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Active case-finding of dementia in ambulatory care settings: a comparison of three strategies

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Abstract

Background: To reduce the diagnostic gap of dementia, 3 strategies can be employed for case-finding of cognitive impairment in ambulatory-care-settings, namely using informant-report, brief-cognitive-test, or combination of informant-report and brief-cognitive-test. The right strategy to adopt-across different healthcare settings-remains unclear. This diagnostic study compared the performance of the 3 strategies for detecting dementia (*primary aim*), as well as for detecting both mild-cognitive-impairment(MCI) and dementia (*secondary aim*).

Methods: Participants 65 years (n=11,057) were recruited from Alzheimer's-Disease-Centers across USA. Participants provided data on an informant-report (Functional-Activities-Questionnaire, FAQ), a brief-cognitive-test (4-item short-variant of Montreal-Cognitive-Assessment, MoCA), and a combined measure with informant-report and brief-cognitive-test (sum of FAQ and MoCA short-variant). They also received standardized assessments (clinical history, physical examination and neuropsychological testing) to diagnose MCI and dementia. Areas-under-the-receiver-operating-characteristic-curve(AUC) of the 3 strategies were compared using the DeLong method, with AUC>90% indicating excellent performance.

Results: All 3 strategies had excellent performance in detecting dementia, although informant-report (AUC=95.9%, 95%CI=95.4–96.3%) was significantly better than brief-cognitive-test (AUC=93.0%, 95%CI=92.4–93.6%), and combined measure had the best performance (AUC=97.0%, 95%CI=96.7–97.4%). However, to detect both MCI and dementia, only the combined measure had excellent performance (AUC=93.0%, 95%CI=92.5–93.4%), while stand-alone informant-report or brief-cognitive-test performed sub-optimally (AUC<90%). Performance of the 3 strategies was not affected by participants' age, educational attainment, or underlying prevalence of MCI and dementia.

Conclusions: For case-finding of dementia in ambulatory-care-settings, informant-reports would suffice as first-line measures, and brief-cognitive-tests may optionally be added-on-in

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DISCLOSURE OF CONFLICTS OF INTEREST

The author declares no financial or other conflicts of interest.

DATA SHARING AND DATA ACCESSIBILITY

The data were obtained from the National Alzheimer's Coordinating Center (NACC). For further information on access to the database, please contact NACC (contact details can be found at https://www.alz.washington.edu/WEB/researcher_home.html).

services with available resources—to further improve the accuracy of detection. For case-finding of both MCI and dementia, combination of informant-reports and brief-cognitive-tests remain the most appropriate strategy.

Keywords

Dementia; case finding; diagnostic gap; Functional Activities Questionnaire; Montreal Cognitive Assessment

INTRODUCTION

Dementia is consistently underdiagnosed around the world, with a recent meta-analysis – based on 23 studies from various countries – showing that 61.7% of older persons with dementia never received any formal diagnosis of the condition [1]. Without formal diagnosis of dementia, the older persons may not have access to the critical elements of dementia management – such as the prescription of cognitive enhancers [2–6], management of behavioral issues [7–11], and support for their caregivers [7–11] – which can impact on their well-being [8, 9] and put them at high-risk of premature nursing home placement [2–7, 10, 11]. In the presence of cognitive impairment, they may also have difficulty collaborating with healthcare professionals in managing their chronic diseases and adhering to medical advice on medications and lifestyle changes. Yet with the cognitive impairment unbeknownst to their physicians, they may not receive the necessary support that are relevant to individuals with cognitive impairment, such as medication reminders, case management, and home visits. Consequently, they can be at higher risk of inappropriate healthcare utilization related to missed appointments, emergency room visits, hospitalizations, and longer hospital stay [12, 13]. To address the issue of undiagnosed dementia, various international bodies (including the Alzheimer's Disease International [14], the International Association of Gerontology and Geriatrics [15] and the Gerontological Society of America [16]) have emphasized the importance of active case-finding among *high-risk groups* in ambulatory care settings. Notably, most international guidelines have contrasted active case-finding from universal screening (that intends to detect dementia in all patients regardless of their risk profile), and highlighted the relevance of active case-finding specifically among patients who are at high-risk of dementia. In particular, the International Association of Gerontology and Geriatrics recommends active case-finding among the older patients in current healthcare services, given that age is the strongest risk factor for dementia [15].

Conventionally, 3 strategies can be employed in the case-finding of dementia, that is, using *informant reports* alone (such as AD8 and Functional Activities Questionnaire) [17, 18], *brief cognitive tests* alone (such as Mini-Cog and short variants of Montreal Cognitive Assessment [MoCA]) [19–22] or *combined measures* that pair informant reports with brief cognitive tests [23–29]. Each case-finding strategy has inherent strengths and limitations, with the literature remaining unclear on the right strategy to adopt across different healthcare services with varying clinical resources and patient profiles. Although *informant reports* can be more convenient to administer in routine practice (requiring only self-administration by patients or family members), they are subjected to measurement errors related to informant's recall and desirability biases. In contrast, *brief cognitive tests* are less prone to informant-

related biases and can provide more accurate descriptions of current cognitive function. However, *brief cognitive tests* are more time-consuming, require the availability of trained personnel to administer, and can be prohibitive in services with high patient load and limited resources for test administration. *Combined measures* that pair informant reports with brief cognitive tests have been suggested in the literature to balance the limitations of stand-alone informant reports or brief cognitive tests [15], yet evidence on combined measures has been conflicting across different healthcare settings, with some studies demonstrating their better performance [23–26] while others reporting the contrary [27–29].

This study sought to compare the 3 strategies of case-finding (informant report, brief cognitive test, or combined informant report and brief cognitive test); and using a large sample from USA, aimed to provide more conclusive evidence on the right strategy to adopt across different healthcare services. As the study was based on the dataset from National Alzheimer's Coordinating Center (NACC), it utilized the informant report and brief cognitive test that were available in the dataset – namely the Functional Activities Questionnaire (FAQ) [18] and a short-variant of MoCA [30] – and compared the performance in dementia detection across the following 3 strategies:

1. FAQ alone;
2. MoCA short-variant alone;
3. Summed scores of FAQ and MoCA short-variant.

As a secondary aim, this study also examined the performance of the 3 strategies in detecting cognitive impairment (that is, capturing *both* mild cognitive impairment and dementia), considering that some healthcare services may also be interested to capture mild cognitive impairment for clinical trials [31] and preventive interventions (such as physical exercise, cognitive training, and management of cardiovascular risk factors) [32–36]. Additionally, as different healthcare settings often differ by patient characteristics (particularly, age and educational attainment) as well as underlying prevalence of cognitive impairment, the study also examined whether these factors (age, educational attainment, and underlying prevalence) would modify the performance of the 3 strategies and consequently, affect the choice of case-finding strategy across different healthcare settings.

METHOD

Participants and procedures

This cross-sectional diagnostic-study involved participants recruited from approximately 39 Alzheimer's Disease Centers across USA (as available in NACC dataset between March 2015 and August 2019) [37]. It was developed in accordance with the Standards for Reporting of Diagnostic Accuracy Studies in dementia and cognitive impairment (STARDdem) reporting guideline [38]. The study included those who fulfilled the following criteria: (1) age ≥ 65 years; (2) provided data on FAQ; and (3) provided data on MoCA. Of note, although only those with complete data on FAQ and MoCA were included in the primary analysis of this study, multiple imputation was conducted in subsequent sensitivity analyses to examine the robustness of the results to missing data. The Alzheimer's Disease

Centers obtained informed consent from participants, as well as received approval by their local institutional review boards.

Participants were accompanied by informants who knew them well (usually their spouse, child or friend) and took part in standardized assessments which included clinical history, physical examination and detailed neuropsychological testing (involving the domains of immediate memory, visuospatial abilities, delayed memory, language, attention, processing speed and executive function) [31, 39]. The clinical diagnoses were made based on the standardized assessments, with majority (83.6%) made via consensus conference and remainder made by single clinicians. Mild cognitive impairment (MCI) was diagnosed using modified Petersen criteria [40]; while dementia was diagnosed with McKhann (2011) criteria [41], with further classification into the primary etiologies of Alzheimer's dementia [41], vascular dementia [42], dementia with Lewy Bodies [43, 44], frontotemporal lobar degeneration [45–48], or other etiologies.

Measures

FAQ is an informant measure of the instrumental activities of daily living that can be affected in people with dementia (such as managing personal finances, shopping for groceries, and traveling in the neighborhood) [18]. Its 10 items were rated by informants on 4-point Likert scales, and could be summed [18] to generate a maximum score of 30. FAQ was used in this study as it was the only informant measure that was available in the NACC dataset. To align FAQ score in the same direction with that of MoCA short-variant, FAQ was reverse-coded in this study with higher scores indicating better functional abilities.

MoCA [49] is a widely-used cognitive test that assesses seven cognitive domains: Visuospatial/Executive, Naming, Attention, Language, Abstraction, Delayed recall and Orientation. It has a maximum score of 30, with higher scores corresponding to better cognition. Although MoCA is widely-regarded as a useful cognitive test, it often requires 10–15 minutes to administer [20] and may not be well-suited for case-finding efforts where large number of patients are involved. Consequently, various short-variants of MoCA have been developed in the literature to reduce its administration time. In a recent comparative study [22], the short-variant by Cecato (2016) [30] has been suggested to have better performance than the other short-variants of MoCA in distinguishing dementia from non-dementia, and hence were selected as the exemplar of brief cognitive test in this study. The short-variant by Cecato (2016) comprises 4 items (Clock-drawing, Naming–rhinoceros, Delayed-recall and Orientation), and has a maximum score of 15 [30]. It was previously developed by identifying MoCA items that are most discriminative of participants with dementia [30]. Of note, although the short-variant by Cecato (2016) was used in the primary analysis of this study, an alternative short-variant of MoCA [21] as well as the full version of the MoCA were also tested in the subsequent sensitivity analyses to examine the robustness of the results to the choice of brief cognitive test.

Statistical analyses

Area-under-the-receiver-operating-characteristic-curve (AUC) was computed and used as the primary metric to examine the performance of the 3 strategies (FAQ, MoCA short-variant, or

summed scores of FAQ and MoCA short-variant) in distinguishing dementia from non-dementia, with the analyses further stratified by educational attainment (≤ 12 years of education; and >12 years of education). AUC estimates the probability of correctly distinguishing dementia from non-dementia when a test is presented with pairs of dementia and non-dementia. It provides a convenient approach to compare the 3 strategies in this study, as AUC incorporates information on test sensitivity and specificity across all possible cut-off scores and circumvents the need to select arbitrary cut-off scores for comparison purposes. The use of AUC can also be particularly relevant in this study as there have not been well-established cut-off scores for FAQ or the combined measure based on FAQ and MoCA short-variant, and hence direct comparisons based on specific cut-off scores may not be possible across the three strategies. In general, $AUC > 0.9$ is deemed as excellent performance [50], and indicates that a strategy has low error-rate ($<10\%$) and is suitable for case-finding purposes. AUC were also compared among the 3 strategies via a non-parametric approach proposed by DeLong et al [20, 21, 31, 51–53], with *statistically*-significant differences defined as $p < 0.05$; and *clinically*-significant differences defined as AUC differences of $\geq 1\%$ (when a test is used for case-finding in a large population of say one million people, 1% difference in AUC would have translated into an additional 10,000 people being misclassified) [21].

For the secondary aim, the analyses were repeated to examine the performance of the 3 strategies in distinguishing *MCI and dementia* from normal cognition. Additionally, sensitivity analyses were conducted to assess robustness of the results:

1. among the younger participants between the age of 65 to 74 years;
2. among the older participants ≥ 75 years;
3. if the *prevalence of MCI and dementia* was artificially halved (this was done by *randomly* selecting and including only a subset of participants with MCI and dementia, so that the proportion of MCI and dementia was lowered by half in comparison to that in the present dataset);
4. if the brief cognitive test was based on an alternative short-variant of MoCA by Liew (2019) [21], instead of the short-variant by Cecato (2016). The MoCA short-variant by Liew (2019) comprises 4 items (Clock-drawing, Tap-at-letter-A, Orientation and Delayed-recall), and has a maximum score of 15 [21]. This short-variant was previously derived from MoCA using a computationally-intensive technique, which selected MoCA items that best distinguished dementia from non-dementia [21]. It was shown to have comparable performance to MoCA in dementia detection [21]. It also demonstrated better performance in dementia detection than the other short variants of MoCA, as well as 3 other commonly-used brief cognitive tests (Memory Impairment Screen [54], Mini-Cog [19] and GPCOG [55]) [21];
5. if the brief cognitive test was based on the original, full-version of MoCA (instead of the short-variants of MoCA);
6. If multiple imputation was used to address the missing data on FAQ and MoCA in NACC dataset (instead of excluding participants with such missing data).

Details on the conduct of multiple imputation are separately described in Supplementary Material 1.

All analyses were conducted in Stata (version 16).

RESULTS

Flow diagram related to participant selection is presented in Supplementary Material 2. Among the participants who were ≥ 65 years ($n=14,320$), 3,263 participants could not be included in the primary analysis due to missing data in FAQ or MoCA, resulting in the final sample size of 11,057 participants. A comparison of demographic information between those with and without missing data is shown in Supplementary Material 3. Those with missing data were more likely to be older, female, and non-White. In addition, those with missing FAQ were more likely to have normal cognition, while those with missing MoCA were more likely to have dementia. In the final sample that was included in the primary analysis ($n=11,057$), 53.9% had normal cognition, 22.7% had MCI and 23.4% had dementia. Among those with dementia ($n=2,589$), 70.9% had the primary etiology of Alzheimer's dementia, 1.3% had vascular dementia, 7.3% mixed Alzheimer's/vascular dementia, 6.7% dementia with Lewy Bodies, 11.6% frontotemporal lobar degeneration, and 2.2% due to other or unknown etiology. The participant characteristics of the final sample are further shown in Table 1.

All 3 strategies had excellent performance ($AUC > 90\%$) in detecting dementia (Table 2). However, informant report was significantly better than brief cognitive test (AUC 95.9% versus 92.7%), while combined measure had the best performance (AUC 97.0%). The results remained consistent across education subgroups. The sensitivity and specificity statistics are presented in Table 3. Informant report had 90.9% sensitivity and 88.6% specificity at the cut-off score of <27 ; while brief cognitive test had lower sensitivity and specificity (84.5% and 87.3%, respectively) at the cut-off score of <10 ; and combined measure had the best sensitivity and specificity (91.7% and 90.8%, respectively) at the cut-off score of <36 .

In contrast, for the detection of MCI and dementia, stand-alone informant report or brief cognitive test had poorer performance ($AUC < 90\%$), and combined measure was the only strategy that had excellent performance (AUC 92.9%) (Table 4). At the cut-off score of <41 , combined measure had 85.2% sensitivity and 85.7% specificity in detecting MCI and dementia. Detailed results on sensitivity and specificity statistics are presented in Table 5.

The results remained robust in the sensitivity analyses even when the performance of the 3 strategies were re-examined across the various scenarios, namely among younger participants aged 65–74 years (Supplementary Material 4–5), among older participants aged ≥ 75 years (Supplementary Material 6–7), when the prevalence of MCI and dementia was artificially halved (Supplementary Material 8–9), when an alternative MoCA short-variants was used (Supplementary Material 10–11), when the full-version of MoCA was used (Supplementary Material 12–13), and when the missing data on FAQ and MoCA were accounted for using multiple imputation (Supplementary Material 14–15).

DISCUSSION

This study sought to provide more conclusive evidence on the utility of 3 case-finding strategies (informant report, brief cognitive test, or combined informant report and brief cognitive test) for detecting cognitive impairment in ambulatory care settings. All 3 strategies had excellent performance in detecting dementia ($AUC > 90\%$), although informant report was better than brief cognitive test, and combined measure had the best performance. However, for detecting MCI and dementia, only the combined measure had excellent performance while stand-alone informant report or brief cognitive test performed sub-optimally ($AUC < 90\%$). Notably, performance of the case-finding strategies was not affected by participants' age, educational attainment, underlying prevalence of MCI and dementia, the different variants of a brief cognitive test, or the presence of missing data.

The findings on the performance of brief cognitive test are consistent with prior meta-analyses of brief cognitive tests [56, 57], where brief cognitive tests were generally shown to have better performance in detecting dementia than MCI. For example, in a recent meta-analysis focusing on dementia detection [56], the AUC for Addenbrooke's Cognitive Examination-Revised (ACE-R) was 96%, Mini-Cog 95%, and Mini-Mental State Examination 92%. In contrast, in a separate meta-analysis focusing on MCI detection [57], the AUC for ACE-R was 84%, Consortium to Establish a Registry for Alzheimer's Disease Battery (CERAD) 86%, MoCA 85%, and Mini-Mental State Examination 76%. Similarly, the findings on the better performance of combined measure are also consistent with some of the available evidence [23–25]. They are understandable, because informant reports and brief cognitive tests respectively capture the two criteria that are critical to the definition of MCI and dementia, namely subjective reports of cognitive decline and objective evidence of cognitive deficits [41, 58]. When used in combination, the two measures provide complementary information on individuals' cognitive status and hence would have better performance in detecting cognitive impairment. In particular, combined measure offers better performance in capturing MCI (on top of dementia), when stand-alone informant reports or brief cognitive tests would not have been sensitive enough in detecting earlier and more subtle cognitive impairment.

Contrary to the call for blanket use of combined measures to detect dementia (as recommended by some researchers in the field) [15], this study provided more clarity on the appropriate indications to use combined measures and potentially supports a more nuanced approach in case-finding efforts. For the purpose of detecting *dementia* in ambulatory care settings, a workflow similar to that presented in Figure 1 is prudent (especially among older patients who have reliable informants), where informant reports would have sufficed as first-line measures, given its excellent performance ($AUC > 90\%$), its better performance than brief cognitive tests, as well as its ease-of-administration (which can be especially critical in services with high patient load and limited resources). Optionally, in services with available resources, brief cognitive tests may still be added-on (as part of combined measures) to further improve the accuracy of dementia detection. Notwithstanding the above, brief cognitive tests can still be used as first-line measures if no suitable informants are available, given the similarly excellent performance of brief cognitive tests ($AUC > 90\%$) as shown in this study. Moreover, if the intention is to detect *cognitive impairment* (that is, capturing

both MCI and dementia), combined measures with both informant reports and brief cognitive tests would remain the most appropriate option as seen in this study.

The generalizability of the results may potentially come into question, as there can be genuine doubts on whether findings based on NACC dataset may apply to other healthcare settings that may have different age profiles, lower educational attainment (than the participants in NACC), or much lower prevalence of cognitive impairment (such as in primary care settings). This issue is pertinent, given the suggestions from recent literature that age [19], educational attainment [15, 19, 59, 60], and underlying prevalence of cognitive impairment [61] may impact on the performance of case-finding instruments and consequently, the choice of case-finding strategy. This concern was addressed in the sensitivity analyses, by stratifying the results by age and education subgroups, and by examining the effects of underlying prevalence of cognitive impairment. Of which, the study demonstrated the inconsequential effects of age, educational attainment and underlying prevalence on the choice of case-finding strategy, and suggests the potential applicability of the findings even across different healthcare services with varying patient profiles.

The findings should be considered in the light of the strengths and limitations of this study. The study has the strengths of well-characterized samples (with standardized assessments, and rigorous diagnostic evaluations of cognitive impairment), as well as a large number of participants that were recruited from across USA. At the same time, the study also has several limitations that should be noted. First, the participants in the study involved those who volunteered at the Alzheimer's Disease Centers, which may have explained the higher prevalence of dementia (23.4%) compared to those commonly reported in community-settings. Taking this limitation into consideration, the findings from this study is probably less generalizable to patients in community settings, and mostly applicable to patients in ambulatory care settings, where patients often present voluntarily to healthcare services (not unlike those who volunteered in this study) [62, 63]. Second, majority of the participants with dementia (70.9%) had the primary etiology of Alzheimer's dementia. Although such large proportion of Alzheimer's dementia is consistent with what is expected of the older population with dementia, the findings may vary in other populations with a different composition of dementia etiologies. Third, FAQ and MoCA short-variant may not necessarily be the most commonly used measures in many clinical practices, and were only used in this study as exemplars of informant reports and brief cognitive tests. Although they provided estimations on the relative performance across the 3 strategies, the results may plausibly vary when alternative measures are used. Fourth, the primary analysis in this study excluded participants with missing data in FAQ or MoCA, which may arguably bias the findings. However, further sensitivity analyses – using multiple imputation – showed that the results remained consistent even when these missing data could be accounted for. Although there can be other approaches to address missing data in diagnostic studies [64], multiple imputation can be a particularly useful approach to address the missing data in this study, given that there were many auxiliary variables that differed significantly between those with and without missing data (Supplementary Material 3), and hence these auxiliary variables could be included in multiple imputation to predict the missing data.

CONCLUSIONS

This study sought to identify the right strategy to employ for case-finding of cognitive impairment – across different ambulatory care settings with varying clinical resources and patient profiles – and potentially provide a more nuanced approach in case-finding efforts. As shown in this study, informant reports would suffice for case-finding of dementia, although brief cognitive tests may optionally be added-on – in services with available resources – to further improve the accuracy of dementia detection. For case-finding of both *MCI and dementia*, combined measures are preferred, as stand-alone informant reports or brief cognitive tests perform sub-optimally. Notably, the choice of case-finding strategy is not dependent on age profile, educational attainment, or prevalence of cognitive impairment of the clinical population.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

A proposed workflow to facilitate the active detection of dementia in ambulatory care settings, among older patients who have reliable informants.

FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment.

^aThe cut-off age, as well as the frequency, of case finding depends on the available resources and the risk profile of the patients in the respective healthcare services. ^b The original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant.

Table 1.

Characteristics of the study participants at baseline (n=11,057)

Variable	Overall sample (n=11,057)	Normal cognition (n=5,958)	MCI (n=2,510)	Dementia (n=2,589)
Age, median (IQR)	75 (70–80)	74 (69–79)	76 (71–81)	76 (71–82)
Female sex, n (%)	6,381 (57.7)	3,862 (64.8)	1,262 (50.3)	1,257 (48.6)
Years of education, median (IQR)	16 (14–18)	16 (14–18)	16 (14–18)	16 (13–18)
Ethnicity, n (%)				
White	9,007 (81.5)	4,775 (80.1)	2,020 (80.5)	2,212 (85.4)
African American	1,300 (11.8)	770 (12.9)	309 (12.3)	221 (8.5)
Others/Unknown	750 (6.8)	413 (6.9)	181 (7.2)	156 (6.0)
FAQ total score, median (IQR) ^a	30 (24–30)	30 (30–30)	29 (25–30)	13 (7–20)
MoCA total score, median (IQR)	24 (20–27)	26 (24–28)	22 (20–25)	15 (11–19)

IQR, interquartile range; MCI, mild cognitive impairment; FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment.

^aThe original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant. Higher scores indicate better functional abilities. As the participants may find some FAQ items inapplicable to them, those who provided data on at least 5 out of the 10 items in FAQ were included in this study, with the total score rescaled to match the maximum score of 30 (the total score was divided by the number of items completed, and multiplied by 10).

Table 2.

Comparing the performance of the 3 case-finding strategies in distinguishing dementia from non-dementia in: (a) overall sample; (b) 12 years of education; and (c) >12 years of education.

Case-finding strategy	AUC, % (95% CI)	P-value ^a
<u>(a) Overall sample (n=11,057)</u>		
Informant report (FAQ) ^b	95.9 (95.4–96.3)	Reference
Brief cognitive test (MoCA short-variant) ^c	92.7 (92.1–93.3)	<0.001
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	97.0 (96.6–97.3)	<0.001
<u>(b) 12 years of education (n=1,848)</u>		
Informant report (FAQ) ^b	95.2 (94.2–96.2)	Reference
Brief cognitive test (MoCA short-variant) ^c	92.6 (91.2–93.9)	<0.001
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	96.6 (95.9–97.3)	<0.001
<u>(c) >12 years of education (n=9,209)</u>		
Informant report (FAQ) ^b	95.9 (95.4–96.5)	Reference
Brief cognitive test (MoCA short-variant) ^c	92.6 (91.9–93.3)	<0.001
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	97.0 (96.5–97.4)	<0.001

FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment; AUC, area under the receiver operating characteristics curve; CI, confidence interval.

^aBonferroni-adjusted p-values, based on comparisons of AUC with that of FAQ (reference).

^bThe original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant.

^cBased on the MoCA short-variant by Cecato (2016), comprising Clock-drawing, Naming–rhinoceros, Delayed-recall and Orientation.

^dThe sum of FAQ (reverse-scored) and MoCA short-variant.

Table 3.

The sensitivity and specificity of the 3 case-finding strategies, at various cut-off scores, in distinguishing dementia from non-dementia.

Cut-off	Overall sample ^a		12 years of education ^a		>12 years of education ^a	
	Se, %	Sp, %	Se, %	Sp, %	Se, %	Sp, %
Informant report (FAQ) ^b						
<23	82.1	95.4	82.0	94.1	82.1	95.6
<24	83.9	94.4	83.6	92.6	84.0	94.7
<25	86.5	92.8	85.6	90.6	86.8	93.2
<26	88.3	91.3	87.3	88.6	88.6	91.7
<27	90.9	88.6	90.3	84.9	91.0	89.2
<28	93.7	85.2	93.9	80.7	93.6	85.9
<29	95.7	81.0	96.3	75.8	95.5	81.9
Brief cognitive test (MoCA short-variant) ^c						
<8	61.7	97.6	71.3	95.2	58.5	98.0
<9	74.9	93.8	84.1	88.5	71.9	94.7
<10	84.5	87.3	90.3	78.3	82.6	88.8
<11	90.7	76.9	93.9	62.9	89.7	79.3
<12	93.9	66.0	95.9	50.8	93.2	68.5
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d						
<31	80.7	96.7	82.0	95.5	80.3	96.9
<32	82.8	95.9	83.6	94.2	82.5	96.2
<33	85.6	94.9	86.1	92.3	85.4	95.3
<34	87.8	93.8	87.2	90.0	88.0	94.4
<35	89.8	92.4	90.3	88.3	89.7	93.0
<36	91.7	90.8	93.0	86.5	91.3	91.5
<37	93.4	89.0	95.2	83.4	92.9	90.0
<38	94.5	86.8	95.9	80.5	94.0	87.8
<39	96.1	82.9	98.1	75.0	95.4	84.2

FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment; Se, sensitivity; Sp, specificity.

^aThe optimal cut-off score is bold-faced and based on a balance between sensitivity and specificity.

^bThe original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant.

^cBased on the MoCA short-variant by Cecato (2016), comprising Clock-drawing, Naming–rhinoceros, Delayed-recall and Orientation.

^dThe sum of FAQ (reverse-scored) and MoCA short-variant.

Table 4.

Comparing the performance of the 3 case-finding strategies in distinguishing mild cognitive impairment and dementia from normal cognition in: (a) overall sample; (b) 12 years of education; and (c) >12 years of education.

Case-finding strategy	AUC, % (95% CI)	P-value ^a
<u>(a) Overall sample (n=11,057)</u>		
Informant report (FAQ) ^b	87.7 (87.1–88.3)	Reference
Brief cognitive test (MoCA short-variant) ^c	88.5 (87.9–89.1)	0.076
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	92.9 (92.4–93.4)	<0.001
<u>(b) 12 years of education (n=1,848)</u>		
Informant report (FAQ) ^b	87.7 (86.3–89.1)	Reference
Brief cognitive test (MoCA short-variant) ^c	87.6 (86.0–89.1)	1.00
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	91.5 (90.2–92.7)	<0.001
<u>(c) >12 years of education (n=9,209)</u>		
Informant report (FAQ) ^b	87.6 (86.9–88.3)	Reference
Brief cognitive test (MoCA short-variant) ^c	88.4 (87.7–89.1)	0.105
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d	93.0 (92.5–93.6)	<0.001

FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment; AUC, area under the receiver operating characteristics curve; CI, confidence interval.

^a Bonferroni-adjusted p-values, based on comparisons of AUC with that of FAQ (reference).

^b The original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant.

^c Based on the MoCA short-variant by Cecato (2016), comprising Clock-drawing, Naming–rhinoceros, Delayed-recall and Orientation.

^d The sum of FAQ (reverse-scored) and MoCA short-variant.

Table 5.

The sensitivity and specificity of the 3 case-finding strategies, at various cut-off scores, in distinguishing mild cognitive impairment and dementia from normal cognition.

Cut-off	Overall sample ^a		12 years of education ^a		>12 years of education ^a	
	Se, %	Sp, %	Se, %	Sp, %	Se, %	Sp, %
Informant report (FAQ) ^b						
<27	62.5	97.7	66.1	95.6	61.5	98.0
<28	67.9	96.3	71.8	94.2	66.8	96.6
<29	73.1	94.0	76.2	90.9	72.3	94.4
<30	80.0	89.0	81.4	86.5	79.6	89.3
Brief cognitive test (MoCA short-variant) ^c						
<9	46.8	98.7	59.4	96.9	43.3	99.0
<10	59.5	96.2	69.8	90.5	56.7	97.0
<11	72.0	89.4	80.2	77.9	69.7	91.0
<12	80.8	80.0	86.2	65.4	79.3	82.1
<13	89.1	63.8	92.1	46.1	88.2	66.3
Informant report and Brief cognitive test (FAQ + MoCA short-variant) ^d						
<38	67.8	98.1	74.1	95.6	66.0	98.5
<39	72.9	96.4	78.9	91.8	71.2	97.0
<40	78.9	92.9	83.2	85.4	77.8	94.0
<41	85.2	85.7	88.0	73.2	84.5	87.5
<42	90.1	75.6	92.5	60.1	89.4	77.8
<43	94.5	60.0	95.7	42.0	94.2	62.5

FAQ, Functional Activities Questionnaire; MoCA, Montreal Cognitive Assessment; Se, sensitivity; Sp, specificity.

^aThe optimal cut-off score is bold-faced and based on a balance between sensitivity and specificity.

^bThe original FAQ was reverse-scored to align its total score in the same direction with that of MoCA short-variant.

^cBased on the MoCA short-variant by Cecato (2016), comprising Clock-drawing, Naming–rhinoceros, Delayed-recall and Orientation.

^dThe sum of FAQ (reverse-scored) and MoCA short-variant.