Received: 27 February 2020 | Accepted: 11 April 2020

DOI: 10.1002/gps.5312

RESEARCH ARTICLE

International Journal of Geriatric Psychiatry WILEY

Validation of the Brief Assessment of Impaired Cognition and the Brief Assessment of Impaired Cognition Questionnaire for identification of mild cognitive impairment in a memory clinic setting

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Funding information
Ministeriet Sundhed Forebyggelse, Grant/Award Number: 1604063

Objectives: The aim of this study was to validate the Brief Assessment of Impaired Cognition (BASIC) and the Brief Assessment of Impaired Cognition Questionnaire (BASIC-Q) for identification of mild cognitive impairment (MCI) in a memory clinic setting.

Methods: A total of 163 sociodemographically matched patients (MCI, n = 42, and dementia, n = 121) and 83 control participants were included in the study. Two instruments were validated: (a) BASIC, including the components self-report, informant report, and two brief cognitive tests, and (b) BASIC-Q, including the components self-report, informant report, and orientation. BASIC can be administered in 5 minutes and BASIC-Q in less than 5 minutes.

Results: A high discriminative validity for MCI vs control participants was found for both BASIC (sensitivity 0.86, specificity 0.89) and BASIC-Q (sensitivity 0.88, specificity 0.88). In comparison, the MMSE had low sensitivity (0.61) and moderate specificity (0.72). All components of BASIC and BASIC-Q contributed significantly to differentiate MCI from control participants. The components of BASIC and BASIC-Q also contributed significantly to differentiate MCI from dementia, except for self-report, which was identical in the two groups.

Conclusions: Both BASIC and BASIC-Q are brief, valid, and effective instruments for identification of patients with possible MCI in a memory clinic setting. Further cross-validation of the instruments in a general practice or primary care setting is needed.

KEYWORDS

BASIC, BASIC-Q, cognitive assessment, cognitive screening, dementia, diagnostic accuracy, discriminative validity, mild cognitive impairment, predictive validity

1 | INTRODUCTION

Brief, accurate, and practical case-finding instruments are highly relevant for identification of mild cognitive impairment (MCI) in a clinical setting. MCI is clinically defined as a condition where the person is not cognitively intact, but without dementia, and with preserved basic activities of daily living. Historically, clinical criteria for MCI, focusing on memory impairment, were initially defined by Ronald Petersen,[1,2] but in 2004 a broader conception including both amnestic and non-amnestic MCI-subtypes was introduced[3,4] which has essentially been adopted by subsequent definitions and elaborations of MCI-criteria.[5-7]

Estimates of the prevalence of MCI from epidemiological studies show considerable variation which may be attributed to differences in methodology and definitions of MCI,[8] but the majority of studies report a prevalence in the range of 12% to 18% in people aged 60 years or older.[9] In clinical samples, the prevalence is even higher. Thus, in Danish memory clinics approximately 25% of newly referred patients are subsequently assigned a diagnosis of MCI.[10]

In a clinical context, both the differentiation between normal ageing and MCI and the differentiation between MCI and mild dementia may be a challenge. Cognitive tests and brief test batteries[11-15] are often used for identification of dementia and MCI but the time needed for test administration (10 minutes or more) may be a disadvantage in a busy clinical setting, test performance may be influenced by sociodemographic variables such as education and age,[16-23] and some test items (such as Serial sevens in The Mini-Mental State Examination, MMSE,[11] and in the Montreal Cognitive Assessment, MoCA[12]) may be perceived as difficult or confrontational possibly causing unnecessary discouragement during testing. According to a meta-analysis of 19 studies,[24] the MMSE has acceptable specificity but low sensitivity for detection of MCI vs healthy controls. A systematic review of cognitive screening instruments for identification of MCI vs controls from 2009 identified 15 screening measures, four of which had sensitivity and specificity values ≥0.79, whereas the rest performed less favourably.[25] Another systematic review identified more than 40 brief cognitive instruments for identification of amnestic MCI vs controls, of which the MoCA was the most comprehensively investigated.[26] Neuropsychological measures of immediate and delayed memory generally have acceptable accuracy for detection of MCI vs healthy controls,[27] and also seem to be accurate in predicting progression from MCI to dementia.[28] Neuropsychological assessment, however, is relatively time consuming and access to neuropsychological assessment may be limited in clinical practice. Consequently, there is a need for accurate, time-saving and nonconfrontational tools for identification of MCI in a clinical setting.

We have previously developed and validated two new brief case-finding instruments in a Danish multicenter study: The Brief Assessment of Impaired Cognition (BASIC),[29] and the Brief Assessment of Impaired Cognition Questionnaire (BASIC-Q).[30] We found BASIC to be highly accurate in classifying dementia (sensitivity 0.98, specificity 0.95), while BASIC-Q, that is primarily intended for use in community settings, was highly accurate in classifying cognitive impairment (including dementia and MCI; sensitivity 0.92, specificity 0.97). Both instruments appear to be relatively unaffected by sociodemographic characteristics.[29,30] The aim of this study was to examine the ability of the BASIC and BASIC-Q to identify MCI in a memory clinic setting.

Key points

- Accurate, time-saving, and easy-to-use tools for identification of mild cognitive impairment (MCI) in a clinical setting are valuable. The present results indicate that patients with possible MCI for whom further diagnostic assessment should be considered may be identified by means of a brief case-finding instrument integrating self-report and informant report with either cognitive assessment (BASIC) or questions regarding orientation (BASIC-Q). The administration time for each instrument is 5 minutes or less.
- BASIC and BASIC-Q are perceived by patients and relatives as relevant and nonconfrontational. Both instruments appear to be less affected by education, age, and gender than more complex instruments such as the Mini-Mental State Examination (MMSE) or the Montreal Cognitive Assessment (MoCA).
- The self- and informant report components of BASIC and BASIC-Q are equally valid measures of cognitive impairment early in the process of decline, but as dementia sets in, the validity of self-report becomes inferior to informant report, possibly reflecting loss of insight. In contrast, the validity of informant report seems to increase with the progression of cognitive impairment.

2 | METHODS

BASIC and BASIC-Q include identical self-report and informant report components, but BASIC additionally includes two brief cognitive tests: Supermarket Fluency, and Category Cued Memory Test, whereas BASIC-Q instead includes four orientation items (Table 1).

BASIC and BASIC-Q were inspired by existing, validated instruments[31-33] and includes elements from validated questionnaires.[34,35] According to interviews with patients and informants, BASIC and BASIC-Q are perceived as relevant and nonconfrontational.[29] A total BASIC score is obtained by summing the scores of four components into a composite score (range 0-25 points), whereas a total BASIC-Q score is obtained by summing the scores of three components into a composite score (range 0-20 points). If reliable informant report cannot be obtained, a pro-rated score estimate may be used in both instruments. Although BASIC and BASIC-Q are separate instruments intended for use in different settings, they were derived from the same preliminary instrument and were validated simultaneously in the

TABLE 1 Brief Assessment of Impaired Cognition (BASIC) case-finding instrument and Brief Assessment of Impaired Cognition Questionnaire (BASIC-Q)

BASIC	Score range	BASIC-Q	Score range
1. Self-report		1. Self-report	
Three questions from the Cognitive Function Instrument (CFI) regarding self-rated memory functioning	0 to 6	(Items identical to BASIC)	0 to 6
2. Supermarket fluency		2. Orientation	
With an interval scoring algorithm	0 to 5	Orientation in time (year, month, day of week) and orientation in person (age)	0 to 8
3. Category cued memory test			
Free and category cued recall of four pictures	0 to 8		
4. Informant report		3. Informant report	
Three questions from the Informant Questionnaire of Cognitive Decline (IQCODE) regarding the cognitive functioning of the patient	0 to 6	(Items identical to BASIC)	0 to 6
BASIC total score	*0 to 25*	*BASIC-Q total score*	*0 to 20*

Note: Optimal BASIC cutoff score for mild cognitive impairment (MCI) vs control group is 21/22. Optimal BASIC-Q cutoff score for MCI vs control group is 17/18.

same setting. In this study, we therefore present results for both instruments regarding identification of MCI.

2.1 | Participants

The study was carried out in accordance with the Code of Ethics of the World Medical Association for experiments involving humans and was approved by the Danish Data Protection Agency (RH-2018-34). Written informed consent was obtained from all participants. A clinical sample and a control sample was included and assessed in 2018. Inclusion criteria for all participants were (a) age ≥65 years, (b) being fluent in Danish, (c) a relevant informant (eg, relative) present at the examination, (d) referred from general practice for diagnostic evaluation. Five Danish outpatient memory clinics recruited participants and collected data.

Patients were consecutively included at their initial memory clinic admission and administered a preliminary instrument containing both BASIC and BASIC-Q. Patients further underwent an extensive diagnostic work-up as described in a previous publication.[29] Dementia was diagnosed according to National Institute of Aging and Alzheimer's Association (NIA-AA) workgroup criteria[36] and clinical research criteria were used for specific subtypes of dementia disorders.[37-39] The diagnosis of MCI adhered to revised Petersen criteria[4,40] including both amnestic and nonamnestic phenotypes. All MCI patients underwent comprehensive neuropsychological assessment including tests of episodic memory (eg, Rey Auditory Verbal Learning Test,[41] Rey Complex Figure Test[42]), semantic memory/language (eg, Boston Naming Test[43]), executive functions (eg, verbal fluency measures[44]), processing speed (eg, Trail Making Test[45]), and visuoconstructional skills (eg, Block Design Test[46]). The control sample was recruited among participating patients' relatives (mainly spouses) and volunteers from ongoing research projects at the involved memory clinics. Exclusion criteria for the control sample have been previously described.[29]

2.2 | Procedure

The validation of BASIC and BASIC-Q for identification of MCI is based on further analysis of data from the primary validation of the two instruments, which was a prospective study in which patients were assessed prior to diagnosis.[29] In most cases, diagnosis was established 1 to 3 months later. At each site, the preliminary instrument was administered by trained nurses or physicians. Administration was standardized across memory clinics. Informants concurrently completed a brief informant report questionnaire. Control participants served as their own informants. Age, gender, and postsecondary education (type and approximate length of education exceeding compulsory education), were registered for all participants.

2.3 | Data analysis

The significance of group differences on continuous variables was determined using independent samples *t*-test. The significance of group differences in gender distribution was determined using the Pearson χ^2 test. Effect sizes were calculated as Hedges' *g*.[47] Effect sizes of 0.2 to 0.5 were considered small, >0.5 to 0.8 were considered moderate and >0.8 were considered large. Discriminative validity was assessed by calculating sensitivity, specificity and likelihood ratios using a clinical diagnosis of MCI as reference standard. The optimal balance between sensitivity and specificity for discrimination between groups was determined by Youden's J.[48] Receiver operating

TABLE 2 Demographic and cognitive participant characteristics

	Controls	MCI	Dementia
Number	83	42	121
Age (y)	74.7 (5.56)	74.3 (4.77)	76.0 (4.87)
Postsecondary education (y)	2.3 (1.56)	2.4 (1.64)	2.1 (1.52)
Female/male	36/47	11/31	50/71
BASIC (range 0-25)	23.4 (1.31)	17.9 (3.33)[a]	13.5 (3.70)[c]
BASIC-Q (range 0-20)	18.9 (1.11)	14.6 (2.76)[a]	10.9 (3.57)[c]
MMSE (range 0-30)	28.7 (1.65)	27.0 (3.15)[b]	22.6 (4.37)[c]
Components of BASIC and BASIC-Q:			
• Self-report (range 0-6)	5.2 (0.92)	3.7 (1.20)[a]	3.7 (1.63)
• Informant report (range 0-6)	5.8 (0.43)	3.3 (1.71)[a]	1.8 (1.51)[c]
• Category cued memory test (range 0-8)	7.7 (0.53)	7.0 (1.33)[b]	5.6 (2.16)[c]
• Supermarket fluency (range 0-5)	4.7 (0.74)	3.8 (1.11)[a]	2.5 (1.32)[c]
• Orientation (range 0-8)	7.9 (0.38)	7.5 (0.86)[b]	5.4 (2.64)[c]

Note: Ages and scores are reported as mean and SD.
Abbreviations: BASIC, Brief Assessment of Impaired Cognition; BASIC-Q, Brief Assessment of Impaired Cognition Questionnaire; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination.
[a]MCI vs control sample comparison: $P < .001$ (two-tailed).
[b]MCI vs control sample comparison: $P < .01$ (two-tailed).
[c]MCI vs dementia sample comparison: $P < .001$ (two-tailed).

characteristic (ROC) curves for BASIC, BASIC-Q, and MMSE were constructed and the areas under the curve (AUC) were compared using the nonparametric approach by DeLong et al[49] for correlated ROC curves. Predictive validity was calculated according to Bayes' classical theorem.[50] Positive predictive validity (PPV) is essentially the proportion of individuals screening positive at a given cutoff score and later being assigned a diagnosis of MCI, whereas negative predictive validity (NPV) is the proportion screening negative and being without MCI. PPV can also be interpreted as an estimate of the probability of MCI for individuals scoring positive according to a given cutoff, whereas NPV may work as an estimate of the probability of being without MCI for individuals scoring negative according to the cutoff. The diagnostic classification performance of BASIC, BASIC-Q and their components was further estimated by calculating odds ratios (OR) using binary logistic regression. The OR represents the change in odds of being in one of two diagnostic categories when the value of the independent (predictor) variable increases by one unit.[51] An online clinical research calculator (www.vassarstats.net) was used to calculate 95% confidence intervals (CI) for sensitivity, specificity, PPV, and NPV. MedCalc statistical software was used for comparison of ROC curves (www.medcalc.org). All other analyses were performed with IBM SPSS Statistics (version 25). $P < .05$ (two-tailed) was considered significant.

3 | RESULTS

From the primary BASIC and BASIC-Q validation study, 428 participants (293 cases and 135 controls) were eligible for inclusion. In the patient sample, 14% of the participants were diagnosed with MCI, 57% were diagnosed with dementia and 29% with other, mainly neurological or psychiatric conditions. To minimize the possible impact of sociodemographic variables on the discriminative validity analyses, we selected three sociodemographically matched subsamples through stepwise exclusion of participants from the control group and dementia group until statistically significant differences in age, education and gender between the three groups were suspended: (a) an MCI group (n = 42); (b) a matched control group (n = 83); and (c) a dementia group (n = 121; Table 2). The mixed clinical sample with neurological or psychiatric conditions was not included in the analyses. Sociodemographic and cognitive characteristics of the included matched samples are summarized in Table 2.

The dementia group included Alzheimer's disease (AD; n = 61), vascular dementia (n = 19), Lewy body dementia (n = 8), mixed dementia (n = 8), dementia not otherwise specified (n = 8), frontotemporal dementia (n = 7), Parkinson's disease dementia (n = 4), alcohol-related dementia (n = 3), and other causes of dementia (n = 3). Significant differences with large effect sizes were present between MCI and controls on BASIC (t [123] = 10.34, $P < .001$, g = 2.50) and BASIC-Q (t [123] = 9.86, $P < .001$, g = 2.37). A significant difference with a moderate effect size was found between MCI and controls on MMSE (t [123] = 3.20, $P < .01$, g = 0.73; Table 2). Further information regarding the score distribution for BASIC in the three samples are depicted in Figure 1. Information regarding the score distributions for BASIC-Q and MMSE in the three samples are shown in the Figures S1 and S2.

Significant differences with moderate to large effect sizes were present between MCI and controls on the components of BASIC and BASIC-Q: Self-report (t [123] = 7.18, $P < .001$, g = 1.47), Informant report (t [123] = 8,92, $P < .001$, g = 2.36), Category Cued Memory Test

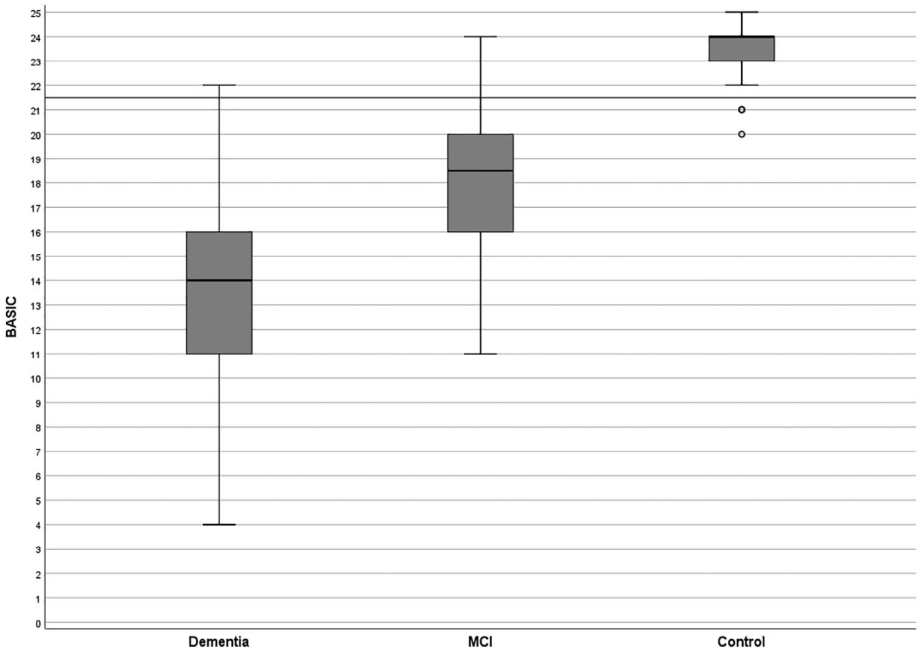

FIGURE 1 Boxplot of score distribution for BASIC. The median for each data set is indicated by the black center line and the upper and lower horizontal lines of each bar represent the 75th and 25th percentile scores, respectively. Maximum and minimum scores are depicted by the ends of the lines extending from the boxes. Outliers are indicated by small circles. The horizontal reference line represents the optimal cutoff score (21/22) for differentiating between the MCI and control group. BASIC, Brief Assessment of Impaired Cognition; MCI, mild cognitive impairment

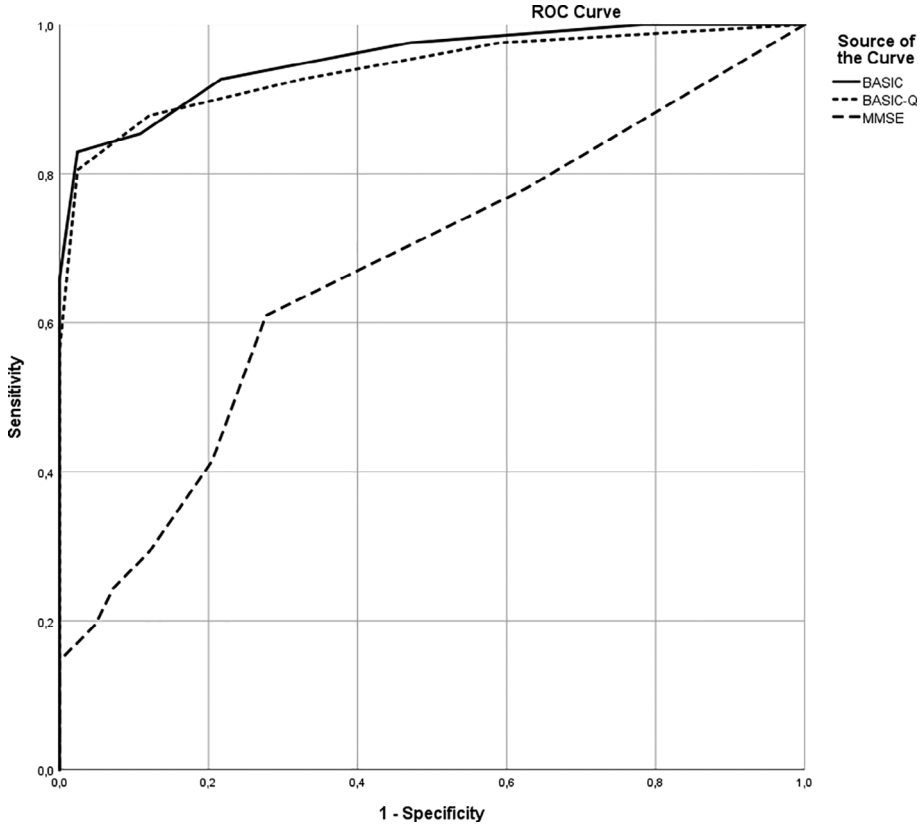

FIGURE 2 Receiver operating characteristics of BASIC, BASIC-Q, and MMSE as case-finding tools for MCI vs control sample. Areas under the ROC curve (AUC): BASIC = 0.95 (95% CI 0.91-1.00); BASIC-Q = 0.94 (95% CI 0.89-0.99); MMSE = 0.67 (95% CI 0.56-0.77). BASIC, Brief Assessment of Impaired Cognition; BASIC-Q, Brief Assessment of Impaired Cognition Questionnaire; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination

(t [123] = 3.27, P = .002, g = 0.79), Supermarket Fluency (t [123] = 4.51, P < .001, g = 0.96), and Orientation (t [123] = 2.90, P = .006, g = 0.70; Table 2). Significant differences were also present between the MCI and dementia group on BASIC, BASIC-Q and their components except for self-report where mean scores (3.7) were identical in the two groups.

3.1 | Discriminative validity

Using the AUC as a general index of discriminative validity, both BASIC (AUC = 0.95) and BASIC-Q (AUC = 0.94) were accurate in differentiating patients with MCI from control participants. In comparison, the MMSE had an AUC of 0.67 (Figure 2).

TABLE 3 Classification accuracy of BASIC, BASIC-Q, and MMSE for MCI vs control sample at different cutoff scores

	Cutoff	Sensitivity (95% CI)	Specificity (95% CI)	LR+	LR−
BASIC	19/20	0.64 (0.48-0.78)	1.00 (0.94-1.00)	N/A	0.36
	20/21	0.83 (0.68-0.92)	0.98 (0.91-1.00)	34.58	0.17
	21/22[a]	0.86 (0.71-0.94)	0.89 (0.80-0.95)	7.90	0.16
	22/23	0.93 (0.79-0.98)	0.78 (0.68-0.86)	4.28	0.09
	23/24	0.98 (0.86-1.00)	0.53 (0.42-0.64)	2.08	0.04
	24/25	1.00 (0.90-1.00)	0.22 (0.14-0.32)	1.28	0.00
BASIC-Q	15/16	0.55 (0.39-0.70)	1.00 (0.94-1.00)	N/A	0.45
	16/17	0.79 (0.63-0.89)	0.98 (0.91-1.00)	32.61	0.22
	17/18[a]	0.88 (0.74-0.96)	0.88 (0.79-0.94)	7.31	0.14
	18/19	0.93 (0.79-0.98)	0.67 (0.56-0.77)	2.85	0.11
	19/20	0.98 (0.86–1.00)	0.41 (0.30-0.52)	1.65	0.06
MMSE	23/24[b]	0.15 (0.06-0.30)	1.00 (0.94–1.00)	N/A	0.85
	28/29[a]	0.61 (0.45-0.75)	0.72 (0.61-0.81)	2.20	0.54

Abbreviations: BASIC, Brief Assessment of Impaired Cognition; BASIC-Q, Brief Assessment of Impaired Cognition Questionnaire; CI, confidence interval; LR+, positive likelihood ratio; LR−, negative likelihood ratio; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination.
[a]Optimal cutoff score for discrimination between MCI and control sample.
[b]Commonly applied cutoff score for MMSE.

TABLE 4 Classification performance of BASIC, BASIC-Q, and their separate components for differentiating MCI from control participants

	OR	95% CI	*P*	AUC
BASIC	3.39	2.17 to 5.31	<.001	0.95
BASIC-Q	3.92	2.37 to 6.50	<.001	0.94
MMSE	1.36	1.13 to 1.63	.001	0.67
Components of BASIC and BASIC-Q:				
• Self-report	3.87	2.33 to 6.45	<.001	0.83
• Informant report	7.84	3.61 to 17.06	<.001	0.90
• Category cued memory test	2.36	1.45 to 3.83	.001	0.63
• Supermarket fluency	2.57	1.66 to 3.97	<.001	0.72
• Orientation	2.89	1.47 to 5.68	.002	0.61

Note: Odds ratios, 95% CI, and *P* from logistic regression.
Abbreviations: AUC, area under the ROC curve; BASIC, Brief Assessment of Impaired Cognition; BASIC-Q, Brief Assessment of Impaired Cognition Questionnaire; CI, confidence interval; MCI, mild cognitive impairment; MMSE, Mini-Mental State Examination; OR, odds ratio.

Pairwise comparisons of ROC curves revealed that both BASIC (z = 5.36, P < .001) and BASIC-Q (z = 4.84, P < .001) had significantly higher classification accuracy than the MMSE. Discriminative validity statistics for BASIC and BASIC-Q for identification of MCI vs controls at different cutoff scores are presented in Table 3.

A cutoff score of 21/22 on BASIC provided optimal discrimination between the MCI and control group with high sensitivity (0.86) and specificity (0.89). This is in accordance with the score distribution for BASIC, as 81 of 83 control participants scored in the range of 22 to 25, whereas the majority of MCI participants scored below 21 (Figure 1). A roughly similar classification accuracy (sensitivity 0.88, specificity 0.88) was found for BASIC-Q at an optimal cutoff score of 17/18 (Table 3 and Figure S1). By comparison, the MMSE had poor sensitivity (0.61) but moderate specificity (0.72) at an optimal cutoff score of 28/29, and negligible sensitivity (0.15) but maximum specificity (1.00) at the commonly applied cutoff score of 23/24 (Table 3 and Figure S2).

The diagnostic classification performance of the individual components of BASIC and BASIC-Q depends on the comparison condition. In the MCI vs control comparison all components contributed significantly to the discriminative validity (Table 4).

Informant report (OR 7.84, AUC 0.90) and self-report (OR 3.87, AUC 0.83) appear to have the strongest classification performance in this comparison. Similarly, in the control vs dementia comparison condition, all components of BASIC and BASIC-Q contributed significantly to differentiating the two groups (Table S1). But in this comparison, the classification performance of informant report (OR 34.87, AUC 0.99) was markedly superior to self-report (OR 2.64, AUC 0.79). In the MCI vs dementia comparison condition, mean self-report scores were identical (3.7; Table 2), and the classification performance of self-report was at chance level (OR 1.02, AUC 0.49; Table S2). Predictive validity estimates for a range of scores below and above the optimal cutoff at selected base rates of MCI are presented in Table S3.

4 | DISCUSSION

This study validated BASIC and BASIC-Q as case-finding instruments for MCI in a memory clinic setting. A high discriminative validity for both BASIC (sensitivity 0.86, specificity 0.89) and BASIC-Q (sensitivity 0.88, specificity 0.88) was found for identification of MCI vs sociodemographically matched control participants. In comparison, the MMSE optimally had a sensitivity of 0.61 and a specificity of 0.72 for identification of MCI. Statistical comparison of ROC curves indicated that both BASIC and BASIC-Q had significantly higher classification accuracy than MMSE.

The data regarding the score distribution for MMSE indicate a ceiling effect in the MCI group (Figure S2), whereas no ceiling effect appears to be present for BASIC (Figure 1) or BASIC-Q (Figure S1). Both instruments are relatively unaffected by education, age, and gender,[29,30] they are easy to use, and can be administered in 5 minutes or less compared to the approximately 10 minutes necessary for administering the MMSE or MoCA. MoCA was introduced in 2005 and has eventually become the standard instrument for identification of MCI.[24,26] According to a meta-analysis of 9 studies, MoCA has high sensitivity (0.89; 95% CI 0.84-0.92) for identification of MCI and moderate specificity (0.75; 95% CI; 0.62-0.85).[24] The diagnostic accuracy of MoCA partly depends on the cutoff score.[52] In the primary MoCA validation study, a sensitivity of 0.90 and a specificity of 0.87 was found using a cutoff score of 25/26,[12] but results from subsequent studies indicate that a cutoff score of 22/23 yields better diagnostic accuracy.[53,54] A possible alternative to MoCA is the Quick Mild Cognitive Impairment Screen (Qmci)[55] which is shorter and appears to have better classification accuracy than MoCA.[56] Although BASIC and BASIC-Q appear to be as accurate as MoCA or Qmci, a direct comparison is presently not possible as diagnostic accuracy statistics are essentially sample-dependent. This should be addressed in future studies.

Although this is not a longitudinal study, comparison of the mean component scores across the three participant groups may provide insight on the relative validity of the components at different stages of cognitive decline (Table 2). All component scores decrease in the MCI group compared to the control group and component scores further decrease in the dementia group compared to the MCI group, except for self-report where mean scores are identical in the two cognitively impaired groups. The results indicate that self-report may be a valid indicator of cognitive impairment in MCI, but the discriminative validity of self-report decreases with the onset of dementia, possibly due to lack of insight (Table 4; Tables S1 and S2). In comparison, informant report, orientation and the two brief cognitive tests yield valid diagnostic information in both MCI and dementia. Relative to the other components, the validity of informant report seems to increase with the progression of cognitive impairment. Similar results regarding the validity of self- and informant report have been reported in studies using the Cognitive Function Instrument (CFI) that combines similarly phrased self- and informant report versions of the same questionnaire.[35] According to a longitudinal study, both CFI versions were associated with cognitive decline during 4-year follow-up. But self-report appeared more accurate when the respondent was cognitively intact, whereas the accuracy of informant report improved concurrently with cognitive impairment.[35,57] In a Norwegian validation study, both versions of the CFI discriminated between people with dementia and those with either MCI, subjective cognitive impairment, or a reference group.[58] But again, the informant report version of CFI had better discriminatory power than the self-report version in the dementia stage.

Although the classification performance of BASIC and BASIC-Q for MCI is similar, we recommend the longer BASIC in clinical settings, as it provides more detailed information on cognitive functioning than BASIC-Q. Also, BASIC contains a larger proportion of "objective" measures of cognitive functioning compared to BASIC-Q, possibly preserving the validity of BASIC in situations where the patient lacks insight.

In the present sample, the optimal cutoff scores for separation of persons with MCI from control participants was 21/22 for BASIC and 17/18 for BASIC-Q. However, when evaluating the performance of an individual person, optimal group separation is not the focus of interest. Instead, the probability of MCI vs the probability of being cognitively intact associated with a given performance is more relevant. We therefore present predictive validity estimates for different base rates of MCI (Table S3). In Danish memory, clinics approximately 25% of the patients referred for assessment are assigned an MCI diagnosis.[10]

In this setting, both PPV (0.72) and NPV (0.95) seem acceptable. But in a low base rate setting, for example, a general practice setting, PPV is attenuated (0.30) due to a higher proportion of false positive cases. For instance, in a 5% base rate setting a downwards adjustment of the BASIC cutoff score to 20/21 or even 19/20 may be considered in order to ensure an acceptable PPV. A high NPV is also desirable in a general practice setting, but this requirement appears easily met for BASIC and BASIC-Q as NPV for both instruments is in the 0.98 to 1.00 range depending on cutoff score.

The patients in this study were referred from general practice and undiagnosed at the time of assessment. As BASIC and BASIC-Q had no influence on subsequent clinical diagnosis, the risk of circular evidence was minimal. Among the limitations of the study is the relatively small MCI sample and the fact that we did not have access to neuropsychological assessment results or AD biomarker data as patients were examined at five different sites. Consequently, we were not able to perform independent verification of MCI-diagnoses or conduct a subtyping of MCI-cases based on neuropsychological profiles (eg, amnestic vs non-amnestic MCI) or biomarkers (eg, prodromal vs non-prodromal AD). A further limitation is the fact that data were collected exclusively in a memory clinic setting. Our clinical sample may be representative for persons referred from general practice at their first memory clinic admission, but not for a general practice or primary care setting. Future studies are needed to cross-validate BASIC and BASIC-Q in these settings.

5 | CONCLUSION

The results of this study indicate that both BASIC and BASIC-Q meet criteria for accurate, time-saving, and easy-to-use tools for

identification of MCI in a memory clinic setting. Both instruments appear to be sensitive and specific for identification of MCI among persons referred from general practice for expert diagnostic evaluation. It must be emphasized, though, that neither instrument can substitute expert clinical evaluation. A diagnosis of MCI cannot be based solely on a brief case-finding instrument, but BASIC and BASIC-Q appear to be effective tools for identifying patients for whom further diagnostic assessment should be considered.

ACKNOWLEDGEMENTS

The authors would like to thank all the participants in this study for their time. We would like to thank the staff of the five memory clinics who recruited and examined the participants: Danish Dementia Research Centre, Department of Neurology, Rigshospitalet, Copenhagen University Hospital; Regional Dementia Research Centre, Department of Neurology, Zealand University Hospital; Department of Geriatrics, Odense University Hospital, Svendborg Hospital; Dementia Clinic, Department of Neurology, Aarhus University Hospital; Dementia Clinic, Department of Neurology, Aalborg University Hospital. This work was funded by the Danish Ministry of Health (Authorization No. 1604063). The Danish Dementia Research Centre is supported by the Danish Ministry of Health. The study funder had no role in study design, collection, analysis or interpretation of data, writing of the manuscript, or the decision to submit for publication.

CONFLICT OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

Gunhild Waldemar, Frans B. Waldorff, Kasper Jørgensen, and Ann Nielsen designed the study. Ann Nielsen and Kasper Jørgensen coordinated the data collection. Kasper Jørgensen and Thomas R. Nielsen developed the BASIC and BASIC-Q, analyzed the data, and drafted the initial version of the manuscript. All authors contributed to revision and editing of the article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Jørgensen K, Nielsen TR, Nielsen A, Waldorff FB, Waldemar G. Validation of the Brief Assessment of Impaired Cognition and the Brief Assessment of Impaired Cognition Questionnaire for identification of mild cognitive impairment in a memory clinic setting. *Int J Geriatr Psychiatry*. 2020;35:907–915. https://doi.org/10.1002/gps.5312