

The value of routine screening for cognitive impairment in a primary care setting: a retrospective cross-sectional study

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Research Article

Keywords: cognitive impairment, MoCA, screening, routine care, primary care

Posted Date: February 15th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-151864/v1>

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Abstract

BACKGROUND

Cognitive impairment is not uncommon among older individuals but is often underdiagnosed in the primary care settings. Our objective is to identify the prevalence of varying degrees of cognitive impairment in older adults in urban primary care clinics.

METHODS

This cross-sectional study was undertaken from May to July 2019. The Montreal Cognitive Assessment (MoCA) was administered to participants 65-year and older who were seen during a routine visit to our primary care clinic. The participants were recruited on a sequential basis. The primary outcomes of the study were the MoCA scores, and the level of cognitive impairment, if any, indicated by the scores.

RESULTS

Out of the 133 participants, 46 (34.6%) scored below the cut-off of 23 out of 30, indicating certain level of cognitive impairment. The mean MoCA score was 23.24. The average age was 75.19 years. Average years of education was 12.6. In our cohort, higher MoCA scores were associated with increased years of education. MoCA scores were not inversely correlated with age. Language proficiency in the MoCA test version administered had significant impact on the MoCA scores.

CONCLUSIONS

A relatively high prevalence of cognitive impairment was found in our cohort. Further study is required to accurately assess the prevalence of cognitive impairment in general population. However, the findings attest the value of routine screening for cognitive impairment in primary care settings and warrant routine screening of older individuals to help in early detection of mild cognitive impairment.

Background

Mild cognitive impairment (MCI) refers to a “grey-zone” in which cognitive functions are in an intermediate stage beyond normal aging but do not meet the criteria for classification as dementia or Alzheimer’s disease¹⁻². Longitudinal studies showed that patients with MCI may progress to Alzheimer’s disease at a higher rate than those without cognitive impairment³. Dementia is considered underdiagnosed in primary care settings, and MCI is even more so. One study reported an estimated prevalence of dementia of 6.0%, with only 19% of the patients with confirmed diagnosis of dementia had documentation of dementia in their medical records⁴. Meanwhile, an earlier study done in a midwestern

US county reported an estimated prevalence of MCI of 16%⁵. A more recent study across diverse geographical and ethnocultural regions reported estimated prevalence of MCI ranging from 5%-36.7%⁶. Missed or delayed diagnosis of cognitive impairment may be due to patient attitudes toward dementia and primary care physicians' hesitation to make this diagnosis, along with other factors such as communication barriers and training⁷. Nevertheless, early recognition of cognitive problems may allow clinicians and patients to address possible reversible factors and plan for future care decisions⁸.

The Montreal Cognitive Assessment (MoCA) has been demonstrated to be more sensitive at detecting MCI, has a higher classification accuracy for distinguishing MCI from healthy cognitive aging, and is superior to Mini-Mental Status Exam (MMSE) as a global assessment tool⁹⁻¹². The MoCA has also been demonstrated to be effective as a screening tool for cognitive impairment in various clinical settings, including in older patients with cancer¹³, in amnesic patients¹⁴, and in the elderly at the primary health care level¹⁵. One drawback in using the MoCA is that the test scores could be affected by years of education¹⁶, and despite the one-point correction for less than grade 12 education, the suggested cut-off score of 26 to diagnose MCI may over-diagnose MCI in patients with less formal education¹⁷⁻¹⁸.

Our objective is to analyze the use of MoCA testing in a primary care clinic to identify the prevalence of various levels of cognitive impairment in participants to determine if routine screening of MCI is warranted in all primary care clinics.

Methods

Study aim and design

In this cross-sectional study, the MoCA was administered to the patients individually and the scores were recorded to evaluate cognitive impairment in patients. The demographic data including age, gender, years of education, and first language were recorded. Data on comorbidities including hypertension, diabetes (DM), dyslipidemia, other cardiovascular risk factor, family history of dementia, depression, and brain surgery/injury/stroke were also analyzed.

The English version of the MoCA was the default version for assessment. As the clinic has a sizable Mandarin-speaking patient population, the participants who only speak Mandarin were administered the Mandarin version of the MoCA.

This study used a conservative MoCA cut-off score of 23 and adjusted the scores for education (+1 point if years of education \leq 12 years) to lower the false positive rate¹⁹, despite the reported concern of possible lower sensitivity to identify MCI²⁰, in order to reach a better diagnostic accuracy compared to the original cut-off score of 26/30²¹. The level of cognitive impairment was then categorized as mild cognitive impairment (scores between 18-22), mild dementia (11-17), moderate dementia (6-10), and severe dementia (< 6).

Setting and patients

Our cohort included participants 65 years and older who were patients visiting an urban primary care clinic in the Greater Toronto Area (GTA). The participants were recruited sequentially from the patients visiting the clinic who met the age criteria. A total of 144 patients were invited for assessment from May to Jul 2019. Six patients (4.2%) declined to participate in the study. Five patients (3.5%) were excluded from the final cohort because of complete language barrier, hearing impairment, or visual impairment that precluded completion of the MoCA without assistance from a third party. The final cohort included 133 patients (92.3%).

Statistical analysis

The independent *t*-test was used to examine the impact on the MoCA scores by gender, as well as potential confounders including hypertension, diabetes, hypercholesterolemia, depression or other psychiatric diagnoses, and family history of dementia. Level of significance is $p < 0.05$.

The subjects were categorized into 3 groups based on age in years, 65–74, 75–84, and ≥ 85 , respectively. The subjects were also stratified by years of education in years, ≤ 12 , 13–15, and ≥ 16 , to analyze the potential effect of years of education on MoCA scores. These stratifications were set to correspond to the level of education up to high school, college/university, and postgraduate degrees, respectively.

The subjects were also categorized based on whether the MoCA was administered in their first language (only English and Mandarin versions available) to analyze the potential impact of language barrier. We defined first language based on patient indication as either their mother tongue or language of greatest fluency, if other than English or Mandarin.

The association of MoCA scores and age subgroups, years of education subgroups, and language proficiency in the MoCA version used was analyzed by ANOVA test. We used IBM® SPSS Statistics 26 and JASP 0.12.2.0 for statistical analysis.

Results

A total of 144 patients aged 65 years and older were recruited. Of these patients, 6 (4.2%) declined to participate in the study and 5 (3.5%) were excluded from the final cohort. Of the 133 patients included in the study, 46 (34.6%) had a MoCA score below the cut-off of 23, indicating certain level of cognitive impairment (Table 1). Thirty-three participants (24.8%) were in the MCI category. The mean MoCA score was 23.24 (min: 9, max: 30).

Table 1
Levels of cognitive function classified by MoCA scores and number of patients (n = 133) found in each classification

MoCA Classification	Number of patients (percentage)
No Cognitive Impairment (≥ 23)	n = 87 (65.4%)
Mild Cognitive Impairment (18–22)	n = 33 (24.8%)
Mild Dementia (11–17)	n = 10 (7.5%)
Moderate Dementia (6–10)	n = 3 (2.3%)
Severe Dementia (< 6)	n = 0 (0%)

The average age of our cohort was 75.19 years (range: 65–93 years). There were 75 females (56.4%) and 58 males (43.6%). The average years of education was 12.64 years (range: 0–18 years). Ninety-two participants (69.2%) received the MoCA in a version concordant with their first language (English or Mandarin). Other participants reported a first language other than English or Mandarin, including 8 European languages, 7 Asian/Southeast Asian languages, and 2 African languages. Mean MoCA score was relatively lower in the oldest age group, and mean MoCA score was also relatively lower in the language discordant group (Table 2). In our cohort, 98 participants (73.7%) had hypertension, 49 (30.8%) had diabetes, 85 (63.9%) had hypercholesterolemia, 16 (12.0%) had depression or other psychiatric disorders, and 3 (2.26%) had known family history of dementia.

Table 2
MoCA scores categorized by age, gender, and years of education

Demographic characteristics	Number of patients (percentage)	Mean MoCA score (+/- SD)
Age (years)		
65–74	63 (47.4%)	23.16 ± 4.136
75–84	59 (44.4%)	23.66 ± 4.671
≥ 85	11 (8.3%)	21.45 ± 6.669
Gender		
Female	75 (56.4%)	23.30 ± 4.878
Male	58 (43.6%)	23.16 ± 4.280
Education in years		
≤ 12	64 (49.14%)	22.41 ± 5.401
13–15	37 (19.83%)	23.54 ± 3.548
≥ 16	32 (31.03%)	24.56 ± 3.689
Language (test version = mother tongue or the most fluent language)		
Y (concordant)	92 (69.2%)	23.99 ± 4.356
N (discordant)	41 (30.8%)	21.56 ± 4.801

Using independent *t*-test analysis, there was no significant difference in MoCA scores between males and females ($p = 0.678$), with or without DM ($p = 0.057$), with or without hypercholesterolemia ($p = 0.893$), with or without depression or other psychiatric disorder ($p = 0.058$), and with or without family history of dementia ($p = 0.272$). There is borderline statistical significance in the MoCA scores between participants with or without hypertension ($p = 0.047$). However, the p values in the analysis of hypertension ($p = 0.047$), DM ($p = 0.057$), and mental health issues ($p = 0.058$) were all minimally above or below the statistically significant cut point of $p < 0.05$ which may be affected by a much larger sample size. Nonetheless, significant difference was noted between participants who received the MoCA with a language version concordant versus not in concordance with the test-takers' first language ($p < 0.005$).

Using one-way ANOVA, we found that there was no significant difference in MoCA scores among different age groups ($p = 0.343$). Though the ≥ 85 years age group had a slightly lower mean MoCA score, Post Hoc tests did not identify significant difference ($p = 0.261$ vs 75–84 years age group, and $p = 0.148$ vs 65–74 years age group). Among different education level groups, Post Hoc tests showed a statistical difference between the participants with ≤ 12 years of education versus ≥ 16 years of education ($p =$

0.031). There was no significant difference between other comparisons among different education level groups.

Using two-way ANOVA, we saw no significant difference among the different age groups stratified by education level, and no interaction between the age and education level. Significant difference was between different language groups ($p < 0.001$), and there was significant interaction of the language factor on the age groups ($p = 0.021$), mostly with the ≥ 85 years age group. There was significant difference in MoCA scores among different education groups ($p = 0.011$) and language factors ($p = 0.007$). There was no significant interaction of language with education level ($p = 0.211$).

Discussion

Interpretations

In our cohort, 46 participants (34.6%) had a MoCA score lower than the cut-off of ≥ 23 indicating cognitive impairment. Of these, 29 (72.5% of the cognitive impaired participants, or 24.2% of all participants in this study) had mild cognitive impairment. The percentage of MCI among our patients was unexpectedly high despite the more conservative cut-off and education level adjusted scores, although not higher than prior studies (up to 36.7%)⁵⁻⁶. In addition, we found that MoCA scores were significantly lower when the test language of MoCA is not the test-takers' mother tongue or the most fluent language. Our clinic is an urban primary care clinic in the Greater Toronto Area (GTA) serving a diverse community with many immigrants. English is not the first language in a significant proportion (at least 30%) of our cohort. This makes our study cohort different from prior published studies which usually had relatively homogeneous cohorts. However, our multi-ethnocultural community has become quite typical for many large Canadian or American cities, and the findings from our cohort may reflect similar results in many Canadian or American cities.

Our results concur with another study that education could affect the MoCA scores¹⁶. The participants with a total of education less than 12 years scored lower in MoCA. There is a significant difference in the MoCA scores when comparing the group with ≤ 12 years of education (high school graduate or fewer years of education) with the group with ≥ 16 years of education (university graduate or higher degree). The difference is also significant when the education level groups were stratified by the MoCA version concordant or not with the first language (Table 3). It is unclear if more years of education could slow down the progression of cognitive impairment or just mask the ability of current screening tools to identify cognitive impairment.

Table 3
MoCA scores in different education groups stratified by language

Education (years)	Test Language Concordant (Y)	Test Language Discordant (N)	Total
<=12	n = 47	n = 17	n = 64
	mean = 23.511 (\pm 4.849)	mean = 19.353 (\pm 5.809)	mean = 22.406 (\pm 5.401)
13–15	n = 25	n = 12	n = 37
	mean = 24.240 (\pm 3.455)	mean = 22.083 (\pm 3.423)	mean = 23.541 (\pm 3.548)
>=16	n = 20	n = 12	n = 32
	mean = 24.800 (\pm 4.188)	mean = 24.167 (\pm 2.791)	mean = 24.563 (\pm 3.689)

Our results suggest that older age could, but not necessarily, have a higher chance of developing cognitive impairment. The group of participants ≥ 85 years old had lower mean MoCA score than the groups of participants 65–74 years old and 75–84 years old, yet not statistically significant. Age is not the sole determinant for cognitive impairment. A 92-year-old participant had a near perfect MoCA score, and conversely several younger participants tested quite low in the MoCA. We may get a better picture when the screening for MCI becomes a routine practice.

DM ($p = 0.057$) and hypertension ($p = 0.047$) were also found to be borderline significant towards the participants' MoCA score. As our study had a relatively small sample size, a clearer statistical association may be elucidated with an increased sample size. Several studies had previously shown a significant association between DM and dementia^{22–23} or cognitive impairment²⁴. However, the association of DM and cognitive impairment is not statistically conclusive in our study due to borderline p value. Few studies had examined the relationship between hypertension or cardiovascular disease and cognitive impairment rather than vascular dementia. Our study revealed a marginal statistically significant association between hypertension and cognitive impairment. As hypertension is a common comorbid condition to diabetes, we suggest that the potential effects of DM and hypertension/cardiovascular disease on dementia and cognitive impairment be further investigated together in the future. Moreover, our study showed borderline statistically significant association between depression and cognitive impairment which merits further investigation.

In our study, we use the MoCA instead of MMSE to screen for cognitive function. Both tools rely heavily on reading, writing, and verbal response. Only English and Mandarin versions were used in our study due to administrators' personal language proficiency. In our study, language barrier demonstrates a significant impact on MoCA score, the difference is most significant in the ≥ 85 years group (Table 4). It is unclear whether participants with a hearing or visual impairment, or other communication disorders perform less well in the MoCA, yet not representing their real cognitive functions. We may have to

consider provide more choices in the language versions of MoCA, including sign language and Braille assistance, to offset any potential confounding effect.

Table 4
MoCA scores in different age groups stratified by language

Age	Test Language Concordant (Y)	Test Language Discordant (N)	Total
65–74	n = 45	n = 18	n = 63
	mean = 23.333 (± 4.359)	mean = 22.722 (± 3.594)	mean = 23.159 (± 4.136)
75–84	n = 40	n = 19	n = 59
	mean = 24.600 (± 4.419)	mean = 21.684 (± 4.679)	mean = 23.661 (± 4.671)
≥ 85	n = 7	n = 4	n = 11
	mean = 24.714 (± 3.904)	mean = 15.750 (± 7.042)	mean = 21.455 (± 6.669)

Two participants of interest (screened at their own requests) were not included in this study. The first participant was a 29-year-old gentleman who had brain trauma and scored 18 in the MoCA. The second participant was a 55-year-old gentleman with strong family history of dementia scored 21 in the MoCA. They both fell in the mild cognitive impairment category at a very young age. It is unclear if prior brain injury and positive family history could affect the cognitive functions. The potential impact from these factors could also be investigated in future study.

Limitations

The MoCA and other cognitive tests may be susceptible to repeat practice effects and should be taken into consideration when repeatedly employing the cognitive tests in older adults²⁵. In Ontario, individuals 80 years and older must complete the drawing of a clock as part of the license renewal process. It is unclear whether there are positive practice effects that could potentially improve the performance when these individuals subsequently take any cognitive tests.

Various risk factors have been reported to be associated with an increased risk of dementia, including school district and financial status²⁶, anticholinergic drugs²⁷, and exposure to certain air particulates such as PM2.5 and ozone (O₃)²⁸. Our study did not investigate these potential factors.

Conclusion

More than 30 percent of the participants in our study have certain level of cognitive impairment using the MoCA as a simple screening test. The overall higher percentage of MCI compared to other studies is unexpected. Most of the participants with cognitive dysfunction had mild cognitive impairment, which may not be easily identified in a routine primary care encounter. It is important to raise awareness so that

similar screening tests can be applied in all primary care settings to early identify patients with cognitive impairment. For clinics with high turn-over and unable to conduct a standard MoCA, other screening tests such as the Mini-Cog may be an alternative for rapid screening.

In our study, we found that participants older than 85 years and with education less than 12 years scored lower in the MoCA when the test version is not concordant with their first language. These factors impact both screening process and compliance with treatment. With these risk factors in mind, physicians can be more vigilant about early screening and recognition of potential cognitive impairment. Ultimately, we hope that screening for cognitive impairment in appropriate patients will become routine practice in primary care settings.

List Of Abbreviations

MoCA	Montreal Cognitive Assessment
MCI	Mild Cognitive Impairment
MMSE	Mini-Mental Status Exam
DM	Diabetes
ANOVA	Analysis of Variance
GTA	Greater Toronto Area

Declarations

Ethics approval and consent to participate

Cognitive function test is a part of standard care in routine assessment of certain patients. No additional or unnecessary testing was involved in this study. Informed consent was obtained from all participants. The data was obtained by a retrospective review of patient charts in the electronic medical record. There has been no inappropriate disclosure of patient information and no breach of confidentiality in any way. At no time was there any risk of harm to the patients in terms of physical injury, adverse drug effects or interactions, or mental anguish, nor of unauthorized disclosure of information.

The research relies on secondary use of anonymous information, and the process of data linkage, analysis, or dissemination of results does not generate identifiable information. REB approval is not required according to the national regulations, Article 2.4, https://ethics.gc.ca/eng/tcps2-epct2_2018_chapter2-chapitre2.html#a.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

The authors received no specific funding for this work.

Authors' contribution

CPC contributed to the conception and design of the study. HQ and CPC collected, analyzed, and interpreted the data. JC and CPC were major contributors in writing the manuscript. All authors had read and approved the final manuscript.

Acknowledgement

The authors thank Dr. Lionel Mandell for his invaluable opinion.

Footnotes

Not applicable.

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