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Research Article

Brief Report: The Tele-health Administration of the Montreal Cognitive Assessment (MoCA)

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Abstract

Due to the impact of the COVID-19 pandemic there is an increased need for assessments to be administered through telehealth services. The MoCA, a screener for cognitive and memory impairment, has not been fully evaluated for the effectiveness of tele-administration. This study identifies the MoCA as an effective measure for screening cognitive and memory impairment when administered electronically. College students were administered the MoCA via tele-administration and the Total Scores were evaluated (N = 90). The tele-administration sample scores were significantly higher than those of in-person non-concussed national/college athletes. The group of tele-administered participants in their 20's in our study scored significantly higher than two in-person administered samples. However, the mean Total Score on the MoCA for this study's population and the comparison groups was above the recommended cut-off score (> 26) which is indicative of normal functioning (with 82% of the tele-administered sample scoring above the cutoff). Our results indicate that the tele-administered MoCA performed comparably to in-person administration samples. All groups in our study scored on average above the recommended cut-off score of 26, utilized to detect cognitive impairment.

Keywords: Montreal Cognitive Assessment (MoCA); Telehealth; Neurological Screening; Healthy Sample; College

Introduction

At the onset of the COVID-19 pandemic there was a substantial increase in the amount of mental health professionals who began to offer services through telehealth [1]. In order to continue meeting the needs of the community, teleconferencing services were utilized to conduct therapy, psychoeducational workshops, and psychological assessment. Prior to the pandemic psychologists on average completed 7.07% of their clinical work via telehealth, which increased to 85.53% during the pandemic [1]. Due to the rapid need for assessment measures to become available electronically, many test developers created guidelines to adapt their measure to an electronic administration format. Of those measures, the test developers of the Montreal Cognitive Assessment (MoCA) distributed instructions on May 8th, 2020 regarding how to administer and score their measure via teleconferencing [2].

The MoCA was developed as a quick screening tool to assist in the detection of cognitive or memory impairment. This measure specifically assesses deficits in short-term memory difficulties, visuospatial abilities, executive functioning, attention, concentration, working memory, language, and orientation to time and place [2]. Initial validation studies of the MoCA (n = 277; ages 55 to 85) found that when utilizing a cut-off score of 26, the MoCA achieved a 90% sensitivity rate for identifying individuals with mild cognitive impairment, 100% sensitivity rate for identifying individuals with Alzheimer's disease and an 87% sensitivity rate in normal controls [3].

Various versions of the MoCA have been published to assist in the wide variety of populations utilizing this measure (e.g., paper administration, application administration) [2]. Versions 8.1 through 8.3 of the MoCA Audio Visual version offers electronic administration adaptations for the measure such as having participants verbally respond to answers that were previously drawn, draw stimuli that is then captured on screen by the examiner, and having them make eye contact with the camera when answering

questions [2]. It was of particular importance to have this measure available electronically as it is primarily used with the elderly population who were especially affected by the pandemic and required to implement strict quarantine procedures [4]. Furthermore, the MoCA has different versions allowing individuals to be assessed more than once and in multiple languages, making this assessment accessible to diverse populations.

Although the test developers of the MoCA had established guidelines to utilize the electronic administration, there has been a limited evaluation on the effectiveness of this measure when administered via telehealth. The lack of research has been primarily due to the rapid need to make measures available and the recency of the COVID-19 pandemic. A preliminary review of the studies available that have evaluated the administration of the MoCA via telehealth yields promising results with different populations [5,6].

In a study conducted by DeYoung and Shenal [5], the MoCA was administered to a group of veteran's who had suspected neuropsychological deficits. The MoCA was scored and administered through two different methods (in person with the researcher present via telehealth and via telehealth with the researcher present in person). Results indicated that the participants suspected of neuropsychological deficits adapted less reliably to tele-administration than the healthy control group. Participants in the healthy control group yielded an inter-rater reliability of r = .99 while those in the group with suspected cognitive impairment, the inter-rater reliability was r = .93. In another study, the telehealth version of the MoCA was administered to 28 individuals experiencing Alzheimer's disease [7]. Lindauer and colleagues found that the MoCA was suitable for tele-administration with participants who had mild to severe dementia. They found that the MoCA yielded excellent intraclass correlation (ICC = .93) after it was administered in person the first time and via telehealth two weeks later. Participants received a mean score of 12.2 when they completed the MoCA in person and a mean score of 13.1 when it was complete via telemedicine.

The MoCA is a well-established and popular screening tool utilized in the detection of mild cognitive impairment (MCI) for a variety of populations. The present study focuses on the young adult population, where screening for mild cognitive impairment is likely to be more beneficial than screening for other neurological concerns due to a lower prevalence rate (e.g., dementia). Earlier studies have looked at the use of the MoCA in samples across the lifespan [7,8]. Debert and colleagues [7] found that out of 183 college and professional athletes (average age of 26.8, SD = 3.4) who had no history of concussions (ages 18 - 36) only 24% scored in the MCI range (score of 18 to 25). The remaining 76% of this sample scored a 26 or above. Gluhm and colleagues [8] gave the MoCA to 254 community-dwelling participants between the ages of 20 to 89. Participants in their twenties had a mean score of 28.9 (SD = 1.7; range = 25 - 30) and participants in their thirties scored on average a 27.8 (SD = 2.0; range = 23 - 30). These studies all utilized in-person administration. The young adult population is expected to perform well on this measure, and the current studies provide a basis for furthering an understanding in the effectiveness of the MoCA when utilized through tele-health in young adults.

Based on this current deficit in the research, our exploratory study aimed to evaluate the effectiveness of the MoCA through telehealth administration, as a screener for cognitive or memory impairment. It is hypothesized that approximately 75% of the sample will score above the recommended cut off for Mild Cognitive Impairment (MCI) of ≥ 26. Additionally, it is hypothesized that there will not be a significant difference between the in-person comparative sample and the tele-health administration in our sample for young adults.

Methods

Participants

A total of 90 undergraduate and graduate students from a small private southern university in the U.S. were recruited to engage in this study. While all participants were administered the MoCA in English as part of a screening process in order to participate in the next stage of a larger study, those who indicated English as a second language were excluded from this analysis, and there were three participants that were not included due to varying factors (e.g., missing data). The age of this population ranged from 18 to 38 years with a mean of 22.30 years (SD = 4.65). Out of the 90 participants, 55 (46.6%) identified their gender as female and 35 (29.7%) identified as male. Additionally, participants identified predominantly as White/Caucasian (50.8%). Out of the 90 participants, 26 (22.0%) were classified as freshman academic rank, 13 (11.0%) as sophomore, 13 (11.0%) as junior, 12 (10.2%), and 26 (22.6%) as graduate students.

Measures

The MoCA is a clinician-administered screener that consists of 30-questions to screen for the presence of cognitive impairment.

The MoCA administration is completed within approximately 10 minutes. The MoCA assesses an individual's short-term memory, visuospatial abilities, executive functioning, attention, concentration, working memory, language, and orientation to time and place [2]. Participants can score a maximum of 30 points on this measure. According to Nasreddine [2], if a Total Score ranges between 18 - 25 this falls within the "Mild Cognitive Impairment" classification, a Total Score ranging from 10 - 17 is classified as "Moderate Cognitive Impairment" and a Total Score less than ten is considered a "Severe Cognitive Impairment" classification. A cut-off score of 26 is indicative of a normal score, whereas a score between 18 to 25 is utilized to distinguish those with mild cognitive impairment and those likely to be experiencing symptoms related to Alzheimer's.

For the purposes of this study, the English Verizon 8.1 video-conferencing format of the assessment was utilized. The tele-administration of the MoCA differs in a number of ways. Via tele-administration participants are required to utilize their own paper and pencil, are asked to draw visual stimuli on their paper and hold it to the camera to be screen captured, scored, and saved to later reference for scoring in the visuoconstruction subtest. Participants are also asked to clap instead of tap for the attention-vigilance subtest. For the orientation questions participants are asked the location of the clinic instead of their current location and must look at the camera when answering these questions.

Procedures

This study occurred during the COVID-19 pandemic resulting in data collection occurring through tele-administration, completed utilizing the video-conferencing platform Zoom. Participants were informed the use of recording, cell-phones, or other electronics were forbidden during the study. The adjustments made for the tele-administration aligned with the American Psychological Association's Guidelines for the Practice of Telepsychology [9]. At the start of the study, participants began reviewing the electronic informed consent, which provided details of the study (i.e., the purpose, procedures, risk, benefits, compensations, and confidentiality) and were ensured their personal information would remain confidential, through the use of de-identified codes. Participants then electronically agreed to the informed consent through Qualtrics, a secure data collection platform. Further, the participants were then administered the MoCA, which was completed in approximately 10 minutes.

Audio-Visual Conference Instructions were utilized in this study. Additional measures unrelated to this study were then administered, including a demographic questionnaire. Recruitment for student participation was completed through SONA, an online experiment management system, and undergraduate or graduate psychology courses. Students that registered to engage in this study through SONA were provided extra credit or participated due to a requirement in their course. Furthermore, participants were invited to enter their information in a lottery system for the chance to receive a $50 USD gift card. Inclusion criteria for this study required participants to be enrolled university students over the age of 18.

Data analysis

Our data will be compared by age groups since there are generational differences in comfort with technology [10]. To examine the differences between in-person and tele-administration previously published comparison samples from in-person administrations will be utilized. The first published in-person comparison group consisted of 183 non-concussed student and professional athletes [7]. Secondly, we utilized a comparison group of in-person administrations that were conducted with a community sample, this sample was divided into those aged 20 - 29-years (M age = 23.6, SD = 3.0) and 30 - 39-years (M age = 34.0, SD = 3.3) [8]. The comparison group from the studies aforementioned was utilized due to the similar age of the participants in the current study. By utilizing groups with similar age ranges, we decrease the likely generational differences in comfort with technology. These groups were then compared to our sample of participants with corresponding age ranges.

Results

Our sample scored on average above the recommended cut-off $\geq$ 26, thus indicating no cognitive impairment. Approximately 82% of our sample scored above the recommended cut-off score of greater than or equal to 26 (M = 27.40, SD = 2.03). This supports our hypothesis that the majority of the sample will score above the recommended cut-off score.

To explore the impact of tele-administration, community and student comparison samples with in-person administration were utilized. A one-sample t-test was conducted to determine whether the mean Total Score on the tele-administered MoCA from our full

college student sample was significantly different from the mean Total Score of 26.8 on the in-person MoCA of non-concussed student and national athletes [7]. The mean score on the MoCA for our tele-administration population (M = 27.40, SD = 2.03) was statistically significantly higher than the mean Total Score of 26.8 on the in-person MoCA for the student and national athletes (mean difference of .60, 95% CI [.17 to 1.03], t(89) = 2.80, p = .006) with a medium effect size (Cohen's d = .30). It is notable that 76% of the non-concussed student and national athletes and 82% from our college student sample scored on average above the cut-off, thus indicating no cognitive impairment.

To explore how the MoCA score may be impacted by administration type at different ages, we explored differences between our tele-administration sample and comparable in-person administrations by age group. We compared our sample in their 20's to a total sample of participants that completed the MoCA within the community, as the mean age of our 20-year old sample was 23.22 (SD = 2.7) and closer to their mean age of (M = 23.6, SD = 3.0) [8]. A one-sample t-test was conducted to determine whether the mean Total Score on the tele-administered MoCA in our college student population in their 20's (n = 49) was significantly different from the mean Total Score on the in-person administered MoCA of individuals in the community in their 20's [8]. The mean of score on the tele-administered MoCA (M = 27.43, SD = 2.04) was statistically significantly lower than in-person MoCA (M= 28.9, SD=1.7) for the community population in their 20's (mean difference = -1.47, 95% CI [-2.06 to -.89], t(48) = -5.05, p < .001), with a medium effect size (Cohen's d = 0.78).

Additionally, a one-sample t-test was conducted to determine whether the mean Total Score on the tele-administered MoCA in our college student population in their 20's (N = 49) was significantly different from the mean MoCA score in-person administered on non-concussed student and national athletes [7]. The mean of score on the tele-administered MoCA for our college population (M = 27.43, SD = 2.04) was statistically significantly higher than the in-person administered MoCA (M= 26.8, SD = 2.0) of non-concussed student and national athletes (mean difference of .63, 95% CI [.04 to 1.21], t(48) = -2.16, p = .04), a medium effect size (Cohen's d = 0.31).

A one-sample t-test was conducted to determine whether the mean Total Score on the MoCA from the participants above the age of 30-years from our tele-administered college student population (n = 6) was significantly different from the mean Total Score of 27.8 on the MoCA of individuals in the community in their 30's [8]. The mean of score on the MoCA for our tele-administered college population was (M = 27.83, SD = 1.17) was not different than the in-person mean MoCA for the participants in their 30's in the community sample (M = 27.8, SD = 2.0; mean difference of .03, 95% CI [-1.19 to 1.26], t(5) = .07, p = .95).

As differences emerged between ages, all demographic variables were examined for an impact on the MoCA Total Scores within our sample through the use of a one-way ANOVA. There were no significant differences in our tele-administered sample's MoCA Total Score based on gender (F (89) = 1.13, p = .29). There were no significant differences in our tele-administered sample's MoCA Total Score based on ethnicity (F (89) = .75, p = .61). A simple linear regression showed that age did not significantly predict MoCA Total Score in our tele-administered sample (b = .05, t(88) = 1.07, p = .29). There were no significant differences in our tele-administered sample's MoCA Total Score based on years of education (F (89) = .99, p = .42). However, there was an upward trend as education increased, see figure 1. This is consistent with patterns found on in-person administrations, as MoCA scoring for persons with less than 12 years of education are prorated by adding 1 point to their total score [2].

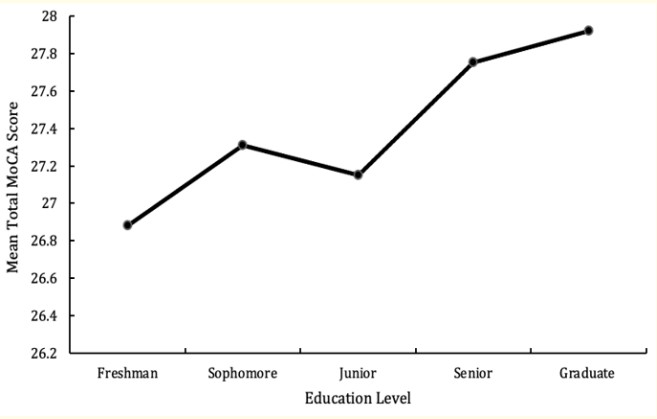

Figure 1: Mean total tele-administered MoCA scores by level of education.

Note: This figure demonstrates the mean Total MoCA Score for each academic rank. Freshman (M = 26.88, SD = 2.10), Sophomore (M = 27.31, SD = 1.84), Junior (M = 27.15, SD = 2.34), Senior (M = 27.75, SD = 1.91), Graduate students (M = 27.92, SD = 1.94).

Discussion and Conclusion

As the use of technology increases within the field of psychology it is essential to evaluate the impact of different modes of administration on assessment outcomes. Our results indicate that tele-administration of the MoCA did not result in our samples mean Total Score dropping below the recommended cut-off which would indicate impairment (< 26). In comparing our college student sample to the in-person comparative groups, some age groups differed from community and athlete samples. However, age and education level did not predict MoCA scores in our tele-administration sample and all group comparisons had mean scores above the recommended cut-off score. Additionally, any significant differences that were found were within .60 to 1.47 of a point of the other samples average. These findings are within the standard error of measurement on the MoCA [11]. Comparing our sample to college and national athletes we found that our total sample scored significantly higher than the athletes [7]. When we separated and compared the participants within their 20's to the sample of athletes our sample also performed better than the athletes [7]. When comparing our sample to the community sample of 20-year olds we found that our college student sample scored slightly below the community members' mean score [8]. When comparing our sample of 30-year olds to a community sample of 30 year olds, no significant differences were found [8]. Given that our sample consisted of many participants with a high level of education these findings are expected. Additionally, the mean score of all of the groups exceeded the cut-off of ≥ 26 as anticipated in this population.

Within our sample, it was also notable that as level of education increased, the Total Score on the tele-administered MoCA trended upward (as seen in figure 1). When scoring the MoCA you are required to add one point to the Total Score if the participant has less than or equal to 12 years of education [2]. The findings in the current study support the need to add an additional point to participants who fall under this bracket of educational attainment. Overall, our findings were consistent with the results found during in-person administrations of the MoCA to healthy young adults. They indicate that tele-administration is feasible and can be utilized as an acceptable method of administration with young adults.

Although these results are promising, supporting assertions by Phillips., *et al*. [12] electronic administration of the MoCA should further research the impact of alterations in subtest items on Total Score outcomes. The use of the current recommended cut-off score should be evaluated in the context of electronic administration. Throughout our study, a number of potential factors were identified when comparing in-person administration to electronic administration that could negatively influence Total Score outcomes. Participants may score higher on the orientation questions as the answer may be easily visible on their computer screen. For the fluency subtest, participants may perform better as they may have more objects to readily name based on the ability to look around their room/environment to provide answers versus a standardized testing room. These factors may account for some of the higher scores we yielded in our sample in comparison to in-person administrations. Scoring may be impacted by unstable internet connections and natural delays that occur through electronic video transmission particularly on the attention subtest when clapping should be synchronous with the cue provided. When administering this subtest of the MoCA electronically, examiners have to pause for a longer period of time to account for expected electronic transmission of information. Internet delays may also impact the fluency subtest where the examinee is expected to complete the task in 60 seconds. Unstable internet connection could invalidate the fluency subtest and provide the examinee more time to produce responses. An option for pro-rated scoring may be warranted. During our tele-administration of the MoCA screen shots were captured for the clock and cube responses and later double-scored for accuracy. It was often difficult to capture a clear image of the response when examinees were holding the image up to the camera. Currently, the audiovisual instructions of the MoCA do not address having a record of the examinees response on these two portions of the test. Thus, scoring at a later date cannot be verified. Examiners should also assess hearing and vision prior to administration and ensure that the examinee has access to adequate technological systems and to ensure accurate scoring [12].

Despite some significant differences in our results, generally our sample performed similarly to in-person samples and the hypotheses were supported. All groups in our sample and the in-person administrations scored on average above the recommended cut-off of greater than or equal to 26 on the MoCA which is indicative of normal functioning [2,7,8]. The present study provides preliminary data regarding the efficacy of the MoCA via tele administration. Future studies should aim to have a larger sample size and include participants across the lifespan. It should also be evaluated with

participants who have suspected cognitive impairment. Similar to previous tele-administration studies on the MoCA the participant should be evaluated in person and via telehealth with two different versions (e.g., 8.1 and 8.2) to validate consistency [5,6]. Future research should also evaluate the impact of age and other cognitive factors on the outcome of the MoCA as well as evaluate the impact of the adaptation of subtests on the overall Total Score.

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