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Detecting mild cognitive impairment remotely with the modified memory impairment screen by telephone

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ABSTRACT

The original Memory Impairment Screen by Telephone (MIST) was designed to identify individuals with dementia but was relatively ineffective for identification of less severe impairment observed in mild cognitive impairment (MCI). We expanded the original MIST to create a modified instrument (mMIST) with greater sensitivity to less severe memory impairment. Older men and women with subjective cognitive decline were assessed by phone with the mMIST and subsequently classified independently with MCI or non-pathological cognitive decline. Participants with MCI produced lower scores on the mMIST than did participants without MCI, 10.8 ± 2.7 vs 13.3 ± 1.3 , $t = 5.68$, $p < 0.001$, and performance on the mMIST predicted performances on the California Verbal Learning Test (CVLT), Verbal Paired Associate Learning Test (VPAL), Montreal Cognitive Assessment (MoCA) total score, and MoCA memory index score, $p < 0.001$. Receiver operating characteristic (ROC) analyses identified the optimal cut score on the mMIST to distinguish participants with and without MCI with Sensitivity = 73.1%, Specificity = 79.1%, and AUC = 0.79. Predictive values for distinguishing the amnesic form of MCI (aMCI) from non-amnesic MCI were Sensitivity = 81.8%, Specificity = 30%, and AUC = 0.82. These findings indicate that the mMIST is a valid screening instrument for identifying MCI. It can be administered remotely at low cost and low participant burden. Also, the mMIST has potential utility for remote cross-sectional and longitudinal evaluation in research and clinical contexts. Further investigation is indicated to corroborate its utility for assessment of aging patients and research participants.

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Remote memory assessment; aging; subjective cognitive decline; mild cognitive impairment; Alzheimer's disease

Introduction

Late-life dementia of the Alzheimer's type involves progressive neurodegeneration that develops over many years (Sperling et al., 2011). The prevalence of Alzheimer's disease (AD) is increasing and projected to reach 13.8 million cases in the US by the year 2050 (Hebert et al., 2013). Mild cognitive impairment (MCI; Petersen, 2004) is a clinical construct that implies the presence of greater than expected cognitive impairment in non-demented individuals and substantially increased risk for future AD and other dementing

conditions. The annual rate of progression from MCI to dementia has been projected to be between 8% and 15% (Petersen, 2016). Currently available pharmaceutical treatments for dementia are largely ineffective. However, recent evidence indicates that multimodal lifestyle interventions administered in advance of dementia can forestall progression of cognitive decline (Isaacson et al., 2019; Ngandu et al., 2015). The ability to identify clinically meaningful cognitive decline consistent with MCI will be essential for intervention efforts intended to mitigate progression of neurodegeneration.

While in-person, examiner-administered cognitive evaluation has been the standard, computer-administered testing, online evaluation, and other distance assessment methods have become increasingly common (Binng et al., 2020; Lavigne et al., 2022). Phone and video streaming evaluation methods can reduce the time commitment and expense associated with travel to a clinic or research facility. In addition, remote screening would allow for more frequent assessments to track clinical course in longitudinal and intervention research. The capability for remote screening of memory function also can expand geographic boundaries, facilitating access to larger and more diverse samples.

The original Memory Impairment Screen (MIS) was designed as an in-person, examiner-administered assessment to identify those with severe memory impairment indicative of dementia. It involved a four-item verbal memory task that used controlled, category cue learning and free and cued recall testing (Buschke et al., 1999). The delay interval between learning and recall was two to three minutes, and overall administration time was about five minutes. The original MIS exhibited sensitivity = 80% and specificity = 90% for the detection of dementia of any type and sensitivity = 87% and specificity = 96% for the detection of AD specifically (Buschke et al., 1999). Subsequently, this task was adapted for use by telephone (MIST; Lipton et al., 2003) and demonstrated sensitivity = 78% and specificity = 93% for detection of dementia of any type and sensitivity = 89% and specificity = 93% for detection of AD (Lipton et al., 2003).

Other phone-based instruments have been developed to screen for cognitive decline, and the majority of extant instruments of this type were designed to detect severe impairment indicative of dementia (Castanho et al., 2014). There have been fewer screening tasks for remote administration to identify individuals with MCI. However, the Telephone Interview for Cognitive Status (TICS; Brandt et al., 1988; Welsh et al., 1993) and the Telephone-Montreal Cognitive Assessment (T-MoCA; Pendlebury et al., 2013) have been studied in the context of screening for MCI. Both the TICS and T-MoCA were found to be effective telephone screening tools to detect MCI poststroke in an initial study (Zietemann et al., 2017), although this was not corroborated in subsequent research. The T-MoCA performed less well compared with in-person administration to detect MCI (Katz et al., 2021). In addition, Manly et al. (2011) found, as with the original MIST, that while the TICS was effective when screening for dementia, it performed much less well when screening for MCI specifically, even in the context of a large, diverse sample and when combined with other assessment instruments. Similarly, a modification of the TICS (TICS-m) performed well when used to screen for dementia but mis-classified 57.1% of those with MCI (Knopman et al., 2010).

Generally, the original MIS (Buschke et al., 1999; Kuslansky et al., 2002), MIST (Lipton et al., 2003), and other such screening tasks demonstrated excellent capability to identify dementia, in particular Alzheimer's disease. However, MCI has been more difficult to detect most likely because the level of memory decline can overlap with that observed

in non-pathological cognitive aging (non-MCI). Here, we sought to modify the MIST to improve identification of individuals with MCI by remote assessment. We increased the number of test items from four to eight to create a more challenging and more sensitive measure to detect clinically significant but less severe memory impairment, investigated its validity against other examiner-administered memory tasks, and assessed its diagnostic capability to detect MCI.

Materials and methods

Participants

The data collection was accomplished in the context of clinical research studies registered with ClinicalTrials Identifiers NCT01746303 and NCT00599508. We used print notices placed in a major local newspaper to recruit men and women aged 62 and older who were aware of mild, age-related memory decline for participation in the research. Those with diabetes, liver or kidney disease, prior diagnosis of neurologic or cognitive disorder, severe psychiatric condition, substance abuse, or regular use of sedating or psychostimulant medications were excluded.

Procedure

The recruitment notices instructed interested individuals to call our research phone line. University of Cincinnati Medical IRB-approved oral consent was obtained for participation in the telephone assessment, and participants signed the full, IRB-approved written informed consent document at the subsequent study visit. During the telephone contact, participants endorsed the statement that cognitive function had declined from a former level in order to document the presence of subjective cognitive decline (SCD; Jessen et al., 2020). This condition represents a self-experienced, persistent decline in cognitive capability not associated with significant functional impairment, an acute condition, or advanced neurodegeneration. Generally, the timeframe for such perceived cognitive decrement is five to ten years (Jessen et al., 2020). During the telephone contact we also administered the Academic and Medical History Questionnaire (Krikorian et al., 2004) to obtain information about educational attainment, medical conditions, and medication and supplement use, along with our modified version of the Memory Impairment Screen by Telephone (mMIST). Approximately 315 individuals were screened to achieve enrollment of 89 participants in the study.

In the mMIST task, a list of four common words, each representing a different semantic category, was presented orally at the rate of one word per second. Participants were asked to recall the list immediately after its initial presentation. Following the immediate recall, a category was introduced by the examiner and the participant was asked to produce the word from the list representing that category to provide controlled semantic cueing. If the response to the category cue was incorrect, the participant was reminded of the correct word. Then, a second list of four words was introduced and controlled curing with four different categories was performed so that the participant was exposed to a total of eight words and associated category cues. Participants were not informed during the learning trials that they would be asked to recall the words subsequently. A delay interval of three

minutes involved collection of demographic, medical, and educational information. Then, the participants were asked to recall as many of the eight words as possible. For any word not produced during this free recall trial, the previously established category cue was provided to facilitate recall. Two points were credited for each correct response during free recall and one point for each correct response during category cueing. The maximum total score was 16.

In order to determine stage of cognitive impairment we administered the Clinical Dementia Rating (CDR; Hughes et al., 1982). This instrument has been used extensively to classify older adults with respect to level of cognitive decline based largely on reports of functional capability in everyday activities (Morris, 1993). The original CDR is a semi-structured interview involving the patient or research participant and an informant, typically a spouse or adult child. The informant provides information concerning the functional capability of the participant and judgments are solicited concerning memory and other cognitive and functional domains. In this study, we administered the original CDR to 35 participants and their informants. In addition, 54 participants were administered the modified version of the CDR (mCDR; Duara et al., 2010), a structured interview assessment that relies on information about the participant provided by an informant. The mCDR has been shown to be highly correlated with the original version but is briefer, more reliable and valid, and offers enhanced discrimination of individuals with normal cognitive function from those with MCI (Duara et al., 2010). We found no difference in performances on objective cognitive tasks between those classified with the original CDR and those classified with the mCDR.

At the subsequent, in-person study visit scheduled within two weeks of the telephone screening, we performed further evaluation to measure overall intellectual ability, memory function, and mood, and to establish an independent classification of MCI or non-MCI. The Peabody Picture Vocabulary Test, third edition (PPVT-III; Dunn & Dunn, 1997) was used to estimate lexical knowledge and verbal IQ. This is a multiple-choice task that requires the participant to select a picture from among four options that depicts the meaning of a word presented orally by the examiner. We also administered the Montreal Cognitive Assessment (MoCA) to evaluate overall cognitive function (Nasreddine et al., 2005). The MoCA includes assessments of orientation, executive ability, attention, picture naming, visuospatial function, and memory that contribute to a maximum total score of 30. The MoCA has demonstrated sensitivity (90%) and specificity (87%) for detecting MCI for those who score less than 26 (Nasreddine et al., 2005). In addition to the total score, we calculated the Memory Index Score (Julayanont et al., 2014), which is derived from the five-word delayed recall task within the MoCA. The California Verbal Learning Test-II (CVLT; Delis et al., 2000) also was administered. This is a well-established word list learning task with extensive normative data that can differentiate normal from impaired memory performance in aging individuals. Participants are exposed to a list of 16 common words during five learning and immediate recall trials followed by exposure to a second, potentially interfering list. After a delay, recall and recognition memory testing are performed. We also included the Verbal Paired Associate Learning Test (VPAL; Krikorian, 1996). Paired associate learning makes cognitive demands that are different and generally more challenging than those involved in list learning (Krikorian, 1996). Participants are given four exposure and recall trials with 10 word pairs. Five of the pairs represent established semantic associations (such as north-south) and five pairs are composed of

semantically unrelated words (such as east-building). New associative learning is measured by the number of unrelated pairs acquired during the four learning trials. The 30-item Geriatric Depression Scale (GDS; Yesavage, 1988) was used to evaluate level of depressive symptomology that might influence cognitive performance.

MCI classification

In order to identify those with MCI we implemented a clinical consensus method with members of the research team including two neuropsychologists, the research coordinator, and an experienced research assistant. This method recapitulates the recommendations of Petersen (2004) to determine MCI. The consensus was informed by demographic information, the diagnostic classification based on the Clinical Dementia Rating (CDR; Hughes et al., 1982; Morris, 1993) or modified Clinical Dementia Rating (mCDR; Duara et al., 2010), and objective performance on the MoCA (Nasreddine et al., 2005). This consensus method classified 41 participants with MCI and 48 participants without MCI. In all cases, those judged to have MCI received CDR or mCDR classifications of 0.5 and scored less than 26 on the MoCA.

We also applied criteria recommended by Jak et al. (2009) to identify those with amnesic MCI (aMCI) within the MCI subgroup. This method prescribed that performances on a minimum of two objective measures of learning and memory fall more than 1 SD below the age-corrected level. For this purpose, we considered the cumulative learning score and long-delay free-recall score from the CVLT and the number of semantically unrelated pairs learned on the VPAL. Participants who scored one standard deviation below the mean for the study sample on at least two of these measures were classified as having the amnesic form of MCI ($n = 11$).

Data Analysis

T-tests were used to compare performances between diagnostic subgroups (MCI vs non-MCI; aMCI vs non-amnesic MCI) with respect to the performances on the mMIST, MoCA, MoCA memory index score, CVLT, and VPAL. Logistic regression was used to assess how well mMIST performance predicted MCI status. Correlations and multiple regression analyses also were used to determine how well mMIST performance predicted performances on the CVLT, VPAL, and MoCA. Descriptive and correlational analyses were performed with Statistica (StatSoft, Inc, 2010). Separate receiver operator characteristic (ROC) analyses were performed for each of the models; that is, identifying cases with MCI within the entire sample (Model 1) and identifying cases with amnesic MCI within the MCI subgroup (Model 2). A distance index [$d^2 = (1 - \text{sensitivity})^2 + (1 - \text{specificity})^2$] representing the misclassification rate was used to identify the cut score for each model by selecting the lowest value of d^2 . We derived mMIST score frequency data above and below the cut score to calculate Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV) for each model (Trevethan, 2017). Area under the curve (AUC) from each ROC plot also was used to assess predictive capability (Hajian-Tilaki, 2013; Zweig & Campbell, 1993). ROC analyses were performed with SAS 9.4M7, SAS Institute, Cary, NC, USA.

Table 1. Sample characteristics and summary cognitive performances.

	<i>N</i> = 89
Age, y	72.0 (6.7)
Education, y	15.1 (2.3)
PPVT-III, standard score	103.6 (10.5)
mMIST total score	12.1 (2.4)
MoCA total score	24.5 (2.7)
CVLT cumulative learning trials raw score	44.6 (10.6)
CVLT long delay free recall raw score	9.4 (3.5)
VPAL cumulative learning score	9.1 (5.1)
GDS total score	5.3 (3.8)

Note. PPVT-III = Peabody Picture Vocabulary Test-III. mMIST = modified Memory Impairment Screen by Telephone. MoCA = Montreal Cognitive Assessment. CVLT = California Verbal Learning Test-2. VPAL = Verbal Paired Associate Learning Test. GDS = Geriatric Depression Scale. Values represent *M* (*SD*) raw scores except where indicated otherwise.

Results

There were 89 participants; 40 were male and 49 were female. Table 1 contains sample characteristics and cognitive performance scores. On average, members of the sample were well-educated, exhibited average range lexical knowledge, and reported low levels of depressive symptoms.

There was no gender difference for mMIST performance for the total sample, $t = 1.32$, $p = 0.18$. In addition, there was no gender difference for mMIST performance among participants with MCI ($n = 21$ male, $n = 20$ female; $t = 0.01$, $p = 0.99$) or aMCI ($n = 6$ male, $n = 5$ female; $t = 1.71$, $p = 0.12$). However, in the non-MCI group, women ($n = 29$) performed better than men ($n = 19$) on the mMIST, $t = 1.99$, $p = 0.05$.

Table 2 shows performance scores by diagnostic group for the mMIST and the other cognitive tasks including the MoCA total score, the MoCA memory index score, the CVLT learning trials score, the CVLT long delay free recall score, and the VPAL cumulative score. Mean scores on all objective cognitive measures declined incrementally across diagnostic

Table 2. Performances on the modified memory impairment screen by telephone and other objective cognitive tasks by diagnostic subgroup.

	Non-MCI (<i>n</i> = 48)	MCI (all) (<i>n</i> = 41)	Non-amnesic MCI (<i>n</i> = 30)	Amnesic MCI (<i>n</i> = 11)
mMIST total score	13.3 (1.3)	10.8 (2.7)	11.3 (2.7)	9.4 (2.2)
MoCA total score	26.0 (2.3)	22.7 (2.2)	23.2 (2.0)	21.3 (2.2)
MoCA memory index score	2.9 (0.2)	0.9 (0.2)	1.0 (1.1)	0.5 (0.0)
CVLT learning trials	49.5 (9.5)	39.0 (9.0)	42.4 (7.5)	29.7 (5.7)
CVLT long delay free recall	11.1 (3.0)	7.5 (3.2)	8. (2.6)	4.0 (1.5)
VPAL	11.5 (4.2)	6.4 (4.7)	8.0 (4.4)	1.9 (1.6)

Note. mMIST = modified Memory Impairment Screen by Telephone. MoCA = Montreal Cognitive Assessment total score. MoCA memory index score = 5-word delayed free recall. CVLT = California Verbal Learning Test-2. VPAL = Verbal Paired Associate Learning Test cumulative hard associate score. Values represent *M* (*SD*) raw scores.

Diagnostic subgroup *t*-test comparisons for the mMIST, MoCA total score, MoCA memory index score, CVLT learning trials, CVLT long-delay free recall, and VPAL were statistically significant comparing non-MCI vs MCI ($p < 0.001$). Diagnostic subgroup *t*-test comparisons for amnesic MCI vs. non-amnesic MCI were statistically significant for CVLT learning trials, CVLT long delay recall, and VPAL at $p < 0.001$; for the mMIST at $p = 0.04$; and for the MoCA total score at $p = 0.01$. The *t*-test comparison for the MoCA memory index score for amnesic MCI vs non-amnesic MCI was not significant ($p < 0.21$). *T*-test comparisons between non-amnesic MCI and MCI (all) or amnesic MCI and MCI (all) were not performed because these subgroups were contained within the MCI (all) group.

groups that carried increasing risk for dementia. Specifically, participants without MCI exhibited significantly higher mean scores on all measures, followed by those with non-amnestic MCI. The amnestic MCI subgroup exhibited the lowest mean scores.

Logistic regression indicated that the mMIST differentiated non-MCI from MCI participants, $OR = 0.53$, $p < 0.01$, and identified participants with aMCI, $OR = 0.74$, $p = 0.04$. Correlational analyses showed that performance on the mMIST were associated with all other memory measures including the CVLT learning trials, $r = 0.49$, $p < 0.0001$; CVLT long-delay free recall, $r = 0.50$, $p < 0.0001$; associative learning on the VPAL, $r = 0.44$, $p < 0.0001$; MoCA total score, $r = 0.36$, $p < 0.001$; and MoCA memory index score, $r = 0.45$, $p < 0.0001$. Multiple regression also was used to predict MoCA performance with age, education level, GDS score, PPVT, and the mMIST as predictors. The overall model was significant, $F = 7.88$, $p < 0.0001$, with an overall fit (R^2) = 0.33. Significant predictors were age, standardized beta (β_{st}) = -0.15 , $p < 0.0001$; PPVT, $\beta_{st} = 0.08$, $p < 0.01$; and the mMIST, $\beta_{st} = 0.37$, $p < 0.01$, which was most strongly associated with MoCA performance.

We used Receiver Operator Characteristic (ROC) analyses to evaluate detection of MCI (Model 1) and detection of amnestic MCI (Model 2) based on mMIST performance. Table 3 shows the Sensitivity and Specificity values for mMIST scores for both models. With respect to discriminating MCI from non-MCI (Table 3, left panel), the mMIST cut score (13) was associated with the lowest misclassification rate. The associated ROC curve showed area under the curve (AUC) = 0.79 for identifying MCI (Figure 1, panel a). With respect to discriminating the amnestic MCI subgroup from non-amnestic MCI, the same cut score (13) was associated with the lowest misclassification rate (Table 3, right panel) and AUC = 0.82 (Figure 1, panel b).

We applied the cut score (13) to assess the adequacy and utility of the mMIST as a screening measure for each model by tabulating mMIST score frequencies above and below the cut score; that is, mMIST score counts >12 and ≤ 12 . Then, using the independent clinical consensus diagnoses we were able to determine the True positive, False positive, False negative, and True negative values for each model. These data were used

Table 3. Receiver Operator Characteristic (ROC) sensitivity and specificity analyses.

mMIST total score	MCI vs non-MCI			Amnestic MCI vs non-Amnestic MCI		
	Sensitivity ^a	Specificity ^b	d^2 ^c	Sensitivity ^a	Specificity ^b	d^2 ^c
16	0.042	0.976	0.918	0.039	1.000	0.924
15	0.146	0.927	0.735	0.130	1.000	0.757
14	0.188	0.951	0.662	0.143	1.000	0.734
13	0.417	0.878	0.355	0.299	0.833	0.519
12	0.854	0.171	0.709	0.169	0.917	0.698
11	0.979	0.146	0.730	0.922	0.083	0.847
10	0.958	0.122	0.773	0.935	0.167	0.698
9	1.000	0.024	0.953	1.000	0.083	0.841
8	1.000	0.146	0.729	0.948	0.167	0.697
7	1.000	0.073	0.859	1.000	0.250	0.563
6	1.000	0.024	0.953	0.013	1.000	0.974

mMIST = modified Memory Impairment Screen by Telephone. mMIST scores are whole numbers by design and recommended cut scores were determined accordingly. Data from the Model 1 ROC analysis (MCI vs non-MCI) is represented in the left panel. Data from Model 2 ROC analysis (amnestic MCI vs non-amnestic MCI) is represented in the right panel. Bold, italic text indicates the cut score in whole numbers determined for each model by the lowest misclassification rate (d^2). ^a Sensitivity = the proportion of individuals correctly identified as having memory impairment (MCI or amnestic MCI) or the true positive rate. ^b Specificity = the proportion of individuals correctly identified as not having memory impairment or the true negative rate. ^c d^2 = the misclassification rate calculated as $[(1 - \text{sensitivity})^2 + (1 - \text{specificity})^2]$.

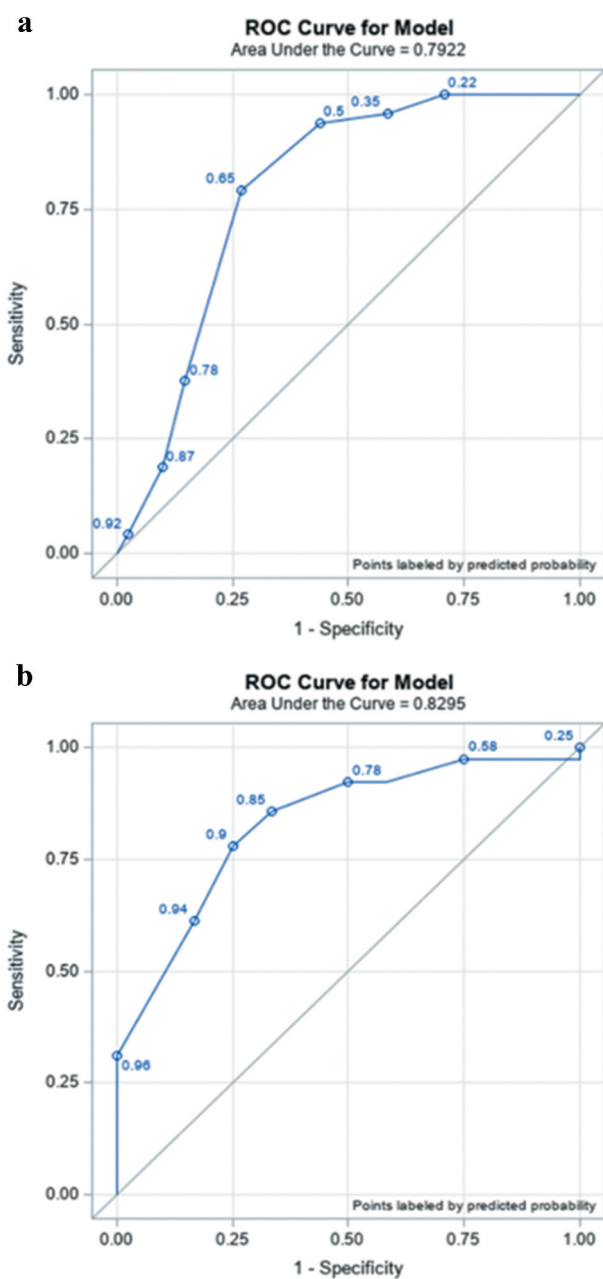


Figure 1. Panel a. ROC curve of the mMIST data for identifying MCI within the entire sample (AUC = 79.2%). Panel b. ROC curve of mMIST data for identifying amnesic MCI within the MCI subgroup (AUC = 82.9%). ROC = receiver operating characteristic. mMIST = modified memory impairment screen by telephone. AUC = area under the curve.

to calculate Model 1 Sensitivity = 73.1%, Specificity = 79.1%, Positive Predictive Value (PPV) = 75%, and Negative Predictive Value (NPV) = 77.5% for detection of MCI within the entire sample (Trevethan, 2017). The same method was used with regard to detection of the amnesic form of MCI among the MCI subgroup (Model 2) with Sensitivity = 81.8%, Specificity = 30%, PPV = 30%, and NPV = 81.8% (Trevethan, 2017).

Discussion

This study investigated the effectiveness of the mMIST, an instrument designed to be administered remotely to identify memory impairment consistent with MCI in older adults. We established the diagnosis of MCI using clinical consensus methodology to integrate information from the Clinical Dementia Rating and objective cognitive test performances. Further, memory test performance criteria developed empirically (Jak et al., 2009) were used to identify the amnesic MCI subgroup. As shown in Table 3, as a group, participants without MCI exhibited the highest mMIST scores, while those with MCI performed less well. Among participants with MCI, the amnesic subgroup performed least well, as expected.

We also demonstrated convergent validity with in-person, examiner-administered memory assessments as the mMIST predicted performances on objective verbal memory tasks involving different types of learning and recall including the CVLT, VPAL, and the MoCA memory index score. In addition, the mMIST predicted general cognitive function as assessed by the MoCA total score.

The ROC analyses indicated that the mMIST was able to distinguish those with MCI from cognitively unimpaired older adults (non-MCI) with AUC = 79.2. Generally, acceptable AUC for a screening instrument should fall between 0.7 and 0.8 (Hanley & McNeil, 1982). This was supported further by the Sensitivity, Specificity, and predictive values derived for identification of MCI. In particular, relatively high PPV indicates that the mMIST has reasonably good capability to detect True positive cases while avoiding False positive cases (Trevethan, 2017). In the second model (screening for amnesic MCI within the MCI group), those who scored ≤ 12 were identified as having amnesic MCI at a relatively high rate, Sensitivity = 81.8%, so that the mMIST generally detected amnesic MCI while avoiding False negative classifications. However, Specificity and PPV were low (30%), indicating that the mMIST was much less effective at excluding False positive cases of aMCI in this sample (Trevethan, 2017). It is likely that the low Specificity and PPV for detection of aMCI ($n = 11$) within the MCI group ($n = 41$) were a function of the small sample size of the aMCI subgroup, which reduced power to discriminate. This was the case despite the significantly lower performances of the aMCI subgroup on all the cognitive and memory tasks including the mMIST, even relative to those with non-amnesic MCI. With respect to screening for aMCI, the current data indicate a high rate of True and False positive detection, which is preferable, given the serious health implications of a higher False negative rate. The latter would imply failure to identify cases with markedly elevated risk for dementia.

The other instruments designed for remote detection of MCI include the TICS, TICS-m and the T-MoCA. None of these screening tasks was found to have predictive capability superior to the mMIST. The TICS was reported to have high Sensitivity for distinguishing demented from non-demented individuals and good Specificity for distinguishing

dementia from MCI but could not reliably distinguish MCI from non-MCI (Manly et al., 2011). The modification of the TICS (TICS-m) was reported to be effective in differentiating MCI from non-MCI, although Sensitivity, Specificity, and predictive values were not reported (Duff et al., 2009). In another investigation, the TICS-m was able to distinguish those with MCI from those with normal cognition with Sensitivity = 71.4% and Specificity = 78.3% (Knopman et al., 2010). The T-MoCA was evaluated in a diverse community sample from which individuals with dementia were excluded and Sensitivity and Specificity were reported to be 72% and 59%, respectively (Katz et al., 2021).

Overall, the findings indicated that the mMIST is a brief, valid, and effective screening tool for identifying the presence of memory impairment consistent with MCI. We expect that this task would have utility in clinical and research settings as a screening instrument to help determine whether subjective memory complaints reflect clinically significant memory decline and greater risk for progression. Because the mMIST can distinguish cognitively unimpaired older adults from those with MCI, this instrument would identify those for whom further cognitive evaluation is indicated, thereby serving as an early indicator of clinically significant memory decline.

There are several advantages to the mMIST. The brief administration time (about five minutes) allows for rapid screening. Further, the validated use by phone will increase accessibility, which has applications for both research and clinical purposes. We also have established preliminary validity with respect to multiple, established measures of memory and general cognitive function.

There are limitations associated with this research. Our sample is not representative of the general population given that we selected participants from the community based on self-perceived cognitive decline and excluded prospective participants with dementia and other neurocognitive disorders, with medication use known to affect cognition such as benzodiazepines and psychostimulants, and those with diabetes. However, in this initial study, we felt that a more homogeneous sample without complicating conditions would be appropriate to demonstrate effectiveness of the instrument. Notably, the sample did not include an adequate number of participants classified with the amnesic form of MCI, which almost certainly contributed to the less effective cut score to identify aMCI with adequate Specificity, although the cut score determined in this study did imply good Sensitivity with respect to aMCI. We expect that the Specificity for the detection of aMCI would be improved substantially if the mMIST were assessed with a larger sample. It has been emphasized that prioritizing Sensitivity over Specificity can be preferable, especially in the context of screening measures designed to assess conditions with serious health implications (Habibzadeh et al., 2016). We reasoned that risks associated with over-diagnosing MCI would be outweighed substantially by the risks related to False negative values, given that the latter might imply that no further assessment or treatment would be offered to those who had the condition but screened negative. In order to support early detection and intervention, we chose to increase the Sensitivity rate (Habibzadeh et al., 2016).

Developing and validating an alternate equivalent form of the mMIST would be useful for longitudinal investigations and clinical care. An alternate form also could be implemented in assessing the effectiveness of interventions over time and as an index of progression of neurocognitive decline. To expand its utility as a screening instrument and improve access to diverse and geographically distributed populations, the mMIST

also could be adapted and validated for self-administered, automated remote administration. We also have begun to evaluate its use in face-to-face settings, as well as during telehealth video visits.

In conclusion, the mMIST is a brief, effective screening tool to identify memory changes associated with MCI in older adults with subjective cognitive impairment. Its brevity, relative ease of administration, and usefulness for remote assessment make it amenable for use in both clinical and research settings.

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Disclosure statement

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