Original Article

The Correlation and Agreement of Montreal Cognitive Assessment, Mini-Mental State Examination and Abbreviated Mental Test in Assessing the Cognitive Status of Elderly People Undergoing Hemodialysis

Maryam Rahmani[1], Azar Darvishpour[1,2], Parand Pourghane[1]

[1]Department of Nursing, Zeynab (P.B.U.H) School of Nursing and Midwifery, Guilan University of Medical Sciences, Rasht, Iran, [2]Social Determinants of Health Research Center, Guilan University of Medical Sciences, Rasht, Iran

Abstract

Background: Cognitive disorders are one of the most common disorders in elderly people with chronic renal failure. This study aimed to investigate the correlation and agreement of Montreal Cognitive Assessment (MoCA), Abbreviated Mental Test Score (AMTS), and Mini-Mental State Examination (MMSE) tests in assessing the cognitive status of elderly patients undergoing hemodialysis at Guilan University of Medical Sciences in north of Iran. **Materials and Methods:** This cross-sectional study was conducted on 84 elderly people undergoing hemodialysis. Inclusion criteria was having an age of 60 years old and older, hemodialysis treatment for at least 6 months, and having reading and writing skills. The Pearson correlation test, Intraclass Correlation Coefficient (ICC) test, and Bland–Altman plot were used for data analysis. **Results:** The majority of samples were in the age group of 60–65 years (28.57%) and the majority of them were male (66.66%). The results showed a significant positive correlation between MoCA and MMSE ($r = 0.69$, $p = 0.001$), between MMSE and AMTS ($r = 0.64$, $p = 0.001$), and between MoCA and AMTS tests ($r = 0.62$, $p = 0.001$). The results also showed a weak agreement between MoCA and MMSE tests (ICC = −0.11, $p = 0.633$), between MMSE and AMTS tests (ICC = −0.007, $p = 0.369$), and between MoCA and AMTS tests (ICC = −0.001, $p = 0.780$). **Conclusions:** Based on the results, these tools seem to complement each other. The inconsistency between cognitive tests indicates a serious need to develop appropriate instruments for detecting cognitive disorders in elderly.

Keywords: *Aged, kidney failure, Mental Status and Dementia Tests, cognitive dysfunction, hemodialysis*

Introduction

Ageing is a natural process. In the broader sense, ageing reflects all the changes taking place over the course of life.[1] Aging is a progressive functional decline characterized by a gradual deterioration in physiological function and behavior.[2] As the population ages, the risk of chronic diseases increases and the need for more care increases.[3,4] The prevalence of Chronic Kidney Disease (CKD) as a serious public health problem is growing in the elderly.[5] Over the past two centuries, the number of elderly patients with chronic renal failure has increased in most countries.[6] This trend poses an increasing burden on dialysis centers.[7] On the other hand, the relationship between cognitive impairment and chronic renal failure has been reported in various studies.[8-11] Based on the evidence, with age, predictable and reproducible changes in natural cognition occur.[12] Contributing to the high cost of CKD is the remarkably high prevalence of cognitive impairment or overt dementia that ranges from 20% to 50% in older patients with moderate CKD and may reach as high as 70% in severe CKD/dialysis.[13]

Patients with CKD are at increased risk for cognitive decline.[14] Cognitive decline is one of the behavioral manifestations of brain damage in CKD.[15] Cognitive impairment in patients with chronic renal failure shows increasing prevalence,[16] so that the prevalence of moderate to severe cognitive impairment among hemodialysis or peritoneal dialysis patients was >2.5 times higher than that found in healthy controls.[17] In evaluating the relationship between chronic renal disease

How to cite this article: Rahmani M, Darvishpour A, Pourghane P. The correlation and agreement of montreal cognitive assessment, mini-mental state examination and abbreviated mental test in assessing the cognitive status of elderly people undergoing hemodialysis. Iran J Nurs Midwifery Res 2022;27:531-7.

Submitted: 31-Mar-2021. **Revised:** 13-Jun-2021. **Accepted:** 23-May-2022. **Published:** 18-Nov-2022.

Address for correspondence:
Dr. Azar Darvishpour, Zeynab (P.B.U.H) School of Nursing and Midwifery, Martyr Yaghoub Sheikhi St. Leyla Kooh, Langeroud, Guilan, Iran.
E-mail: Darvishpour@gums.ac.ir

Access this article online

Website: www.ijnmrjournal.net

DOI: 10.4103/ijnmr.ijnmr_56_21

Quick Response Code:

and cognitive impairments, researchers have shown that renal functioning decline is associated with a decline in cognitive functioning, especially in the areas of general cognitive ability, abstract reasoning, and verbal memory.[7] Cognitive impairment impacts patients negatively by contributing to functional dependence and behavioral symptoms that result in poor outcomes and decreased medication and medical care compliance.[13] Cognitive changes affect patients' quality of life[12] and may even interfere with their social and work performance.[18] Additionally, it more than doubles mortality risk and increases days spent in the hospital, contributing to the tremendous individual, societal, and economical burden of CKD.[13] Thus, the diagnosis of cognitive impairments associated with chronic renal disease is crucial for both the patients and their families, and cognitive status screening can help identify at-risk patients, and awareness of the predictability of cognitive impairment in functional disability can improve the level of care for the elderly.[19] Also, when it is possible to prevent or delay the complications of an underlying disease by therapeutic interventions, screening for the disease in the early stages of the disease seems to be reasonable.[20] Cognitive status screening by health staff and physicians can help identify at-risk elderly people and to develop and implement programs to delay the onset or progression of cognitive impairment in this group.[19] As well, the diagnosis of Mild Cognitive Impairment (MCI) in elderly people can prevent dementia.[21] In this regard, having a confirmatory instrument to ensure the diagnosis of MCI can be helpful for clinical professionals. One of the instruments that has always been used by professionals and researchers is the Mini-Mental State Exam (MMSE), which was first developed by Folstein *et al*., in 1975.[22] However, to complete the various aspects of MCI diagnosis, newer instruments in this field are needed. Hence, another instrument, called the Montreal Cognitive Assessment (MoCA) test was introduced in this area. Nasreddine *et al*. (2004)[23] designed this instrument. This test assesses a wider range of cognitive domains compared to the MMSE.

The abbreviated cognitive test (i.e., abbreviated mental test score, AMTS) is also an instrument used to assess cognitive status. It is less dependent on the subject's education compared to similar questionnaires, such as MMSE.[24] This instrument was first developed by Hodkinson in 1972.[25] Then Qureshi and Hodkinson, during a study in 1974, determined its sensitivity and specificity.[26] Diagnosis of cognitive impairments (including MCI and dementia) is difficult for clinical professionals.[27] International guidelines recommend that older people should be assessed in terms of cognitive impairment. The use of cognitive screening instruments is still controversial. There is not an agreement on the best method of its assessment and various screening strategies, including the use of one test, two tests, or a combination of tests that have been reported.[28] Therefore, there is a great need to identify instruments that can easily diagnose suspected disorders.[29] In this regard, various studies have investigated the consistency of cognitive status assessment instruments. In the study of Emery *et al*. (2020),[30] the AMTS was identified as highly specific for cognitive impairment but relatively insensitive and a quarter of those with normal AMTS had moderate/severe impairment on the MoCA test. The results of the study conducted by Chehrehnegar *et al*. (2011)[29] showed inconsistency between the results of MoCA and MMSE tests. The results of the study conducted by Lazo-Porras *et al*. (2016)[28] to evaluate the association among MoCA, MMSE, and LCT (Leganes cognitive test) tests, showed that there were significant differences among three common screening tests in terms of assessing cognitive impairments. Despite recent studies conducted on cognitive functioning assessment tests, no study has yet been conducted to examine the correlation among common cognitive instruments (MoCA, MMSE, and AMT). Therefore, given the diversity of cognitive status assessment instruments and because screening and early identification of at-risk elderly people can be a major step in preventing cognitive impairments and disabilities in this high-risk group, this study aimed to investigate the correlation and agreement of MoCA, AMTS, and MMSE tests in assessing the cognitive status of elderly patients undergoing hemodialysis.

Materials and Methods

The present study was a cross-sectional study. The sample included 84 elderly patients undergoing hemodialysis at Guilan University of Medical Sciences in the north of Iran in 2019. Sample size based on the study by Olson *et al*. (2008)[31] with p1 = 0.30 (prevalence of cognitive impairment with MMSE tool) and p2 = 0.80 (prevalence of cognitive impairment with MoCA instrument), and a significance level of 0.05, 50 sample were calculated and in order to increase the accuracy and calculation of sample attrition, 84 people were finally determined. Inclusion criteria was having an age of 60 years old and older, hemodialysis treatment (at least 6 months), and having reading and writing skills in Persian. Noninclusion criteria included severe visual, hearing, and speech impairments, inability to communicate, having muscular weakness in the dominant hand (to draw and write questionnaires), mental retardation, use of psychotropic drugs in the last year, and a history of drug addiction. Multistage cluster sampling was used in this study. Accordingly, 13 public health centers of Guilan in the north of Iran with the hemodialysis department were divided into three clusters of center, west, and east of Guilan province. Then, two centers were selected from west and east clusters. In the center cluster, only one hospital (Razi Hospital) was equipped with dialysis and that center was selected. Afterward, according to the share of each treatment center in the required sample size, the samples were randomly selected based on the list of patients undergoing dialysis.

For sampling, the researcher, after obtaining permission from the ethics committee of the university's vice chancellor

and also the dean of the faculty of Nursing and Midwifery, referred to the selected medical centers to conduct research. After selecting the subjects and introducing herself to them and providing sufficient explanations about the purpose of the research and obtaining their written consent, the researcher completed the questionnaires during the interview with them. Research instruments included demographic characteristics and MoCA, MMSE, and AMT questionnaires, which are described below.

MMSE is a 30-question screening test that quantitatively examines the severity of cognitive impairments and cognitive changes over time in six domains, including time and space orientation, three-word recording, attention and calculation, three-word recall, language and its skills, and visual structure skills.[32] This test is a short mini-test that can be performed in 10 min or less.[33] The MMSE is a paper-based test with a maximum score of 30. The lower scores indicate more severe cognitive problems. The scoring in this test is done in this way: 0–10 (severe cognitive impairment), 11–20 (moderate cognitive impairment), 21–26 (MCI), and 27–30 (normal cognition).[34] Various studies have been conducted to investigate the psychometric properties of the MMSE. For example, Folstein *et al*.,[22] in 1975, calculated its reliability at 0.88. In the study of Khodamoradi *et al*. (2020),[35] the total Cronbach's alpha value for all domains of MMSE was >0.7. The reliability of this tool in the present study based on Cronbach's alpha coefficient was 0.80.

MoCA questionnaire is a cognitive screening questionnaire designed by Nasreddine *et al*., in 2005.[23] This one-page test has a maximum score of 30 and lasts <15 min.[36] The questionnaire assesses more cognitive domains and comprises more complex skills than MMSE, making it more sensitive to MCI diagnosis. The test assesses eight cognitive domains through various skills, including short-term memory (delayed recall), visual-spatial skills (drawing cube and clock), executive functions (following numbers and letters, speech and abstraction), attention, concentration, working memory (deletion, subtraction, counting capacity), language (naming, repetition of sentence), and awareness of time and place.[37] The scoring on this test is as followed: ≥26 (natural status) and <26 (MCI).[29] The results of a study conducted by Nasreddine *et al*.,[23] in 2005, showed that the reliability of the test using Cronbach's alpha coefficient was 0.92. Also, the reliability of this test in a study conducted by Duro *et al*.[32] in 2010 was reported at 0.90 using Cronbach's alpha. In the study by Rashedi *et al*. (2021),[38] the Cronbach α of the MoCA was 0.86. The reliability of this scale in the present study based on Cronbach's alpha coefficient was 0.87.

The AMT is a 10-item instrument designed by Hodgkinson in 1972 to assess the cognitive status.[25] It is one of the most widely used cognitive status screening methods in the world.[39] The implementation of AMT takes only 3 min. The test assesses orientation, concentration/attention, short-term and long-term memory, and is used to screen cognitive impairments in the elderly. In this questionnaire, a score of 10 is given for each correct answer. The lower the total score, the more severe the cognitive impairment.[36] A score of 0–3 indicates severe cognitive impairment, a score of 4–6 indicates moderate cognitive impairment and a score of 7–10 indicates normal cognitive status.[26] The reliability and validity of this test have been evaluated in different countries. For example, the Spanish version of the AMT was tested in the Spanish rural community and its sensitivity was reported at 100% and its specificity was reported at 53% with a cut-off point of 7–8.[40] In Iran, the validity and reliability of AMT in a group of Iranian elderly people living in a nursing home were also assessed in a study conducted by Foroughan et al in 2017. The internal consistency of AMT was also estimated at 0.90 using Cronbach's alpha method.[39] The reliability of this tool in the present study based on Cronbach's alpha coefficient was 0.78.

The Pearson correlation test was used to evaluate the correlation of the questionnaires presented in this study. Intraclass Correlation Coefficient (ICC) and the Bland–Altman plot were used to examine the consistency between the instruments. The obtained data were analyzed by the Statistical Package for the Social Sciences (SPSS) version 20 software (IBM Corp. Armonk, New York).

Ethical considerations

Ethical considerations of the research included approval of the research plan, obtaining the permission from the Ethics Committee of Guilan University of Medical Sciences (Ethics code No: IR.GUMS.REC.1397.266), obtaining patients' consent and cooperation, assuring confidentiality, and allowing the subjects to withdraw from the study.

Results

The results of the present study showed that the majority of subjects were in the age group of 60–65 years (28.57%) and the majority of them were male (66.66%). The results of the demographic characteristics of elderly people undergoing hemodialysis at Guilan University of Medical Sciences are presented in Table 1.

The results of the correlation between the Montreal Cognitive Test (MoCA) and the Mini-Mental State Examination (MMSE) in assessing the cognitive status of elderly people undergoing hemodialysis indicated a positive and significant relationship between the two tests (p = 0.001, r = 0.69). Intraclass correlation results showed weak agreement between the two tests (p = 0.633, ICC = −0.11) to determine the correlation between the MoCA and MMSE tests [Table 2]. The Bland–Altman plot in Figure 1 indicates this issue.

The results of the correlation between the MoCA and the AMTS tests also showed a positive and significant relationship between the two tests (r = 0.64, p = 0.001). Intraclass correlation results also showed disagreement or partial agreement between the two tests of MoCA and

AMTS (p = 0.36, ICC = −0.007) [Table 3]. The Bland–Altman plot in Figure 2 also illustrates this issue.

The results of the correlation between MMSE and AMTS tests also showed a significant positive relationship between these two tests (r = 0.62, P = 0.001). Intraclass correlation results also showed disagreement or partial agreement between MMSE and AMTS tests (p = 0.780, ICC = −0.001) [Table 4]. The Bland–Altman plot in Figure 3 also illustrates this issue.

Discussion

The present study aimed to investigate the correlation and agreement of common cognitive tests (MoCA, MMSE, and AMT) in elderly patients undergoing hemodialysis at Guilan University of Medical Sciences. The results of the correlation between MoCA and MMSE tests in assessing cognitive status of elderly people undergoing hemodialysis showed that there was a positive and significant correlation between these tests. This indicates that both tests are valid for assessing the cognitive status. Consistent with the present study, the results of the study conducted by Tiffin-Richards *et al*. (2014)[41] showed a positive and moderate correlation between total MoCA and MMSE scores. In line with the results of the present study, the results of the study conducted by Trzepacz *et al*.[42] also showed that there was a significant correlation between the scores of these two tests. Also, the results of the present study are consistent with those of the studies conducted by Rambe *et al*. (2017) and[43] Roalf *et al*. (2017).[44] However, the results of the study conducted by Rademeyer *et al*.[45] showed that there was a significant difference between the mean scores of these two tests in assessing patients' cognitive functioning, which indicates that the findings of the present study are not consistent with it. The reason for this difference may also be due to the difference of the study population in the two studies. Because the above study was conducted on schizophrenia patients, and the present study was conducted on elderly patients undergoing hemodialysis.

The results of the agreement of the MoCA and MMSE tests in assessing the cognitive status of elderly people undergoing hemodialysis showed that these tests were not consistent in agreement with each other. The results of the study conducted by Chehrehnegar *et al*.[29] also showed that there was no agreement between these two tests, which is consistent with the results of the present study. In the study conducted by Lazo-Porras *et al*. (2016),[28] the agreement between MoCA and MMSE tests was obtained at 63.3%. In the study conducted by Olson *et al*. (2008),[31] MoCA and MMSE tests did not have an agreement in assessing cognitive status in 50% of patients. Luis *et al*. (2009)[46] reported that MoCA is more sensitive than MMSE. In the study conducted by Lee *et al*. (2018),[47] MoCA was reported as a more sensitive instrument than MMSE in the diagnosis of cognitive impairment in patients undergoing hemodialysis. The results of the study conducted by Tiffin-Richards *et al*.[41] (2014) showed that although MMSE can detect cognitive impairment in

Table 1: Demographic characteristics of the elderly people undergoing hemodialysis at Guilan University of Medical Sciences (n=84)

Variable	*n* (%)	Variable	*n* (%)
Age		Level of education	
60-65 years	24 (28.57)	Illiterate	6 (7.14)
66-70 years	16 (19.05)	Elementary	39 (46.43)
71-75 years	19 (22.62)	Under diploma	18 (21.43)
76-80 years	15 (17.86)	Diploma	14 (16.67)
81 years and older	10 (11.90)	Academic	7 (8.33)
Gender		Underlying disease	
Female	28 (33.33)	Diabetes	7 (8.33)
Male	56 (66.67)	Hypertension	36 (42.86)
History of hemodialysis		Diabetes and hypertension	18 (21.43)
1-5 years	56 (66.67)		
6-10 years	20 (23.81)	Polycystic renal	12 (14.29)
Over 10 years	8 (9.52)	others	11 (13.09)

Table 2: Correlation and agreement between MoCA* and MMSE tests (n=84)**

Variable	MMSE			
	Correlation coefficient (r)	Significance level (p)	Intra class correlation (ICC)	Significance level (p)
MoCA test	0.69	0.001	−0.011	0.633

*Montreal Cognitive Assessment, **Mini-Mental State Exam

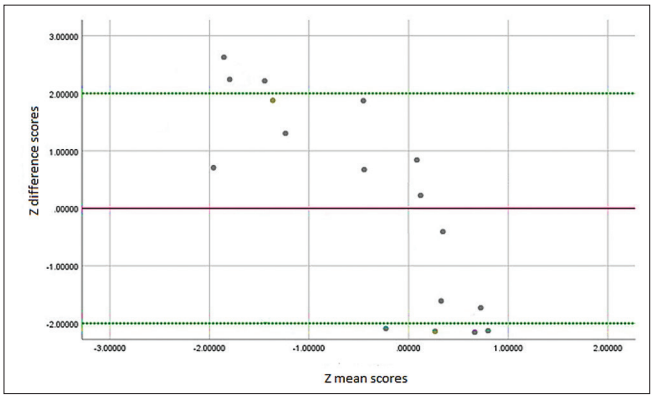

Figure 1: Bland–Altman plots between MoCA and MMSE tests

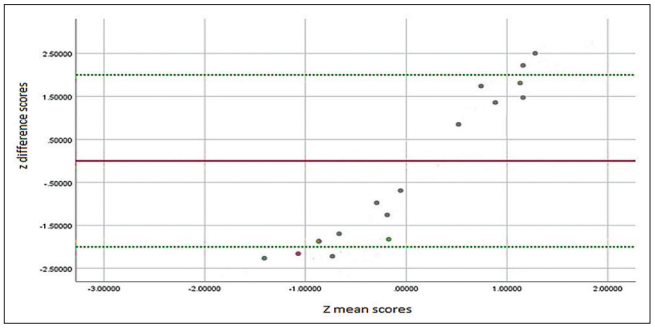

Figure 2: Bland–Altman plots diagram between MoCA and AMTS tests

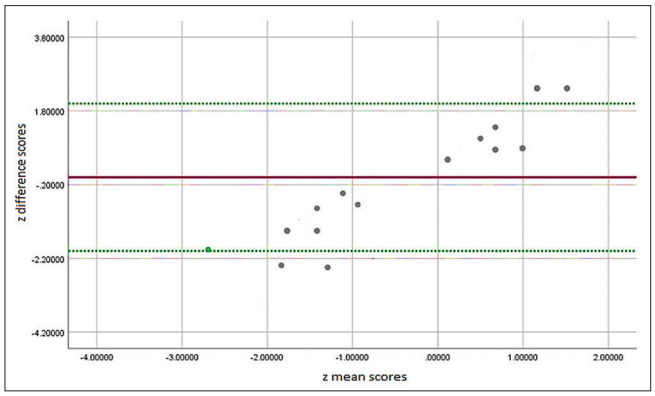

Figure 3: Bland-Altman plots between the MMSE and the AMTS tests

patients undergoing hemodialysis, it is less suitable for early detection of MCI. Finally, in their study, the researchers reported that MoCA was an appropriate cognitive screening instrument for hemodialysis patients.

The results of the present study on the correlation between the MoCA and AMTS tests in assessing the cognitive status of elderly people undergoing hemodialysis showed that there was a positive and significant correlation between these tests. This indicates that both tests are valid for assessing cognitive status. The results of the study carried out by Chehrehnegar *et al*.[29] are also in line with the results of the present study. In the study conducted by Pendlebury *et al*.,[48] the correlation between the AMTS and MoCA tests was also reported at a high level, which is in line with the results of the present study.

The results of this study conducted to examine the agreement of the MoCA test with the AMTS test in assessing the cognitive status of elderly people undergoing hemodialysis showed that these tests were not in agreement. There was no similar study to discuss and interpret the results in this case. Considering the inconsistency of the two instruments, despite correlating with each other, it should be noted that the correlation does not show agreement, and only the alignment can be deduced from it. In other words, there may be a strong correlation between the two measurements, but the two measurements do not agree.[49]

The results of this study on the correlation between MMSE and AMTS tests in assessing the cognitive status of elderly people undergoing hemodialysis showed that there was a positive and significant correlation between these tests. This result is in line with the result of the study conducted by Foroughan *et al*.[39] on the presence of correlation between these two instruments. The results of the study conducted by Pendlebury *et al*.[48] are also in line with the results of the present study.

The results of this study on the agreement of the MMSE and AMTS tests in assessing the cognitive state of elderly people undergoing hemodialysis showed that these tests were not in agreement. Concerning the discussion and

Table 3: Correlation and agreement between the MoCA* and AMTS tests (*n*=84)**

Variable	Abbreviated mental test score (AMTS)			
	Correlation coefficient (*r*)	Significance level (*p*)	Intra class correlation (ICC)	Significance level (*p*)
MoCA	0.64	0.001	−0.007	0.369

*Montreal Cognitive Assessment, **Abbreviated Mental Test Score

Table 4: Correlation and agreement between MMSE* and AMTS tests (*n*=84)**

Variable	Abbreviated mental test score (AMTS)			
	Correlation coefficient (*r*)	Significance level (*p*)	Intra class correlation (ICC)	Significance level (*p*)
MMSE	0.62	*0.001	−0.001	0.780

*Mini-Mental State Exam, **Abbreviated Mental Test Score

interpretation of the results, in this case, no similar study was found in the review of the existing studies. Although it makes it difficult to compare this study with other studies to strengthen, and it is considered as a limitation of the study, it can also be considered as strength of this study as it provides new information in this regard.

However, cognitive impairment influences quality of life, employment rates, treatment adherence, hospital admissions, health care costs, morbidity, and mortality.[10] The association of the elderly with this disease increases its negative effects. While the MMSE has a long history of use in clinical and research settings for the assessment and monitoring of acute neurocognitive impairments, it has limited utility in detecting subtle changes in cognition that may signal pending impairment in at-risk individuals and has a relatively poor accuracy in identifying patients with MCI.[44] MoCA is a simple screening tool that is valid for a patient's initial study and clinical practice in outpatient clinics, although it may have a lack in the specificity that can be assessed the patient's cognitive status by more accurate neurophysiological tests.[10] Comparisons of these two measures find that the MoCA has better sensitivity and specificity in MCI. Thus, the MoCA may be most informative when attempting to differentiate mild forms of dementia from typical age-related decline. However, one of the most significant limitations of the MoCA is the 10–15 min administration time.[44] Abbreviated cognitive test (AMTS) is one of the most widely used methods of screening the cognitive status of the elderly in the world, due to its shortness, speed of execution, need for brief training, simplicity, reproducibility, and possibility to follow the elderly in different periods of health before the onset of dementia, no dependence on literacy and also, low communication in language and culture, method sounds plausible.[30]

Early and accurate detection of cognitive impairment in older adults that indicate transition to dementia can enhance clinical management as well as lead to better understanding of individual differences in disease progression.[44] However, the appropriate tools for screening cognitive status in primary care, in addition to being concise and taking little time to complete, should be reliable and easy to use, and these should be considered in addition to saving time. Accordingly, the AMTS test seems to be a more appropriate tool in terms of saving time in clinics and emergency centers, but in hospitals and nursing homes where there is more opportunity to assess the cognitive status of the elderly, the use of MOCA and MMSE tools is recommended. One of the limitations of this study is that this study was performed on the elderly undergoing hemodialysis in Guilan province and, therefore, cannot be generalized to the elderly with other diseases. The multiplicity of questionnaires is another limitation of this research which was out of the researcher's control due to the main purpose of the research. However, in order to prevent the clients' fatigue, an attempt was made to complete the questionnaires during dialysis and at intervals.

Conclusion

The results of correlation and agreement of the MoCA, MMSE, and AMTS tests showed that despite the positive and significant correlation, these tests were not in agreement. These instruments seem to complement each other and should be used together for proper screening. However, given the importance of the subject, studies on other demographic groups seem to be necessary. Due to the importance of screening the cognitive status of the elderly undergoing hemodialysis to prevent the progression of mild cognitive disorders to severe cognitive disorders, dementia, and Alzheimer's and the lack of studies to support the findings in the present study, further studies are suggested.

Acknowledgements

The authors would like to thank ethics Committee of Guilan University of Medical Sciences in Rasht, Iran for approving the project. Hereby, we would like to thank the chief and the personnel of hemodialysis wards at Guilan University of Medical Sciences' hospitals who helped us through the research process and the patients who participated in our study.

Financial support and sponsorship

Guilan University of Medical Sciences, Rasht, Iran

Conflicts of interest

Nothing to declare.

References

1. Amarya S, Singh K, Sabharwal M. Ageing process and physiological changes. In: D'onofrio G, Greco A, Sancarlo D, editors. Gerontology. London: IntechOpen; 2021. Available from: https://www.intechopen.com/chapters/60564. [Last accessed on 2021 Jul 14].
2. Rivera DS, Lindsay CB, Oliva CA, Bozinovic F, Inestrosa NC. A multivariate assessment of age-related cognitive impairment in *Octodon degus*. Front Integr Neurosci 2021;15:1-13.
3. Atella V, Piano Mortari A, Kopinska J, Belotti F, Lapi F, Cricelli C, *et al*. Trends in age-related disease burden and healthcare utilization. Aging Cell 2019;18:e12861.
4. Darvishpour A, Esmaeilpour-Bandboni M, Salmalian Z, Azimi SAR. Relationship between elder abuse by family and demographic characteristics among the elderly admitted to the Educational Hospitals. CJHAA 2019;4:30-9. [in persian].
5. Malekmakan L, Khajehdehi P, Pakfetrat M, Malekmakan A, Mahdaviazad H, Roozbeh J. Prevalence of chronic kidney disease and its related risk factors in elderly of Southern Iran: A population-based study. ISRN Nephrol 2013;2013:1-6.
6. Azami M, Tavan H, Solymanian L, Borji M. Comparing quality of life between elderly undergoing hemodialysis and healthy elders. QJ Geriatr Nurs 2016;2:84-93.
7. Segall L, Nistor I, Van Biesen W, Brown EA, Heaf JG, Lindley E, *et al*. Dialysis modality choice in elderly patients with end-stage renal disease: A narrative review of the available evidence. Nephrol Dial Transplant 2017;32:41-9.
8. El Belbessi AS, El Gohary IE, Sheshtawi HA, Mohamed MMA. Cognitive disorders in chronic kidney disease and hemodialysis patients. J Egypt Soc Nephrol Transplant 2018;18:130-6.
9. Kepecs DM, Glick L, Silver SA, Yuen DA. Does chronic kidney disease-induced cognitive impairment affect driving safety? Can J Kidney Health Dis 2018;5:2054358118777133. doi: 10.1177/2054358118777133.
10. Gupta A, Mahnken JD, Johnson DK, Thomas TS, Subramaniam D, Polshak T, *et al*. Prevalence and correlates of cognitive impairment in kidney transplant recipients. BMC Nephrol 2017;18:1-8.
11. Simões ES, Miranda AS, Rocha NP, Teixeira AL. Neuropsychiatric disorders in chronic kidney disease. Front Pharmacol 2019;10:1-11.
12. Murman DL. The impact of age on cognition. Semin Hear 2015;36:111-21.
13. Bronas UG, Puzantian H, Hannan M. Cognitive impairment in chronic kidney disease: Vascular milieu and the potential therapeutic role of exercise. Biomed Res Int 2017;2017:1-10.
14. Kurella Tamura M, Tam K, Vittinghoff E, Raj D, Sozio SM, Rosas SE, *et al*.; CRIC Study Investigators. Inflammatory markers and risk for cognitive decline in chronic kidney disease: The CRIC study. Kidney Int Rep 2017;2:192-200.
15. Viggiano D, Wagner CA, Blankestijn PJ, Bruchfeld A, Fliser D, Fouque D, *et al*. Mild cognitive impairment and kidney disease: Clinical aspects. Nephrol Dial Transplant 2020;35:10-7.
16. Gela YY, Getu AA, Adane A, Ayal BM, Akalu Y, Ambelu A, *et al*. Cognitive impairment and associated factors among chronic kidney disease patients: A comparative cross-sectional study. Neuropsychiatr Dis Treat 2021;17:1483-92.
17. Chen HJ, Zhang LJ, Lu GM. Multimodality MRI findings in patients with end-stage renal disease. Biomed Res Int 2015;2015:1-13.
18. Bassett SS. Cognitive impairment in Parkinson's disease. Prim Psychiatry 2005;12:50-5.
19. Masoumi N, Jafrodi S, Ghanbari A, Ebrahimi S, Kazem Nejad E, Shojaee F, *et al*. Assessment of cognitive status and related factors in elder people in Rasht. Iran J Nurs Res 2013;8:80-6. [in persian].
20. Sikaroodi H, Majidi A, Samadi S, Shirzad H, Aghdam H, Azimi Kia A, *et al*. Evaluating reliability of the Montreal cognitive assessment test and its agreement with neurologist

diagnosed among patients with cognitive complaints. Police Med 2012;1:11-7. [in persian].

21. Heyrani R. Comparison of cognitive functioning of the depressed and non-depressed elderly in a Montreal cognitive test and a brief examination of mental status. Master's Thesis. Available from: Al-Zahra University. [in persian] 2016. https://ganj.irandoc.ac.ir/#/search?keywords=%D8%B1%D8%A7%D8%AD%D9%84%D9%87%20%D8%AD%DB%8C%D8%B1%D8%A7%D9%86%DB%8C&basicscope=5&item_id=747534. [Last accessed on 2020 Aug 14].
22. Folstein MF, Folstein SE, McHugh PR. Mini-mental state: A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 1975;12:189-98.
23. Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, *et al*. The Montreal Cognitive Assessment, MoCA: A brief screening instrument for mild cognitive impairment. J Am Geriatr Soc 2005;53:695-9.
24. Sarasqueta C, Bergareche A, Arce A, Munain D, Lopez A, Poza J, *et al*. The validity of Hodkinson's Abbreviated Mental Test for dementia screening in Guipuzcoa, Spain. Eur J Neurol 2001;8:435-40.
25. Hodkinson H. Evaluation of a mental test score for assessment of mental impairment in the elderly. Age Ageing 1972;1:233-8.
26. Bakhtiyari F, Foroughan M, Fakhrzadeh H, Nazari N, Najafi B, Alizadeh M, *et al*. Validation of the Persian version of the abbreviated mental test (AMT) in elderly residents of kahrizak charity foundation. Iran J Diabet Lipid Disord 2014;13:487-94.
27. Janssen J, Koekkoek PS, Moll van Charante EP, Jaap Kappelle L, Biessels GJ, Rutten GEHM. How to choose the most appropriate cognitive test to evaluate cognitive complaints in primary care. BMC Fam Pract 2017;18:1-8.
28. Lazo-Porras M, Pesantes MA, Miranda JJ, Bernabe-Ortiz A. Evaluation of cognitive impairment in the elderly population with hypertension from a low-resource setting: Agreement and bias between screening instruments. eNeurologicalSci 2016;5:35-40.
29. Chehrehnegar N, Shams F, Zarshenas S, Kazemi F. Evaluating the reliability of the montreal cognitive assessment test and its agreement with mini mental state examination among healthy elderly. J Res Rehabilit Sci 2011;7:674-80. [in persian].
30. Emery A, Wells J, Klaus SP, Mather M, Pessoa A, Pendlebury ST. Underestimation of cognitive impairment in older inpatients by the abbreviated mental test score versus the montreal cognitive assessment: Cross-sectional observational study. Dement Geriatr Cogn Dis Extra 2020;10:205-15.
31. Olson RA, Chhanabhai T, McKenzie M. Feasibility study of the Montreal Cognitive Assessment (MoCA) in patients with brain metastases. Support Care Cancer 2008;16:1273-8.
32. Duro D, Simoes MR, Ponciano E, Santana I. Validation studies of the Portuguese experimental version of the Montreal Cognitive Assessment (MoCA): Confirmatory factor analysis. J Neurol 2010;257:728-34.
33. Burns A, Lawlor B, Craig S. Rating scales in old age psychiatry. Br J Psychiatry 2002;180:161-7.
34. Lorbach ER, Webster KE, Menz HB, Wittwer JE, Merory JR. Physiological falls risk assessment in older people with Alzheimer's disease. Dement Geriatr Cogn Disord 2007;24:260-5.
35. Khodamoradi Z, Beheshti M, Khodamoradi M. Construct and validity of Persian Mini Mental Status Examination in illiterate elderly. Alzheimers Dement 2020;16(S7). doi.org/10.1002/alz.036864.
36. Zamaninejad S, Rashedi V, Malakouti SK, Maghsodlou-Estarabadi B. Oral health status of male older adults admitted to Razi psychiatric hospital, 2016. J Gerontol 2017;2:11-7. [in persian].
37. Athilingam P. Validation of an instrument to measure cognitive function in patients with heart failure. Doctoral Dissertation. Rochester, NY: University of Rochester School of Nursing; 2008. Available from: https://urresearch.rochester.edu/institutionalPublicationPublicView.action; jsessionid=BFA15F87EB230BE19BC3EF49B84444AE?institutionalItemId=5398&versionNumber=1. [Last accessed on 2021 Feb 03].
38. Rashedi V, Foroughan M, Chehrehnegar N. Psychometric properties of the Persian Montreal Cognitive Assessment in mild cognitive impairment and Alzheimer disease. Dement Geriatr Cogn Dis Extra 2021;11:51-7.
39. Foroughan M, Wahlund LO, Jafari Z, Rahgozar M, Farahani IG, Rashedi V. Validity and reliability of Abbreviated Mental Test Score (AMTS) among older Iranian. Psychogeriatrics 2017;17:460-5. [In Persian].
40. de Caso JG, Rodriguez-Artalejo F, Claveria L, Coria F. Value of Hodkinson's test for detecting dementia and mild cognitive impairment in epidemiological surveys. Neuroepidemiology 1994;13:64-8.
41. Tiffin-Richards FE, Costa AS, Holschbach B, Frank RD, Vassiliadou A, Krüger T, *et al*. The Montreal Cognitive Assessment (MoCA)-A sensitive screening instrument for detecting cognitive impairment in chronic hemodialysis patients. PLoS One 2014;9:e106700.
42. Trzepacz PT, Hochstetler H, Wang S, Walker B, Saykin AJ. Relationship between the Montreal Cognitive Assessment and Mini-Mental State Examination for assessment of mild cognitive impairment in older adults. BMC Geriatr 2015;15:1-9.
43. Rambe AS, Fitri FI. Correlation between the Montreal cognitive assessment-Indonesian version (Moca-INA) and the mini-mental state examination (MMSE) in the elderly. Open Access Maced J Med Sci 2017;5:915-9.
44. Roalf DR, Moore TM, Mechanic-Hamilton D, Wolk DA, Arnold SE, Weintraub DA, *et al*. Bridging cognitive screening tests in neurologic disorders: A crosswalk between the short Montreal Cognitive Assessment and Mini-Mental State Examination. Alzheimers Dement 2017;13:947-52.
45. Rademeyer M, Joubert P. A comparison between the Mini-Mental State Examination and the Montreal Cognitive Assessment Test in schizophrenia. S Afr J Psychiatr 2016;22:1-5.
46. Luis CA, Keegan AP, Mullan M. Cross-validation of the Montreal Cognitive Assessment in community-dwelling older adults residing in the Southeastern US. Int J Geriatr Psychiatry 2009;24:197-201.
47. Lee SH, Cho A, Min Y-K, Lee Y-K, Jung S. Comparison of the Montreal Cognitive Assessment and the Mini-Mental State Examination as screening tests in hemodialysis patients without symptoms. Ren Fail 2018;40:323-30.
48. Pendlebury S, Klaus S, Mather M, De Brito M, Wharton R. Routine cognitive screening in older patients admitted to acute medicine: Abbreviated mental test score (AMTS) and subjective memory complaint versus Montreal Cognitive Assessment and IQCODE. Age Ageing 2015;44:1000-5.
49. Asghari Jafarabadi M, Soltani A, Mohammadi SM. Statistics series: Correlation and regression. Iran J Diabetes Metab 2013;12:479-506. [in persian].