

Research Paper



# Psychometric Evaluation of Self-assessment Persian Version of the Alzheimer Questionnaire (AQ)

Mahsa Roozrokh Arshadi Montazer<sup>1</sup>, Roohollah Zahediannasab<sup>2,3,4</sup>, Mohammad Nami<sup>2,3,4,5</sup>, Mahshid Tahamtan<sup>2,3,4</sup>, Roxana Sharifian<sup>1\*</sup>, Mahdi Nasiri<sup>6</sup>

1. Department of Health Information Health Management, School of Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.
2. Neuroscience Laboratory (Brain, Cognition, and Behavior), Department of Neuroscience, School of Advanced Medical Sciences and Technologies, Shiraz University of Medical Sciences, Shiraz, Iran.
3. Department of Neuroscience, School of Advanced Medical Sciences and Technologies, Shiraz University of Medical Sciences, Shiraz, Iran.
4. DANA Brain Health Institute, Iranian Neuroscience Society-Fars Chapter, Shiraz, Iran.
5. Academy of Health, Senses Cultural, Sacramento, California, United States.
6. Health Human Resources Research Center, School of Health Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.



**Citation** Roozrokh Arshadi Montazer, M., Zahediannasab, R., Nami, M., Tahamtan, M., Sharifian, R., & Nasiri, M. (2022). Psychometric Evaluation of Self-assessment Persian Version of the Alzheimer Questionnaire (AQ). *Basic and Clinical Neuroscience*, 13(4), 477-488. <http://dx.doi.org/10.32598/bcn.2021.2238.1>

**doi** <http://dx.doi.org/10.32598/bcn.2021.2238.1>



**Article info:**

**Received:** 28 Nov 2019  
**First Revision:** 19 May 2020  
**Accepted:** 12 Jul 2020  
**Available Online:** 01 Jul 2022

**Keywords:**

Aging, Cognitive dysfunction, Self-assessment, Psychometrics, Persian

## ABSTRACT

**Introduction:** Mild cognitive impairment (MCI) is a primary disorder intensified by aging. Rapid diagnosis of MCI can prevent its progression towards the development of dementia. Thus, the present study was conducted to evaluate the psychometric features of the self-assessment Persian version of the Alzheimer questionnaire (AQ) in the elderly to detect MCI.

**Methods:** First, the AQ was translated into the Persian language; then, its content validity was evaluated by the content validity index (CVI) and content validity ratio (CVR) method, and face validity was determined by two checklists for expert panel and the elderly. The convergent validity of the self-assessment AQ with the Montreal cognitive assessment (MoCA) was assessed using the Pearson correlation. The test-retest and internal consistency reliability were evaluated using intra-class correlation (ICC) and Kuder-Richardson coefficients, respectively. Moreover, the receiver operating characteristic curve was used to determine the optimal cut-off point of self-assessment AQ. Among 148 older people who took part in this study, 93 met our inclusion criteria (aged 60 years old or older, had reading and writing skills, and were able to speak and communicate).

**Results:** A translated version of the questionnaire was named “M-check.” The developed test showed good content and face validity. Statistically significant correlations were found between M-check and MoCA ( $r=-0.83$ ,  $P<0.05$ ). The Kuder–Richardson and ICC coefficients were obtained as 0.84 and 0.92, respectively. Area under the curve presented satisfactory values (Area under curve [AUC]=0.852, sensitivity=0.62, specificity=0.94).

**Conclusion:** The M-check can be used as a valid and reliable instrument for assessing cognitive state and screening MCI in older adults.

**\* Corresponding Author:**

Roxana Sharifian, PhD.

**Address:** Department of Health Information Management, School of Health Management & Information Sciences, Shiraz University of Medical Sciences, Shiraz, Iran.

**Tel:** +98 (917) 3154688

**E-mail:** sharifianr@sums.ac.ir, sharifianroxana@gmail.com

## Highlights

- All questions achieved desired face validity.
- The convergent validity of Alzheimer Questioner (AQ) was confirmed with high correlation.
- The AQ is statistically significant with Montreal Cognitive Assessment (MoCA).
- The AQ had acceptable stability, repeatability, and reliability.
- All findings demonstrated that the M-Check had high values in predicting MCI in the early stages.

## Plain Language Summary

Mild cognitive impairment (MCI) is a subset of mental disorders that is an early condition that may lead to dementia. People with MCI are usually prone to forgetfulness in a short time. If MCI is not detected in the early stages, it can progress to dementia or Alzheimer's to higher degrees. On the other hand, cognitive decline and MCI can cause major problems for patients and their families. So it is essential to act out as soon as possible. It is considered that a tool for the early identification of MCI that is self-assessed by individuals, without the presence of an expert and trained person to interpret the results, was not observed in Iran. Thus, the present study was conducted to evaluate the psychometric features of the self-assessment Persian version of the Alzheimer questionnaire (AQ) in the elderly. The results showed that the AQ is a simple one that can be quickly completed by any person at home or by family members of the elderly so that people can refer to the relevant specialist more soon if needed.

### 1. Introduction

**C**ognition is a complex set of mental processes, including memory, attention, language, and decision-making (Ashford et al., 2007). Cognitive skills have a pivotal function in the daily activity of the elderly. Unfortunately, aging can lead to decreased cognitive skills (e.g., memory, problem-solving activities, or speed processing) (Harada, Natelson Love, & Triebel, 2013).

The time course of brain cognitive change includes standard cognitive change, subjective cognitive impairment (SCI), mild cognitive impairment (MCI), and Alzheimer disease (AD) (Reisberg et al., 2008) but poorly understood condition, frequently occurring in older persons. METHODS The past and the emerging literature on SCI and synonymously named conditions is reviewed. RESULTS Findings include: (1. SCI refers to recognizing changes in memory and cognition without clinical examination. SCI is a risk factor that may be changed into MCI (Jessen et al., 2014; Reisberg, Shulman, Torossian, Leng, & Zhu, 2010). MCI is a primary disorder that may lead to dementia and can be accompanied by systemic, neurological, or psychiatric disorders, leading to cognitive impairment (Lopez, 2013). MCI is a moderate condition between standard cognition change and dementia, with normal functional abilities (Hugo

& Ganguli, 2014). Both SCI and MCI are pre-dementia stages, which can progress to AD (Reisberg et al., 2010). Dementia is a progressive disease destroying the patient's cognitive and mental function and daily physical activity (Mental, Gap, & Programme, 2012). AD is one of the most prevalent causes of dementia without definitive treatment (Malik & Robertson, 2017; Prince, Comas-Herrera, Knapp, Guerchet, & Karagiannidou, 2016). Understanding normal cognitive changes is essential due to their effects on the daily functions of the elderly and helping in determining the normal form of the disease (Harada et al., 2013).

It is estimated that the prevalence of dementia and the elderly population will increase from 2015 to 2050 (Malik & Robertson, 2017; Mental et al., 2012; Prince et al., 2016; WHO, 2017). Also, the prevalence of MCI in adults older than 65 is between 10% and 20% (Langa & Levine, 2014). Accordingly, rapid diagnosis of MCI and appropriate and timely interventions and treatment can prevent progression to dementia and other cognitive impairments (Alzheimer's Association, 2015; Roberts R, 2014). Due to a lack of valid and reliable clinical tools, MCI cannot be timely diagnosed (Chin, Ng, Narasimhalu, & Kandiah, 2013). The challenge for physicians is distinguishing between normal and abnormal cognitive functions (Knopman & Petersen, 2014). Also, most of the available assessment tests for

MCI are usually objective or traditional tests taken by physicians in a clinical setting (Vancouver Coastal Health, 2014). They are needed to be interpreted by an experienced clinician, making them challenging to be used by the people in society. Hence, there is a need for a short screener tool for the diagnosis of dementia, especially in the early stages (Chin et al., 2013).

On the other hand, screening tools are essential to diagnosing MCI or dementia, as there are different kinds of tests available; Montreal Cognitive Assessment (MoCA) was more sensitive to the detection of MCI among the older population (Ciesielska et al., 2016). However, to assess the elderly by MoCA test, an expert should be present to evaluate the elderly and also interpret it.

Some studies were conducted on the psychometric evaluation of the Persian version of tests to assess the cognition stage. They can be used as a valid and reliable tool for assessing the cognitive state of older people (Lotfi, Tagharrobi, Sharifi, & Abolhasani, 2016; Rezaei, Rashedi, Lotfi, Shirinbayan, & Foroughan, 2018) gender, and education entered the study. The diagnostic and statistical manual of mental disorders criteria for dementia were used as gold standard. A battery of scales included the abbreviated mental test score (AMTS, but an expert should interpret them.

The Alzheimer Questionnaire (AQ) was designed to be used in a primary care setting, which can be completed within approximately 3 min based on daily activities. The AQ is completed by an expert from one of the patient's family members (Sabbagh et al., 2010). In this study, AQ was used to detect MCI in healthy adult people, which they can do. Self-assessment testing of cognitive impairment based on their daily life activities may be effective. A person with SCI can individually implement the test, and in case of progress to MCI, his family members and relatives can evaluate him by the test. Therefore, this research was conducted to evaluate the psychometric features of the self-assessment version of AQ in older adults.

## 2. Materials and Methods

This cross-sectional study was implemented from December 23, 2018, to June 22, 2019. The study was designed to evaluate the validity and reliability of the Persian version of the self-assessment version of AQ, a brief and quick screener for cognitive impairment developed by Sabbagh et al. (2010).

### Study participants

The present study was conducted in two elderly day-care centers in Shiraz City, Iran. Among 148 older adults who took part, 56 were excluded due to the exclusion criteria. Thus, the final sample was composed of 93 subjects. Participants included the elderly aged 60 years old or older, had reading and writing skills and could speak and communicate. Also, the participants were excluded from the study if they did not tend to participate in the survey, used psychosocial medications, or had a history of neurological disease.

### Study tools

#### Alzheimer Questionnaire

The AQ is a 21-item (yes/no format) scale designed to be used in a primary care setting. It can be completed within approximately 3 min. It has five main domains: memory, orientation, functional ability, visuospatial ability, and language. Items receiving a "yes" response are given one point; however, six items are given two points. The total AQ score ranges from 0 to 27, with higher scores indicating significant impairment. The AQ is completed by an expert from one of the patient's family members (Sabbagh et al., 2010). Since the primary purpose of this study was to use a self-assessment tool to identify the elderly, who may have a mild cognitive impairment, the AQ was translated to be evaluated with the first-person pronoun.

#### Montreal Cognitive Assessment (MoCA)

The Montreal Cognitive Assessment (MoCA) is a brief 30-question test (which takes around 10 to 12 min to be completed), assessing people regarding the existence of dementia. The MoCA evaluates different domains of cognitive abilities: attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations, and orientation. The total MoCA score ranges from 0 to 30, in which a score of 26 and higher is generally considered normal (Nasreddine et al., 2005). A psychometric evaluation of the Persian version of assessing cognitive deficits was also performed. MoCA can be a valid and reliable tool for evaluating cognitive impairment in the Iranian population. The Cronbach alpha of the Persian version of MoCA (MoCA-P) and the Spearman correlation coefficients between the mini mental state examination (MMSE) and the MoCA-P was reported at 0.808 and 0.738, respectively. Moreover, The MoCA-P had acceptable content and face validity (Badrkhahan, Sikaroodi,

Sharifi, Kouti, & Noroozian, 2019) cognitive impairment; Mild Cognitive Impairment (MCI). Furthermore, another study, "Evaluating the Reliability of the MoCA and its Agreement with Mini-Mental State Examination (MMSE) Among Healthy Elderly," reported that the MoCA has high internal consistency. Moreover, the MoCA test was more proper for the early detection of MCI in older adults than MMSE (Chehrehnegar, Shams, Zarshenas, & Kazemi, 2012).

## Translation of AQ into the Persian language

### Forward translation

In the first stage, two translators (Translators 1 and 2) who were native speakers of Persian and had sufficient proficiency in English and Persian languages independently translated the AQ. These two versions were reviewed by a neuroscientist (N.M) after applying changes and providing suggestions for improving translation, and then the initial self-assessment Persian version of AQ was developed.

### Back-translation

The initial application changed and provided suggestions for improving translation, and then the initial self-assessment Persian version of the AQ was back-translated into English by an expert translator (Translator 3) without awareness of the original questionnaire text. The expert panel compared the back-translated version with the original English version, and any distinction or variation between them was resolved. The Final Persian version of self-assessment AQ was obtained after cultural adjustment and expert panel discussion.

### Expert panel

The researchers selected ten experts and professors from Shiraz University of Medical Sciences based on their academic background and asked to cooperate with the researcher, including two clinical psychologists, two psychiatrists, two neuroscientists, two occupational therapists, and two speech therapists.

## Measurement of validity and reliability of the questionnaire

### Content validity

Five to ten experts are needed to determine content validity (Lynn, 1986). Therefore, to calculate content validity, content validity ratio (CVR) according to Lawshe's method (Lawshe, 1975) and content validity index (CVI)

based on Waltz and Basel method (Polit & Beck, 2006) were used. There are two forms of CVI: CVI for the item (I-CVI) and CVI for scale (S-CVI) (Yusoff, 2019). In this study, we used the I-CVI forms to calculate the CVI.

### Face validity

Two checklists with 14 and 15 items were designed for two groups to determine face validity (expert panel and the elderly). The researcher and neuroscience experts provided each item of face validity checklists. The checklists were given to an expert panel and ten older adults; the checklists ranged from 0 to 10 based on the colored visual analog scale (VAS) (a score of 0 means the lowest score, and a score of 10 means the highest score in that feature for testing).

### Convergent validity

At this stage, the AQ was given to 60 older adults. To assess convergent validity, the MoCA test was used. The results of both tests were compared with each other.

### Reliability

To determine the test-retest reliability, the AQ was given to 23 older people twice at a 2-week interval. Moreover, to assess internal consistency reliability, 93 older people took part.

### Study procedure

For data gathering, necessary permissions were obtained from the Welfare Organization in Fars Province (Iran). Then, the researcher explained the purpose of the study for the elderly before the start of their educational classes in the two elderly day-care centers so that people were free to take part if they wished. The questionnaires were distributed before the beginning of the elderly's classes. After completion, they were delivered to the researcher. The MoCA test also was taken in a quiet room individually. Informed consent was obtained from all study participants who received the Persian version of the questionnaire. Some demographic data were also collected, including sex, marital status, handedness (left, right, or both), smoking, alcohol use, physical activity, daily usage of fruit and vegetables, and family history of Alzheimer disease or forgetfulness.

### Statistical analyses

For evaluation of face validity, the mean scores of VAS were considered. The Pearson correlation, Kuder-Richardson, and inter-class correlation coefficient

(ICC) were used to evaluate convergent validity, test-retest reliability, and internal consistency. Moreover, the standard error of measurement (SEM) was used to assess response stability; considering the standard error of measurement, the absolute minimal detectable change (MDC95%) was calculated. The following formulas were used (Mesquita et al., 2013) Equation 1:

$$1. \quad SEM = SD \sqrt{1 - ICC}$$
$$MDC95\% = 1.96 SEM \sqrt{2}$$

Reliability correlation coefficient values were more significant than 0.7 and considered satisfactory. Moreover, the receiver operating characteristic curve (ROC) was used to determine the optimal cut-off point (OCP) of the self-assessment MCI test. The area under the ROC curve (AUC) was calculated as a higher AUC indicated a better ability to differentiate the two groups. Sensitivity and specificity were also calculated using Youden's J index (i.e.,  $J = \text{sensitivity} + \text{specificity} - 1$ ) (Böhning, Böhning, & Holling, 2008). The analysis was done in IBM SPSS software, version 16 and Microsoft Excel software 2010. A  $P < 0.05$  was considered statistically significant in all statistical procedures.

### 3. Results

The Mean  $\pm$  SD age of the participants was 67.49  $\pm$  5.28 years), with an age range of 60-85 years old. The sociodemographic characteristics of study participants are shown in Table 1.

#### Content validity

The degree to which a test includes items necessary to measure the concept is called content validity (Lawshe, 1975). The expert panel evaluated the content validity of the Persian version of AQ. Total CVR for all five domains and 21 Items of the self-assessment MCI tool was obtained as 0.87, and CVI as 0.97. Therefore, it was found that all questions were valid. Since the CVR was above 0.62 (0.87) and CVI was higher than 0.79, the validity of this tool was confirmed. Also, the translated version was named "M-check" for "Memory check."

#### Face validity

Face validity shows the validity of the test based on its appearance. Based on the VAS checklist completed by the expert panel and the elderly, the total mean face validity of the test based on VAS was measured as 8.86 and 9.20, respectively, for the expert panel and the elderly, as shown in Table 2.

#### Convergent validity

Convergent validity applies to how a new scale is relevant closely to other variables and measures of the same construct (P. F. M. Krabbe & Krabbe, 2017) validity is the extent to which an instrument measures what it is meant to measure. Here, in the setting of health measurement, it is divided into content validity and construct validity. Content validity is the extent to which an instrument covers the concept of the latent construct (e.g., mobility, depression, physical functioning, self-esteem. To assess convergent validity, the Pearson correlation coefficient "r" was used, which was -0.83 for correct answers. Statistically significant negative correlations were found between M-Check and MoCA total scores ( $P < 0.05$ ). Details on convergent validity are shown in Figure 1. As shown in Figure 1, MoCA and M-check are negatively correlated. In the MoCA test, if a person scores more than 26, the person is cognitively healthy, and a lower score (below 26) indicates cognitive inefficiency. While in the M-Check test, it was the opposite, meaning that a higher score on the M-Check test indicates possible cognitive disorder (score more than 4), and lower ratings indicate normal cognitive ability (score lower equal than 4). Hence, a statistically significant negative correlation was found in this regard ( $r = -0.83$ )

#### Internal consistency

Internal consistency shows how closely related a set of items are as a group (Tavakol & Dennick, 2011). The Kuder-Richardson coefficient is suitable for a nominal variable with two-choice options (yes or no, or true or false) (Zeller & Carmines, 1979). So, Kuder-Richardson coefficient was used to assess the internal reliability of the Persian version of self-assessment AQ. The Kuder-Richardson coefficient was obtained as 0.84.

#### Tests-retest reliability

Among 93 older people, 23 completed the questionnaire for the first time and fill it out again after 2 weeks. ICC was used for test-retest reliability assessment. ICC coefficient was obtained as 0.92 for the total score (95% confidence interval [CI]: 0.81-0.96) ( $P < 0.0001$ ) (Figure 2).

The SEM estimates the standard error in a set of repeated measures. The standard error of measurement rises as the standard deviation increases. Also, the standard error of measurement increases as the test reliability declines, showing an inverse relationship (Russek, 2004).

**Table 1.** Sociodemographic characteristics of study participants

| Characteristic  | Variables | No. (%)             |
|---|-----------|---------------------|
|   |           | Participants (n=93) |
| Sex (n=87)  | Male      | 26(29.9)            |
|   | Female    | 61(70.1)            |
| Marital status (n=85)                                       | Single    | 1(1.2)              |
|   | Married   | 66(77.6)            |
|   | Widow     | 2(2.4)              |
|   | Divorced  | 16(18.8)            |
| Educational status (n=85)                                   | ≤12       | 52(61.2)            |
|   | >12       | 33(38.8)            |
| Handedness (n=85)   | Left      | 3(3.5)              |
|   | Right     | 79(92.9)            |
|   | Both      | 3(3.5)              |
| Smoking (n=86)  | Yes       | 4(4.7)              |
|   | No        | 82(95.3)            |
| Alcohol use (n=86)  | Yes       | 3(3.5)              |
|   | No        | 83(96.5)            |
| Physical activity (n=86)                                    | Yes       | 66(76.7)            |
|   | No        | 20(23.3)            |
| Daily usage of fruit and vegetables (n=86)                  | Yes       | 71(82.6)            |
|   | No        | 15(17.4)            |
| Family History of Alzheimer disease or forgetfulness (n=93) | Yes       | 15(16.1)            |
|   | No        | 78(83.9)            |

\* Represents valid percent.

NEUROSCIENCE

The MDC values indicate the minimum amount of change detected in repeated measures beyond the error threshold (Mesquita et al., 2013). The MDC is calculated with different confidence intervals, usually 95% (Huang et al., 2011). Hence, this research's SEM and MDC 0.95 values were 0.92 and 2.55, respectively. Figure 2 illustrates test-retest reliability, in which the test showed significant reliability over time (ICC=0.92).

#### Cut-off scores

The area under the curve presented good values (AUC=0.852). The curve is shown in Figure 3. Also,

sensitivity and specificity were used to find an ideal cut-off point for the M-Check test. The results are shown in Table 3. According to the highest value found for differences in sensitivity and specificity, a score of 4.50 is the ideal cut-off point (sensitivity=0.62 and specificity=0.94).

#### 4. Discussion

The aging population is growing, leading to an increase in the prevalence and incidence of age-related cognitive disorders. We need neuropsychological tools to effectively detect and appropriately manage these disorders

**Table 2.** Mean of face validity's items of VAS for expert panel and the elderly

|                                   | Variables  | Mean  | Number of Participations |
|-----------------------------------|--|-------|--------------------------|
| Items of VAS for the expert panel | Simplicity of test   | 9.11  | 9                        |
|                                   | Level of used clarity terms in the test                                | 8.46  | 9                        |
|                                   | Ease of learning in using the test                                     | 9     | 9                        |
|                                   | Effectiveness in connecting to the medical staff                       | 8.62  | 8                        |
|                                   | Ease of using the test   | 9.34  | 9                        |
|                                   | Short time for completing the test                                     | 9.02  | 9                        |
|                                   | Effectiveness of the test  | 8.89  | 9                        |
|                                   | Degree of satisfaction with the test                                   | 8.89  | 9                        |
|                                   | Degree of suitability for the age range of the elderly                 | 8.79  | 9                        |
|                                   | Level of communication and correlation of questions with each other    | 9     | 9                        |
|                                   | Amount of concept taken from the questions                             | 8.37  | 8                        |
|                                   | Level of communication with the scale                                  | 8.98  | 8                        |
|                                   | Likelihood of future retesting as part of diagnostic care for patients | 8.79  | 9                        |
|                                   | Level of introducing to colleagues or friends                          | 8.79  | 9                        |
| Items of VAS for the elderly      | Simplicity of test   | 9.45  | 11                       |
|                                   | Level of test organization   | 8.82  | 11                       |
|                                   | Clear terms  | 9.64  | 11                       |
|                                   | Ease of learning in using the test                                     | 9.64  | 11                       |
|                                   | Effectiveness in connecting to the medical staff                       | 9.40  | 10                       |
|                                   | Ease of using the test   | 10.00 | 8                        |
|                                   | Short time for completing the test                                     | 9.27  | 8                        |
|                                   | Effectiveness of the test  | 9.27  | 11                       |
| Items of VAS for the elderly      | Degree of satisfaction with the test                                   | 9.18  | 11                       |
|                                   | Degree of suitability for the age range of the elderly                 | 9.09  | 11                       |
|                                   | Amount of concept taken from the questions                             | 9.00  | 11                       |
|                                   | Amount of help in talking about disease conditions for patients        | 9.38  | 8                        |
|                                   | The amount of pleasure is the test                                     | 8.50  | 10                       |
|                                   | Likelihood of future retesting as part of diagnostic care for patients | 9.11  | 9                        |
|                                   | Level of introducing to friends  | 8.20  | 10                       |

**Table 3.** Sensitivity, specificity, and youden's j indices at different cut-off scores for self-assessment mild cognitive impairment test

| Score  | Sensitivity | Specificity | Youden's J Indices | Score  | Sensitivity | Specificity | Youden's J Indices |
|--------|-------------|-------------|--------------------|--------|-------------|-------------|--------------------|
| ≥-1.00 | 1.000       | 0           | 0.000              | ≥6.50  | 0.333       | 1           | 0.333              |
| ≥0.50  | 0.958       | 0.333       | 0.292              | ≥8.00  | 0.250       | 1           | 0.250              |
| ≥1.50  | 0.833       | 0.527       | 0.361              | ≥9.50  | 0.167       | 1           | 0.167              |
| ≥2.50  | 0.792       | 0.750       | 0.542              | ≥11.00 | 0.125       | 1           | 0.125              |
| ≥3.50  | 0.750       | 0.8056      | 0.556              | ≥13.50 | 0.083       | 1           | 0.083              |
| ≥4.50  | 0.625       | 0.944       | 0.569              | ≥16.50 | 0.042       | 1           | 0.042              |
| ≥5.50  | 0.542       | 1           | 0.542              | ≥19.00 | 0.000       | 1           | 0.000              |

NEURSCIENCE

(Badrkhahan et al., 2019). The present study aimed to evaluate the psychometric features of the self-assessment Persian version of the Alzheimer questionnaire (AQ) in the elderly to detect MCI.

The current study translated the AQ to Persian using a forward-backward translation method. In the translation stage, minor changes were made according to suggestions by the expert panel. These changes were mainly related to converting the test to a self-assessment questionnaire (changing the third-person to first-person format). Also, some minor cross-cultural changes (e.g., golf and dance in the main questionnaire changed to physical activity) were applied. One of the aims of the translation process is to generate an instrument that is suitable based on culture and target population (WHO, 2010). Also, the translated version was named "M-check" for "Memory check."

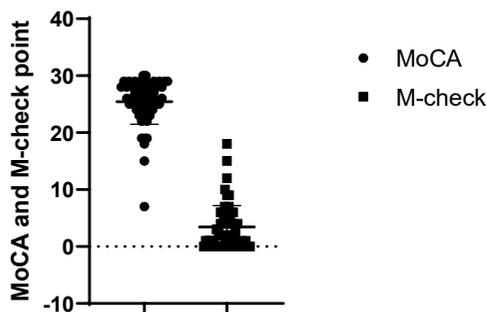
Cognitive function is typically classified into five areas: learning and memory, language, visual-spatial visibility, executive, and psychomotor (Knopman & Petersen, 2014). Some studies have used self-assessment tools for diagnosing cognitive impairment with different scopes. Rattanabannakit et al. (2016) used a cognitive change index for cognitive impairment. This tool consists of 3 domains with 20 subsets: memory (12 questions), executive function (5 questions), and language (3 questions) rated on a 5-point Likert scale (Rattanabannakit et al., 2016). Also, Broadbent et al. (1982) designed the cognitive failures questionnaire. This 25-item questionnaire was rated on a 5-point Likert questionnaire. It is a self-assessment scale to identify cognitive decline, including slips and errors of perception, memory, and motor function (Broadbent, Cooper, FitzGerald, & Parkes, 1982). The AQ questionnaire in this study consists of five domains: memory, orientation, functional ability, visuospatial, and language, which were more completed than other researches.

### Content validity

The content validity process is critical to developing new tools (Almanasreh, Moles, & Chen, 2019) judgment and quantifying stage, and revising and reconstruction stage. To quantify the expert judgments, several indices have been discussed in this paper such as the content validity ratio (CVR). Two standard methods to measure content validity are CVI and CVR, which we used them. The acceptable CVI score must be at least 0.79, preferably higher than 0.90 (Polit & Beck, 2006) using ratings of item relevance by content experts. We analyzed how nurse researchers have defined and calculated the CVI, and found considerable consistency for item-level CVIs (I-CVIs). In this study, the CVI score among 21 items indicated good scale content validity (CVI=0.97). According to Lawshe (1978), the acceptable CVR value for ten experts is equal to 0.62 (Lawshe, 1975), and as mentioned earlier, the CVR score among 21 items was obtained as 0.87, which was satisfactory.

### Face validity

In assessing face validity by two groups (consisting of the expert panel and the elderly), all face validity questions (14 for the expert panel and 15 for the elderly) achieved desired face validity. Face validity means how an instrument looks valid to the respondents who have to fill it up (P. Krabbe, 2017). Connell et al. (2018) noted that face validity is an essential step in the acceptability and validity of items in developing a new instrument (Connell et al., 2018). Finally, the assessment of content and face validities of M-Check did not result in changes in the number of items, and only some revisions were applied.



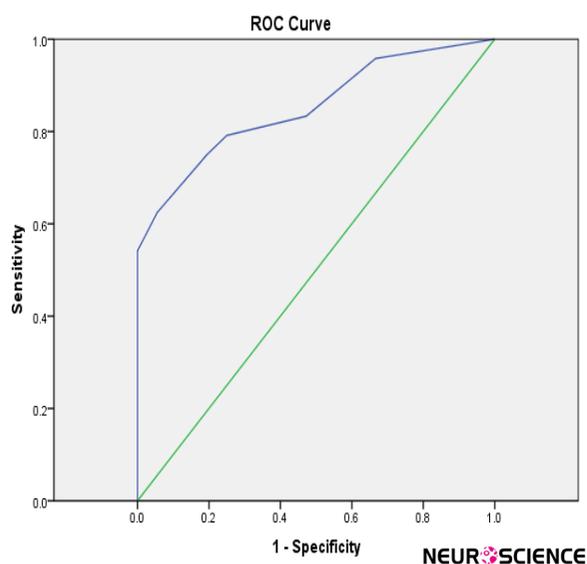
**Figure 1.** Convergent validity of the montreal cognitive assessment (MoCA) and M-Check

### Convergent validity

The Pearson correlation coefficient was used to measure convergent validity, and “r” between scores of M-Check and MoCA was obtained as -0.83. [Hinkle et al. \(2003\)](#) reported the size of correlation in the range of 0.70 to 0.90 (-0.70 to -0.90) as a high positive (negative) correlation ([Hinkle, Wiersma, & Jurs, 2003](#)). Accordingly, the convergent validity of the M-Check was confirmed.

### Reliability

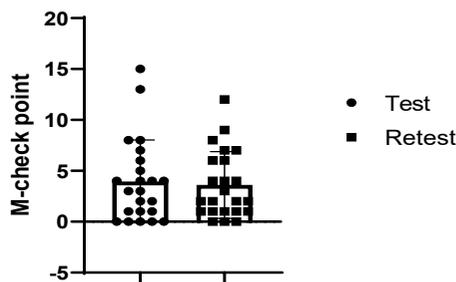
The questionnaire was distributed among several older people, and the Kuder-Richardson coefficient was measured to measure the internal consistency of the M-Check. This method is beneficial for tests comprising two responses (true and false or yes or no) ([Zeller](#)



**Figure 3.** ROC Curve of M-Check

AUC=0.852; SE=0.054; P<0.05; 95% CI=0.746-0.957.

AUC: area under the curve; SE: standard error; CI: confidence interval.



**Figure 2.** Test-retest reliability of M-Check

[& Carmines, 1979](#)). The minimal acceptable value for internal consistency is equal to 0.7, indicating an excellent amount for internal consistency.

Stability measures the consistency of repetition, so the test-retest method was used to assess stability. ICC is one of the most common tests to measure stability ([de Vet, Terwee, Knol, & Bouter, 2006](#)). The minimum value of 0.70 is considered satisfactory ([Terwee et al., 2007](#)). The ICC and SEM of M-Check both were reported as 0.92. The ICC and SEM may differ, i.e., the ICC of measurements may be close to perfect, but the SEM may be small and vice versa. In other words, it depends on how the measurement will be interpreted ([Russek, 2004](#)). Also, [Musselwhite and Wesolowski](#) have stated, "if the reliability is close to perfect ( $r=1$ ), the standard error will be small, indicating the examinee has observed score is very similar to the true score" ([Musselwhite & Wesolowski, 2018](#)). In this study, the small SEM value indicated that test-retest measurements were stable over time, mentioning measurement accuracy. Accordingly, the M-Check had acceptable stability, repeatability, and reliability.

[Rezaei et al. \(2018\)](#) assessed the psychometric properties of the Mini-Cog in Iranian older adults. The result showed that the test-retest reliability of the Persian version of Mini-Cog was acceptable ( $r=0.86$ ,  $P<0.01$ ) ([Rezaei et al., 2018](#)). Another study that evaluated the psychometric properties of the Persian version of the cognitive state test (COST) in a sample of Iranian older adults showed that the COST had a significant correlation with the clinical dementia rating ( $rS=-0.76$ ,  $P<0.001$ ). It indicated an acceptable concurrent validity for the test ([Lotfi et al., 2016](#)). These studies were in accordance with the result of this study. However, both mentioned studies were not self-assessment, and the tests performed for all the participants by a trained therapist or aimed to promote the clinical assessment ([Malakouti, Panaghi, Foroughan, Salehi, & Zandi, 2012](#)). However, in this study, the M-Check can be conducted by older people at home without expert help. Results of this study showed that the area under the ROC curve for

predicting MCI based on M-Check was equal to 0.85, and the cut-off value was measured as 4.5. So, the sensitivity and specificity were equal to 0.62 and 0.94, respectively. All findings demonstrated that the M-Check had high values in predicting MCI in the early stages.

### Strengths and limitations of the study

An essential strength of our study was using AQ as a self-assessment tool in MCI detection. It can be done at home without the presence of a physician.

There were also some limitations in this study. First, the sample size was small. It is suggested to conduct the same survey with a large group of the elderly. Second, it is suggested to conduct a study in the future based on the main version (a physician completes the main version of AQ by asking the patients' family or relatives), which was not done in this study due to time limitations. Third, one of the main risk factors for MCI is lower educational level and male sex (Roberts et al., 2012). While in this study, most participants were female, and we excluded the elderly who were illiterate. This limitation may reduce the effectiveness of these instruments in identifying MCI, so it is recommended to conduct further studies to clarify the sensitivity of self-assessment AQ for recognizing MCI.

### 5. Conclusion

Screening tools are essential to detect MCI or dementia, as different tests are available. They can be used as a valid and reliable tool for assessing the cognitive state of older people (Lotfi et al., 2016; Rezaei et al., 2018) gender, and education entered the study. The diagnostic and statistical manual of mental disorders criteria for dementia were used as gold standard. A battery of scales included the abbreviated mental test score (AMTS, but an expert should have interpreted them. Therefore, a valid test to assess cognitive dysfunction in the elderly alone can be beneficial in managing this dysfunction. The M-Check has adequate psychometric properties as a screening instrument for detecting MCI among the Iranian elderly. So, the M-check can be used as a valid and reliable instrument for assessing cognitive state and screening MCI in older adults. Also, it can be used by the elderly to monitor their cognitive status at home.

### Ethical Considerations

#### Compliance with ethical guidelines

The Ethics Committee approved this study at Shiraz University of Medical Sciences (SUMS) (No.: IR.SUMS.REC.1397.715). Participation in the study was voluntary, and all participants submitted written informed consent before enrolment.

### Funding

This work was supported by grants from Shiraz University of Medical Sciences (SUMS) (97-01-07-17037).

### Authors' contributions

Conceptualization and Supervision: Mahsa Roozrokhs Arshadi Montazer, Roxana Sharifian, Roohollah Zahediannasab and Mohammad Nami; Methodology: Mahsa Roozrokhs Arshadi Montazer, Roxana Sharifian, Roohollah Zahediannasab and Mohammad Nami; Investigation, Writing—original draft, and Writing—review & editing: All Authors; Data collection: Mahsa Roozrokhs Arshadi Montazer and Roohollah Zahediannasab; Data analysis: Mahsa Roozrokhs Arshadi Montazer, Roohollah Zahediannasab, Mahshid Tahamtan, and Mahdi Nasiri.

### Conflict of interest

The authors declared no conflict of interest.

### Acknowledgments

This paper is a part of an MSc. thesis of the first author, entitled "Mobile-Based Self-Assessment Tool for Mild Cognitive Impairment (Design and Assessment)." The authors wish to thank the Welfare Organization of Fars Province (Iran) and senior care centers in Shiraz, Iran. We are grateful to all the experts and the elderly who participated in this study.

### References

- Almanasreh, E., Moles, R., & Chen, T. F. (2019). Evaluation of methods used for estimating content validity. *Research in Social and Administrative Pharmacy*, 15(2), 214-221. [DOI:10.1016/J.SAPHARM.2018.03.066] [PMID]
- Alzheimer's Association. (2015). Mild cognitive impairment. Retrieved from: [https://www.alz.org/dementia/downloads/topicsheet\\_MCI.pdf](https://www.alz.org/dementia/downloads/topicsheet_MCI.pdf)
- Ashford, J. W., Borson, S., O'Hara, R., Dash, P., Frank, L., Robert, P., et al. (2007). Should older adults be screened for dementia? It is important to screen for evidence of dementia! *Alzheimer's & Dementia: The journal of the Alzheimer's Association*, 3(2), 75-80. [DOI:10.1016/j.jalz.2007.03.005.Should] [PMID] [PMCID]
- Badrkhahan, S. Z., Sikaroodi, H., Sharifi, F., Kouti, L., & No-roozian, M. (2019). Validity and reliability of the Persian version of the Montreal Cognitive Assessment (MoCA-P) scale among subjects with Parkinson's disease. *Applied Neuropsychology. Adult*, 27(5), 431-439. [DOI:10.1080/23279095.2019.1565762] [PMID]

- Böhning, D., Böhning, W., & Holling, H. (2008). Revisiting youden's index as a useful measure of the misclassification error in a meta-analysis of diagnostic studies. *Statistical Methods in Medical Research*, 17(6), 543-554. [DOI:10.1177/0962280207081867] [PMID]
- Broadbent, D. E., Cooper, P. F., FitzGerald, P., & Parkes, K. R. (1982). The Cognitive Failures Questionnaire (CFQ) and its correlates. *The British Journal of Clinical Psychology*, 21 (Pt 1), 1-16. [DOI:10.1111/j.2044-8260.1982.tb01421.x] [PMID]
- Chehrehnegar, N., Shams, F., Zarshenas, S., & Kazemi, F. (2012). Evaluating the reliability of the Montreal cognitive assessment test and its agreement with mini-mental state examination among healthy elderly. *Journal of Research in Rehabilitation Sciences*, 7(5), 674-680. [DOI:10.22122/jrrs.v7i5.330]
- Chin, R., Ng, A., Narasimhalu, K., & Kandiah, N. (2013). Utility of the AD8 as a self-rating tool for cognitive impairment in an Asian population. *American Journal of Alzheimer's Disease and Other Dementias*, 28(3), 284-288. [DOI:10.1177/1533317513481090] [PMID]
- Ciesielska, N., Podhorecka, M., Kędziora-Kornatowska, K., Mazur, E., Sokołowski, R., & Polak-Szabela, A. (2016). Is the Montreal Cognitive Assessment (MoCA) test better suited than the Mini-Mental State Examination (MMSE) for mild cognitive impairment (MCI) detection among people aged over 60? *Meta-analysis. Psychiatria Polska*, 50(5), 1039-1052. [DOI:10.12740/pp/45368] [PMID]
- Connell, J., Carlton, J., Grundy, A., Taylor Buck, E., Keetharuth, A. D., Ricketts, T., et al. (2018). The importance of content and face validity in instrument development: Lessons learned from service users when developing the Recovering Quality of Life measure (ReQoL). *Quality of Life Research: An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation*, 27(7), 1893-1902. [DOI:10.1007/s11136-018-1847-y] [PMID] [PMCID]
- de Vet, H. C. W., Terwee, C. B., Knol, D. L., & Bouter, L. M. (2006). When to use agreement versus reliability measures. *Journal of Clinical Epidemiology*, 59(10), 1033-1039. [DOI:10.1016/j.jclinepi.2005.10.015] [PMID]
- Harada, C. N., Natelson Love, M. C., & Triebel, K. L. (2013). Normal Cognitive aging. *Clinics in Geriatric Medicine*, 29(4), 737-752. [DOI:10.1016/j.cger.2013.07.002] [PMID] [PMCID]
- Hinkle, D. E., Wiersma, W., & Jurs, S. G. (2003). *Applied Statistics for the Behavioral Sciences*. Boston, MA: Houghton Mifflin Company. [Link]
- Huang, S.-L., Hsieh, C.-L., Wu, R.-M., Tai, C.-H., Lin, C.-H., & Lu, W.-S. (2011). Minimal detectable change of the Timed "Up & Go" test and the dynamic gait index in people with parkinson disease. *Physical Therapy*, 91(1), 114-121. [DOI:10.2522/ptj.20090126] [PMID]
- Hugo, J., & Ganguli, M. (2014). Dementia and cognitive impairment: Epidemiology, diagnosis, and treatment. *Clinical Geriatric Medicine*, 30(3), 421-442. [DOI:10.1016/j.cger.2014.04.001.Dementia] [PMID] [PMCID]
- Jessen, F., Amariglio, R. E., van Boxtel, M., Breteler, M., Ceccaldi, M., Chételat, G.; Subjective Cognitive Decline Initiative (SCD-I) Working Group, S. C. D. I. (SCD-I. W. (2014). A conceptual framework for research on subjective cognitive decline in preclinical Alzheimer's disease. *Alzheimer's & Dementia. The Journal of the Alzheimer's Association*, 10(6), 844-852. [DOI:10.1016/j.jalz.2014.01.001] [PMID] [PMCID]
- Knopman, D. S., & Petersen, R. C. (2014). Mild cognitive impairment and mild dementia: A clinical perspective. *Mayo Clin. Proc.*, 89(10), 1452-1459. [DOI:10.1016/j.mayocp.2014.06.019.Mild] [PMID] [PMCID]
- Krabbe, P. (2017). *The measurement of health and health status: Concepts, methods, and applications from a multidisciplinary perspective*. Elsevier. [DOI:10.1016/C2013-0-19200-8]
- Krabbe, P. F. M. (2017). Validity. *The Measurement of Health and Health Status*, 113-134. [DOI:10.1016/B978-0-12-801504-9.00007-6]
- Langa, K., & Levine, D. (2014). The diagnosis and management of mild cognitive impairment: A clinical review. *Journal of the American Medical Association*, 312(23), 2551-2561. [DOI:10.1001/jama.2014.13806.The] [PMID] [PMCID]
- Lawshe, C. H. (1975). A quantitative approach to content validity (Vol. 28). [DOI:10.1111/j.1744-6570.1975.tb01393.x]
- Lopez, O. L. (2013). Mild cognitive impairment. *Continuum (Minneapolis, Minn.)*, 19(2 Dementia), 411-424. [DOI:10.1212/01.CON.0000429175.29601.97] [PMID] [PMCID]
- Lotfi, M. S., Tagharrobi, Z., Sharifi, K., & Abolhasani, J. (2016). Psychometric evaluation of the Cognitive State Test (COST) in a sample of Iranian elderly people. *Iranian Red Crescent Medical Journal*, 18(5). [DOI:10.5812/ircmj.23786]
- Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382-386. [DOI:10.1097/00006199-198611000-00017]
- Malakouti, S. K., Panaghi, L., Foroughan, M., Salehi, M., & Zandi, T. (2012). Farsi version of the Neuropsychiatric Inventory: Validity and reliability study among Iranian elderly with dementia. *International Psychogeriatrics*, 24(2), 223-230. [DOI:10.1017/S1041610211001797] [PMID]
- Malik, G. A., & Robertson, N. P. (2017). Treatments in Alzheimer's disease. *Journal of Neurology*, 264(2), 416-418. [DOI:10.1007/s00415-017-8395-1] [PMID] [PMCID]
- World Health Organization (WHO). (2017). Global action plan on the public health response to dementia 2017-2025. WHO. Retrieved from: [Link]
- Mesquita, R., Janssen, D. J., Wouters, E. F., Schols, J. M., Pitta, F., & Spruit, M. A. (2013). Within-day test-retest reliability of the Timed Up & Go test in patients with advanced chronic organ failure. *Archives of physical medicine and rehabilitation*, 94(11), 2131-2138. [DOI:10.1016/j.apmr.2013.03.024] [PMID]
- Musselwhite, D. J., & Wesolowski, B. C. (2018). *The SAGE encyclopedia of educational research, measurement, and evaluation*. (B. B. Frey, Ed.), SAGE Publications, Inc. Thousand Oaks. [DOI:10.4135/9781506326139.n658]
- Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., et al. (2005). The Montreal Cognitive Assessment, MoCA: A brief screening tool for mild cognitive impairment. *Journal of the American Geriatrics Society*, 53(4), 695-699. [DOI:10.1111/j.1532-5415.2005.53221.x] [PMID]
- Polit, D. F., & Beck, C. T. (2006). The content validity index: Are you sure you know what is being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489-497. [DOI:10.1002/nur.20147] [PMID]

- Prince, M., Comas-Herrera, A., Knapp, M., Guerchet, M., & Karagiannidou, M. (2016). World Alzheimer Report 2016 Improving healthcare for people living with dementia. Coverage, Quality, and costs now and in the future. *Alzheimer's Disease International (ADI)*, 1-140. Retrieved from: [\[Link\]](#)
- Rattanabannakit, C., Risacher, S. L., Gao, S., Lane, K. A., Brown, S. A., McDonald, et al. (2016). The cognitive change index as a measure of self and informant perception of cognitive decline: Relation to neuropsychological tests. *Journal of Alzheimer's disease : JAD*, 51(4), 1145-1155. [\[DOI:10.3233/JAD-150729\]](#) [\[PMID\]](#) [\[PMCID\]](#)
- Reisberg, B., Prichep, L., Mosconi, L., John, E. R., Glodzik-Sobanska, L., Boksay, I., et al. (2008). The pre-mild cognitive impairment, subjective cognitive impairment stage of Alzheimer's disease. *Alzheimer's & dementia: the journal of the Alzheimer's Association*, 4(1 Suppl 1), S98-S108. [\[DOI:10.1016/j.jalz.2007.11.017\]](#) [\[PMID\]](#)
- Reisberg, B., Shulman, M. B., Torossian, C., Leng, L., & Zhu, W. (2010). Outcome over seven years of healthy adults with and without subjective cognitive impairment. *Alzheimer's & dementia: the journal of the Alzheimer's Association*, 6(1), 11-24. [\[DOI:10.1016/j.jalz.2009.10.002\]](#) [\[PMID\]](#) [\[PMCID\]](#)
- Rezaei, M., Rashedi, V., Lotfi, G., Shirinbayan, P., & Foroughan, M. (2018). Psychometric properties of the Persian adaptation of mini-cog test in Iranian older adults. *International Journal of Aging and Human Development*, 86(3), 266-280. [\[DOI:10.1177/0091415017724547\]](#) [\[PMID\]](#)
- Roberts, R. O., Geda, Y. E., Knopman, D. S., Cha, R. H., Pankratz, V. S., Boeve, B. F., et al. (2012). The incidence of MCI differs by subtype and is higher in men: The Mayo Clinic Study of Aging. *Neurology*, 78(5), 342-351. [\[DOI:10.1212/WNL.0b013e3182452862\]](#) [\[PMID\]](#) [\[PMCID\]](#)
- Roberts R, K. D. (2014). Classification and Epidemiology of MCI. *Clinics in Geriatric Medicine*, 29(4), 1-19. [\[DOI:10.1016/j.cger.2013.07.003.Classification\]](#)
- Russek, L. (2004). Factors affecting interpretation of reliability coefficients. *Journal of Orthopaedic and Sports Physical Therapy*, 34(6), 341-349. [\[DOI:10.2519/jospt.2004.0797\]](#) [\[PMID\]](#)
- Sabbagh, M. N., Malek-Ahmadi, M., Kataria, R., Belden, C. M., Connor, D. J., Pearson, C., et al. (2010). The Alzheimer's questionnaire: A proof of concept study for a new informant-based dementia assessment. *Journal of Alzheimer's disease: JAD*, 22(3), 1015-1021. [\[DOI:10.3233/JAD-2010-101185\]](#) [\[PMID\]](#) [\[PMCID\]](#)
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55. [\[DOI:10.5116/ijme.4dfb.8dfd\]](#) [\[PMID\]](#) [\[PMCID\]](#)
- Terwee, C. B., Bot, S. D., de Boer, M. R., van der Windt, D. A., Knol, D. L., Dekker, J., et al. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology*, 60(1), 34-42. [\[DOI:10.1016/j.jclinepl.2006.03.012\]](#) [\[PMID\]](#)
- Vancouver Coastal Health. (2014). Occupational Therapy Cognitive Assessment Inventory & References. Retrieved from: [\[Link\]](#)
- World Health Organization (WHO). (2017). Mental health of older adults. WHO. Retrieved from: [\[Link\]](#)
- Efstathiou, G., Suhonen, R., Stolt, M., Papastavrou, E. (2019). Individualized care: Theory, measurement, research and practice. Springer, Cham. [\[Link\]](#)
- Yusoff, M. S. B. (2019). ABC of content validation and content validity index calculation. *Education in Medicine Journal*, 11(2), 49-54. [\[DOI:10.21315/eimj2019.11.2.6\]](#)
- Zeller, R. A., & Carmines, E. G. (1979). Reliability and validity assessment. New York: Sage Publications. [\[DOI:10.4135/9781412985642\]](#)