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Montreal Cognitive Assessment as a screening instrument for cognitive impairments in schizophrenia

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ABSTRACT

Background: Cognitive impairment is one of the core features of schizophrenia. For its evaluation, current clinical practice relies on detailed neuropsychological batteries which require trained testers and considerable amount of time to administer. Therefore, a brief and reliable screening tool for identification of overall cognitive impairment prior to a detailed comprehensive neurocognitive assessment is needed in a busy clinical setting. This study evaluates the clinical utility of the Montreal Cognitive Assessment (MoCA) in detecting cognitive impairments in schizophrenia and its relationship with functional outcome and demographic characters.

Methods: The MoCA, the Brief Assessment of Cognition in Schizophrenia (BACS), and the Brief UCSD Performance-based Skills Assessment (UPSA-B) were administered to 64 patients with schizophrenia. Mild and severe cognitive impairments were defined as BACS Z-score (calculated with the age and gender adjustments using previously published local norm data) of one or two standard deviations below the mean, respectively.

Results: The results showed that the MoCA was significantly correlated with BACS ($r = .61$, $p < .001$) and sensitive to detect both mild (AUC = 0.82, $p < .001$) and severe (AUC = 0.81, $p < .001$) cognitive impairments in schizophrenia. The MoCA was significantly correlated with UPSA-B score ($r = .51$, $p < .001$), and accounted for significant additional variance in UPSA-B score beyond the BACS.

Conclusion: These findings indicate that MoCA is a useful bedside cognitive screening instrument for people with schizophrenia.

1. Introduction

Schizophrenia is associated with enduring cognitive impairments in domains such as executive functioning, attention and memory (Bowie and Harvey, 2006; Halder and Mahato, 2015). These deficits affect at least 80% of people with schizophrenia and are clinically significant in predicting patients' treatment and functional outcomes (Bora et al., 2010; O'Carroll, 2000). Due to its clinical importance, clinicians who in their daily practice incorporate brief cognitive evaluations to detect cognitive impairments, can enhance treatment plan by making adjustments to patients' medication dose, or refer appropriate patients for further neurocognitive assessments or rehabilitation programs.

At present, there are various well-validated and comprehensive neuropsychological batteries such as the MATRICS Consensus Cognitive Battery (MCCB) (Nuechterlein et al., 2008) and the Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004) that have been developed to measure cognitive abilities (Schulz and Murray, 2016). Indeed, these comprehensive batteries provide health practitioners with detailed understanding of the subject's specific cognitive abilities. However, in routine clinical consultations, administration of such batteries may not be particularly feasible, where completing the MCCB takes about 60 min and at least 30 min for the BACS. Furthermore, these assessments can only be conducted by fully trained testers or neuropsychologists, and require added time for scoring and interpretation of scores. Echoing this point, a previous survey found that clinicians prefer

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brief cognitive assessments (Keefe et al., 2016). Thus, in light of these issues, there is a need to evaluate the clinical utility of bedside cognitive screening instruments to screen for overall cognitive deficits in individuals with schizophrenia. Identified individuals can then be referred for comprehensive cognitive assessments.

One such bedside cognitive instrument is the Montreal Cognitive Assessment (MoCA), a 30-item screener that assesses a broad area of cognitive functions (Nasreddine et al., 2005). Originally designed to detect mild cognitive impairment in older adults with dementia, the MoCA has also been found to be applicable in assessing other clinical populations such as patients with stroke (Cumming et al., 2011), learning disability (Edge et al., 2016), sleep disorder (Gagnon et al., 2010), substance use disorders (Copersino et al., 2009), and in patients attending psychiatry inpatient/outpatient service (Gierus et al., 2015; Helmi et al., 2016). In another study on patients with severe mental illness (18 patients with schizophrenia and 10 with mood disorders), Musso et al. (2014) explored the relationship between MoCA total scores (with the 1 point education correction for those with <12 years of education), BACS composite score and functioning outcome on the UPSA-2. They reported a favorable sensitivity of 89% on the MoCA in differentiating patients from healthy controls. They also reported a stronger association between the MoCA ($r_s = .66$, $p < .001$) and the functional measures than that between the BACS ($r_s = .27$, n.s.) and the functional measures.

There were two published studies that were intended to validate the use of MoCA in people with schizophrenia. Ramírez et al. (2014) tested the concurrent validity of MoCA and reported a moderate correlation between the MoCA and the Mini-Mental State Examination (MMSE) ($r = .62$, $p < .001$), as well as the cognitive subscale of the PANSS ($r = .55$, $p < .001$). Similarly, Fisekovic et al. (2012) conducted a study with 30 patients where they reported a moderate positive correlation ($r = .40$, $p = .027$) between the MoCA and the MMSE. The authors opined that the MoCA is more sensitive in detecting milder cognitive deficits as the MoCA was able to detect more cases with mild cognitive impairments as compared to the MMSE. The common limitation of these two studies is that both the MoCA and the MMSE are cognitive screening tools. Previous studies have shown that MMSE is unsatisfactory in detecting mild cognitive impairments (Hoops et al., 2009) and insensitive to the cognitive impairments typically found in schizophrenia (Pendlebury et al., 2010; Popovic et al., 2007); therefore, it might not be appropriate to adopt MMSE as the reference cognitive assessment in schizophrenia (Manning et al., 2007). Two other studies have also highlighted the need of validating the MoCA against standard neurocognitive test batteries (Fisekovic et al., 2012; Wu et al., 2014). Taken together, despite some results supporting the utility of the MoCA in schizophrenia, evidence in this area is still limited. To date, there are no studies that have conclusively studied the clinical utility of the MoCA in detecting cognitive impairments in schizophrenia.

The aim of this study is to examine the ability of the MoCA as a bedside cognitive screening tool in detecting cognitive impairments in people with schizophrenia. In this study, MoCA was compared against the BACS; the diagnostic accuracy of the MoCA in detecting mild and severe cognitive impairments and its relation to functioning were evaluated. The effects of demographic characteristics, e.g., age, gender, education on MoCA performance were also tested.

2. Material and methods

2.1. Participants

Sixty-four outpatients diagnosed with schizophrenia were recruited from the Institute of Mental Health, Singapore. All patients' diagnoses were ascertained on the Structured Clinical Interview for DSM-IV (SCID) by trained research psychologists. The inclusion criteria of the study include diagnosis of schizophrenia, aged 16–65, English speaking and fit to provide informed consent. The exclusion criteria include history of strokes, traumatic brain injuries and neurological disorders such as epilepsy. Ethics approval for the study was provided by the National Healthcare Group Domain Specific Review Board. Written informed consent was obtained from all participants after the study procedures were fully explained.

2.2. Measures

The Montreal Cognitive Assessment (MoCA) (Nasreddine et al., 2005) is a brief screening instrument used to detect mild cognitive impairments with a reported administration time of about 10 min. Cognitive domains assessed by the MoCA include visuospatial skills, language, attention, memory, executive functions, abstraction, calculation and orientation. The total score ranges from 0 to 30, with a score of 26 or greater indicating "normal" cognitive functioning. This MoCA total score takes into account years of education where the total score of individuals who completed 12 years or less are adjusted by adding 1 point, as suggested in the MoCA manual.

The Brief Assessment of Cognition in Schizophrenia (BACS) (Keefe et al., 2004) is a well-established neuropsychological battery used to evaluate cognitive functioning in patients with schizophrenia. It consists of six subscales, namely Verbal Memory, Digit Sequencing, Token Motor Task, Semantic Fluency, Symbol Coding and Tower of London which measure verbal memory and learning, working memory, psychomotor function, verbal fluency and executive function. The BACS subscale and composite Z-scores were calculated with the age and gender adjustments using previously published local norm data (Eng et al., 2013). BACS Z-scores of one and two standard deviations below the mean were defined as mild and severe cognitive impairment, respectively.

The Brief UCSD Performance-based Skills Assessment (UPSA-B) (Mausbach et al., 2007) is a brief tool used to examine functional capacity in two areas of everyday functioning – communication and finances. Participants were assessed through role-play exercises, such as writing a cheque for the bill and calling to reschedule a doctor's appointment. The total score ranges from 0 to 100, with higher scores indicating better functional capacity.

2.3. Statistical analyses

In keeping with the suggestions of the MoCA manual, the MoCA total scores were adjusted for years of education in this study. The analyses with MoCA total scores without 1-point education correction are available in the supplementary material. Analyses were conducted in four steps. First, Pearson's correlations were employed to investigate relationships between MoCA performance, age and total years of education. Independent Samples *t*-Test was used to examine the effect of gender on the MoCA total score. Second, Receiver Operating Characteristic (ROC) curve analysis was performed to evaluate the diagnostic performance of MoCA in the detection of mild and severe cognitive impairments; AUC, sensitivity, specificity, positive and negative likelihood ratios and odds ratios were calculated on MoCA cut-off scores. A Stuart-Maxwell test (Everitt, 1997) was used to assess whether the classification rates of normal, mild and severe cognitive impairments differ by using BACS and MoCA. Third, we examined the relationships between MoCA and BACS and its subscales using Pearson's correlation as all variables were normally distributed. MoCA adjusted total score (i.e. residuals derived via linear regression after partialing out the effects of age and gender) was used in this and next step of analyses. Lastly, the relationships between cognitive tests (MoCA and BACS) and functioning (UPSA-B) were examined using Pearson's correlation. In addition, hierarchical regression modeling was employed to examine the additional variance MoCA or BACS had in predicting UPSA-B scores. For the first hierarchical regression, the BACS-Z score was entered into step 1 and MoCA adjusted score was entered into step 2. For the second hierarchical regression, the BACS-Z score and MoCA adjusted score were entered into the model in a reverse order. All analyses were performed with IBM SPSS Statistics 23.

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