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Psychometric Properties of the Persian Version of the Multidimensional Assessment of Interoceptive Awareness, Version 2 (MAIA-2)

Elnaz Melhi[1] (PhD Candidate), Fariba Zarani[2] (PhD), Leili Panaghi[3] (PhD), Mohammad-Hossein Harirchian[4] (MD)

1. Department of Psychology, Faculty of Psychology, Shahid Beheshti University, Tehran, Iran
2. Clinical and Health Psychology Department, Faculty of Psychology and Educational Sciences, Shahid Beheshti University, Tehran, Iran
3. Department of Family Health, Shahid Beheshti University, Tehran, Iran
4. Department of Neurology, Iranian Centre of Neurological Research, Neuroscience Institute, Tehran University of Medical Sciences, Tehran, Iran

Corresponding Author:
Elnaz Melhi,
Department of Psychology,
Faculty of Psychology,
Shahid Beheshti University,
Tehran,
Iran
E-mail: emelhi.sbu@gmail.com

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Abstract

Introduction: Interoceptive awareness is a multidimensional concept encompassing appraisals, beliefs, attention, and behavioral responses, playing a vital role in emotional regulation, decision-making, and self-awareness. As abnormal self-reported interoception is associated with mental health problems, the 37-item Multidimensional Assessment of Interoceptive Awareness version 2 (MAIA-2) is widely used in clinical and non-clinical settings. However, its psychometric properties in different linguistic and cultural contexts need to be examined to ensure its validity and reliability. This study aimed to explore the psychometric properties of a Persian translation of the MAIA-2.
Method: A cross-sectional study was conducted with 475 residents in Tehran (409 women and 66 men) who completed the translated MAIA-2 in 2021. Psychometric properties were assessed using the Confirmatory Factor Analysis (CFA). Additionally, validated measures of Emotion Regulation and Mindful Attention Awareness were used to evaluate divergent and convergent validity.
Results: The eight-factor model of MAIA-2 has been confirmed with appropriate fit indices (RMSEA = 0.055 [95% CI 0.052–0.058]; SRMR = 0.064), and demonstrated improved internal consistency reliability. The MAIA-2 also exhibited significant divergent validity (-0.20 to -0.59) with the Difficulties in Emotion Regulation Scale and significant convergent validity (0.18 to 0.38) with the Mindful Attention Awareness Scale, both at the 0.01 significance level. Additionally, the Cronbach's alpha coefficients for the factors were within the satisfactory range, ranging from 0.58 to 0.95.
Conclusion: The findings concluded that the Persian version of MAIA-2 is a valuable tool for assessing interoceptive awareness in Persian-speaking populations.

Keywords: MAIA-2, Interoception, Interoceptive Awareness, Statistical Factor Analysis, Psychometric

Introduction

Influential theories propose that knowledge relevant to an individual's life is connected to fundamental phenomena that originate in the body. Additionally, the processing and perception of these bodily signals can offer important insights into both internal and external environments [1].

The ability to detect internal bodily changes is referred to as interoception [2]. Interoception is a complex concept encompassing the sensation, interpretation, and integration of sensory information within the body. This term, initially introduced by Sherrington in 1906, was later redefined by Graig as the perception of the physiological state of the physical

body [3] including input from autonomic sensory nerves throughout the body, pain, and tactile sensations. Through interoception, the nervous system interprets, integrates, and maps the internal landscape of an organism in the present moment. It can be understood as a two-way process between the brain and the body, involving feedback and feedforward loops and serving as a comprehensive internal model for predicting the future states of the body [4].

Interoceptive awareness has a significant impact on affective, cognitive experiences and physical and psychological health processes. Motivation, learning, and conditioning all contribute to interoceptive processing. Cardiac interoception is linked to better learning, improved recognition of emotional faces, and stronger expectations for unconditioned stimuli [5]. Individuals with high interoceptive accuracy are more sensitive to negative affect but less accurate at recognizing fear and sadness. Interoceptive processing has broad relevance to various behaviors, leading researchers to study its relationship with key psychological constructs. Individuals who report greater mindfulness during psychological challenges are more likely to meet interoceptive accuracy criteria [6]. Additionally, interoceptive sensitivity is associated with better prospective memory performance, improved sleep, and reduced rumination [7]. These findings suggest that interoceptive processing ability confers behavioral advantages. Overall, interoceptive processing is generally associated with adaptive behavior, indicating its importance in understanding human cognition and behavior [5].

Interoceptive dysfunction has been associated with various mental and physical health conditions. For instance, individuals who have attempted suicide or engaged in no suicidal self-injury exhibit greater interoceptive deficits [8]. These individuals tend to rely less on self-regulation based on bodily sensations and are more prone to distracting themselves from these sensations. Additionally, individuals with autism spectrum disorder demonstrate reduced interoceptive accuracy and interoceptive sensitivity [9]. Studies conducted with eating disorder subjects suggest bulimia may be characterized by sensory processing deficits, interoceptive appraisal dysfunctions, and reduced interoceptive accuracy. Interoceptive dysfunctions are also observed in individuals with obsessive-compulsive disorder [10], borderline personality disorder [11], and female sexual arousal disorder [12].

Moreover, interoceptive processing deficits have been linked to various medical conditions. Hypertensive patients, for example, exhibit impaired interoceptive performance and reduced heart-evoked potential modulation [5]. Patients with Parkinson's disease, functional motor disorders, fibromyalgia, and frontotemporal dementia also show lower interoceptive accuracy and performance [13]. These findings suggest that interoceptive dysfunction may be present across a range of medical conditions, not limited to psychiatric disorders. By employing more robust, sensitive, and quantitative measures to assess these deficits, we may gain insights into the risk, progression, and response to interventions for a broader spectrum of medical conditions [5].

Interoception includes both viscerception and proprioception. The former points to the perception of visceral signals (i.e., heart, respiration, satiety, and the autonomic nervous system sensations related to emotions), and the latter refers to the joint angles and muscle tensions of movement, posture, and balance [3]. However, recent studies have questioned whether interoception includes proprioception [14].

Different models of interoception have been proposed to explain the mechanism of involvement of interoception in embodied behaviors, emotions, and cognitions. For example, Garfinkel et al. developed a multi-faceted model of interoception and introduced three distinct dimensions. First, *interoceptive accuracy (IAcc)* refers to the correspondence between physical signals (e.g., heartbeats) and their perception, to the ability to detect internal bodily sensations accurately and objectively. Second, *interoceptive sensibility (IS)* is a self-perceived tendency to be self-focused internally and cognizant interoceptive. Finally, *interoceptive awareness (IAw)* reflects the accordance between objective and subjective dimensions and the metacognitive awareness of interoceptive accuracy [15].

To encompass both proprioception and interoception awareness, Mehling et al. [16] defined *body awareness* as the sensory awareness of the body's physiological states, processes (e.g., pain and emotion), actions (e.g., movement), and functions as an interactive process including a person's appraisal and formed by attitudes, beliefs, and experiences. Although the processing and perception of bodily signals play an essential role in a person's life, this body awareness can be adaptive and beneficial (seen in mindfulness) or maladaptive (experienced in psychological disorders). Available measurements are objective and limited to the laboratory environment or self-reporting tools focusing on specific (e.g., maladaptive) aspects. So, Mehling et al. [16] developed the Multidimensional Assessment of Interoceptive Awareness (MAIA) questionnaire to assess interoceptive awareness. On one hand, the value of MAIA is that it distinguishes between different adaptive or maladaptive interoceptive attentional styles. On the other hand, it is used to identify changes in interoceptive awareness following clinical interventions. The instrument includes the following subscales; Noticing (awareness of uncomfortable, comfortable, and neutral sensations in the body), Not Distracting (ignorance or distraction from sensations of pain or discomfort), Not Worrying (emotional distress or worry related to sensations of pain or discomfort), Attention Regulation (sustaining and controlling attention to body sensations), Emotional Awareness (being aware of the link between body sensations and emotional states), Self-Regulation (control of psychological distress through attention to body sensations), Body Listening (actively listens to the body for insight), and Trusting (experiences one's body as safe and trustworthy) [16].

MAIA has been translated into different languages for many years, and its psychometric properties have been studied. In some of these studies, confirmatory factor analysis confirmed the eight-factor structure of the scale, including the Persian version [17], the German version [18] the Italian version [19], the Spanish version [20], the English version [21], the Chinese version [22], and the French version [23]. However, it has been repeatedly reported that the Not-Distracting and Not-Worrying scales have problematic internal consistency (Cronbach's < .70), and the Noticing subscale has also been found to have low internal consistency in some studies [18, 22, 24-26]. So, recent changes to the MAIA (the MAIA-2) have addressed this issue. Since the number of items on a scale can affect internal consistency reliability estimates, the MAIA-2 has been updated with 37 items by adding five new items in the Not-Distracting and Not-Worrying subscales to the original MAIA [27]. The validity and reliability of MAIA-2 in Turkish were evaluated using data from 400 participants. It showed a six-factor structure with acceptable Cronbach Alphas and positive standardized loadings, confirming its validity and reliability for assessing interoceptive awareness in the Turkish population [28]. The Norwegian version of MAIA-2 (MAIA-2-N) was analyzed with 306 participants in this study. In this population, MAIA-2-N was an adequate measure of interoceptive awareness, with an eight-factor model providing the best fit in Confirmatory Factor Analysis (CFA). A moderate relationship between certain MAIA-2-N factors and health was moderated by gender, age, and education [29]. An evaluation of the psychometric properties of MAIA-2C was conducted in a Chinese population using the MAIA-2. With a Cronbach's alpha of 0.822 and a seven-factor structure, the MAIA-2C showed good reliability. A confirmatory factor analysis confirmed the model fit. Correlations with the Five-Facet Mindfulness Questionnaire and State-Trait Anxiety Inventory-Trait anxiety indicate convergence and discriminant validity [30]. A study was conducted to evaluate the psychometric properties and validate the French versions of two self-report measures of body awareness: The Postural Awareness Scale (PAS) and the MAIA-2. Data was collected from a non-clinical adult sample. As results showed, the French version of MAIA-2 has a six-factor structure with satisfactory internal consistency, construct validity, and reliability [31]. The Ukrainian version of the MAIA-2 questionnaire was tested for reliability and compared with the original versions. The study involved 400 first-year university students, with consistent validation results in line with the original MAIA-2. The Ukrainian adaptation showed high statistical significance in correlation matrix connections, good sampling adequacy, and high sphericity criterion. Across all interoceptive dimensions, the reliability coefficient (Cronbach's alpha) met the recommended value, indicating good internal consistency [32].

This study aims to fill a crucial gap in the research by evaluating the psychometric properties of the MAIA-2 self-report instrument in Persian. As the present version of MAIA-2 has yet to be studied in Iran, this research will provide valuable insights into the tool's reliability and validity in assessing interoceptive awareness. The findings will not only contribute to the existing knowledge on the subject but also offer clinicians and researchers in Iran an effective instrument to assess both the adaptive and maladaptive aspects of interoceptive awareness, further enhancing our understanding of its impact on human cognition, emotion, and behavior.

Method

For this cross-sectional study, first, a psychologist translated the MAIA-2 into Persian. A native English speaker and a fluent Persian translator translated Persian into English but had not seen the original version. Fifteen experts conducted a qualitative evaluation of content validity, including clinical psychologists, health psychologists, general psychologists, and psychometricians. Then, 30 participants reviewed and provided feedback on the translated questionnaire to ensure face validity. They were requested to comment on the difficulty of the scale's terminology (difficulty), the likelihood of misunderstanding the items, and ambiguous wording (ambiguity). They reported doubts, questions, or misunderstandings concerning instructions or sentence structure. Based on this feedback, we concluded this process and began collecting data. Two questionnaires, the Difficulties in Emotion Regulation Scale (DERS) and Mindful Attention Awareness Scale (MAAS), were used to test the divergent and convergent validity of the scale. A Persian version of three questionnaires were given to the patients in one link, and the relationship between them was calculated with the Pearson correlation coefficient. The MAIA-2 was translated into Persian and validated in 2021 among a healthy population. Following standard translations and back-translations, all questionnaires were computerized and completed online via a secure digital survey platform (Porsall). The MAIA-2 questionnaire was completed by participants first, completely independent of other questionnaires used to test convergent and discriminant validity. In addition, The *Research Ethics Committees of Shahid Beheshti University* approved all data collection procedures (Approval ID: IR.SBU.REC.1400.253).

This online-based cross-sectional study was conducted in Tehran between July 2021 and October 2021. The study participants were healthy individuals living in Tehran who agreed to participate and were selected by convenience sampling method. We needed at least 370 participants (10 × Items of MATA-2 (37) = 370) to conduct an appropriate CFA [33]. So, we advertised on Shahid Beheshti University's social platforms and students' social media groups. Volunteers completed questionnaires on a secure digital survey platform (Porsall). The inclusion criteria included: not suffering from physical and psychological illness, living in Tehran, with a bachelor's degree or higher, and 18-45- years old. Participants were informed that their participation was voluntary; they were free not to participate,

and all information would remain confidential. Some of the 536 participants were excluded from the study because they suffered from mental and physical health problems and other inclusion criteria. Finally, 475 questionnaires were entered into the final analysis.

The tools used in this study were as follows:

Demographic Information: The demographic form comprises details regarding gender (male/female), education level (bachelor's, master's, PhD), marital status (single, married), age, suffering from mental and physical health problems (yes/no).

Multidimensional Assessment of Interoceptive Awareness Version-2 (MAIA-2) [27]: The original MAIA measures multiple dimensions of interoception bodily awareness developed by Mehling et al. It consists of 32 items and eight distinct subscales [16]. The MAIA-2 includes five additional items over version 1, which improve the MAIA's internal consistency and reliability. MAIA-2 retains the eight subscales of the original but contains 37 items. Three new items have been added to the Not-Distracting scale: (1) I try to ignore pain (R); (2) I push discomfort away by focusing on something else (R); and (3) When I feel unpleasant body sensations, I occupy myself with something else so I do not have to feel them (R). On the Not-Worrying scale, the two new items are (1) I can stay calm and not worry when I have discomfort or pain, and (2) When I am in discomfort or pain, I cannot get it out of my mind (R). Reverse scoring is indicated by R. MAIA-2 items range from 0 "never" to 5 "always," with nine reversed items (items 5, 6, 7, 8, 9, 10, 11, 12, 15 are reversed). Cronbach's alpha determined MAIA-2's reliability. The number of items varied for each subscale: Noticing (4 items, α=0.64), Not-Distracting (6 items, α=0.74), Not-Worrying (5 items, α=0.67), Attention Regulation (7 items, α=0.83), Emotional Awareness (5 items, α=0.79), Self-Regulation (4 items, α=0.79), Body Listening (3 items, α=0.80) and Trusting (3 items, α=0.83). The arithmetic average of the items is taken to calculate the subscale scores. The higher the score, the better the self-reported interoception [27]. According to the Lawshe table, the Content Validity Ratio (CVR) of 0.73 was reported by 15 experts who evaluated the translation of each item and greater than 0.49 for all items, which indicates the importance and necessity of including relevant items in the scale. Furthermore, according to the Content Validity Index (CVI), for the total scale, 0.86 was ≥ 0.79, showing a satisfactory level of validity [34].

Difficulties in Emotion Regulation Scale (DERS) [35]: The Difficulties in Emotion Regulation Scale was developed by Gratz and Roemer in 2004. On a 5-point Likert scale (ranging from 0 (=almost never [0%–10%]) to 5 (=almost always [91%–100%]), higher scores indicate greater difficulty in ER (i.e., total score from 36 to 180). Six components make up this questionnaire: 1- Nonacceptance of emotional responses, 2- Difficulty engaging in goal-directed behavior, 3- Difficulty controlling impulses, 4- Lack of emotional awareness, 5- Limited access to emotion regulation strategies, and 6- Lack of emotional clarity. Using factor analysis, six factors were identified. The results show that this scale has a high internal consistency of 0.93 and all six scales have a Cronbach's alpha greater than 0.80 [35]. According to Besharat and Bazzazian, the Cronbach's alpha coefficients for the components of this questionnaire ranged from 0.73 to 0.92, and the retest reliability was also between 0.69 and 0.87 [36]. Using factor analysis and internal consistency coefficients, the test results were also valid and reliable and above 0.93 [35]. In addition, the Persian version of the DERS had an internal consistency of 0.79 to 0.92. In the present study, the internal consistency of this questionnaire was 0.94 using the Cronbach's alpha method.

Mindful Attention Awareness Scale (MAAS): The Mindful Attention Awareness Scale (MAAS) comprises 15 items, and individuals rate their responses using a 6-point Likert scale, ranging from 'almost always' (score of 6) to 'almost never' (score of 1). This scale, developed by Brown and Ryan in 2003, demonstrates good internal validity with Cronbach's alpha ranging from 0.82 to 0.87 across various sample groups. It also shows a strong correlation ($p < 0.0001$) with several mental health variables. The scale's construct and concurrent validity have been evaluated in cancer patients too [37]. In Iran, the scale was implemented with a Cronbach's alpha of 0.82 and showed associations with relevant variables such as self-esteem and mental health in different samples [38]. According to Cronbach's alpha, this questionnaire had an internal consistency of 0.88 in the present study.

Results

In the present study, 475 participants were presented; this sample consisted of 409 (86.1%) women and 66 (13.9%) men. The study sample in terms of marital status comprised 251 (52.8%) single and 224 (47.2%) married. In terms of education level, 206 people (43.4%) had a bachelor's degree, 207 people (43.6%) had a master's degree, and 62 people (13%) had a doctorate. In the present study, the mean and standard deviation of the age of the participants were 31.83 and 7.11, respectively. Almost all 30 participants indicated they had no difficulties reading and understanding the questionnaire but suggested minor changes to strengthen clarity. In addition, the item impact factor test revealed that all items scored ≥ 1.5, indicating the importance to the target group. Then, to evaluate the construct validity of the MAIA-2 in the Persian language, the CFA method was used. Prior to confirmatory factor analysis, the sampling adequacy assumptions of Kaiser-Meyer-Olkin (KMO) (0.90) and Bartlett sphericity ($\chi2=9871.82$, $p = 0.001$) indicate the suitability of the observed variables for measuring its factors. Finally, confirmatory factor analysis with eight latent variables was used to determine the overall fit of the present research tool with collected data. Descriptive statistics indices for the eight MAIA-2 subscales have been presented in Table 1.

Table 1. Basic Descriptive Statistics for the Eight MAIA Scales with Cronbach alphas, Scale Means, Skewness and Kurtosis

MAIA scales	# of items	Item numbers	Alpha	Means (SD)	Skewness	Kurtosis
Noticing	4	1–4	0.58	13.98 (2.99)	-0.86	1.268
Not-Distracting	6	5–10	0.84	14.26 (5.43)	0.29	-0.28
Not-Worrying	5	11–15	0.79	11.19 (4.24)	-0.01	-0.17
Attention Regulation	7	16–22	0.88	20.75 (5.79)	-0.5	0.29
Emotional Awareness	5	23–27	0.83	18.85 (3.70)	-0.85	1.77
Self-Regulation	4	28–31	0.85	11.32 (4)	-0.32	-0.17
Body Listening	3	32–34	0.87	8.25 (3.09)	-0.21	-0.22
Trust	3	35–37	0.87	9.65 (3.18)	-0.39	-0.16

Chu and Bentler consider the cutoff point of ±3 as appropriate for the skewness value. For the kurtosis index, values over ±10 are generally problematic in multivariate research [39]. The values obtained for the skewness and kurtosis of the variables indicate that the assumption of normality is fulfilled. In order to determine the reliability of the questionnaire, we utilized the internal consistency method. Cronbach's alpha for noticing is equal to 0.58, non-distracting is equal to 0.84, not-worrying is equal to 0.79, attention regulation is equal to 0.88, emotional awareness is equal to 0.83, self-regulation is equal to 0.85, body listening was 0.87, and trust was 0.87.

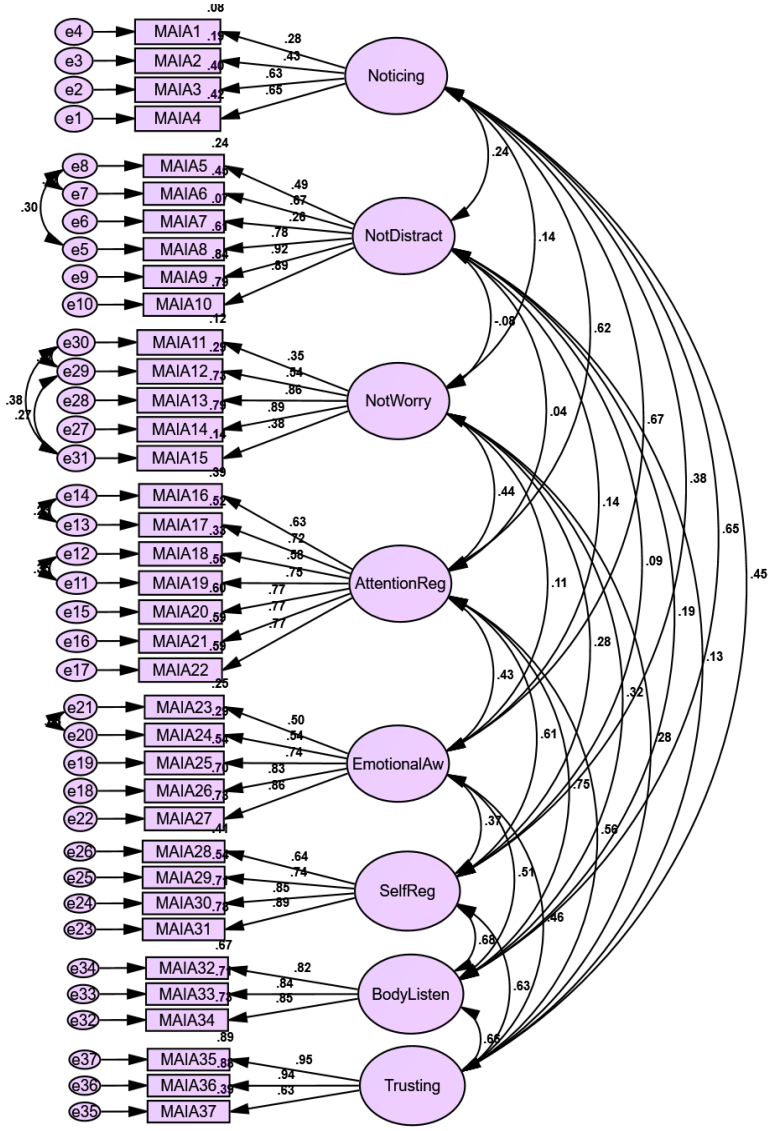

Figure 1. Standard factor loads of MAIA-2.

Table 2. Hypothetical Model Fit Indices

Fit indices	Chi-Square	Chi-Square/df	RMSEA	SRMR	CFI	GFI	IFI	NNFI	NFI
Eight-factor model	1429.05	2.41	0.05	0.08	0.91	0.85	0.91	0.90	0.85
Admission threshold	-	Less than 3	Less than 0.08	Less than 0.08	More than 0.90	More than 0.90	More than 0.90	More than 0.90	More than 0.90

As indicated in Table 2, absolute and adaptive fit indices were used to determine the hypothetical model fit. RMSEA and SRMR are the main indicators of model fit. For an optimal model fit, the RMSEA value should be less than 0.1 and preferably less than 0.08. Also, the SRMR value should be less than 0.08. For CFI, NNFI, and IFI indices, values above 0.9 indicate model acceptance, and 0.95 indicate good model fit [34].

As shown in Table 3, the t-test for all path coefficients was greater than 1.96, indicating that all paths are significant. To evaluate the convergent and divergent validity of this questionnaire, the correlation of the eight factors of this questionnaire, including noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trust with mindfulness variables and emotion regulation difficulty, were calculated and have been presented in Table 4.

Table 3. Standard Coefficients and Significant Indices of Factor Loads

Factors	Item	β	b	Se	t	p
Noticing	1	0.27	1		Reference indicator	
	2	0.43	0.93	0.2	4.65	0.001
	3	0.63	2.16	0.42	5.08	0.001
	4	0.65	2.23	0.43	5.10	0.001
Non-Distracting	5	0.48	1		Reference indicator	
	6	0.67	1.21	0.10	11.26	0.001
	7	0.25	0.42	0.08	5.00	0.001
	8	0.78	1.58	0.13	11.93	0.001
	9	0.91	1.64	0.14	11.12	0.001
	10	0.88	1.57	0.14	11.03	0.001
Not-Worrying	11	0.35	1		Reference indicator	
	12	0.54	1.75	0.21	8.03	0.001
	13	0.85	2.94	0.39	7.37	0.001
	14	0.89	3.001	0.40	7.36	0.001
	15	0.37	1.22	0.17	7.15	0.001
Attention Regulation	16	0.62	1		Reference indicator	
	17	0.71	1.08	0.07	14.6	0.001
	18	0.57	0.90	0.08	10.77	0.001
	19	0.74	1.09	0.08	13.23	0.001
	20	0.77	1.12	0.08	13.58	0.001
	21	0.77	1.15	0.08	13.52	0.001
	22	0.77	1.24	0.09	13.53	0.001
Emotional Awareness	23	0.49	1		Reference indicator	
	24	0.54	0.89	0.08	10.97	0.001
	25	0.73	1.21	0.11	10.20	0.001
	26	0.83	1.46	0.13	10.72	0.001
	27	0.85	1.60	0.14	10.80	0.001
Self-Regulation	28	0.63	1		Reference indicator	
	29	0.73	1.04	0.07	13.47	0.001
	30	0.84	1.30	0.08	14.88	0.001
	31	0.88	1.35	0.08	15.28	0.001
Body Listening	32	0.81	1		Reference indicator	
	33	0.84	1.12	0.05	20.84	0.001
	34	0.85	1.13	0.05	21.18	0.001
Trusting	35	0.94	1		Reference indicator	
	36	0.93	0.97	0.02	33.94	0.001
	37	0.62	0.54	0.03	16.14	0.001

Table 4. Correlation of Noticing, Non-Distracting, Not-Worrying, Attention Regulation, Emotional Awareness, Self-Regulation, Body Listening and Trust with Mindfulness Variables and Emotion Regulation Difficulty

Variables	Mindfulness	Emotion regulation difficulty
Noticing	0.246**	-0.236**
Non-distracting	0.380**	-0.260**
Not-worrying	0.292**	-0.468**
Attention regulation	0.355**	-0.560**
Emotional awareness	0.213**	-0.196**
Self-regulation	0.182**	-0.414**
Body listening	0.336**	-0.495**
Trust	0.324**	-0.451**

As it can be seen in Table 4, there is a positive and significant relationship between the variables of noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trust with mindfulness that is equal to 0.25, 0.38, 0.29, 0.35, 0.21, 0.18, 0.34 and 0.32 respectively, which are significant at the level of 0.01, and these direct correlations indicate the convergent validity of the research tool. Also, according to Table 3, it can be seen that there is a significant negative relationship between the variables of noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trust with the difficulty of emotion regulation that is equal to -0.24, -0.26, -0.47, -0.56, -0.20, -0.41, -0.49 and -0.45, respectively which are significant at the level of 0.01. These negative correlations indicate divergent validity of the research tool.

Discussion

The MAIA aims to identify beneficial interoceptive attentional styles (e.g., receptive, mindful) and maladaptive attentional styles (e.g., anxiety-driven). MAIA provides eight subscales in a five-dimensional conceptual framework of body awareness and the main focus of this questionnaire is on interpretative facets of interoception. In order to improve the MAIA, Mehling et al. [27] conducted factor analyses of the original MAIA. They added new items to the Not-Distracting and Not-Worrying subscales, which were found to have limited internal consistency reliability in several applications. A 37-item MAIA-2 with improved psychometrics was derived from adding five new items to the original 32-item MAIA. Due to its increasing clinical use and the high clinical impact of interoceptive disturbances in mental and physical diseases [8-13], it is necessary to investigate the preliminary psychometric properties of MAIA-2. Therefore, the purpose of this study was to examine the psychometric properties of a Persian version of MAIA-2.

This paper describes the translation procedure, the structure, the validity, and the reliability of the MAIA-2 in Iran. As transferring instruments that are conceptually and functionally appropriate into another language is a complex process requiring extensive research [23], we followed the guidelines for cross-cultural adjustment of psychometric measurement in the psychometric process in order to attain cultural and conceptual equivalence. As a result, the Iranian translation of the MAIA-2 was culturally appropriate for Iranians.

As expected, the results of the CFA supported an eight-factor structure of the MAIA-2. In the first stage, the CFA method was used to investigate the unchangeability of the MAIA-2 questionnaire. Indicators obtained from factor analysis demonstrate the optimal, desirable, and acceptable fit between the eight-factor model and the data, according to the factor structure of the original validation study [27], the German [40] and the Norwegian versions [29]. Also, confirmatory factor analysis results showed that all questions were identified in their relevant factor, and no question was deleted from the questionnaire.

To assess the convergent validity of the MAIA-2 questionnaire, correlations were calculated between its subscales and mindfulness variables by using the MAAS. The Pearson's correlation coefficients show positive and significant correlations between noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trust subscales with mindfulness. In accordance with prior studies [6, 31], these findings indicate that individuals with higher interoceptive awareness tend to have greater mindfulness, supporting the convergent validity of the questionnaire. The divergent validity was evaluated by calculating the correlation between the MAIA-2 subscales and emotion regulation difficulty by using the DERS. The Pearson's correlation coefficients demonstrate significant negative correlations between noticing, non-distracting, not-worrying, attention regulation, emotional awareness, self-regulation, body listening, and trust subscales with emotion regulation difficulty. Congruent with previous research [5, 8, 9], this suggests that individuals with better interoceptive awareness tend to have lower difficulty in emotion regulation, further supporting the divergent validity of the MAIA-2 questionnaire.

In examining the reliability of the questionnaire, Cronbach's alpha ranged from 0.58 for the noticing subscale to 0.88 for the trust subscale, which is satisfactory. The Not-Distracting and Not-Worrying subscales of the Persian MAIA-2 version had appropriate internal consistency and reliability (Cronbach's $\alpha > .70$), as the original validation study indicated [27]. These results were confirmed by some other translations of the MAIA-2 [28, 40]. However, internal consistency and reliability of the Noticing subscale remained suboptimal ($\alpha < .70$), in line with Mehling et al.'s [27] and the German version [40]. The Noticing subscale includes comfortable, uncomfortable, and neutral body sensations. While people tend to notice uncomfortable sensations, awareness of comfort and neutrality requires experience and practice in body-mind communication, influenced by cultural and environmental factors. These factors can contribute to differences in reliability across samples. Given that this study was conducted in an Iranian population, the cultural framework may have impacted the subjective aspects of body awareness, affecting the noticing subscale's reliability [41]. Additionally, in the MAIA-2, using ω will likely yield a more accurate estimate [42]. Since the internal consistency may have been underestimated in Cronbach's α as there is a requirement for a τ-equivalent model, the MAIA-2 doesn't meet this requirement (i.e., factor loadings will be equal) [43]. As similar challenges like this encountered in previous psychometric assessments too, minor modifications (e.g., adding items) would be suggested to the original eight-factor model in order to validate the MAIA-2 scale in cross-cultural use [28]. Despite this, the present study provides important evidence that the Persian version of MAIA-2 could be a valuable dimensional measurement for researchers studying interoception and body awareness in Iran, subjects that have received little attention.

Conclusion

In conclusion, this study successfully demonstrates that the MAIA-2 questionnaire effectively measures interoceptive awareness within the Iranian society, showing appropriate reliability and validity. However, it is essential to acknowledge the limitations of the study, as the sample was limited to healthy individuals residing in Tehran. This limitation might restrict the generalizability of the findings to other populations. To address this, further research is needed to validate the MAIA-2 in diverse populations, including clinical samples and individuals with varying levels of education and body-mind awareness. Understanding how interoceptive awareness varies across different subcultures within Iran could also provide valuable insights. Therefore, future studies should aim to include a more diverse range of participants from various regions and backgrounds to obtain a more comprehensive understanding of interoceptive awareness in the Iranian society. Exploring interoceptive awareness in different subgroups could shed light on potential cultural and social influences on body awareness. Such efforts will enhance the instrument's utility and broaden our understanding of the complex interplay between culture, body awareness, and mental well-being.

Conflict of Interest

The authors declare that they have no conflicting interests.

Ethical Approval

The following article is an excerpt from the PhD thesis of the first author. The Research Ethics Committees of Shahid Beheshti University approved all data collection procedures (Approval ID: IR.SBU.REC.1400.253).

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