Cross-Cultural Validation of the Brazilian Portuguese Version of the Pain Vigilance and Awareness Questionnaire

Fernanda Salloume Sampaio Bonafé, PhD
Graduate Student
Dental Sciences Program
School of Dentistry
São Paulo State University (UNESP)
Campus (Araraquara), São Paulo, Brazil

João Marôco, PhD
Professor
Department of Ciências Psicológicas & William James Center for Research
Instituto Universitário de Ciências Psicológicas, Sociais e da Vida-ISPA/IU
Lisbon, Portugal

Juliana Alvares Duarte Bonini Campos, PhD
Professor
Department of Food Science and Nutrition
School of Pharmaceutical Sciences
São Paulo State University (UNESP)
Campus (Araraquara), São Paulo, Brazil.

Correspondence to:
Dr Juliana Alvares Duarte Bonini Campos
Departmento de Alimentos e Nutrição
Faculdade de Ciências Farmacêuticas de Araraquara
Univ Estadual Paulista - UNESP
Rodovia Araraquara Jaú, Km 01
Campos Ville,
CEP:14800-903 – Araraquara
São Paulo, Brazil
Email: jucampos@fcfar.unesp.br

Aims: To cross-culturally adapt the Pain Vigilance and Awareness Questionnaire (PVAQ) to the Brazilian Portuguese language, to evaluate its psychometric properties when applied to Brazilian pain-free adults and to adults with different pain profiles, and to compare the PVAQ factor scores of different groups using a new method for calculating the overall scores for vigilance, attention to pain, and awareness of changes in pain. **Methods:** A total of 1,143 adults (79% women; mean ± standard deviation [SD] age of 38.56 ± 10.73 years) participated. Face validity and content validity of the Brazilian Portuguese version of the PVAQ were tested. The fit of four PVAQ models was evaluated with confirmatory factor analysis (CFA), and the invariance of the model with the best fit was estimated across two independent samples (test sample: n = 732; validity sample: n = 411). The overall scores of the factors pain vigilance, attention to pain, and awareness of changes in pain were calculated by using the regression weight matrix obtained in the CFA. The overall scores between the four pain groups (no pain, n = 334; pain < 3 months, n = 386; recurrent pain ≥ 3 months, n = 244; continuous pain ≥ 3 months, n = 179) were compared. **Results:** The refined two-factor model of the PVAQ fit best to the sample (χ^2/degrees of freedom = 6.095; comparative fit index = 0.926; goodness of fit index = 0.928; root mean square error of approximation = 0.083; average variance extracted > 0.45; composite reliability and Cronbach's alpha > 0.85) and presented strong invariance in independent samples. Individuals with pain presented higher scores on PVAQ factors, and the highest scores were found among individuals with continuous pain. **Conclusion:** The Brazilian Portuguese version of the PVAQ was found to be adequate and reliable when applied to the sample. The methodologic considerations presented could improve research on pain vigilance and help clinicians assess PVAQ factors among patients. *J Oral Facial Pain Headache 2018;32:e1–e12. doi: 10.11607/ofph.1853*

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Pain is a complex manifestation involving the activation of biologic, physiologic, psychological, and social processes[1,2] and alerts the individual that something is wrong.[3] For Linton and Shaw,[4] attention is a basic requirement for pain perception. When the attention to pain is excessive, this can be defined as hypervigilance. Studies have found that hypervigilance is associated with more intense pain, greater physical incapacity, and more frequent clinician visits.[5–7]

To measure hypervigilance, McCracken[5] developed the Pain Vigilance and Awareness Questionnaire (PVAQ) in English for individuals with chronic pain. The PVAQ was initially treated as a single-factor psychometric instrument composed of 16 items. Other theoretical models have been proposed for the PVAQ, including a three-factor model[6] and a two-factor model.[6,8,9] However, the recent literature[10–12] still lacks a consensus on the best model for the PVAQ.

The PVAQ is currently being used in different countries, with versions available in English,[5] Dutch,[8] Chinese,[13] Spanish,[10,14] Italian,[11] and German.[12] No Portuguese version of the instrument was found in the literature. In addition, although the PVAQ has been used on different samples,[6,8–11,15,16] validity studies have been conducted only in samples with specific characteristics, such as in individuals with continuous

chronic pain[9–11,15] and students with no pain.[6,8] Only one study[12] has sought to investigate the psychometric properties of the PVAQ among individuals with acute pain and among individuals without pain who were not students, and it also seems to be the only study to compare the vigilance scores of groups with different pain characteristics. However, the researchers themselves noted that one limitation of the study was that the factorial structure of the PVAQ in this sample of individuals with pain was not assessed due to the small sample size. Because of the known influence of sample-based characteristics on the operationalization of psychometric instruments,[17] there is a need to investigate the validity of the PVAQ before it is used on samples experiencing different types of pain. That is the only way to define the best model to be employed and to ensure the quality of data collected for decision-making.

The overall vigilance score based on the sum of the answers to the 16 items of the PVAQ was offered in the original proposal for the instrument.[5] However, due to scientific and evidence-based advancements and the use of confirmatory factor analysis (CFA), in which the operationalization of a concept may be altered as a function of the characteristics of a study sample,[18] it is important to be aware of the limitation of this analytical strategy. Not all of the items are of equal importance in the formulation of the concept being measured, and there is always the probability that items that compromise the use of the sum will be excluded so that the overall score can be calculated. Thus, this study was developed in order to *(1)* cross-culturally adapt the PVAQ to the Brazilian Portuguese language; *(2)* to evaluate the psychometric properites of the PVAQ when applied to pain-free Brazilian adults and to Brazilian adults with different pain profiles (such as psychometric sensibility, construct and external validity, and reliability); *(3)* to propose a method for calculating the overall scores for vigilance, attention to pain, and awareness of changes in pain; and *(4)* to compare the vigilance scores of groups with different pain characteristics.

Materials and Methods

Sample Characterization

Demographic information (ie, gender, age, marital status, and monthly income) were obtained for each participant. The socioeconomic stratum and average household income were estimated based on the Brazilian government's Economic Classification Criteria.[19] The Brazilian criterion system categorizes participants into socioeconomic strata referred to as Strata A, B, C, D, and E. Next, an estimated average household income is attributed to each stratum.

Information on pain was also collected. The criteria proposed by the International Association for the Study of Pain (IASP)[1,2] was used for the definition of pain. These criteria include the presence of pain, the duration of pain, and the time-based pain pattern. In this step, the participants answered the following question: "In the last 24 hours, have you experienced pain?" If their answer was affirmative, they were asked, "How often have you been experiencing this pain?" and "Does this pain come and go at any specific frequency? Does it come as temporary episodes or crises (recurrently), or is it continuous?" This information helped to classify the participants into four groups. Group 0 (G0), the no pain group, included individuals who had not experienced pain in the last 24 hours. Group 1 (G1) included participants who had experienced pain within the last 24 hours and who had been experiencing the pain for less than 3 months. Among individuals who had reported pain for 3 months or more, the pain pattern was also considered when their group assignment was determined: Group 2 (G2) was made up of individuals who reported experiencing pain within the last 24 hours and recurrent pain for 3 months or more, and Group 3 (G3) was reserved for participants who had experienced continuous pain for 3 months or more.

To complement the characterization of the pain, each participant who reported not having experienced pain in the last 24 hours was asked to answer the question, "When was the last time you experienced pain?" Participants who reported recurrent pain for 3 months or more prior were asked, "When did you first experience this pain?" It is important to note that all participants were also asked, "What hurts the most?" This information shed light on the location of the pain (ie, orofacial pain or bodily pain) and on the possible origin of the pain (ie, odontogenic, musculoskeletal, headache related, or other; the most common "other" category was visceral pain, such as the pain caused by kidney problems).

All of the information used to characterize the sample was collected by using a questionnaire developed by the authors and specifically designed for this study. It is important to note that these data were collected and presented in order to support the results of this study, as this is an instrument validation study in which the sample characterization process is fundamental for replicating the results obtained.

Sample

The psychometric properties of the PVAQ were estimated for a sample of adult individuals, all of whom were volunteers who did not present compromised cognitive ability or any severe psychiatric conditions. The sample was comprised of participants who had sought treatment at the School of Dentistry of

São Paulo State University, Brazil in 2015. These individuals were treated in the radiology, urgent care, oral medicine, surgery and traumatology, primary care/prevention, periodontics, endodontics, cosmetic dentistry, removable partial denture, partial fixed prosthodontics, complete denture prosthodontics, and temporomandibular disorder (TMD) departments. The individuals were recruited from each department's waiting room before their dental treatment or appointment.

The minimum sample size was estimated based on the study by Hair et al,[20] which suggests the need for 5 to 10 subjects per model parameter. Given the fact that the factor models to be tested for the PVAQ could present up to 31 parameters, the minimum size estimated for the sample/subsample was 155 to 310 individuals. Because the objective was to make comparisons between four subsamples, the sample needed to be at least four times as large—that is to say, from 620 to 1,240 subjects. In addition, after considering the possibility of the subjects' refusal to participate in the study, the estimate was increased by 15% (n = 1,426). A total of 1,426 individuals were therefore invited to participate in the study, and 1,214 (85.1%) agreed to participate and signed the informed consent form. Of these 1,214 patients, 1,143 (94.1%) responded to all items on the PVAQ and were included in the study.

Brazilian Portuguese Version of the PVAQ

The original version of the PVAQ is written in English[5] and comprised of 16 items with 6 response choices that vary from 0 (never) to 5 (always). Two items in the PVAQ (item 8: ignore pain; and item 16: not dwell on pain) have an inverted response scale relative to the other items.

To create the Brazilian Portuguese version of the instrument, the content validity processes (face validity and the content validity ratio [CVR]) were performed according to the specifications provided by Guillemin et al[21] and Lawshe.[22] The steps are described below. It is important to note that the present authors obtained authorization for this cross-cultural adaptation from the original author of the instrument.

First, the PVAQ was translated. Three independent bilingual translators who were experts in the fields of health care and psychology participated in this step. The translators' native language was Portuguese (two Brazilian translators and one Portuguese translator), and they had knowledge of the cultural context of the English language. Three independently produced Portuguese translations were written. The discrepancies and inconsistencies among the three Portuguese translations were discussed among the three translators. After a consensus was reached for each discrepancy or inconsistency, these translations were compiled into one version by the first author of this paper. In the development of this Portuguese version, the orthographic treaty established between Portuguese-speaking countries in 2009 was used.

A back-translation of the instrument was then performed by a translator who was an expert in health care and psychology, whose native language was English, and who had knowledge of the Portuguese language. It is important to note that the translator was not informed that it would be a back-translation.

Later, two professionals working within the fields of psychology and pain (who are not authors of this article) and two Portuguese-language specialists analyzed the idiomatic, semantic, cultural, and conceptual equivalencies of the instruments. After this evaluation, an intermediary version in Portuguese was obtained, and pre-testing was performed.

This pre-testing included 25 Brazilian adult patients (81% women) with a mean ± standard deviation (SD) age of 45.73 ± 10.41 years who sought treatment from the School of Dentistry of São Paulo State University (UNESP), Brazil. The average time they required to complete the PVAQ was measured. To verify the participants' understanding of the terms and words used in each item, these participants were interviewed in person and were asked to report the difficulty they experienced in understanding each item. When difficulty in comprehension was reported, the item was re-evaluated or rewritten. The researcher was trained in order to standardize the processes used to approach the individuals and carry out the interviews, as well as to minimize the interference of personal contact between interviewer and patient in the responses.

The average length of the PVAQ interview was 3.67 ± 1.45 minutes. Only one item (item 2: "Estou atento a qualquer mudança súbita/repentina ou temporária da dor"/"I am aware of sudden or temporary changes in pain") was found to create difficulties in comprehension (n = 6; 24%). For that reason, the item was reformulated by adding the word repentina (sudden) to the word súbita (abrupt). After this adjustment the individuals were consulted again, and they confirmed that they correctly understood the item. Through this procedure, the Brazilian Portuguese version of the PVAQ was established (Table 1).

The CVR of the Brazilian Portuguese version of the PVAQ was obtained by using the approach proposed by Lawshe.[22] Eight specialists in the field of pain with knowledge on psychometrics participated in this step. They classified each item of the PVAQ according to its importance with the following categories: essential, useful but not essential, and unnecessary. The method described by Wilson et al[23] was used for decision-making. The significance level was set at 5%, and two-tailed distribution was used ($CVR_{8;.05}$ = .693).

Table 1 Portuguese Translations and Content Validity Ratios (CVRs) of the Items on the Pain Vigilance and Awareness Questionnaire (PVAQ)

	Face Validity		Content validity	
Item	Original PVAQ[a]	Portuguese PVAQ (Questionário de Vigilância e Consciência relacionado à Dor)	Essential (n[b])	CVR
1	I am very sensitive to pain.	Eu sou muito sensível à dor.	8	1.00
2	I am aware of sudden or temporary changes in pain.	Estou atento(a) a qualquer mudança súbita/repentina ou temporária da dor.	8	1.00
3	I am quick to notice changes in pain intensity.	Eu sou rápido(a) para detectar alterações na intensidade da dor.	8	1.00
4	I am quick to notice effects of medication on pain.	Sou rápido(a) para notar efeitos da medicação sobre a dor.	8	1.00
5	I am quick to notice changes in location or extent of pain.	Eu sou rápido(a) para notar alterações na localização ou na extensão da dor.	8	1.00
6	I focus on sensations of pain.	Eu me concentro nas sensações de dor.	8	1.00
7	I notice pain even if I am busy with another activity.	Eu noto a dor mesmo se eu estou ocupado(a) com outra atividade.	8	1.00
8	I find it easy to ignore pain.	Eu acho fácil ignorar a dor.	8	1.00
9	I know immediately when pain starts or increases.	Eu sei imediatamente quando a dor começa ou aumenta.	8	1.00
10	When I do something that increases pain, the first thing I do is check to see how much pain was increased.	Quando eu faço algo que aumenta a dor, a primeira coisa que faço é verificar o quanto a dor aumentou.	8	1.00
11	I know immediately when pain decreases.	Eu sei imediatamente quando a dor diminui.	8	1.00
12	I seem to be more conscious of pain than others.	Eu pareço ser mais consciente da dor do que outros.	6	.50[c]
13	I pay close attention to pain.	Eu presto muita atenção à dor.	8	1.00
14	I keep track of my pain level.	Eu registro/acompanho o nível da minha dor.	8	1.00
15	I become preoccupied with pain.	Eu fico preocupado(a) com a dor.	8	1.00
16	I do not dwell on pain.	Eu não me debruço sobre a dor.	6	.50[c]

[a]McCracken.[5] [b]Number of specialists that deemed the item essential. [c]Items with values below recommendations ($CVR_{8;.05}$ = .693).

After the face validity and CVR steps, the Brazilian Portuguese version of the PVAQ was evaluated in terms of its psychometric properties, as described below.

Procedures and Ethical Aspects

All data, including those from the pre-testing phase of the PVAQ, were collected in the waiting rooms of the departments of the School of Dentistry of São Paulo State University before the beginning of the consultation. Individuals waiting for dental treatment in the departments were invited to participate. The interviews were performed individually and in person. The participants in both the pre-testing phase and the intended study agreed to and signed an informed consent form before participating in the study. This study was approved by the Ethics Committee on Human Research of the School of Dentistry of São Paulo State University (CAAE Registry No. 14986014.0000.5416).

Statistical Analyses

Analysis of the Psychometric Properties

The psychometric characteristics of the PVAQ applied to the sample were analyzed by considering the four theoretical models (M) proposed in the literature:

- M1: McCracken's original proposal[5] comprises 16 items distributed across a single factor, termed pain vigilance and awareness.
- M2: Proposal by McWilliams and Asmundson[6] and Roelofs et al[8] contains 16 items distributed across two factors: awareness to change/attention to changes in pain (items 2, 3, 4, 5, 9, and 11) and intrusion-monitoring/attention to pain (items 1, 6, 7, 8, 10, 12, 13, 14, 15, and 16).
- M3: McWilliams and Asmundson's proposal[6] comprises 16 items distributed across three factors: awareness of changes in pain (items 2, 3, 4, 5, 9, and 11), monitoring (items 1, 7, 8, and 16), and intrusion (items 6, 10, 12, 13, 14, and 15).
- M4: McCracken's proposal[9] contains 13 items distributed across two factors: passive awareness (items 1, 3, 4, 5, 7, 9, and 11) and active vigilance (items 6, 10, 12, 13, 14, and 15).

For the M2, M3, and M4 models, second-order hierarchical models (M2H, M3H, and M4H) were proposed to which a common factor referred to as vigilance was attributed.

The steps used to evaluate the psychometric properties are presented below.

Psychometric Sensitivity. The psychometric sensitivity of each of the PVAQ items was analyzed by using the measures of central tendency and variability, as well as the shape of the distribution given by the participants' responses. Absolute values of < 7 in the case of kurtosis (Ku) and of < 3 in the case of skewness (Sk)[18,24] were considered adequate. The

multivariate normality of data was estimated by using the Madia test.[25]

Construct Validity. Structural validity, convergent validity, and discriminant validity were estimated to evaluate the construct validity.

Factorial Validity. CFA was performed to determine the degree to which the suggested factors satisfied the expected structure. The maximum likelihood estimation method was used. The ratio between the χ^2 test and degrees of freedom (χ^2/df), the comparative fit index (CFI), the goodness of fit index (GFI), and the root mean square error of approximation (RMSEA)[18,24] were all used as indices to evaluate the goodness of fit.

First, the analysis was performed by using two-thirds of the total sample (n = 732). This subsample, named test sample, was selected at random by using SPSS software. The fit of the model was deemed adequate when χ^2/df ≤ 3.00, when CFI and GFI ≥ .90, and when RMSEA < .10.[18,26] It is important to note that the RMSEA was considered acceptable when .05 < RMSEA < .10 and very good when RMSEA < .05.[18,26] The models that did not exhibit adequate fit were refined. Items that presented factor loading (λ) < .50 were removed. Correlations between the errors of the items were inserted when revealed by the modification indices calculated by using the method of Lagrange multipliers (LM > 11, P < .001).[18] Next, the fits of these models, which had been refined to the sample, were evaluated (M1R, M2R, M3R, and M4R).

The most parsimonious factorial model (that which presented the lowest value in one or more of these indices) was defined by using information theory–based indices Akaike information criterion (AIC), Browne-Cudeck criterion (BCC), and Bayes information criterion (BIC).

Convergent Validity. Convergent validity was used to determine whether the items contained in the factor strongly contributed to this factor. The system proposed by Fornell and Larcker,[27] which recommends estimating the average variance extracted (AVE), was applied to the assessment. An AVE of ≥ 0.50[19,23] was deemed adequate.

Discriminant Validity. Discriminant validity was estimated for the models comprised of more than one factor and was used to confirm that items that reflect a given factor were not correlated with each another. Correlational analysis was used to this end. When AVE_i and $AVE_j \geq r_{ij}^2$ (r_{ij}^2 = the square of the correlation between factors i and j), the results were considered to be indicative of discriminant validity.[27]

Reliability. Reliability was estimated by using Cronbach's alpha (α) and composite reliability (CR). To calculate the internal consistency of the instrument as a whole, stratified Cronbach's α was used.[28] Values of α and of CR ≥ 0.70 were indicative of adequate internal consistency.[18,20]

External Validity. To evaluate the external validity of the PVAQ, the psychometric properties of the model that exhibited the best fit in the test sample (n = 732) were applied to the remaining one-third of the total sample, which was thereby referred to as the validation sample (n = 411). After the confirmation of the model applied to the validation sample, factorial invariance was evaluated across independent samples (test sample vs validation sample). Factorial invariance was estimated by analyzing multiple groups using a χ^2 difference test ($\Delta\chi^2$).[18]

The invariance test was run with equality restrictions on the models of both subsamples. The model presented metric invariance when the factor loadings were invariant ($\Delta\chi^2\lambda$; P ≥ .05), which represents weak measurement invariance. The existence of scalar invariance was accepted when the factor loadings and the intercepts did not diverge statistically between the subsamples ($\Delta\chi^2\lambda$, $\Delta\chi^2$i; P ≥ .05), representing strong measurement invariance. When the factor loadings, the intercepts, and the variances/covariances of the residuals did not differ statistically between the subsamples ($\Delta\chi^2\lambda$, $\Delta\chi^2$i, and $\Delta\chi^2$Res; P ≥ .05), strict invariance was obtained.[18]

The external validity of the instrument was considered adequate when at least a strong factorial invariance was found between the independent samples.

Calculating Overall Score. To calculate the overall score of the PVAQ factors, the regression weight matrix (W) was used. The matrix was obtained in the CFA by estimating both the covariance matrix between the observed variables (items) and the covariance matrix between the observed variables and the latent variables (factors and errors).[18] In other words, a weight was estimated to calculate the overall score of the factor to be measured for each item of the instrument.

However, to maintain the exact metric of the instrument's original items (0 to 5), the proportion of each item's contribution to the overall score was used to correct the original factor scores' weights. By estimating a weight for each item, the overall score of the factor can then be obtained by employing a weighted average, which is the product of the weight of each item and the response provided by each individual for that specific item. Lastly, all of the values are added together to obtain the overall score. Thus, the overall score and the score for each factor of the PVAQ may vary from 0 to 5.

Degree of Pain Vigilance. One useful strategy for classifying individuals according to their degree of pain vigilance is to consider the 25th, 50th, and 75th percentiles of the overall scores of each of the factors in the PVAQ. In this example, the individuals

Table 2 Sample Characteristics

	Sample						
Characteristic	G0	G1	G2	G3	Test	Validation	Total
n	334	386	244	179	732	411	1,143
Gender							
Male	84	103	31	22	154	86	240
Female	250	283	213	157	578	325	903
Marital status							
Single	99	140	60	32	221	110	331
Married/common-law marriage	198	203	154	111	423	243	666
Widowed	9	8	8	7	21	11	32
Divorced	28	35	22	29	67	47	114
Social economic stratum (average household income US $[a])							
Strata A and B ($3,984.52)	145	131	92	57	264	161	425
Stratum C ($670.28)	169	217	123	106	400	215	615
Stratum D and E ($237.77)	20	38	29	16	68	35	103
Age, mean (SD)	38.10 (10.71)	36.56 (9.95)	37.9 (10.87)	44.61 (10.14)	39.20 (10.78)	39.19 (10.63)	38.56 (10.73)
Location of pain							
Orofacial/odontogenic	70	285	52	21	281	147	428
Orofacial/headache related	97	26	62	6	117	74	191
Orofacial/musculoskeletal	–	8	4	6	11	7	18
Bodily/musculoskeletal	120	59	107	139	271	154	425
Bodily/other	47	8	19	7	52	29	81

G0 = no pain; G1 = pain < 3 months; G2 = recurrent pain ≥ 3 months; G3 = continuous pain ≥ 3 months; SD = standard deviation.
[a]Exchange rate of 1 Brazilian real (R) equaling US $3.23 provided by the Brazilian Central Bank on September 23, 2016. [a]R $12,870.00 = US $3,984.52; R $2,165.00 = US $670.28; R $768.00 = US $237.77.

who presented scores < 1.25 can be considered individuals with low vigilance, attention to pain, and/or awareness of changes in pain; scores of 1.25 to 3.75 can be considered moderate vigilance/attention/awareness; and scores ≥ 3.75 represent hypervigilance and increased attention to pain and/or awareness of changes in pain. This strategy is based exclusively on the metrics of the response scale constructed to identify the different degrees of involvement (varying from 0 to 5).

Comparison of Overall Scores. Analysis of variance (ANOVA) was used to compare the groups' overall scores on pain vigilance, attention to pain, and awareness of changes in pain. The homoscedasticity of the data was calculated by using Levene's test. Multiple comparisons were made with the Games-Howell post hoc test. A significance level of 5% was used for decision-making.

Significant differences between the groups' overall scores reflect adequate validity of the instrument for distinguishing between individuals with different pain profiles (criterion discriminant validity). Lower scores are expected to be found in the group of pain-free individuals. In addition, the standard error of measurement (SEM) and the smallest detectable change (SDC) were calculated[29,30] for each factor of the PVAQ to determine whether differences in group scores were beyond the variability of the instrument. The reliability measurement used to estimate the SEM was Cronbach's α in the formula: $SEM = SD \times \sqrt{(1-\alpha)}$. To calculate the SDC, the formula used was: $SDC = 1.96 \times \sqrt{2} \times SEM$. The analyses were performed in the IBM SPSS Statistics software v. 22 and the AMOS 22.0 software (SPSS IBM).

Results

Table 1 presents the Brazilian Portuguese version of the PVAQ and the CVR of the items.

The specialists considered neither item 12 nor item 16 to be essential for assessing hypervigilance; however, it should be noted that this is a preliminary and complementary analysis that should be taken into account during the PVAQ psychometric property evaluation process only when the indices suggest lack of good fit of the items being used to evaluate the concept in question. The characteristics of the study sample of the 1,143 participants are presented in Table 2.

The majority of the participants in all of the subsamples were women, married or in a common-law marriage, and reported an average monthly income of US $670.28. The pain characteristics were also considered. The individuals who reported experiencing no pain in the 24 hours prior to the interview (G0; n = 334) reported having had their latest painful experience on average 45.91 ± 111.43 days before the interview. Individuals in G1 (< 3 months; n = 386) reported that the pain had been present for an average of 13.62 ± 17.58 days before the interview. The pain experienced by individuals in G2 (≥ 3 months; recurrent; n = 244) had been present for an average of

Table 3 Descriptive Statistics Showing the Mean and Standard Deviation (SDs), Kurtosis, and Skewness of Participant Responses to the Items of the Brazilian Portuguese PVAQ

	Mean (SD)/Kurtosis/Skewness						
Item	G0	G1	G2	G3	Test	Validation	Total
1	2.55 (1.58)/ −1.00/0.05	3.27 (1.46)/ −0.83/−0.39	3.21 (1.44)/ −0.786/−0.33	3.60 (1.42)/ −0.31/−0.72	3.04 (1.52)/ −0.90/−0.27	3.20 (1.56)/ −0.89/−0.40	3.10 (1.54)/ −0.90/−0.31
2	3.04 (1.66)/ −1.04/−0.37	3.57 (1.44)/ −0.16/−0.81	3.42 (1.51)/ −0.38/−0.70	3.94 (1.36)/ 1.03/−1.29	3.42 (1.52)/ −0.45/−0.71	3.48 (1.57)/ −0.52/−0.74	3.44 (1.54)/ −0.48/−0.72
3	3.36 (1.59)/ −0.77/−0.59	3.84 (1.36)/ 0.37/−1.06	3.58 (1.47)/ −0.34/−0.77	4.09 (1.23)/ 1.78/−1.48	3.63 (1.46)/ −0.14/−0.88	3.77 (1.44)/ −0.07/−0.96	3.68 (1.46)/ −0.12/−0.91
4	3.55 (1.45)/ −0.17/−0.81	3.81 (1.34)/ 0.37/−1.06	3.74 (1.28)/ 0.19/−0.89	3.92 (1.42)/ 1.23/−1.40	3.70 (1.36)/ 0.15/−0.92	3.80 (1.40)/ 0.50/−1.13	3.74 (1.38)/ 0.26/−1.00
5	3.37 (1.60)/ −0.78/−0.61	3.73 (1.33)/ 0.12/−0.90	3.57 (1.37)/ −0.13/−0.77	4.13 (1.19)/ 1.92/−1.48	3.63 (1.40)/ −0.13/−0.83	3.71 (1.46)/ −0.042/−0.95	3.65 (1.42/ −0.11/−0.87
6	2.29 (1.86)/ −1.38/0.16	2.93 (1.84)/ −1.28/−0.34	2.88 (1.83)/ −1.24/−0.33	2.74 (2.00)/ −1.52/−0.23	2.73 (1.84)/ −1.35/−0.19	2.65 (1.97)/ −1.50/−0.14	2.70 (1.89)/ −1.41/−0.17
7	3.19 (1.67)/ −0.91/−0.51	3.78 (1.41)/ 0.31/−1.06	3.68 (1.50)/ 0.17/−1.04	3.97 (1.41)/ 1.06/−1.39	3.56 (1.53)/ −0.32/−0.83	3.71 (1.54)/ −0.16/−1.09	3.62 (1.54)/ −0.17/−0.92
8	2.10 (1.77)/ −1.32/0.20	1.46 (1.64)/ −0.68/0.75	1.55 (1.71)/ −0.98/0.62	1.66 (1.83)/ −0.98/0.67	1.70 (1.73)/ −1.11/0.50	1.68 (1.77)/ −0.97/0.61	1.70 (1.74)/ −1.06/0.54
9	3.66 (1.46)/ −0.16/−0.88	3.99 (1.26)/ 0.98/−1.22	3.85 (1.37)/ 0.82/−1.23	4.12 (1.28)/ 1.98/−1.60	3.88 (1.33)/ 0.64/−1.15	3.89 (1.40)/ 0.60/−1.20	3.88 (1.36)/ 0.63/−1.17
10	2.68 (1.92)/ −1.44/−0.19	3.26 (1.80)/ −0.85/−0.72	2.98 (1.91)/ −1.26/−0.49	3.39 (1.78)/ −0.85/−0.75	3.08 (1.85)/ −1.15/−0.53	2.99 (1.93)/ −1.28/−0.49	3.05 (1.88)/ −1.19/−0.51
11	3.78 (1.33)/ 0.33/−1.01	3.98 (1.29)/ 1.25/−1.33	3.94 (1.22)/ 0.73/−1.11	4.12 (1.26)/ 1.78/−1.50	3.91 (1.29)/ 0.74/−1.15	3.98 (1.29)/ 1.11/−1.29	3.94 (1.29)/ 0.86/−1.20
12	2.49 (1.98)/ −1.54/−0.47	2.97 (1.92)/ −1.31/−0.44	2.75 (1.99)/ −1.50/−0.24	3.33 (1.97)/ −1.02/−0.77	2.84 (1.96)/ −1.44/−0.32	2.84 (2.02)/ −1.48/−0.33	2.84 (1.98)/ −1.45/−0.32
13	2.74 (1.87)/ −1.40/−0.17	3.35 (2.79)/ −0.77/−0.77	3.06 (1.90)/ −1.21/−0.51	3.42 (1.85)/ −0.80/−0.81	3.17 (1.81)/ −1.07/−0.56	3.04 (1.97)/ −1.33/−0.47	3.12 (1.87)/ −1.16/−0.53
14	1.89 (2.01)/ −1.38/0.47	2.51 (2.02)/ −1.60/−0.09	2.19 (2.02)/ −1.58/0.17	2.79 (2.12)/ −1.65/−0.25	2.29 (2.04)/ −1.61/0.12	2.34 (2.08)/ −1.65/0.08	2.30 (2.06)/ −1.62/0.11
15	2.94 (1.77)/ −1.12/−0.39	3.53 (1.68)/ −0.31/−0.95	3.40 (1.75)/ −0.64/−0.81	3.53 (1.80)/ −0.42/−0.99	3.34 (1.72)/ −0.69/−0.74	3.31 (1.82)/ −0.85/−0.74	3.33 (1.76)/ −0.75/−0.74
16	1.94 (1.97)/ −1.37/0.42	2.11 (1.98)/ −1.49/0.26	2.05 (1.99)/ −1.54/0.26	1.88 (2.01)/ −1.43/0.46	1.99 (1.94)/ −1.39/0.35	2.06 (2.06)/ −1.58/0.31	2.01 (1.98)/ −1.46/0.34

G0 = no pain; G1 = pain < 3 months; G2 = recurrent pain ≥ 3 months; G3 = continuous pain ≥ 3 months.

10.91 ± 16.21 days before the interview, and the first painful episode in the group had started on average 6.61 ± 7.60 years before the interview. Continuous pain for 3 months or more (G3; n = 179) had begun on average 5.68 ± 6.92 years prior. In G1, most of the participants reported orofacial odontogenic pain, while those in G2 and G3 complained of bodily musculoskeletal pain.

The descriptive statistics of the participants' responses to the items of the PVAQ can be found in Table 3.

All of the items in the PVAQ presented adequate psychometric sensitivity in all of the subsamples. Therefore, there was no large violation in normality. Multivariant normality of the data was observed (Mardia test = 1.42).

The psychometric properties of the models fit to the test sample can be found in Table 4. To obtain the best fit of the models to the data, refinement of the models was necessary (M1R, M2R, M3R, M4R). To achieve this, items with low factor loadings (λ) were excluded (items 1, 8, and 16). The modification indices were used to insert the correlation between the errors of items 9 and 11 (LM = 27.851, $P < .001$). This correlation between the items may be justified by the theoretical similarities between their contents, since individuals with greater awareness of the start of pain or increases in it (item 9) are more aware of decreases in pain as well (item 11).

After refinement, it was determined that only the original model (M1 and M1R) did not fit to the sample. The other refined models (M2R, M3R, M4R) and the second-order hierarchical models (M2H, M3H, M4H), which were proposed based on the refined models and with a common factor (vigilance), exhibited adequate fits to the sample data. However, the most parsimonious models were M2R/M2H and M4R/M4H, although the M2R/M2H presented slightly higher goodness of fit indices and an additional item.

Table 4 Confirmatory Factor Analysis (CFA), Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's α of the PVAQ Models Fit to the Test Sample (n = 732)

	CFA									
Model	λ	χ^2/df	CFI	GFI	RMSEA	AIC	BIC	BCC	r	AVE
M1	−0.11/0.76	9.516	0.814	0.819	0.108	1,053.626	1,200.681	1,055.139	–	0.37
M1R	0.51/0.76	11.604	0.842	0.826	0.120	806.281	925.771	807.296	–	0.43
M2	−0.17/0.83	6.227	0.887	0.897	0.085	707.380	859.041	708.951	0.77	0.34–0.53
M2R	0.59/0.83	6.095	0.926	0.928	0.083	440.009	568.691	441.103	0.76	0.45–0.54
M2H	0.59/0.83	6.095	0.926	0.928	0.083	440.009	568.691	441.103	–	0.45–0.54
M3	−0.13/0.82	5.989	0.894	0.903	0.083	674.896	835.749	676.563	0.74–0.87	0.21–0.54
M3R	0.50/0.83	5.881	0.923	0.924	0.082	493.305	640.370	494.646	0.73–0.92	0.35–0.54
M3H	0.50/0.83	5.881	0.923	0.924	0.082	493.305	640.370	494.646	–	0.35–0.54
M4	0.45/0.79	6.844	0.907	0.910	0.089	492.012	616.098	493.066	0.78	0.45–0.46
M4R	0.60/0.79	6.858	0.921	0.921	0.090	408.639	528.129	409.580	0.77	0.46–0.51
M4H	0.60/0.79	6.858	0.921	0.921	0.090	408.639	528.129	409.580	–	0.46–0.51

M1 = single-factor model (McCracken[5]); M2 = two-factor model (McWilliams and Asmundson[6] and Roelofs et al[9]); M3 = three-factor model (McWilliams and Asmundson[6]); M4 = two-factor model (McCracken[11]); R = refined model after exclusion of items and insertion of the correlation (r) between the errors of the items; H = second-order hierarchical model created based on the refined model; λ = factor loading, χ^2/df = ratio between chi-square and degrees of freedom; CFI = comparative fit index; GFI = goodness of fit index; RMSEA = root mean square error of approximation; r = correlation between two factors.

Table 5 Weights Obtained from the Regression Matrix and Attributed to the PVAQ Items for Calculating the Overall Scores for the Factors Vigilance, Attention to Pain, and Awareness of Changes in Pain

	Weights								
Score	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 9	Item 10	Item 11
Vigilance	0.11	0.18	0.08	0.13	0.04	0.06	0.08	0.06	0.06
Attention to pain	0.04	0.06	0.03	0.04	0.09	0.13	0.03	0.13	0.02
Awareness of changes in pain	0.15	0.25	0.11	0.17	0.02	0.02	0.11	0.02	0.08

The factor awareness of change of the M2R and M3R and the factor passive awareness of M4R presented adequate convergent validity. The discriminant validity of the factors in the two- and three-factor models was not adequate; meanwhile, reliability was adequate for all models, with the exception of the intrusion factor in M3R.

Based on the data, M2R/M2H was considered to be the best model for the study sample. Therefore, M2H was chosen for estimating vigilance.

The fit of the M2H model was also found to be adequate for the validation sample (χ^2/df = 3.595; CFI = .931; GFI = .924; RMSEA = .080). M2H was found to exhibit strong measurement invariance in independent samples ($\Delta\chi^2$: λ = 4.729; *P* = .944; i = 16.011; *P* = .249; Res = 25.223; *P* = .022). Figure 1 presents the structure of M2H for the overall sample.

The fit of the M2H model was also found to be adequate for the subsample of individuals with different pain characteristics (G0: χ^2/df = 2.880, CFI = 0.950, GFI = 0.927, RMSEA = 0.075; G1: χ^2/df = 3.142, CFI = 0.927, GFI = 0.931, RMSEA = 0.075; G2: χ^2/df = 2.930, CFI = 0.918, GFI = 0.900, RMSEA = 0.089; G3: χ^2/df = 2.250, CFI = 0.905, GFI = 0.900, RMSEA = 0.084).

After the best factor structure was chosen and evaluated, the regression weight matrix was estimated for the weight of the PVAQ items in order to calculate the overall score. The factors vigilance, attention to pain, and awareness of changes in pain were considered in this calculation (Table 5). These weights allow for the calculation of the overall score of each factor of the PVAQ for each individual. According to the degree of pain vigilance, 45.93% of the participants were found to be hypervigilant to pain.

The comparison of the overall scores of the different groups for vigilance, attention to pain, and awareness of changes in pain (G0, G1, G2, and G3) are presented in Table 6. Welch's ANOVA was used due to the heterocedasticity of the data between the groups (Levene's test: *P* < .001). The mean overall scores for vigilance, attention to pain, and awareness of changes in pain were lowest among individuals who reported experiencing no pain for the 24 hours prior to the interview (G0). Among the individuals with pain for 3 months or more (G2 and G3), those with continuous pain (G3) presented higher scores for vigilance, attention to pain, and awareness of changes in pain, on average. The scores for these three factors were very similar between the group experiencing pain for

CR	α	Excluded items	Items with correlated errors
0.89	0.87	–	–
0.91	0.90	1, 8r, 16r	–
0.80–0.87	0.75–0.86	–	–
0.85–0.87	0.85–0.87	1, 8r, 16r	9–11
0.85–0.87	0.92	1, 8r, 16r	9–11
0.34–0.87	0.31–0.86	–	–
0.51–0.87	0.53–0.87	8r, 16r	9–11
0.51–0.87	0.94	8r, 16r	9–11
0.84–0.85	0.83–0.85	8r, 16r	–
0.83–0.86	0.83–0.86	1, 8r, 16r	9–11
0.83–0.86	0.96	1, 8r, 16r	9–11

Item 12	Item 13	Item 14	Item 15
0.04	0.08	0.05	0.04
0.09	0.18	0.10	0.08
0.02	0.03	0.02	0.01

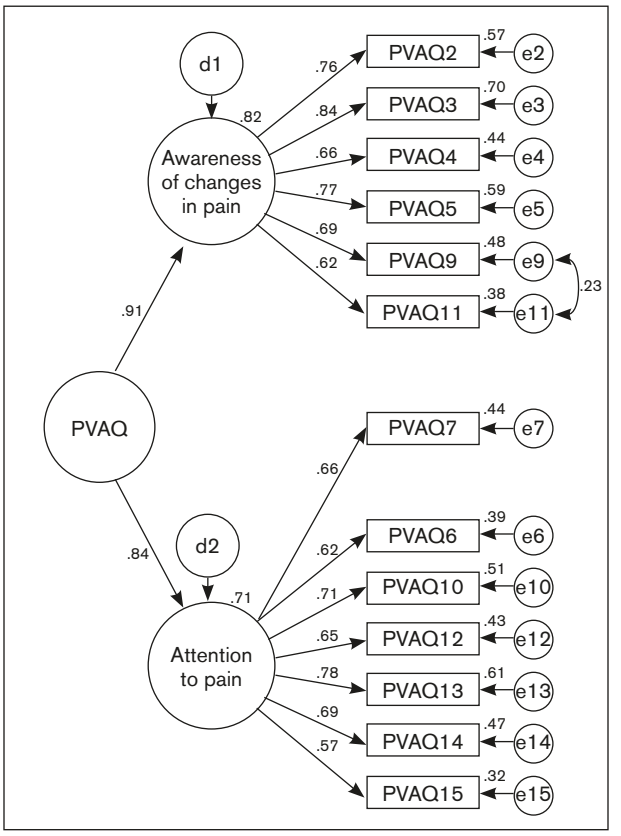

Fig 1 The second-order hierarchical two-factor model (M2H) of the Pain Vigilance and Awareness Questionnaire (PVAQ) fit best to the overall sample (χ^2/df = 7.902; comparative fit index = .934; goodness of fit index = .939; root mean square error of approximation = .078).

Table 6 Comparison of the Means and Standard Deviations (SD) of the Total Scores for Vigilance, Attention to Pain, and Awareness of Changes in Pain Between Groups

	Mean (SD)		
Group	Attention to pain	Awareness of changes in pain	Vigilance
G0	2.80 (1.32)[a]	3.30 (1.27)[a]	3.13 (1.25)[a]
G1	3.35 (1.15)[b,c]	3.72 (1.00)[b]	3.59 (1.00)[b,c]
G2	3.15 (1.23)[b]	3.55 (1.12)[a,b]	3.41 (1.11)[b]
G3	3.50 (1.16)[c]	3.97 (0.94)[c]	3.80 (0.96)[c]
Total	3.17 (1.24)	3.60 (1.12)	3.45 (1.12)
Welch's ANOVA	F = 17.181; *P* < .001	F = 16.383; *P* < .001	F = 17.987; *P* < .001

G0 = no pain; G1 = pain < 3 months; G2 = recurrent pain ≥ 3 months; G3 = continuous pain ≥ 3 months; ANOVA = analysis of variance. The same superscript letters indicate statistical similarity. Games-Howell post hoc test. Significance level of 5%.

less than 3 months (G1) and the group experiencing recurrent pain (G2). When the criterion discriminant validity was considered, the instrument was found to distinguish between groups with different pain profiles overall.

When the SDC values were calculated, the scores for awareness of changes in pain, attention to pain, and vigilance were 1.12, 1.34, and 0.87, respectively; the differences in these results are considered statistically significant. However, despite the statistically significant differences between the groups, there were no important significant differences; that is, it can be difficult to discern the differences between groups in clinical practice.

Discussion

This study has presented for the first time a Brazilian Portuguese version of the PVAQ and revealed the

psychometric sensibility, construct and external validity, and reliability of the PVAQ when applied to pain-free adults and adults with different pain profiles. The study also presented a new method for calculating the overall scores used to compare the factors vigilance, attention to pain, and awareness of changes in pain among groups with different pain profiles.

Cultural adaptation is a fundamental step for developing psychometric instruments from one language/culture to another.[20] This process ensures the maintenance of the theoretical meaning upon which the formulation of the items was based, thus giving the instrument the capability to measure constructs (in this case, vigilance, attention to pain, and awareness of changes in pain). The different theoretical models[5,6,8,9] presented for the PVAQ reflect different interpretations of the constructs. This number of different models may have occurred because of the existing differences in the samples evaluated (such as cultural or demographic differences) and/or because of the use of the exploratory analysis strategy adopted for the evaluation of the construct without first confirming the theoretical model originally proposed.[5] In cases in which these models do not fit to the sample and/or need improvement, then and only then can other strategies be used as complements.[18]

In this study, the two-factor model[6,8] presented the best fit to the data. However, it is important to stress that McWilliams and Asmundson[6] called the factors "awareness of change" and "monitoring + intrusion," while Roelofs et al[8] referred to them as "attention to changes in pain" and "attention to pain." In the present study, it was decided to use the term awareness of changes in pain[6] for the first factor and the term attention to pain[8] for the second factor since these denominations would be the closest to the theoretical concepts covered by the items contained in each factor. The removal of three items was necessary (items 1, 8, and 16). It is important to note that two of these items are represented with an inverted scale for the response relative to the other items. The occurrence of a psychometric artifact involving the creation of a response stereotype on the part of the participants could be suggested; that is to say, the individuals learn to respond using an increasing scale (0 to 5) and do not notice the inversion of the scale when responding to the 8th and 16th items. These items have also been excluded in other studies in the literature.[8–11,13–15] Item 16 was deemed nonessential by the specialists. Although it was less frequent in the literature, the exclusion of item 1 has also been reported.[10]

As mentioned previously, the fit of a theoretical model can be influenced by the sample characteristics; therefore, an external validity assessment of the evidence presented in an independent sample is necessary. This study performed such an evaluation, and the model proposed for the PVAQ was found to be invariant (test sample vs validation sample), a finding that attests to the external validity of the model.[18]

The proposal of a methodology for calculating the overall score for vigilance, attention to pain, and awareness of changes in pain has been guided by the fact that conventional methods for calculating the overall score, such as the sum or mean of the responses provided by individuals, may not be adequate.[18] For example, measurements resulting from the summation method could easily be altered by excluding items, and measurements that are based on the simple mean will not consider that there may be differences in the contribution of each item to the construct. Therefore, the use of a regression weight matrix is recommended in order to preserve the importance of the items, factors, errors, and correlations when calculating the overall score,[18] though these values may be specific to each sample. Another contribution of this study is the proposed classification of individuals based on the percentile of their vigilance, attention to pain, and awareness of changes in pain scores established using the metric of the response scale (0 to 5), an option which could help professionals in clinical practice. A professional or researcher working in a clinic could see this methodology as unfeasible in a clinical practice due to its statistical complexity; however, once the instrument validation process (a mandatory condition for its use) is performed, the weights attributed to each item could be inserted in a computer program or a mobile app that could easily generate the overall score, as well as the classification of the individual according to their degree of attention to pain and awareness of changes in pain (low, moderate, or increased) by using the proposed cut-off points. The scores and classification systems suggested in this study will present greater accuracy than those obtained by other estimation means, thus improving the clinical decision-making process. The proposal of an overall score with a metric that corresponds to the metric of the instrument may also provide researchers and clinics with a standard to which they can compare their findings. In this way, they can begin a discussion on the factors vigilance, attention to pain, and awareness of changes in pain in different studies.

From the comparison of the vigilance scores of the groups with different pain characteristics, it can be inferred that the presence of pain may change vigilance patterns. This study found that, in the presence of pain, individuals' vigilance scores were significantly higher than those of participants who did not report pain (G0). Other authors[31,12] have reported similar findings.

Linton and Shaw[4] have highlighted the important contribution of the mechanisms of attention to the

presence of pain and report that these mechanisms are fundamental for survival. Nevertheless, these authors have warned that in cases of continuous pain, this attention does not necessarily represent a warning sign, but instead a permanent hypervigilance as a result of the clinical situation the individual is experiencing. Other individuals with continuous pain for 3 months or more (G3) presented higher vigilance scores than the group reporting recurrent pain for 3 months or more (G2), and these scores are suggestive of hypervigilance. This situation is particularly important because, according to the literature,[3,5–7] the consequences of this attention required by continuous pain may lead to the development of a clinical problem involving more symptoms of depression, such as incapacity, withdrawal from social situations, and more frequent medical visits.

It is also important to consider the similarity between the scores for G1 (individuals with pain for less than 3 months) and G2 (individuals with recurrent pain). This similarity may be associated with interpretations of recurrent pain. Some people with recurrent pain may consider these episodes to be isolated events, and the experiences they report are therefore more similar to those reported by individuals experiencing acute pain (G1).

Despite the statistically significant differences observed between the groups (which resulted from the high power of the test due to the very large sample size), no important differences were detectable between the groups; that is, it can be difficult to discern the differences between groups in clinical practice. Further clinical measurements or instruments are required to detect, monitor, and follow pain experiences and progression among individuals with different pain conditions.

A limitation in this study was the cross-sectional nature of the research, which did not allow for inferences into causality. However, this method is commonly used in validation studies and is capable of adequately reaching the proposed objectives. Other possible limitations of this study were the lack of a concurrent validity assessment and test-retest. These steps may serve to complement the validity analyses performed in this study. The concurrent validity assessment can enrich analyses once the scores obtained for the PVAQ have been correlated with the scores obtained for other instruments evaluating similar concepts. The test-retest, in turn, can support the establishment of the significant changes in health status, which are based on measurements at two different time points, such as before and after clinical intervention and/or follow-up. Furthermore, the development of follow-up studies that may provide evidence on PVAQ responses over time with or without clinical intervention and considering different pain conditions is encouraged. The authors suggest that this Brazilian version also be tested in other Portuguese-speaking countries once it has been adapted according to their orthographic treaties.

Conclusions

This study has presented a Portuguese version of the PVAQ and evidence that the refined two-factor model provided adequate factorial validity and reliability for a sample of Brazilian adults without pain and with different pain profiles. The use of the regression weight matrix has been recommended for the calculation of PVAQ factor scores, as it respects the existing differences in each item's contribution to the operationalization of the factors (vigilance, attention to pain, and awareness of changes in pain). A comparison of the different groups' scores suggests that both the presence and the pattern of continuous pain are factors that may contribute to increased vigilance, attention to pain, and awareness of changes in pain among adults.

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