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Assessing the Equivalence of Telephone-MoCA and MoCA-22 in Healthy Adults

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Conflict of Interest
The authors have no financial conflicts of interest.

ABSTRACT

Background and Purpose: The Telephone-Montreal Cognitive Assessment (T-MoCA) is a remote cognitive screening tool increasingly used in clinical and research contexts. However, its applicability in Korean populations remains underexplored.
Methods: This study examined the equivalence between the T-MoCA and the face-to-face Korean MoCA-22 (K-MoCA-22) in a community-based sample of 113 cognitively normal adults aged 21–91 years. The sample was stratified into 2 age groups (<60 and ≥60 years) for subgroup analyses. All participants completed both the T-MoCA and K-MoCA-22 in a counterbalanced order, with a one-month interval between assessments.
Results: Both T-MoCA and K-MoCA-22 scores were significantly associated with age and education, but not with sex in either age group. However, none of these variables significantly influenced the score differences between the 2 tests. Lin's concordance correlation coefficient indicated strong agreement between the 2 tests in the overall sample and in participants aged ≥60, with minimal systematic bias. Equivalence testing using the two one-sided tests procedure supported statistical equivalence in the total sample and the <60 group, but not in the ≥60 group. Subtest-level differences were observed in the ≥60 group, with higher repetition scores on the K-MoCA-22 and higher delayed recall scores on the T-MoCA, possibly reflecting absence of visual cues, reduced supervision, and lower anxiety during remote testing.
Conclusions: These findings support the T-MoCA as an equivalent and reliable alternative to the K-MoCA-22 for remote cognitive screening in Korean adults. Nonetheless, age-related and modality-specific factors should be considered when interpreting scores, particularly in older individuals.

Keywords: T-MoCA; MoCA-22; Cognitive Screening Test

INTRODUCTION

With the rapid growth of the aging population, the number of individuals at risk for cognitive impairment is also increasing.[1,2] Consequently, there is growing demand for highly sensitive cognitive screening tools to detect early signs of cognitive decline. The need for remote assessment tools has further intensified since the coronavirus disease 2019 pandemic, which

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Author Contributions

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has limited face-to-face evaluations. Remote cognitive screening offers advantages in terms of accessibility, cost-effectiveness, and feasibility in both clinical and research contexts.[3-8]

Among various remote cognitive screening instruments, the Telephone-Montreal Cognitive Assessment (T-MoCA)[9] has emerged as a practical alternative to in-person cognitive screening. The T-MoCA is derived from the Montreal Cognitive Assessment (MoCA),[10] a widely used paper-and-pencil instrument developed to detect mild cognitive impairment (MCI) in its early stages. The MoCA evaluates multiple cognitive domains and has been translated into numerous languages, making it a globally validated tool for identifying subtle cognitive decline.[11-13] Although initially designed to detect cognitive impairment associated with Alzheimer's disease,[10] the MoCA has since been applied to a broad range of conditions, including vascular disorders[14,15] and movement disorders,[16] traumatic brain injury,[17] substance use disorders,[18] and HIV-related cognitive impairment.[19]

The T-MoCA is a telephone-administered version of the MoCA that excludes tasks requiring visual or motor responses (e.g., Trail Making, Cube Copying, Clock Drawing, and Naming), resulting in a maximum score of 22 instead of the original 30 points. It utilizes the same items as the MoCA-Blind,[20] a version originally developed for individuals with visual impairments. Although the term "MoCA-Blind" was initially intended to reflect its use in visually impaired populations, it has since been applied more broadly across various clinical groups. Accordingly, the more neutral term "MoCA-22" has gained wider acceptance in the literature. In contrast to the in-person administration of the MoCA-22, the T-MoCA is conducted remotely via telephone. Pendlebury et al.[9] were among the first to administer the MoCA-22 via telephone in patients with acute vascular events, contributing to the broader clinical adoption of the T-MoCA.

Due to its abbreviated structure, the T-MoCA has limited ability to assess certain cognitive domains such as executive function, visuospatial construction, and language. As a result, its discriminative power is considered slightly lower than that of the full MoCA-30.[21] Nonetheless, Katz et al.[22] reported that the T-MoCA achieved an area under the curve (AUC) of 0.71 for detecting MCI, indicating fair diagnostic accuracy. Other studies have also demonstrated the T-MoCA's clinical utility in various populations, including patients with transient ischemic attack,[9] stroke,[23,24] Parkinson's disease,[25] atrial fibrillation,[26] and community-dwelling older adults.[22]

The T-MoCA has shown comparable performance to other telephone-based screening tools, such as the Telephone Interview for Cognitive Status,[24,27,28] in differentiating MCI and dementia from normal cognition. Moreover, a recent study reported the T-MoCA's utility in tracking cognitive changes across racially and ethnically diverse older populations.[29] These findings support the value of the T-MoCA as a viable tool for remote cognitive assessment in settings where in-person testing is not feasible.

However, evidence supporting the validity and applicability of the T-MoCA in Korean populations remains limited. A recent study[21] demonstrated that the Korean version of the MoCA-22 (K-MoCA-22) exhibits comparable discriminative power to both the full Korean MoCA-30 (K-MoCA-30)[30] and the Korean Mini-Mental State Examination (K-MMSE).[31] Building on these findings, the present study aimed to assess whether the T-MoCA is an equivalent and reliable remote alternative to the in-person K-MoCA-22 among Korean older adults. As the K-MoCA-22 is a validated face-to-face counterpart of the T-MoCA that employs

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identical test items, it serves as an appropriate benchmark for assessing test equivalence. Given that remote cognitive performance is known to be significantly influenced by age,[32] we further investigated the test equivalence by stratifying participants into 2 age groups: under-60 and 60-and-above years.

METHODS

Participants

The participants were 113 cognitively normal adults recruited through community outreach. All participants demonstrated normal performance on the Korean-Mini Mental State Examination, 2nd edition (K-MMSE~2)[33] and met Christensen's health screening criteria,[34] which excluded individuals with a history of neurological or psychiatric disorders, significant sensory impairments, or use of medications known to affect cognitive function.

Materials

The K-MoCA-22, which was developed for individuals with visual impairments and administered face-to-face,[20,21] and the T-MoCA, which used the same items as the K-MoCA-22 but was conducted via telephone,[11] were administered. Both assessments excluded 4 subtests from the K-MoCA-30—Alternating Trail Making, Copy Cube, Clock Drawing, and Naming—which require motor responses or visual stimuli, thereby reducing the maximum possible score from 30 to 22.[11,20]

Procedures

Data were collected by clinical psychologists with expertise in neuropsychological screening assessments. Assessments were conducted in participants' homes, university facilities, or community centers. Each participant completed both the K-MoCA-22 and the T-MoCA, with a one-month interval between administrations. The order of test administration was counterbalanced across participants, controlling for age, sex, and educational level.

For the T-MoCA, participants were instructed in advance to take the assessment in a quiet, distraction-free environment where they could be alone. To minimize the risk of external assistance or note-taking, they were prohibited from using writing instruments during the assessment and were instructed to hold the phone with their dominant hand, typically the hand used for writing.

Statistical analysis

Baseline demographic characteristics were summarized by 2 age groups (under-60 and 60-and-above groups). Group differences were examined using *t*-tests for continuous variables and $ tests for categorical variables.

To examine associations between T-MoCA, K-MoCA-22, and their difference scores (T-MoCA minus K-MoCA-22) with demographic variables, multivariate regression models were employed. Lin's concordance correlation coefficient (CCC)[35] was calculated to assess the degree of agreement between T-MoCA and K-MoCA-22, incorporating both consistency and accuracy (closeness to the perfect agreement). Equivalence between T-MoCA and K-MoCA-22 was evaluated using the two one-sided tests (TOST)[36] procedure, with narrow equivalence bounds set at −0.75 to 0.75 points on the 22-point scale, corresponding to a Cohen's *d* of 0.3.[37,38] A Bland–Altman plot[39] was also generated to visually assess agreement

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between the 2 measures by plotting the difference against the mean of paired scores for each participant. Additionally, paired *t*-tests were conducted to examine differences in subtest scores between the T-MoCA and K-MoCA-22.

Equivalence analysis was conducted in R 4.0.1 using the "TOSTER" package,[40] while all other statistical analyses were performed using IBM SPSS Statistics 21.0 (IBM Corp., Armonk, NY, USA).

Ethics statement

The study protocol was reviewed and approved by the Institutional Review Board (IRB) of Hallym University (HIRB-2024-103).

RESULTS

The demographic characteristics of the participants are presented in **Table 1**. Participants ranged in age from 21 to 91 years (58.41±19.09), and in education from 0 to 19 years (10.98±4.74). The sample was evenly distributed by sex, with 57 men and 56 women. Test order was counterbalanced: 57 participants completed the T-MoCA before the MoCA-22, and 56 completed the test in the reverse order.

Participants were divided into 2 age groups: those under 60 years (n=53) and those aged 60 years or older (n=60). There were no significant differences in sex distribution or test order between the groups. However, the younger group had significantly more years of education than the older group (t [111]=−6.80; p<0.001). Although the older group scored significantly lower on both the T-MoCA and K-MoCA-22, the mean score difference between the 2 tests (0.26 vs. 0.45) did not significantly differ by age group.

Multivariate regression analyses revealed that both T-MoCA and K-MoCA-22 scores were significantly associated with age (B=−0.08 and −0.09, respectively; both p<0.001) and education (B=0.33 and 0.35, respectively; both p<0.001), but not with sex. These associations remained consistent across both age groups. In the under-60 group, age was negatively associated with T-MoCA and K-MoCA-22 scores (B=−0.05 and −0.07; p=0.006 and 0.001, respectively), while education was positively associated (B=0.24 and 0.31; p=0.005 and 0.001, respectively). Similarly, in the 60-and-above group, age remained a significant negative predictor (B=−0.20 and −0.22; both p<0.001), and education remained a significant positive

Table 1. Demographical characteristics of the participants

Variables	Total (N=113)	<60 years old (n=53)	≥60 years old (n=60)	t or $
Age (yr)	58.41±19.09	41.03±11.71	73.76±7.74	17.28***
Sex (M/W)	57/56	27/26	30/30	$=0.01
Education (yr)	10.98±4.74	13.64±2.70	8.63±4.93	−6.80***
Test order				$=0.01
T-MoCA→K-MoCA-22	57	27	30	
K-MoCA-22→T-MoCA	56	26	30	
T-MoCA	17.09±3.65	19.25±1.79	15.18±3.82	−7.38***
K-MoCA-22	16.73±3.78	18.98±2.04	14.73±3.84	−7.45***
T-MoCA minus K-MoCA-22	0.36±1.83	0.26±1.69	0.45±1.95	0.54

Values are presented as mean ± standard deviation.
M: men, W: women, T-MoCA: Telephone Montreal Cognitive Assessment, K-MoCA-22: Korean-Montreal Cognitive Assessment-Blind version 22.
***p<0.001.

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predictor (B=0.36 and 0.37; both p<0.001). Sex was not a significant predictor in either group. In contrast, the difference in scores between T-MoCA and K-MoCA-22 was not significantly associated with any demographic variable in either age group (**Table 2**).

Lin's CCC indicated strong agreement between T-MoCA and K-MoCA-22 in the total sample (CCC=0.88; 95% confidence interval [CI], 0.82 to 0.91) and the 60-and-above **group (CCC=0.86; 95% CI, 0.78 to 0.9he 60-and-above**