Validation in french of the montreal cognitive assessment 5-minute, a brief cognitive screening test for phone administration

Kathy Dujardin, S. Duhem, N. Guerouaou, S. Djelad, Elodie Drumez, Alain Duhamel, Stephanie Bombois, Z. Nasreddine, Regis Bordet, D. Deplanque

Version of Record: https://www.sciencedirect.com/science/article/pii/S0035378720307372
Manuscript_e81e7be2a40e49e311af71c9ae8ec226

Validation in French of the Montreal Cognitive Assessment 5-Minute, a brief cognitive screening test for phone administration

Kathy Dujardin[1,3], Stéphane Duhem[2], Nadia Guerouaou[2], Soufiane Djelad[3], Elodie Drumez[4], Alain Duhamel[4], Stéphanie Bombois[1], Ziad Nasreddine [5], Régis Bordet[1], Dominique Deplanque[1]

[1] Univ. Lille, Inserm, CHU Lille, Lille Neurosciences and Cognition, Lille, F-59000 France
[2]Clinical Investigation Center, Lille University Medical Center, France
[3]Neurology and Movement Disorders, Lille University Medical Center, France
[4]Univ. Lille, CHU Lille, EA 2694 - METRICS : évaluation des technologies de santé et des pratiques médicales, Lille, France
[5]MoCA Clinic & Institute, Quebec, Canada

Corresponding author:
Kathy Dujardin
Neurology and Movement Disorders, CHU Lille
Hôpital Salengro
Rue Emile Laine
59037 Lille, Cedex, France

kathy.dujardin@univ-lille.fr

Validation in French of the Montreal Cognitive Assessment 5-Minute, a brief cognitive screening test for phone administration – *1st revision*

Abstract

Background: The prevalence of cognitive impairment and dementia is high and steadily increasing. Early detection of cognitive decline is crucial since some interventions can reduce the risk of progression to dementia. However, there is a lack of manageable scales for assessing cognitive functions outside specialized consultations. Recently, the MoCA-5min, a short version of the Montreal Cognitive assessment (MoCA), phone-administered, was validated for screening for vascular cognitive impairment. The aim of the present study was to validate the MoCA-5min in French in diverse clinical populations.

Methods: The Cantonese version of the MoCA-5min was adapted for French language. Healthy volunteers and patients with possible or established cognitive impairment (Alzheimer's disease or related disorders, Parkinson's disease, Huntington's disease, type-2 diabetes) participated in the study. The original MoCA and the MoCA-5min were administered, by phone, with a 30-day interval. Alternate forms were used to reduce learning effects.

Results: The scores of the original MoCA and MoCA-5min correlated significantly (Spearman rho =0.751, $p<0.0001$, 95% confidence interval 0.657 to 0.819). Internal consistency was good (Cronbach alpha=0.795). The area under the ROC curve was 0.870 and the optimal cut-off value for separating patients with and without cognitive impairment with the MoCA-5min was ≤27 with 87.32% sensitivity and 76.09% specificity. Interrater and test-retest reliability were adequate.

Conclusion: This study demonstrates that the French version of the MoCA-5min is a valid and reliable scale for detecting cognitive impairment in different clinical populations. It is administrable by phone and thus suitable for remote assessment as well as for large-scale screening and epidemiological studies.

Keywords:

Cognition
Mild cognitive impairment
Dementia
MoCA
Screening test
Remote administration

1. Introduction

The prevalence of cognitive impairment and dementia is high and steadily increasing. According to the World Health Organization, around 50 million people worldwide have dementia and this number is expected to reach 82 million by 2030 (https://www.who.int/news-room/fact-sheets/detail/dementia). Moreover, a considerable proportion of individuals have mild cognitive impairment (MCI), an intermediate state between normal aging and dementia [1]. The rate of MCI ranges from 5.0 to 36.7%, depending on the country, the sample characteristics and the screening method [2,3]. This condition whose incidence increases with age, has been shown to increase the risk of developing dementia [4]. Besides being one of the main manifestations of most neurodegenerative diseases, cognitive disorders are a frequent consequence of cerebrovascular pathology [5–7]. After a stroke, one in ten patients develops dementia and this ratio increases to one in three in the case of recurrent stroke [8]. The societal impact of cognitive impairment is considerable due to the loss of autonomy it causes. It is namely one of the main causes of institutionalization [9].

Several scales exist to screen for cognitive impairment, but most of them are recommended for use in specialized clinical practice. Overall, there is a lack of manageable scales for assessing cognitive functions outside specialized consultations. Recently, Wong et al. validated the MoCA-5min, a short-form version of the MoCA, phone-administered, for screening for vascular cognitive impairment in the Hong Kong area [10]. The psychometric qualities of this Cantonese version have been demonstrated. However, its use in French required prior adaptation and validation.

The main aim of the present study was to validate the French version of the MoCA-5min, administrable by phone, and test its applicability in diverse clinical populations.

2. Methods

2.1 Adaptation to French language of the Cantonese version of the MoCA-5min

The MoCA-5min protocol design details have been described by Wong et al. [10]. Briefly, the MoCA-5min has been designed by extracting four subtests of the original MoCA (5-word learning, verbal fluency, orientation, 5-word recall).

The 5-word learning subscore is not included in the score of the original version but in the MoCA-5min protocol, each word correctly recalled at the first learning trial of the immediate recall receives 1 point. This item has been kept in the same form for the French version.

Due to the specificity of the Cantonese language that is not based on an alphabetic system, the verbal fluency subtest was changed in the French version of MoCA-5min. We reverted to the original version of the MoCA, i.e. to phonemic fluency. However, after pre-tests, we realized that the way of scoring used by Wong et al. (0.5 point by correct output with a maximum of 9 points) was not appropriate. We thus developed a specific scoring system.

We used retrospective data from 198 neurological patients collected with the original MoCA examination and we noted the number of words per F uttered in one minute. It ranged from 2 to 19. We then chose three reference points: the minimum value (=2), the 10th percentile (=4), the 1st quartile (=8). We decided that people who scored below or at the minimum (=2) should receive no point, those scoring below or at the 10th percentile (=4) should receive 3 points, those scoring between the 10th percentile and the 1st quartile should receive 6 points and those scoring above the 1st quartile (=8) should receive 9 points.

Wong et al. kept the orientation subtest as in the original version [10]. However, our pre-tests revealed that the questions regarding the geographic orientation were not appropriate. Indeed, when the subject is at home, it is not very relevant to ask, "*Tell me the name of*

where we are now and in which city is this?". Hence, for this subtest, we asked the patient to tell the name of the city in which they are currently and to situate this city in relation to Paris (North, South, East, West). The date orientation was kept as in the original version.

Finally, Wong et al. adapted the scoring of the delayed recall subtest by giving weight not only to free recall but also to cued recall and recognition [10]. We adopted exactly the same way to administer and score this subtest. Table 1 shows the similarities and differences between the full and short versions of the MoCA with detailed subtests and scoring procedures.

Original MoCA	MoCA-5min Cantonese version	MoCA-5min French version
Visuospatial/executive section (/5) • Short trail making test • Cube copy • Clock drawing	Not included	Not included
Naming section (/3) • Naming three animals	Not included	Not included
Memory – learning (/0) • Learning of a 5-word list • Two trials • No points	Memory – learning (/5) • Learning of a 5-word list • Two trials • 1 point for each word correctly recalled in first trial	Memory – learning (/5) • Learning of a 5-word list • Two trials • 1 point for each word correctly recalled in first trial
Attention (/6) • Serial digit recall forward • Serial digit recall backward • Detection of the "A" letter • Serial 7 subtraction starting at 100	Not included	Not included
Language (/3) • Repetition of two sentences • Fluency (words beginning by the letter F in one minute – 1 point if the number is ≥11)	Language (/9) • Not included • Fluency (name of animals - 0.5 point for each correct output with a maximum score of 9)	Language (/9) • Not included • Fluency (words beginning by the letter F in one minute – 0 point if the number is ≤2, 3 points if the number is in the interval]2,4], 6 points if it is in the interval]4,8], 9 points if it is >8
Abstraction (/2) • Similarity between concepts	Not included	Not included
Memory - delayed recall (/5) • Recall of the 5 words learned before - 1 point by correct uncued recall	Memory - delayed recall (/10) • Recall of the 5 words learned before - 2 points for each of the 5 words spontaneously recalled; 1 point for each word by cued recall or recognition but not spontaneously recalled	Memory - delayed recall (/10) • Recall of the 5 words learned before - 2 points for each of the 5 words spontaneously recalled; 1 point for each word by cued recall or recognition but not spontaneously recalled
Orientation (/6) • Complete date • Place • City	Orientation (/6) • Complete date • Place • City	Orientation (/6) • Complete date • City • Situation relative to Paris
Total score /30	Total score /30	Total score /30

Table 1. Summary of the differences between the original version of the Montreal Cognitive assessment (MoCA), the Cantonese and the French version of the MoCA-5min.

As serial assessments are frequently required in clinical follow-up, the original MoCA proposes alternate forms (v2 and v3) in addition to the usual form (v1) of the test. In the same way, three versions of the French MoCA-5min (v1, v2 and v3) were designed. The administration and scoring procedure were the same as described above. We used the items of the three alternate forms of the original MoCA to design these alternate forms. The French version of the MoCA-5min protocol and its alternate forms as well as the instructions are available on the mocatest.org website https://www.mocatest.org.

2.2 Validation of the French version

2.2.1 Population

Healthy volunteers and patients participated in the study that was approved by the local institutional review board and the national ethic committee (CPP N°2017/06; ID-RCB2017 / A00131-52 - ClinicalTrials.gov Identifier: NCT03232697).

For all participants, inclusion criteria were as follows: men or women, age from 40 to 89 years, having a health insurance, available by phone.

Patients were enrolled if they had established or potential cognitive impairment. We included patients with cognitive impairment due to a known clinical diagnosis of Alzheimer's disease or related disorders (ADRD), Parkinson's disease, Huntington's disease (both were grouped as movement disorder, MD) or type-2 diabetes (T2-D). We planned to enroll 40 patients of each category.

Healthy volunteers suffering from neurological, psychiatric, heart, or metabolic disease were excluded. Hearing loss incompatible with phone use was an exclusion criterion for all participants.

2.2.2 Procedure

The healthy volunteers were selected from the directory of volunteers of the Clinical Investigation Center of Lille, according to a stratification method. According to statistical power calculation (see Statistical Analysis section), we planned to recruit 120 healthy subjects (HC). They were divided into three age groups (40-59 years, 60-75 years, 76 years and over). Each age group included 40 subjects (20 men and 20 women), divided into four formal education levels: level 1 (elementary or middle school); level 2 (high school); level 3 (higher education-short duration); level 4 (higher education-long duration). This stratification allowed to obtain a relevant variability. Subjects meeting the inclusion criteria were contacted by phone and if they accepted to participate, they had a screening visit and signed informed consent. Thereafter, their demographic characteristics were recorded, and they had a cognitive assessment with the original MoCA. The version used was randomized.

Patients were outpatients attending the Lille University Medical Center for a follow-up visit including cognitive assessment. If at the end of this routine visit they met the inclusion criteria, they were invited to participate in the study. If they accepted, they signed informed consent. Thereafter, their demographic and clinical characteristics were recorded, and their treatment was checked. If the visit already included a cognitive assessment with the MoCA, the data were collected. Otherwise, the original MoCA was administered. The selected version was randomized.

One month after the visit, the MoCA-5min was administered by phone. Before administration of the protocol, patients were invited to sit in a quiet environment with the radio and television turned off. When present, caregivers were encouraged to remove any distraction and not to help patients during administration of the MoCA-5min. All treatments were also checked to ensure that they had remained stable since the previous visit. If there was any significant change in the treatment that could have an impact on cognition, the collected data were not used and the participant was removed from the analyses.

2.2.3 Statistical Analysis

Quantitative variables are expressed as mean (standard deviation) or median (interquartile range (IQR)) and qualitative variables as numbers and percentages. Normality of distribution was assessed graphically and using the Shapiro-Wilk test. The correlation between the original MoCA score and the MoCa-5min score was evaluated using the Spearman correlation coefficient and its 95% confidence interval (CI) assessed with Fisher transformation. We considered that a correlation coefficient greater than 0.80 corresponded to a high correlation value and we expected an observed coefficient correlation of 0.87 according to Wong A et al. Considering this hypothesis, by recruiting 240 subjects (120 patients and 120 healthy volunteers), a two-sided test at 0.05 significance level would have statistical power >90% to show a coefficient correlation between the original MoCA and the MoCA-5min greater than 0.80.

The scores of the original MoCA and the MoCa-5min were compared between patients and healthy volunteers using the Mann-Whitney U test. Association between the MoCa-5min score and demographic characteristics was evaluated using the Spearman correlation

coefficient for age, the Mann-Whitney U test for sex and the Kruskall-Wallis test for educational level.

Internal consistency of the items of the MoCA 5-min protocol was assessed by the Cronbach α, which was expected to be greater than 0.70 [11].

The diagnostic power of the MoCA-5min score for the presence of cognitive disorders was assessed using the area under the receiver operating characteristics (ROC) curve and its 95% CI. Cognitive disorder was defined by an original MoCA score <26. The optimal threshold of the MoCA-5min was calculated to optimize scale sensitivity and specificity, using the Youden index. The performance of this cut-off score was described by the sensitivity, specificity and proportion of well-classified subjects.

Inter-observer reliability and test-retest were evaluated by the intraclass correlation coefficient (ICC) and graphically by the Bland and Altman method. We planned to recruit a minimum of 20 HC and 15 patients for these measures. Two-sided 95% CI for ICC was calculated using the bootstrap method with 2000 replicates obtained with replacement.

As mentioned in the procedure, the original MoCA was always administered first and the MoCA-5min one month after. To alleviate a possible learning effect, the three alternate forms (v1, v2, V3) of the original MoCA were used and three alternate forms the French MoCA-5min (v1, v2, v3) were designed (see details in paragraph 2.1 of this section). The six possible sequences of administration of the original MoCA and MoCA-5min (A-B, A-C, etc.) were randomized. The homogeneity of the correlations between MoCA and MoCA-5min among the six randomized sequences of administration was tested.

All statistical tests were performed with a two-tailed alpha risk of 0.05, using the SAS version 9.4 (SAS Institute, Cary, NC) software.

3. Results

3.1 Population

At the end of the inclusion period (July 2017-July 2019), 225 participants were enrolled (86 HC, 44 ADRD, 46 MD and 49 T2-D). Twenty-two were lost to follow-up at the time of the MoCA-5min administration (7 ADRD, 6 MD, 9 T2-D). Not being able to contact patients by phone or patients who declined a second assessment were the main reasons for drop outs. Only one patient in the MD group was excluded from the analysis due to a significant change in treatment between the two visits. Complete data were available for 203 participants whose characteristics are shown in Table 2.

	HC	**ADRD**	**MD**	**T2-D**
n	86	37	40	40
Age (y)	62.7 ± 12.7	73.5 ± 8.1	58.7 ± 10.1	55.8 ± 8.9
Sex, Male (%)	37 (43.0)	18 (48.7)	22 (55.0)	26 (65.0)
Education				
Elementary or middle school	17 (19.8)	16 (43.2)	11 (27.5)	6 (15.0)
High school	28 (32.6)	12 (32.4)	18 (45.0)	23 (57.5)
Higher education (short duration)	19 (22.1)	6 (16.2)	8 (20.0)	7 (17.5)
Higher education (long duration)	22 (25.6)	3 (8.1)	3 (7.5)	4 (10.0)
Original MoCA (/30)	28.3 ± 1.5	16.4 ± 4.4	23.4 ± 4.4	27.2 ± 2.4
MoCA-5min (/30)	29.3 ± 1.3	18.1 ± 6.8	25.3 ± 4.6	27.9 ± 3.0

Table 2. Demographical characteristics and performance at both forms of the Montreal Cognitive assessment (MoCA) of the participant groups. Values are presented as mean ± standard deviation or numbers (percentage). Abbreviation: HC=healthy volunteers;

ADRD=Alzheimer's disease and related disorders; MD=movement disorder (Parkinson or Huntington disease); T2-D= type2-diabetes.

3.2 Convergent validity and internal consistency of the French MoCA-5min

In the whole population, the correlation coefficient between the original MoCA and the MoCA-5min scores was 0.714 (95%CI, 0.638 to 0.775). When considering only the patients, the correlation coefficient was 0.751 (95%CI, 0.657 to 0.819, Figure 1). The MoCA-5min score was on average 1.4 points higher than the original MoCA score.

When compared with HCs, patients performed significantly lower on the MoCA-5min (median (IQR), 30 (29 to 30) for HC vs. 25 (21 to 30) for patients, $p<0.0001$) and on the original MoCA (median (IQR), 29 (27 to 29) for HCs vs. 24 (19 to 27) for patients; $p<0.0001$). The MoCA-5min score correlated negatively with age ($r=-0.278$, $p<0.0001$), differed with duration of education (median (IQR), 24 (20 to 30) for elementary or middle school, 29 (25 to 30) for high school, 29 (26 to 30) for higher education-short duration and 29.5 (29 to 30) for higher education-long duration, $p=0.0004$). We did not observe a significant effect of sex: median (IQR), 29 (24 to 30) for women vs. 29 (23 to 30) for males, $p=0.64$.

The Cronbach alpha coefficient, calculated on the four items of the scale, was 0.795, which revealed an acceptable internal consistency.

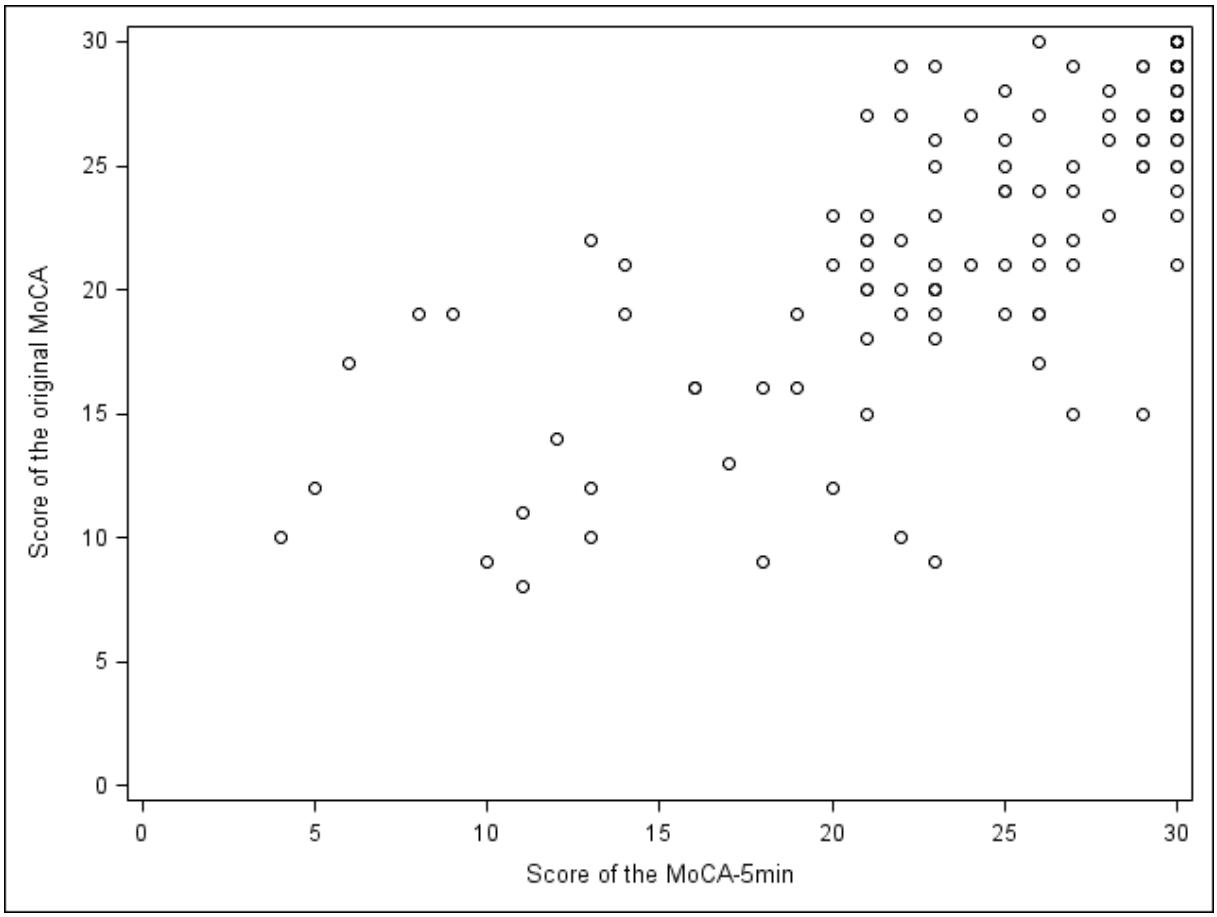

Figure 1. Scatter plot of scores at the original Montreal Cognitive assessment (MoCA) and the French version of the MoCA-5min for patients.

3.3 Diagnostic power of the French MoCA-5min

The lower the MoCA-5min score, the higher the likelihood of cognitive impairment (odds-ratio = 0.66, 95%CI, 0.57 to 0.78). The area under the ROC curve (shown in Figure 2) was 0.87 (95%CI 0.81 to 0.93). The optimal cut-off value to separate patients with impairment from those without was a MoCA-5min score ≤27. When applying this cut-off, 82.9% of the patients were well classified. Sensitivity and specificity were 87.3% (95%CI 79.6 to 95.1) and 76.1% (95%CI 63.8 to 88.4), respectively.

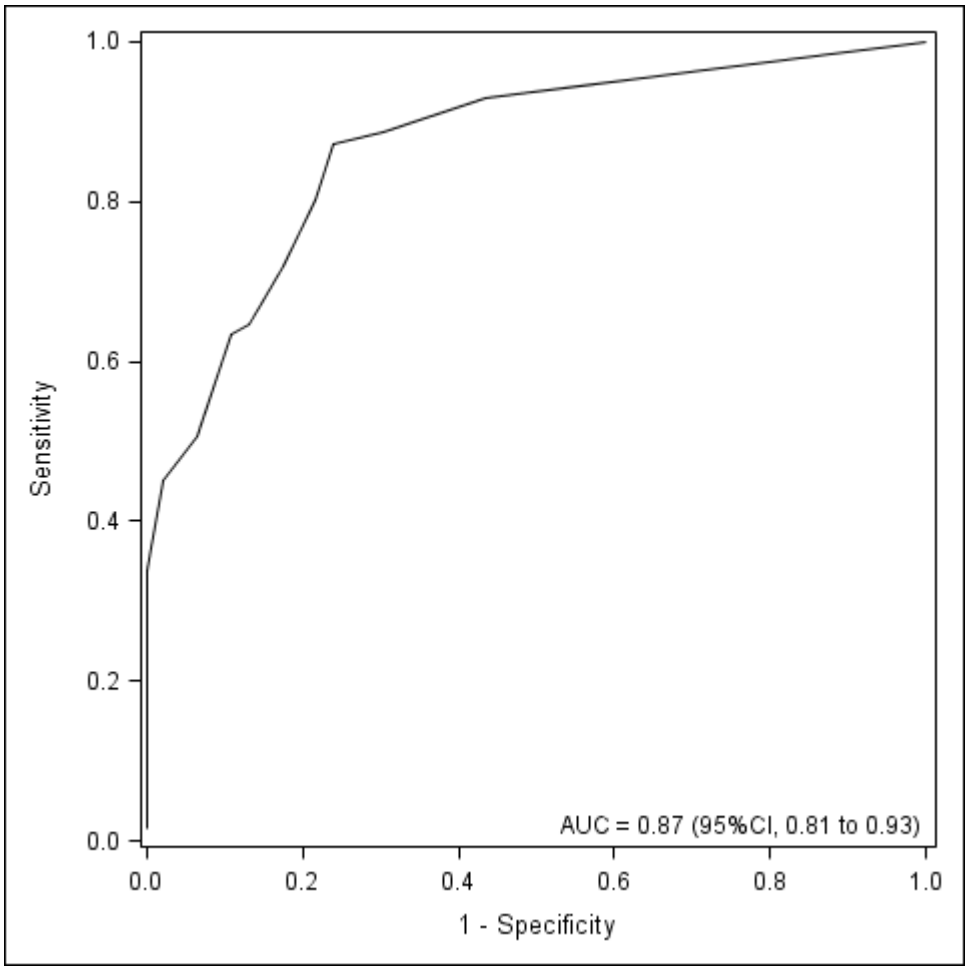

Figure 2. Area under the receiver operating characteristics (ROC) curve of the French MoCA-5min for diagnosis of cognitive impairment in patients

3.4 Interrater and test-retest reliability of the French MoCA-5min

Interrater consistency was high with an ICC= 0.989 (n = 31, 95%CI 0.969-0.999, Figure 3). Twenty participants completed a second MoCA-5min at a one-month interval. Regarding test-retest reliability, 15 of the 20 participants had exactly the same score at both test administrations as shown on the Bland-Altman plot (Figure 3). For the other participants, the difference between the two scores was not greater than 3.

Regarding the reliability of the alternate forms of the MoCA-5min, the correlations between MoCA and MoCA-5min among the six randomized sequences of administration ranged from 0.71 to 0.77.

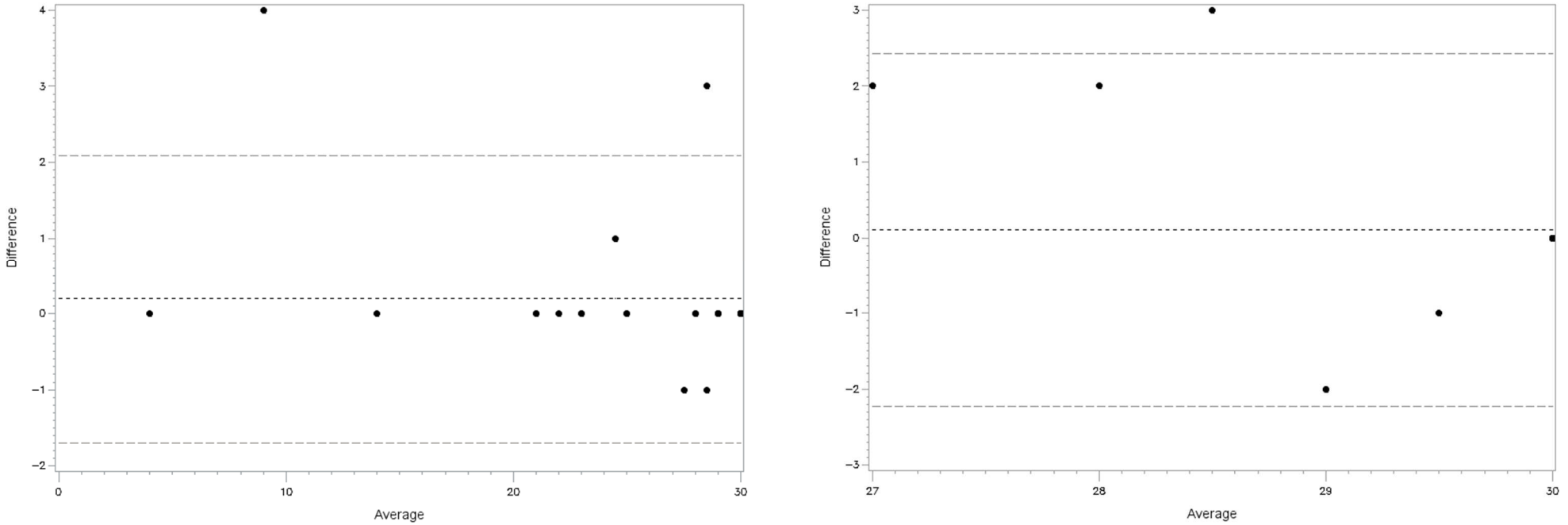

Figure 3. Bland-Altman plot of scores of the French version of the MoCA-5min for inter-rater reliability (Left) and test-retest (Right).
Inter-rater reliability: mean of difference= 0.2, 95% limits of agreement -1.7 to 2.1; Test-retest reliability: mean of difference, 0.1, 95% limits of agreement -2.2 to 2.4.

5. Discussion

This study demonstrates the validity of the phone-administrable French version of the MoCA-5min for detecting cognitive impairment in clinical populations. As in the princeps study by Wong, the MoCA-5min score was highly correlated with the original MoCA score, showing that both scales assess overall cognition in a convergent way. We did not find a correlation coefficient as high as in the Wong et al.'s study [10] (0.71 vs. 0.87) in the whole sample. However, this result was quite logical since Wong et al. [10] validated the MoCA-5min protocol in a relatively focused study population (104 patients with ischemic stroke or transient ischemic attack, free from moderate to severe dementia). They even considered that it was a limitation of their study, preventing generalization of the results. In the present study, we enrolled a large group of healthy controls and patients with established or possible cognitive impairment of diverse origins. When considering only the patient group, the correlation was higher and did not significantly differ from 0.80, which is commonly considered as a high correlation value. This stronger correlation in the patient group is due to greater score variability in clinical populations. It was previously observed in earlier studies and confirms that the MoCA is particularly suitable for detection of cognitive impairment in clinical populations [12,13]. Moreover, we showed in the present validation study that the MoCA-5min can be administered, like the original MoCA, in patients with moderate to severe dementia with reproducible results as illustrated in Table 2.

The other psychometric properties of the MoCA-5min were also confirmed in the present study. Internal consistency was high, confirming the significant input of each item to the overall evaluation. Interrater and test-retest reliability were very good. In the patient group, we also showed that the MoCA-5min performed well to discriminate subjects with and

without deficits. A cut-off value was determined, whose sensitivity and specificity were good since the rate of well-classified subjects was around 83%. Sensitivity (87.32%) was slightly better than specificity (76.09%), which is not a drawback for a screening test. Compared to Wong et al. [10], determination of this cut-off value is thus an added value of our study. As previously reported for the original MoCA score [12,14,15], age and duration of formal education, but not sex, significantly influenced the MoCA-5min score. As in the original MoCA, the total score of the French MoCA-5min was adjusted according to duration of formal education. However, the MoCA score is currently not adjusted for age. The recurrent observation of a significant correlation of the total score with age suggests that this issue should probably be considered in further studies, especially since the overall population is aging.

As follow-up is often essential in clinical populations or in cohort studies, we designed alternate forms of the MoCA-5min to reduce practice effect in consecutive administrations. Our results showed that the correlation between the original MoCA score and the MoCA-5min score was very homogeneous whatever the alternate form. This is in agreement with Costa et al. [12] who demonstrated the excellent reliability of the alternate forms of the original MoCA.

We are aware of several limitations in our study. Firstly, as pointed out by Wong et al. [10], this short-form version of the MoCA, administrable by phone, does not include items evaluating executive or visuospatial/visuoconstructive functions as does the original MoCA. Nevertheless, the scores of the two scales were strongly correlated. Moreover, we showed that the MoCA-5min performs well in detecting cognitive impairment in clinical populations like Parkinson's disease or T2-D in whom cognitive impairment is characterized by dysexecutive syndrome. An alternative could be a videoconference administration of the

original MoCA. Chapman et al. reported however wide variability between face-to-face and videoconference administrations [16]. Secondly, to classify participants as cognitively intact or impaired, we did not use a comprehensive neuropsychological assessment but the original MoCA score. The sensitivity/specificity of this scale has however been largely demonstrated [15,17–19]. Thirdly, the number of HCs included in the study was less than expected. This was due to our stratification method. In fact, it was very difficult to recruit subjects under the age of 60 with the lowest level of formal education. In the same way, it was difficult to find subjects over 76 with the highest level of education. Apart from these two categories, the others were correctly represented in our sample.

6. Conclusion

Our study confirms that the MoCA-5min is a brief, valid and reliable scale for screening for cognitive impairment in various clinical populations. The scale is now usable for French speakers. As it is adapted for phone administration, its large-scale use should favor the detection of cognitive disorders and its use in epidemiological studies.

Abbreviations

MCI: mild cognitive impairment
MMSE: Mini Mental State Examination
MoCA: Montreal Cognitive Assessment
HC: healthy subjects
ADRD: Alzheimer's disease or related disorders
MD: movement disorder
T2-D: type-2 diabetes
IQR: interquartile range
CI: confidence interval
ROC: receiver operating characteristics
ICC: intraclass correlation coefficient

References

[1] Petersen RC. Clinical practice. Mild cognitive impairment. New Engl J Medicine 2011;364:2227–34. https://doi.org/10.1056/nejmcp0910237.

[2] Petersen RC, Roberts RO, Knopman DS, Geda YE, Cha RH, Pankratz VS, et al. Prevalence of mild cognitive impairment is higher in men. The Mayo Clinic Study of Aging. Neurology 2010;75:889–97. https://doi.org/10.1212/wnl.0b013e3181f11d85.

[3] Sachdev PS, Lipnicki DM, Kochan NA, Crawford JD, Thalamuthu A, Andrews G, et al. The Prevalence of Mild Cognitive Impairment in Diverse Geographical and Ethnocultural Regions: The COSMIC Collaboration. Plos One 2015;10:e0142388. https://doi.org/10.1371/journal.pone.0142388.

[4] Farias ST, Mungas D, Reed BR, Harvey D, DeCarli C. Progression of mild cognitive impairment to dementia in clinic- vs community-based cohorts. Arch Neurol-Chicago 2009;66:1151–7. https://doi.org/10.1001/archneurol.2009.106.

[5] Vermeer SE, Prins ND, Heijer T den, Hofman A, Koudstaal PJ, Breteler MMB. Silent Brain Infarcts and the Risk of Dementia and Cognitive Decline. New Engl J Med 2003;348:1215–22. https://doi.org/10.1056/nejmoa022066.

[6] Barbay M, Diouf M, Roussel M, Godefroy O, GRECOGVASC study group. Systematic Review and Meta-Analysis of Prevalence in Post-Stroke Neurocognitive Disorders in Hospital-Based Studies. Dement Geriatr Cogn 2018;46:322–34. https://doi.org/10.1159/000492920.

[7] Lo JW, Crawford JD, Desmond DW, Godefroy O, Jokinen H, Mahinrad S, et al. Profile of and risk factors for poststroke cognitive impairment in diverse ethnoregional groups. Neurology 2019;93:e2257–71. https://doi.org/10.1212/wnl.0000000000008612.

[8] Sun J-H, Tan L, Yu J-T. Post-stroke cognitive impairment: epidemiology, mechanisms and management. Annals of Translational Medicine 2014;2:80. https://doi.org/10.3978/j.issn.2305-5839.2014.08.05.

[9] Fukawa T. Prevalence of dementia among the elderly population in Japan. Heal Prim Care 2018;2. https://doi.org/10.15761/hpc.1000147.

[10] Wong A, Nyenhuis D, Black SE, Law LSN, Lo ESK, Kwan PWL, et al. Montreal Cognitive Assessment 5-minute protocol is a brief, valid, reliable, and feasible cognitive screen for telephone administration. Stroke; a Journal of Cerebral Circulation 2015;46:1059–64. https://doi.org/10.1161/strokeaha.114.007253.

[11] Streiner DL, Norman GR. Health measurement scales. A practical guide to their development and use. 2nd ed. Oxford: Oxford University; 1995.

[12] Costa AS, Fimm B, Friesen P, Soundjock H, Rottschy C, Gross T, et al. Alternate-Form Reliability of the Montreal Cognitive Assessment Screening Test in a Clinical Setting. Dement Geriatr Cogn 2012;33:379–84. https://doi.org/10.1159/000340006.

[13] Bernstein IH, Lacritz L, Barlow CE, Weiner MF, DeFina LF. Psychometric evaluation of the Montreal Cognitive Assessment (MoCA) in three diverse samples. Clin Neuropsychologist 2010;25:119–26. https://doi.org/10.1080/13854046.2010.533196.

[14] Freitas S, Simoes MR, Alves L, Santana I. Montreal Cognitive Assessment: Influence of Sociodemographic and Health Variables. Arch Clin Neuropsych 2012;27:165–75. https://doi.org/10.1093/arclin/acr116.

[15] Wong A, Xiong YY, Kwan PWL, Chan AYY, Lam WWM, Wang K, et al. The validity, reliability and clinical utility of the Hong Kong Montreal Cognitive Assessment (HK-MoCA) in patients with cerebral small vessel disease. Dementia and Geriatric Cognitive Disorders 2009;28:81–7. https://doi.org/10.1159/000232589.

[16] Chapman JE, Cadilhac DA, Gardner B, Ponsford J, Bhalla R, Stolwyk RJ. Comparing face-to-face and videoconference completion of the Montreal Cognitive Assessment (MoCA) in community-based survivors of stroke. J Telemed Telecare 2019:1357633X19890788. https://doi.org/10.1177/1357633x19890788.

[17] Nasreddine ZS, Phillips NA, Bédirian V, Charbonneau S, Whitehead V, Collin I, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. Journal of the American Geriatrics Society 2005;53:695–9. https://doi.org/10.1111/j.1532-5415.2005.53221.x.

[18] Hoops S, Nazem S, Siderowf AD, Duda JE, Xie SX, Stern MB, et al. Validity of the MoCA and MMSE in the detection of MCI and dementia in Parkinson disease. Neurology 2009;73:1738–45. https://doi.org/10.1212/wnl.0b013e3181c34b47.

[19] Pendlebury ST, Cuthbertson FC, Welch SJV, Mehta Z, Rothwell PM. Underestimation of cognitive impairment by Mini-Mental State Examination versus the Montreal Cognitive Assessment in patients with transient ischemic attack and stroke: a population-based study. Stroke; a Journal of Cerebral Circulation 2010;41:1290–3. https://doi.org/10.1161/strokeaha.110.579888.

Figure Legends

Figure 1. Scatter plot of scores at the original Montreal Cognitive assessment (MoCA) and the French version of the MoCA-5min for patients.

Figure 2. Area under the receiver operating characteristics (ROC) curve of the French MoCA-5min to diagnosis of cognitive impairment in patients.

Figure 3. Figure 3. Bland-Altman plot of scores of the French version of the MoCA-5min for inter-rater reliability (Left) and test-retest (Right).
Inter-rater reliability: mean of difference= 0.2, 95% limits of agreement -1.7 to 2.1; Test-retest reliability: mean of difference, 0.1, 95% limits of agreement -2.2 to 2.4.