Validity of the Brazilian version of the *Godin-Shephard Leisure-Time Physical Activity Questionnaire*

Validade da versão brasileira do *Godin-Shephard Leisure-Time Physical Activity Questionnaire*

Validez de la versión brasileña del *Godin-Shephard Leisure-Time Physical Activity Questionnaire*

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Abstract

This study provides evidence of construct validity for the Brazilian version of the Godin-Shephard Leisure-Time Physical Activity Questionnaire *(GSLTPAQ), a 1-item instrument used among 236 participants referred for cardiopulmonary exercise testing. The* Baecke Habitual Physical Activity Questionnaire *(Baecke-HPA) was used to evaluate convergent and divergent validity. The self-reported measure of walking (QCAF) evaluated the convergent validity. Cardiorespiratory fitness assessed convergent validity by the* Veterans Specific Activity Questionnaire *(VSAQ), peak measured (VO_{2peak}) and maximum predicted (VO_{2pred}) oxygen uptake. Partial adjusted correlation coefficients between the GSLTPAQ, Baecke-HPA, QCAF, VO_{2pred} and VSAQ provided evidence for convergent validity; while divergent validity was supported by the absence of correlations between the GSLTPAQ and the Occupational Physical Activity domain (Baecke-HPA). The GSLTPAQ presents level 3 of evidence of construct validity and may be useful to assess leisure-time physical activity among patients with cardiovascular disease and healthy individuals.*

Cardiovascular Diseases; Motor Activity; Validation Studies; Questionnaires; Psychometry

Resumo

Este estudo fornece evidências de validade de construto da versão brasileira do Godin-Shephard Leisure-Time Physical Activity Questionnaire *(GSLTPAQ), instrumento de 1 item usado entre 236 participantes encaminhados ao teste de esforço cardiopulmonar. O* Questionário de Atividade Física Habitual de Baecke *(AFH-Baecke) avaliou a validade convergente e divergente. A medida de autorrelato de caminhada (QCAF) acessou a validade convergente. A aptidão cardiorrespiratória avaliou a validade convergente por meio do* Veterans Specific Activity Questionnaire *(VSAQ), consumo pico (VO_{2pico}) e máximo (VO_{2pred}) de oxigênio. Coeficientes de correlação parciais ajustados entre o GSLTPAQ, Baecke-HPA, QCAF, VO_{2pred} e VSAQ forneceram evidências de validade convergente; enquanto a validade divergente foi apoiada pela ausência de correlações entre a GSLTPAQ e o domínio Atividade Física Ocupacional (AFH-Baecke). O GSLTPAQ apresenta nível 3 de evidência de validade de construto e parece útil para avaliar a atividade física no tempo de lazer entre pacientes com doença cardiovascular e indivíduos saudáveis.*

Doenças Cardiovasculares; Atividade Motora; Estudos de Validação; Questionários; Psicometria

Background

It is widely recognized that regular participation in physical activity and exercise results in several positive health-related outcomes, from both a preventive and a rehabilitative perspective [1]. physical activity is defined as "*any bodily movement produced by skeletal muscles that results in energy expenditure*" [2] (p. 126). physical activity can further be categorized in a range of ways and the simplest classification identifies the physical activity that occurs during the different moments of a regular day: sleeping, at work, and at leisure [2].

Nowadays it is acknowledged that there is less physical activity in the working environment in industrialized countries, due to an increase in technology and the automation of tasks, leading to people taking up more sedentary jobs [3]. For this reason, occupational physical activity has decreased over time [4] and leisure-time physical activity has received widespread attention, making it a more representative measure of physical activity practiced by the economically active population [5]. Moreover, sedentary individuals in their leisure-time also present the lowest levels of overall physical activity in their daily life, suggesting that leisure-time physical activity is one of the most important dimensions of overall physical activity [6]. Thus, an accurate assessment of the leisure-time physical activity dimension of physical activity is relevant.

In this context, the *Godin-Shephard Leisure-Time Physical Activity Questionnaire* (GSLTPAQ) is considered a valid and reliable instrument that is used worldwide as a measure of leisure-time physical activity. Among the questionnaires for the measurement of physical activity, this specific one was created in Canada in 1985 to fill a perceived gap in the literature, given the absence of a concise and simple instrument that is valid, reliable and capable of measuring physical activity in leisure time. The instrument's questions were developed after careful evaluation of items used in other questionnaires that had demonstrated, using univariate analyses, that they could successfully discriminate between very active individuals and those who were sedentary [7]. This unidimensional 1-item questionnaire was developed and validated within a study with 306 Canadian healthy adults (163 men and 143 women) aged from 18 to 65 years [7]. Values of body fat ($r = 0.13$; $p < 0.01$; Pearson correlation coefficient) and predicted maximal oxygen consumption ($r = 0.24$; $p < 0.001$; Pearson correlation coefficient), expressed in percentiles appropriate for age and sex were used as criteria for the validation of the questionnaire. Since its validation, the questionnaire has been used among different populations in several countries [8,9,10,11,12,13,14,15] and evaluated by different studies [16,17,18] and reviews [19,20].

The GSLTPAQ score is expressed in units and can be computed in two steps. First, weekly frequencies of strenuous, moderate, and mild activities are multiplied by nine, five, and three, respectively; these three latter values correspond to MET value categories for the activities listed. The total weekly leisure activity score is then computed in arbitrary units by summing the products of the separate components, as shown in the following formula [7]:

Weekly leisure-time activity score = (9 x Strenuous) + (5 x Moderate) + (3 x Mild)

Recently [18], the author of the GSLTPAQ reviewing the instrument, proposed a categorization of its total score as "active", "moderately active" and "insufficiently active", in regard to the well-documented "dose response" relationship between physical activity and health.

Although the GSLTPAQ has demonstrated its relevance to science and to the study of physical activity [17,19,20], there was no version available to the Brazilian scientific community. Thus, a previous study was conducted to proceed to the cross-cultural adaptation to Brazil of GSLTPAQ [21]. The Brazilian GSLTPAQ demonstrated evidence of content validity and reliability regarding stability (ICC = 0.84) [21]. However, reliability is essential, but not sufficient for validity. Therefore, this study aims to present the validation process of the Brazilian version of GSLTPAQ regarding convergent and divergent construct validity.

Methods

Settings and sample

This study was carried out in Southeastern Brazil. Data were gathered over a 5-month period in 2011, consecutively until the end of the established period for data collection. Participants were then allocated into three groups: healthy volunteers (n = 100), hypertensive (n = 100) and coronary heart disease (CHD) outpatients (n = 36).

Participants were recruited on the day of their regular appointment for the cardiopulmonary exercise test, conducted by a cardiologist and accompanied by a nurse or a physiotherapist to carry out the gas analysis. Participants using drug altering heart rate were not included in this sample. The investigation conforms to the principles outlined in the *Declaration of Helsinki*.

Sample clinical and sociodemographic data

Sociodemographic data were obtained through interview-administered instruments that were tested beforehand [22]. Clinical data were gathered through analysis of medical records and interview. Clinical associated conditions were assessed. Direct measures were made to obtain anthropometric data.

Questionnaires

All the questionnaires were administered by means of interview, in order to respect different levels of schooling among participants.

- ***Godin-Shephard Leisure-Time Physical Activity Questionnaire***

The 1-item questionnaire aimed at evaluating the weekly frequency and intensity of the leisure-time physical activity session of "at least 15 minutes" was used. A suggestion was made to only consider the frequency of moderate and strenuous activity for computing the total score of the GSLTPAQ, since most of the activities listed as "mild" in the original instrument did not provide substantial health benefits, except for light walking and golf [18]. However, given that walking plays an important role in the range of the Brazilian physical activity [23], it was decided to keep the total score of GSLTPAQ. The results are therefore presented according to both scores – with and without mild activities.

In the present study, the GSLTPAQ score was presented as a dichotomized variable, because 60.6% of the participants reported no participation in leisure-time physical activity when including mild activities, but 83.9% of them were considered inactive when excluding mild activities based on the GSLTPAQ score. This fact does not affect the quality of the data, since the continuous GSLTPAQ score presented the same performance. In order to respect data distribution, the dichotomization was carried out by attributing a score of zero (0) to participants who were classified as "moderately active" and "insufficiently active". On the other hand, those who were categorized as "active" received a score of one (1). Although the questionnaire was previously constructed to be self-administered, in our study it was administered by means of interview, with the agreement of the author of the original instrument.

- **Self-report measure of walking behavior**

This measure was derived from the *Psychosocial Determinants of Physical Activity among Coronary Heart Disease Patients Questionnaire* [22]. In this question, respondents were asked "In the last month, how many times have you walked at least 30 minutes?" This was assessed by means of a 4-point scale ranging from less than once a week (1), to up to 3 or more times per week (4). The questionnaire was originally developed in interview form and its content was validated among coronary heart disease outpatients in a previous study [22].

- ***Habitual physical activity – the Baecke Questionnaire***

The Brazilian version of the *Baecke Questionnaire of Habitual Physical Activity* (Baecke-HPA) was used [24]. The Baecke-HPA is easy to understand and apply, and ensures qualitative and quantitative indices through 16 questions encompassing three dimensions of physical activity in the past 12 months: (1) occupational physical activity (8 questions); (2) physical exercises in leisure (4 questions); and (3) leisure and locomotion activities (4 questions). The items are scored on a five-point Likert scale, ranging from never to always, generating scores from 1 to 5, with higher scores indicating higher levels of physical activity. The total score (HPA-score) is a summation of the three dimensional scores and the range varies from 3 (inactive) to 15 (very active). This questionnaire has been used among healthy [24,25] and non-healthy [26] populations and is considered a valid and reliable tool for measuring physical activity. As for the validity, the questionnaire has been tested with evidences of valid measures of physical activity [24,26]. Although in the original study this questionnaire was self-administered, in our study it was administered by means of interview.

- ***Veterans Specific Activity Questionnaire***

The Brazilian version of the *Veterans Specific Activity Questionnaire* (VSAQ) was applied prior to exercise testing [27]. The VSAQ makes it possible to determine different intensities of daily activities that are limited by cardiovascular disease symptoms. It consists of a list of activities presented in progressive order according to METs, ranging from 1 to 13. The MET values associated with each activity were derived from the Brazilian version of the *Compendium of Physical Activities*. The VSAQ score was age-adjusted by using a nomogram according to the equation: METs = 4.7

+ 0.97 (VSAQ) - 0.06 (age), as recommended [28]. In the present study, the original unit of the questionnaire (METs) was converted to $ml.kg^{-1}.min^{-1}$, by multiplying the VSAQ score by 3.5, in order to standardize data, according to the other measures of cardiorespiratory fitness used in the study, that consider the same unit. The VSAQ has demonstrated acceptable levels of reliability (kappa = 0.86; $p < 0.001$) and was strongly correlated with measured-peak VO_2 ($r = 0.63$; $p < 0.001$) [27]. Although in the original study this questionnaire was self-administered, in our study it was administered by interview, as in the validation of the Brazilian version [27].

- **Measures of cardiorespiratory fitness**

Three methods were assessed: the Brazilian version of the VSAQ, the maximum direct oxygen uptake and the maximum predicted oxygen uptake. Since physical activity consists of a behavioral attribute, which comprises the energy expenditure from volitional and non-volitional activities, it most commonly relied on self-reports. But while questionnaires can be useful tools to report outcomes, they may lack the validity necessary to predict health results in individuals. Therefore, maximum oxygen uptake predicted (VO_{2pred}) is considered adequate as an indirect criterion for questions regarding higher intensities. Highest correlations have been demonstrated in questions about vigorous, rather than light and moderate activities [6].

- **Cardiopulmonary exercise testing in treadmill with oxygen uptake**

Exercise testing with oxygen uptake analysis was performed on a treadmill using ramp protocol, as recommended [29]. The exercise was terminated for generalized fatigue, symptom or sign limits, or electrocardiographic changes for all participants [30].

Oxygen uptake was determined and averaged every 10 seconds using the MedGraphics VO2000 portable metabolic measurement system and the software Aerograph (Medical Graphics Corp., St. Paul, U.S.A.). Gas exchange was obtained with the individual wearing a nose clip and a facial mask, breathing room air through a one-way directional valve system. Peak oxygen uptake (VO_{2peak}) was defined as the maximum attained oxygen consumption at the end of exercise testing. Calibration of the system was performed according to the recommendations of the manufacturer.

In addition to the direct measure of oxygen consumption, the maximum oxygen uptake predicted (VO_{2pred}) was estimated by means of the software used during the test, which is based on the equation proposed by the American College of Sports Medicine – ACSM (where VO_{2max} = (Heart Rate x Stroke Volume) x (arteriovenous oxygen difference)) and recommended by the American Heart Association (AHA), considering it as the highest rate at which oxygen can be taken up and used by the body during severe exercise [31].

The VO_{2pred} outcome was selected once it is already known that patients with cardiovascular diseases are not able to reach VO2max, which corresponds to the real maximum oxygen consumption during exercise. Participants referred to the test were advised by their doctors to stop the use of beta-blockers before the test. Participants who did not follow their doctor's recommendation were re-scheduled for another day or not included.

Measurement properties

Validity is indicated as the degree of authenticity and refers to how the test measures what it is intended to measure and can also be defined as the extent to which an instrument measures the true exposure of interest. There are three main types of validity: content, construct and criterion [32].

In the present study, construct validity was assessed. It is one of the most important characteristics of a measuring instrument, since it corresponds to the assessment of the degree to which an instrument measures the construct that it was designated to measure, and involves hypotheses testing. It can be assessed by correlational evidence (convergent validity), the absence of correlational evidence (divergent validity), discriminant evidence (discriminant validity) and factor analysis [33]. Convergent validity is achieved when correlational evidence between two or more measures that measure the same construct is observed. Divergent validity is obtained when there is a lack of correlation between variables measuring theoretically different constructs and that, therefore, should not present correlational evidence [32,33].

Statistics

Convergent validity of the GSLTPAQ was tested with self-reported measure of behavior, Baecke scores (physical exercise in leisure and leisure and locomotion activities), VSAQ score and measures of oxygen uptake; and divergent validity was tested using the Occupational Physical Activity (OPA) Domain (Baecke-HPA). All the correlation analyses were conducted using adjusted

partial coefficients with 95% confidence interval (95%CI) controlling for sex, age, education, body mass index (BMI) and disease groups (CHD or hypertension). The use of adjusted partial correlations was decided considering that once the size measure effect (i.e., the correlation coefficient) is adjusted for other variables, the goal is to prevent detecting spurious correlations. Therefore, correlation coefficients of a magnitude between 0.30 and 0.50 were considered as acceptable values [34]. The presence of univariate or multivariate outliers was verified and none were identified.

With the purpose of respecting the analyses of data distribution and although the continuous GSLTPAQ score presented the same performance, the analyses of dichotomized GSLTPAQ scores were presented. The score was then dichotomized into two categories: some activity (score > 0) and inactivity (score = 0) in individuals.

The Statistical Analysis System for Windows program, version 9.2 (SAS Inst., Cary, U.S.A.) was used for all statistical analyses.

Hypotheses

- **Convergent construct validity**

Significant positive correlation was expected between the GSLTPAQ score:
1) And the domain Physical Exercise in Leisure (PEL) of the Baecke-HPA. This domain investigates the practice of regular physical activity exclusively during leisure-time, considering different levels of intensity, according to energy expenditure (mild, moderate or vigorous) and also provides duration and frequency of leisure-time physical activity (hours per week and months per year) for each activity reported;
2) And the domain Leisure and Locomotion Activities (LLA) of the Baecke-HPA. This domain refers to such activities of leisure as watching television, walking, cycling and minutes spent daily with activities of locomotion (walking or use a bicycle to go to work, school or shopping);
3) Including mild activities and the self-reported measure of walking behavior, since walking is considered a mild physical activity;
4) Including mild activities and the measures of cardiorespiratory fitness;
5) Excluding mild activities and the measures of cardiorespiratory fitness.

- **Divergent construct validity**

No correlation was expected between the GSLTPAQ score and the domain OPA of the Brazilian version of the Baecke-HPA, since this domain contains specific questions regarding work activities.

Ethical aspects

Participants were invited to engage in the research and their agreement was formalized by signing a consent term. Ethical approval was granted from the Faculty of Medical Sciences ethics committee of the Campinas State University (document n. 1,062/2009). All participants provided informed voluntary consent.

Results

Sociodemographic and clinical characterization

The sample was composed mostly of females, with the exception of the CHD group. Ages ranged from 19 to 77 years, with a mean of 52.8 (11.1) years. Education ranged from 0 to 16 years, with a low mean among the total sample and groups. Family monthly income ranged from US$ 109.30 to US$ 4,371.60 and mean income was US$ 911.70. The majority of the sample was white, living with a companion and professionally active, except for the CHD group, and was composed mostly of housewives. The number of symptoms ranged from 0 to 7, with similar means for the total sample, hypertensive individuals and the CHD group (Table 1). Symptoms and associated clinical conditions were not evaluated among healthy volunteers. Angina was the most frequently reported symptom over the last month, followed by fatigue and palpitation, in both groups. Edema was referred to by 50% of people from the CHD group and 46% of hypertensive patients. Fainting was a complaint of 49% of hypertensive and 36.1% of CHD patients; and dyspnea was perceived in 44% of hypertensive and in 36.1% of CHD patients (Table 1).

The number of associated clinical conditions ranged from 0 to 5. Hypertension was present in CHD patients as a major condition (63.9%); followed by dyslipidemia (66.7% for CHD, 32% for hypertensive individuals); and diabetes (50% for CHD, 27% for hypertensive individuals). Among the CHD patients, 67.7% were diagnosed with myocardial infarction and 33.3% with angina. The analysis of the BMI revealed predominance of obese and overweight participants, with BMI ranging from 16.9 to 52.6kg/m^2, with a higher mean for hypertensive patients and similar means for healthy volunteers and CHD patients (Table 1).

Table 1

Sociodemographic and clinical characterization of the total sample (N = 236) and groups: hypertensive patients (n = 100), patients with coronary heart disease (CHD, n = 36) and healthy volunteers (n = 100). Campinas, São Paulo State, Brazil, 2011.

Variables	Total sample (N = 236)			Healthy (n = 100)			Hypertensive (n = 100)			CHD (n = 36)		
	n (%)	Mean (SD)	Median (IQR)	n (%)	Mean (SD)	Median (IQR)	n (%)	Mean (SD)	Median (IQR)	n (%)	Mean (SD)	Median (IQR)
Sociodemographic												
Age (years)		52.8 (11.1)	53.0 (14.7)		49.6 (11.5)	51.0 (14.7)		54.3 (10.7)	54.0 (14.7)		57.3 (8.7)	56.5 (11.0)
Education (years)		5.7 (3.2)	5.0 (4.0)		6.3 (3.3)	6.0 (4.0)		5.0 (3.0)	4.0 (3.0)		5.8 (3.4)	4.0 (4.0)
Family income (US$)		911.7 (620.7)	765.0 (588.2)		1,039. 2 (730.1)	819.7 (726.5)		787.2 (410.9)	735.0 (470.6)		903.3 (714.7)	683.1 (488.2)
Sex – Female	138 (58.5)			52 (52.0)			73 (73.0)			13 (36.1)		
Color – White	194 (82.2)			85 (85.0)			79 (79.0)			30 (83.3)		
Marital status – with companion	172 (72.8)			70 (70.0)			72 (72.0)			30 (83.3)		
Professional status												
Active	122 (51.7)			59 (59.0)			49 (49.0)			14 (38.9)		
Non-active/Housewife	114 (48.3)			41 (41.0)			51 (51.0)			22 (61.1)		
Clinical												
Symptoms		3.7 (2.2)	4.0 (4.0)		-	-		3.7 (2.2)	4.0 (4.0)		3.6 (2.2)	3.0 (4.0)
Associated clinical conditions		2.2 (1.0)	2.0 (2.0)		-	-		2.1 (1.0)	2.0 (2.0)		2.6 (1.1)	3.0 (1.0)
Body mass index		29.6 (5.6)	29.1 (6.8)		28.3 (5.0)	28.2 (6.9)		31.2 (6.0)	30.2 (8.3)		28.7 (4.9)	27.7 (7.5)

IQR: interquartile range; SD: standard deviation.

Descriptive analysis of physical activity and cardiorespiratory fitness measures

Regarding the GSLTPAQ score assessment [in order to respect data distribution, the presented analyses refer to the dichotomized GSLTPAQ score (some activity: score > 0; inactivity: score = 0). The continuous GSLTPAQ score presented the same performance that the dichotomized one], the majority of participants reported low scores of leisure-time physical activity – 189 participants were considered insufficiently active according to the GSLTPAQ scores. Considering the GSLTPAQ score with mild activities, 143 people were inactive, with a score of 0 (zero), which represents most of the total sample (60.6%). When observing the GSLTPAQ score excluding mild activities, 198 individuals presented a score of 0 (zero), which represents an even larger share of the sample (83.9%). Concerning the other measures of physical activity, the mean scores of Baecke-HPA and behavior are lower than half of the maximum possible score – the maximum for the Baecke questionnaire is 15 and the observed mean was 7.2, and the maximum score for behavior is 4, with a mean of 1.7. The measures of cardiorespiratory fitness also exhibited low levels. The VSAQ presented a mean of 22.0 (9.8) $ml.kg^{-1}.min^{-1}$, the VO_{2peak} mean was 19.7 (5.7) $ml.kg^{-1}.min^{-1}$ and the VO_{2pred} mean was 29.1 (11.3) $ml.kg^{-1}.min^{-1}$. Among this sample, five patients of the 236 did not present gas analysis due to technical difficulties during data collection (Table 2).

Table 2

Descriptive analyses of physical activity and cardiorespiratory fitness of the total sample (N = 231). Campinas, São Paulo State, Brazil, 2011.

	Range	n (%)	Mean (SD)	Median (IQR)
Physical activity measures				
GSLTPAQ (higher score means higher leisure-time physical activity)				
Mild activities	0.0-21.0		1.0 (1.8)	0.0 (2.0)
Moderate activities	0.0-35.0		0.4 (1.2)	0.0 (0.0)
Strenuous activities	0.0-45.0		0.1 (0.5)	0.0 (0.0)
Continuous score				
With mild activities	0.0-60.0		5.8 (9.3)	0.0 (9.0)
Excluding mild activities	0.0-45.0		2.8 (7.6)	0.0 (0.0)
Categorized score				
Insufficiently active (< 14 units)		189 (80.1)		
Moderately active (≥ 14 and < 23 units)		33 (14.0)		
Active (≥ 24 units)		14 (5.9)		
Baecke-HPA				
Occupational physical activity (1-5; higher score = higher occupational physical activity)	1.1-4.7		2.6 (0.9)	2.6 (1.9)
Physical exercise in leisure (1-5; higher score = higher physical exercise in leisure)	1.0-4.2		2.1 (0.6)	2.0 (0.7)
Leisure and locomotion activities (1-5; higher score = higher leisure and locomotion physical activity)	1.0-4.5		2.5 (0.6)	2.5 (1.0)
Total score (3-15; higher score = higher total habitual physical activity)	3.9-12.0		7.2 (1.5)	7.2 (2.0)
Self-report behavior measure (1-4; higher score = higher physical activity)				
Score	1-4		1.7 (1.2)	1.0 (1.0)
Less than once a week (1)		173 (73.3)		
Once a week (2)		9 (3.8)		
Twice a week (3)		12 (5.1)		
3 or more times/week (4)		42 (17.8)		
Cardiorespiratory fitness measures				
Direct				
VO_{2peak} ($ml.kg^{-1}.min^{-1}$)	8.2-42.4		19.7 (5.7)	19.2 (6.9)
Indirect				
VSAQ * ($ml.kg^{-1}.min^{-1}$)	5.2-50.7		22.0 (9.8)	20.3 (15.0)
VO_{2pred} ($ml.kg^{-1}.min^{-1}$)	3.5-59.4		29.1 (11.3)	27.2 (17.5)

Baecke-HPA: *Baecke Habitual Physical Activity*; GSLTPAQ: *Godin-Shephard Leisure-Time Physical Activity Questionnaire*; IQR: interquartile range; SD: standard deviation; VSAQ: *Veterans Specific Activity Questionnaire*.

* The original unit of the questionnaire (METs) was converted to $ml.kg^{-1}.min^{-1}$, by multiplying the VSAQ score by 3.5, in order to standardize data, according to the other measures of cardiorespiratory fitness.

Convergent validity of GSLTPAQ

The analyses revealed significant positive correlations between the GSLTPAQ total score including mild activities and the sub scores of the Baecke-HPA: correlation with PEL score ($r = 0.62$; $p < 0.0001$); with the total score of HPA ($r = 0.36$; $p < 0.0001$) and with the LLA score ($r = 0.16$; $p = 0.01$). The GSLTPAQ total score including mild activities was also significantly correlated with the self-reported measure of walking behavior ($r = 0.62$; $p < 0.0001$). The GSLTPAQ total score excluding mild activities was significantly associated with the PEL score of the Baecke-HPA ($r = 0.47$; $p < 0.0001$), the LLA score ($r = 0.17$; $p = 0.01$), and the total HPA score ($r = 0.25$; $p = 0.0001$) of the Baecke-HPA. The GSLTPAQ excluding mild activity score was also significantly correlated with the self-report measure of walking behavior ($r = 0.19$; $p = 0.004$) (Table 3).

Significant positive correlations were observed between the GSLTPAQ score including

Table 3

Partial correlation with 95% confidence interval (95%CI) between the GSLTPAQ, Baecke-HPA and the self-report measure of behavior (walking) for the total sample (N = 236). Campinas, São Paulo State, Brazil, 2011.

Physical activity measures	GSLTPAQ	
	Score including mild activities r* [95%CI]	Score excluding mild activities r* [95%CI]
Baecke-HPA		
Occupational physical activity	0.02 [-0.11, 0.15]	0.08 [-0.05, 0.21]
Physical exercise in leisure	0.62 ** [0.53, 0.69]	0.47 ** [0.36, 0.56]
Leisure and locomotion activities	0.16 *** [0.03, 0.28]	0.17 *** [0.04, 0.29]
Total score	0.36 ** [0.24, 0.47]	0.25 ** [0.13, 0.37]
Self-report measure of walking behavior	0.62 ** [0.53, 0.69]	0.19 # [0.06, 0.31]

Baecke-HPA: *Baecke Habitual Physical Activity*; GSLTPAQ: *Godin-Shephard Leisure-Time Physical Activity Questionnaire*.

* Adjusted correlation controlling for sex, age, body mass index, education levels and groups (coronary heart disease and hypertension);

** $p < 0.001$;

*** $p < 0.05$.

# $p < 0.01$.

mild activities and VO_{2pred} ($r = 0.15$; $p = 0.03$) and VSAQ ($r = 0.23$; $p = 0.0006$), and between the GSLTPAQ score excluding the mild activities and the VO_{2pred} ($r = 0.19$; $p = 0.004$). Significant correlation was also observed between the GSLTPAQ score excluding mild activities and the VSAQ ($r = 0.34$; $p < 0.0001$). No significant correlation was observed between any of the GSLTPAQ total scores and the direct measure of oxygen uptake (VO_{2peak}) (Table 4).

Divergent validity of GSLTPAQ

No significant correlation between the GSLTPAQ score and the occupational score of the Baecke-HPA was observed (Table 3). The correlation between the GSLTPAQ score including ($r = 0.02$; $p = 0.73$) and excluding ($r = 0.08$; $p = 0.24$) mild activities was not significant.

Discussion

The purpose of this study was to evaluate the measurable properties of the Brazilian version of the GSLTPAQ regarding the aspects of convergent and divergent construct validity.

The unidimensional 1-item questionnaire has presented acceptable levels of convergent validity in order to measure leisure-time physical activity, since significant correlations with both the Baecke-HPA and the self-report measure of behavior were observed. There was a significant correlation between the GSLTPAQ and the PEL sub score, which is a specific domain, related to leisure-time physical activity. In fact, this relation was confirmed when mild activities were both included and excluded. It is also relevant to highlight the divergent validity aspect observed, since no significant correlation was observed between the GSLTPAQ score and the OPA score, from the Baecke-HPA. This finding, in conjunction with the large correlation observed between the GSLTPAQ scores and the specific domain for leisure exercise of the Baecke-HPA, reinforces the capacity of the questionnaire to correctly measure the specific domain of leisure-time physical activity.

Although the correlation coefficient values found were not of a large magnitude, it is well recognized in the international literature that the main finding in studies like this one is to find a significant correlation between objective measures and questionnaires, given the major subjective aspects that permeate the use of psychometric measures [19,34,35], such as the GSLTPAQ. It is therefore safe to report that in our study, the convergent and divergent validity hypotheses were supported by the findings, despite the size of the correlations, since there were significant correlations found between the GSLTPAQ and the direct gold-standard measures, such as peak oxygen.

Regarding the other measure of physical activity used to evaluate convergent validity, the GSLTPAQ score with mild activities presented a large significant coefficient with the self-report measure of walking behavior, but not when these activities were excluded. This was foreseen, since

Table 4

Partial correlation and 95% confidence interval (95%CI) between the GSLTPAQ and VO2peak, VSAQ and VO2pred for the total sample (N = 231). Campinas, São Paulo State, Brazil, 2011.

Cardiorespiratory fitness	GSLTPAQ	
	Score including mild activities r * [95%CI]	Score excluding mild activities r * [95%CI]
Direct measure		
VO_{2peak}	0.09 [-0.04, 0.22]	0.03 [-0.10, 0.16]
Indirect measures		
VO_{2pred}	0.15 ** [0.02, 0.27]	0.19 *** [0.06, 0.31]
VSAQ	0.23 # [0.10, 0.35]	0.34 # [0.22, 0.45]

GSLTPAQ: *Godin-Shephard Leisure-Time Physical Activity Questionnaire*; VSAQ: *Veterans Specific Activity Questionnaire*.

* Adjusted correlation controlling for sex, age, body mass index, education and groups (coronary heart disease and hypertension);

** $p < 0.05$;

*** $p < 0.01$;

# $p < 0.001$.

the behavior questionnaire is focused on walking behavior only, which is considered a mild physical activity.

Relevant reviews [20,34] highlight that in general the sample population selected for a validation study should reflect the population to whom the questionnaire will be applied. In this subject, physical activity questionnaires are frequently planned to measure population-level associations with chronic diseases, such as CHD, hypertension or diabetes; and are commonly tested only among these specific populations. The present study has an advantage in this matter hence GSLTPAQ was tested among a diverse population including not only healthy individuals but also hypertensive and CHD outpatients. Therefore, this sample is representative of the population to which the questionnaire can be applied.

Additionally, participants with BMI > 30kg/m² were excluded in previous physical activity-based studies, since these individuals may be less active [36]. Nevertheless, in this study, it was chosen to include obese individuals, since they represent an important population [37], even though they may report physical activity differently to the actual pattern [38].

With regard to recommendations for engaging physical activity practice and considering the lack of international consensus, the most widely accepted guidelines are those sanctioned by the ACSM and the AHA. These associations propose that individuals aged between 18 and 65 should practice a minimum of 30 minutes of moderate physical activity at least 5 days a week, or 20 minutes of vigorous physical activity at least 3 days a week, or a combination of the two [39].

In contrast to this concept, physical inactivity has been defined as less than 150 minutes/week of moderate physical activity or 60 minutes/week of vigorous physical activity [25]. In our study, the majority of the sample (80.1%, n = 189) was considered insufficiently active according to the GSLTPAQ categorization. Indeed, a large portion of our sample presented a GSLTPAQ score of 0 (zero). Another Brazilian study evaluating the prevalence of leisure-time physical inactivity found that 96.7% of the sample was inactive considering this domain of physical activity [40].

The correlation of the GSLTPAQ was also analyzed considering different measures of cardiorespiratory fitness, including the gold standard measure, which is peak oxygen. Although measures of cardiorespiratory fitness are not the gold standard to evaluate physical activity behavior, and considering that no gold standard for physical activity measure has ever been determined, it is expected that more active people will develop a better level of physical fitness than those with lower levels of physical activity, or those who are inactive [16]. This justifies the use of peak oxygen as the criterion for evaluating convergent validity in this study. Thus, the correlations observed between the GSLTPAQ scores and auto-reported (VSAQ) and predicted values (VO_{2pred}) of cardiorespiratory fitness were expected and proven in this study, as evidenced by others that tested this assumption [6,41]. It is worthwhile to emphasize that the correlations observed between the

GSLTPAQ and the indirect measures of cardiorespiratory fitness were higher when the mild activities are excluded from the score, which reinforces previous findings stating that cardiorespiratory fitness measures are better correlated with strenuous activities [6,41].

However, correlations were not observed between the GSLTPAQ scores and the direct measure of cardiorespiratory fitness (VO_{2peak}). There are some possible explanations as to why leisure-time physical activity outcomes did not directly reproduce cardiorespiratory fitness: among CHD and hypertensive outpatients, the patients' condition noticeably limits the range of activities that they are able to perform, as reported elsewhere [42]. In this study, this absence of correlation may be explained first by the factor of the submaximal nature of the cardiopulmonary exercise test performed. It is not possible to assure that participants of this study reached the VO_{2max} due to their health status, thus the VO_{2peak} should be considered for the analyses, as recommended [35]. The use of VO_{2peak} to represent VO_{2max} has some limitations, since the accuracy of this estimation may be affected by the presence and extent of disease, among other factors [35]. Further studies involving cardiorespiratory fitness assessment by direct measures should consider the anaerobic threshold as a valid measure, since this parameter allows for the evaluation of aerobic performance at submaximal powers [43].

Second, the very sedentary pattern of the studied population, evidenced by the narrow variation of the GSLTPAQ scores and the concentration in the inactive category also helps to explain this finding. Other studies which tried to assess the relationship between direct measures of oxygen uptake and physical activity questionnaires were also not successful at obtaining significant correlations, as described in Japan [44] and the United States [41].

It is important to highlight that the interview-administered version of the Brazilian GSLTPAQ was tested, thus the evidence of validity relates to this mode of administration of the questionnaire. Further studies may be necessary in order to evaluate the validity of the Brazilian version of the GSLTPAQ when self-administered. Therefore, this may be a limit to the generalization of the results regarding external validity.

According to the *Qualitative Attributes and Measurement Properties of Physical Activity Questionnaires* study (the QAPAP) [19], the highest level of evidence for validity would be obtained by comparing the physical activity questionnaire with a gold standard, i.e., the instrument that measures the same construct and has perfect reliability and validity (also known as criterion validity). In this sense, the more similar the constructs that are being compared, the more evidence is provided. Therefore, comparison with objective measures of physical activity is considered the best level of evidence (1 or 2) and constructs not really measuring current physical activity (such as maximal oxygen uptake) or another questionnaire, provide a level 3 of evidence [20], as observed in the present study.

Finally, in evaluating the validity of the GSLTPAQ as a measure of general physical activity behavior, positive evidence of its validity must be considered; from the significant correlations observed with all the other measures of physical activity (questionnaires) and the predicted measures of cardiorespiratory fitness, despite the low variability in the GSLTPAQ score. Another main strength of the present study consists of its sample size being relatively large for validation studies, especially those using direct measures such as gas analyses. Nevertheless, the major strength of the study is to present evidence of two types of validity – convergent and divergent, among a large sample including a diverse population that cover cardiovascular disease outpatients, since it is not usual to evaluate them as presented in this paper, with direct measures of physical fitness such as direct VO_{2peak}.

Limitations of the study

As with other validation studies which include both direct and indirect measures of physical activity, this study is not without its limitations since pedometers were not used, although walking is the most practiced physical activity in Brazil. Their use was not possible since individuals had only one meeting with the researcher, since the setting was an outpatient clinic which they did not attend regularly. This particularity could be harmful to the data collection procedure, since the pedometers would have to be returned to the researcher. It is also worth mentioning that such devices tend to underestimate walking and overestimate jogging activity, and may also show only weak relations to maximal oxygen intake [34]. The fact that more than 80% of the sample was considered inactive according to the GSLTPAQ score was also a limitation, since the score variation was limited and recommended the use of the dichotomized score instead of the continuous score. In further studies using the Brazilian GSLTPAQ, we recommend that the responsible statistician evaluate if there is a need of dichotomizing the data, according to its variability. The heterogeneous aspect of the Brazilian population should also be considered, especially because it

is a populous country, characterized by a large number of states with different cultural aspects. In this sense, the administration of the questionnaire in different regions of the country is recommended, in addition to the southeast, among individuals with different sociodemographic and clinical characteristics.

Conclusion

The Brazilian version of the GSLTPAQ demonstrated level 3 of evidence of validity with indirect measures of physical activity and cardiorespiratory fitness, suggesting that this questionnaire is a valid tool to estimate physical activity in leisure-time in the Brazilian population with or without cardiovascular disease. Further studies are recommended in order to corroborate or add to this level of evidence.

Resumen

Este estudio proporciona evidencia de validez de constructo de la versión brasileña del Godin-Shephard Leisure-Time Physical Activity Questionnaire *(GSLTPAQ), instrumento de 1 ítem utilizado entre 236 participantes referidos a la prueba de esfuerzo cardiopulmonar. El* Cuestionario de Actividad Física Habitual de Baecke *(AFH-Baecke) se utilizó para evaluar la validez convergente y divergente. La medida de autoreporte de caminar (QCAF) evaluó la validez convergente. Aptitud cardiorrespiratoria fue evaluada por el* Veterans Specific Activity Questionnaire *(VSAQ), medida pico (VO_{2pico}) y máximo (VO_{2pred}) del consumo de oxígeno. Coeficientes de correlación parciales ajustados entre el GSLTPAQ, AFH-Baecke, QCAF, VO_{2pred} y VSAQ investigaran la validez convergente; y la validez divergente fue apoyada por ausencia de correlación entre GSLTPAQ y la Actividad Física Ocupacional (AFH-Baecke). El GSLTPAQ presenta nivel 3 de evidencia de validez de constructo y puede ser útil para valorar la actividad física en el tiempo libre entre los pacientes con enfermedad cardiovascular y individuos sanos.*

Enfermedades Cardiovasculares; Actividad Motora; Estudios de Validación; Cuestionarios; Psicometría

Contributors

T. M. São João made substantial contributions to the conception and design of the work, and to the acquisition, analysis, and interpretation of data for the work; drafting the work and revising it critically for important intellectual content; approved the final version of the paper. R. C. M. Rodrigues made substantial contributions to the conception and design of the work, and approved the final version of the paper. M. C. B. J. Gallani drafting the work and revising it critically for important intellectual content, and approved the final version of the paper. C. T. P. Miura and G. B. L. Domingues contributed to the acquisition, analysis, and interpretation of data for the work, and approved the final version of the paper. S. Amireault contributed to the analysis and interpretation of data for the work; critically revising for important intellectual content; and approved the final version of the paper. G. Godin revising the work critically for important intellectual content, and approved the final version of the paper.

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Declaration of conflicting interests

The authors declare that there is no conflict of interest.

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