Original Article

Diagnostic Performance of Short Portable Mental Status Questionnaire for Screening Dementia Among Patients Attending Cognitive Assessment Clinics in Singapore

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Abstract

Introduction: The Short Portable Mental Status Questionnaire (SPMSQ) is a brief cognitive screening instrument, which is easy to use by a healthcare worker with little training. However, the validity of this instrument has not been established in Singapore. Thus, the primary aim of this study was to determine the diagnostic performance of SPMSQ for screening dementia among patients attending outpatient cognitive assessment clinics and to assess whether the appropriate cut-off score varies by patient's age and education. A secondary aim of the study was to map the SPMSQ scores with Mini-Mental State Examination (MMSE) scores. Materials and Methods: SPMSQ and MMSE were administered by a trained interviewer to 127 patients visiting outpatient cognitive assessment clinics at the Singapore General Hospital, Changi General Hospital and Tan Tock Seng Hospital. The geriatricians at these clinics then diagnosed these patients with dementia or no dementia (reference standard). Sensitivity and specificity of SPMSQ with different cut-off points (number of errors) were calculated and compared to the reference standard using the Receiver Operator Characteristic (ROC) analysis. Correlation coefficient was also calculated between MMSE and SPMSQ scores. Results: Based on the ROC analysis and a balance of sensitivity and specificity, the appropriate cut-off for SPMSQ was found to be 5 or more errors (sensitivity 78%, specificity 75%). The cut-off varied by education, but not by patient's age. There was a high correlation between SPMSQ and MMSE scores (r = 0.814, *P* <0.0001). Conclusion: Despite the advantage of being a brief screening instrument for dementia, the use of SPMSQ is limited by its low sensitivity and specificity, especially among patients with less than 6 years of education.

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Key words: Cognitive impairment, Dementia, SPMSQ, Validation

Introduction

Healthcare workers and researchers have widely acknowledged the need for a brief cognitive screening instrument for the diagnosis of dementia. While many physicians use the Mini-Mental State Examination (MMSE), it is considered too long and too difficult to interpret, especially by junior healthcare workers. The Short Portable Mental Status Questionnaire (SPMSQ) is a widely used 10-item cognitive screening instrument, whose items test orientation to time and place, memory, current event information (date, day of the week, name of this place, telephone number, date of birth, age, name of current prime minister and previous prime minister, mother's maiden name), and calculation (subtract 3s starting with number 20). The total number of errors is computed and it ranges from 0 to 10.[1] It was first validated by Pfeiffer in a sample of 141 clinic patients in which SPMSQ scores were found to be correlated with clinical diagnosis of organic brain impairment.[1] The validity and reliability of SPMSQ was also subsequently established in other studies.[2-6] These studies have reported a high specificity, but lower sensitivity of SPMSQ. For instance, Erkinjuntti et al found the sensitivity and specificity of SPMSQ to be 86.2% and 99.0%, respectively, among community and medical inpatient samples of Finnish elderly, using the cut-off point of 3 or more errors.[2] A study by Fillenbaum reported 55% sensitivity and 96% specificity for SPMSQ,[5] while another by Albert et al, found the sensitivity and specificity of

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SPMSQ to be 34.4% and 94.3%, respectively.[4] A Spanish language validation of SPMSQ reported its sensitivity and specificity as 85.7% and 79.3% respectively, with a cut-off of 3 or more errors.[6] In contrast, in a study by Dalton et al, SPMSQ was not found to be significantly related to either clinical or neuropsychological diagnosis.[3]

While the validity of SPMSQ has been established in many settings, it has never been used in Singapore. The majority of Singapore's population is Chinese (74.1%), with a smaller proportion of Malays (13.4%) and Indians (9.2%).[7] It has a rapidly ageing population, with the proportion of older adults ≥60 years being 8% and projected to increase to 19% by 2030.[8] The prevalence of dementia among older adults aged ≥60 years is currently 5.2% and is likely to increase as the population ages.[9] While a brief instrument such as SPMSQ for screening cognitive impairment secondary to dementia among people of different ethnic groups will be useful, its scores will be considered meaningful only if its diagnostic performance has been systematically evaluated against standard clinical diagnosis.

Thus, the primary aim of this study was to determine the diagnostic performance of SPMSQ for screening dementia among patients attending outpatient cognitive assessment clinics and assess whether the appropriate cut-off score varies by patient's age and education. A secondary aim of the study was to map the SPMSQ scores with MMSE scores; this could be useful as it would enhance our ability to compare results across studies.

Materials and Methods

Data Collection

Data collection was conducted between December 2010 and November 2011. All patients attending cognitive assessment clinics were invited by their treating physicians to participate in this study. A total of 127 patients visiting outpatient cognitive assessment clinics at the Singapore General Hospital (n = 42), Changi General Hospital (n = 44) and Tan Tock Seng Hospital (n = 41), consented to participate and were administered the SPMSQ and MMSE by a trained interviewer. SPMSQ was administered in English or Chinese based on participants' preference. The Chinese version was back-translated to ensure accuracy. The geriatricians at these clinics then diagnosed these patients with dementia or without dementia after a thorough work up which included taking patient history, physical examination, psychometric assessment, laboratory and neuroimaging investigations; this clinical diagnosis served as the reference standard. The geriatrician and clinic nurse were blinded to the SPMSQ scores.

Statistical Analysis

Unpaired t-test was used to compare the number of errors on SPMSQ among patients with and without a clinical diagnosis of dementia. Then, sensitivity and specificity of SPMSQ with different cut-off points (number of errors) were calculated and compared to the reference standard. Receiver Operating Characteristic (ROC) analysis was conducted and area under the curve (AUC) was calculated. During the ROC analysis, we compared the sensitivity and specificity of SPMSQ at different cut-off points. The cut-off point chosen was the one that provided the best balance of sensitivity and specificity. The ROC analysis was then repeated for subgroups of patients in the 2 education categories (<6 years vs ≥6 years), to determine whether the optimal cut-off value for SPMSQ changed by education.

The correlation coefficient was also calculated between the MMSE and SPMSQ scores. The pre-defined categories of SPMSQ (intact, <3 errors; mild, 3 to 4 errors; moderate and severe, 5 or more errors)[1] and MMSE scores (intact, score ≥24; mild, score 18 to 23; severe, score ≤17)[10] were cross-tabulated to assess the extent of agreement between the cognitive impairment categories determined using the 2 scoring scales.

Results

Demographics

The majority of the patients were ≥75 years of age (78.7%), female (69.3%), had <6 years of education (59.8%), were Chinese (90.6%) and had dementia (81.1%) (Table 1). The distribution of SPMSQ scores for patients without dementia (cognitively intact/ mild cognitive impairment) and with

Table 1. Demographic Characteristics of Study Participants (n = 127)

Characteristics	n (%)
Age (60 to 94 years)	
60 to 74	27 (21.3)
≥75	100 (78.7)
Gender	
Male	39 (30.7)
Female	88 (69.3)
Education	
<6 years	76 (59.8)
≥6 years	51 (40.2)
Ethnicity	
Chinese	115 (90.6)
Malays, Indians, and Others	12 (9.4)
Diagnosis	
Intact cognition	9 (7.1)
Mild cognitive impairment	15 (11.8)
Dementia	103 (81.1)

Table 2. Distribution of Short Portable Mental Status Questionnaire Scores

	Intact cognition/ Mild cognitive impairment Mean number of errors ± SD	Dementia Mean number of errors ± SD	*P* values
Total sample	3.2 ± 2.5 (n = 24)	6.3 ± 2.4 (n = 103)	
Education			
<6 years	5.4 ± 2.8 (n = 7)	6.8 ± 2.4 (n = 69)	<0.0001
6 to 12 years	2.2 ± 1.8 (n = 17)	5.4 ± 2.3 (n = 34)	
Age			
60 to 74 years old	3.5 ± 4.0 (n = 4)	6.3 ± 2.9 (n = 23)	0.73
≥75 years old	3.1 ± 2.3 (n = 20)	6.3 ± 2.3 (n = 80)	

dementia (mild/moderate/severe) is shown in Table 2. Table 2 also shows that SPMSQ scores varied significantly by level of education (<6 years vs ≥6 years), but not by age (60 to 74 years vs ≥75 years).

Optimal Cut-off Values

The AUC for the overall sample was 0.81. For those with <6 years of education, it was 0.64 and for those with ≥6 years of education, it was 0.87. Based on the ROC analysis and a balance of sensitivity and specificity, the appropriate cut-off point was found to be 5 or more errors (78% sensitivity, 75% specificity) (Fig. 1). For those with <6 years of education, the appropriate balanced cut-off was 6 or more errors (72% sensitivity, 43% specificity). Among those with ≥ 6 years of education, the appropriate balanced cut-off was 4 or more errors (79% sensitivity, 76% specificity) (Figures not shown).

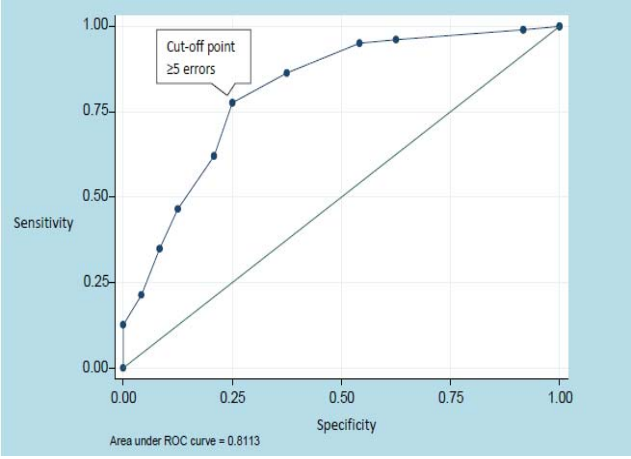

Fig. 1. Receiver Operating Characteristic (ROC) curve for the overall sample.

Mapping with MMSE

We found a high correlation between SPMSQ and MMSE scores (r = 0.814, *P* <0.0001). The mean number of errors on SPMSQ among patients categorised as having intact cognition with MMSE (score ≥24) was 2.3 ± 2.0, among those defined as having mild cognitive impairment (MMSE score 18 to 23) was 4.6 ± 1.9 and among those with severe cognitive impairment (MMSE score ≤17) was 7.5 ± 1.9. Cross-tabulation of cognitive impairment categories using MMSE (intact, mild, severe) and original SPMSQ categories (intact, <3 errors; mild, 3 to 4 errors; moderate and severe, 5 or more errors) showed an overall 70% agreement between the categories defined by the 2 scores. However, 21 of the 41 patients (51.2%) determined as having mild cognitive impairment using MMSE, were classified as having moderate/severe cognitive impairment on SPMSQ (Table 3). The kappa statistic (i.e. the agreement between 2 scales above and beyond that expected by chance alone) was 0.47 (*P* <0.0001), suggesting moderate agreement.

Discussion

Previous studies have reported a high specificity and sensitivity of SPMSQ using a cut-off of 3 or more errors for classifying cognitive impairment/dementia.[2,6] Using a similar cut-off for our study, we get a high sensitivity (95.1%), but a much lower specificity (45.8%). On the other hand, a cut-off of 5 or more errors—as recommended by Pfeiffer—for moderate to severe cognitive impairment

Table 3. Cross-tabulation of Mini-Mental Status Examination and Short Portable Mental Status Questionnaire Categories

Short Portable Mental Status Questionnaire	Mini-Mental Status Examination		
	Intact cognition (n = 21)	Mild cognitive impairment (n = 41)	Severe cognitive impairment (n = 65)
Intact cognition (n = 16)	12	4	0
Mild cognitive impairment (n = 25)	5	16	4
Moderate/ severe cognitive impairment (n = 86)	4	21	61

provides a good balance of sensitivity (78%) and specificity (75%), which indicates that this value is the more balanced cut-off point for screening cognitive impairment secondary to dementia.[1] The low sensitivity and specificity of SPMSQ at a cut-off point of 5 may be because SPMSQ is limited in the cognitive domains assessed. Thus, while SPMSQ has the advantage of being a brief screening instrument for dementia, the low sensitivity and specificity may limit its ability to be used alone in certain clinical settings, where a more comprehensive test assessing multiple cognitive domains may be more useful. On the other hand, in situations where screening will be followed by a more detailed cognitive assessment, a cut-off point (e.g. 3 or more errors) with high sensitivity, but low specificity may also be acceptable.

In addition, the study results demonstrate that optimal number of errors on SPMSQ for screening dementia varies by education. Several previous studies have also shown that low education level increases the likelihood of cognitively intact people being misclassified as having dementia (i.e. false positives). On the other hand, there are likely false negative cases among those with high education level.[11,12] Thus, educational level needs to be taken into account while using SPMSQ. Similar to the original SPMSQ scoring,[1] we propose that those with less than 6 years of education should be allowed one more error, and those with 6 or more years of education should be allowed one less error. The low specificity of SPMSQ at the proposed cut-off point among those with less than 6 years of education, suggests that it should be used with caution in this group of population and if possible, limit its use among those with 6 or more years of education. SPMSQ's correlation with education thus limits its use in current clinical settings where most patients have lower levels of education, although its potential as a screening tool may improve with a better-educated ageing population.

We also found SPMSQ to be correlated with MMSE scores, possibly because of several common items across the 2 scales. However, the cross-tabulation of MMSE and SPMSQ scores suggested that SPMSQ is likely to assign about 51% of the individuals with mild cognitive impairment by MMSE as having moderate/severe cognitive impairment. This should be kept in mind while comparing prevalence estimates from SPMSQ and MMSE across different studies/settings.

The main strength of this study is that it is a multicentre study conducted in 3 cognitive assessment clinics in Singapore. We included dementias of any aetiology and of all severities (mild, moderate, severe) in this study because a screening instrument with good validity should be able to pick up dementias with mixed aetiology and severity. A main limitation of this study is that it has been conducted only among patients visiting cognitive assessment clinics. As a result, there were only a few people with intact cognition in the sample. Future attempts to validate this instrument should include a cognitively intact sample from the community. Moreover, the majority of our patients were Chinese, thus limiting the external validity of the instrument for dementia screening among other ethnic groups, notably Malays and Indians. No information was available for patients who did not consent to participate. Thus, we are unable to say whether those patients who participated were different from those who did not.

Conclusion

In conclusion, SPMSQ can distinguish between patients with dementia and those without, especially among those with 6 or more years of education. To maximise sensitivity and specificity, a cut-off point of 5 or more errors is suggested for screening patients with dementia. However, the cut-off needs to be adjusted depending on the educational level of the patient.

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