Research Article

Translation, Cultural Adaptation, and Validity of Barnes Language Assessment in Persian Ageing Population: A Preliminary Study

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Citation Khatoonabadi AR, Modarres Zadeh A, Jafari Sh, Maroufizadeh S, Bryan K. Translation, Cultural Adaptation, and Validity of Barnes Language Assessment in Persian Ageing Population: A Preliminary Study. Journal of Modern Rehabilitation. 2025; 19(2):200-210. http://dx.doi.org/10.18502/jmr.v19i2.18353

http://dx.doi.org/10.18502/jmr.v19i2.18353

Article info:
Received: 16 Dec 2024
Accepted: 02 Jan 2024
Available Online: 01 Apr 2025

ABSTRACT

Introduction: As the global population ages, the need for sensitive language assessments for dementia increases. While the Barnes language assessment (BLA) is a valuable tool in English, it has not been translated and validated for Persian-speaking populations.

Materials and Methods: This cross-sectional translated and culturally adapted the BLA into Persian (BLA-Per) and evaluated its psychometric properties. The translation process followed the international quality of life assessment protocol. The BLA-Per was administered to 30 healthy older adults and 30 individuals with Alzheimer disease (AD). Test-retest reliability was assessed in the AD group. Statistical data analysis was performed using the SPSS software (version 24) at a significance level of 0.05.

Results: Due to significant differences between the patients and cognitively healthy groups regarding age and education years, we used the analysis of covariance to control for these variables' effects on between-group comparisons. Significant differences in BLA-Per scores were observed between healthy controls and AD patients in 8 out of 14 test components, demonstrating good discriminative validity. Intra-class correlation coefficients for test-retest reliability were above 0.75 for most subtests.

Conclusion: The BLA-Per demonstrated good validity and reliability in assessing language impairments in Persian-speaking individuals with AD. Future research should investigate the BLA-Per in larger samples across different age groups and stages of AD.

Keywords:

Alzheimer disease; Aging; Language tests; Psychometrics; Test validity; Test reliability

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Introduction

As a complex biological process, aging is associated with a gradual decline in physiological function and an increased vulnerability to age-related diseases due to a variety of genetic, cellular, and environmental factors [1]. This complex deterioration phenomenon can impact various aspects of an individual's life, including their health, mobility, cognitive abilities, emotion, sensory functions, language, and social interactions [2].

Alzheimer disease (AD) is a progressive neurodegenerative disorder that impairs memory, cognition, behavior, and daily functioning and is considered the most common cause of dementia in the elderly [3-5]. The main symptoms of AD comprise memory loss, confusion, disorientation, decision-making deficits, and language difficulties [6]. As the disease progresses, individuals may also experience changes in mood and behavior, as well as challenges with motor functions [7].

Language and communication impairment (LCI) is often detected early in most forms of dementia, including AD. Language impairments may manifest as difficulties with word finding, forming complex sentences, or receptive language [8]. Impaired language can impact a person's communication ability, reduce social interactions, and decrease quality of life [9]. While some language changes are a normal part of aging, the language difficulties associated with AD are different and more severe, progressive, and disruptive to daily communication. To be more specific, there are distinct patterns of language changes associated with normal aging [10, 11], which must be distinguished from pathological changes associated with such disease processes as dementia [12].

As stated above, language disorders are regarded to be among the most common symptoms of AD as a direct and natural consequence of cognitive impairment [13]. Specifically, there is ample evidence that performance in naming, semantic, and phonemic fluency tasks deteriorates early in AD, sparing syntax [14, 15]. However, significant changes in fine-grained grammatical variables are evident in the spontaneous speech of AD patients [16]. Language impairments of patients with AD are not limited to the production and comprehension of nouns and may extend to verb processing [17]. Accordingly, based on the picture description performance of AD patients, their language impairments can be categorized into three categories: Semantic, syntactic, and informational [18, 19].

Apart from the type of language disturbances in AD, the severity of these deficits increases as the disease progresses. In the first stages of the disease, language problems can be seen as difficulty retrieving vocabulary and understanding complex and abstract language [20]. In the middle or moderate stages, language problems manifest as a reduced vocabulary, repetition of ideas, forgetfulness of topics, jargon speech, and paraphasias [21]. In the later stages, the patient rarely uses language meaningfully, and in some cases, the patient completely loses their speaking abilities or becomes echolalic [22]. Language impairments appeared throughout AD, implying that the semantic and pragmatic language systems, which rely more on cognition, are more impaired than syntax and articulation [23].

Therefore, the assessment of LCI is a crucial first step in providing adequate support to enhance the retained communicative skills of individuals with dementia and the communicative competencies of their families [24]. However, one outstanding issue is that few psychometrically sound language assessments are explicitly designed for use in patients with dementia [24]. In their review article, Dooley and Walshe (2019) identified four assessment tools that are commercially available for cognitive communicative assessment of people with dementia and have appropriate psychometric properties, including content validity, construct validity, and test-retest reliability: Severe impairment battery [25], Arizona battery for communication disorders [26], functional linguistic communication inventory [27], and cognitive-linguistic quick test [28]. Another test, the detection test for language impairments in adults and the aged [29], is also designed to assess language in neurodegenerative diseases. Although these tests (namely, severe impairment battery, Arizona battery for communication disorders, and the detection test for language impairments in adults and the aged) offer a comprehensive language evaluation, their usefulness is more evident when there is a cognitive impairment. The authors stated that even though the Barnes language assessment test [12] is a valuable diagnostic tool and is capable of assessing and profiling language skills to indicate further interventions, it is not included in their review because it has not been published yet. To the best of the authors' knowledge, there is no available comprehensive language assessment tool specific to the aging population in Persian.

The Barnes language assessment is the most comprehensive screening instrument specifically designed to assess older individuals' receptive and expressive language skills. This test was originally developed for a UK population; therefore, cultural adaptations of the test are

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needed to make the test more appropriate for Persian-speaking older people, and its psychometric properties in this population must be determined for its utility in clinical settings. The test has not yet been translated into other languages, so its Persian version is the first translation aside from English. The BLA evaluates different aspects of language, including vocabulary, grammar, comprehension, and story-telling skills. This test comprises four main sections: Expression, which includes subtests of picture description, phonemic fluency, semantic word fluency, and lexical description or definition; comprehension, which involves word-picture matching, following instructions, and a grammar comprehension test; reading and writing, including oral reading, spelling, and dictation; memory, which includes story-telling and digit span.

The BLA allows clinicians to compare cases where diagnosis is unsure, but language testing alone would not be sufficient to diagnose AD. Feedback from the clinicians using the test suggested that the BLA could be used with participants who had moderate and severe dementia as well as with those at earlier stages of the disease process. Where the BLA did not give sufficient diagnostic information, it did give indicators for more detailed language testing, thus allowing clinicians to target further assessment efficiently. The BLA also provides a profile of preserved skills as well as language difficulties which may be important in designing strategies for aiding everyday communication [12].

Given the paucity of comprehensive language assessment tools for older Persian speakers and the Barns language assessment's diagnostic potential for detecting early language impairments in AD, the present study investigates the performance of older patients with confirmed diagnoses of AD compared to healthy older people in this test. More specifically, to enable clinicians and researchers to make distinctions between age-related and pathological language changes in the Persian-speaking aging population, we decided to translate and culturally adapt the BLA and investigate its discriminative validity and test-retest reliability in this study.

Materials and Methods

This cross-sectional descriptive-analytical study was conducted in two stages. The first stage included translating the BLA and determining its validity and reliability. Secondly, all participants in this study were residents of Tehran City, Iran, and testing stages were conducted in an affiliated speech-therapy clinic of Tehran University of Medical Sciences.

Translation and cultural adaptation

After receiving permission from the correspondent author to translate the BLA into Persian, the researchers translated the BLA according to the standard International Quality of Life Assessment translation protocol [30]. Accordingly, two Persian translators who were experts fluent in English translated the original BLA independently. As BLA includes both regular and irregular word stimuli in the reading and spelling subtests and has a story-retelling subtest, the translators' aim at this stage was to achieve linguistic and cultural adaptation of the test items rather than a direct translation. For spelling and reading subtests, irregular Persian words were considered based on high, medium, and low frequencies [31, 32]. Also, the story-telling subtest was translated in such a way that it follows the shopping culture of Iranians.

Then, the research team compared and synthesized the two forward translations into one standard Persian version. This forward version was given to two translators so they could translate the questionnaire back into English. The two backward translations underwent review by experts in geriatric speech-language therapy. Any variances found were corrected through discussion, and further revisions were made to produce the final original version of the instrument. The final English version was sent to the lead author (Karen Bryan) to ensure conceptual equivalence with the source version. Equivalence to the original version of BLA was confirmed.

Study instruments

The Persian version of BLA (BLA-Per) consists of 15 subtests, which are grouped into five subtests for expression, three for comprehension, three for reading and writing, two for memory, and two for executive function. Each modality includes critical areas of language functioning such as word fluency, naming, word and sentence comprehension, and word and sentence reading and writing. The test subtests were decomposed into 23 variables in statistical analysis for a detailed description of the study participants' performance. After completing the test, the scores from each section are totaled to obtain a final score. Administering this test typically takes about 1 h. If necessary, it can be conducted in more than one session.

Study participants

BLA-Per was administered to 30 neurologically healthy participants and 30 patients with mild and moderate dementia recruited based on the following inclusion and exclusion criteria. The inclusion criteria for people with AD were as follows: Diagnosis of AD by a neurologist, age over 65 years, elementary-level reading and writing skills, absence of other accompanying psychiatric and neurological problems, and absence of uncorrected hearing or vision problems. For the neurologically healthy participants. Meanwhile, the inclusion criteria were having no diagnosis of AD or complaints of cognitive problems, particularly memory issues. Additionally, they should have at least an elementary level of literacy and no uncorrected hearing or vision problems. It was also a requirement that all participants had Persian as their native or first language. The cognitive performance of both groups was assessed by the mini-mental state examination test [33]. All participants signed an informed consent before the test administration. Healthy and patient participants were selected through the convenience sampling method with the assumption that a minimum number of 30 subjects in each group is sufficient for obtaining statistically significant results [34].

Validation and reliability

The BLA-Per was validated in two stages. In the first stage, the test was administered to individuals in the healthy and patient groups to determine discriminative validity. Then, after a week, it was re-administered in the patient group to determine test-retest reliability. Before the testing, each participant or their caregiver filled out a personal history questionnaire. Assessment sessions were held individually in a quiet, well-lit room with a minimum number of distractions. The examiner explained each subtest using simple language to the examinee. The examinee's responses were recorded on the specified answer sheet and audio-recorded for further analysis. The test was re-administered to the same 30 patients one week after the initial testing at the same location.

Statistical analysis

In the present study, continuous variables were expressed as Mean±standard deviation (SD) and categorical variables as frequency (percentage). Demographic characteristics between healthy individuals and patients with AD were compared using t tests for continuous variables and chi-square test for categorical variables. Analysis of covariance (ANCOVA) was used to compare the groups after controlling for age and level of education. Furthermore, partial eta squared (η^2_p), which estimated the magnitude of the mean differences was calculated. η^2_p values of 0.01-0.06, 0.06-0.14, and >0.14 were considered as small, moderate, and large effect size, respectively. Test-retest reliability was examined using intra-class correlation coefficients (ICC) in patients with AD. Data analysis was performed using IBM SPSS Statistics for Windows, version 24.0 (IBM Corp., Armonk, NY, USA), and the level of significance was set at 0.01.

Results

Cultural adaptation

The subtests that required cultural adaptation included picture naming, spelling to dictation, word definition, following commands, and reading aloud. In the picture naming and word definition subtests, the item "harp" was replaced with "violin", as the former is an unfamiliar musical instrument to many Iranians. Regular and irregular words were selected based on their frequency in a Persian lexical corpus for the spelling to dictation and reading-aloud subtests. Additionally, since coins are no longer used in Iran's currency, large and small shirt buttons were utilized instead of 5p and 10p coins in the following commands subtest.

Participants' characteristics

Table 1 presents the demographic characteristics of the healthy and AD groups. On average, patients with AD were 16.6 years older than healthy individuals (t_{58}= 8.88, P<0.001) and they had lower education levels (t_{58}= 4.30, P<0.001). There were no significant differences in gender between the healthy and AD groups (P=1.000).

Comparison of barnes language assessment-persian scores by group

To assess the BLA-Per discriminative validity, we used the ANCOVA test to determine the difference between the AD patients and healthy controls in each subtest while controlling the interfering effects of existing differences in age and education between the two groups. The test could reveal the significant differences in the ANCOVA (Table 2) showed a significantly lower auditory picture matching total correct score for the patients with AD (Mean±SD=11.35±0.40) compared to the healthy individuals (Mean±SD=13.28±0.40) after adjusting for age and education ($F_{1, 56}$=7.90, P=0.007, η^2_p=0.124). The same results were also found for the auditory picture matching total error ($F_{1, 56}$=7.90, P=0.007, η^2_p=0.124), verbal fluency ($F_{1, 56}$=61.65, P<0.001, η^2_p=0.524), picture naming ($F_{1, 56}$=18.81, P<0.001, η^2_p=0.251), writing to dictation total correct score ($F_{1, 56}$=21.64, P<0.001, η^2_p=0.279), writing to the dictation of regular words ($F_{1, 56}$=8.52, P=0.005, η^2_p=0.132), writing to the dictation of irregular words ($F_{1, 56}$=22.65,

Table 1. Participants' demographic characteristics

Characteristics		Mean±SD/No. (%)		P
		Healthy Participants	Patients	
Age (y)		59.57±5.98	75.73±7.99	<0.001
Gender	Male	14(46.7)	14(46.7)	1
	Female	16(53.3)	16(53.3)	
Years of Education		12.80±2.38	9.10±4.06	<0.001
MMSE score		29.27±1.41	19.07±4.47	<0.001

SD: Standard deviation; MMSE: Mini-mental state examination.

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$P<0.001$, $\eta^2_p=0.288$), verbal fluency phonemic ($F_{1, 56}=61.65$, $P<0.001$, $\eta^2_p=0.524$), verbal fluency semantic ($F_{1, 56}=40.28$, $P<0.001$, $\eta^2_p=0.418$), word definition 2 ($F_{1, 56}=30.37$, $P<0.001$, $\eta^2_p=0.352$), test for recognition of grammar ($F_{1, 56}=17.78$, $P<0.001$, $\eta^2_p=0.241$), memory span ($F_{1, 56}=20.45$, $P<0.001$, $\eta^2_p=0.268$), following command ($F_{1, 56}=12.53$, $P<0.001$, $\eta^2_p=0.183$), story retelling ($F_{1, 56}=24.14$, $P<0.001$, $\eta^2_p=0.301$), and reading total score ($F_{1, 56}=7.32$, $P=0.009$, $\eta^2_p=0.116$), sentence writing ($F_{1, 56}=20.07$, $P<0.001$, $\eta^2_p=0.264$), trail-making time 1 ($F_{1, 56}=17.20$, $P<0.001$, $\eta^2_p=0.235$) and trail-making time 2 ($F_{1, 56}=6.46$, $P=0.014$, $\eta^2_p=0.103$).

Although the reading regular words and writing to the dictation of irregular words subtest scores for healthy individuals were better than those for patients with AD, the differences were not statistically significant ($F_{1, 56}=3.50$, $P=0.066$, $\eta^2_p=0.059$, and $F_{1, 56}=3.54$, $P=0.065$, $\eta^2_p=0.060$, respectively).

There were no statistically significant differences between healthy and AD groups on trail-making 1 (P=0.556), trail-making 2 (P=0.598), word definition 1 (P=0.669), and picture description scores (P=0.611).

Test-retest reliability

All ICC values (Table 3) were within the acceptable range (greater than 0.75), except for trail-making 1 (ICC=0.734), word definition 1 (ICC=0.664), word definition 2 (ICC=0.224), test for recognition of grammar (ICC=0.544), and picture description (ICC=0.188).

Discussion

This study aimed to adapt and validate the BLA test in two groups of Persian-speaking older adults with and without AD. In terms of linguistic and cultural adaptation, three subtests, namely reading, spelling, and story retelling, required modifications. We selected regular and irregular words from a modern Persian language corpus to serve as stimuli for the reading and spelling subtests. Additionally, the story retelling subtest was translated to reflect Iranian culture while preserving the core information units of the original narrative. Following the adaptation phase, we conducted the validation phase of the BLA-Per with a sample of 30 cognitively healthy individuals and 30 patients with mild to moderate dementia of Alzheimer type. In the original study where the BLA was first introduced, the language performance of healthy individuals was not compared to that of individuals with AD. This comparison was conducted for the first time using the Persian version of the test. Moreover, since this is the first study of this test in Persian, we included patients with mild to moderate AD. The healthy aging group was younger and more educated than the patient group. Therefore, we applied ANCOVA to control for the effects of age and education in comparing these two groups' performances in the BLA-Per test. Considering the time constraints and difficulty of recruiting AD patients, age and education matching between healthy and patient groups was not fully possible, which is one of the study's limitations. The results of administering this test to cognitively healthy individuals and patients with AD indicate that the test generally demonstrates acceptable discriminant validity, as a significant difference was observed between the two groups in 17 out of the 23 variables. In those variables where no statistically significant difference was shown, the Alzheimer's group performed lower. Moreover, the present study confirmed the results of current research that language impairment is the hallmark feature of dementia [35-37]. Patients with AD demonstrated lower performance than healthy participants in all subtests of the BLA-Per. This indicates that there are impairments in various cognitive areas within this population. Not only are word retrieval and lexical knowledge affected, as shown by the results in

Table 2. Analysis of covariance results for Barnes language assessment-Persian subtests

Variables	Groups	Mean±SD		Adjusted Mean Difference (95% CI)	$F_{1,56}$	P	ES (η^2_p)
		Crude	Adjusted				
Matching TC	Healthy	13.93±1.66	13.28±0.40	1.93 (0.55, 3.30)	7.90	0.007	0.124
	AD	10.70±2.00	11.35±0.40				
Matching TE	Healthy	1.07±1.66	1.72±0.40	-1.93 (-3.30, -0.55)	7.90	0.007	0.124
	AD	4.30±2.00	3.65±0.40				
Verbal Fluency (phonemic)	Healthy	13.90±3.43	14.76±0.80	10.62 (7.91, 13.23)	61.65	<0.001	0.524
	AD	5.00±3.32	4.14±0.80				
Picture Naming	Healthy	14.03±1.27	13.19±0.55	4.04 (2.17, 5.90)	18.81	<0.001	0.251
	AD	8.30±3.12	9.15±0.55				
Dictation TC	Healthy	17.20±3.31	17.31±1.00	7.86 (4.47, 11.24)	21.64	<0.001	0.279
	AD	9.57±5.33	9.46±1.00				
Dictation Reg	Healthy	8.70±1.64	8.68±0.50	2.48 (0.78, 4.19)	8.52	0.005	0.132
	AD	6.17±2.67	6.19±0.50				
Dictation IReg	Healthy	8.50±1.72	8.22±0.52	4.18 (2.42, 5.94)	22.65	<0.001	0.288
	AD	3.77±2.96	4.04±0.52				
Trail 1 Time	Healthy	7.00±3.80	2.88±3.47	-24.37 (-36.14, -12.60)	17.20	<0.001	0.235
	AD	23.13±20.37	27.25±3.47				
Trail Making 1	Healthy	0.47±0.86	0.76±0.32	-0.32 (-1.42, 0.77)	0.35	0.556	0.006
	AD	1.37±1.77	1.08±0.32				
Trail Time 2	Healthy	19.53±7.45	14.81±4.91	-21.15 (-37.81, -4.48)	6.46	0.014	0.103
	AD	31.23±28.42	35.96±4.91				
Trail Making 2	Healthy	0.60±1.13	1.23±0.42	-0.37 (-1.78, 1.04)	0.28	0.598	0.005
	AD	2.23±2.28	1.60±0.42				
Verbal Fluency (semantic)	Healthy	20.13±4.94	19.48±1.10	11.87 (8.12, 15.61)	40.28	<0.001	0.418
	AD	6.97±4.21	7.62±1.10				
Word Definition1	Healthy	8.07±3.28	7.57±0.73	-0.53 (-3.03, 1.96)	0.18	0.669	0.003
	AD	7.60±2.69	8.10±0.73				
Word Definition2	Healthy	6.67±3.23	7.18±0.66	6.20 (3.95, 8.45)	30.37	<0.001	0.352
	AD	1.50±2.08	0.98±0.66				
TROG	Healthy	34.40±3.42	31.24±1.52	10.84 (5.69, 15.99)	17.78	<0.001	0.241
	AD	17.23±8.78	20.40±1.52				

Variables	Groups	Mean±SD		Adjusted Mean Difference (95% CI)	$F_{1,56}$	P	ES (η^2_p)
		Crude	Adjusted				
Memory Span	Healthy	6.03±1.00	5.64±0.24	1.81 (1.01, 2.62)	20.45	<0.001	0.268
	AD	3.43±1.07	3.83±0.24				
Following Command	Healthy	5.00±0	5.09±0.22	1.31 (0.57, 2.06)	12.53	<0.001	0.183
	AD	3.87±0.00	3.78±0.22				
Sentence Writing	Healthy	0±0	-0.04±0.13	-0.97 (-1.41, -0.54)	20.07	<0.001	0.264
	AD	0.90±0.76	0.94±0.13				
Story Retell-ing	Healthy	12.57±3.21	11.70±0.73	6.07 (3.60, 8.55)	24.14	<0.001	0.301
	AD	4.77±2.97	5.63±0.73				
Reading T	Healthy	38.67±2.17	36.94±1.57	7.21 (1.87, 12.56)	7.32	0.009	0.116
	AD	28.00±10.07	29.73±1.57				
Reading Reg	Healthy	19.63±0.72	18.99±0.93	2.95 (-0.21, 6.11)	3.50	0.066	0.059
	AD	15.40±5.40	16.04±0.93				
Reading IReg	Healthy	18.43±3.55	17.47±1.08	3.45 (-0.22, 7.11)	3.54	0.065	0.060
	AD	13.07±6.10	14.03±1.08				
Picture De-scription	Healthy	3.80±1.30	3.16±0.45	0.39 (-1.14, 1.92)	0.26	0.611	0.005
	AD	2.13±2.34	2.77±0.45				

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Abbreviations: TC: Total correct; TE: Total errors; Reg: Regular words; IReg: Irregular words; TROG: Test for recognition of grammar; Reading T: Reading total score; AD: Alzheimer disease; SE: Standard error; SD: Standard deviation; CI: Confidence interval.

auditory picture matching, picture naming, word definition, verbal fluency, and picture description tasks but there are also deficits in sentence comprehension, grammatical competence, reading and writing skills. Notably, in addition to significantly lower scores of AD patients in correct auditory picture matching, their errors in this task were higher, implying a decline of semantic memory within this population [38]. These findings are consistent with previous research on the language challenges faced by individuals with AD [39]. Story retelling also poses a significant difficulty to the AD patients of this study as they conveyed a lower number of information units and increased number of repetition of ideas which confirms previous research on the story retelling abilities of AD patients [40].

The results showed that even when age and education were controlled, the AD group had lower scores in most BLA-Per subtests, demonstrating the effects of disease pathology on cognitive functioning. Education can be seen as a cognitive reserve that may help delay the onset of AD to some extent [41-43], but it cannot inhibit the development of the disease [44].

The BLA-Per can appropriately discriminate between the language skills of healthy older adults and AD patients, as seen by the significant differences in the test sub-scores between these two groups. All subtests, except for Trail Making 1, Word Definition 1, Word Definition 2, TROG, and Picture Description had high ICC values. Some subtests, such as Trail Making 1 and Trail Making 2, could not differentiate between healthy and AD groups. This may be explained as trail-making abilities decline with advanced age in neurologically healthy people, indicating its low discriminative validity [45, 46], or that the tests are difficult to understand for Persian-speaking people. As this subtest examines executive functioning, more precise tests are required to reveal

Table 3. Test-retest reliability of the Barnes language assessment-Persian subtests

Subtests	Intraclass Correlation Coefficient
Matching TC	0.960
Matching TE	0.960
Verbal fluency	0.895
Picture naming	0.955
Dictation TC	0.880
Dictation Reg	0.993
Dictation IReg	0.965
Trail 1 time	0.921
Trail making 1 TE	0.734
Trail time2	0.949
Trail making 2 TE	0.836
Verbal fluency semantic	0.899
Word definition 1	0.664
Word definition 2	0.224
TROG	0.544
Memory span	0.955
Following command	0.973
Sentence writing	0.970
Story retelling	0.985
Reading T	0.994
Reading Reg	0.839
Reading IReg	0.985
Picture description	0.188

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Abbreviations: TC: Total correct; TE: Total errors; Reg: Regular words; IReg: Irregular words; TROG: Test for recognition of grammar; Reading T: Reading total score.

impairment in this area [47]. In other subtests (e.g. reading regular and irregular words), the results show that individuals with Alzheimer's performed at a lower level than healthy individuals. However, the lack of statistical difference and the small effect size may be attributed to the small sample size.

The Word Definition 1 subtest scores did not differ in healthy and diseased subjects. In Word Definition 1, the participants were asked to provide a synonym for a given word, for example, for "home", they could say "housing" or "house". By contrast, in Word Definition 2, they were required to describe semantic features related to the word, such as "room", "window", "door", "garden", "roof", and "building". The patients and healthy subjects did not show a difference in defining word 1, indicating that the semantic classification was spared in patients compared to healthy individuals. Another reason for this statistical indifference is that word definitions, as a whole, rely on networks of semantic features. Research shows that older individuals can be susceptible to deficits in these semantic features [48], and when these deficits are combined with low education levels, they may resemble the performance of someone with dementia, and, hence, the equal performance of healthy older adults and AD patients. The third and perhaps most crucial factor is that a difference may exist in this subtest between healthy individuals and patient groups; however, this study could not demonstrate this due to the small sample size. Nonetheless, there was a difference in the Word Definition 2 between the two groups, supporting the theory of semantic network vulnerability in Alzheimer's disease [49]. This result may be interpreted as a sign of progressive damage. That is, the semantic characteristics are damaged first, and then the semantic classification difficulty follows.

The results show no discernible difference between the two groups in the picture description task. Picture description involves lexical, syntactic, and phonological processing. In addition to these language-based factors, this task requires intact cognitive skills, particularly working memory and executive functioning [37]. Therefore, the significant impairment in this task in dementia patients is predictable, and the insignificant results in our study can be in part due to the low sample size. On the other hand, this is also may be attributed to the ability of individuals with Alzheimer's to utilize other features in the image. This is of potential rehabilitation value, meaning that the affected individuals can still maintain verbal communication within a pictorial context despite the disease's impact. This result also highlights the importance of sample size in studies on the relationship between cognition and language [50].

This study suggests that Word Definition 1 and Word Definition 2, following commands, and picture description subtests did not possess test-retest reliability. The lack of reliability of Word Definition 1 and picture description subtests could be due to the progressive nature of the disorder and the sensitivity of these two subtests over time. The unreliability of Word Definition 2 can also be attributed to the rapid dissolution of semantic networks. Further research is needed to determine whether the subtests should be omitted from BLA-Per or if they should be conducted in less severe AD patients. This research should involve controlling the stages of AD patients and larger groups of both AD patients and normally aging people. It would also be possible to examine language profiles in patients with other forms of dementia.

Conclusion

This study indicates that this test is suitable for examining speech, language, and cognitive skills in older adults and people with AD. It also demonstrates the vulnerability of language skills in the early stages of AD, which can be targeted in the treatment and rehabilitation process of the affected individuals. Moreover, the processing speed of patients with AD may decrease, as is evident in the significantly increased time required to complete the test's two trail-making tasks.

Study limitations

The major shortcoming of this study was its small sample size in both healthy and patient groups which makes it hard to draw decisive conclusions about the language performance of participants in the BLA test. The BLA-Per should be used with larger samples of Persian-speaking healthy older people and people with AD, before undertaking further research to compare groups of older people with different types of dementia. Based on the mini-mental state examination scores, our patient sample consisted of individuals with mild to moderate AD. It would be valuable to conduct tests on patients with severe AD to understand the effects of advanced stages of dementia on language functioning.

Ethical Considerations

Compliance with ethical guidelines

The objectives and procedures of the study were explained in plain language to all participants, who signed a written informed consent form approved by the Tehran University of Medical Sciences before the study's initiation. Participants could withdraw from the study at any time. The assessment timing was customized for each patient to avoid conflicts with their medical appointments or other evaluations. Tehran University of Medical Sciences ethics committee approved the study (Code: 92-03-32-24417).

Funding

This study received funding from the Tehran University of Medical Sciences (Grant No.: 13015).

Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interception of the results, and manuscript drafting. Each author approved the submission of the final version of the manuscript.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

We would like to express our gratitude to the patients who voluntarily participated in and completed our assessments. We also extend our appreciation to Tehran University of Medical Sciences for their support.

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