Annals of Psychophysiology

Ann. psychophysiol.
ISSN 2412-3188 (Online) | 2410-1354 (Print)

Original Article

Evaluating Age-related Cognitive performance; An Observational Pilot Study

Aiman Khan, Aimon Ashraf, Huda Siddiqui, Khadija Ahmed, Fatima Ali, Laveeza Azam, Fariha Akbar & Huma Bugti
Psychophysiology Research Lab, MAHQ Biological Research Centre, University of Karachi.

Abstract

Background: To the best of our knowledge, the general population of Pakistan has never been evaluated for age-related cognitive performance. We aimed to determine the decline in cognitive abilities using the Mini-Mental State Examination (MMSE) and Mini-Cognition (Mini-Cog) in the three age brackets, i.e. younger, middle-aged and older adults.
Methodology: This cross-sectional study was conducted over a sample of 200 subjects (both male and female) divided into three different groups with respect to their age, i.e. younger, middle-aged and older adults. For cognitive assessment, MMSE and Mini-Cog were used with predetermined cut-off values. A point was scored for each correct answer based on the participant's familiarization of environment, memory, speech, and ability to follow instructions to read or write. The collected data were analyzed using SPSS version 22.0.
Results: Based on the study findings, MMSE suggested that 2.5% of participants had severe cognitive impairment, and 23% had mild cognitive impairment. Of these, 23 participants were in between 56 to 75 years of age, indicating increased cognitive decline among older adults. The mean MMSE score was 26.58 among young adults, which further decreased to 24.06 among older adults. The results of the regression analysis displayed that age, occupational load and educational levels were independent predictors of cognitive performances (higher MMSE score) ($p<0.05$). Besides for Mini-Cog scores, only education and occupation were the significant predictors.
Conclusion: This pilot study determining the cognitive performance in different age groups yielded positive outcomes. Both MMSE and Mini-Cog findings were comparable and indicated that there was a significant age-related cognitive decline which was comparatively more pronounced among males than females. However, further descriptive studies might help in defining the appropriate and timely screening of cognitive abilities using MMSE and Mini-Cog.

Keywords

Cognitive Performance Decline, Ageing, Mini-Mental Status Examination (MMSE), Mini-Cognition (Mini-Cog).

OPEN ACCESS

Citation: Khan A, Ashraf A, Siddiqui H, Ahmed K, Ali F, Azam L, Akbar F, Bugti H. Evaluating Age-related Cognitive performance; An Observational Pilot Study. APP. 2020; 7(1):31-38

Corresponding Author Email: humayousaf786@outlook.com

DOI: 10.29052/2412-3188.v7.i1.2020.31-38

Received 12/03/2020

Accepted 13/08/2020

Published 01/10/2020

Funding: The author(s) received no specific funding for this work.

Conflicts of Interests: The authors have declared that no competing interests exist.

ISSN 2412-3188 (Online) | 2410-1354 (Print)

Introduction

Cognitive performance refers to the acquisition, deposition, assimilation, and utilization of information relevant to the surrounding circumstances and performing accordingly, and it is critical for information processing, integration, and responsiveness[1]. Although there are certain brain areas involved in reasoning that develop with age, generally, it is evident that memory, processing, and functioning decreases with increasing age either as a predetermined physiological mechanism or due to any underlying disease[2]. This age-related cognitive decline is associated with decreasing brain function as a result of vascular damage or neurodegenerative conditions. If it went undiagnosed, it might further lead to unfavourable conditions. Therefore, various screening tests are performed for preliminary assessment of cognitive impairment in order to diagnose and treat the condition before the development of serious outcomes[3]. The appropriate diagnosis within the recommended time duration plays an important role in devising a suitable therapeutic plan for cognitive impairment, and it prevents already the feeble body of aged individuals from being adversely affected by the severe cognitive disorders[4].

Among various cognitive performance screening tools, the MMSE is globally used to determine any alterations in the normal physiology of the brain. MMSE is of immense importance in evaluating the impacts of socio-demographic characteristics on cognitive abilities, i.e., lower education and increasing age, which yield lower cognitive outcomes[5]. It has a certain set of questions that analyses the individual's orientation, memory, speech, and ability to follow instructions to read or write[6]. Such a tool with a specific scoring method is essential to screen and predict future development of degenerative diseases such as Alzheimer's disease based on their contemporary cognitive abilities[7,8].

Considering the necessity of MMSE usage in older patients of dementia due to its rationality and authenticity, it is used in primary care centers to gauge the extent of their cognitive decrement, lesser ability to carry out fundamental activities, and worsening psychomotor actions[9]. Also, its electronic version has been designed to be used at a comfortable and convenient setup of personal accommodations[10]. In one such mental health program, a pronounced cognitive decline is observed in elderly patients, i.e., 55-74 age range, with MMSE score < 17, and also such trend is observed in people with an education level less than grade 8 in comparison to the patients of age range 35-54 years. Although, a cut-off point of < 23 is used in the studies of MMSE to determine mild incongruences in cognitive functions[11]. Whereas, such optimal value to determine decreasing cognitive functions is affected by increasing age[12] and by the population under observation[13].

While the Mini-Cog scale is comparatively a simpler tool developed by Borson et al., in 2000, for the detection of cognitive impairment among the elderly[14], it was primarily developed with the aim to improve the diagnostic evaluation among dementia patients[15]. The reported sensitivity and specificity of the tool are 76 to 99% and 89 to 93%, respectively[14,16,17]. The Mini-Cog tests the short term memory with three-word recall, and it also includes the Clock Drawing Test (CDT). In comparison to other comprehensive assessment tools, Mini-Cog is easier and provides the overall assessment of cognitive functions, including memory testing, structural concepts, and executive functioning.

Our aim was to examine the cognitive performance among different age groups, for which the age-wise declination in the cognitive abilities was assessed. The secondary objective was to assess the change in the cognitive performance with respect to gender, education level, and the occupational load.

ISSN 2412-3188 (Online) | 2410-1354 (Print)

Methodology

An observational pilot study was conducted over a sample of 200 participants of three different age groups, i.e. 15 to 35 years (Young Adults), 36 to 55 years (Middle-Aged), and 56 to 75 years (Older Adults). The study continued for a duration of 3 months, and data was collected from various sites as per the sample accessibility including University of Karachi, Markaz-e-Umeed, and Koohi Goth. The study complies with the Helsinki Declaration of 1975 and other modified proclamations. All participants between 15 to 75 years of age of both genders and with no severe physiological and psychological dysfunctions were included in the study. In contrast, those with severe brain trauma, injury, and those with any physiological disabilities were excluded from the study sample.

The literacy rate and educational status were also assessed, and < 3 years of education was categorized as low education, 4 to 7 years as medium education, and ≥ 8 years as high education. Cognitive domains were measured using MMSE[18] and Mini-Cog[14]. All the data concerning the subject's socio-demographic characteristics and cognitive performance was noted in a pre-designed questionnaire. For MMSE scoring, the maximum total score was 30, and the score between 0 to 9 was indicative of severe cognitive impairment, 10 to 24 as mild to moderate cognitive impairment, and 25 to 30 as no cognitive impairment. While in the Mini-Cog, the maximum score of Mini-Cog was 9. 1 point assigned for each correctly recalled word after CDT where participants scoring 0 to 4 were defined having cognitive impairment, score 9 suggested no cognitive impairment while participants having intermediate scores like 5 to 8 were classified based on CDT. Participants with normal CDT was indicative of no cognitive impairment, while abnormal CDT suggested possible cognitive impairment.

The data was statistically analyzed using SPSS version 22.0, where all qualitative variables were presented using frequency and percentages, and quantitative variables were given as mean and standard deviation. A Chi-square test was used for significance testing, and multiple linear regression analysis was performed to determine the possible predictors of cognitive impairment. P-value < 0.05 was considered statistically significant.

Result

Based on the study findings, 3.5% of participants had a low educational level, 16.5% were labelled as a medium, while 79.5% had a high education level, as shown in table 1. The mean MMSE score of the sample was 25.22 ± 3.49, and the Mini-Cog score was 4.34 ± 0.766.

Table 1: Demographic characteristics of study participants

Variables		n=200
Age (Years)		42.45 ± 16.73
Age Categories	Younger Adults	69(34.5)
	Middle Age	64(32.0)
	Older Adults	67(33.0)
Gender	Male	90(45)
	Female	110(55)
Marital Status	Married	142(71)
	Unmarried	58(29)
Employment Status	Working	90(45)
	Non-working	110(55)

ISSN 2412-3188 (Online) | 2410-1354 (Print)

Occupational Load	Moderate	137(68.5)
	High	20(10)
	Low	43(21.5)
Education Level	Low	7(3.5)
	Medium	33(16.5)
	High	159(79.5)

**Values are given as Mean ± SD or n(%)*

The majority of participants displayed no cognitive impairment, i.e. 74.5% had no cognitive impairment followed by mild cognitive impairment among 23% participants, and 2.5% had severe cognitive impairment. Around 98.5% of participants had no cognitive impairment as per the scores obtained from the Mini-Cog tool, while only 1.5% displayed cognitive impairment.

Table 2: Shows the distribution of study participants based on MMSE & Mini-Cog scores

Scoring		n	%
MMSE	Severe cognitive Impairment (Score 0 to 9)	5	2.5
	Mild cognitive Impairment (Score 10 to 24)	46	23.0
	No cognitive Impairment (Score 25 to 30)	149	74.5
Mini-Cog	Cognitive Impairment (Score 0 to 4)	3	1.5
	No Cognitive Impairment (Score 9)	197	98.5

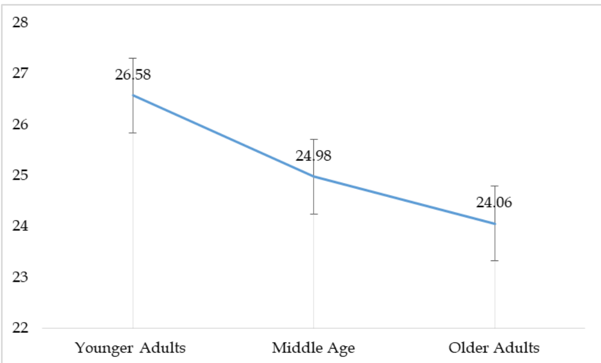

Figure 1: Age-associated decline in the mean MMSE Score

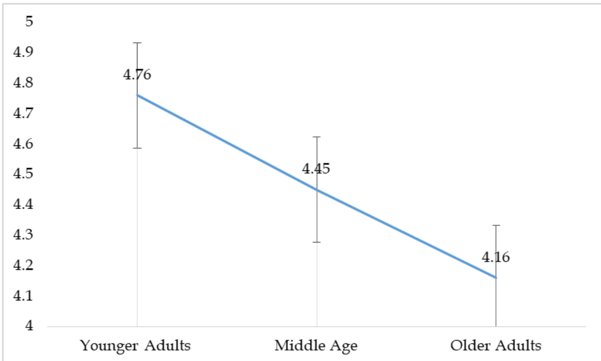

Figure 2: Age-associated decline in the mean Mini-Cog Score

Figure 1 & 2 shows the mean decline in cognitive abilities with increasing age. The mean MMSE score was 26.58 among young adults, which further decreased to 24.98 among middle-aged participants and, finally, 24.06 among older adults. Similar age-related declination was observed through Mini-Cog scores, i.e. the score decreased from 4.76 among younger adults to 4.16 among older adults.

Multiple linear regression analysis was performed taking MMSE score as the dependent variable against age, gender, education and occupational load (independent variables). A significant effect of age (β=-.005, *p*=0.032), occupational load (β=-.084, *p*=0.042), and educational level (β=.173, *p=0.012*) on cognitive performance (measured using MMSE) were observed.

Table 3: Multiple linear regression analysis for independent predictors of individual's MMSE score

Variables	N=200 (Adj R^2=.091)		
	Beta	95% CI	p-value
Age	-.005	-.010,.000	.032*
Gender	.105	-.045,.254	.169

ISSN 2412-3188 (Online) | 2410-1354 (Print)

Marital Status	.006	-.138,151	.932
Employment	.099	-.060,.257	.220
Occupation	-.084	-.165,-.003	.042*
Education	.173	.038,.308	.012*

**Adj R^2-Adjusted R^2; CI – Confidence Interval*

**p-value < 0.05 is considered significant*

Using Mini-Cog, it was found that only occupational load (β=.138, *p=0.030*) and educational level (β=.348, *p=0.001*) had a significant effect on cognitive performance.

Table 4: Multiple linear regression analysis for independent predictors of individual's Mini-Cog Score

Variables	N=200 (Adj R^2=.073)		
	Beta	**95% CI**	**p-value**
Age	-.004	-.011,.003	.227
Gender	.033	-.197,.263	.779
Marital Status	.061	-.161,.283	.586
Employment	.117	-.126,.361	.342
Occupation	.138	.013,.262	.030*
Education	.348	.140,.556	.001*

**Adj R^2-Adjusted R^2; CI – Confidence Interval*

**p-value < 0.05 is considered significant*

Discussion

Our findings truly support the hypothesis, suggesting a significant age-associated decline in the cognitive functions. The results supported the widely accepted notion that MMSE and Mini-Cog (CDT) can be used by professionals for observation of the cognitive decline in relevance to increasing age[19]. Considering the alarmingly growing population with many aged 65 and above, and most of them being affected with dementia-specific to age and gender, there is a need to diagnose any imminent neuropathology[20]. Therefore, the urge to develop a reliable and sensitive tool for distinguishing age-related cognitive changes and deterioration has become inevitable[21,22].

As per the reliability is concerned, a study indicated that the majority of the older individual had a low MMSE score, which was further supported by their death, indicating that MMSE is among the most reliable screening methods for cognitive decline with age[23]. Similarly, a correlation was found between alkaline phosphatase level and low MMSE score among Alzheimer's patients of older age group suggesting neurocognitive mislaying[24]. Presently, both MMSE and Mini-Cog are the most widely used, comparatively easier and consistent tools parallel to other comprehensive assessment tools used for screening of cognitive disabilities[16,25]. Although MMSE is quite popular in the majority countries but the preference is thought to be linked with shorter time duration for testing, i.e. 10 minutes, while on the other hand, Mini-Cog takes more time, but it is detailed and covers diverse cognitive aspects[26].

We have examined the cognitive decline among enrolled participants using both MMSE and Mini-Cog Scores, and it was tracked with respect to age, the mean MMSE score decreased from 26.58 among young adults to 24.06 among older adults, and the same was with the mean Mini-Cog Scores (Figure 1 & 2). This is also supported by the results of a similar study, participants < 75 years of age had the mean MMSE score of

ISSN 2412-3188 (Online) | 2410-1354 (Print)

28.14 while those > 75 years had a mean score of 27.81 and CDT declined from 4.47 to 4.19 among the two age groups[4]. In addition to age, the effects of gender, educational levels, and occupational load on cognitive functioning were also investigated. No significant gender-based variation was observed in the MMSE and Mini-Cog scores (Table 3 & 4). Shuba and Prakash, in their study, also displayed no association between the two variables. Moreover, a higher level of cognitive impairment was observed among males, i.e., mean MMSE score of 24.94 among males vs. 25.47 among females, and the same was for the Mini-Cog score (4.30 vs. 4.37). Other studies with similar findings suggested that this gender-based difference might be due to various environmental and occupational stressors[4,27].

Occupational load plays an important role in the overall cognitive performance, occupations requiring higher cognitive involvement are found to be associated with lower cognitive impairments due to the indulgence of a person in high cognitive activities[28]. Another study suggested that physical frailty has a significant impact on cognitive activities and mental health[28]. As per our results, the occupational load was significantly associated with cognitive performance, and participants with low to moderate occupational load had mild to severe cognitive impairment as compared to those with high occupational load (Table 3 & 4). The educational level also had a significant impact on the cognitive abilities of the participants ($p < 0.05$). Mild cognitive decline was observed more among the participants with low to medium educational levels as compared to those with high educational years. A similar trend was observed by Ghavidel et al., in their study[4].

This pilot study provided an opportunity to investigate the age-associated cognitive decline and the impact of related factors, including occupational load and educational levels, among the people of Karachi, Pakistan. Although the findings are not the true presentation of the local data but to the best of our knowledge, no such study involving the local population of all three age groups, i.e. younger adults, middle-aged people, and older adults, has been conducted till now. Future research is recommended to present descriptive outcomes involving the impact of other influencers like comorbid conditions, smoking, and health associated habits that might be a significant cofactor for this cognitive decline other than ageing.

Conclusion

This pilot study revealed a noticeable decline in cognitive performance among older adults as compared to those of the middle-aged or young ones. Findings from both of our screening tools MMSE and Mini-Cog, were comparable and suggested that this age-related cognitive impairment was more pronounced among males as compared to females. Other than that, there was also a significant effect of occupational load and educational levels on the cognitive abilities of the study participants. However, a large-scale descriptive study is required to confirm this hypothesis and to endorse the use of initial screening of cognitive performance using the mentioned screening tools.

Acknowledgment

The authors would like to acknowledge Dr. Sadaf Ahmed for her assistance and support in designing this study.

References

1. Nassif AA, El Semary MM, Abdallah GA, Mohamed RA. A Comparison of Different Cognitive Screening Instruments on Early Detection of Mild Cognitive Impairments in Post-Stroke Patients. Nurs Health Sci. 2018; 7(3):85-92.
2. Harada CN, Love MC, Triebel KL. Normal cognitive aging. Clin. Geriatr. Med. 2013; 29(4):737-752.
3. Gaeta L, Azzarello J, Baldwin J, Ciro CA, Hudson MA, Johnson CE, John AB. Effect of

ISSN 2412-3188 (Online) | 2410-1354 (Print)

Reduced Audibility on Mini-Mental State Examination Scores. J Am Acad Audiol. 2019; 30(10):845-855.
4. Ghavidel F, Salehi Fadardi J, Sedaghat F, Tabibi Z. Testing Older Adults for Signs of Age-Related Cognitive Decline: Clock Drawing Test vs. Mini-Mental State Examination. Clin Psychol. 2017; 5(2):141-148.
5. Mazzi MC, Iavarone A, Russo G, Musella C, Milan G, D'Anna F, Garofalo E, Chieffi S, Sannino M, Illario M, De Luca V. Mini-Mental State Examination: new normative values on subjects in Southern Italy. Aging Clin Exp Res. 2019:1-4.
6. Crum RM, Anthony JC, Bassett SS, Folstein MF. Population-based norms for the Mini-Mental State Examination by age and educational level. JAMA. 1993; 269(18):2386-2391.
7. Kelly Peterson OO, Guerrero R, Picard RW. Personalized Gaussian Processes for Future Prediction of Alzheimer's Disease Progression. arXiv preprint arXiv:1712.00181. 2017.
8. Pinto TC, Machado L, Bulgacov TM, Rodrigues-Júnior AL, Costa ML, Ximenes RC, Sougey EB. Is the Montreal Cognitive Assessment (MoCA) screening superior to the Mini-Mental State Examination (MMSE) in the detection of mild cognitive impairment (MCI) and Alzheimer's Disease (AD) in the elderly?. Int Psychogeriatr. 2019; 31(4):491-504.
9. Morais A, Santos S, Lebre P. Psychomotor, functional, and cognitive profiles in older people with and without dementia: what connections?. Dementia. 2019; 18(4):1538-1553.
10. Yao Y, Liu K, Liu Z, Sato R. The Development of Electronic Medical Tools of Cognitive Ability Testing for Home Use and Early Detection. In 2018 IEEE 7th Global Conference on Consumer Electronics (GCCE) 2018:118-119.
11. Lin JS, O'Connor E, Rossom RC, Perdue LA, Eckstrom E. Screening for cognitive impairment in older adults: a systematic review for the US Preventive Services Task Force. Ann. Intern. Med. 2013; 159(9):601-612.
12. Kvitting AS, Fällman K, Wressle E, Marcusson J. Age-Normative MMSE Data for Older Persons Aged 85 to 93 in a Longitudinal Swedish Cohort. J Am Geriatr Soc. 2019; 67(3):534-538.
13. Bartos A, Raisova M. The Mini-Mental State Examination: Czech norms and cut-offs for mild dementia and mild cognitive impairment due to Alzheimer's disease. Dement Geriatr Cogn Disord. 2016; 42(1-2):50-57.
14. Borson S, Scanlan J, Brush M, Vitaliano P, Dokmak A. The mini-cog: a cognitive 'vital signs' measure for dementia screening in multi-lingual elderly. Int J Geriatr Psychiatry. 2000; 15:1021–1027.
15. Borson S, Scanlan JM, Watanabe J, Tu SP, Lessig M. Improving identification of cognitive impairment in primary care. Int. J. Geriatr. Psychiatry. 2006; 21(4):349-355.
16. Shulman KI, Herrmann N, Brodaty H, Chiu H, Lawlor B, Ritchie K, Scanlan JM. IPA survey of brief cognitive screening instruments. Int Psychogeriatr. 2006; 18: 281–294.
17. Borson S, Scanlan JM, Chen P, Ganguli M. The Mini-Cog as a screen for dementia: validation in a population-based sample. J Am Geriatr Soc. 2003; 51:1451–1454.
18. Mf F. 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(3):189-198.
19. Cacho J, Benito-León J, García-García R, Fernández-Calvo B, Vicente-Villardón JL, Mitchell AJ. Does the combination of the MMSE and clock drawing test (mini-clock) improve the detection of mild Alzheimer's disease and mild cognitive impairment?. J Alzheimers Dis. 2010; 22(3):889-896.
20. Yang Z, Slavin MJ, Sachdev PS. Dementia in the oldest old. Nat. Rev. Neurol. 2013; 9(7):382-393.
21. Zhao Y, Tudorascu DL, Lopez OL, Cohen AD, Mathis CA, Aizenstein HJ, Price JC, Kuller LH, Kamboh MI, DeKosky ST, Klunk WE. Amyloid β deposition and suspected non-Alzheimer pathophysiology and cognitive decline patterns for 12 years in oldest old participants without dementia. JAMA neurology. 2018; 75(1):88-96.
22. Ichii S, Nakamura T, Kawarabayashi T, Takatama M, Ohgami T, Ihara K, Shoji M. CogEvo, a cognitive function balancer, is a sensitive and easy psychiatric test battery for age-related cognitive decline. Geriatr Gerontol Int. 2020; 20(3):248-255.
23. Skoog J, Backman K, Ribbe M, Falk H, Gudmundsson P, Thorvaldsson V, Borjesson-Hanson A, Ostling S, Johansson B, Skoog I. A longitudinal study of the Mini-Mental State Examination in late nonagenarians and its relationship with dementia, mortality, and

education. J Am Geriatr Soc. 2017; 65(6):1296-1300.
24. Vasantharekha R, Priyanka HP, Swarnalingam T, Srinivasan AV, ThyagaRajan S. Interrelationship between Mini-Mental State Examination scores and biochemical parameters in patients with mild cognitive impairment and Alzheimer's disease. Geriatr Gerontol Int. 2017; 17(10):1737-1745.
25. Milne A, Culverwell A, Guss R, Tuppen J, Whelton R. Screening for dementia in primary care: a review of the use, efficacy and quality of measures. Int Psychogeriatr. 2008; 20(5):911–926.
26. Li X, Dai J, Zhao S, Liu W, Li H. Comparison of the value of Mini-Cog and MMSE screening in the rapid identification of Chinese outpatients with mild cognitive impairment. Medicine. 2018; 97(22): e10966.
27. Stout JW, Beidel DC, Brush D, Bowers C. Sleep disturbance and cognitive functioning among firefighters. J. Health Psychol. 2020: Article 1359105320909861.
28. Liu T, Wong GH, Luo H, Tang JY, Xu J, Choy JC, Lum TY. Everyday cognitive functioning and global cognitive performance are differentially associated with physical frailty and chronological age in older Chinese men and women. Aging Ment Health. 2018; 22(8):942-947.