Kermanshah University of Medical Sciences

Journal of Kermanshah University of Medical Science

Journal homepage: Htpp://journals.kums.ac.ir/ojs/index.php/jkums

Original Article

The psychometric properties of the third version of Addenbrooke's Cognitive Examination (ACE-III) in a sample of Iranian older adults

Majid Mahmoud Alilou[1], Zeinab Khanjani[1], Touraj Hashemi[1], Soheila Parvaz[1]*

1. Dept. of Psychology, Faculty of Education & Psychology, University of Tabriz, Tabriz, East Azarbaijan, Iran

Article Info

Keywords: ACE, psychometric properties, older adult, factor analysis

***Corresponding Author**:
29 Bahman Boulevard, Faculty of Education & Psychology, University of Tabriz, Tabriz, East Azarbaijan, Iran
Tel: +98 9185627601
Email:
Parvaz_soheila@tabrizu.ac.ir

Received: 02 May, 2017
Accepted: 05 September, 2017

J Kermanshah Univ Med Sci. 2017; 21(2): 57-61

Abstract

Introduction: Cognitive problems such as dementia are common in older adults and their prevalence increases with age. The early identification and diagnosis of patients with dementia can help with their treatment and improve their quality of life. The present study was conducted to investigate the psychometric properties and validate the Addenbrooke's Cognitive Examination (ACE) in a sample comprising older adult Iranians.

Methods: The present cross-sectional and correlational study recruited 300 older adults in Kahrizak Geriatric Nursing Home in Iran, including 198 men and 102 women selected using simple random sampling. The data collection tools comprised the ACE-III, the Mini–Mental State Examination (MMSE) and the Geriatric Depression Scale (GDS). Confirmatory factor analysis was used to investigate the construct validity of the test, and the Pearson's correlation coefficient to examine its convergent and divergent validity. Cronbach's alpha was also used to investigate the internal consistency of the items. To examine the diagnostic validity, cut-off point, sensitivity and specificity of the test were calculated.

Results: The results found correlations between the ACE-III and other tools (P>0.01), thus suggesting a proper convergent and divergent validity. The test-retest reliability coefficient with a two-week interval and the Cronbach's alpha of the ACE-III were respectively calculated as 0.90 and 0.95. The optimal cut-off point that struck a balance between sensitivity and specificity was found to be 75, with a sensitivity of 0.99 and specificity of 0.95. The results of the factor analysis indicated a good fit of the single-factor structure of this test.

Conclusion: The ACE-III has good psychometric properties and it can be used to screen for dementia.

Introduction

Given advancements in medical sciences and improvements in nutrition and health, today's world is experiencing a new phenomenon, namely population aging (1). The population of older adults is estimated to rise from 694 million in 1970 to 1.2 billion in 2025 and close to 2 billion in 2050 (2). Old age is associated with certain physiological changes that disrupt the performance of the body systems and cause more vulnerability to diseases (3). Cognitive impairment is a common disorder associated with severe and progressive disability in old ages. Despite the growing public awareness about old-age problems, many people still consider cognitive impairment and progressive memory loss a normal part of the aging process; nevertheless, given today's promoted neuropsychological knowledge of aging and advanced medical technology, normal changes in the aging period can be discriminated from brain-damaging processes. Dementia is a common disorder associated with cognitive processes in old age that highlights the importance of screening (4). Dementia is a disorder which is characterized by numerous cognitive defects, including serious memory loss (5). Cognitive changes in dementia are normally associated with mood, behavior and personality disorders (6). The prevalence of cognitive impairment in older adult populations has rarely been investigated in Iran. A study conducted by Sharifi et al. (7) is the first comprehensive research on the prevalence of dementia in Iranian older adults. These researchers found the prevalence of dementia to be 7.9%, i.e. 7.8% in women and 6.9% in men, in the population aged over 60. They estimated this prevalence at 8.1%, i.e. 9.6% in women and 6.5% in men, based on age-associated WHO standards. They also found the dementia prevalence to be 3.7% in 60-64-year-olds, 6.2% in 65-69-year-olds, 10.4% in 70-74-year-olds, 14.4% in 75-79-year-olds and 13% in those aged over 80. This study found the lowest prevalence of dementia to be in East Azarbaijan and the highest to be in North Khorasan. Rashedi et al. (8) used the MMSE to investigate the prevalence of cognitive impairment in older adults and to examine its relationship with demographic variables such as age and level of education in the day care center of Hamadan, Iran. The results showed mild cognitive impairment in

45.3% of the subjects, moderate cognitive impairment in 51.9% and severe cognitive impairment in 2.8% of them. They also found that older age and lower level of education were associated with lower the MMSE scores and higher intensity of cognitive impairment.

Evaluating one's performance through a mini-cognitive test is a common method of diagnosing dementia and a prerequisite for more tests and investigations, which are usually called screening tools. Compelling evidence suggests that the early diagnosis of patients with cognitive impairment and referring them to counseling services can help reduce stress in the families and caregivers of these patients. It is worth mentioning that dementia is not only the cause of much suffering and debilitation in these patients, but also it heavily involves families who are mainly responsible for their care. The stress caused by taking care of patients with dementia is high and research suggests a high prevalence of psychological disorders in the caregivers (9-10). Simple-to-use and reliable tools are therefore urgently needed for daily clinical routines. Western countries, which faced the phenomenon of population aging for several decades, have designed and developed different tools over the last forty years. Some of these tools were globally accredited, translated to different languages and standardized. Given the recent growing population of Iranian older adults, simple tools are needed to be developed and normalized to identify cases with a suspected dementia and to reliably document the cognitive changes caused by the damaging processes and therapeutic factors (9). The benefits of developing this type of tools are as follows: 1) Conducting community-based epidemiological studies with the minimum cost and time (the statistics obtained from these studies will help health planning and contribute to the optimal use of resources). 2) Given the introduction of new treatments including such as acetylcholinesterase inhibitors, which slow down the disease progression, simplify the control of the symptoms and improve the cognitive and psychological status of the patient (9), highly-valid tools, which can be used to quantitatively record the changes caused by the medication, play a key role in determining the beginning and end of the treatment as well as detecting responsive and non-responsive cases to the treatment. 3) Given the high cost of medical therapies and the fact that these medicines are effective only in the initial and mild stages of the disease and lose their impact with the progression of the damaging process, the quantitative evaluation of the cognitive status of the patients is necessary. These tools play a key role in clinical trials and determining the effectiveness of new medicines which are rapidly introduced to the market. The timely diagnosis and referring of the patient leads to the early start of the treatment, helps the relatives and caregivers use counseling and support services, and reduces the financial, social, psychological and physical costs of the disease.

Neuropsychological investigations constitute a fundamental part of evaluating cases with a suspected dementia. Several screening and diagnostic tests have been developed for dementia, most of which are beyond the cognitive evaluation range and require special equipment or trained people. MMSE (12) is extensively used for evaluating the psychological status. Although MMSE can detect dementia with a relatively high sensitivity and specificity (15-16), it is criticized for inadequately examining cognitive functions, including fronto-executive functions, visual-spatial functions and semantic memory. All these functions can contribute to fundamental defects in specific declining circumstances such as frontotemporal dementia and Lewy body dementia (15-16). Other weaknesses of the MMSE include its variable accuracy for diagnosing patients with dementia with different ages, levels of education and ethnicity (17), and its low sensitivity for detecting mild cases of cognitive impairment (18-19).

Given these limitations, the ACE was developed by Mathuranath et al. (20) in the memory clinic of Edinburgh Hospital in Cambridge, the UK to diagnose dementia and differentiate Alzheimer's disease from frontotemporal dementia (21). These developers felt a need for screening this test for three reasons as follows. 1- A large proportion of patients already diagnosed with Alzheimer's disease presented other declining conditions such as Lewy body dementia and frontotemporal dementia (22). 2- Accessibility of factors and techniques modifying the disease highlights the importance of the early diagnosis of dementia (20). 3- Growing concerns about memory loss in declining years in ordinary populations (23). ACE was revised in 2006 and ACE-R (24) was developed to increase sensitivity and specificity of the test for detecting cognitive impairment associated with dementia. The other purpose of this test was to increase sensitivity to mild cognitive impairment. Owing to some weaknesses, a few items were replaced in ACE-R to develop ACE-III. This tool is used today as a valid test for diagnosing dementia in diagnostic and treatment centers. This test can enter the diagnostic and treatment system of Iran through preliminary investigations, and can be used as a reliable instrument for diagnosing and screening for dementia in Iranian older adults. Given that these patients present to different centers, this test can be used in clinics, nursing homes, psychiatric hospitals, health homes, outpatient clinics and rehabilitation centers. Although Iran has a young population, the fear is that the prevalence of Alzheimer's disease and dementia significantly increases after today's young population reach old age. It therefore appears reasonable to upgrade our knowledge about the screening and diagnosis of this disease and achieve a proper tool for this purpose.

Materials and Methods

The present study is correlational in terms of objective and descriptive in terms of data collection method. The data collected were analyzed in SPSS-20 and LISREL-8 using the Pearson correlation coefficient and confirmatory factor analysis. Simple random sampling was used to select 300 older adults from Kahrizak Geriatric Nursing Home, including 198 men and 102 women with an age of 65-90 years. The mean age of the study men was 75±1.92 and that of women 78±1.34.

Tools

ACE-III: The main version of ACE-III was developed by Mathuranath et al. (20) in the memory

clinic of Edinburgh Hospital to diagnose dementia and differentiate Alzheimer's disease from frontotemporal dementia (21). Two revisions of ACE include ACE-R and ACE-III. ACE-III comprises five domains, namely attention/orientations, memory, verbal fluency, language and visual-spatial skills. This test takes an average of 15 minutes to be completed, the maximum score is 100 and higher scores denote better cognitive performance. ACE-III has an internal consistency coefficient of 0.88, a sensitivity of 100% and a specificity as high as 0.96 with a cut-off point of 88 (23). Research confirms the effectiveness of this test for the early diagnosis of dementia and differentiating frontotemporal dementia from Lewy body dementia (25). No studies have validated ACE-III in Iran.

MMSE: This questionnaire was introduced to clinical experts by Folsein et al. (12) in 1975 as a practical method of scaling the psychological status of patients. Five to ten minutes is required to respond to its 11 items. The domains of this test include orientation to time and place, attention/concentration, language, as well as immediate and delayed recall. The split-half method was used and the reliability coefficient was reported to be 0.72, specificity 0.84 and sensitivity 0.90 (10). Foroghan et al. (26) normalized this test in Iran. The results suggested that the internal consistency of the test is 0.87 based on calculating the Cronbach's alpha and the reliability coefficient is 0.71 using the split-half method. With a cut-off point of 21, sensitivity was obtained as 0.90 and specificity as 0.84. This test was used in the present study to investigate the convergent validity of ACE-III.

GDS: Yesavage et al. (27) developed this test in 1983 as a tool for screening depression in older adults. The long-form GDS includes 30 items and the short-form 15 items, which are rated by Yes and No. The internal consistency (Cronbach's alpha) of this tool was reported as 0.94, and its reliability coefficient was calculated as 0.94 using the split-half method. The test-retest also suggested a reliability coefficient of 0.85 after a week. The concurrent validity coefficients between this test and the Beck Depression Inventory, the Zung Self-Rating Depression Scale and the Hamilton Rating Scale for Depression was respectively reported to be 0.73, 0.84 and 0.83 (28). A study was conducted on 300 randomly-selected older adults in Iran to examine the reliability and factor structure of GDS (29). The internal consistency coefficient was calculated as 0.4 and the Cronbach's alpha as 0.9. The reliability coefficient was calculated as 0.89 using the split-half method and 0.58 using the test-retest after two weeks (29). This test was used in the present study to investigate the divergent validity. Numerous studies have examined the relationship between depression and cognitive decline. The findings suggest relationships between cognitive impairment and depression, which abound in senior care centers (30). Investing on family ties and social support appears to help older adults resist depression and cognitive impairment (30).

Findings

Table 1 shows the mean values of the study variables. The test-retest coefficient of ACE-III was also obtained by calculating the correlation between performing the test twice with a two-week interval.

Table 1. The mean values associated with ACE-III and its dimensions and the test-retest coefficient (n=30)

Cognitive dimension	Mean	Standard Deviation	Pearson Correlation Coefficient
Attention	14.65	4.32	0.91**
Memory	22.41	3.87	0.89**
Verbal Fluency	12.20	2.09	0.93**
Language	23.50	4.32	0.92**
Visual-Spatial Skills	14.29	2.55	0.90**
Overall ACE-III Score	89.59	9.09	0.90**

** P<0.01

The findings associated with convergent validity, i.e. correlation with MMSE, and divergent validity, i.e. correlation with GDS, confirm the validity of ACE-III (Table 2). Table 3 indicates that there are correlations among all dimensions of the ACE-III (P<0.01). Confirmatory factor analysis was used to assess the internal constructs of the items of ACE-III subscales, and the findings suggested that the single-factor pattern has a good fitness in the study sample, since some of the measured indices associated with the fit of the model were within the acceptable range; the root mean square

Table 2. Findings associated with convergent validity (correlation with MMSE) and divergent validity (correlation with GDS)

Cognitive Dimension	MMSE	GDS
Attention	0.66**	-0.56**
Memory	0.75**	-0.54**
Verbal Fluency	0.65**	0.41**
Language	0.53**	0.39**
Visual-Spatial Skills	0.56**	-0.43**
Overall Score	0.69**	-0.53**

** P<0.01

Table 3. Matrix of correlation among the dimensions of ACE-III

Cognitive Dimension	1	2	3	4	5
1-Attention	-				
2-Memory	0.85**	-			
3-Verbal Fluency	0.40**	0.37**	-		
4-Language	0.77**	0.64**	0.19**	-	
5-Visual-Spatial Skills	0.75**	0.67**	0.43**	0.77**	-

** P<0.01

error of approximation (RMSEA) was acceptable, i.e. equal to 0.65, and the values of the fit indices, including NFI, AGFI, GFI, CFI and NINFI, were all acceptable, i.e. equal to 0.90. In addition, the ratio of X^2/df was found to be less than 5 and thus acceptable (P<0.01). Moreover, investigating the internal consistency of the items and the correlation coefficient of the score of every item with the overall factor score suggested that there are no needs for eliminating any of the items.

To assess ACE-III in terms of discriminating patients with dementia from normal subjects, 30 patients with Alzheimer's disease were matched with 30 healthy subjects in terms of age and level of education and compared and the ROC was obtained (Figure 1). Given the ROC, with a cut-off point of 75, sensitivity was found to be 0.99, specificity 0.95 and the area under the ROC was 0.94.

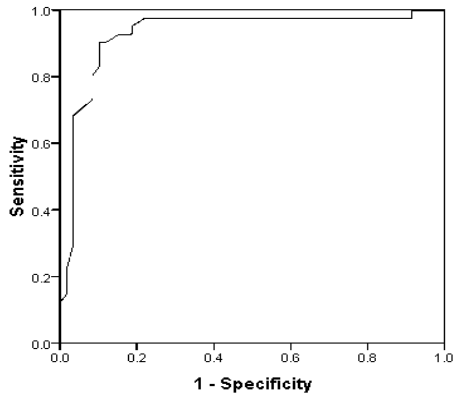

Figure 1. The ROC for discriminating patients with dementia from normal cases

Discussion

ACE-III was developed by Mathuranath et al. for the early diagnosis and screening of people with a suspected dementia. This tool assesses five dimensions, namely memory, verbal fluency, language and visual-spatial skills. The present study was conducted to investigate the psychometric properties of this test. The results confirmed the discriminant, convergent and divergent validity of this test. The internal consistency coefficient and the scale reliability were also confirmed. The confirmatory factor analysis of the ACE-III showed that the single-factor pattern has a good fitness. A review of the literature suggests the lack of studies on the factor structure of ACE-III. The results associated with the discriminant validity of the test and its dimensions showed that the questionnaire dimensions can well discriminate patients with dementia from healthy subjects. These findings are consistent with those found in the literature (25 and 31). The diagnostic ability of ACE-III and the closeness between the results it produced and clinical diagnosis highlight its value as far as the main purpose of the scale is concerned. The relationship between depression and dementia has frequently been emphasized in older adults (33). The negative correlation between depression and ACE-III can indicate an aspect of its validity given the divergent validity shown. The correlations of ACE-III and its dimensions with the MMSE were found to be positive. Lower scores obtained from ACE-III indicate higher risks of dementia. ACE-III must therefore show a positive correlation with MMSE. The present study findings thus confirmed the reliability and validity of ACE-III in Iranian older adults. Given the limitations of the present study, it can be used to examine dementia in the Iranian older adult population. ACE-III has been found to be significantly correlated with standard neurological tests used to evaluate attention, language, verbal memory and visual-spatial skills (21). The ACE-III has also been shown to be correlated with ACE-R. Hsieh et al. (25) validated ACE-III in patients with frontotemporal dementia and patients with Alzheimer's disease and compared it with other standard tests. The results still suggested a high sensitivity and specificity for this test. With a cut-off point of 88, sensitivity was 100 and specificity 96. The relationship between every cognitive dimension of ACE-III and the associated tests, e.g. the relationship between memory and digit span in the Wechsler intelligence scale, suggested high correlations and confirmed the test validity. The study conducted by Mathuranath et al. (20) suggested a high sensitivity of the test in diagnosing dementia and discriminating Alzheimer's disease from frontotemporal dementia. In fact, one of the strengths of ACE-III compared to other tests is that it measures cognitive domains that are damaged in different types of dementia.

Conclusion

ACE-III possesses favorable psychometric properties which are adapted to the Iranian culture. It can be used in clinical practices to differentiate patients with dementia from normal cases. This test can also be used as a screening method for identifying patients with a suspected dementia in different outpatient clinics and also in different research projects.

Acknowledgments

The authors would like to express their sincere gratitude to all who helped conduct the present research. It is worth noting that we received no funding for this study.

References

1. Larson EB. Prospects for delaying the rising tide of worldwide, late-life dementias. Int Psychogeriatr. 2010; 22(8): 1196-202.
2. World Health Organization. Dementia: a public health priority. United Kingdom, 2012. http://www.who.int/mental_health/publications/dementia_report_2012/en/
3. Denton FT, Spencer BG. Chronic health conditions: changing prevalence in an aging population and some implications for the delivery of health care services. Can J Aging. 2010; 29(1): 11-21.
4. Chop WC, Robnett HR. Gerontology for the health care from fissional. 3th ed. Philadelphia: FA Davis Company. 1999; 92-11.
5. Kaplan HI, Sadock BJ. Synopsis of psychiatry: Behavioral sciences clinical psychiatry. 11th ed. New york: Williams & Wilkins Company. 2015;2437-5.
6. Walash D. Dementia care training manual for staff in nursing and residential setting. 2th ed. London: Jesica Kingsley Publishers 2006; 78-9.

7. Sharifi F, Fakhrzadeh H, Varmaghani M, Arzaghi SM, Alizadeh Khoei M, Farzadfar F,et al. Prevalence of dementia associated factors among older adults in Iran: National Elderly Health Survey(NEHS). Arch Iran Med 2016;19(12): 838-44.
8. Rashedi V, Rezaei M, Gharbi M. Prevalence of cognitive impairment in community-dwelling older adults. Basic Clin Neurosci. 2014; 5(1): 28-30.
9. Foroghan M. [Dementia screening: validated cognitive tests in Iranian elderly (Persian)]. 1st ed. Teharan: Arjomand Publications 2003; 24-6.
10. Noroozian M. The elderly population in Iran: An ever growing concern in the health system. Iran J Psychiatry Behav Sci. 2012;6:1-6.
11. National Institute for Clinical Excellence: Guidance on the use of donepezil, rivastigmine and galantamine for the treatment of Alzheimer's disease. NICE Technology Appraisal Guidance 2001, No.19 (http://www.nice.org.uk/pdf/ ALZHEIMER_full_guidance.pdf).
12. Folstein MF, Folstein SE, McHugh PR. Mini-Mental State Examination. A Practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res. 1975; 12(3): 189-98.
13. Rosen WG, Mohs RC, Davis KL. A new rating scale for Alzheimer's disease. AM J Psychiatry. 1984; 141(11): 1356-64.
14. Zaudig M, Mittelhammer J, Hiller W, Pauls A, Thora C, Morinigo A, Mombour W. SIDAM–A structured interview for the diagnosis of dementia of the Alzheimer type, multi-infarct dementia and dementias of other aetiology according to ICD-10 and DSM-III-R. Psychol Med. 1991; 21(01): 225-36.
15. Bak TH, Mioshi E. A cognitive bedside assessment beyond the MMSE: the Addenbrooke's Cognitive Examination. Pract Neurol. 2007;7(4):245-9.
16. Tomburgh TN, McIntyre NJ. The mini-mental examination: A comprehensive review. J Am Geriatr Soc. 1992; 40(9): 922-35.
17. Cullen B, O'Neill B, Evans JJ, Coen RF, Lawlor BA. A review of screening tests for cognitive impairment. J Neurol Neurosurg Psychiatry. 2007;78:790-9.
18. Boustani M, Peterson B, Hanson L, Harris R, Lohr KN. Screening for dementia in primary care: a summary of the evidence for the U.S. Preventive Services Task Force. Ann Intern Med. 2003; 138(11): 927-37.
19. Kukull W, Larson E, Teri L, Bowen J, McCormick W, Pfanschmidt M. The mini-mental state examination score and the clinical diagnosis of dementia. J Clin Epidemiol. 1994; 47(9): 1061-7.
20. Mathuranath PS, Nestor PJ, Berrios GE, Rakowicz W, Hodges JR. A brief cognitive test battery to differentiate Alzheimer's disease and Frontotemporal dementia. Neurology. 2000; 55(11): 1613-20.
21. Stokholm J, VogelA, Johannsen P, Waldemar G. Validation of the Danish Addenbrooke's Cognitive Examination as a screening test in a memory clinic. Dement Geriatr Cogn Disord. 2009; 27(4): 361-5.
22. McKeith I, Fairbairn A, BothwellR, Moore P, Ferrier I, Thompson P, et al. An evaluation of the predictive validity and inter- rater reliability of clinical diagnostic criteria for senile dementia of Lewy body type. Neurology. 1994; 44(5): 872-7.
23. Verhey FR, Jolles J, Ponds RW, Rozendaal N, Plugge LA, De vet RC. A Comparison between a monodisciplinary and a multidisciplinary approach. J Neuropsychiatry Clin Neurosci. 1993;5(1):78-85.
24. Mioshi E, Dawson K, Mitchell J, Arnold R, Hodges JR. The Addenbrooke's Cognitive Examination Revised (ACE-R): a brief cognitive test battery for dementia screening. Int J Geriatr Psychiatry. 2006;21(11):1078-85.
25. Hsieh S, Schubert S, Hoon C, Mioshi E, Hodges JR. Validation of the Addenbrooke's Cognitive Examination III in Frontotemporal dementia and Alzheimer's disease. Dement Geriatr Cogn Disord. 2013; 36(3-4): 242-50.
26. Foroghan M, Jafari Z, Shirinbayan PF, Barahani ZP, Rahgozar M. [Standardization mini- mental state examination(MMSE) in elderly in Tehran (Persian)]. J NEW Cog Sci. 2009;10(2):29-37.
27. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, et al. Development and validation of a geriatric depression screening scale: a preliminary report. J Psyichiatr Res. 1983;17(1):37-49.
28. Spreen O, Strauss E. A compendium of Neuropsychological test. 2th ed. Oxford.1998;113-14.
29. Malakouti k, Fathollah C, Mirabzadeh A, Salavati M, Khany SH. [Standardization of geriatric depression scale(GDS), form of 15 questions in Iranian (Persian)]. Int J Geriatr Psychiatry. 2006; 21(6): 588-93.
30. Rashedi V, Khedmati Morasae E. Depression and cognition state of older adults resorting to day care centers: are they related?. Europ Geriatr Med. 2014; 83-158.
31. Pouretemad H, Khatibi A, Ganjavi A, Shams J, Zarei M.Validation of Addenbrooke's Cognitive Examination(ACE) in a Persian-speaking population. Dementia Geriatr Cog Disord. 2009; 28: 343-7
32. Gillery DW, Wilson RS, Bienias JL, Bennett DA, Evans DA. Predictors of depressive symptoms in persons with AD. J Gerontology. 2004; 59(4): 75-83.