

Cognitive Screening of Pakistani Substance-Dependent Male Patients using Montreal Cognitive Assessment Score (MoCA)

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Abstract

Objectives: The objective of this study was to determine the cognitive impairments present in Pakistani substance –dependent patients admitted in rehabilitation centers of Islamabad/Rawalpindi in a time-efficient and cost effective way. Globally, Montreal Cognitive Assessment (MoCA) is being used for cognitive screening of patients, due to its established clinical utility and ease of administration. Therefore, we sought to investigate acceptability of this test in substance –dependent patients of Pakistani origin.

Study design: This is a multi-site, cross-sectional study.

Methods: In this study, MoCA was administered to 100 substance dependents in- patients together with 60 age and education level matched non-substance using healthy controls. All the study participants were male and aged between 23-47.

Results: The mean MoCA score was 18.5 ± 4.5 for addicted patients and 74% had abnormal score (≤ 26 value) and 29.1 ± 1.2 for the controls. In our study population, age and education levels were negatively associated with MoCA scores. Visuospatial processing, working memory and executive function domains were found to be significantly impaired in all the cases. Majority of our substance –dependent patients (86%) did not find cognitive screening with MoCA as an unpleasant experience.

Conclusions: MoCA test can be used as an initial cognitive screening tool in Pakistani substance- dependent patients admitted in rehabilitation centers.

Keywords

Mild cognitive impairment, Substance abuse, MoCA, Cognitive screening, Cognitive deficit

Introduction

Neuropsychological research has consistently showed that chronic substance dependence is associated with mild to severe cognitive impairment [1]. Although, a greater fraction of studies have focused on alcohol dependence induced cognitive deficits, accumulating evidence show similar level of cognitive impairment is associated with poly-substance use [2-4]. Global executive functioning impairment has been shown to exist in 69% of substance dependent patients (including cocaine and opiates) [4]. Specifically, impairment of working memory, visuospatial processing and cognitive flexibility has been frequently reported in these patients. The executive function impairments greatly affect the rehabilitation process in these patients in residential settings. Usually, such

patient's exhibit reduced willingness to change [5] with high treatment attrition rates [6] poor attendance at out-patient therapy sessions [7], altogether with increased impulsivity, and lower abstinence rates.

Early identification and intervention can support the course of rehabilitation and treatment adherence; therefore, neuropsychological screening tools with good specificity and sensitivity are essential.

The Montreal Cognitive Assessment (MoCA) test was developed a decade ago [8], since then a growing number of studies have supported its superiority in terms of excellent sensitivity and good specificity over the commonly used Mini Mental State Exam (MMSE) [9-12]. In a study of 120 community psychiatric patients, with a diagnosis of alcohol dependence, schizophrenia and both conditions (dual diagnosis), Manning et al. [13] found the MMSE scores insensitive to cognitive impairments in these groups, whereas, Dong et al., 2012 [10] reported greater sensitivity of MoCA over MMSE in discriminating mild cognitive impairment from lower risk groups.

In contrast to MMSE, MoCA cover 8 cognitive domains including higher executive function (which is not assessed by MMSE) and can be administered in a very short duration of 10 minutes.

Initially, MoCA was developed for detection of cognitive impairment in geriatric population, but due to its good discriminative ability and brevity, has been used in screening a wide variety of patients groups, including substance dependent patients. Bergly and Sømhovd [14], Bruijnen et al. [15]. Coopersino and colleagues assessed the accuracy, validity and clinical utility of MoCA in poly-substance use disorder patients. They used Neuropsychological Assessment Battery-Screening Module (NAB-SM), a 45 mins neuropsychological test battery, which is routinely used in substance use disorder (SUD) clinical setups, as the reference criterion. Overall, good agreement between the MoCA and the five NAB-SM cognitive sub-domains, including attention, language, memory, spatial, and executive domains was observed. However, unlike NAB-SM, MoCA is brief, requires comparatively less specialist training and is available free of cost, in 22 languages. Additionally, MoCA demonstrated good ecological validity without compromising the internal validity of the neuropsychological measures, which underscores its suitability for standard clinical practice.

Apart from conventional cognitive impairment screening, MoCA has also been validated in criterion related measures such as predicting treatment attendance [16] and drop-out rates [17]. Both, the studies supported the validity of MoCA in predicting a clinically relevant behavior. Specifically these investigations support the predictive validity of MoCA in identification of such patients who are less likely to attend all of their treatment sessions. Consequently, with appropriate therapeutic interventions, treatment adherence can be improved for such patients from the very beginning of the course of treatment.

Despite the established clinical utility of MoCA in SUD patients, fewer studies have investigated the acceptability of MoCA as a screening tool for cognitive impairment in substance dependents patients from Asia. Whereas, the subject remains completely elusive in East Asian countries like, Pakistan, where there is ever-increasing need of time efficient and cost-effective neuropsychological test.

In Pakistan, drug addiction crisis is growing enormously and currently there are 6.7 million drug users, of which, 4.25 million are drug dependents, who need long-term treatments in residential setups [18]. Despite the high prevalence, the nature and extent of cognitive impairment present in Pakistani-substance dependents, admitted in rehabilitation centers, remains completely elusive. Therefore, the objective of this study was to investigate the cognitive impairments present, and the acceptability of MoCA in substance dependent patients admitted in rehabilitation centers of Islamabad/Rawalpindi region.

Materials and Methods

Study design

This is a case-control, multi-site study. A total of 160 subjects participated in this study, out of which 100 were chronic substance-dependent patients who were recruited from three different rehabilitation centers of Islamabad/Rawalpindi region during the period from August to December, whereas, 60, non-substance using healthy volunteers also participated in this study.

Study participants

All the participants in our study were exclusively males due to inaccessibility to female patients. Healthy volunteers were recruited via advertisements and word of mouth. A general exclusion criterion for all the participants was diagnosis of dementia, Alzheimer's disease, Schizophrenia, psychosis, diabetes or any current or past head injury. Controls were also excluded if they fulfill DSM IV criteria for any psychiatric disorder including substance dependence.

For substance-dependent patients, only those who fulfilled DSM IV criteria for dependence (diagnosis made with structured clinical interview for DSM-IV), were chronically dependent on psychoactive substances for more than 3 years, and were abstinent from all drugs for at least 8 days prior to MoCA administration were recruited for the study.

Ethical approval

The study protocol was in adherence to the Helsinki Declaration of 1975 as revised in 2000 and the research study was accepted and approved by the Ethics Review Board of the Department of Biosciences, COMSATS University Islamabad. The participants of the study were briefed about the aims and objectives of the study. Demographic information was collected in the form of questionnaire from all study participants only after the signed informed consent of the participants.

Montreal Cognitive Assessment (MOCA) Test

The 7.1 version of the MoCA test was used in Urdu language. The MoCA test explores cognitive functions across 8 different domains: Executive function, working memory, naming, attention, language, abstraction, delayed recall, orientation and visuospatial ability. Executive function is assessed using trail-making, phonemic fluency, and verbal abstraction tasks. Working memory is assessed using sustained attention, serial subtraction, and digit span forward/backward tasks. Short-term memory is assessed through the delayed recall of five nouns. Language is assessed using naming (low familiarity animals), sentence repetition, and the phonemic fluency task. MoCA score of < 26 out of 30 implies cognitive impairment. One point is added if the examinee has less than 12 years of education.

Method

MoCA was administered after 8 days of drug-free period, when patients were no longer on medications for withdrawal management which could affect cognitive ability. The test was conducted in a quiet room in the morning session by a trained and experienced researcher, who conducted tests for all the study participants. 15 mins was the standard test duration. Total test duration was recorded of all the study participants. At the end of the test participants were verbally asked, "whether they found the cognitive screening with MoCA unpleasant". The responses were recorded as Yes or No by the interviewer.

Statistical Analysis

Quantitative values were described using their number, mean and standard deviation. *Group differences were analyzed using student's t-test. Effect sizes are reported as Cohen's d* (standardized mean differences), for which 0.3 is considered small, 0.5 medium, and ≥ 0.8 as large effect [19]. Multiple comparisons were controlled using Bonferroni test. One-way ANOVA was used to analyze group differences for substances misused with significance level set at $p < 0.05$.

The chi-square test was used to investigate test acceptability between patients and controls. *The effect of age and education on MoCA scores was analyzed using Pearson's Correlation coefficient. Significance level was set at $p < 0.05$. All analyses were performed using IBM SPSS software V22.0.*

Results

A total of 100 substance-dependent patients together with 60 non-substance using healthy controls, met the inclusion criteria and participated in this study. All the participants were male and aged between 23-47 years and the mean age of participants was 35 ± 6.2 . The mean duration of education years was 10 ± 2.0 . Majority of the study participants (76%) were educated up to secondary level, where as 18% had 12 years of education, whereas, 4% of the participants were educated up to primary level. No significant age and education level difference was observed between cases and controls ($p > 0.05$). All the participants were of Pakistani ethnicity.

Among the substance dependent patients, (88%) met the

DSM IV criteria for opioid dependence, 7 % for cannabis dependence and 5% for cocaine dependence. The mean duration of dependence was 5 ± 3.6 years and mean frequency of substance use was 25.4 days per month (see table 1).

Table 1: Demographic and substance abuse variables for the study participants. Mean differences in demographic variables were calculated based on the t-test, $p < 0.05$ was considered significant.

Demographic variables	Cases (N=100)	Controls (N=60)	P-value
Age (Mdn)	35 ± 6.2	34 ± 5.9	$P > 0.05$
Education	10 ± 2.0	10 ± 2.7	$P > 0.05$
Primary substance of misuse (%)			
Opioids	88	-	
Cannabis	7	-	
Cocaine	5	-	
Mean Duration of dependence (yrs)	5 ± 3.6	-	
Mean Frequency of Use (days / month)	25.4	-	

MoCA test administration and values

MoCA was administered to all the 160 study participants. 74% of the substance dependent patients had abnormal values (< 26) and scored significantly quite less than the controls. The mean MoCA score was 29 ± 1.2 for the controls and 18.05 ± 4.5 for the cases ($p < 0.0001$, $d = 3.2$, $r = 0.85$). The raw MoCA score values ranged from 8 to 27 in the substance-dependent patients. In our study population, age ($r = 0.061$, $P = 0.71$) and education level ($r = 0.073$, $p = 0.369$) were not found to be associated with the MoCA score. Overall, cognitive performance did not vary significantly with the substance used, due to relatively small sizes of these groups [$F(1,100) = 2.56$, $p > 0.05$]. A large majority of substance dependent patients (86%) and controls (44%) did not find the test unpleasant [$\chi^2(1, N = 160) = 3.14$, $P > 0.05$].

Analysis of MoCA Subscores

The contribution of each MoCA sub score was analyzed in both healthy controls and substance-dependent patients in order to identify the cognitive domains with highest cognitive deficits (table 2). The cognitive domains analyzed were visuospatial capacity, naming, delayed recall, attention, language, orientation, and abstraction. Overall, controls outperformed patients, highly significantly in five of its seven subscales scores (all $p < 0.0001$; Bonferroni corrected $p < 0.001$) except for the naming ($P > 0.05$, $d = 1.1$, $r = 0.48$) and orientation ($P > 0.05$, $d = 1.48$, $r = 0.61$), where the differences were not significant. Greater cognitive deficits were observed in visuospatial capacity ($d = 2.187$, $r = 0.74$), delayed recall ($d = 2.32$, $r = 0.75$) whereas, moderate effects were observed in the cognitive domains of attention ($d = 1.66$, $r = 0.64$), language ($d = 1.22$, $r = 0.52$) and abstraction ($d = 0.603$, $r = 0.32$).

The immediate memory domain is not scored in MoCA and is assessed through the delayed recall of five nouns. For a successful test, a patient should be able to repeat at least 4 out

Table 2: MoCA sub-score values tested across 8 cognitive domains in Cases vs. Controls using student's t test, effect sizes are estimated using Cohen's d and correlation coefficient for each cognitive domain is calculated.

Index	Controls (n = 60)	Cases (n = 100)	t(df)=	P-value	Effect size (Cohen's d)	Correlation coefficient r
Visuospatial capacity	4.0 ± 0.5	1.7 ± 1.4	7.72	< 0.001	2.187	0.74
Naming	3.0 ± 0.4	2.5 ± 0.5	1.21	NS	-	-
Delayed recall	4.5 ± 0.5	1.9 ± 1.5	5.6	< 0.001	2.32	0.75
Attention	5.8 ± 0.4	4.2 ± 1.3	4.21	< 0.001	1.66	0.64
Language	3.0 ± 0.6	2.2 ± 0.7	2.80	< 0.001	1.22	0.52
Orientation	6.0 ± 0.3	4.7 ± 1.2	1.52	NS	-	-
Abstraction	1.82 ± 0.40	1.4 ± 0.9	3.17	< 0.001	0.603	0.32
Total	29±1.2	18.05± 4.5	7.74	< 0.0001	3.2	0.85

of 5 words in both the rounds. In our study sample, majority of patients were not able to perform well in this task. 57% were successful in the first round, but failed the second, where as 43% were successful in the second round. In delayed recall task, when same 5 words had to be repeated at the end of the test, overall performance of the patients deteriorated inclusive of those patients who were able to perform well in the second round in immediate memory recall.

Discussion

The present study used a brief cognitive functioning screening tool, MoCA, among the residents of three, different, substance use disorder treatment centers in Rawalpindi and Islamabad. We observed cognitive deficits in 74 % of substance- dependent patients, which is in close confirmation to the impairment rates (68-83%) reported in the literature from diverse study populations [20-22].

We did not find any differences in MoCA outcomes due to the type of substance misused. One possibility, can be that the group sizes in the study, were not large enough to detect these differences. Secondly, the prevalence of poly substance use in patients, seeking treatment in residential clinics, might also explain the lack of significant differences in neuropsychological outcomes.

In addition to that, we could not investigate any gender specific trends in MoCA outcomes, as all the participants in our study were exclusively males. It's difficult to get access to female substance dependent patients as generally they are not admitted in majority of the de-addiction centers due to lack of trained female supervisors and nursing staff and absence of separate female wards. However, the study of impact of sex differences on cognitive functioning in substance use patients is important and will be accounted for in future neuropsychological studies.

Overall, in all the cognitive domains tested, substance dependent patients demonstrated greater cognitive deficits in visuospatial abilities, executive functioning and working memory domains than controls. Whereas, orientation and naming of list of letters and repeat were found to be least affected. The higher cognitive functions such as executive

functioning and working memory are important for meaningful treatment engagement and better treatment outcomes, whereas, cognitive deficits have been found to be the most consistent risk factor for treatment dropout. It has been shown that, cognitively impaired, dependent subjects are less likely to attend all of their therapy sessions than the unimpaired subjects [16] and have higher treatment dropout rates [23] which greatly thwarts the process of recovery from addiction [24, 25]. Therefore, early assessment and detection might lead to timely modifications in treatment to rectify cognitive deficits, which can result in better treatment adherence and successful recovery from addiction.

An interpretive challenge faced during screening of cognitive impairments and executive functions among SUD patients is the influence of co-morbid psychiatric symptoms and psychological distress, which to a greater extent can confound the neuropsychological profile and inflict changes in cognitive functions [26].

However, the type of cognitive screening tests used, largely influences the measure of executive function. Broadly, the two main types of neuropsychological tests are performance-based and rating measures of executive functions, which assess different, underlying mental constructs. Specifically, performance-based measures like MoCA, assess the processing efficiency of cognitive abilities, whereas, ratings of executive functions like BRIEF-A, assess the extent to which the individual is achieving his/her goals. Consequently, in SUD patients, the co-morbid psychological symptoms might bias the outcomes of latter type of tests which usually engages the "reflective" neural component and can be more prone to psychological distress in comparison to the performance-based tests, which are generally, conducted in a supervised setting and are known to operationalize the "algorithmic" neural component rather than the reflective [27].

In fact, in a recent empirical study of 202 SUD patients, recruited from 10 multi-sites, Hagen and colleagues [28] found the measure of cognitive impairment by MoCA to be independent of psychological distress in comparison to BRIEF-A, a 75-item self-report inventory, routinely used with SUD patients. The study employed SCL-90 R, a brief self-report questionnaire, designed to evaluate a broad range

of psychological problems as a measure of psychological distress and found strong association between BRIEF-A and SCL-90 GSI scores. Therefore, these findings might suggest that performance-based tests like MoCA could reduce the impact of psychological distress in cognitive screening and can be routinely employed in clinical settings for initial screening for cognitive impairments in SUD patients.

Ideally, for SUD patients, there is a need of serial assessment of neuropsychological parameters during clinical follow-ups to better gauge the effects of cognitive therapy, especially pre and post treatment. However, such measures, might be confounded by practice or learning effects. Recently, two alternate versions of the MoCA have been validated for repeated testing. Interestingly, no practice effects were found over short 60 minutes re-test intervals [29] in healthy elderly populations and in other study at one month intervals [30]. Whereas, no significant difference in total mean scores was observed between original and alternative MoCA versions. However, these alternative forms have yet to be evaluated in longer longitudinal studies. In addition, to that, these forms need to be developed in several other languages in order to increase its utility.

Generally, cognitive screening is not part of the typical addiction rehabilitation program in most South-Asian countries including, Pakistan, due to prohibitively time consuming and lack of resources. To the best of our knowledge, this is the first study, which has investigated the feasibility of MoCA test in SUD treatment centers in Pakistan. The brevity of this test, together with its availability in Urdu language adds to the feasibility of the test. A large majority of our study participants (86%) did not find the test unpleasant. In addition to that, the findings of this study add to the limited data on cognitive screening in substance dependent patients in East-Asian region.

Overall, our study results support the use of MoCA as a cognitive screening tool in clinical and residential setups for Pakistani substance-dependent patients.

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Conflict of Interests

The author declares no conflicts of interest.

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