











The Baecke Habitual Physical Activity Questionnaire (BHPAQ): a valid internal structure of the instrument to assess healthy Brazilian adults

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SUMMARY

OBJECTIVE: This study aimed to validate the internal structure of the Brazilian version of the Baecke Habitual Physical Activity Questionnaire.

METHODS: A cross-sectional study was conducted with individuals over 18 years old of both sexes, with Brazilian Portuguese as their native language. The structure of the Baecke Habitual Physical Activity Questionnaire was tested by confirmatory factor analysis. The model fit was evaluated by the following indices: root mean square error of approximation, comparative fit index, Tucker-Lewis index, standardized root mean square residual, and χ^2 /degrees of freedom. We used the Akaike information criterion and Bayesian information criterion to compare different structures of the Baecke Habitual Physical Activity Questionnaire.

RESULTS: A total of 241 individuals participated in this study. The original structure of the Baecke Habitual Physical Activity Questionnaire with 16 items and 3 domains was compared to a structure with 14 items and 3 domains. The internal structure of the Baecke Habitual Physical Activity Questionnaire with 14 items showed better fit indices and lower Akaike information criterion and Bayesian information criterion values.

CONCLUSION: The best internal structure of the Brazilian version of the Baecke Habitual Physical Activity Questionnaire in adults presents 3 domains and 14 items.

KEYWORDS: Physical activity. Factor analysis. Reproducibility of results.

INTRODUCTION

The Baecke Habitual Physical Activity Questionnaire (BHPAQ) is a self-administered and self-evaluating instrument capable of measuring the physical activity of the past 12 months, created in the Netherlands in 1982. The original study initially involved the measurement of construct and content validity, in addition to test-retest reliability. Initially, the BHPAQ had 29 items, reduced to 16 items after principal component analysis (PCA). It included three domains: physical activity in occupation (items 1–8), physical activity in sports in free time (items 9–12), and leisure-time physical activity other than

sports (items 13–16). For each domain, the score ranges from 1–5, with higher scores indicating higher physical activity¹.

This instrument has been translated, adapted, and validated for several countries, such as Belgium², Portugal³, and Iran⁴. In Brazil, several validation studies have been conducted. The process of translation and cross-cultural adaptation of the BHPAQ was carried out by Sardinha et al.⁵ and Florindo et al.⁶, who also determined the internal consistency of the questionnaire to be good when applied to men aged 50 years or older.

Florindo and Latorre⁷ validated and investigated the test-retest reliability of the BHPAQ in adult men and concluded that the tool is a good choice for evaluating habitual physical activity in

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Brazilian men. In another study, Guedes et al.⁸ verified the validity and reliability of the BHPAQ in adolescents, obtaining satisfactory results regarding its measurement properties. Garcia et al.⁹ verified the construct validity of the BHPAQ using the accelerometer as a reference and found acceptable values. In contrast, Carvalho et al.¹⁰ concluded that the construct validity was inadequate when applied to patients with chronic lower back pain.

Despite these scientific initiatives, there are no studies defining the internal structure of the BHPAQ in Brazil considering the three domains defined in the original version, despite the questionnaire being used commonly in the country. Structural validity is useful to measure whether the result obtained reflects the dimensionality of the instrument to be evaluated¹¹. Given the importance of this instrument for research and practical applications in healthcare, the objective of this study was to evaluate the internal structure of the Brazilian version of the BHPAQ.

METHODS

Study design

This was a cross-sectional, quantitative study. Data were collected online using the Google Forms platform (Mountain View, CA, USA). After reading the informed consent form, all participants included in the study confirmed their participation ticking the option “I agree to participate” on the first page of the online form. This study was approved by the Research Ethics Committee of the Universidade Ceuma (under number 3.115.347).

Participants

The sample size followed the recommendations of the COnsensus-based Standards for the selection of health Measurement INstruments (COSMIN): seven times the number of items of the questionnaire. Therefore, a minimum of 112 individuals was recommended based on the inclusion of 16 items¹¹. The inclusion criteria adopted in this study were as follows: healthy individuals of both sexes, practicing physical activity or not, with Brazilian Portuguese as their native language, and aged 18 years or over. The exclusion criteria for this study were as follows: participants without a fixed profession or unemployed, presence of a medical diagnosis of cognitive alteration, and inability to read or write.

Baecke Habitual Physical Activity Questionnaire

The BHPAQ is a self-applicable, self-report instrument that assesses physical activity over the past 12 months. It consists

of 16 items, divided into 3 domains: physical activity in occupation (items 1–8), physical activity in sports in free time (items 9–12), and physical activity during leisure other than sport (items 13–16). There are five Likert scale (1–5) response possibilities¹⁶.

The score of the occupational domain is calculated by summing the answers indicated and dividing by 8 (for item 2, the value indicated should be subtracted by 6). The score of the sports domain is calculated by summing the values indicated and dividing by 4. To calculate the leisure domain score, all of the checked answers must be summed and the value must be divided by 4 (for item 13, the indicated value must be subtracted by 6). For each domain, the final score ranges from 1 to 5; the higher the score, the higher the level of physical activity⁶.

Statistical analysis

Descriptive statistical analysis was performed, with the presentation of the values as mean and standard deviation for quantitative variables and using absolute number and percentage for qualitative variables. Descriptive analysis was performed using the SPSS software version 17.0 (Chicago, IL, USA).

The validity of the BHPAQ structure was tested by confirmatory factor analysis (CFA), using the R Studio software (Boston, MA, USA) with the lavaan and semPlot packages. CFA was performed with the implementation of a polychoric matrix and the robust extraction method diagonally weighted least squares (RDWLS), as recommended by specialized literature¹². The model fit was evaluated using the following indices: root mean square error of approximation (RMSEA) with confidence interval (CI) at 90%, comparative fit index (CFI), Tucker-Lewis index (TLI), standardized root mean square residual (SRMR), and chi-square/degrees of freedom (DF)^{13,14}.

In this study, values >0.90 were considered adequate for CFI and TLI, and values <0.08 were considered adequate for RMSEA and SRMR. Values <3.00 were considered adequate in the interpretation of chi-square/DF^{13,15,16}. In CFA, factor loadings ≥ 0.40 were considered adequate for the domain. The RMSEA and SRMR indices evaluate the model residuals; in the best of conditions, the residual should be equal to 0. In another perspective, CFI and TLI calculate the relative fit of the observed model and compare it with a base model; under the best of conditions, the value should equal 1.

For comparison between the BHPAQ models, i.e., the original version of the questionnaire with 16 items versus 14 items, the Akaike information criterion (AIC) and Bayesian information criterion (BIC) indices were used. The structure with the lowest AIC and BIC values was considered to be the most

parsimonious model, as recommended in the specialized literature¹⁷. Parsimonious models are simple models that explain the data with a minimum number of parameters.

Criterion validity was assessed by correlating the score of the BHPAQ domains with 14 and 16 items, considering a correlation magnitude >0.70 as adequate¹¹. Therefore, normality was verified using the Kolmogorov-Smirnov test and correlations were performed using Spearman's correlation coefficient (rho).

RESULTS

A total of 241 individuals participated in this study. As can be seen in Table 1, most participants were women, young adults, and single adults, with secondary education and who were mildly overweight. Regarding the BHPAQ score, all domains scored slightly higher than 2.50.

The internal structure of the BHPAQ was evaluated by means of CFA. However, as can be seen in Figure 1, items 6 and 13 had a factor loading below 0.40. Therefore, we compared the

original structure of the BHPAQ with 16 items and 3 domains versus the structure with 14 items and 3 domains (excluding items 6 and 13), as given in Table 2. The internal structure with 14 items presented the best fit indices and lowest values of AIC and BIC. In addition, Figure 1 also presents the factor loadings of the BHPAQ with 14 items and 3 domains, and all items have a factorial load >0.40. The Brazilian version of the BHPAQ with 14 items is available on the website: <https://questionariosbrasil.blogspot.com>

Regarding criterion validity, we observed a satisfactory correlation between the occupational domain with 8 and 7 items (rho=0.985, p<0.001) and between the leisure domain with 4 and 3 items (rho=0.907, p<0.001). As the sport domain did not change in the number of items, the correlation was not performed.

Table 1. Personal characteristics of study participants (n=241).

	Mean (standard deviation) or number (%)
Age (years)	27.73 (9.58)
Gender (female)	130 (53.9)
Marital status	
Single	184 (76.3)
Married	51 (21.2)
Divorced	2 (0.8)
Widower	4 (1.7)
Schooling	
Primary	13 (5.4)
Secondary	150 (62.2)
Superior	78 (32.4)
Mass (kg)	70.57 (16.32)
Height (m)	1.68 (0.10)
Body mass index (kg/m ²)	25.11 (6.64)
BHPAQ (score, 1-5)	
Occupational domain (8 items)	2.71 (0.66)
Occupational domain (7 items)	2.66 (0.71)
Sport domain (4 items)	2.52 (0.81)
Leisure domain (4 items)	2.58 (0.68)
Leisure domain (3 items)	2.51 (0.77)

BHPAQ: Baecke Habitual Physical Activity Questionnaire.

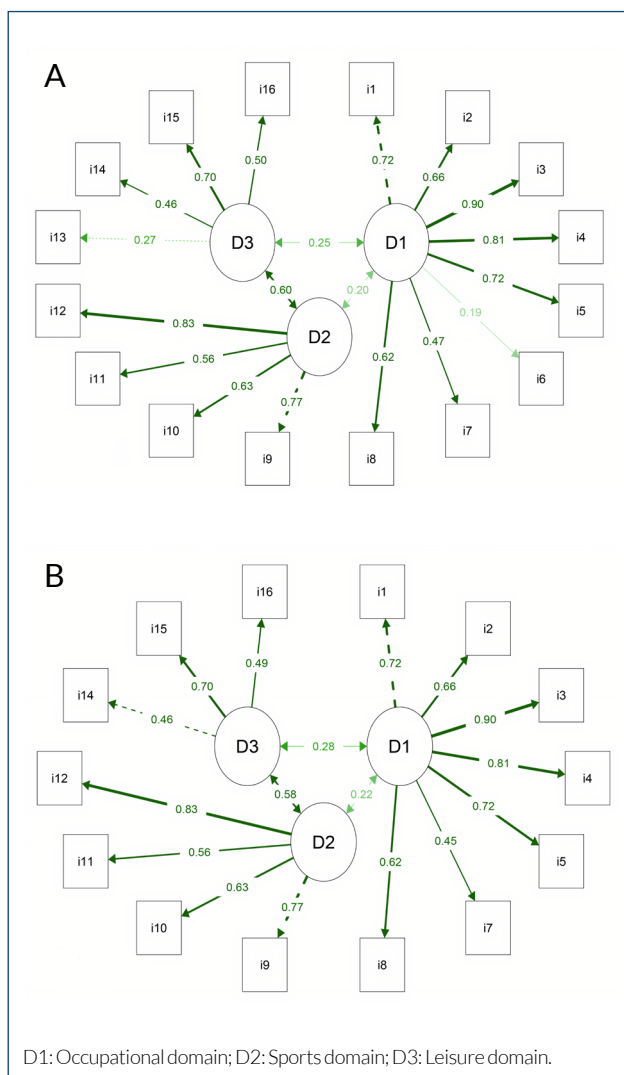


Figure 1. Path diagram of the Baecke Habitual Physical Activity Questionnaire (BHPAQ) with 16 items (A) and 14 items (B).

Table 2. Comparison between the internal structures of the Baecke Habitual Physical Activity Questionnaire (BHPAQ).

Structure	χ^2	DF	χ^2/DF	CFI	TLI	RMSEA (90%CI)	SRMR	AIC	BIC
16 items	230.498	101	2.28	0.935	0.923	0.073 (0.061-0.086)	0.077	10576.960	10698.928
14 items	131.437	74	1.77	0.971	0.964	0.057 (0.041-0.073)	0.061	9192.560	9300.589

DF: degrees of freedom; CFI: comparative fit index; TLI: Tucker-Lewis index; RMSEA: root mean square error of approximation; CI: confidence interval; SRMR: standardized root mean square residual; AIC: Akaike information criterion; BIC: Bayesian information criterion.

DISCUSSION

This study identifies the most appropriate structure for the Brazilian version of the BHPAQ with 3 domains, according to the original article, however, with 14 items: 7 items in the physical activity domain in occupation (items 1–5, 7, 8), 4 in the physical activity domain in sports (items 9–12), and 3 items in the physical activity domain in leisure without sport (items 14–16). Thus, items 6 (occupation domain) and 13 (leisure domain) were excluded. Item 6 refers to how physically tired the individual becomes after work, and item 13 refers to watching television during leisure time.

To the best of our knowledge, only two studies in the literature have verified the internal structure of the BHPAQ. The original version of the questionnaire was carried out by Baecke et al.¹ and used PCA to identify the number of retained factors, finding a structure with 3 dimensions and 16 items. Almeida and Ribeiro³ evaluated the structure of two of the three domains of the BHPAQ, excluding the occupation domain for methodological reasons. A valid internal structure with two dimensions and eight items was found.

Both studies above did not use the most appropriate analysis method to verify the internal structure of the BHPAQ¹¹. According to Tabachnick and Fidell¹⁶, PCA has less adequacy when compared to factor analysis because it considers all variance and is, therefore, contaminated by the variability of error, so it is not recommended to evaluate the internal structure of a questionnaire.

After analysis of the BHPAQ, in this study, items 6 (occupation domain) and 13 (leisure domain) were excluded following the suggestion of the literature regarding items with non-significant factor loading, in this case, <0.40. The low factor load may be due to the following aspects: item 6 asks the respondent to describe physical fatigue after work; however, it may be difficult to differentiate between physical fatigue and mental fatigue. The individual may be mentally tired, but this does not represent their usual physical activity. Item 13 is related to watching television at leisure; however, due to technological changes and the increasing use of

modern devices such as mobile phones, it may be that other sedentary habits during leisure time are more important than watching television today.

Our study was carried out in Brazilians and the conclusions must be restricted to this population. However, considering that the BHPAQ was created in 1982¹, it is important that the original version of the questionnaire should be revised in all languages, as society has undergone consistent changes in recent years and physical activity has been considerably affected by these changes. We suggest that consistent factor analyses be considered to suit the ordinal characteristics of the possible responses to the BHPAQ.

CONCLUSION

The structure of the Brazilian version of the BHPAQ with 3 domains and 14 items is the most appropriate based on factor analysis and should be used to investigate physical activity related to occupation, sport, and leisure.

AUTHORS' CONTRIBUTIONS

DSR: Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft. **JCS:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft. **LFSa:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft. **GNS:** Conceptualization, Data curation, Formal Analysis, Methodology, Writing – original draft. **AVDF:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing. **AF:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing. **RRJT:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing. **ASR:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing. **CAFPG:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing. **DBD:** Conceptualization, Formal Analysis, Methodology, Writing – review & editing.

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