Original Article

Performance of illiterate and low educated Egyptian elderly in SLUMS (Saint Louis University Mental Status) Examination.

Doaa Sayed Hanafi, Adel Taha Alloush, Mohamad Ahmad Alsadany, Shereen Moustafa Mousa.

Geriatrics and Gerontology Department Faculty of Medicine, Ain Shams University, Cairo, Egypt

Abstract

Background: The use of cognitive assessment tools originally designed for affluent nations in low- and middle-income countries (LMIC) has faced criticism due to potential cultural, educational, and literacy biases. Such adaptations may lead to misclassification and an inflated perception of dementia prevalence. There is a pressing need for further research to create cognitive assessment instruments and dementia diagnosis methods which are suitable as well as practical for clinical application in low- and middle-income countries environments.

Aim: The aim of this study was to assess the efficiency of the Arabic version of the Saint Louis University Mental Status (SLUMS) examination in a sample of illiterate and low-educated Egyptians in comparison to Clinical Dementia Rating (CDR) for detection of cognitive impairment.

Subjects and Methods: We conducted a cross-sectional study that included ninety elderly participants, aged 60 years and above, who attended the Geriatric outpatients' clinic at Ahmed Shawki-Geriatric Medicine Hospital, Ain Shams University Hospitals, Cairo, Egypt. The elderly participants had either normal cognition, mild cognitive impairment or mild dementia, defined as CDR score 0-1. Our participants were classified to illiterates, 1-6 years of education,7-9 years of education for further analysis. All participants had a comprehensive geriatrics assessment and cognitive assessment with Arabic version of the CDR and the Arabic version of the SLUMS.

Results: The study showed that the Arabic version of SLUMS had a high sensitivity of 95.4%, but with a low specificity at 38.3% for detection of mild cognitive impairment in illiterate and low educated Egyptian elderly.

Conclusion: SLUMS is a valid yet not the best tool to screen for cognitive impairment and dementia in the illiterate and low educated Egyptian elderly.

Keywords: Saint Louis University Mental Status (SLUMS), mild cognitive impairment, Low Educated, Illiterate, Egyptians.

Introduction

Dementia is a condition that causes a gradual deterioration in cognitive functions,like memory, language, orientation, judgment, and physical abilities. This decline ultimately leads to a loss of independence [1].

The functional independence of seniors is heavily reliant on cognition, influencing their ability to live independently, manage finances, correctly handle medications, and drive safely. Moreover, intact cognitive abilities are crucial for effective communication and appropriate responses to others [2].

The reduction in cognitive function linked to aging imposes substantial personal, societal, and financial challenges, affecting both pathological conditions such as dementia and

the wider non-clinical population. Estimates suggest that by 2050, around 152 million individuals worldwide will be grappling with dementia [3].

As individuals age, cognitive abilities frequently experience a decline. It is crucial to differentiate between the anticipated changes in cognition associated with normal aging and those that may indicate the onset of a neurodegenerative disease. Understanding these distinctions is essential for effective assessment and intervention [2].

Consequently, Understanding the impact of aging on cognition is essential, and it's important to investigate strategies, whether preventive or therapeutic, that can protect cognitive function in advanced age. Any interventions that can mitigate the detrimental effects of aging on cognition or decrease the risk of developing neurodegenerative dementias have the potential to significantly improve life quality for millions of older adults [4].

About two thirds of patients with dementia reside in low and middle-income countries, which represent a serious challenge for these countries due to limited financial resources, shortages and a difficult access to health and social care services [5]. Patients with lower socioeconomic status and less education are at higher risk for cognitive decline [6]. Early detection, with a suitable screening test, may allow proper diagnosis, and management of cognitive impairment at a milder level before a crisis disrupts the patient's life and requires urgent intervention [7].

Current approaches to dementia screening in high-income countries have beencriticized for being used in low- and middle-income countries, as this typically produces educational, cultural, and literacy biases, increasing the risk of misclassification and an overestimation of dementia prevalence [8].

For early detection of both mild cognitive impairment and major neurocognitive disorder, it's crucial to use brief cognitive screening tests, typically takes less than 20 minutes, as an initial evaluation for suspected cognitive impairment. While these tests are useful for both specialists and primary Care professionals, they alone cannot confirm a diagnosis. Using them alone may lead tomisinterpretations, especially as they often rely heavily on reading and writing skills. This can result in false negatives for highly educated individuals masking their decline and false positives for less-educated individuals struggling with literacy demands. This "educational bias" could exclude a significant portion of the population with lower education levels from available diagnostic tools [9].

The SLUMS (Saint Louis University Mental Status Examination) enhance detection capabilities by including advanced tasks and removing some from the MMSE (Mini-Mental Status Exam), like repetition and construction. These refinements aim to make the SLUMS a more precise tool for diagnosing mild neurocognitive disorders and dementia, offering a better chance of identifying and treating these conditions effectively [10]. The performance of illiterates and low educated elderly in cognitive tests including SLUMS was always a matter of debate, and in Arabic speaking countries as Egypt, more studies are needed.

Aim

The aim of our study was to assess the efficiency of the Arabic version of SLUMS examination among illiterate and low-educated Egyptian elderly attending the Geriatric outpatients' clinic at Ahmed Shawki-Geriatric Medicine Hospital, Ain Shams University Hospitals, in comparison to CDR for early detection of cognitive impairment.

Subjects and Methods

A cross-sectional study done which included 90 elderly participants, males and females, 60 years and above. The study participants were recruited consecutively from the Geriatric outpatients' clinic at Ahmed Shawki-Geriatric Medicine Hospital, Ain Shams university hospitals, Cairo, Egypt. Recruitment of the participants was started in October 2022 and completed in May 2023.

The approval for the study was granted before starting the subjects' recruitment process. we had the approval from the ethics committee in Ain Shams Faculty of Medicine. Explaining the Purpose of the study and assuring the confidentiality of all participants, a written informed consent was given from each participant or their caregiver.

Our inclusion criteria were elderly male and female patients 60 years old and above. The elderly participants had either normal cognition, mild cognitive impairment, or mild dementia, defined as (CDR) score 0-1. They were either Illiterates or low educated (1-9 years of education). The exclusion criteria were: (i) Elderly participants with previous diagnosis of depression or screened positive for depression at the time of assessment. (ii) Elderly participants with significant cognitive decline, defined with CDR score of more than 1. (iii) Elderly participants with severe sensory impairment (visual or hearing impairment) interfering with their assessments. (iv) Elderly participants with known neurodegenerative disorders, neurological diseases, or acute medical disease that interfere with test performance (such as aphasia, paralysis, etc.), (v) Elderly participants who were taking any antidepressant medication or memory enhancers (e.g.: Donepezil, Rivastigmine, Meantime).

Each participant had:

(1) Comprehensive geriatric assessment (CGA).

(2) Screening for depression was done by using the Arabic version [11] of the 9-questions Patient Health Questionnaire (PHQ-9) [12].

(3) Functional assessment was done by activities of daily living (ADL) [13] and instrumental activities of daily Living (IADL) [14].

Cognitive assessment for each participant was done on two stages, first by using the Arabic version [15] of (CDR) [16] to include patients with 0-1 score, then cognitive assessment was done by the Arabic version [10] of (SLUMS) [17]to evaluate participants' performance in the test.

The CDR has gained global acceptance as the standard measure for categorizing the stages of dementia. It evaluates cognitive and functional deterioration across various clinically significant domains [18]. The CDR demonstrates robust interrater reliability in multicenter trials [19], substantial content and criterion validity [20], and internal consistency and responsiveness [21].

The SLUMS is a cognitive assessment tool scored on a 30-point scale. It incorporates questions evaluating calculation, orientation, word and story recall, semantic verbal fluency, reverse digit span, clock drawing, and visuospatial function. Notably, the inclusion of items more directly assessing executive function sets it apart, demonstrating superior discriminative ability compared to the MMSE for Mild Cognitive Impairment [18,22].

The SLUMS form puts different thresholds for identifying MCI (<25 points if <12 years of education, <27 points if ≥12 years of education) and dementia (<20 points if <12 years of education, <21 points if ≥12 years of education) [18]. The cutoff points for less than 12 years of education were the ones used in our study.

Participants were further classified to illiterates, 1-6 years of education, 7-9 years of education for further analysis.

Statistical analysis: The data underwent statistical analysis utilizing the Statistical

Software Package for Social Science (SPSS) 20, developed by IBM in 2011, in which the data was presented, and appropriate analyses were conducted based on the specific characteristics of each parameter.

For parametric numerical data, the statistical measures included the mean, standard deviation (± SD), and range, whereas for non-parametric numerical data, the median and interquartile range (IQR) were calculated. Non-numerical data was analyzed in terms of frequency and percentage. To evaluate the statistical significance of differences among means in more than two study groups, the analysis of variance (ANOVA) test was employed.

A Post Hoc Test was utilized to conduct pairwise comparisons among group means. The Chi-Square test was employed to investigate the relationship between two qualitative variables. In instances where the expected count is below 5 in more than20% of cells, Fisher's exact test is applied to assess the relationship between two qualitative variables. For assessing the strength of association between two quantitative variables, correlation analysis is conducted using Spearman's rho method. The correlation coefficient, symbolically denoted as "r," defines the magnitude and direction (positive or negative) of the linear relationship between the two variables. Specifically, an "r" value of 0-0.19 is considered a very weak correlation, 0.2-0.39 is categorized as a weak correlation, 0.40-0.59 signifies a moderate correlation, 0.6-0.79 indicates a strong correlation, and 0.8-1 denotes a very strong correlation.

Kappa statistics are employed to calculate the degree of agreement between two investigational methods. A Kappa value exceeding 0.75 is considered excellent, while a range of 0.40 to 0.75 indicates fair to good agreement, and a value below 0.40 is considered poor. The level of significance (P-value) is interpreted as follows:$P > 0.05$ is considered non-significant (NS), and $P < 0.05$ is deemed significant (S).

RESULTS

The study had a total ninety elderly participants, with mean age 70.47 ± 6.41 years. Most of them were females (53.33%), married (50%), and almost half of the patients were illiterate (48.89%). The most common comorbidities found among participants were hypertension (67.78%), diabetes (57.78%), ischemic heart disease (33.33%), heart failure (30%), arrhythmia (24.4%), and COPD (20%). (Table 1). The Participants were classified, according to their educational level, into three subgroups: illiterate (44.89%), with 1-6 years of education (28.89%), and with 7-9 years of education (22.22%) for further analysis. Regarding functional performance, our results showed that poor functional status, as indicated by lower performance in ADL and IADL, was significantly associated with poor cognitive performance in both CDR and SLUMS assessment (P= 0.001 and 0.002 respectively). (Table 2).

Though all participants were low educated, comparison between the3 educational subgroups (illiterate, 1-6 years of education, and 7-9 years of education) showed a statistically significant differences among participants regarding performance in SLUMS, as the more the years of education, the higher the SLUMS score (P=<0.001). (Table 3).

According to our study, cross-tabulation of CDR and SLUMS scores for the study groups indicate that there is a fair to good agreement (57.8%) between the CDR and the SLUMS, and that the difference in the distribution of the categories is statistically significant ($p<0.001$) in favor of SLUMS. This suggests that the SLUMS is a valid tool to screen for cognitive impairment and dementia in illiterates and low educated. (Table 4).

Finally, we studied the sensitivity and specificity of SLUMS among illiterate and low educated Egyptian elderly. SLUMS showed high sensitivity (95.4%) referred to CDR but low specificity (38.3%) In detecting MCI and mild dementia in illiterate and low educated elderly. (Table 5).

Table (1): Descriptive data of the studied population

Demographic and clinical characteristics		**Mean ± SD N (%)**	**Median (IQR)**	**Range**
Age		70.47 ± 6.41	71 (66 - 75)	(60 - 86)
SEX	Male	42 (46.67%)		
	Female	48 (53.33%)		
Marital status	Single	10 (11.11%)		
	Married	45 (50%)		
	Widow/WIDOWER	32 (35.56%)		
	Divorced	3 (3.33%)		
Education	illiterate	44 (48.89%)		
	1 - 6 years	26 (28.89%)		
	7 - 9 years	20 (22.22%)		
Smoking	Non-smoker/ex- smokers	71 (78.89%)		
	Smoker	19 (21.11%)		
COMORBIDITIES	Hypertension	61 (67.78%)		
	Diabetes	52 (57.78%)		
	Ischemic heart disease	30 (30%)		
	Heart failure	27 (24.44%)		
	Arrhythmia	22(24.44%)		
	COPD	20 (22.22%)		
	Fall	18(20%)		
	Liver disease	14(15.56%)		
	Renal disease	14(15.56%)		
	Osteoporosis	9 (10%)		
	Malignancy	6 (6.67%)		
	Bronchial asthma	8 (8.89%)		

COPD: chronic obstructive pulmonary disease, Liver disease includes chronic liver disease, hepatitis C or B infection, renal disease includes acute kidney injury, chronic kidney disease, End stage renal disease.

Table (2): Comparison between cognitive performance using both CDR and SLUM as regards Functional status

Functional assessment		CDR performance			Test of significance		
		Normal (n= 47)	MCI (n= 23)	Mild dementia (n= 20)			
		Mean ± SD N (%)	Mean ± SD N (%)	Mean ± SD N (%)	Value	p-Value	Sig.
ADL		5.19 ± 1.01	4.52 ± 1.78	2.6 ± 1.79	*f*= 23.095	<0.001 **(A1)**	S
ADL	Dependent	0 (0%) **a**	2 (8.7%) **b**	3 (15%) **b**	FE	<0.001	S
	Assisted	23 (48.94%) **a**	11 (47.83%) **a**	17 (85%) **b**			
	Independent	24 (51.06%) **a**	10 (43.48%) **a**	0 (0%) **b**			
IADL		6.06 ± 2.1	4.26 ± 2.56	2.75 ± 2.59	*f*= 15.148	<0.001 **(A2)**	S
IADL	Dependent	0 (0%) **a**	2 (8.7%) **b**	4 (20%) **b**	FE	0.001	S
	Assisted	33 (70.21%) **a**	17 (73.91%) **a**	16 (80%) **a**			
	Independent	14 (29.79%) **a**	4 (17.39%) **a,b**	0 (0%) **b**			
		SLUMS			Test of significance		
		Normal	MCI	Dementia			
		Mean ± SD N (%)	Mean ± SD N (%)	Mean ± SD N (%)	Value	p-Value	Sig.
ADL		4.65 ± 1.95	4.98 ± 1.2	3.5 ± 1.95	*f*= 6.992	0.002 **(A2)**	S
ADL	Dependent	2 (10%) **a**	0 (0%) **b**	3 (10.71%) **a**	FE	0.002	S
	Assisted	7 (35%) **a**	23 (54.76%) **a,b**	21 (75%) **b**			
	Independent	11 (55%) **a**	19 (45.24%) **a**	4 (14.29%) **b**			
IADL		5.25 ± 2.77	5.33 ± 2.46	3.89 ± 2.78	*f*= 2.793	0.067	NS
IADL	Dependent	2 (10%) **a**	0 (0%) **b**	4 (14.29%) **a**	FE	0.009	S
	Assisted	11 (55%) **a**	33 (78.57%) **a**	22 (78.57%) **a**			
	Independent	7 (35%) **a**	9 (21.43%) **a,b**	2 (7.14%) **b**			

ADL: activities of daily living, IADL: instrumental activities of daily living, CDR: clinical dementia rating, SLUMS: Saint Louis University Mental Status Examination, MCI: Mild cognitive impairment.

Table (3): SLUMS performance among the study participants as regards level of education.

	Education			One Way ANOVA		
	Illiterate	1 - 6 years	7 - 9 years			
	Mean ± SD	Mean ± SD	Mean ± SD	f	p-Value	Sig.
SLUMS	20.16 ± 2.94	22 ± 3.09	24.65 ± 3.08	15.456	<0.001*	S

SLUMS: Saint Louis University Mental Status Examination, S: significant. *Post hoc Bonferroni test was significant between all group.

Table (4): Agreement test between SLUMS and CDR

Agreement test between SLUMS and CDR		CDR Performance			Agreement %	Kappa	p-Value	Sig.
		Normal (n= 47)	MCI (n= 23)	Mild dementia (n= 20)				
		N (%)	N (%)	N (%)				
SLUMS	Normal (n= 20)	18 (20%)	2 (2.22%)	0 (0%)	57.8%	0.393	<0.001	S
	MCI (n= 42)	26 (28.89%)	15 (16.67%)	1 (1.11%)				
	Dementia (n= 28)	3 (3.33%)	6 (6.67%)	19 (21.11%)				

CDR: clinical dementia rating, SLUMS: Saint Louis University Mental Status Examination MCI: mild cognitive impairment, S: significant, NS: non-significant

Table (5): Sensitivity and specificity of SLUMS, referred to CDR.

Sensitivity and specificity		CDR		Sensitivity	Specificity	PPV	NPV
		Diseased	Normal				
		N (%)	N (%)				
SLUMS	Diseased	41 (45.6%)	29 (32.2%)	95.4%	38.3%	58.6%	90%
	Normal	2 (2.2%)	18 (20%)				

CDR: clinical dementia rating, SLUMS: Saint Louis University Mental Status Examination. PPV: positive predictive value, NPV: negative predictive value.

Discussion

This study aimed to assess the efficiency of SLUMS examination among illiterate and low-educated Egyptian elderly attendees to the Geriatric outpatients' clinic at Ahmed Shawki-Geriatric Medicine Hospital, Ain Shams University Hospitals, in comparison to the Clinical Dementia Rating (CDR) for early detectionof cognitive impairment. The study included ninety elderly participants with mean age of 70.47 ± 6.41 years. About 53.33% were females, 48.89% were illiterate, 28.89% had 1-6 years of education, and 22.22% had 7-9 years of education.

The functional status of all participants was assessed by The ADL and IADL tools whose scores were found significantly lower in the mild dementia group compared to the normal and MCI groups in both the CDR and SLUMS assessment, indicating a higher level of functional impairment with mild cognitive impairment. This agrees with the study conducted by Gray et al.[23] who found a positive relationship between physical function and cognitive status. Regarding illiteracy and low education which is an important concern in theEgyptian elderly and may impact results of different cognitive assessment tools, we categorized the study participants according to their CDR assessment into three subgroups: normal, MCI, and mild dementia. The Subjects were included then the SLUM was applied to discover its agreement with CDR and testing its sensitivity and specificity in detecting MCI and mild dementia among this population.

We found a fair to good agreement

(57.8%) between CDR and SLUM assessment in detecting MCI and mild dementia and that SLUMS was significantly better ($p<0.001$) in detecting them. Assessing the sensitivity and specificity of SLUMS showed that the SLUMS had a high sensitivity (95.4%) but with a low specificity (38.3%), meaning that many illiterate and low educated patients being told of the possibility of having cognitive impairment when they are normal. This leads to the fact that further work is needed when an illiterate or low educated Egyptian elderly gets diagnosed with cognitive impairment with SLUMS.

Considering these insights, we can advocate for the utilization of the SLUMS as a screening instrument for cognitive decline when the aim is to rule out cognitive impairment, yet lacking high specificity reduces the chance of the SLUMS as a good screening test for MCI and Mild dementia among illiterate and low educated.

Feliciano et al, [24], demonstrated the SLUMS' superior predictive capability for neuropsychological performance, particularly in memory and executive functioning, compared to the MMSE. The SLUMS' comprehensive assessment, which includes a focus on memory and executive functions areas, that typically impacted early in cognitive disorders, renders it a robust tool for early detection. The SLUMS, designed at the Saint Louis Veterans Affairs Medical Center for cognitive screening, requires approximately 8 minutes for administration, making it quicker than the average 12-minute duration of the Montreal Cognitive Assessment(MoCA) [25].

The SLUMS examination demonstrated high sensitivity for detecting mild cognitive impairment (MCI) and dementia in individuals with less than a high school education, with values of 0.92 and 1.00, respectively. Additionally, the specificity was notable, measuring 0.81 for MCI and 0.98 for dementia. The sensitivity of SLUMS examination to detect MCI and dementia in individuals witha high school education or greater was 0.95 and 0.98, respectively, and the specificity was 0.76 and 1.00, respectively [26].

Although the participants in our study had low years of education (1-9), a significant correlation between the number of years of education and SLUMS score was found. Our results indicated positive and moderate correlation between the two variables (Spearman'srho = 0.517) meaning that higher education levels (7-9 years) were significantly associated with higher SLUMS scores .

Additionally, the relationship between the SLUMS scores of the three groups of participants with different levels of education was evaluated, and There was a significant difference among the groups, with the highest mean score (24.65 ± 3.08) for the group with 7-9 years of education, followed by the group with 1-6 years of education (22 ± 3.09), and the lowest mean score for the group with illiterate participants (20.16 ± 2.94). This suggests that education has a positive effect on cognitive performance in this sample, and this came in agreement with Xu et al. [27] in their study who found reduction of dementia risk by 7% for a per-year increase in education, and that study was significant as it not only reaffirmed but also quantified the dose-response relationship between educational attainment and dementia.

Also, our research aligns with previous investigations, such as the work conducted by Abdelrahman and El Gaafary [10] and Fratiglioni and Wang [28], that established a definitive link between low education

and a heightened risk of cognitive impairment and dementia. Moreover, Stewart et al [29] posited that lower educational levels might adversely affect early brain development and subsequent cognitive function levels. Corroborating these findings, Bosma et al [30] conducted a longitudinal study which showed that individuals with lower educational attainment exhibited a more pronounced decline in various cognitive domains, including memory and information processing speed. These collective findings underscore the significant impact of educational background on cognitive health in the aging population.

In conclusion, SLUMS is a valid yet not the best tool to screen for cognitive impairment and dementia in the illiterate and low educated Egyptian elderly.

Ethical considerations

The study received approval from the ethical committee at the Faculty of Medicine, Ain Shams University, with the assigned approval number M S 629/2022.

Funding

The research did not receive any specific grant from funding agencies in the public, commercial, or not for profit sectors.

Declaration of Conflicting Interests

The authors have stated that they have no potential conflicts of interest concerning the research, authorship, and/or publication of this article.

References

1) *Duong, S., Patel, T., & Chang, F. (2017). Dementia: What pharmacists need to know. Canadian Pharmacists Journal/Revue des Pharmaciens du Canada, 150(2), 118-129.*

2) *Murman, D. L. (2015, August). The impact of age on cognition. In Seminars in hearing (Vol. 36, No. 03, pp. 111-121). Thieme Medical Publishers.*

3) *Australia, D., Baker, S., & Banerjee, S. (2019). Alzheimer's Disease International World Alzheimer Report 2019: Attitudes to Dementia. Alzheimer's Disease International; Alzheimer's Disease International: London, UK.*

4) *Alzheimer's Association. (2014). 2014 Alzheimer's disease facts and figures. Alzheimer's & Dementia, 10(2), e47-e92.*

5) *Mattap, S. M., Mohan, D., McGrattan, A. M., Allotey, P., Stephan, B. C., Reidpath, D. D., ... & Chaiyakunapruk, N. (2022). The economic burden of dementia in low-and middle-income countries (LMICs): a systematic review. BMJ global health, 7(4), e007409.*

6) *Jongsiriyanyong, S., & Limpawattana, P. (2018). Mild cognitive impairment in clinical practice: a review article. American Journal of Alzheimer's Disease & Other Dementias®, 33(8), 500-507.*

7) *Weintraub, S. (2022). Neuropsychological assessment in dementia diagnosis. Continuum: Lifelong Learning in Neurology, 28(3), 781-799.*

8) *Magklara, E., Stephan, B. C., & Robinson, L. (2019). Current approaches to dementia screening and case finding in low-and middle-income countries: Research update and recommendations. International journal of geriatric psychiatry, 34(1), 37.*

9) *Pellicer-Espinosa, I., & Díaz-Orueta, U. (2022). Cognitive screening instruments for older adults with low educational and literacy levels: A systematic review. Journal of Applied Gerontology, 41(4), 1222-1231.*

10) *Abdelrahman, H.M.M. and El Gaafary, M.M., 2014. Validation of arabic version of Saint-Louis-University-Mental-Status (SLUMS)-Examination and prevalence of cognitive impairment in community dwelling Egyptian older adults. Middle East Journal of Age and Ageing, 83(1492), pp.1-9.*

11) *AlHadi, A. N., AlAteeq, D. A., Al-Sharif, E., Bawazeer, H. M., Alanazi, H., AlShomrani, A. T., ... & AlOwaybil, R. (2017). An arabic translation, reliability, and validation of Patient Health Questionnaire in a Saudi sample. Annals of general psychiatry, 16(1), 1-9.*

12) *Kroenke, K., Spitzer, R. L., & Williams, J. B. (2001). The PHQ-9: validity of a brief depression severity measure. Journal of general internal medicine, 16 (9), 606-613.*

13) *Katz S, Ford AB, Moskowitz RW, et al. (1963): Studies of illness in the aged: The index of ADL: A standardized measure of biological and psychosocial function. JAMA; 185(12):914-919.*

14) Lawton MP and Brody EM (1969): Assessment of older people: self- maintaining and instrumental activities of daily living. Gerontologist; 9 (3):179-186.

15) Karam, G.E., Khandakji, M.N., Sahakian, N.S., Dandan, J.C. and Karam, E.G., 2018. Validation into Arabic versions of dementia rating scales, dementia caregivers scales, and dementia research instruments. Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring, 10, pp.796-801.

16) Berg, L. C. L. W. R. J., Hughes, C. P., Coben, L. A., Danziger, W. L., Martin, R. L., & Knesevich, J. (1982). Mild senile dementia of Alzheimer type: research diagnostic criteria, recruitment, and description of a study population. Journal of Neurology, Neurosurgery & Psychiatry, 45(11), 962-968.

17) Tariq, S. H., Tumosa, N., Chibnall, J. T., Perry III, M. H., & Morley, J.E. (2006). Comparison of the Saint Louis University mental status examination and the mini-mental state examination for detecting dementia and mild neurocognitive disorder—a pilot study. The American journal of geriatric psychiatry, 14(11), 900-910.

18) Morris, J. C. (1993). The Clinical Dementia Rating (CDR) current version and scoring rules. Neurology, 43(11), 2412-2412.

19) Schafer, K. A., Tractenberg, R. E., Sano, M., Mackell, J. A., Thomas, R. G., Gamst, A., ... & Morris, J. C. (2004). Reliability of monitoring the clinical dementia rating in multicenter clinical trials. Alzheimer disease and associated disorders, 18(4), 219.

20) Fillenbaum, G. G., Peterson, B., & Morris, J. C. (1996). Estimating the validity of the Clinical Dementia Rating scale: the CERAD experience. Aging Clinical and Experimental Research, 8, 379-385.

21) Coley, N., Andrieu, S., Jaros, M., Weiner, M., Cedarbaum, J., & Vellas, B. (2011). Suitability of the Clinical Dementia Rating-Sum of Boxes as a single primary endpoint for Alzheimer's disease trials. Alzheimer's & Dementia, 7(6), 602-610.

22) Szcześniak, D., & Rymaszewska, J. (2016). The usefulness of the SLUMS test for diagnosis of mild cognitive impairment and dementia. Psychiatr Pol, 50(2), 457-472.

23) Gray, M., Gills, J. L., Glenn, J. M., Vincenzo, J. L., Walter, C. S., Madero, E. N., ... & Bott, N. T. (2021). Cognitive decline negatively impacts physical function. Experimental gerontology, 143, 111164.

24) Feliciano, L., Horning, S.M., Klebe, K.J., Anderson, S.L., Cornwell, R.E. and Davis, H.P., (2013). Utility of the SLUMS as a cognitive screening tool among a nonveteran sample of older adults. The American Journal of Geriatric Psychiatry, 21(7), pp.623-630.

25) Nasreddine, Z. S., Phillips, N. A., Bédirian, V., Charbonneau, S., Whitehead, V., Collin, I., ... & Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society, 53(4), 695-699.

26) Cummings-Vaughn, L. A., Chavakula, N. N., Malmstrom, T. K., Tumosa, N., Morley, J. E., & Cruz-Oliver, D. M. (2014). Veterans affairs Saint Louis university mental status examination compared with the Montreal cognitive assessment and the short test of mental status. Journal of the American Geriatrics Society, 62(7), 1341-1346.

27) Xu, W., Tan, L., Wang, H. F., Tan, M. S., Tan, L., Li, J. Q., ... & Yu, J. T. (2016). Education and risk of dementia: dose-response meta-analysis of prospective cohort studies. Molecular neurobiology, 53, 3113-3123.

28) Fratiglioni, L. and Wang, H.X., (2007). Brain reserve hypothesis in dementia. Journal of Alzheimer's disease, 12(1), pp.11-22.

29) Stewart, R., Kim, J.M., Shin, I.S. and Yoon, J.S., (2003). Education and the association between vascular risk factors and cognitive function: a cross- sectional study in older Koreans with cognitive impairment. International psychogeriatrics, 15(1), pp.27-36.

30) Bosma, H., Van Boxtel, M.P.J., Ponds, R.W.H.M., Houx, P.J.H. and Jolles, J., (2003). Education and age-related cognitive decline: the contribution of mental workload. Educational gerontology, 29(2), pp.165-173.