVNOSTI ADOLESCENATA U SRBIJI

Fizička aktivnost (FA) predstavlja jedan od najvažnijih promenljivih faktora rizika za mnoge hronične bolesti. Instrumenti za procenu fizičke aktivnosti, posebno kod mlađih osoba, su neophodni za sistematsko praćenje nivoa FA i poređenje na nacionalnom i međunarodnom nivou. Cilj ovog istraživanja je bio je da se ispita validnost Međunarodnog upitnika o fizičkoj aktivnosti (engl. skraćenica IPAQ) u grupi urbanih adolescenata iz Srbije. Postavljena je hipoteza da IPAQ ima dobru validnost u poređenju sa pedometrijom za populaciju adolescenata. U istraživanju je učestvovalo 29 adolescenata (uzrasta 15-17 godina) iz Niša, Srbija. Nivo FA je dobijen upotrebom duže verzije upitnika IPAQ na srpskom jeziku i podaci su upoređeni sa objektivnim podacima izbrojanih koraka dobijenim pedometrom koji je nošen 7 uzastopnih dana. Upitnikom dobijena FA je izražena u metaboličkim ekvivalentima na nedeljnom nivou (MET-min/nedeljno) i klasifikovana kao niska, umerena i živahna. Statistički značajna korelacija je dobijena između nivoa FA utvrđene upitnikom IPAQ i nivoa FA dobijene pedometrom, osim za adolescente koji su bile nedovoljno fizički aktivni. Pedometrom utvrđena FA je čvrsto korelirala sa umerenom i živahnom FA dobijene upitnikom ($r = 0.746$, $p < 0.0001$), kao i sa ukupnom FA ($r = 0.998$, $p < 0.0001$). Poređenjem sva četiri domena FA dobijenih upitnikom (FA u slobodno vreme, aktivnosti u domaćinstvu i bašti, FA u školi i FA povezana sa kretanjem do škole) i FA utvrđena pedometrom, nađena je značajna korelacijan za sve domene ($p < 0.0001$), sem transportnog. Zaključujemo da je Srpska verzija upitnika IPAQ validna kao jednostavan instrument za ocenu FA adolescenata.

Ključne reči: *fizička aktivnost, adolescent, upitnik, pedometar*