

ORIGINAL ARTICLE

Validity and reliability of Abbreviated Mental Test Score (AMTS) among older Iranian

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INTRODUCTION

As the population of older adults increases, health problems that are common among them increase as well.¹ Dementia is a major health problem commonly found among older persons. It causes patients to experience cognitive and functional decline, impaired functioning, and poor quality of life. Dementia may also complicate their other health conditions.^{2–4}

Dementia care is a long and difficult endeavour that imposes a high burden on patients, their families, and society.⁵ It was estimated that 35.6 million people worldwide were living with dementia in 2010. This figure is expected to almost double every 20 years,

Abstract

Background: Cognitive impairment is common among older people and is associated with increased morbidity and mortality. The main aim of this study was to evaluate the validity of the Persian version of the Abbreviated Mental Test Score (AMTS) as a screening tool for dementia.

Methods: Data were obtained from a cross-sectional study. One hundred and one older adults who were members of Iranian Alzheimer Association and 101 of their siblings were entered into this study by convenient sampling. The *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition, criteria for diagnosing dementia and the Mini-Mental State Examination were used as the study tools. The gathered data were analyzed by the Mann–Whitney *U*-test, the Kruskal–Wallis test, Spearman's rank correlation coefficient, and the receiver–operating characteristic.

Results: The AMTS could successfully differentiate the dementia group from the non-dementia group. Scores were significantly correlated with *Diagnostic and Statistical Manual of Mental Disorders* diagnosis for dementia and Mini-Mental State Examination scores ($P < 0.001$). Educational level ($P < 0.001$) and male sex ($P = 0.015$) were positively associated with AMTS, whereas ($P < 0.001$) was negatively associated with AMTS. Total Cronbach's α coefficient was 0.90. The scores 6 and 7 showed the optimum balance between sensitivity (99% and 94%, respectively) and specificity (85% and 86%, respectively).

Conclusions: The Persian version of the AMTS is a valid cognitive assessment tool for older Iranian adults and can be used for dementia screening in Iran.

which means that there will be 65.7 million people with dementia by 2030 and 115.4 million by 2050.⁶ According to Global Burden of Disease estimates, dementia accounts for 11.2% of years lived with disability among people aged 60 years and older—a percentage that is higher than that for stroke (9.5%), musculoskeletal disorders (8.9%), cardiovascular disease (5.0%), and all forms of cancer (2.4%).⁷

Older population growth has been fast during recent decades in Iran. Within the last 15 years, the elderly have gone from 6.6% of the population to 8.2%.⁸ As far as we know, there has been no nationwide study on the prevalence of dementia in Iran, but

it has been estimated that there are 300 000 cases in the country.⁹

Various instruments, including the Abbreviated Mental Test Score (AMTS),¹⁰ Mini-Mental State Examination (MMSE),¹¹ Global Deterioration Scale,¹² clock-drawing test,¹³ and Blessed Orientation Memory Concentration,¹⁴ have been developed to screen for dementia among the at-risk population, and the importance of early detection has increased. Moreover, new biological and psychosocial interventions for managing cognitive disorders have been introduced, although they may not offer improvement to all individuals with dementia. Importantly, evidence has shown that the medical and nursing staff may not recognize dementia properly without cognitive testing. Formal testing increases the accuracy of dementia diagnoses in different settings.¹⁵ Therefore, the provision of appropriate and valid cognitive assessment tools has an important role in increasing the accuracy and rate of dementia diagnosis.

The MMSE, which is probably the most widely used measure of cognitive function,¹⁶ has been validated and used in Iran,^{17–19} but in our clinical experience, we encountered some difficulties using it, which is probably common in similar developing nations. First, it is culturally biased because it heavily depends on the examinee's educational level.^{20–22} As such, the MMSE may not be appropriate for the current generation of older Iranians, who have had little education and are often illiterate. Second, administering the MMSE requires special training and skilled staff and, thus, greater human and economic resources. Third, the MMSE is detailed and time-consuming, so administering it in heavily crowded public clinics may not be worthwhile or even possible. Finally, it is costly to administer the MMSE and could place an undue burden on the health budget of a mid-income country like Iran. Searching for a short, inexpensive, and more culturally appropriate tool, we chose Hodkinson's AMTS mainly because of its brevity, ease of administration by non-physicians, and reportedly good psychometric properties.¹⁰

The AMTS is a brief, 10-item test, with a 10-point scale.¹⁰ It was derived from a longer cognitive instrument, the Mental Test Score (rated out of 34) and contains the 10 questions with the most discriminatory value from the original test. It includes items requiring intact short- and long-term memory, attention, and orientation. A score <8 suggests a

significant cognitive deficit.²³ Previous reports have indicated that the AMTS may quickly provide a severity assessment that is comparable to that obtained from longer tests.²⁴ It has sufficient discriminatory ability to detect cognitive changes associated with postoperative delirium.²⁵ Its administration usually takes 3 min in elderly patients.²⁶

Several studies have shown that the AMTS has an acceptable sensitivity and specificity when compared to well-validated cognitive tests, such as the MMSE and the Informant Questionnaire for Cognitive Decline in the Elderly, and it is a valid and reliable test for dementia screening in older adults.^{26–28} A score of 7 or 8 (out of 10) has been suggested as the cut-off between cognitive impairment and no impairment.¹⁶ A validation study on the Spanish version showed a sensitivity of 100% and a specificity of 82.4% for a cut-off point of 7.²⁹ A similar study in Hong Kong showed a sensitivity of 96% and a specificity of 96% for a cut-off point of 6.³⁰ The main aim of our study was to evaluate the validity of AMTS as a screening tool for dementia.

METHODS

Design and participants

In this cross-sectional study, 101 older adults, who were members of Iranian Alzheimer Association, were entered into the study by a convenient sampling method. Inclusion criteria were as follows: (i) aged 60 and over (the World Health Organization has set age 60 as the onset of ageing in less developed countries);³¹ (ii) the ability to read and write; and (iii) the ability to communicate. One hundred and one healthy siblings within the same age group were entered as control group. To select the control group, we asked caregivers to introduce us to some of the patients' siblings, neighbours, and family friends who were in the same age group and at the same socio-economic level. They were then invited by phone to participate in this study. Our invitation was accepted mostly by the patients' siblings.

This study was approved by the Ethics Committee of the Deputy of Research and Technology at the University of Social Welfare and Rehabilitation Sciences (Tehran, Iran). Informed consent was obtained from all participants and/or their legal guardians.

To distinguish cognitively individuals healthy from non-healthy ones, a general physical and neurological examination, lab tests, and neuroimaging were performed by trained physicians on both the patients and the controls. The diagnosis of dementia was made according to the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (text revision), criteria, which is our gold standard.³² Consequently, two groups of individuals were identified: the dementia group and the non-dementia group. The Persian version of the MMSE and the prepared version of the AMTS were administered to all the participants.¹⁸

Translation

The AMTS asks the examinee to do the following: (item 1) provide their age; (item 2) indicate the time (to the nearest hour); (item 3) recall the location where the test was administered; (item 4) indicate the year; (item 5) name the location; (item 6) identify two persons (e.g. doctor, nurse); (item 7) provide their date of birth; (item 8) indicate the year World War I began; (item 9) name the Queen; and (item 10) count backwards from 20 to 1. The AMTS was translated by two accredited bilingual translators and then back translated into English by two other accredited translators. In a group discussion, the translators and the research team re-examined the translated versions and compared them with the original AMTS. Some modifications were made to the original version to make it culturally appropriate. Specifically, item 8 was changed to refer to the Iran–Iraq War, and in item 9, the Queen was replaced by the name of the current leader of Iran.

Statistical analysis

Receiver–operating characteristic (ROC) analysis, which can be used for diagnostic tests with outcomes measured on ordinal, interval, or ratio scales, was used in this study. Diagnostic sensitivity and

specificity depend on the selected cut-off value and must be considered for a thorough test evaluation and comparison. All possible combinations of sensitivity and specificity that can be achieved by changing the test's cut-off value can be summarized using a single parameter: the area under ROC curve. The ROC technique can also be used to optimize cut-off values with regard to a given prevalence in the target population and to the cost ratio of false-positive and false-negative results.³³

All analyses were performed using SPSS[®] version 13 (SPSS Inc., Chicago, IL, USA). The Mann–Whitney *U*-test, Kruskal–Wallis test, and Spearman's rank correlation coefficient were used to assess the association between variables. Cronbach's α was used to measure the degree of internal consistency and homogeneity between the items. To evaluate the validity of the AMTS, both convergent and discriminate validities were examined.

RESULTS

The mean ages of the dementia and non-dementia groups were 76.3 ± 6.6 years and 71.5 ± 7.5 years ($P < 0.001$), respectively. The percentage of female participants in dementia group was significantly higher than in the non-dementia group (50.5% vs 30.8%; $P = 0.004$). The educational levels in two groups also differed, with the people in the non-dementia group having a higher level of education ($P = 0.007$).

As illustrated in Table 1, the scores of the majority of elders in the dementia group were below 7 on the AMTS. The mean AMTS for the dementia group was 2.82 ± 3.10 , and it was 9.06 ± 0.89 for non-dementia group; the difference was statistically significant ($P < 0.001$).

Spearman's rank correlation coefficient showed that the MMSE and AMTS were positively and significantly correlated in both groups (Table 2). However, this correlation was lower in non-dementia group,

Table 1 AMTS distribution in dementia and non-dementia groups

AMTS points	Dementia group	Non-dementia group
0	38 (37.6%)	—
1–2	20 (19.8%)	—
3–4	12 (11.9%)	—
5–6	16 (15.8%)	1 (1.0%)
7–8	7 (6.9%)	22 (22.4%)
9–10	8 (7.9%)	75 (76.5%)
Total	101 (100%)	98 (100%)

AMTS, Abbreviated Mental Test Score.

Table 2 Correlation of MMSE and AMTS in dementia and non-dementia groups

Group	Test used	AMTS
Dementia group	MMSE, Spearman's correlation	0.89*
Non-dementia group	MMSE, Spearman's correlation	0.54*

* $P < 0.001$. AMTS, Abbreviated Mental Test Score; MMSE, Mini-Mental State Examination.

Table 3 The correlation of AMTS with age, sex, and educational levels

Variable	Mean \pm SD	Mean rank	Test used	P-value
Age	60–69	8.37 \pm 2.45	Kruskal–Wallis: 32.09	<0.001
	70–79	5.08 \pm 3.85		
	80+	4.95 \pm 3.89		
Sex	Male	6.43 \pm 3.76	Mann–Whitney U-test: 3719.50	0.015
	Female	5.08 \pm 3.97		
Education	Primary	4.67 \pm 3.75	Kruskal–Wallis: 36.43	<0.001
	Secondary	6.36 \pm 3.55		
	University+	7.95 \pm 3.13		

AMTS, Abbreviated Mental Test Score.

suggesting greater diversity among the non-dementia groups, which was expected.

As illustrated in Table 3, AMTS was significantly related to age, sex, and educational level.

Results showed that both dementia and non-dementia participants had difficulty responding to items 4 and 8. In contrast, all non-dementia participants successfully answered items 1, 2, 3, and 5, but the dementia group found these moderately difficult (Table 4).

To see if there was enough internal consistency and homogeneity between the items, Cronbach's α test was used. The corrected item-total correlations ranged from 0.88 to 0.91 (Table 5). Omission of each of the items did not lead to a considerable increase in the total Cronbach's α of 0.90. Therefore, all the items were preserved.

Table 4 Mean \pm SD scores of individual AMTS items in dementia and non-dementia groups

Group	Item	Mean \pm SD	n
Dementia	1	0.31 \pm 0.46	100
	2	0.47 \pm 0.50	100
	3	0.19 \pm 0.39	100
	4	0.03 \pm 0.17	100
	5	0.56 \pm 0.49	100
	6	0.26 \pm 0.44	100
	7	0.35 \pm 0.47	100
	8	0.07 \pm 0.25	100
	9	0.26 \pm 0.44	100
	10	0.35 \pm 0.47	100
Non-dementia	1	1.00 \pm 0.00	98
	2	1.00 \pm 0.00	98
	3	1.00 \pm 0.00	98
	4	0.56 \pm 0.49	98
	5	1.00 \pm 0.00	98
	6	0.93 \pm 0.24	98
	7	0.97 \pm 0.14	98
	8	0.65 \pm 0.47	98
	9	0.96 \pm 0.17	98
	10	0.95 \pm 0.19	98

AMTS, Abbreviated Mental Test Score.

The ROC analysis is presented in Table 6 and Figure 1. Sensitivity and specificity values, based on the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (text revision), diagnoses of dementia, are shown in Table 6.

DISCUSSION

In this study, the authors intended to translate, culturally adapt, and examine the validity of the AMTS as an appropriate cognitive assessment tool in a

Table 5 The corrected item-total correlations of Cronbach's α values

Subscales	Cronbach's α
1. Age in years	0.88
2. Time to the nearest hour	0.89
3. Address for recall at the end of test	0.89
4. Current year	0.91
5. Name of place	0.90
6. Recognition of two persons	0.89
7. Date of birth	0.89
8. Year the Iran–Iraq War started	0.90
9. Name of current leader	0.89
10. Count backwards from 20 to 1	0.88

Table 6 Sensitivity and specificity values of AMTS for detecting patients with a DSM-IV-TR diagnosis of dementia

AMTS cut-off point	Sensitivity (%)	Specificity (%)
0	100	37
1	100	47
2	100	57
3	100	67
4	100	49
5	100	77
6	99	85
7	94	86
8	76	91
9	35	98
10	0	100

AMTS, Abbreviated Mental Test Score; DSM-IV-TR, *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (text revision).

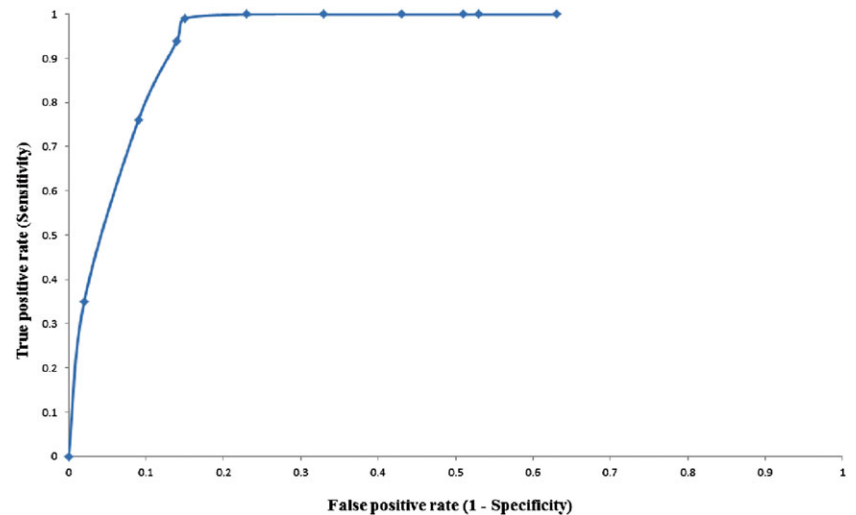


Figure 1 ROC plot for the AMTs as screening test for dementia.

sample of older Iranian adults. The results showed that the AMTS could discriminate those with dementia (diagnosed in terms of the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition (text revision)), from individuals who did not have dementia ones; the optimal cut-off points were 6 and 7 (Fig. 1). These findings are consistent with the results obtained by Sarasqueta *et al.*²⁹ Chu *et al.*³⁰ Antonelli Incalzi *et al.*³⁴ and Rocca *et al.*³⁵ These four studies confirmed the value of the AMTS in detecting cognitive impairment and indicated that a score of 7 or less was predictive of cognitive impairment, which points to the need for a more sophisticated form of cognitive evaluation.

Our results also showed that the AMTS and MMSE scores positively correlated with each other, and both correctly assessed the cognitive states of the participants and confirmed the convergent validity of the Persian version of the AMTS. This finding was similar to the results of previous studies,^{28,36,37} and to the best of our knowledge, no study has claimed anything to the contrary.

We examined the association between main demographic variables and AMTS. The AMTS was positively correlated with the educational level and male sex, but negatively with age; these findings were consistent with those of previous studies.^{28,38,39}

It is well recognized that sensitivity and specificity are inversely related depending on the choice of cut-off value. As illustrated in Table 6, 100% sensitivity could be attained with a score of 5 on the Persian versions of the AMTS, but this score also resulted in a false-positive 23% of the time. In contrast, for

scores of 6 and 7, the sensitivity was slightly lower, but the specificity considerably increased. As such, it seems that the best cut-off points for the Persian version of the AMTS are 6 and 7. Many other studies in different communities have also reported the same cut-off points.^{29,30,34,35,37}

The finding that the mean scores for items 4 and 8 were low for both the dementia and non-dementia groups requires more consideration. Both items involve remembering a date, and time perception may change in older people in part because of retirement and less active lifestyles; this may explain the low means scores on these items. However, social and cultural factors need to be considered as well, especially given that most of our sample had a low education level.

The findings of this study confirm that the Persian version of the AMTS value is a valid instrument for assessing the cognitive function of older Iranian adults. Therefore, using this instrument as a dementia screening tool in clinical and research fields is recommended.

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