Psychometric Properties of the Persian Version of the Short Form of the McGill Pain Questionnaire in Orthodontic Patients

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ABSTRACT

Aims Orthodontic pain is the most common reason why patients request for ceasing treatment. This study was intended to assess the psychometric properties of the Persian version of the SF-MPQ (P-SF-MPQ) after a translation and back-translation process.

Instruments & Methods The items of the questionnaire were translated from English to Persian by an orthodontist and retranslated to English by another orthodontist. To determine the face validity and content validity, a questionnaire was prepared. The reliability of the research tool was evaluated by Cronbach's alpha and intraclass correlation coefficient. In order to assess the construct validity, 200 patients were asked to fill out the P-SF-MPQ.

Findings Two items of SF-MPQ were omitted from the final version according to their low CVR. The mean of the CVI, CVR, and Impact Coefficient was obtained as 0.798, 0.53, and 3.29, respectively. To evaluate internal consistency Cronbach's alpha was calculated as 0.851. To evaluate the stability of the results The ICC for the whole questionnaire was 0.848, which was statistically significant ($p<0.001$). The KMO value was calculated as 0.90, which indicates the appropriate sample size for exploratory factor analysis (KMO>0.6). The value of Chi-square was calculated as 108.52 which indicates the desirability of the model ($p<0.001$). Factor analysis showed that items of the P-SF-MPQ can be organized into three factors: chronic pain, beating pain, and sharp pain.

Conclusion The results showed that the Persian version of the revised McGill Pain Scale in orthodontic patients is valid and can be used to evaluate orthodontic pain in Iranian patients.

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Introduction

Approximately 95% of orthodontic patients report pain during treatment [1]. Orthodontic pain is due to transient pulpitis, compression of the periodontal ligament, and mechanical trauma to the soft tissue and usually begins 4 hours after placement, peaks between 12 hours and 3 days after placement, and Then gradually decreases until the seventh day [2]. Orthodontic pain is the most common reason why patients request for ceasing treatment [1]. Patients consider this pain the worst part of orthodontic treatment [1]. The orthodontic pain is usually mild and short. However, some cases experience severe pain that might make chewing or even brushing difficult [3].

It has been demonstrated that the intensity of pain in patients undergoing orthodontic treatment is significantly and negatively correlated with their cooperation [4, 5]. On the other hand, in patients undergoing orthodontic treatment, the patient's cooperation is considered the most effective factor in the progress and success of treatment [6].

Pain management during orthodontic treatment will be suitably possible with comprehensive information concerning pain and pain assessment [7]. Pain assessment should not be exclusively limited to the intensity of pain [8]. This assessment should also entail pain quality and cognitive, psychological, and behavioral aspects [8]. Currently, a visual analog scale (VAS) is widely used for evaluating pain intensity during orthodontic treatment, comparing different interventions, and also the effectiveness of pain relief methods [7]. Other assessment techniques, such as verbal rating scales or pressure algometry have limited use [7].

The McGill pain questionnaire (MPQ), has been widely utilized in medical sciences [7]. The key benefit of this questionnaire, in comparison with the old methods including VAS, is the possibility of qualitative assessment of pain in patients and differentiating diverse types of dental pain [9, 10].

This questionnaire provides an opportunity for statistical analysis of pain due to having quantitative indices. Evaluations revealed that the MPQ has sufficient sensitivity for determining the efficacy of distinct pain control methods [9].

The long form of MPQ has been summarized as a short form. Investigations showed that The Short Form of McGill pain questionnaire (SF-MPQ) has sufficient sensitivity for pain assessment, compared to the standard long-form questionnaire and is efficient for the cases where the standard long-form questionnaire is too long [11].

 The SF-MPQ has 3 parts:

1- 15 items were about the quality of pain and each one had a pain intensity scale
2- Present Pain intensity Index (PPI)
3- VAS

SF-MPQ is filled out in 5-10 minutes. The patients must understand the meaning of the words. If Some of them are beyond the patient's vocabulary they need to be defined. Sometimes a patient is not sure whether a word in a subclass is appropriate and asks to have the words re-read. This may be done several times until the patient reaches the right decision. The administrator must utilize patience and understanding. This questionnaire helps patients to understand various aspects and accurate descriptions of pain better [9].

The English version of the SF-MPQ was designed as a valid tool for pain assessment in orthodontics and its validity and reliability have been confirmed [12]. Also, the evaluation of orthodontic pain is an important subject in our clinical work. That is why we choose the evaluation of validity and reliability of this questionnaire in the current study. However, there is a need for a valid instrument to evaluate the pain in societies with different languages. Considering this necessity in Persian-speaking orthodontic patients, it was intended to assess the psychometric properties (validity and reliability) of the Persian version of the SF-MPQ (P-SF-MPQ) after a translation and back-translation process.

Instrument and Methods

This intercultural psychometric study was conducted in the department of Orthodontics at Tabriz University of Medical Sciences in collaboration with 8 private dental offices. 200 orthodontic patients participating in the study filled out the questionnaires from August to December 2019. The patients were in the three stages of treatment including leveling and aligning (67 patients), space closure (67 patients), and finishing (66 patients). The purpose of the study was mentioned to all of the participants. Persian language-speaking patients were undergoing fixed orthodontics treatment in three treatment stages. Patients excluded who did not want to fill out the questionnaire, or who was with headaches due to diseases, migraine, and cluster headaches confirmed by physician diagnosis, any history of sinusitis or inflammation and oral-facial infection confirmed by a physician, history of recent trauma to jaws and face, psychological problems and disorders, deep tooth decays, periodontal diseases, any pathologic lesion or trauma in mouth, jaws, and face, Herpes Simplex Virus (HSV) infection confirmed by a physician, otitis, use of analgesics 24 hours before filling out the questionnaire, any other pain not related to the orthodontic treatment.

The SF-MPQ has 15 pain descriptor items. Descriptors 1 to 11 represent the sensory dimension of pain experience and 12 to 15 represent the affective dimension. Each descriptor is ranked on an intensity scale of 0=none, 1=mild, 2=moderate, and

3=severe The Present Pain Intensity (PPI) and the visual analog (VAS) are also included to provide overall intensity scores [11].

In the current study, the SF-MPQ was translated to Persian and retranslated to English and its psychometric features (validity and reliability) were evaluated. The validity of the questionnaire was investigated in terms of face, content, and construct validities. Wild *et al.* protocol was used to perform the translation and re-translation technique [13]. We followed these steps:

1- Preparation: initial work carried out before the translation work begins;

2- Forward translation: translation of the original language, also called source, version of the instrument into another language, often called the target language;

3- Reconciliation: comparing and merging more than one forward translation into a single forward translation;

4- Back translation: translation of the new language version back into the original language;

5- Back translation review: comparison of the back-translated versions of the instrument with the original to highlight and investigate discrepancies between the original and the reconciled translation, which is then revised in the process of resolving the issues;

6- Harmonization: comparison of back translations of multiple language versions with each other and the original instrument to highlight discrepancies between the original and its derivative translations, as well as to achieve a consistent approach to translation problems;

7- Cognitive debriefing: testing the instrument on a small group of relevant patients or lay people to test alternative wording and to check the understandability, interpretation, and cultural relevance of the translation;

8- Review of cognitive debriefing results and finalization: comparison of the patients' or lay persons' interpretation of the translation with the original version to highlight and amend discrepancies;

9- Proofreading: final review of the translation to highlight and correct any typographic, grammatical, or other errors;

10- Final report: report written at the end of the process documenting the development of each translation.

Development of a form to assess the face validity and content validity of the P-SF-MPQ

In order to determine the face validity and content validity of this series of items, a questionnaire was prepared and presented to the orthodontists and orthodontic patients in three different stages of treatment.

The demographic characteristics questioned at the beginning of the questionnaire were age, gender, educational level, occupation, and time passed after the initiation of orthodontic treatment. First, senior faculty members were asked to evaluate the items qualitatively to report any ambiguity and error in the grammar of the items or the presence of ay vague words, while rating the items against the Content Validity Ratio (CVR) assessment criteria. The content Validity Index (CVI), and Impact Coefficient (IC) of the items were calculated in the second and third stages by the participation of the same faculty members [14].

It was also asked for any recommendations about adding further items for pain assessment. The questionnaire assessing face validity and content validity was delivered to 15 orthodontists and was completed by 14 of them. These 14 questionnaires were used to calculate the CVR, CVI, and IC of each item and the whole questionnaire.

Content and face validity assessment

Content validity evaluated whether each item could assess pain or not. For this purpose, each item was evaluated by professionals in terms of simplicity, relevance, clarity, and necessity [14]. Content validity was determined in two qualitative and quantitative methods.

In the qualitative evaluation of the content validity, the professionals were asked to assess the items regarding the appropriateness of the grammar, the words, and the scoring of the items. The CVR and CVI were utilized in quantitative evaluation [15]. For determining CVR, the professionals were asked to evaluate each item based on the three-part scale of "essential", "beneficial but not essential", and "not essential". Afterward, the answers were analyzed using the following equation:

$$CVR = \frac{n_e - \frac{n}{2}}{\frac{n}{2}}$$

n_e=number of professionals who selected "essential"
n=the total number of professionals.

The CVR calculated by the formula is between 0 and 1 and is compared with the relevant numbers in the Lawshe table [16]. In the present study, CVR was obtained as 0.51 which has an acceptable value considering 14 professionals.

Next, for evaluating CVI, three criteria of simplicity, relevance, and clarity were assessed by the same 14 orthodontists separately using a four-part Likert scale (completely relevant: 4, relevant: 3, partly relevant: 2, irrelevant: 1). The CVI was calculated summing scores of 3 and 4 obtained for each item and dividing by the total number of professionals. The CVI is between 0 and 1 and items were accepted with CVI > 0.79 [15].

In the next step, the face validity of the items was evaluated by presenting them to orthodontists and patients. The main question in this regard is whether the instrument seems suitable for orthodontic patients and lay persons. To determine

face validity, both quantitative and qualitative techniques were utilized [15]. In qualitative evaluation, difficulty level, disproportionality, and vagueness of the items were scrutinized. Furthermore, the questionnaire was evaluated and filled out by 10 patients to determine face validity qualitatively.

For quantitative evaluation of face validity, Impact Coefficient was applied as scores 5, 4, 3, 2, and 1 for completely appropriate, appropriate, moderately appropriate, a little appropriate, and not appropriate, respectively. Next, the Impact Coefficient of each item was calculated considering scores 5 and 4 using the following formula: Impact Coefficient= Frequency (%) × Importance.

In this formula "Frequency" is the number of responses "completely appropriate" and "appropriate" for each item and "Importance" refers to the scores of 5 and 4 regarded for each answer. The result is a number between 1 to 5 and scores higher than 1.5 for each item are acceptable. Items with scores lower than the acceptable criterion were reevaluated and omitted in case of not being accepted. Finally, the remaining items were organized as a questionnaire.

Reliability assessment
In this study, the reliability of the research tool was evaluated by Cronbach's alpha to assure the similarity, accuracy, predictability, and reliability of the results of P-SF-MPQ among orthodontic patients in Persian-speaking countries [17]. In addition, the Intraclass Correlation Coefficient (ICC) was calculated to assess the consistency of the results [18].

Cronbach's alpha > 0.7 and ICC ≥ 0.8 were considered acceptable [14]. The sample size for reliability assessment was 40 patients. In order to calculate ICC, 40 patients attending the Orthodontics Department of Tabriz Faculty of Dentistry filled out questionnaires two times at an interval of two weeks. Afterward, the answers were evaluated in terms of consistency in the results. Assessment of the indices of face validity, content validity, and reliability, determined the construct validity of the P-SF-MPQ possible.

Construct validity assessment
The construct validity of BPQ was examined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). It is recommended to perform each EFA or CFA by participating at least 200 ones from the target group [19]. In order to assess the construct validity of the P-SF-MPQ, 200 patients (40 patients of the Orthodontics department of Tabriz Dentistry Faculty and 160 patients from 8 private orthodontics offices in Tabriz) were asked to fill out the P-SF-MPQ.

The Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of Sphericity were utilized to determine whether the data were suitable for factor analysis or not. To evaluate the factor validity of the P-SF-MPQ tool, exploratory factor analysis was used. Exploratory and confirmatory factor analyses were conducted using SPSS (Statistical Package for the Social Sciences) and AMOS (Analysis of a Moment Structures) and LISREL software respectively. Maximum Likelihood Estimation (MLE) was used for model fitting and the matrix of the variance and covariance of data were entered into the model input data [20]. In this confirmatory factor analysis, the ratio of chi-square to the degrees of freedom, Goodness of Fit Index (GFI), Adjusted GFI (AGFI), Comparative Fit Index (CFI), Non-Normed Fit Index (NNFI), Root Mean square Residual (RMR), and Root Mean Square Error of Approximation (RMSEA) were used as the measures of model fitness. The ratio of chi-square to the degrees of freedom lower than 3 was accepted. The GFI, AGFI, CFI, and NNFI indices larger than 0.9, RMR close to 0, and RMSEA < 0.08 were considered acceptable for model fitness [21, 22].

Exploratory factor analysis was performed using SPSS software and principal components analysis. Data periods were performed using the Oblimen method. Components whose eigenvalues were greater than one were extracted. The size of loading above 0.5 was considered desirable [23]. Using regression models and utilizing the Spearman correlation test, T-test, and one-way analysis of variance (ANOVA) test relationships between the background variables and the mean scores of factors, the relationship between each background variable and the mean of factors were investigated. Kolmogorov-Smirnov statistical test was used to check the normality of continuous data distribution and the Shapiro-Wilk test was used to check the normality of sequential data distribution. Normal data were reported as Mean±SD and abnormal data were reported as Median ± IQR.

Findings
Translation and retranslation of the SF-MPQ
The items of SF-MPQ were translated into Persian. The items of the questionnaire were translated from English to Persian by an orthodontist proficient in English and Persian and were again retranslated to English by another person. The new English questionnaire was compared with the original one to find any inconsistency in the meaning of the items. In all, the items were translated to Persian with minimum changes in the structure to maintain the meaning of the items. All the items were designed in the same constructs as they were in the original SF-MPQ. Moreover, emojis were used in the VAS part for the subjective evaluation of the patient's pain intensity. The meaning of the items in both the new English questionnaire and the original one did not differ from each other.

Face validity and content validity
Considering the obtained Impact Coefficients, seven items were noted as not acceptable. At this time, orthodontists participating in the study were questioned again concerning the answers. English items of the main questionnaire were evaluated, and the needed consultations were performed.

Some changes were made in items and five items were accepted by orthodontists after minor modifications. Two items of SF-MPQ, namely "fearful" and "punishing-cruel" pains were omitted from the final version of the translated questionnaire according to their low CVR. The mean of the CVI, CVR, and Impact Coefficient for the items of the P-SF-MPQ was obtained as 0.798, 0.53, and 3.29, respectively. The mean value of CVI in simplicity, relevance, and clarity parts was obtained as 0.79, 0.8, and 0.8, respectively.

Reliability of the Questionnaire
Following the statistical analyses, Cronbach's alpha was calculated as 0.851, which is acceptable. [24] In addition, the ICC for the whole questionnaire was 0.848, which was statistically significant (p<0.0001). As a result, the SF-MPQ was found to have acceptable reliability.

Construct Validity of the Questionnaire
Demographic information of the participating patients in the construct validity assessment of the P-SF-MPQ was presented in Table 1.

Table 1) Demographic information of the samples

Variable	N (%)	
Age (Years)		
<10	0	
10-20	69	(34.5)
20-30	88	(44.0)
30-40	39	(19.5)
>40	4 (2.0)	
Gender		
Male	51 (25.5)	
Female	149 (74.5)	
Education level		
Illiterate	0	
High school student	66 (33.0)	
High school graduate	33 (16.5)	
University degree	101 (50.5)	
Occupation		
Unemployed	41 (20.5)	
High school student	66 (33.0)	
University student	45 (22.5)	
Governmental job	19 (9.5)	
Private sector	29 (14.5)	

The KMO was found as 0.9, which is indicative of the suitable sample size for exploratory factor analysis (more than the min of 0.6). Furthermore, the significance level of Bartlett's test of Sphericity was obtained as p<0.001 showing a significant relationship between the variables.

The scree plot extracted from factor analysis showed that all items of the P-SF-MPQ can be organized into three factors. Based on the literature, these three factors were named as follows:

Factor one: chronic pain, factor two: beating pain, and factor three: sharp pain.

Confirmatory factor analysis: Following exploratory factor analysis, confirmatory factor analysis was performed by the obtained assumptions using LISREL software. The results of the confirmatory factor analysis are reported in Table 2.

Table 2) Results of confirmatory factor analysis

Index	Number	Interpretation
Chi-square	108.52	**P<0.001**
RMR	0.036	**Close to zero (acceptable)**
SRMR	0.051	**Close to zero (acceptable)**
Chi-Square/ D.F	1.75	**1-5 (acceptable)**
GFI	0.92	**Almost 0.9 (acceptable)**
AGFI	0.89	**Almost 0.9 (acceptable)**
NFI	0.95	**Almost 0.9 (acceptable)**
NNFI	0.97	**Almost 0.9 (acceptable)**
IFI	0.98	**Almost 0.9 (acceptable)**
CFI	0.98	**Almost 0.9 (acceptable)**
RMSEA	0.061	**< 0.1 (acceptable)**

Discussion

There is a need for a valid instrument to evaluate the pain in societies with different languages. Considering this necessity in Persian-speaking orthodontic patients, it was intended to assess the validity and reliability of the P-SF-MPQ after a translation and back-translation process.

Following the translation and retranslation of the SF-MPQ, the validity and reliability of the Persian version (P-SF-MPQ) were evaluated and confirmed in Iranian patients. The validity of the original version (in English) of SF-MPQ had been confirmed for evaluating pain in orthodontic male and female patients [12]. In addition, it had been determined that VAS has the required validity for subjective examinations, such as pain evaluation by patients [12].

The data suggest that the SF-MPQ can provide a valid, responsive, and efficient assessment of both neuropathic and nonneuropathic pain qualities [25]. Also, previous studies showed that SF-MPQ-2 has adequate validity and reliability to measure pain in people with Parkinson's disease [26]. In the previous studies, the validity and reliability of Turkish [27] and Swedish [28] versions of SF-MPQ have been confirmed.

In this intercultural psychometric study, the items of the questionnaire were evaluated in terms of face validity and reliability after the translation and retranslation of the SF-MPQ. The answers of 10 patients were used for determining qualitative face validity and 14 orthodontics specialists were questioned for quantitative face validity and content validity. Moreover, the responses of 40 orthodontic patients were utilized to determine the reliability and 200 orthodontic patients were surveyed for the construct validity of the questionnaire. According to the statistics, this sample size was sufficient for calculating the intended indices [19].

First, seven items were diagnosed as invalid and five items were validated after consultation with orthodontists and modifications in the translation and writing structure. Therefore, two items of the SF-MPQ, including the "fearful" and "punishing-cruel" were omitted from the final version of the translated questionnaire. It seems that these terms are not usually applied in Persian for expressing orthodontic pain. So the P-SF-MPQ has 2 items less than the original SF-MPQ.

In this study, it was identified that translated version of SF-MPQ has a suitable CVI and CVR. Unfortunately, we do not have any similar study that investigates the validity of the Persian version of SF-MPQ.

Also in this study, Cronbach's alpha and ICC were obtained as 0.851 and 0.848, respectively, and were acceptable [20]. In the study performed by Kachooei et al. [29] on the Persian-translated version of SF-MPQ about the pain of patients affected by knee osteoarthritis, the mean ICC and Cronbach's alpha at the first visit, and Cronbach's alpha at the second visit were calculated as 0.9, 0.88, and 0.91, respectively. Adelmanesh et al. [30] in patients with neuropathic pain reported ICC and Cronbach's alpha for the translated version of SF-MPQ as 0.94 and 0.9, respectively. Gauthier et al. [12] for the pain of cancer patients found Cronbach's alpha of the SF-MPQ as 0.89 in young and 0.93 in old patients. In the study performed by Mehdizadeh et al. [26], Cronbach's alpha and ICC were 0.93 and 0.94 for SF-MPQ, respectively.

Although the reliability of SF-MPQ for assessing the pain of orthodontic patients was reported to be acceptable, it is lower than other studies on this questionnaire about the pain of other regions, including knee osteoarthritis, neuropathic pain, and cancer pain. probably it is because of the constantly changing nature of orthodontic pain at different times.

In the study performed by Nikniaz et al. [31], the celiac disease quality of life questionnaire (CDQOL) was translated and validated. The content validation ratio (CVR) and the content validity index (CVI) were used for content validity assessment. The construct validity was assessed by exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The internal consistency and test-retest reliability were measured through Cronbach's alpha and intraclass correlation coefficient (ICC). In this study, we used the same pattern to evaluate the validity and reliability of P-SF-MPQ.

In order to simplify data analysis, the items of the questionnaire were classified under several titles. The scree plot extracted from factor analysis demonstrated that three factors can be selected for the final analysis. These three variables were named based on the literature review: chronic pain, beating pain, and sharp pain.

Following exploratory factor analysis, confirmatory factor analysis was conducted with the obtained assumptions. Considering the obtained values and acceptable values for the indices, the recommended model in this study is suitable.

No significant difference was observed between orthodontic pain of women and men (p=0.42), which is in line with the results of the previous investigations [3]. It should be noted that the number of men participating in the present study (n=51) was almost one-third of the number of women (n=149).

Rosas et al. [32] revealed that demographic and clinical factors affect pain perception and its distinct aspects. In this study, pain intensity in all three factors had a relationship with the time passed after the initiation of orthodontics treatment, and about the items of factor 2 (beating pain) was related to the patient's age, too. However, the relationship between all types of pain and the time passed after orthodontics treatment was contrary to the previous studies that reported the highest orthodontics pain intensity simultaneous with locating the first archwire or after the second orthodontic treatment session [33].

It seems that pain in different phases of fixed orthodontics treatment (i.e. leveling and aligning, space closure and finishing) varies in terms of quality and characteristics. In the current study, all three phases were investigated together and they were not different.

In the present study, patients filled out the questionnaire in all stages of fixed orthodontic treatment to provide high generalizability. However, it seems that the quantity and quality of the pain vary at different stages of orthodontic treatment. It is recommended to assess and compare the pain resulting from diverse appliances and different orthodontic mechanics through the employment of the P-SF-MPQ. Further studies can also compare the results from the P-SF-MPQ and other pain evaluation methods in orthodontic patients.

Conclusion

According to the findings of this exploratory psychometric study, the Persian version of the SF-MPQ (P-SF-MPQ) has appropriate validity and reliability. Applying the P-SF-MPQ as a valid and reliable questionnaire, orthodontists can easily and carefully evaluate and manage the pain of their orthodontic patients. The questionnaire can be beneficial for orthodontic patients too, in a way that they can assess their orthodontic pains by the P-SF-MPQ. Moreover, the Persian version of SF-MPQ could be utilized as a research tool for orthodontic researchers and as an educational tool for university students.

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Ethical Permissions: Approval of the ethics code in research was obtained first of declaration of Helsinki from the Committee of Ethics in Research at Tabriz University of Medical Sciences (IR.TBZMED.REC.1397.623). Moreover, the participants were informed about the research goals and objectives and were assured that they could voluntarily exit the study at any stage. Oral and written informed consent was obtained from all of the participants. An identification code was assigned to each participant during the study. All the information was served anonymous and confidential and all the ethical considerations for using documents were followed.

Conflicts of Interests: This study is a part of a postgraduate thesis by Dr. Ehsan Balaghi at Tabriz University of Medical Sciences supervised by Dr. Aydin Sohrabi and Dr. Saeideh Ghaffarifar.

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