PSYCHOMETRIC CHARACTERISTICS OF THE SERBIAN VERSION OF THE EUROPEAN HEALTH INTERVIEW SURVEY—PHYSICAL ACTIVITY QUESTIONNAIRE—EHIS-PAQ

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Abstract:

The European Health Interview Survey—Physical Activity Questionnaire (EHIS-PAQ) was specially developed to gather data on physical activity of the population for the production of public health statistics in Europe and the calculation of European Core Health Indicators. The aim of this study was to examine the psychometric properties of the Serbian version of the EHIS-PAQ. This was a secondary analysis of the data from the 2019 Serbian National Health Survey, which included 15,621 participants. The psychometric properties of the EHIS-PAQ were examined using exploratory (EFA) and confirmatory factor analyses (CFA). The EFA revealed the existence of three factors that explained 55.02% of the variance. Factor loadings varied from 0.515 to 0.941. The CFA showed that adjusted goodness of fit index (AGFI) was 0.958, goodness of fit index (GFI) was 0.977, comparative fit index (CFI) was 0.958, and root mean square error of approximation (RMSEA) was 0.063 (95% CI: 0.056-0.069). The Serbian version of the EHIS-PAQ showed good construct validity and can be used as a convenient measure of physical activity in the population.

Keywords: *EHIS-PAQ; instrument; physical activity; validity*

Introduction

According to the World Health Organization (WHO, 2018), the adult population aged 18-64 should engage in 150 minutes of moderate-intensity aerobic physical activity (PA), or in 75 minutes of vigorous-intensity aerobic PA, or in the appropriate combination of moderate and vigorous-intensity PA. In addition to aerobic physical activity, two or more days a week should be devoted to muscle-strengthening activities, which should be of moderate to vigorous intensity and should include large muscle groups. Additional health effects can be achieved if the volume of moderate-intensity PA is increased above 300 minutes, or through the increase of the volume of vigorous-intensity PA above 150 minutes, or through the appropriate combination of moderate-intensity and vigorous-intensity PA. It is also essential to minimize sedentary behavior and replace it with physical activity of any intensity (Bull, et al., 2020). Following the recommendations set by the World Health Organization is considered sufficient to reach the level of physical activity required to maintain and enhance health (WHO, 2018). Monitoring the prevalence of sufficient PA is crucial for evaluating public health policies aimed at reducing chronic non-communicable diseases.

Physical activity can be assessed using objective and subjective methods (Dowd, et al., 2018). The most often used objective instruments are accelerometers and pedometers, while the subjective instruments are questionnaires (Ramakrishnan, et al., 2021; Sember, et al., 2020). Questionnaires are widely used in large-scale studies due to their low cost and ease of administration, but their inherent limitations—such as recall bias, over-reporting, and low agreement with objective measures—necessitate cautious interpretation, especially in individual-level or cross-population comparisons (Husu, et al., 2024; Prince, et al., 2020; Sattler, et al., 2021; Sember, et al., 2020; Welk et al., 2023). Combining self-report with objective methods and

ongoing instrument refinement are recommended to improve accuracy and utility in public health research and practice.

The European Health Interview Survey—Physical Activity Questionnaire (EHIS-PAQ) was specially developed to gather population-based data on physical activity for the production of public health statistics in Europe and the calculation of European Core Health Indicators (ECHI). The first EHIS wave used the International Physical Activity Questionnaire Short Form (IPAQ-SF), but challenges led to revisions and the development of the EHIS-PAQ (Finger et al., 2015). The EHIS-PAQ instrument is based on questions regarding physical activity that have previously been used in large epidemiological population surveys (Finger, et al., 2015). Given Europe's cultural and linguistic diversity, the EHIS-PAQ requires validation in different contexts. The meta-analysis results showed that the EHIS-PAQ has only moderate validity (Sember, et al., 2020), which means that while the questionnaire can reasonably estimate PA levels in populations, its results do not strongly align with objective measurements, such as accelerometers. Although national versions of this questionnaire are regularly used in the European Union countries (Hintzpeter, et al., 2019), only four studies have examined the reliability and validity of the EHIS-PAQ (Baumeister, et al., 2016; Meh, et al., 2022, 2023; Sember, et al., 2020).

The EHIS-PAQ was used in the latest 2019 Serbian National Health Survey, in accordance with the methodology of the European Health Interview Survey, thereby enabling the comparability of population health indicators in Serbia with population health indicators in the European Union. This study aimed to assess the psychometric properties of the Serbian version of the EHIS-PAQ.

Methods

This was a secondary analysis of the data from the Serbian National Health Survey, which included a total of 15,621 participants and was conducted between October and December 2019. For the purpose of the current study, data on a total of 13,178 participants older than 15 years were extracted, of whom 5,456 completed the European Health Interview Survey—Physical Activity Questionnaire (EHIS-PAQ) regarding physical activity and were included in this analysis.

The sample in the Serbian National Health Survey was developed following the European Health Interview Survey (EHIS) methodology (Institute of Public Health of Serbia, 2019). The sampling frame included all residents of Serbia living outside institutional housing (such as elderly homes, monasteries, or student dorms), and the determined sample size was 6000 households. The sampling was performed using a two-step cluster sampling, with the first step representing the random selection of census circles and the second representing the random selection of households in each census circle. Details of the sampling have been published elsewhere (Institute of Public Health of Serbia, 2019). The study participants received detailed explanations of the study, including its procedures and objectives, both orally and in writing. All participants provided written informed consent to participate in the study. The analysis was approved by the Ethics Committee of the Faculty of Medicine, University of Belgrade (No. 17/IX-16 from 5 September, 2023). The data for the present analysis were accessed on 30 September, 2023.

The EHIS questionnaire was the instrument used for the Serbian National Health Survey. Information was collected through face-to-face interviews, self-reported questionnaires, and measurements of participants' characteristics, such as height, weight, and arterial blood pressure, which were measured by the field researchers. Physical activity was examined using the EHIS-PAQ questionnaire. The EHIS-PAQ is a 9-item, domain-specific physical activity questionnaire that was used in population surveys before, assessing work-related, transport-related, leisure-time physical activity, and muscle-strengthening physical activity in a typical week (Finger, et al., 2015).

Statistical analysis involved both descriptive and analytical statistics. Exploratory factor analysis (EFA) was conducted on half of the sample to investigate the factor structure according to the initial construct. Factor extraction utilized promax rotation, considering the presence of correlations between the factors. The loading and cross-loading criteria were set at 0.4. A confirmatory factor analysis was conducted on the second half of the sample. The assessment of fit quality involved several measures, such as the goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), comparative fit index (CFI), and root mean error of approximation (RMSEA). The analyses were performed using the Statistical Package for Social Sciences (SPSS) for Windows 22.0 (Armonk, NY, USA).

Results

Of the 5,456 participants, 2,892 (53%) were female and 2,564 (47%) were male. The average age of the participants was 55.76±19.23 years.

In work-related physical activity, almost half of the participants mostly walked or had moderate physical activity (46%), about two-fifths mostly s at or stood (42.9%), and 8% mostly did heavy or physically hard work.

Almost three-quarters of the participants (73.1%) walked seven days a week for at least 10 minutes a day continuously (going to work, school/college, shopping, etc.). The percentage of participants who had never performed such activities was

8.2%. A little more than a third of participants (36.6%) walked for 10-29 minutes a day, 27.6% walked for 30-59 minutes a day, and one-fifth (20.1%) of them walked for 1-2 hours a day. The percentage of participants was the same for those who walked 2-3 hours a day and those who did this activity for 3 or more hours a day (7.9%).

In a typical week, one-fifth (10.2%) of the participants rode a bicycle for at least 10 min a day continuously, while 76.8% of them never performed such physical activity. Half of the participants (51.2%) rode a bicycle for 10-29 minutes a day, while a little less than a third of them (31.4%) rode a bicycle for 30-59 minutes a day.

The largest percentage of participants (88.4%) never engaged in physical activity in their leisure time, such as ball games, running, brisk walking, swimming, etc. Only 4.8% of them engaged in sports, fitness, or recreation three days a week, while only 3.2% of participants practiced it two days a week.

A total of 93.5% of the participants never practiced muscle-strengthening exercises. Of those who practiced this type of exercise, most of them did it three days a week (1.9 %), while 1.7 % did it two days a week.

The average weekly time the participants spent in aerobic activity was 73.11±177.37 min, while the total amount of sitting on a weekly basis (sitting at work, at home, and during leisure time) was 260.52±201.29 min.

The exploratory factor analysis (EFA) showed the existence of three factors. The factor loadings varied from 0.515 to 0.941. Three factors explained 55.02% of the variance (Factor 1: 25.63%, Factor 2: 16.44%, and Factor 3: 12.94%) (Table 1).

The component correlation matrix showed the correlations between the factors. The correlation coefficient for Factors 1 and 2, Factors 1 and 3, and Factors 2 and 3 was 0.301, 0.139, and 0.026, respectively (Table 2).

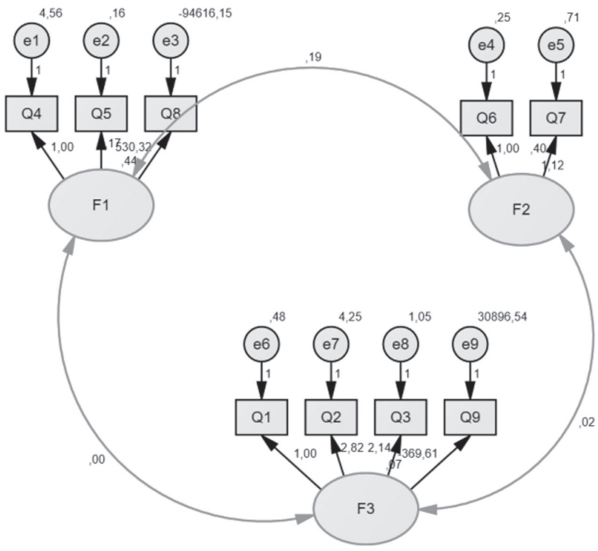
The confirmatory factor analysis (CFA) showed AGFI 0.958, GFI 0.977, CFI 0.958, and RMSEA 0.063 (95% CI: 0.056-0.069) (Figure 1).

Table 1. Factors and factor loadings for each question using component analysis with promax rotation and Kaiser normalization—EHIS-PAQ

Questions	Factor 1	Factor 2	Factor 3
Work-related physical activity (Q1)			0.580
Walking per week (days) (Q2)			0.515
Time spent walking per day (Q3)			0.652
Cycling per week (days) (Q4)	0.737		
Time spent cycling per day (Q5)	0.650		
Aerobic exercise (days) (Q6)		0.829	
Strength exercise (days) (Q7)		0.786	
Aerobic exercise (min) (Q8)	0.941		
Sitting (min) (Q9)			-0.698

Table 2. Component correlation matrix between the principal component analysis and promax rotation and Kaiser normalization

Component	Factor 1	Factor 2	Factor 3
Factor 1	1.00	0.301	0.139
Factor 2	0.301	1.00	0.026
Factor 3	0.139	0.026	1.00



Note. CFA = confirmatory factor analysis.

Fig 1. The path diagram for the three-factor CFA.

Discussion and conclusions

Our study examined the psychometric properties of the Serbian version of the EHIS-PAQ. Previous research has shown that the estimation of the level of physical activity through questionnaires commonly leads to overestimation (Lee, Macfarlane, Lam & Stewart, 2011; Van Holle, De Bourdeaudhuij, Deforche,Van Cauwenberg & Van Dyck , 2015). Another disadvantage of many questionnaires for the assessment of PA, including the IPAQ-SF, previously used in the European Health Interview Survey, is the difficulty that participants face when they need to differentiate the intensity of the physical activity conducted, as well as the duration of the usual activities, such as walking (Finger, et al., 2015). However, to this day, questionnaires remain the most important mode of PA assessment at the population level, mainly due to their low cost and easy administration, but also because numerous different objective measures of physical

activity fail to capture all different modalities and forms of physical activity, such as strength exercise in accelerometers or swimming for use of pedometers (Aparicio-Ugarriza, et al., 2015). One of the main differences between the EHIS-PAQ and other questionnaires aiming to examine physical activity, and one of its main advantages, is the inclusion of recreational physical activity as a separate item (Howley, 2001) and the good validity of EHIS-PAQ when compared to objective measurements such as accelerometers (Meh, et al., 2023).

Since the inclusion of the EHIS-PAQ as the instrument used in the EHIS surveys, it has also been a part of the Serbian National Health Survey. Our study showed that the Serbian version of the EHIS-PAQ had good construct validity. The EFA showed the existence of the three factors with good factor loadings that explained approximately half of the total variance. Factor 1 encapsulates individuals' engagement in aerobic exercise and cycling activities, both in terms of frequency (days per week) and duration (minutes). Factor 2 represents a combination of work-related physical activities, walking, and sitting. Sitting time showed an inverse association with this factor, with a negative loading of -0.679, indicating that participants who spent less time sitting were more likely to have higher factor loadings. Participants with higher factor loadings were more likely to have active work routines that minimized sedentary activities. Factor 3 was related to strength exercise and suggested that participants with higher factor loadings on this factor were likely to have consistent strength exercise routines. For factor extraction, we used *promax* rotation, as it was hypothesized that the factors were mutually correlated. The component correlation matrix confirmed the hypothesized, as there was a moderate positive correlation of 0.301 between Factors 1 and 2, suggesting some overlap between aerobic/cycling activities and work-related tasks, walking habits, and sitting behaviors. There was a weak positive correlation of 0.139 between Factor 1 and Factor 3, indicating a minor connection between aerobic/cycling activities and strength exercises.

The CFA demonstrated an excellent fit based on multiple indices, with an AGFI of 0.958, explaining a substantial portion of the data variance while considering the degrees of freedom. The GFI value of 0.977 reflects a robust fit to the observed data, while the CFI value of 0.958 implies a high fit relative to the baseline model. An RMSEA value of 0.063 is acceptable and indicates that the model fits the data well and accurately represents the relationship between the model and the data.

Limitations

This study has several limitations. First, there was no objective gold standard available to examine validity. Second, the results would be more valid if there was a possibility of comparing the data from the questionnaire with objective assessments of PA as validation criteria, such as an accelerometer, but not for muscle-strengthening activities. Nonetheless, to the best of our knowledge, only four studies have examined the validity and reliability of the EHIS-PAQ, and none have explored the factor structure and theoretical factor model. Additionally, the strength of this study is its sample, because the study was conducted at the national level on a representative sample.

Our study showed that the EHIS-PAQ, as a convenient instrument, can be used for the assessment of physical activity, as it has good construct validity. As the EHIS-PAQ instrument was developed out of the necessity for the valid assessment of important health determinants at the European level, it is very important to confirm the validity of this instrument, along with the advantages in the administration of this instrument, and the convenience for the participants in large epidemiological studies on the variable population.

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