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Psychometric properties of the Persian avoidance-endurance questionnaire in Iranian patients with chronic non-specific low back pain a cross-sectional

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Abstract

Introduction: The Avoidance-Endurance Questionnaire (AEQ) is a suitable instrument for assessing pain-related endurance and avoidance responses in individuals with chronic non-specific low back pain (CNSLBP). The aim of this study was to assess of factor structure and psychometric properties of Persian version of AEQ.

Materials and Methods: The groups that were recruited in this psychometric study were 120 individuals who had history of CNSLBP of more than three months. First, the Persian AEQ factorial structure has been investigated on the basis of the Exploratory Factor Analysis (EFA) with the Principal Axis Factoring and Promax oblique rotation method. An analysis of the usefulness of the extracted model was then performed through a confirmatory factor analysis (CFA) that included bootstrapping procedures and modification indices. Moreover, test-retest reliability and internal consistency were tested to realize the stability and reliability of the factors identified.

Results: The EFA demonstrated two factors in the emotional domain, three in the cognitive domain and four and three in the behavioral domain when it is mild and severe pain, respectively. The Kaiser-Meyer-Olkin (KMO) values were between 0.76 and 0.85; Bartlett Test of Sphericity was significant ($p < 0.001$) which proved that the data is sufficient to conduct factor analysis. The CFA also justified the extracted structure, it was shown that the model fit indices are in the range of poor to acceptable Root Mean Square Error of Approximation (RMSEA) = 0.05-0.10, Comparative Fit Index (CFI) = 0.88-0.98, and χ^2/df = 1.36-2.45. Internal consistency scores varied between 0.66 and 0.91, whereas the Intraclass Correlation Coefficient varied between 0.42 and 0.83, which is satisfactory inter-dimensional reliability.

Conclusion: The AEQ Persian version eventually exhibited a nine-factor structure whose models of fit were in the range of poor to acceptable. In addition, the results connected to internal consistency, test-retest indicate the adequate psychometric characteristics and clinical validity of this version.

Keywords: Low back pain, Psychometrics, Questionnaires, Test-retest reliability, Avoidance-endurance model

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Introduction

Although low back pain (LBP) is one of the most prevalent musculoskeletal disorders, it affects individuals of all age groups, and it is the leading cause of disability in all age groups. This disease presents a significant clinical and socioeconomic burden on the healthcare systems of the world (1). Although the prevalence of LBP is expected to increase significantly by 2050, the International Consensus on the Global Burden of Disease 2021 estimates that the disease burden will be especially high in areas that will include the Middle East and North Africa (2). A significant part of this load can be attributed to chronic non-specific low back pain (CNSLBP), which is never predetermined by biomechanical parameters alone but also regulated by a complex of cognitive, behavioral, and psychosocial factors that affect the expression of pain and subsequent disability (3).

A broad scholarly research has extensively supported the connection between psychological reactions and chronic pain (4). The Fear-Avoidance Model by Vlaeyen and Linton explains how catastrophising induced by pain causes fear, avoidance behavior, physical deconditioning, and finally leads to the acquisition of long-term disability (5). Conversely, endurance responses imply a pattern in which people maintain an activity even when they suffer pain (and even reduce or suppress nociceptive signals); maladaptive coping mechanisms can increase the persistence of symptoms or precondition the future overuse of injuries (6). Hasenbring and colleagues have conceptualised these ideas in the Avoidance-Endurance Model (AEM) and identified maladaptive coping as comprising two major domains: fear-avoidance responses (FAR) and endurance responses (ER) (6). The Dynamic Model of Affect also highlights the importance of impaired emotional processing in the development of these behavioral patterns, thus further leading to the persistence of symptoms (7). The patients with CNSLBP also showed discernible differences in lumbar muscle activities patterns in avoidance-reactive and endurance-reactive groups during ambulation (8). In addition, the two groups were differentiated by the measures of pain intensity and functional disability (9).By combining them, these theoretical frameworks demonstrate the centrality of Avoidance-Endurance model in the conceptualization of CNSLBP and the necessity of a systematic evaluation of these constructs in the clinical practice and research (10). The stratification of patients with CNSLBP based on their coping mechanisms could also be utilized in clinical practice to maximize the homogeneity of rehabilitation groups and, therefore, the effectiveness of the therapeutic intervention (8, 9).

Since the Avoidance-Endurance model is of critical concern, researchers have a critical role to play in ensuring that they develop assessment tools that have undergone the rigorous psychometric assessment process with utmost methodological rigor (6). One instrument that is one of the most effective in assessing cognitive, emotional, and behavioral aspects of pain-related coping is the Avoidance-Endurance Questionnaire (AEQ), which was developed by Hasenbring and others in 2009 (10). The AEQ, which is made up of nine different subscales that represent diverse aspects of the Fear-Avoidance Response (FAR) and the Endurance Response (ER) has been translated into more than one language (11-15). However, cross-cultural assessments of the instrument have indicated that the factor structure, subscale constructions, and performance of items differ significantly between different cultural contexts and thus the call to have population-specific psychometric validation (11-15). Such structural differences can best be explained by cultural differences in beliefs about pain, style of response, and semantic interpretation, which also argues the need to use methodologically sound adaptation procedure (16).

In the narrow case of the Iranian people, the AEQ was translated into the Persian language and subsequently only validated among patients with chronic pain in their necks (13). Although the said preliminary study had acceptable internal reliability, it failed to perform an exploratory and confirmatory factor analysis, and since there is a great difference in the psychological, behavioral, and motor aspects of the neck-pain and the LBP groups, it is risky to assume structural equivalence, According to empirical evidence, CNSLBP patients have a particular motor-psychological profile, different patterns of kinesiophobia, and specific manifestations of avoidance and endurance behaviors in comparison with cervical pain patients (17-19). Therefore, a concentrated analysis of the factor structure of the Persian AEQ in a CNSLBP cohort is a gap of critical necessity that needs to be fulfilled in order to have a valid and useful instrument. Cultural factors further intensify the need for rigorous adaptation, as pain expression, coping behaviors, and cognitive interpretations are shaped by sociocultural norms. Research demonstrates that cross-cultural differences significantly influence responses to pain questionnaires, necessitating careful examination of conceptual, semantic, and operational equivalence during the adaptation process. A culturally validated Persian version of the AEQ tailored to CNSLBP would thus enhance the accuracy of psychological assessment and support clinical decision-making in Iranian populations. In line with this, the present study attempted to evaluate these hypotheses:

1. The factor structure of the Persian version should be similar to that of the original AEQ

2. The subscales of the Persian version are supposed to have good reliability in this population.

Materials and methods

This study employed a psychometric design. A total of one hundred and twenty participants with CNSLBP were conveniently selected by a physical therapist and an orthopedic specialist between the summer and fall of 2019 from all the clinics and hospitals in Tehran. While several approaches exist for determining an adequate sample size, this study followed Kline's recommendation, which suggests that a sample size of approximately 100 participants is sufficient for psychometric analyses (20). After the initial analyses, I conducted a post-hoc power test with G*Power 3.1.9.7 (21) to determine the statistical power of the study. To achieve a medium level of association (r = 0.30) between subscales, such as reliability studies, at a two-tailed, 0.05 level of significance and a sample size of 120 respondents, the power was 0.92 (92 per cent). The result indicates that there is enough power to identify moderate effects.

Eligible participants were individuals experiencing CNSLBP localized between the 12th thoracic vertebrae region and the gluteal chin, without radiation to the lower extremities, and with symptoms persisting for 12 weeks or longer (22, 23), visual analogue scale (VAS) score between 20 and 70 mm on the 0–100 mm scale. The participants were native Persian speakers, patients who were 18 years and above. Exclusion criteria included cognitive impairments, alcohol dependence, a history of fracture, and discopathy (24), canal stenosis (25), pregnancy, or lumbar radiculopathy(26).

Demographic information, including sex and age, was collected using a custom-designed self-report questionnaire. Following eligibility screening, participants were informed about the study procedures—specifically, the completion of the Persian version of the AEQ and those who agreed to participate provided written informed consent. The study protocol was approved by the institutional ethics committee (No:IR.USWR.REC.1396.205).

Instruments

Avoidance-Endurance Questionnaire (AEQ)

The AEQ comprises 49 items and evaluates cognitive, emotional, and behavioral responses to pain. The emotional domain encompasses the Positive Mood Scale (PMS) and anxiety/depression scale (ADS). cognitive domain, the subscales include the Thought Suppression Scale (TSS), Catastrophizing Scale (CTS), and Helplessness/Hopelessness Scale (HHS). In the behavioral domain, subscales include the Avoidance of Social Activities Scale (ASAS), Avoidance of Physical Activities Scale (APAS), and the Pain Persistence Behavior Scale (PPS), Humor/Distraction Scale (HDS), and Behavioral Endurance Scale (BES, 12 items; sum of PPS and HDS) for ER, reflecting behavioral patterns of avoidance or endurance in response to chronic pain. Each question had seven options on a Likert scale, rated from 0 (never) to 6 (always): 0 for never, 1 for almost never, 2 for rarely, 3 for sometimes, 4 for often, 5 for very often, and 6 for always. You could use either the total score or the average score to show a participant's response level, but in this study, we went with the average score for each subscale when analyzing the data (10). Under the behavioral dimension, the reactions of the participants to NSCLBP are outlined under two circumstances:

mild pain and severe pain. In the process of briefing the participants, they were asked to identify how they would answer the questionnaire in cases where there was mild pain and where they faced severe pain. The AEQ version in Persian was utilized (13). Table 1 contains all of the questionnaire's details.

Table 1. Avoidance-endurance questionnaire.

Domain	Subscales	Response	Item	Number
PER	ADS	FAR	1, 3, 4, 6 ,7 ,8 10	7
	PMS	ER	2, 5, 9	3
PCR	HHS	FAR	1, 2, 3, 6, 8, 9, 11, 12, 14	9
	CTS	FAR	4, 7, 15	3
	TSS	ER	5, 10, 13, 16	4
PBR $_{MP/SP}$	ASAS $_{MP/SP}$	FAR	2, 7, 8, 14, 18, 21	6
	APAS $_{MP/SP}$	FAR	1, 3, 9, 10, 20	5
	HDS $_{MP/SP}$	ER	13, 16, 17, 22, 23	5
	PPS $_{MP/SP}$	ER	4, 5, 6, 11, 12, 15, 19	7
	BES $_{MP/SP}$	ER	13, 16, 17, 22, 23, 4, 5, 6, 11, 12, 15, 19	12

PER; Patient Emotional Response, PCR; Patient Cognitive Response, PBR; Patient Behavioral Response, ADS; Anxiety/Depression scale, PMS; Positive Mood scale, HHS; Help/Hopelessness scale, CTS; Catastrophizing scale, TSS; Thought Suppression scale, ASAS; Avoidance social Activity scale, SP; severe pain, MP; mild pain, APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale, BES; Behavioral. Endurance scale. FAR: fear avoidance response, ER: endurance response.

Visual Analogue Scale (VAS)

It is the standard, accepted method in our field for determining the true severity of the pain, which was used to assess the pain intensity. It was as simple as drawing a 100-mm horizontal line with the words "worst pain imaginable" at one end and "no pain" at the other. Every patient simply marked the spot on the line where they felt the most pain. The score was obtained by measuring the distance in millimeters between the "no pain" end and their location using a ruler. It was a mainstay in pain research, and researchers consistently supported its strong validity and reliability (27). Further, all measures were done by one evaluate who had undergone rigorous training which ensured that there was consistency in ratings as well as the inter-rater disparity was very low.

Statistical analysis

Factor structure and structural validity

In order to investigate the latent structure inherent in the pain-related data, the exploratory factor analysis (EFA) was used, which, in turn, allowed the current patterns of response to emerge, and no theoretical restrictions were imposed on them. The extraction to determine the latent constructs in the EFA was done through Principal Axis Factoring (PAF) and Promax oblique rotation method (28, 29). Sampling adequacy was measured using Kaiser–Meyer–Olkin (KMO), and a value of greater than 0.77 was considered satisfactory, and communalities greater than 0.30 were included (30). To determine the applicability of the data to a PAF, the Bartlett test of sphericity was then used, and statistically significant results were obtained, which show the suitability of the data to be analyzed. (15). Following the elimination of cross-loadings and the items having communality values lower than 0.30, the PFA was re-run to achieve a more basic, interpretive, and stable factor model. This process of refinement by iteration increases the clarity of factor loadings and also the robustness and conceptual soundness of the extracted factors (31).

The analyses were conducted as structural analyses on the emotional level, cognitive level, and behavioral level. The number of factors was determined by using two criteria: the eigenvalue criterion, in which the eigenvalues exceeding one were maintained; the scree plot, which offers a graphical representation of the eigenvalues (29). The final solution included only those items whose loading to the factor exceeded 0.40 (10, 28), whereas those with a cross-loading (the second greater than 0.35) were rejected (15).

Confirmatory factor analysis (CFA) was performed in AMOS-20 (IBM, Chicago, IL, USA) to assess the validity and fit of the identified models following EFA component extraction. Multivariate normality was assessed by calculating Mardia's (1985) coefficient of multivariate kurtosis and looking at its critical ratio (CR). The sample can be considered multivariate normal at the 0.05 significance level if the CR of Mardia's coefficient of when the multivariate kurtos is less than 1.96, indicating that it is not statistically significantly different from zero (32, 33). The Bollen–Stine bootstrap method with 2,000 resamples was used if the multivariate normality assumption was broken (34). An appropriate model fit and support for model adoption are shown by a P-value of more than 0.05. Modification indices (MI) may be taken into consideration if the model is rejected, as long as their use is backed by valid theoretical reasoning (28). MI indicates the expected reduction in the chi-square difference ($\Delta\chi^2$) associated with releasing a parameter (which has been held constant) to freedom. With the standard significance level of 5% ($\alpha = 0.05$), the critical value of $\Delta\chi2=3.84$; any value above that level means that the difference between the base model and the modified model is statistically significant and therefore indicates that the proposed change has a noticeable effect on the goodness of fit, and a value below that level indicates that the proposed change has no observable effect on the goodness of fit (35, 36).

Model fit was assessed using three standard goodness-of-fit indices: The Chi-square (χ^2) statistic, the Root Mean Square Error of Approximation (RMSEA), and the Comparative Fit Index (CFI). A Chi-square value below 3 indicates an acceptable model fit, while values below 2 reflect a good fit. RMSEA values under 0.08 suggest a good fit, those between 0.08 and 0.10 indicate a moderate fit, and values exceeding 0.10 imply a poor fit. The CFI, commonly used in structural equation modeling, reflects model adequacy, with values above 0.90 denoting good fit, between 0.80 and 0.89 indicating marginal fit, between 0.60 and 0.79 suggesting poor fit, and below 0.60 representing very poor fit. (37, 38). In addition, the intercorrelation between extracted factors of the Persian version of the AEQ was also measured by calculating Spearman's rank correlation coefficients among the factors.

Reliability

To compute intraclass correlation coefficients (ICCs), the data were entered into SPSS version 20 (IBM, Chicago, IL, USA) using two-way random one effects model with emphasis on $ICC_{(2,1)}$ (sixty participants with CNSLBP twice, at the baseline and one week later (39)). The level of reliability was considered to be satisfactory when the estimated ICC was at least 0.70. The SEM was determined by replacing the ICC value and the standard deviation of the raw scores (first-round data) in the formula that was established, and the minimal detectable change (MDC) was derived based on the SEM. The equations used are as below (39);

$$SEM = SD \times \sqrt{(1 - ICC)}$$

$$MDC = SEM \times 1.96 \times \sqrt{2}$$

The internal consistency was found to be the key measure of homogeneity between the items in one construct. The traditional measure used in the rehabilitation research was Cronbach's alpha, which was therefore applied in this analysis. This coefficient was calculated using first-round data and gave a value of 0.70, thus showing that there is an acceptable level of internal reliability (40).

Results

The average age of the participants was 36.4 years (SD 10.5), and the age range was 18 to 68 years. The pain intensity at baseline, measured on a 100-mm VAS, had a mean of 30.93mm, with 70.8 percent females and 29.2 percent males. The rest of the descriptive statistics are given in Table 2. All the combined data obtained from the questionnaires showed non-normal data distributions (Kolmogorov-Smirnov and Shapiro-Wilk tests); therefore, the present study employed non-parametric analytical methods to investigate the inter-relationships between the measured variables. There was no missing data.

Table 2. Distribution of quantitative variables in the study sample (No = 120).

Variable	Range	Mean	Standard deviation
Age (years)	19–68	36.36	10.51
Weight (kg)	40–104	70.01	12.36
Height (cm)	140–186	167.0	10.8
Body Mass Index (BMI)	16.2–35.2	24.86	3.72
Current Pain Intensity (mm)	0–100	30.93	19.0
Duration of Pain (months	2–240	27.84	37.28
Physical Activity Level (days)	0–48	2.97	5.66

Factor structure

For the emotional dimension, the KMO hit 0.859, and Bartlett's test was highly significant ($\chi^2 = 502.768$, df = 36, $p < 0.001$), confirming the sample was plenty adequate.

The two factors were extracted, with eigenvalues of 4.53 (50.33% of the variance) and 1.43 (15.97% of the variance), which together explained 66.31% of the total variance. The first factor loaded on items 3, 4, 6, 7, 8, and 10. The second one included items 2, 5, and 9. Item 1 was dropped because its loading crossed.

For the cognitive dimension, the KMO hit value was 0.837, and Bartlett's test was significant ($\chi^2 = 842.202$, df = 78, $p < 0.001$). The three factors were pulled out with eigenvalues at 5.49 (42.22% of the variance), 2.27(17.46% of the variance), and 1.22 (9.41% of the variance), adding up to about 69.10% of the variance explained. The biggest one covered items 1, 2, 3, 8, 12, and 14; the next hit 4, 7, and 15; and the smallest took in 5, 10, 13, and 16. Items 6, 9, and 11 were omitted because their loadings were either too low or crossed over too much with others. Table 3 and Table 4, respectively, list the factors that were extracted to represent the emotional and the cognitive dimensions.

Table 3. Promax rotated factor matrix for the two-factor emotional dimension of the Persian version of the AEQ (n = 120).

	Item	ADS	PMS	Communalities
E8	vulnerable, sensitive	0.815	0.058	0.616
E10	depressed/gloomy	0.790	-0.063	0.68
E4	sad, blue	0.782	-0.065	0.67
E7	nervous, uneasy	0.710	-0.082	0.572
E3	anxious, tense	0.680	0.124	0.387
E6	hesitant/wary	0.594	-0.011	0.359
E2	happy, anyway	0.135	0.885	0.673
E5	cheerful, in good mood	-0.008	0.842	0.716
E9	optimistic, anyway	-0.183	0.595	0.503

Table 4. Promax rotated factor matrix for the three-factor cognitive dimension of the Persian version of the AEQ (n = 120).

	Item	HHS	CTS	TSS	Communalities
C2	It seems the pain will never ease up.	1.000	0.005	-0.144	0.847
C14	How long do I have to put up with pain like this?	0.840	0.062	-0.052	0.686
C1	Why do I have to bear this heavy burden	0.759	-0.162	0.024	0.557
C8	Oh, it is not going to get any better.	0.716	0.129	0.036	0.614
C3	This damn pain spoils everything	0.707	-0.095	0.153	0.62
C12	Whatever will I do if it gets worse again?	0.588	0.056	0.247	0.61
C16	It is important not to let myself go now.	0.095	0.821	-0.093	0.681
C10	Pull yourself together!	-0.089	0.746	0.120	0.58
C13	Don't make such a fuss!	-0.111	0.678	-0.017	0.428
C5	It is important for me now to hold on!	0.070	0.523	-0.031	0.287
C4	I can't have a tumor, can I?	-0.016	-0.065	0.875	0.722
C7	I wonder if I have the same serious illness as..	0.047	-0.076	0.823	0.695
C15	It is not a serious illness, is it?	0.055	0.228	0.596	0.532

HHS; Help/Hopelessness scale, CTS; Catastrophizing scale, TSS; Thought Suppression scale.

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For the behavioral side under mild pain conditions, the KMO value landed at 0.76, and Bartlett's test of sphericity turned out significant ($\chi^2 = 429$, df = 78, $p < 0.001$). the four factors were pulled out with eigenvalues of 3.449 (26.52% of the variance), 2.243 (17.25% of the variance), 1.455 (11.19% of the variance) , and 1.246 (9.58% of the variance), covering about 64.55% of the total variance. Questions 19 and 20 were dropped due to the lack of communality greater than 0.3. Those that were dropped (items 5 and 18) are those with factor loadings of less than 0.4. Items 3, 7, 12, 15, 21, and 23 were discarded since they either had cross- loadings or they did not obtain adequate loadings. Other factors were pointed out in Table 5.

Table 5. Promax rotated factor matrix for the four-factor behavioral dimension under mild pain conditions in the Persian version of the AEQ (n = 120).

Item	$ASAS_{MP}$	APAS MP	HDS MP	PPS MP	Communalities	
BMI14	When I am in pain, I break off a meeting with friends.	0.751	0.139	0.079	0.015	0.666
BMI8	When I am in pain, I cancel a visit to an event	0.699	0.191	0.035	0.066	0.655
BMI6	When I am in pain, I clench my teeth..	0.638	-0.212	-0.065	0.045	0.346
BMI2	When I am in pain, I avoid visiting my friends	0.579	0.181	0.033	-0.088	0.456
BMI9	When I am in pain, avoid physically strenuous activities.	-0.146	0.968	-0.065	0.053	0.837
BMI10	When I am in pain, I avoid doing sports.	0.145	0.560	-0.023	-0.065	0.42
BMI1	When I am in pain,I stop doing physically demanding activities.	0.111	0.471	0.048	-0.009	0.306
BMI16	When I am in pain, I take it with a laugh.	0.028	-0.088	0.814	0.083	0.731
BMI13	When I am in pain, I laugh heartily anyway.	-0.222	0.177	0.736	-0.010	0.621
BMI17	When I am in pain, I let my family persuade me into things even if I do not feel like it.	0.114	-0.114	0.482	-0.160	0.374
BMI11	When I am in pain, I say to myself: “Don’t make such a fuss!”.	0.053	0.069	-0.030	0.811	0.66
BMI4	When I am in pain, I take care not to let myself go	-0.023	0.058	-0.135	0.622	0.343
BMI22	When I am in pain, I distract myself with physical activity.	0.043	-0.120	0.116	0.492	0.344

ASAS; Avoidance social Activity scale, MP; mild pain, APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale.

For the behavioral dimension under severe pain conditions, the KMO value reached 0.806, and Bartlett’s test was significant ($\chi^2 = 688.486$, df = 78, $p < 0.001$). three factors were identified, with eigenvalues of 5.046 (38.81% of the variance) ,1.763 (13.56% of the variance), and 1.418 (10.90% of the variance). collectively explaining 63.28% of the variance. Items 6,10,19, and 22 were omitted due to factor loading (<0.3). items 5, 13, 16, 17, 18, and 23 were deleted due to cross-loading.

The remaining data corresponding to the acquired factors were presented in Table 6.

Table 6. Promax rotated factor matrix for the three-factor behavioral dimension under severe pain conditions in the Persian version of the AEQ (n = 120).

	Item	ASAS SP	APAS SP	PPS SP	Communalities
BMA14	When I am in pain, I break off a meeting with friends.	0.927	-0.261	0.205	0.698
BMA7	When I am in pain, I cancel private appointments.	0.812	0.131	-0.007	0.802
BMA8	When I am in pain, I cancel a visit to an event.	0.765	0.172	0.089	0.792
BMA21	When I am in pain, I avoid other people's company.	0.692	0.172	-0.038	0.646
BMA12	When I am in pain, I keep my appointments even though I do not feel up to it.	-0.640	0.123	0.201	0.358
BMA2	When I am in pain, avoid visiting my friends	0.607	0.205	-0.088	0.555
BMA1	When I am in pain, I stop doing physically demanding activities.	-0.130	0.740	0.051	0.459
BMA3	When I am in pain, I take a rest.	0.024	0.690	-0.106	0.492
BMA9	When I am in pain, I avoid physically strenuous activities.	0.043	0.625	0.079	0.442
BMA20	When I am in pain, I hand over strenuous activities.	0.100	0.597	0.018	0.44
BMA4	When I am in pain, I take care not to let myself go..	-0.201	0.150	0.685	0.498
BMA11	When I am in pain, I say to myself: "Don't make such a fuss!".	0.056	-0.092	0.642	0.41
BMA15	When I am in pain, I tell myself: "I don't have time for this right now!".	0.111	-0.002	0.402	0.304

ASAS; Avoidance social Activity scale, SP; severe pain , APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale.

All details about cross-loading items and low communalities are pointed out in Table 7.

The multivariate kurtosis of Mardia provided a value of 9.35, which was accompanied by the CR of 3.64, which all indicate the fact that the data of emotional were not normally distributed multivariately. On this basis, a Bollen–Stine bootstrap method with 2, 000 resamples was used in determining the strength of the model—the resulting bootstrap p -value of 0.17 showed that the model fit is satisfactorily upheld . Therefore, the primary model was approved.

In the cognitive domain, in the test offered by Mardia, it obtained a multivariate kurtosis of 29.35, a CR of 8.14, confirming the strong violation of multivariate normality. As a result, a Bollen–Stine bootstrap method using 2,000 resamples was performed to determine the suitability of the model fit. The P-value of the bootstrap 0.002 indicated that the model did not attain a satisfactory fit. In accordance with these findings, MI was studied. It is important to note that the application of modification indices should not be done mechanically, but it should be theoretically based (28). Since the similarity of the conceptual areas of items in the cognitive dimension and overlapping, there was adequate theoretical justification to use this approach. The MI showed that there were correlated error terms between Items 15 and TSS factor (MI= 12.14) and between Items 15 and 12 and 16 (MI= 10.53 and 13.85, respectively). The resulting revised model was found to have a χ^2/df value of 2.04, CFI of 0.92, and a RMSEA of 0.09. In addition, the lack of a statistically significant difference between the first and amended χ^2 ($\Delta\chi^2$ = 0.41 and it is below 3.84) (35). The value also suggested that the changes implemented did not lead to a significant increase in model fit; the primary model was reported.

An analysis of the multivariate normality in the behavioral dimension under mild pain conditions showed that the value of Mardia kurtosis was 13.86 with CR of 3.84. As a result, multivariate normality was determined as being violated. In order to solve this problem, a Bollen–Stine bootstrap method with 2,000 resamples was performed, and the p-value of 0.16 was obtained, which supported the goodness of the model fit. Later on, when the severe pain condition was achieved, the multivariate normality was also breached with the kurtosis of Mardia equal to 22.46 and a CR value of 6.23. Bollen–Stine bootstrap method with 2000 resamples was, however, done, and a p-value was obtained as 0.003, suggesting that the model was rejected. As a reaction to this finding, the MI were analyzed, and a correlated error component between Items 2 and 4 was recommended (MI = 11.06). Nevertheless, since there was no conceptual overlap and theoretical overlap between these items, a sufficient theoretical justification of such a change could not be developed (28). In this way, the initial model was maintained and reported. The final results of the CFA are summarized in Table 8.

Table 7. A collection of all items, was dropped by cross-loading and Communalities.

	Item	Factor 1	Factor 2	Factor 3	Factor 4	Communalities
PER	E1	0.317	-0.346	-	-	-
PCR	C6	0.464	0.390	0.036	-	-
	C9	0.550	0.374	-0.083	-	-
	C11	0.251	0.544	-0.041	-	-
PBR.SP	BMA6	0.355	-0.023	0.158	-	-
	BMA10	0.228	0.245	-0.104	-	-
	BMA19	-0.399	0.031	0.135	-	-
	BMA22	-0.147	-0.020	0.330	-	-
	BMA5	0.104	-0.333	0.555	-	-
	BMA18	0.534	0.273	0.018	-	-
	BMA17	0.170	0.374	-0.104	-	-
	BMA16	-.123	-.141	.376	-	-
	BMA23	0.126	0.633	0.355	-	-
	BMA13	-0.248	0.447	0.182	-	-
PBR.MP	BMI7	0.523	0.035	0.027	0.255	-
	BMI12	-0.243	0.236	0.450	0.345	-
	BMI15	0.263	0.415	0.277	-0.200	-
	BMI21	0.263	0.135	0.478	-0.238	-
	BMI22	-0.153	0.490	-0.272	-0.042	-
	BMI3	0.336	0.276	0.010	-0.023	-
	BMIm5	-0.065	0.399	-0.004	-0.378	-
	BMIm18	0.281	0.193	0.193	0.288	-
	BMI19	-	-	-	-	0.296
	BMI20	-	-	-	-	0.299

PER; pain emotional response, PCR; pain cognitive response, PBR.SP/MP; pain behavioral response, severe pain/mild pain.

The multivariate kurtosis of Mardia provided a value of 9.35, which was accompanied by the CR of 3.64, which all indicate the fact that the data of emotional were not normally distributed multivariately. On this basis, a Bollen–Stine bootstrap method with 2, 000 resamples was used in determining the strength of the model—the resulting bootstrap p -value of 0.17 showed that the model fit is satisfactorily upheld . Therefore, the primary model was approved.

In the cognitive domain, in the test offered by Mardia, it obtained a multivariate kurtosis of 29.35, a CR of 8.14, confirming the strong violation of multivariate normality. As a result, a Bollen–Stine bootstrap method using 2,000 resamples was performed to determine the suitability of the model fit. The P-value of the bootstrap 0.002 indicated that the model did not attain a satisfactory fit. In accordance with these findings, MI was studied. It is important to note that the application of modification indices should not be done mechanically, but it should be theoretically based (28). Since the similarity of the conceptual areas of items in the cognitive dimension and overlapping, there was adequate theoretical justification to use this approach. The MI showed that there were correlated error terms between Items 15 and TSS factor (MI= 12.14) and between Items 15 and 12 and 16 (MI= 10.53 and 13.85, respectively). The resulting revised model was found to have a χ^2/df value of 2.04, CFI of 0.92, and a RMSEA of 0.09. In addition, the lack of a statistically significant difference between the first and amended χ^2 ($\Delta\chi^2$ = 0.41 and it is below 3.84) (35). The value also suggested that the changes implemented did not lead to a significant increase in model fit; the primary model was reported.

An analysis of the multivariate normality in the behavioral dimension under mild pain conditions showed that the value of Mardia kurtosis was 13.86 with CR of 3.84. As a result, multivariate normality was determined as being violated. In order to solve this problem, a Bollen–Stine bootstrap method with 2,000 resamples was performed, and the p-value of 0.16 was obtained, which supported the goodness of the model fit. Later on, when the severe pain condition was achieved, the multivariate normality was also breached with the kurtosis of Mardia equal to 22.46 and a CR value of 6.23. Bollen–Stine bootstrap method with 2000 resamples was, however, done, and a p-value was obtained as 0.003, suggesting that the model was rejected. As a reaction to this finding, the MI were analyzed, and a correlated error component between Items 2 and 4 was recommended (MI = 11.06). Nevertheless, since there was no conceptual overlap and theoretical overlap between these items, a sufficient theoretical justification of such a change could not be developed (28). In this way, the initial model was maintained and reported. The final results of the CFA are summarized in Table 8.

Table 8. Fit indices for the emotional, cognitive, and behavioral dimensions of the Persian version of the AEQ (n = 120).

Subscale	Scale		χ^2	df	P-value	χ^2/df	CFI	RMSEA %95 CI
PER	ADS PMS		35.58	26	0.11	1.36	0.98	0.05 (0.00-0.09)
PCR	HHS CTS TSS	Before MI	152.07	60	< 0.001	2.45	0.88	0.1 (0.08-0.13)
		After MI	120.91	59	< 0.001	2.04	0.92	0.09 (0.07-0.11)
PBR. Mild Pain	ASAS.MP APAS MPP HDS MPP PPS MPP		80.70	59	0.03	1.36	0.94	0.05 (0.01-0.08)
PBR. Severe Pain	ASAS SPP APAS SPP PPS SPP		110.25	62	< 0.001	1.77	0.92	0.08 (0.05-0.1)

PER; Patient Emotional Response, PCR; Patient Cogntive Response, PBR; Patient Behavioral Response , ADS; Anxiety/Depression scale, PMS; Positive Mood scale, HHS; Help/Hopelessness scale, CTS; Catastrophizing scale, TSS; Thought Suppression scale, ASAS; Avoidance social Activity scale, SP; severe pain , MP; mild pain, APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale, BES; Behavioral. Endurance scale. MI; modification indices.

After that, during the factor analytic processes, interrelations in the factors that were extracted are outlined in Table 9.

Reliability and Internal consistency

Specifically, for emotional subscales, the alpha coefficients of Cronbach were in the range of 0.82 to 0.87, with the ICCs in the range of 0.79 to 0.81. Concerning the cognitive subscale, the values of Cronbach's alpha ranged between 0.77 and 0.91, with the ICCs ranging between 0.78 and 0.81 . The behavioral domain in the group of participants who reported mild pain also provided coefficient values of 0.66 to 0.82, and ICCs were in the range of 0.42 to 0.69. Similarly, the behavioral domain had values of 0.72 to 0.84, and their ICCs were in the range of 0.56 to 0.83 among the participants who were in severe pain. The other results related to the reliability of the AEQ questionnaire subscales are presented in Table 10.

Table 9. Intercorrelations of the Persian version of AEQ scales (N=120).

Persian-AEQ	ADS	PMS	HHS	CTS	TSS	ASAS.M	APAS MP	HDS MP	PPS MP	ASAS SP	APAS SP
PMS	-0.506**										
HHS	0.564**	-0.366**									
CTS	0.448**	-0.304**	0.564**								
TSS	0.134	-0.033	0.253**	0.359**							
ASAS.M	0.357**	-0.266**	0.187*	0.168	0.132						
APAS MP	0.161	-0.125	0.086	0.140	0.079	0.498**					
HDS MP	-0.161	0.368**	-0.116	-0.073	0.141	-0.229*	-0.106				
PPS MP	-0.084	0.202*	-0.030	-0.030	0.494**	0.060	-0.059	0.249**			
ASAS SP	0.330**	-0.257**	0.292**	0.247**	0.134	0.580**	0.321**	-0.036	0.214*		
APAS SP	0.184*	-0.236**	0.272**	0.152	0.231*	0.234*	0.427**	-0.016	0.140	0.555**	
PPS SP	-0.222*	0.161	-0.145	-0.126	0.338**	0.101	0.044	0.136	0.593**	0.170	0.104

Anxiety/Depression scale, PMS; Positive Mood scale, HHS; Help/Hopelessness scale, CTS; Catastrophizing scale, TSS; Thought Suppression scale, ASAS; Avoidance social Activity scale, SP; severe pain , MP; mild pain, APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale. **. Correlation is significant at the 0.01 level (2-tailed).*. Correlation is significant at the 0.05 level (2-tailed).

Table 10. Reliability indices of the Persian version of AEQ subscales in participants (n = 60).

Persian-AEQ	ICC (95% CI)	Cronbach's α	M	SD	SEM 95% CI	MDC
ADS	0.79(0.66-0.88)	0.87	2.51	1.77	0.81 (0.92-4.09)	2.24
PMS	0.81(0.69-0.89)	0.82	3.14	2.13	0.92(1.32-4.95)	2.57
HHS	0.78(0.64-0.86)	0.91	2.35	1.83	0.85(0.66-4.03)	2.37
CTS	0.81(0.74-0.91)	0.81	1.25	1.94	0.77(-0.27-2.77)	2.15
TSS	0.81(0.69-0.89)	0.77	2.92	1.97	0.85(1.23-4.06)	2.38
ASAS.M	0.42 (0.06-0.66)	0.7	0.84	0.92	0.7 (-0.52-2.22)	1.94
APAS MP	0.61(0.4-0.75)	0.76	2.55	1.34	0.83 (0.91-4.19)	2.32
HDS MP	0.69(0.51-0.81)	0.82	2.79	1.38	0.77 (1.28-4.30)	2.13
PPS MP	0.49(0.25-0.67)	0.66	3.19	1.53	1.09 (1.05-5.34)	3.03
ASAS SP	0.72(0.56-0.73)	0.84	2.66	1.16	0.61 (1.45-3.87)	1.71
APAS SP	0.83 (0.72-0.90)	0.91	4.25	1.16	0.48 (3.31-5.19)	1.33
PPS SP	0.56(0.33-0.72)	0.72	2.96	1.36	0.90 (1.18-4.73)	2.50

ICC; intraclass correlation coefficient, SEM; standard error of measurement, MDC; minimal detectable change, ADS; Anxiety/Depression scale, PMS; Positive Mood scale, HHS; Help/Hopelessness scale, CTS; Catastrophizing scale, TSS; Thought Suppression scale, ASAS; Avoidance social Activity scale, SP; severe pain , MP; mild pain, APAS; Avoidance physical Activity, HDS; Humor/Distraction scale, PPS; Pain Persistence scale.

Discussion

The initial hypothesis, which was the similarity of the factor structure that was determined in the Iranian version (9 factors) and that which was determined in the original (9 factors) instrument, was proven to be empirically significant in the current study, despite the challenges that were experienced in achieving satisfactory fit indices of the respective models. Moving on to the second hypothesis, the internal consistencies of the obtained factors were in the moderate to acceptable range, and the test-retest reliability was also moderate to acceptable.

Factor structure

After the rejection of the multivariate normality in the emotional and behavioral with mild pain dimensions, the non-significant output of the Bootstrapping test, it seems that the occurrence of a discrepancy is probably due to the violation of the normality assumption, rather than to the absence of the model fit. This observation implies that the model structure is still theoretically and empirically consistent, and that the deviation is largely methodological in character, and not necessarily that substantive model misspecification takes place (41).

Nonetheless, in the cognitive and behavioral (in situations with severe pain) dimensions, following the violation of the multivariate normality assumption and the succeeding bootstrapping analysis that produced significant results, the MI was considered. Covariances in the cognitive dimension were also defined between items 15, 16, and 12 and TSS since they showed conceptual similarity, and thus the application of MI was justifiable. However, after the making of these changes, the change in the chi-square value was less than the accepted level of significance cut-off, meaning that the respective changes introduced caused no significant change in the model fit (35). As a result, the original model was used and reported. Conversely, in the behavioral dimension in the severe pain condition, although the outcome of the Bollen–Stine bootstrap method was significant, the fact that there was no conceptual similarity and theoretical plausibility between the suggested pairs of items (e.g., items 2; avoid visiting my friends and 4; I take care not to let myself go) did not allow the use of the MI (28). In this regard, no MI-based adjustments were carried out, and the original model was reported as the final and primary model. There is an urgent need to be careful. First, these procedures might be used excessively, especially when applied within the framework of a relatively small sample (like this study), which can invalidate Bollen–Stine bootstrap estimates and MI results, leading to the model being overfitted and, as a result, losing its generalizability (28). On the other hand, it should be considered as a major suggestion to conduct the CFA on another independent and larger cohort in the future and cross-validate the results on another sample.

Similar to those reported for the original and Danish versions, the present study differentiated between two subscales, ADS and PMS, within the emotional subscales and found a statistically significant negative correlation between them (r= -0.506) (10, 14). The existence of a strong inverse relation between the two subscales was in line with the Dynamic Model of Affect in the explanation of the reciprocal nature of positive and negative affective approaches, and each of which is supported by a unique set of data processing mechanisms. These subscales' distribution into the avoidance (ADS) and endurance (PMS) pain response also suggests a contradictory but interconnected pattern of behavior. This clinical observation suggests that, people who have high avoidance responses are also observed to be less enduring in their behaviors and vice versa. This level of subtle distinction allows clinicians to build more elaborate patient profiles by observing the behavioral pain responses and, therefore, to inform the choice of specific interventions. As an example, behavioral activation, graded exposure protocols, and avoidance -reduction strategies could be useful with patients who have high avoidance-disengagement scores, and precaution and activity pacing could be required with patients who have high pumping-maintenance scores (7, 42). Parraga et al., on the other hand, found only two factors (anxiety and depression) in the analytic model (15). The results of the CFA proved that the model was satisfactorily fitting, the sample size was sufficient, and the emotional dimension was stable and valid (28). These results are in line with similar reports of other linguistic translations of the instrument (14), thus supporting the cross-cultural validity and psychometric strength of the Persian version.

The cognitive domain provided a tripartite factor structure to replicate identical constructs that were expressed in the original and Danish versions (10, 14). In addition, there was a strong positive intercorrelation that was exhibited between the TSS, HHS, and CTS subscales. Although the TSS subscale represents endurance-based cognitive reactions to pain, the HHS and CTS subscales represent avoidance-based reactions. Considering the Ironic Process Theory by Wegner (43) Suppressive or avoidant rumination inevitably exacerbates pain, increases disability, and promotes the development of cognitive avoidance strategies (44). However, a discordant factor structure was reported by Parraga et al, who only found two factors, CTS and HHS, in their cohort, and TSS items were scattered over these two (15). One likely cause of this deviation is the similar effect that cognitive coping mechanisms have on the experience of pain, and hence, are redefining the factor loading patterns (15). Lastly, the outcomes of the CFA showed that the proposed model had a marginal model fit (RMSEA = 0.10 and CFI =0.88). It is important to note that up until this time, the CFA was only done on the original and Danish versions, both of which reported a strong model fit to the cognitive dimension (10, 14). The present findings may be rooted in the small sample size and the cultural and linguistic diversity of the current sample.

Overall, seven behavioral dimension latent constructs were isolated in mild and severe conditions of pain ($ASAS_{MP}$, $APAS_{MP}$, HDS_{MP}, PPS_{MP}, $ASAS_{SP}$, $APAS_{SP}$, PPS_{SP}), but they were mostly similar to the original and Danish versions (10, 14). The avoidance-related factors ($ASAS_{MP}$~$APAS_{MP}$, $ASAS_{SP}$~$APAS_{SP}$) exhibited a significant positive relationship with each other, which is consistent with positive relationships that were observed between the endurance-related factors (HDS_{MP}~PPS_{MP}). The item that was labeled as Item 12 was initially placed in the PPS_{SP}; nevertheless, in the Persian version, it was loaded on the $ASAS_{SP}$. The factor loading (-0.640) suggests an inverse relationship, meaning that the more one engages in adaptive or active behavioral strategies in extreme conditions, the less he/she supports the behavior that is measured by this item. The presented structural change can probably be attributed to cultural or contextual differences in the perception of endurance-based responses in the face of severe pain, which is consistent with the current avoidance-endurance models (45).In this sample, the correlation that was observed between the PPS_{SP} and $APAS_{SP}$ scales did not occur at a statistically significant level, and these findings are in line with other literature on AEQ. This result aligns with the hypothesis that endurance-based and avoidance-oriented reactions can function as independent variables, and the combination of unique patterns of pain reactivity and the small sample size might explain the null correlation. Therefore, the fact that there was no significant correlation between the two subscales should not be interpreted to imply the absence of substantive merit in either of the two subscales; instead, it highlights the subtle and divergent conceptual constructs that define these measures (15).

Nevertheless, Kim et al. found that only two factors are present in the behavioral dimension in the severe pain condition (11) whereas Parraga et al. found that there are four factors, including the Avoidance of Social and Physical Activities Scale, Pain Persistence and Distraction, Ignoring Pain Scale, and Humor Scale (15). The first of these was the only factor considered to be avoidance-related, with the rest being endurance-related responses; however, none of these endurance-related factors had any significant positive correlations with each other. In the Korean and Spanish versions, there is no model-fit analysis, which constrains the similarity of the current results with the two studies (11, 15).

Unlike the Danish adaptation, but consistent with the original version of AEQ, the behavioral domain had a moderate to satisfactory model fit in both pain-related conditions (10, 14). In total, three studies have examined the EFA of the AEQ, although only two have examined the suitability of the model that was obtained (11, 14, 15).

The research articles by Fatima et al. and Karimi et al. restricted their discussion to the localization, validity, and reliability of the originally used instrument (12, 13).

Since the factorial structures have varied in the different adaptations, it is reasonable to assume that these differences are caused by demographic variables such as the age of the participants, the length of the pain, and the location of the pain. In line with the original version, most, more than fifty percent of the people in the comparative studies were women (10, 11, 14, 15). The age in the current study was lower than that in the original and other adapted versions (10, 11, 14, 15). The subjects of the current research and the subjects of the original one were acquired through individuals having LBP, unlike other studies, where subjects having chronic pain in other parts of the body were used (10, 11, 14, 15). Additionally, Kim's integration included patients with fibromyalgia besides musculoskeletal pain (11). Considering the implications of the chronicity of pain, the target population, and the age factor on the likelihood of adopting avoidance or endurance coping styles, the variables might be used to explain the structural differences that have been reported in the various versions of AEQ.

Reliability and Internal consistency

The results of internal consistency of extracted factors were similar to those of the original version (0.76-0.92) and other language versions (0.72-0.73, 0.73-0.98, 0.77-0.97, 0.85-0.94, 0.85-0.99) (10-15). All the other subscales, except the PPS_{SP} subscale, which showed an internal consistency coefficient of 0.66, thus had satisfactory internal consistency, corroborating the empirical results of the antecedent research (14).

Both the cognitive and emotional dimensions were good in terms of test-retest reliability, with ICCs of 0.79 to 0.81. Also, the SEM values were 0.77-0.92, which is a sufficient value of measurement precision, whereas the minimum significant changes that could be detected at the 95% confidence level ($MDC_{\%95}$) were between 2.38 and 2.57, which is the smallest actual change in excess of measurement error. Clinically, these indices can be used to determine the clinical relevance of the longitudinal variations in patient scores (12). Therefore, they highlight the usefulness of utilizing the AEQ as a tool to track the effects of treatment and guide evidence-based clinical practice. The results of these tests can validate the adequate reliability of the Persian version of the AEQ, and they are in line with the findings of Karimi, Kristensen, An, Fatima, and their team(11-14). In the behavioral dimension, only $APAS_{SP}$, $ASAS_{SP}$, and subscales had a good test-retest reliability, and the rest of the subscales' scores revealed moderate consistency. The difference in the intensity of the pain in the one week between the assessments could be the reason why some of the behavioral subscales were less stable. But the SEM and $MDC_{\%95}$ of the behavioral dimension were similar to those of the affective and cognitive dimension, as well as to the results of earlier versions of the language (11-14). Since even the test-retest reliability of the behavioral subscale was found to be unstable even in mild pain situations, and the recent factor-analytic studies have determined only the behavioral dimension in cases of severe pain, it is recommended that future studies narrow their factor analyses to an item dimension assessing severe pain exclusively. This methodology can be more desirable when there is a heterogeneity of perception of mild pain by patients; the heterogeneity can result in measurement inconsistency and the factor structure underlying such measurements at risk of instability (11, 14, 15).

The main weaknesses of the current research include the lack of CFA on an independent cohort, the small sample size (n = 120) limiting rigorous testing of the factor structure and increasing overfitting risk, data collected in 2019 which may reduce generalizability due to changes in pain coping, cultural norms, and healthcare delivery (including COVID-19 impacts), unassessed construct validity with existing measures, untested responsiveness of the questionnaire, and potential selection bias from convenience sampling in Tehran-based clinics. The authors plan to address these issues in future research with a larger, more diverse sample, performing CFA while simultaneously assessing responsiveness and construct validity.

Conclusion

The current study provides initial results that indicate a suboptimal factorial structure of the Persian version of the AEQ with the nine factors, which is similar to the findings of both original English and Danish versions. It has shown acceptably good internal consistency and moderate test-retest reliability (ICCs) in using it on a sample of Iranian patients with CNSLBP. Although there is a certain difference in factor weightings, which could be probably because of demographic factors such as age, pain course, and anatomical manifestation, the instrument still seems to be able to identify avoidance and endurance coping styles. However, due to methodological shortcomings, such as a small sample, marginally high model fitness measures, such as RMSEA = 0.10, and fairly low intraclass correlations between specific subscales, those findings are tentative and should be substantiated with larger samples, independent CFA, and extensive validity tests. After additional validation, the Persian AEQ would become a useful instrument of psychological measurement and clinical-level decision-making in cohorts of Persian speakers.

Author contribution

SKG contributed to concept development, design, data collection, analysis/interpretation, literature search, writing a substantive part of the manuscript, and critical review of the manuscript for intellectual content.

BA contributed to supervision, concept development, design, analysis/interpretation, literature search, writing a substantive part of the manuscript, and critical review of the manuscript for intellectual content.

MS contributed to supervision, concept development, design, analysis/interpretation, literature search, writing a substantive part of the manuscript, and critical review of the manuscript for intellectual content.

AS contributed to concept development, analysis/interpretation, writing a substantive part of the manuscript, and critical review of the manuscript for intellectual content.

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