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Psychometric Properties of the Multidimensional Pain Inventory Applied to Brazilian Patients with Orofacial Pain

Miriane Lucindo Zucoloto, MSc
PhD Student
Departamento de Odontologia Social
Faculdade de Odontologia de Araraquara
UNESP-Univ Estadual Paulista
Araraquara, Brazil

João Maroco, PhD
Associate Professor
Unidade de Investigação em Psicologia e Saúde (UIPES)
Instituto Superior de Psicologia Aplicada-ISPA-IU
Lisboa, Portugal

Juliana Alvares Duarte Bonini Campos, PhD
Associate Professor
Departamento de Odontologia Social
Faculdade de Odontologia de Araraquara
UNESP-Univ Estadual Paulista
Araraquara, Brazil

Correspondence to:
Profa J. A. D. B. Campos
Departamento de Odontologia Social
Faculdade de Odontologia de Araraquara
UNESP-Univ Estadual Paulista
Rua Humaitá, 1680 - Centro
14801-903 Araraquara
São Paulo, Brazil
Email: jucampos@foar.unesp.br

Aims: To evaluate the psychometric properties of the Multidimensional Pain Inventory (MPI) in a Brazilian sample of patients with orofacial pain. **Methods:** A total of 1,925 adult patients, who sought dental care in the School of Dentistry of São Paulo State University's Araraquara campus, were invited to participate; 62.5% (n = 1,203) agreed to participate. Of these, 436 presented with orofacial pain and were included. The mean age was 39.9 (SD = 13.6) years and 74.5% were female. Confirmatory factor analysis was conducted using χ^2/df, comparative fit index, goodness of fit index, and root mean square error of approximation as indices of goodness of fit. Convergent validity was estimated by the average variance extracted and composite reliability, and internal consistency by Cronbach's alpha standardized coefficient (α). The stability of the models was tested in independent samples (test and validation; dental pain and orofacial pain). The factorial invariance was estimated by multigroup analysis ($\Delta\chi^2$). **Results:** Factorial, convergent validity and internal consistency were adequate in all three parts of the MPI. To achieve this adequate fit for Part 1, item 15 needed to be deleted (λ = 0.13). Discriminant validity was compromised between the factors "activities outside the home" and "social activities" of Part 3 of the MPI in the total sample, validation sample, and in patients with dental pain and with orofacial pain. A strong invariance between different subsamples from the three parts of the MPI was detected. **Conclusion:** The MPI produced valid, reliable, and stable data for pain assessment among Brazilian patients with orofacial pain. *J Oral Facial Pain Headache 2015;29:363–369. doi: 10.11607/ofph.1481*

Keywords: *facial pain, pain measurement, psychometrics, validation studies*

Pain can be conceptualized as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage."[1] Its presence may have psychosocial and economic impacts, which negatively affect the quality of life and the health of individuals.[2] Thus, some authors have emphasized the multidimensional assessment of pain, with a focus on physical, psychological, and social impacts in different contexts and populations.[3–6]

Orofacial pain is a type of pain condition that is highly prevalent worldwide. It can originate in a tooth or in other orofacial structures, including the temporomandibular joint and jaw and facial muscles. Orofacial pain may be a chronic or an acute condition. Orofacial pain may interfere with daily activities, social life, eating, talking, and sleeping, and may influence the individual's social well-being.[5,7]

Since pain is a multidimensional and latent variable (ie, it is not directly measurable), individual perceptions of pain intensity and interference in daily activities have been assessed using psychometric scales. Some instruments have been proposed in the literature for this purpose, including the Brief Pain Inventory (BPI),[8] the McGill Pain Questionnaire,[9] and the Multidimensional Pain Inventory (MPI), which was developed by Kerns et al.[5] The BPI and the MPI are psychometric scales originally proposed for assessing chronic pain conditions. However, they present a solid theoretical construct that can also be applied to acute conditions.

Table 1 Classification of Individuals According to Socioeconomic Status and Clinical Characteristics

Characteristic	n (%)
Economic class	
A	–
B	22 (5.04)
C	151 (34.63)
D	240 (55.05)
E	23 (5.28)
Dental status	
Dentate	124 (28.44)
Partially edentulous	295 (67.66)
Edentulous	17 (3.90)
Chronic disease	
Yes	312 (71.56)
No	124 (28.44)
Location of pain	
Tooth	285 (65.37)
Face	64 (14.68)
Head	39 (8.94)
Ear region/temporomandibular joint	31 (7.11)
Other region	17 (3.90)

This option paves the way for the use of these instruments in broader clinical settings such as dentistry, and thus represents an important gain in the development of evaluation and treatment protocols for individuals with different types of pain conditions.

The MPI has been widely used to screen the severity and impact of different pain conditions[3,10–12] on people's lives from a multidimensional perspective. According to Silva and Ribeiro-Filho,[13] this perspective allows for an enriched understanding of pain, since it enables the development and evaluation of new treatment approaches. This information provides clinicians with a viable strategy for assessing individual differences between patients with pain.

The MPI considers the assessment of pain from a cognitive-behavioral perspective. It was proposed to evaluate the perception of pain and its consequences in the lives of individuals. The MPI was originally called the West Haven-Yale Multidimensional Pain Inventory (WHYMPI), and the first version of the MPI had 61 items, 52 of which were selected using exploratory factor analysis (EFA). These 52 items were divided into 12 factors, which were then subdivided into 3 separate parts (orthogonal structure): one psychosocial part (Part 1) and two behavioral parts (Parts 2 and 3). The MPI has been translated, adapted, and evaluated for its psychometric properties in several countries, including Italy,[11] Netherlands,[14] Spain,[15] Sweden,[16] United States,[10] and Brazil.[13] The Brazilian version of the instrument was proposed by Silva and Ribeiro-Filho.[13] However, to the authors' knowledge, there have been no studies reporting the psychometric results of the Portuguese version among Brazilian patients. Therefore, the present study aimed to evaluate the psychometric properties of the MPI in a Brazilian sample of patients with orofacial pain.

Materials and Methods

Study Design and Sampling

The study had a cross-sectional study design with non-probabilistic sampling. A total of 1,925 adult patients who sought dental care in the School of Dentistry of São Paulo State University's Araraquara campus (UNESP-Araraquara) between September 2012 and April 2013 were invited to participate. The rate of individuals who agreed to participate in the study was 62.5% (n = 1,203). Of these, 436 presented with orofacial pain and were included in the study. The individuals with pain (n = 436) were identified using the question, "Are you in pain at this moment?", which was included in the sample characterization questionnaire. The average age of participants was 39.9 (SD = 13.6) years, and 74.5% were female. The study was approved by the Research Ethics Committee of the UNESP-Araraquara School of Dentistry (CAAE:01040312.5.0000.5416/nº50802). Only patients over 18 years of age who agreed to sign the Free and Informed Consent Form were included.

To characterize the sample, information such as socioeconomic status (economic class), dental status (dentate, edentulous, or partially edentulous), and preexisting chronic disease history was collected. The classification of individuals according to economic class was performed according to the Economic Classification Criteria of the Brazilian Association of Research Companies (ABEP).[17] The location of the pain was also reported. This information is presented in Table 1.

Measuring Instrument

The Portuguese version of the MPI[13] was used. It is a reduced version containing 50 items divided into 3 orthogonal parts. In this version, the items "wash the car" and "work on the car" from Part 1 have been excluded. Part 1 is composed of 20 items divided into 5 factors (pain severity, life interference, support, self-control, and state of mind/affectivity, a translated list which differs slightly from the original inventory). The answers are given on a 7-point rating scale, in which the individual is asked to give a score from 1 to 7 for each item in Part 1. Part 2 consists of 14 items divided into 3 factors (punishing responses, solicitous responses, and distracting responses). Part 3 consists of 16 items divided into 4 factors (household chores, outdoor work, activities away from home, and social activities). The answers to Parts 2 and 3 are distributed in a 6-point rating scale, ranging from "never" to "very often."

Procedures

The instruments were presented on paper, and the patients completed them in the waiting room of the clinics of the UNESP-Araraquara School of Dentistry, privately and independently. A researcher observed the completion process in order to ensure appropriate data collection and to provide the patients with any necessary clarifications.

Analysis of Psychometric Properties

The psychometric sensitivity of each part of the MPI was estimated using measures of central tendency, variability, and data distribution shape. The instrument is psychometrically sensitive when the absolute values of skewness and kurtosis are less than 3 and 7, respectively, values which indicate a reasonable approximation to the normal distribution.[18,19] Multivariate normality was evaluated using Mardia's test, which was implemented using the analysis of moment structures (AMOS) software (v. 21, SPSS).[20]

The content validity ratio (CVR) was estimated to assess the essentiality of the items. To do so, the proposal by Lawshe[21] was considered. At this stage, a panel of 15 experts in the field of dentistry rated each item of the MPI as "essential," "useful, but not essential," or "not necessary." The decision of the significance of the CVR was established in accordance with the proposal by Wilson et al,[22] and a significance level of .05 was adopted.

Construct validity was assessed using the confirmatory factor analysis (CFA) and the maximum likelihood method.[23] To assess the goodness of fit of the model, the factor weights of the items (λ) and goodness of fit indices such as the ratio of the chi-square statistic divided by its degrees of freedom (χ^2/df) were considered; also considered were the comparative fit index (CFI), the goodness of fit index (GFI), and the root mean square error of approximation (RMSEA).[17] The model fit was considered adequate when $\lambda \geq 0.4$, $\chi^2/df \leq 3.0$, CFI and GFI were both > 0.90, and RMSEA $\leq$ 0/10.[18,19] To verify the existence of a correlation between errors, the modification indices estimated from the Lagrange multipliers produced by AMOS (v. 21; SPSS)[19] were considered.

Convergent validity was estimated according to Fornell and Larcker's proposal,[24] which recommends the calculation of the average variance extracted (AVE) and the composite reliability (CR). Values of AVE $\geq$ 0.50 and CR $\geq$ 0.70 were considered indicative of convergent validity. Discriminant validity was evaluated by comparing the AVE of every two factors to their squared correlation (ρ_{ij}^2); it was considered adequate when AVE_i and $AVE_j \geq \rho_{ij}^2$.[24]

Internal consistency was estimated using the standardized Cronbach's alpha coefficient (α). Values larger than 0.70 were indicative of internal consistency.

The stability of the model in independent samples (factorial invariance) was estimated using multigroup analysis and the chi-square difference ($\Delta\chi^2$) for the factor weights (λ), covariances between factors (Cov), and specific factors (Res) from free vs constrained models.[18,19] First, the sample was randomly divided into two parts of approximately 50% each, which were designated as the "test sample" (n = 229) and the "validation sample" (n = 207). Subsequently, a new subdivision of the sample was performed according to the pain condition. These subsamples referred to "individuals with dental pain" (n = 285) and "individuals with other types of orofacial pain" (n = 151).

Results

The summary measures taken of each item in the three parts of the MPI and the CVR are presented in Table 2. All of the items from the three parts of the MPI presented skewness and kurtosis values indicative of no severe violation of normality. The data presented multivariate normality (Mardia's test–kurtosis: Part 1 = 2.70; Part 2 = 2.02; Part 3 = 2.30).

Five items from Part 1, 3 items from Part 2, and 11 items from Part 3 were considered non-essential by the judges. It should be noted that this analysis was only exploratory and was used as a complement to decision-making in the estimation of the model. This analysis was not necessary for decision-making in this sample. Figure 1 presents the factorial models of the MPI.

It is important to note that the three parts of the MPI were found to be an adequate fit to the data. Item 15, which was found to have a below-adequate factor weight (λ = 0.13), needed to be deleted to achieve this adequate fit for Part 1.

Table 3 presents the goodness of fit indices of the factor models (CFA), the AVE, and the CR, in addition to the squared correlation between factors (r^2) and the internal consistency (α) of different subsamples. The goodness of fit indices, the AVE, the CR, and the alpha values were adequate, a result that indicates factorial and convergent validity and internal consistency in all subsamples of the three parts of the MPI. Discriminant validity was compromised between the factors "activities away from home" and "social activities" of Part 3 in the total sample and in the "validation" subsample, as well as in the "orofacial pain" and "dental pain" subsamples.

Table 4 presents the results of the multigroup analysis performed to assess the stability of the MPI models when used on different samples. Table 4 shows a strong invariance between different subsamples from the three parts of the MPI.

Table 2 Summary Measures and Content Validity Ratio (CVR) of Each Item of the Parts 1, 2, and 3 of the Multidimensional Pain Inventory (MPI)

	Part 1					Part 2					Part 3				
MPI	Mean	Median	SD	Skewness	Kurtosis	CVR	Mean	Median	SD	Skewness	Kurtosis	CVR	Mean	Median	SD	Skewness	Kurtosis	CVR
it1	3.80	4.00	2.21	0.14	−1.38	1.00	1.93	1.00	1.19	1.22	1.20	1.00	3.34	3.00	1.92	0.20	−1.39	0.33*
it2	3.98	4.00	2.22	0.04	−1.41	0.87	1.71	1.00	1.07	1.60	2.57	0.33*	3.35	3.00	1.91	0.19	−1.38	0.07*
it3	3.76	4.00	2.16	0.12	−1.35	1.00	1.76	1.00	1.13	1.54	2.15	0.73	3.37	3.00	1.93	0.19	−1.42	0.87
it4	3.44	3.00	2.21	0.33	−1.34	1.00	1.76	1.00	1.29	1.83	2.76	1.00	3.45	3.00	1.92	0.13	−1.42	0.87
it5	3.34	3.00	2.22	0.40	−1.30	1.00	3.08	3.00	1.87	0.45	−1.19	0.60	3.15	3.00	2.03	0.33	−1.47	0.33*
it6	3.45	3.00	2.26	0.36	−1.36	1.00	3.07	3.00	1.88	0.43	−1.20	0.73	2.01	1.00	1.72	1.55	0.88	−0.87
it7	3.23	3.00	2.16	0.47	−1.21	0.73	3.48	3.00	1.91	0.09	−1.40	0.87	2.07	1.00	1.72	1.45	0.64	−0.60
it8	3.12	3.00	2.18	0.58	−1.12	1.00	3.36	3.00	1.94	0.18	−1.44	0.87	2.91	3.00	1.88	0.56	−1.08	−0.20*
it9	3.18	3.00	2.20	0.57	−1.13	0.73	2.71	2.00	1.94	0.72	−1.01	−0.73*	2.59	2.00	1.64	0.84	−0.30	0.47
it10	3.14	3.00	2.17	0.54	−1.15	0.87	3.66	3.00	1.90	−0.03	−1.40	1.00	1.97	1.00	1.54	1.59	1.42	−0.07*
it11	2.79	2.00	2.13	0.85	−0.74	0.47*	1.91	1.00	1.61	1.71	1.59	−0.20*	2.98	3.00	1.80	0.49	−1.03	0.33*
it12	3.03	2.00	2.18	0.63	−1.10	0.73	2.87	3.00	1.88	0.55	−1.11	0.73	2.44	2.00	1.58	0.97	0.04	0.33*
it13	4.49	5.00	2.25	−0.32	−1.39	0.07*	2.87	3.00	1.86	0.57	−1.02	1.00	2.00	3.00	1.51	1.50	1.26	0.47*
it14	4.58	5.00	2.15	−0.36	−1.25	0.20*	2.84	3.00	1.90	0.61	−1.08	0.73	2.90	3.00	1.61	0.62	−0.48	0.20*
it15	4.36	5.00	2.24	−0.24	−1.39	0.60	–	–	–	–	–	–	2.37	2.00	1.70	1.07	−0.09	0.20*
it16	3.52	3.00	2.30	0.36	−1.42	0.73	–	–	–	–	–	–	2.31	1.00	1.68	1.14	0.07	0.33*
it17	3.46	3.00	2.31	0.36	−1.43	0.73	–	–	–	–	–	–	–	–	–	–	–	–
it18	4.84	6.00	2.40	−0.57	−1.32	0.60	–	–	–	–	–	–	–	–	–	–	–	–
it19	4.69	6.00	2.43	−0.47	−1.44	0.47*	–	–	–	–	–	–	–	–	–	–	–	–
it20	4.79	6.00	2.38	−0.54	−1.34	0.47*	–	–	–	–	–	–	–	–	–	–	–	–

*Values below the minimum significant value.
SD = standard deviation; CVR = content validity ratio; CVR15;0.05 = 0.506.

Discussion

This study has presented evidence on the validity, reliability, and stability of data gathered using the MPI, which was applied to a Brazilian sample of patients with orofacial pain. Authors from different countries have focused on assessing the psychometric properties of the MPI and have indicated the need for modification of the original factorial structure of the three parts of the instrument when applied to different samples. For example, some authors have proposed the exclusion of some items,[3,11,15] while other authors have proposed combining certain factors due to the lack of discriminant validity found in previous studies.[3]

In the current study, item 15 needed to be deleted in order to obtain the adequate fit of Part 1 to the data. In the Portuguese version, item 15 is part of the factor translated, literally, as "state of mind and affectivity" and asks about the "state of mind of the individual during the last week."[5] It is important to note, however, that the translation of the Portuguese version of the MPI[13] differs from the proposed content in the original version. In the original version,[5] item 15 refers to the individual's "overall mood (high to low) during the past week," which differs slightly from the Portuguese translation (literally "state of mind"). This incongruity in the translation can justify the low factorial weight obtained for this item, since the concept assessed by this item does not correspond to those assessed by the other items within this factor. Another problem in the translation is the original factor referred to as "negative mood": In the Portuguese version, the translation can literally be understood as "state of mind and affectivity." This inconsistency means that a slightly different construct was measured. Thus, modifications of the Portuguese translation of item 15 and the name of the factor are encouraged in order to more accurately measure the concept. Furthermore, the Portuguese researchers who translated the MPI noted that, in their translation, they excluded two items of the original MPI ("wash the car" and "work on the car"). To the authors' knowledge, the justification for this exclusion has not been presented in the literature. Thus, it is suggested that these items

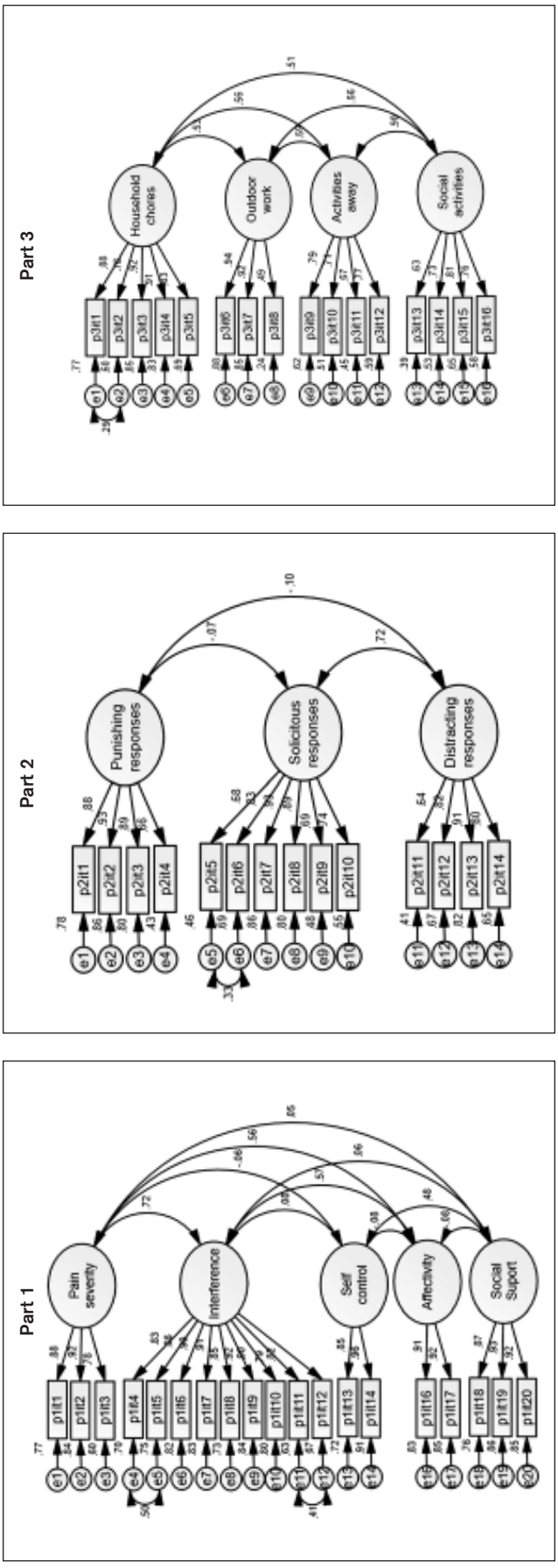

Fig 1 Orthogonal factorial structure of the Multidimensional Pain Inventory (MPI) applied to the sample of Brazilian dental patients (n = 436). *Results of the analyses after exclusion of item 15 (λ = 0.13). Part 1: λ = 0.78–0.96; χ^2/df = 2.67; CFI = 0.97; GFI = 0.92; RMSEA = 0.06. Part 2: λ = 0.64–0.93; χ^2/df = 2.97; CFI = 0.97; GFI = 0.93; RMSEA = 0.07. Part 3: λ = 0.49–0.94; χ^2/df = 3.19; CFI = 0.96; GFI = 0.92; RMSEA = 0.07).

be reincorporated into future Portuguese versions of the instrument.

Part 3 of the MPI showed no evidence of discriminant validity in its three factors. This limitation can be explained by the high correlation between the factors "activities away from home" and "social activities." The lack of discriminant validity between these factors was also detected by Audreu et al.[3] These authors justified this finding by the theoretical similarity of the two dimensions and thus suggested the grouping of these factors into a single factor. In the current study, the change proposed by Audreu et al[3] was not incorporated due to the adequate fit of the model to the present study's data. However, further studies are needed on samples with different characteristics to verify the persistence of the lack of discriminant validity, which, if confirmed, will indicate the need to change the construction of the theoretical model.

Although the MPI was developed for patients with chronic pain,[5] the results of the present study support the expansion of its use to individuals with different pain conditions (such as orofacial pain), regardless of whether it is chronic or acute. In this study, the instrument proved to be valid, reliable, and stable based on the data for the evaluation of dental pain (acute pain) and of other types of orofacial pain (both acute and chronic pain). In previous studies, the MPI was used to investigate orofacial pain in temporomandibular disorder patients[3] and migraine patients[12] in Spanish and Canadian samples, respectively. The results of these studies have confirmed the suitability of the MPI to evaluate the pain conditions of these patients. However, no studies were found on the evaluation of the psychometric characteristics of the MPI instrument results from individuals with dental pain.

A limitation of the present study may have been the non-probabilistic sampling design adopted. However, this strategy has been commonly utilized in validation studies. The use of a sufficient sample size ensures credibility of the decision-making that results from the statistical tests. Thus, it is suggested that the presented structural model be tested in other samples to confirm its stability and to increase its representativeness.

Table 3 Goodness of Fit Indices of the Confirmatory Factor Analysis (CFA) and Validity, Reliability, and Consistency Results for Different Subsamples of the Three Parts of the MPI

			CFA								
Subsample	n	λ	r_{errors} (e)	χ^2/df	CFI	GFI	RMSEA	AVE	CR	α	r^2
Part 1*											
Test sample	229	0.77–0.95	e4–e5, e11–e12	2.17	0.96	0.90	0.07	0.73–0.83	0.84–0.96	0.84–0.96	0.00–0.44
Validation sample	207	0.78–0.95	e4–e5, e11–e12	1.87	0.97	0.90	0.06	0.72–0.90	0.88–0.97	0.88–0.97	0.00–0.49
Dental pain	285	0.78–0.96	e4–e5, e11–e12	2.14	0.97	0.91	0.06	0.75–0.86	0.90–0.97	0.89–0.97	0.00–0.44
Orofacial pain	151	0.71–0.93	e4–e5, e11–e12	2.04	0.94	0.90	0.08	0.71–0.82	0.88–0.96	0.88–0.96	0.00–0.53
Part 2											
Test sample	229	0.63–0.93	e5–e6	2.48	0.95	0.90	0.08	0.62–0.73	0.87–0.92	0.70–0.92	0.01–0.44
Validation sample	207	0.59–0.95	e5–e6	2.01	0.96	0.91	0.07	0.62–0.70	0.88–0.91	0.70–0.90	0.01–0.50
Dental pain	285	0.64–0.95	e5–e6	2.05	0.97	0.93	0.06	0.62–0.72	0.87–0.92	0.86–0.90	0.01–0.42
Orofacial pain	151	0.64–0.93	e5–e6	2.70	0.92	0.90	0.09	0.65–0.72	0.89–0.92	0.89–0.92	0.01–0.56
Part 3											
Test sample	229	0.51–0.94	e1–e2	2.32	0.95	0.90	0.08	0.58–0.96	0.85–0.94	0.82–0.94	0.26–0.56
Validation sample	207	0.58–0.96	e1–e2	2.14	0.95	0.90	0.07	0.50–0.75	0.80–0.94	0.78–0.94	0.15–0.58
Dental pain	285	0.51–0.93	e1–e2	2.34	0.96	0.91	0.07	0.51–0.75	0.81–0.94	0.80–0.94	0.20–0.56
Orofacial pain	151	0.55–0.96	e1–e2	1.99	0.95	0.90	0.08	0.55–0.75	0.83–0.94	0.80–0.94	0.24–0.61

*The factorial weight of the item 15 of Part 1 was below adequate. Thus, this item was excluded, aiming to establish an appropriate factorial structure that could be applied to different subsamples of the study.
n = sample size; λ = factor weights (min–max); CFI = comparative fit index; GFI = goodness of fit index; RMSEA = root mean square error of approximation; AVE = average variance extracted; CR = composite reliability; α = internal consistency; r^2 = correlation coefficient squared.

Table 4 Multigroup Analysis Between Different Subsamples for the Three Parts of the MPI

			$\Delta\chi^2$			
	λ	*P*	Covariance	*P*	Residues	*P*
Part 1						
Test × Validation	7.82	.89	15.34	.43	128.27	< .01
Dental pain × Orofacial pain	13.77	.46	18.44	.24	80.33	< .01
Part 2						
Test × Validation	10.16	.52	2.42	.88	24.18	.04
Dental pain × Orofacial pain	8.48	.67	8.96	.18	49.11	< .01
Part 3						
Test × Validation	19.69	.70	8.17	.61	64.58	< .01
Dental pain × Orofacial pain	10.81	.55	4.62	.92	44.21	< .01

Nonetheless, the results of this study provide support for the use of the MPI in future studies on individuals with different pain conditions. Furthermore, further discussion is encouraged on the need for a reassessment of the Portuguese version of the instrument, and suggestions have been provided that can be incorporated in order to preserve the original theories of pain assessment proposed by the MPI and to allow for cross-country comparisons.

Conclusions

The MPI was shown to be valid, reliable, and stable for pain assessment among Brazilian patients with orofacial pain, making it a viable alternative for assessing the severity and impact of different pain conditions in people's lives.

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