Original Article

Comparison of the Rowland Universal Dementia Assessment Scale and Mini-Mental State Examination cognitive screening tools among older people in Nigeria

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ABSTRACT

Background and objectives: Dementia is progressive neuro-degeneration characterized by ongoing deterioration in cognition and capacity for independent living. Empirical evidence is lacking on the best screening tool because of the cultural and linguistic diversitiesof Nigerians. This study screened for dementia and described the differences between the Rowland Universal Dementia Assessment Scale (RUDAS) and Mini-Mental State Examination (MMSE) tools among older people at the University College Hospital (UCH), Ibadan, Nigeria.

Materials and Methods: Cross-sectional hospital-based descriptivestudy of 96 older people ≥60years at UCH, Ibadan. Dementia was assessed with the RUDAS and MMSE tools. Socio-demographic characteristics and memory issues were also assessed. Descriptive and inferential statistics were done and the level of significance was set at 5%.

Results: The mean age was 70.5±7.4 years and 57(59.4%) were female respondents. The overall mean score on RUDAS was 22.8±4.0 points and MMSE was 24.2±4.8 points. Point prevalence of dementia on RUDAS and MMSE were 6.2% and 4.2% respectively. Using MMSE as the standard, the AUROC for the RUDAS was 85.9% (95% CI:60.4-99.8), and its sensitivity and specificity were75.0% and 96.7% respectively. Both RUDAS and MMSE were associated with age and residence. MMSE, but not the RUDAS, scores were influenced by total years of education ($p<0.001$).

Conclusion*:* RUDAS was as accurate as MMSE for the screening of dementia in our setting. Contrary to the MMSE, RUDAS was not influenced by the years

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of education for dementia. Our finding supports the use of RUDAS as an effective alternative test to MMSE for dementia screening in older Nigerians.

INTRODUCTION:

Validated screening tools are scarce for cognitive function among older Nigerians. Dementia is a growing concern in LMICs due to its rising incidence and burden imposed on functional independence.[1] Similar to the trend in the Low and Medium income countries (LMICs), the incidence of dementia is increasing in Nigeria due to demographic changes in the population and a rise in the prevalence of mutable vascular risk factors.[2] In Nigeria, Adeloye et al. reported a more than a 4-fold increase in the prevalence of dementia in 2019.[1] Hence, there is a need to identify appropriate, objective and reliable methods of assessing cognitive function in a culturally and linguistically diverse (CLAD) population like Nigeria with 250 ethnic groups and well over 450 languages.[3]

Several new cognitive instruments have been specifically developed and validated for dementia in Nigeria such as the Community Screening Interview for Dementia (CSID)[4] and the Intervention for Dementia in Elderly Africans (IDEA) screening tools.[5] However, the ease of administration and methodological challenges results in wide differences in the prevalence and estimates of dementia. Thus, the prevalence of dementia varies widely in Nigeria. The pooled crude prevalence of dementia in Nigeria was 4.9% (95% CI: 3.0–6.9) with a two-fold risk among the women.[1]

Though, the Mini-Mental State Examination (MMSE)is arguably the most common and extensively validated cognitive screening tool used in clinical practice and research around the world, its limitations in low educated and socio-economic disadvantaged people are well known and documented across cultures and languages.[6,7] The attempt at rooting out any socio-cultural bias has yielded new tools like the Rowland Universal Dementia Assessment Scale (RUDAS).[7]

The RUDAS is a cognitive screening tool that is specifically designed to minimize the impact of cultural differences on test performance.[6,8,9] It has been validated in CLAD population both in Australia where it was initially developed, and internationally.[6,10-12]Chaaya *et al.*, validated the Arabic version (A-RUDAS) in primary care and hospital-based specialist clinics in North Africa.[8,13]RUDAS performance is not associated with cultural or language background in multi-cultural settings and in comparison with the MMSE, the RUDAS has generally been found to have similar accuracy for dementia.[6,10,11,13]This study screened for dementia and described the differences between the RUDAS and MMSE tools among older peoplein Nigeria.

MATERIALS AND METHODS

This study cross-sectional comparative hospital-based study was carried out at the Medical Outpatients' (MOP) clinics of the University College Hospital (UCH), Ibadan. UCH was established in November 1957 as the pioneer tertiary hospital in Nigeria, Ibadan is a cosmopolitan city with a population of approximately 3 million and is the capital city of Oyo State, Southwestern, Nigeria.[14]The MOP clinics serve as the gateway for all older people coming to the Department of Medicine, U.C.H, Ibadan. Older people are managed on an outpatient basis at first contact by the specialist teams and those needing further care are admitted into any of the 150 beds in the medical wards based on their diagnoses and specialists' needs.

Study population: A total of 96 male and female older people aged 60 years and above who were administered the Mini-Mental State Examination (MMSE) and Rowland Universal Dementia Assessment Scale (RUDAS) on the same day were recruited consecutively between April and May 2021 from the MOP clinics, UCH. The inclusion criteria were older people aged ≥60 years whose ages were determined by direct recall or by the table of historical events if they could not recall their

ages[15,16] and who consented to take part in the study. Participants who were too ill to participate in the study or those (Participants/proxies) who did not consent to the study were excluded.

Procedure: The participants were interviewed with a semi-structured pretested questionnaire that obtained information on the respondents' socio-demographic characteristics such as age, gender, years of education, occupational status, place of domicile and memory issues.

Assessment of Dementia: This was assessed with the MMSE and RUDAS.

The MMSE described by Folstein and McHugh in 1975 is the most commonly used test worldwide for assessing cognitive function.[17,18]It assesses orientation in time and place, attention, memory, language and visual construction.[18] The MMSE has a maximum of 30 points and lower scores indicate worse cognitive function.[11,19] It takes about 10 minutes to administer.[20]Research has reported different cut-off pointsfor dementia based on ethnicity, culture, language and socio-demographic characteristics. Thus, its sensitivity varies from 71% to 92% and specificity ranges from 56% to 96% depending on the cut-off point used for dementia.[11]Since there was no Nigerian study that has determined the appropriate cut-off score for MMSE among older Nigerians. We determined the cut-off point for the screening of dementia among older Nigerians for this study as a score equal to or less than the 2 standard deviations (SD) below mean score ($\leq \mu - 2SD$).[21,22] Thus, the cut-off score for MMSE was Mean - 2SD (24.2 – 9.6 = 15). Dementia was thereby defined as a score of ≤15 out of 30 points in the MMSE for the population studied.

The RUDAS is a six-item screening test scored out of a total of 30 points and requiring no special equipment for its administration.[6,8] It assesses language, praxis, memory, judgment, construction and fluency. The RUDAS also addresses frontal lobe impairment and includes diverse response formats (verbal, non-verbal, written and praxis) providing a comprehensive screening of overall cognition.[9] It is not reliant on information from a carer/informant.[9]RUDAS has a sensitivity of 89% and a specificity of 98%.[8] The area under the ROC curve for the RUDAS was 0.94 and its inter-rater (0.99) and test-retestreliability (0.98) was high.[8]In Nigeria, the cut-off score for dementiaon RUDAS has not been derived as there was no previous study on RUDAS in Nigeria. Thus, the cut-off score for dementia on RUDAS was taken as a score equal to or less than the 2 standard deviations (SD) below mean score ($\leq \mu - 2SD$).[21,22] The cut-off score for dementia on RUDAS was Mean - 2SD (22.8 – 8.0 = 15). Dementia was thereby defined as a score of ≤15 points out of 30 points on the RUDAS.

Ethical considerations: Informed consent was obtained from each respondent or proxy and ethical approval for the study was obtained from the University of Ibadan/University College Hospital Institutional Review Board (UI/EC/20/0232).

Data analysis: On each study day, the administered questionnaires were checked, sorted and coded serially. Data entering, cleaning and analysis were carried out using SSPS (version 27). Descriptive statistics were used for the socio-demographic characteristics of the respondents. The Student's t-test was used for the continuous variables. The agreement between RUDAS and MMSE was evaluated with the Cohen kappa coefficient. Appropriate charts including the scattered diagram were employed to illustrate the relationship between the screening tools. Using the MMSE as the standard, the diagnostic performance between the RUDAS and MMSE was compared using receiver operating characteristics (ROC) curve analyses based on area under curve (AUC) values. The sensitivity and specificity of RUDAS at standard and optimal cut-offs, along with positive and negative predictive values in the current sample were reported. The p-value of significance was set at ≤0.05.

RESULTS:

There were 96 participants [females = 57 (59.4%) and males = 39 (40.6%)]. The mean age was 70.5 ± 7.4 years with a significant gender difference (males $\mu = 74.2 \pm 7.0$ years vs females $\mu = 68.0 \pm 6.5$ years; $t = 4.50$, $p<0.001$).

The majority ($n = 60$, 62.5%) had more than 6 years of formal education (post-primary school education), were not currently engaged in occupational activities ($n = 64$, 66.7%), lived with their families ($n = 75$, 78.1%), and were domiciled in the urban area ($n = 88$, 91.7%) The overall Mean score on RUDAS was 22.8 ± 4.0 (range 11 – 30 points) and MMSE was 24.2 ± 4.8 points (range 6 – 30 points). On the MMSE and RUDAS screening tools respectively, the scores decrease significantly with an increase in age ($p = 0.02$ & $p = 0.01$). *Significantly, participants living in the urban settings had higher scores on both screening tools compared with those in the rural settings ($p<0.001$ & $p = 0.02$). However, participants who had 6 or more years of formal education scored higher mean points on the MMSE (25.5 ± 4.4 points) than those with less than 6 years of formal education (21.9 ± 4.6 points) $t = 3.86$; $p<0.02$.* (see Table 1).

Table 1: Factors associated with MMSE and RUDAS scores

		MMSE			RUDAS		
	n	**Mean ± SD**	**t/F**	**p**	**Mean ± SD**	**t/F**	**p**
Age Group (years)							
60-69	45	24.6 ± 5.1	4.33	0.02*	23.9 ± 3.4	6.23	0.01*
70-79	38	24.8 ± 4.0			22.6 ± 3.7		
>=80	13	20.6 ± 4.6			19.8 ± 5.3		
Sex							
Male	39	24.8 ± 4.1	1.05	0.30	22.9 ± 3.6	0.18	0.86
Female	57	23.7 ± 5.2			22.8 ± 4.3		
Education							
Primary and below	36	21.9 ± 4.6	-3.86	<0.001*	22.1 ± 4.0	-1.43	0.16
Post primary	60	25.5 ± 4,4			23.3 ± 4.0		
Living arrangement							
Alone	5	26.4 ± 4.1	1.53	0.22	22.9 ± 4.0	0.15	0.86
with family	76	24.3 ± 4.3			22.4 ± 4.4		
with carer	15	22.5 ± 6.8			22.8 ± 4.0		
Occupational status							
Retired	64	24.5 ± 5.1	1.07	0.29	23.1 ± 4.3	0.85	0.40
Not retired	32	23.4 ± 4.3			22.3 ± 3.4		
Residence							
Rural	8	18.4 ± 6.2	-3.78	<0.001*	19.5 ± 3.9	-2.54	0.02*
Urban	88	24.7 ± 4.3			23.1 ± 3.9		
Memory issues							
Yes	76	23.8 ± 4.9	-1.37	0.18	22.6 ± 4.0	-1.03	0.31
No	20	25.5 ± 4.4			23.7 ± 4.0		
Duration of memory issues (n= 76)							
≤6 month	16	22.2 ± 6.1	-1.50	0.14	22.1 ± 5.0	-0.63	0.53
> 6 month	60	24.2 ± 4.5			22.8 ± 3.7		

*Statistically significant at p<0.05

Table 2: Self-reported memory issues with MMSE and RUDAS scores (N = 76)

		MMSE			RUDAS		
	n	Mean ± SD	t/F	p	Mean ± SD	t/F	p
Misplacing frequently used object							
Yes	58	23.7 ± 5.2	-0.30	0.76	22.7 ± 4.2	0.41	0.68
No	18	24.1 ± 3.9			22.3 ± 3.5		
Difficulty remembering words							
Yes	54	23.7 ± 5.0	-0.38	0.71	22.3 ± 3.9	-0.98	0.33
No	22	24.1 ± 4.8			23.3 ± 4.2		
Forgetting recent events							
Yes	16	23.0 ± 4.8	-0.74	0.46	22.4 ± 4.3	-0.27	0.79
No	60	24.0 ± 4.9			22.7 ± 3.9		
Difficulty managing simple tasks							
Yes	3	29.7 ± 0.6	9.30	<0.001*	25.0 ± 1.7	1.06	0.29
No	73	23.6 ± 4.8			22.5 ± 4.0		

*Statistically significant at p<0.05

Table 2 shows the self-reported memory issues and the mean scores on MMSE and RUDAS. The majority of the participants ($n = 76$, 79.2%) reported having memory issues and ($n = 60$, 62.5%) had it for more than 6 months. Those who reported having difficulty in performing simple tasks significantly scored higher points on MMSE than those who could not ($p < 0.001$).

The point prevalence of dementia on RUDAS was 6.2% and 4.2% for MMSE at a cut-off point of 15 (μ - $2SD$). In comparing RUDAS with MMSE, the positive predictive value (PPV) was 50.0% and the negative predictive value (NPV) was 98.9%. The level of agreement between both screening measures was Kappa = 57.9%.

Figure 1 depicts the proportion of participants who had perfect scores on MMSE and RUDAS in the four comparable domains of the screening tools. Higher proportions of participants had perfect scores in the language ($z = 3.64$, $p = 0.08$) and orientation ($z = 8.89$, $p = 0.01$) domains on RUDAS compared with MMSE. While higher proportions of participants had perfect scores in the drawing ($z = 49.89$, $p<0.001$) and memory recall ($z = 7.28$, $p = 0.01$) domains on MMSE compared with the RUDAS.

The scattered diagram of the scores between MMSE and RUDAS is shown in Figure 2. There was a positive linear relationship between both screening measures and the Correlation coefficient was 0.545, $p<0.001$.

Using MMSE as the diagnostic standard, the ROC curve (Figure 3) shows an accuracy of 85.9% (95% CI: 60.4 - 99.8%) at cut-offs set for both screening measures in this study. The Sensitivity was 75.0% and Specificity was 96.7%.

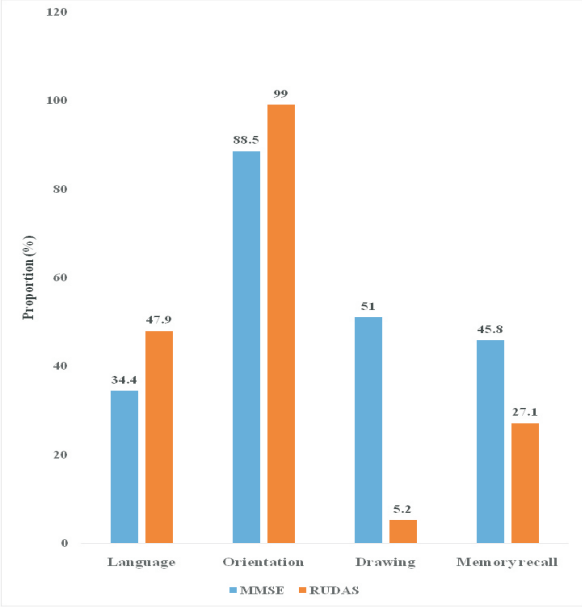

Figure 1: Proportion of participants with perfect scores on MMSE and RUDAS

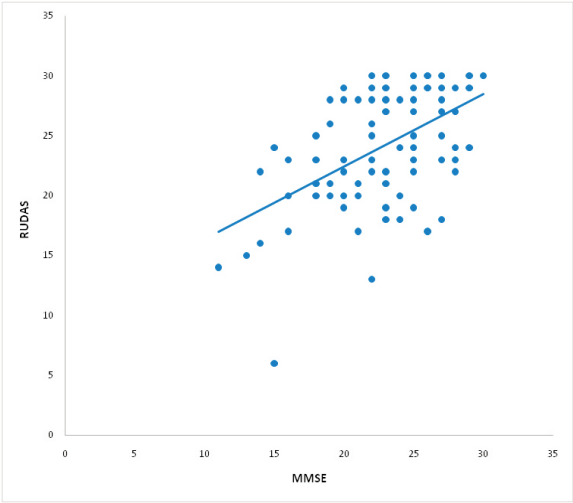

Figure 2: Scattered diagram for MMSE and RUDAS

DISCUSSION:

The current study compared the performance of the RUDAS and MMSE screening tools for the detection of dementia in a tertiary hospital in Nigeria. Both tests were widely acceptable to the participants and the scores which ranged from 0 to 30 points allowed for a direct comparison of RUDAS and MMSE. There were few studies on dementia among older Nigerians, worse still, they were mostly community-based.[1,23] Despite this, the point prevalence of dementia on RUDAS (6.2%) and MMSE (4.2%) in our study was similar to the reports of dementia in Nigeria.[1,23]

Both tools had comparable mean scores, RUDAS (22.8 ± 4.0 points) and MMSE (24.2 ± 4.8 points) with a positive linear correlation on the scattered diagram. Using the MMSE as the standard and based on the Youden index, the performance of RUDAS was comparable with the area under the ROC curve (AUROC) of 85.9%. RUDAS has good sensitivity (75.0%) and specificity (96.7%) to MMSE in screening for dementia among older Nigerians.

Both the RUDAS and MMSE were influenced by age and residence (urban-dwelling) in our study. Increasing age has been recognised as a predictor of dementia in most studies that employed both tools.[1,8,9,24]

Interestingly, we observed that MMSE but not RUDAS was affected by having less than 6 years of formal education for dementia, the severe form of cognitive impairment in our study. There has been a debate on the influence of education on the performance of older persons on cognitive screening tools.[7] Similar to our findings on dementia, the original RUDAS, and its subsequent validation did not report an association between years of formal education and dementia.[8,9,12] Though some studies which used RUDAS reported the influence of having less than six years of formal education on cognitive impairment (CI).[11,13,25] The reason for this observation was attributed to the high prevalence of illiteracy in these settings.[8] The majority of the

participants (62.5%) in our study had more than 6 years of formal education which was not surprising as the adult literacy rate in Nigeria in 2018 was 62.0%.[26] An additional reason could be the non-segregation of the severity of CI, as our study screening for the severe form of CI (dementia). In a review by Paddick*et al*., MMSE performed poorly when compared to other screening tests for dementia despite the inclusion of culturally relevant adaptations.[27] Though MMSE remains the most widely used dementia screening test globally, MMSE and its variations are least likely to be accurate[27]and should be avoided for dementia screening in CLAD populations like Nigeria.

Higher proportions of participants had significantly perfect scores in the language (47.9% vs 34.4%) and orientation (99.0% vs 88.5%) domains on RUDAS but did poorly in the drawing (5.2% vs 51.0%) and memory domains (27.1% vs 45.8%) when compared with MMSE. These findings were not surprising since literacy, culture and language influence MMSE and not RUDAS for dementia. The MMSE concentrates its assessment on orientation, attention/concentration, and language while the RUDAS gives greater weight to verbal, body orientation, and visuospatial praxis,[28,29] which allows RUDAS to detect even different types of dementia syndrome.[29] Thus, it was not surprising that most participants did poorly on drawing in RUDAS compared with MMSE. The cube drawing embedded in the RUDAS has the advantage of providing a good evaluation of executive function and therefore the ability to perform activities of daily living, which declines with dementia.[9] In Peru, the RUDAS-PE was found to detect other types of dementia such as vascular dementia and the variants of frontotemporal dementia that cannot be detected with the MMSE.[29]

CONCLUSION

RUDAS compared accurately with MMSE for the screening of dementia among older Nigerians. For the detection of dementia, RUDAS is not affected by the years of formal education in deference to the MMSE. Our data suggest that using the RUDAS at a cut-off point of 'Mean - 2SD' yields similar results to the MMSE for the detection of dementia. We advocate for further studies among older Nigerians who are clinically diagnosed with dementia to independently determine the diagnostic accuracy of RUDAS and MMSE.

Limitations

We observe some limitations in our study. The hospital-based nature of the study was likely to make our prevalence of dementia to be more than expected in the general population.[27] We take cognisance that the diagnosis of dementia is primarily a clinical judgement.

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