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Validation of psychosocial scales for physical activity in university students

ABSTRACT

OBJECTIVE: Translate the Patient-centered Assessment and Counseling for Exercise questionnaire, adapt it cross-culturally and identify the psychometric properties of the psychosocial scales for physical activity in young university students.

METHODS: The Patient-centered Assessment and Counseling for Exercise questionnaire is made up of 39 items divided into constructs based on the social cognitive theory and the transtheoretical model. The analyzed constructs were, as follows: behavior change strategy (15 items), decision-making process (10), self-efficacy (6), support from family (4), and support from friends (4). The validation procedures were conceptual, semantic, operational, and functional equivalences, in addition to the equivalence of the items and of measurements. The conceptual, of items and semantic equivalences were performed by a specialized committee. During measurement equivalence, the instrument was applied to 717 university students. Exploratory factor analysis was used to verify the loading of each item, explained variance and internal consistency of the constructs. Reproducibility was measured by means of intraclass correlation coefficient.

RESULTS: The two translations were equivalent and back-translation was similar to the original version, with few adaptations. The layout, presentation order of the constructs and items from the original version were kept in the same form as the original instrument. The sample size was adequate and was evaluated by the Kaiser-Meyer-Olkin test, with values between 0.72 and 0.91. The correlation matrix of the items presented $r < 0.8$ ($p < 0.05$). The factor loadings of the items from all the constructs were satisfactory (> 0.40), varying between 0.43 and 0.80, which explained between 45.4% and 59.0% of the variance. Internal consistency was satisfactory ($\alpha \geq 0.70$), with support from friends being 0.70 and 0.92 for self-efficacy. Most items (74.3%) presented values above 0.70 for the reproducibility test.

CONCLUSIONS: The validation process steps were considered satisfactory and adequate for applying to the population.

DESCRIPTORS: Young Adult. Motor Activity. Questionnaires. Translations. Validation Studies.

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INTRODUCTION

Encouraging individuals to perform physical activity is an effective strategy to reduce the risk of cardiovascular diseases, diabetes, obesity, osteoporosis and some cancers.[24,25] However, despite the evidences to support such benefits, understanding how people establish and maintain these physical activities is still a challenge. Behavioral theories use empirical studies to establish models that explain physical activity practice with the objective of helping design programs for promoting physical activity.[2] Reviews surrounding the psychosocial factors related to the practice indicate that constructs from the social cognitive theory[1] (self-efficacy, social support and behavior change process) and the transtheoretical model[14] (self-efficacy and decision-making process) have often been used to explain this behavior.[7,8]

Despite the significant increase in the production of knowledge regarding psychosocial factors and physical activity interventions in Brazil,[6] studies that address these aspects in young adults are still scarce. One contributing reason for this the lack of valid instruments to measure these factors in the Brazilian population. Recently, four psychosocial scale validation studies were published, related to satisfaction,[15] self-efficacy,[16] perceived barriers[21] and social support[18] for performing physical activity. However, current instruments that measure other constructs, which make up the main theories applied to physical activity, are still insufficient, e.g., behavior change strategy, perceived facilitators and barriers for adults.

A group of researchers at the University of San Diego, California, USA, have been developing studies on behavior and style in an initiative entitled "Patient-centered Assessment and Counseling for Exercise" (PACE) since the 1990s. In addition to proposing and evaluating interventions regarding various health outcomes, in different contexts and age groups, PACE has also developed and validated psychosocial scales for health behaviors, including physical activity.[3-5,10-12] However, instruments developed and used in other countries should not be applied without first being translated, culturally adapted and validated for its new target population.

This study aimed to translate PACE into Portuguese, adapt it cross-culturally and identify the psychometric properties of the psychosocial scales for physical activity in young university students.

METHODS

An instrument validation study was conducted at the Universidade Federal Rural de Pernambuco (UFRPE) in 2011.

The original instrument of the study consisted of 39 items distributed into four constructs. Additional information regarding the instrument is available on the PACE project page.[a]

Behavior change strategy. Reflects the thoughts, activities and feelings that individuals can use to increase their physical activity,[19] made up of 15 items with a 5-point Likert scale (never; hardly ever; sometimes; frequently; many times).

Decision-making process. Consists of two factors (perceived facilitators and perceived barriers) to achieve behavior change, which are related to cognitive and motivational aspects involved in the decision-making process.[9,13] This range is made up of 10 items, five for each factor, with the response options set out in a 5-point Likert scale (not important; slightly important; more or less important; very important; extremely important).

Self-efficacy. Related to the degree of confidence or belief with which the individual is capable of performing or adopting a certain behavior when faced with various existing barriers.[9,20,23] The scale is made up of six items, with a 5-point Likert scale (absolutely not; probably not; indifferent/neutral; probably yes; absolutely yes).

Social support from family and friends. Represents support from family and friends regarding the process of changing or maintaining a behavior, which are related to incentives, supporting actions and joint practices.[10] This social support scale consists of eight items, four for support from relatives and four from friends, in a 5-point Likert scale (never; one to two days; three to four days; five to six days; every day).

Regarding implementation, the entire validation process was performed according to procedures identified in the literature[17] and consisted of six steps: (a) conceptual equivalence; (b) items equivalence; (c) semantic equivalence; (d) operational equivalence; (e) measurement equivalence; and (f) functional equivalence.

The conceptual and items equivalence aimed to verify the relevance that each item had in its respective construct, considering the country of origin and the location where it was applied. A review of the studies was performed, including their development, validation and application. Subsequently, an appraisal of the items that make up each construct in relation to local culture was performed. These steps were conducted by three researchers who have experience in instrument validation in the area of physical activity.

[a] PACE Projects. Measures: adolescent psychosocial scales [Internet]. [cited 2010 Apr 19]. Available from: http://www.paceproject.org/Measures.html

The initial translation of the original instrument (English) into Portuguese was independently performed by two native professionals, one native of the Portuguese language and the other the English language. Based on the two translations, one group of researchers summarized a Portuguese version, which was again translated into English by an English native professional, fluent in Portuguese. The denotative meanings were evaluated to verify the literal correspondence between the two versions (English-Portuguese). The connotative significance was also observed, that is, the use of a word with a meaning different from the original, which will be developed according to its context.

The Portuguese translation version was given to 20 university students so as to evaluate the extent to which each item is understood. Each question was evaluated based on the following question: "Do you understand what was asked?" with the response options set out in a 6-point Likert scale (I did not understand anything; I only understood a little; I understood more or less; I understood almost everything, but had some doubts; I understood almost everything; and I understood everything perfectly and I have no doubts). During the operational equivalence evaluation, the characteristics of the original version (layout, completion guidelines, question sequence and response options) and the questionnaire application method (form, location and duration) were assessed.

About the measurement equivalence and functional equivalence, the psychometric properties of the Portuguese translation version from the psychosocial scales for physical activity were tested. The levels of validity and reliability of the scales were estimated.

The target population was made up of both male and female students who were enrolled in the 2010 academic year at the Universidade Federal Rural de Pernambuco (n = 12,451). Students of both genres, aged from 18 to 24 years were considered eligible. Exclusion criteria were: (a) presenting any physical and/or mental disability; (b) institutional exchange students (Brazilian or foreign); and (c) students from distance learning programs, post-graduation courses or those from a different campus. A total of 7,287 students were considered eligible to participate in the study.

The sample size was determined based on the following parameters: (a) population size (n = 12,451); (b) prevalence of sufficient physical activity being performed (≥ 150 minutes/week) estimated at 50.0%; (c) sampling error of five percentage points; (d) sampling design effect of 2. Minimum sample size was estimated at 697 students. To compensate for any possible drop outs or refusals, a decision was made to multiply this total by 1.2, totaling 836 students. For validation studies that use

exploratory factor analysis, the literature recommends a 1:5 or 1:10 item-to-sample ratio for each item to be validated,[17] which would result in a sample of between 210 and 420 participants. Therefore, the required sample size is sufficient for all the validation tests.

The sample was randomly selected and proportionally distributed about the number of enrollments per class in each course and study time. Data was collected between October and November 2011, by eight previously trained students. The interviewers were instructed to conduct individual interviews with the students in an environment that was separated from the classroom. In addition to applying the psychosocial scales for physical activity, information regarding age (in years), economic class,[b] marital status (single, married or otherwise), place of residence (urban, rural), work (yes; no) and classes time (daytime; nighttime) were also collected. The average duration time of the interviews was 30 minutes.

The validity of the scales was verified by means of exploratory factor analysis, using the principal components technique with Promax rotation, and considering that the constructs present a correlation amongst themselves. To determine the number of dimensions and factors in each scale, eigenvalues greater than or equal to 1.0 were adopted as a criterion. Items with factor loadings greater than 0.40 were kept in the scale. The constructs were tested toward sampling adequacy by the Kaiser-Meyer-Olkin (KMO) index, with values above 0.70 being considering adequate.[22] Bartlett's test of sphericity was used to verify whether the correlation matrix differed from an identity matrix. Multicollinearity (high correlation, r > 80) and singularity (perfect correlation, r = 1.0) was verified in the correlation matrix among the items of each construct.

Reliability was evaluated by means of internal consistency and reproducibility. Internal consistency was determined by the Cronbach's alpha coefficient (α), considering α ≥ 0.70 as satisfactory.[22] Test-retest reproducibility was evaluated by the intraclass correlation coefficient (ICC), with values greater than or equal to 0.70 being considered satisfactory.[22] The scales were applied and reapplied with a time interval of 10 to 14 days in a subsample (n = 53), which was randomly selected from the sample. This sub-sample enabled the identification of ICC values of ≥ 0.20 (α = 5.0% and β = 80.0%) as significant. The functional equivalence was obtained based on the evaluation of previous steps.

The data was tabulated using the Epidata 3.1 software (Epidata Assoc, Odense, Denmark) and all analyses were performed using the SPSS 17.0 software.

This study was approved by the Ethics Committee from the Centro de Ciências da Saúde of the Universidade Federal de Pernambuco (Process 313/2010, CAAE 0313.0.172.000-10, 23/11/2011).

RESULTS

Considering the conceptual, items, semantic and operational equivalence, both translations were equivalent and back-translation was similar to the original version. It was decided that in Q4, Q16, Q17, Q18, Q19 direct language would be used, preferably while leaving the verbs in the first person. As to semantics, translator 1 translated the term "reward" as "*prêmio*" (prize) and translator 2, as "*recompensa*" (reward) (Q6). Another term with distinct translations was "surrounding", that translator 1 translated as "*entorno*" (surroundings) and translator 2, as "*meio ambiente*" (environment) (Q4). Both the specialists and students concluded that it would be clearer to use "*recompensa*" and "*meio ambiente*", respectively. In questions Q12 and Q36, the term "encourages" was translated as "*encorajar*" (encourage) and "*incentivar*" (give incentive), with the second option being chosen. Only one term was adapted: the word "school" was replaced with "*universidade*" (university). From the surveyed students, 91.0% reported that they perfectly understood all the items in the translated instrument, while the remaining claimed that they understood almost everything.

The layout, presentation order of the constructs and the items from the original version were kept in their original form. It was only necessary to insert a text defining the meaning of moderate and vigorous activity in the form, in addition to examples of activities that characterize these intensities so as to provide better understanding. The temporal units and the measurement unit of the answer from each construct were highlighted in bold. The original and final versions of the translated and adapted instrument can be seen in Table 1.

Regarding measurement equivalence, a total of 747 students participated in the study. Drop outs and refusals totaled 4.2% (n = 30). The final sample was made up of 717 students (55.9% women), with average age of 20.6 years (SD = 1.9). Most students were single (95.4%), lived in urban areas (97.8%), were not employed (64.6%), studied during the day (67.5%) and were included in the economic class C (almost 50.0%). Prevalence of 34.2% (95%CI 37.8;30.7) of physically active individuals was observed. The subsample used for the reproducibility analysis (n = 53) showed no significant difference between the study variables when compared with the sample from the factor analysis.

During psychometric properties analysis, all constructs were observed to be satisfactory for both the measure of sampling adequacy (KMO) test, with values between 0.72 and 0.91, and Bartlett's test of sphericity (p = 0.00) (Tables 1 to 4). As to singularity and multicollinearity analysis, the correlation matrix had the following minimum and maximum values: behavior change strategy (r = 0.23 and r = 0.68); perception of facilitators (r = 0.21 and r = 0.65) perception of barriers (r = 0.26 and r = 0.61); self-efficacy (r = 0.41 and r = 0.67); social support from family (r = 0.38 and r = 0.53); and social support from friends (r = 0.23 and r = 0.56). The results indicated by the correlation matrix were satisfactory (r < 0.8 and p < 0.05) for all constructs, with all items being kept for exploratory factor analysis.

During the exploratory factor analysis of the behavior change strategy construct, only one factor was identified, with factor loadings ranging from 0.54 to 0.73, thereby explaining 56.7% of the total scale variance. The internal consistency was high (α = 0.88) and all the items were seen to be important for their respective scales, since removing any one of them would have significantly diminished internal consistency (Table 2). Reproducibility ranged from 0.56 to 0.86 with 73.3% of the items reaching values above 0.70.

In the decision-making process construct, two factors were identified, the first related to aspects that make behavior change easier, and the second related to aspects that make it more difficult. Factor loadings ranged from 0.60 to 0.80 for the first factor, and from 0.50 to 0.73 for the second, thereby explaining 25.3% and 20.1% of the items' variance, respectively. Internal consistency was high for both (factor 1 - α = 0.80 and factor 2 - α = 0.73). It was observed that withdrawing any question would result in significantly reducing the internal consistency of the construct. Reproducibility ranged from 0.52 to 0.83 with 70.0% of the items reaching values above 0.70 (Table 3).

Only one factor was identified during the perception of self-efficacy, with factor loadings ranging from 0.72 to 0.80, thereby explaining 59.0% of the variance of the items. Internal consistency was excellent (α = 0.92) and all items presented reproducibility above 0.70. Withdrawing any question would have resulted in significantly reducing the internal consistency of the construct (Table 4).

Two factors were identified in relation to social support, one being related to social support from family, and the other to social support from friends. In factor 1 (support from the family), the factor loadings ranged from 0.66 to 0.52, and in factor 2 (support from the friends), they ranged from 0.43 to 0.63. Internal consistency was satisfactory for both identified factors, with it being greater for factor 1 (α = 0.89), with an explained variance of 29.2%, compared to factor 2 (α = 0.70), that had an explained variance of 25.8%. Withdrawing any question would have resulted in significantly reducing the internal consistency for both constructs.

Table 1. Original and final version translated and adapted from the psychosocial constructs of physical activity.

	Original version	Final translated and adapted version
C1	Physical Activity Change Strategies	*Estratégias de mudança da atividade física*
	The following are activities, thoughts, and feelings people use to help them change their physical activity. Think of any similar experiences you may be having or have had in the past month. Then rate HOW OFTEN you do each of the following.	*A seguir há atividades, pensamentos e sentimentos que as pessoas usam para ajudá-las a mudar sua atividade física. Pense sobre experiências semelhantes que você pode estar passando ou ter passado no último mês. Depois, marque COM QUE FREQUÊNCIA você tem cada uma delas.*
Q1	I look for information about physical activity or sports.	*Eu procuro informações sobre atividade física ou esportes.*
Q2	I keep track of how much physical activity I do.	*Eu me mantenho atento a quanto de atividade física estou fazendo.*
Q3	I find ways to get around the things that get in the way of being physically active.	*Eu encontro maneiras de contornar as coisas que me atrapalham ser fisicamente ativo.*
Q4	I think about how my surroundings affect the amount of physical activity I do. (Surroundings are things like having exercise equipment at home or a park near by).	*Eu penso sobre quanto o meu ambiente afeta a quantidade de atividade física que faço. (Ambiente são coisas como ter equipamentos para se exercitar em casa ou um parque nas redondezas).*
Q5	I put reminders around my home to be physically active.	*Eu coloco lembretes pela casa para ser fisicamente ativo.*
Q6	I reward myself for being physically active.	*Eu me recompenso por ser fisicamente ativo.*
Q7	I do things to make physical activity more enjoyable.	*Eu faço coisas para tornar a atividade física mais agradável.*
Q8	I think about the benefits I will get from being physically active.	*Eu penso sobre os benefícios que vou ter em ser fisicamente ativo.*
Q9	I try to think more about the benefits of physical activity and less about the hassles of being active.	*Eu penso mais sobre os benefícios de ser fisicamente ativo do que nas dificuldades de praticar atividade física.*
Q10	I say positive things to myself about physical activity.	*Eu digo coisas positivas para mim mesmo sobre atividade física.*
Q11	When I get off track with my physical activity plans, I tell myself I can start again and get right back on track.	*Quando saio do meu planejamento, digo a mim mesmo que posso recomeçar e voltar a seguir o plano.*
Q12	I have a friend or family member who encourages me to do physical activity.	*Eu tenho um amigo ou parente que me incentiva a praticar atividade física.*
Q13	I try different kinds of physical activity so that I have more options to choose from.	*Eu tento experimentar diferentes tipos de atividade física, assim tenho mais opções de escolha.*
Q14	I set goals to do physical activity.	*Eu estabeleço metas para realizar atividade física.*
Q15	I make back-up plans to be sure I get my physical activity.	*Eu tenho um plano reserva para assegurar que farei atividade física.*
C2	Physical Activity Pros & Cons	*Percepção dos facilitadores & percepção das barreiras para atividade física*
	The following statements are different beliefs about physical activity. Please rate HOW IMPORTANT each statement is to your decision to do physical activity. Use the following scale:	*As afirmações a seguir representam diferentes crenças sobre atividade física. Marque QUÃO IMPORTANTE cada afirmação é para a sua decisão de praticar atividade física. Use a seguinte escala:*
Q16	Physical activity would help me stay fit.	*Atividade física me ajudaria a ficar em forma.*
Q17	I would feel embarrassed if people saw me doing physical activity.	*Eu me sentiria constrangido se outras pessoas me vissem praticando atividade física.*
Q18	My parents would be happy if I did physical activity.	*Meus pais ficariam felizes se eu praticasse atividade física.*
Q19	There is too much I would have to learn to do physical activity.	*Eu teria que aprender muita coisa para praticar atividade física.*
Q20	I would feel better about myself if I did physical activity.	*Eu me sentiria melhor comigo mesmo se praticasse atividade física.*
Q21	I would need too much help from my parents to do physical activity.	*Eu precisaria de bastante ajuda dos meus pais para praticar atividade física.*
Q22	I do not like the way physical activity and exercise makes me feel.	*Eu não gosto da forma que me sinto quando pratico atividade física ou exercício físico.*
Q23	I would have fun doing physical activity or playing sports with my friends.	*Eu me divertiria fazendo atividade física ou praticando esporte com meus amigos.*
Q24	I would have more energy if I did physical activity.	*Eu teria mais energia se praticasse atividade física.*
Q25	Physical activity takes time away from being with my friends.	*Atividade física toma o tempo em que estaria com meus amigos.*
C3	Self-efficacy	*Autoeficácia*

Continue

Continuation

	There are many things that can get in the way of physical activity. Rate HOW SURE you are that you can do physical activity in each situation.	*Existem muitas coisas que podem dificultar a prática de atividade física. Marque QUÃO SEGURO você está de que praticaria AF em cada uma das situações abaixo.*
Q26	Do physical activity even when you feel sad or stressed?	*Praticaria atividade física mesmo quando está triste ou estressado(a)?*
Q27	Set aside time for physical activity on most days of the week?	*Reservaria tempo para a prática de atividade física na maioria dos dias da semana?*
Q28	Do physical activity even when your family or friends want you to do something else?	*Praticaria atividade física mesmo quando sua família ou seus amigos querem que você faça outra coisa?*
Q29	Get up early, even on weekends, to do physical activity?	*Acordaria cedo, mesmo nos fins de semana, para praticar atividade física?*
Q30	Do physical activity even when you have a lot of schoolwork?	*Praticaria atividade física mesmo quando você tem muita lição de casa?*
Q31	Do physical activity even when it is raining or really hot outside?	*Praticaria atividade física mesmo quando está chovendo ou muito quente?*
C4	Family and friend support	*Apoio social da família e dos amigos*
	During a typical week, how often has a member of your household (e.g., your father, mother, brother, sister, grandparent, or other relatives) and friends:	*Em uma semana típica, com que frequência alguém da sua casa (e.g., seu pai, mãe, irmão, irmã, avós, parentes, e outros) e amigos:*
Q32	Watched you participate in physical activity or play sports?	*Assistiu você participar de atividade física ou praticar esportes?*
Q33	Encouraged you to do sports or physical activity?	*Incentivou você a praticar atividade física ou esportes?*
Q34	Provided transportation to a place where you can do physical activity or play sports?	*Levou você a um local para praticar atividade física ou esportes?*
Q35	Done a physical activity or played sports with you?	*Praticou atividade física ou esportes com você?*
Q36	Do your friends encourage you to do sports or physical activities?	*Seus amigos incentivam você a praticar atividade física ou esporte?*
Q37	Do your friends do physical activity or play sports with you?	*Seus amigos praticam atividade física ou esportes com você?*
Q38	Do your friends or classmates tease you about not being good at physical activities or sports?	*Seus amigos ou colegas de curso brincam com você por não ser bom em atividades físicas ou esportes?*
Q39	Do your friends ask you to walk or bike to school or to a friend's house?	*Seus amigos convidaram você para ir a pé ou de bicicleta para a universidade ou para a casa de outro amigo?*

Reproducibility ranged from 0.56 to 0.90 and support from friends varied from 0.61 to 0.83 (Table 5).

DISCUSSION

Generally speaking, the results indicate that the psychosocial scales for physical activity showed adequate internal consistency, high factorial validity and good reproducibility levels. Evaluating the back-translation and the original version, no differences were observed, and it was well understood by the target population. The validation process followed all the steps that were expected for translating, adapting and validating the instrument.[17]

Culturally adapting the scales for Brazilian university students was relatively simple, since there was no difference between the connotation and denotation of the words or phrases. During a study by Pirasteh et al,[13] which comprehensively validated the PACE instrument in a population of Iranian women, minor adjustments were performed. This evidence supports the idea that the instrument is easy to understand and is highly applicable, even when used in different countries.

Operationally, the layout, completion guidelines, question sequence and response options were complied as described in the original instrument. This instrument has been applied both electronically[10] and as an interview.[10,13] In this study, the decision was to apply it in the form of an interview due to the fact that this strategy decreases the likelihood of information bias, and because electronic questionnaires are not widely accessed by the general Brazilian population.

Exploratory factor analysis extracted the same amount of factors that were observed in studies by Pirasteh et al[13] and Norman et al,[10] one being for the behavior change strategy construct, one for self-efficacy, two for the decision-making process (factor 1: perception of facilitators, and factor 2: perception of barriers) and two others for social support (factor 1: family, and factor 2 : friends). The factor loadings were above 0.40 in all the items that make up the constructs, with the values for self-efficacy always being above 0.70,

Table 2. Exploratory factor analysis and intraclass correlation coefficient for the behavior change strategy construct for physical activity. (N = 717)

Item*	Factor loading	Value of α if the item is withdrawn	ICC	95%CI
Q1	0.65	0.89	0.78	0.65;0.87
Q2	0.73	0.88	0.80	0.67;0.88
Q3	0.66	0.89	0.76	0.62;0.85
Q4	0.60	0.89	0.83	0.74;0.90
Q5	0.70	0.90	0.78	0.65;0.87
Q6	0.54	0.89	0.73	0.59;0.84
Q7	0.72	0.88	0.75	0.60;0.85
Q8	0.68	0.88	0.69	0.53;0.81
Q9	0.69	0.88	0.65	0.51;0.79
Q10	0.67	0.89	0.86	0.76;0.91
Q11	0.75	0.89	0.78	0.65;0.87
Q12	0.64	0.89	0.56	0.34;0.72
Q13	0.62	0.88	0.80	0.68;0.88
Q14	0.73	0.88	0.81	0.69;0.88
Q15	0.65	0.89	0.64	0.45;0.78
Cronbach's alpha (95%CI)	0.88 (0.79;0.93)			
Eigenvalues	6.1			
% variance explained	56.7			
KMO	0.91			
Bartelett's test	4,216.53 (p = 0.0001)			

ICC: Intraclass correlation coefficient (n = 53); KMO: Kaiser-Meyer-Olkin
* See Table 1.

Table 3. Exploratory factor analysis and intraclass correlation coefficient for the decision-making process construct for physical activity. (N = 717)

Item*	Factor 1 Factor loadings	Factor 2 Factor loadings	Value of α if the item is withdrawn	ICC	95%CI
Q17	0.68	–	0.70	0.66	0.47;0.79
Q18	0.60	–	0.73	0.81	0.69;0.88
Q20	0.80	–	0.63	0.74	0.59;0.84
Q23	0.79	–	0.64	0.79	0.66;0.87
Q24	0.66	–	0.70	0.52	0.31;0.68
Q16	–	0.50	0.57	0.77	0.63;0.86
Q19	–	0.60	0.56	0.71	0.55;0.82
Q21	–	0.73	0.46	0.73	0.57;0.83
Q22	–	0.59	0.59	0.54	0.31;0.70
Q25	–	0.67	0.51	0.83	0.66;0.87
Cronbach's alpha (95%CI)	0.80 (0.70;0.91)	0.73 (0.61;0.82)			
Eigenvalues	2.59	1.95			
Explained variance (%)	25.3	20.1			
Total variance (%)	45.4				
KMO	0.72				
Bartelett's test	1,254.4 (p = 0.0001)				

ICC: Intraclass correlation coefficient (n = 53); KMO: Kaiser-Meyer-Olkin
* See Table 1.

Table 4. Exploratory factor analysis and intraclass correlation coefficient for the self-efficacy construct of the physical activity. (N = 717)

Item*	Factor Factor loading	Value of α if the item is withdrawn	ICC	95%CI
Q26	0.74	0.84	0.90	0.86;0.95
Q27	0.77	0.84	0.86	0.77;0.92
Q28	0.79	0.83	0.78	0.65;0.87
Q29	0.72	0.85	0.84	0.74;0.90
Q30	0.80	0.83	0.83	0.71;0.89
Q31	0.80	0.83	0.72	0.72;0.89
Cronbach's alpha (95%CI)	0.92 (0.88;0.96)			
Eigenvalues	3.54			
Explained variance (%)	59.0			
KMO	0.88			
Bartelett's test	1,680.9 (p = 0.0001)			

ICC: Intraclass correlation coefficient (n = 53); KMO: Kaiser-Meyer-Olkin
* See Table 1.

Table 5. Exploratory factor analysis and intraclass correlation coefficient for the social support from family and friends construct for physical activity. (N = 717)

Item*	Factor 1 Factor loading	Factor 2 Factor loading	Value of α if the item is withdrawn	ICC	95%CI
Q32	0.66		0.70	0.86	0.78;0.91
Q33	0.67		0.74	0.85	0.76;0.91
Q34	0.72		0.65	0.90	0.84;0.94
Q35	0.70		0.69	0.56	0.33;0.71
Q36		0.63	0.53	0.76	0.62;0.85
Q37		0.63	0.53	0.82	0.71;0.89
Q38		0.43	0.68	0.67	0.50;0.79
Q39		0.55	0.62	0.61	0.48;0.75
Cronbach's alpha (95%CI)	0.89 (0.82;0.93)	0.70 (0.54;0.81)			
Eigenvalues	3.14	1.24			
Explained variance (%)	29.2	25.8			
Total explained variance (%)	55.0				
KMO	0.79				
Bartelett's test	1,376.4 (p = 0.0001)				

ICC: Intraclass correlation coefficient (n = 53); KMO: Kaiser-Meyer-Olkin
* See Table 1.

thereby corroborating the studies by Pirasteh et al[13] and Norman et al.[10] These results indicate that the scales show levels of factorial validity are satisfactory for measuring these constructs.

All scales presented adequate internal consistency, with Cronbach's alpha values being greater than 0.70. In comparison to studies that used the entire PACE instrument, the internal consistency of the self-efficacy scale (α = 0.92) was greater than that in the studies by

Pirasteh et al[13] (α = 0.84) and Norman et al[10] (α = 0.76). This was also observed in the social support from the family scale (α = 0.89) and in the perception of barriers (α = 0.73). The values observed in the study by Pirasteh et al[13] were α = 0.72 and α = 0.69, while they were α = 0.79 and α = 0.53, respectively, in the study by Norman et al.[10] The reason for these differences was the target population, as these studies were not conducted with university students.

In both studies, by Pirasteh studies et al[13] and Norman et al,[10] as well as in this study, the lowest α values were found for support from friends. This value can be a reflection from Q38, which reads: "Do your friends or classmates tease you about not being good at physical activities or sports?", which has a negative sentence structure and differs from the other items in the construct. However, the decision was made to keep this item to preserve the original scale, since withdrawing it would not have significantly increased the α value and left the scale with few items, which could have influenced on internal consistency.

When compared to studies that used the same scales evaluated in this study, either with more questions or by using only one or more constructs, it is possible to compare the results.[1,9,12,20,23] For example, the original development study of the scale for measuring self-efficacy, performed with adults in the 1980s, was composed of 12 questions, with the variation of loading values for the items being between 0.40 and 0.82.[20] Overall, the original studies of the scales presented similar values for the items and a larger number of questions for building the construct. However, these studies were developed with the objective of exclusively researching one construct. When constructing instruments to measure associated factors or determinants of physical activity for epidemiological studies, these instruments should contain modules that include different constructs from a theoretical model.

The aforementioned studies[10,13] that validated the original scale of the PACE questionnaire presented reproducibility results that only considered the mean value of the score observed in each construct. In this study, it was observed that the ICC values from the constructs ranged from 0.70 (perception of facilitators for behavior change) to 0.82, for self-efficacy. Overall, these results are similar to those reported in the original scale[10] (varying from 0.68 to 0.88), and greater than those found in the study carried out on Iranian women (varying between 0.36 and 0.74).[23]

One limiting factor of this study was the fact that the original scales were developed for American adolescents and, in this study, they were adapted to young adult university students. This limitation has to be considered, as the scales were originally derived from other scales that has been validated for young adults and university students in studies carried out in the 1980s and 1990s.[9,12,19,23] However, it is still not recommended to apply the validated and adapted instrument to Brazilian adolescents due to differences between school and University contexts. In addition, given the socioeconomic and cultural differences in Brazil, testing the psychometric properties in samples of young adult university students from other regions of the country is suggested. There are still other suggested studies that would test the relationship of the constructs with physical activity levels.

Validating these scales can assist in preparing intervention studies based on two aspects: planning, from studying the extent to which psychosocial aspects can explain the behavior of physical activity, and developing intervention strategies that focus on aspects of behavior change.

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