Validation of the Dépistage Cognitif de Québec in the Oldest Old

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ABSTRACT

Objective

We aimed to validate the *Dépistage Cognitif de Québec* (DCQ; www.dcqtest.org) , a new cognitive screening tool for atypical degenerative syndromes, in the oldest old.

Methods

The DCQ was developed by expert behavioural neurologists and clinical neuropsychologists based on updated criteria for Alzheimer's disease, primary progressive aphasia, and behavioural variant frontotemporal dementia. It targets five relevant cognitive domains: Memory, Visuospatial, Executive, Language, and Behaviour. Validation was performed using a prospective community-based sample consisting of 53 healthy French-speaking Canadian volunteers aged between 80 and 94 years old. Normative data were derived from participants with no history of cognitive difficulties and a Montreal Cognitive Assessment (MoCA) score ≥ 24.

Results

The mean DCQ total score (out of 100) was 84.65 (SD = 6.33). Pearson's correlation coefficient showed a moderate, but significant, correlation ($r = 0.36$, $p < .01$) with the MoCA. Normative data shown in percentiles were stratified by age and education for DCQ total score and for each of the five cognitive domains.

Conclusions

This study suggests that the DCQ is a valid cognitive screening test in the oldest old. It is proposed that the DCQ can help early identification of atypical degenerative syndromes.

Key words: aging, dementia, oldest old, Alzheimer's disease, frontotemporal dementia, atypical dementia, validation, normative data, test construction

INTRODUCTION

Dramatic increase in dementia prevalence[1] has made cognitive screening highly valuable for early detection of cognitive impairment.[2] According to the WHO, the population living with dementia, including Alzheimer's disease, has reached 47.5 millions worldwide.[3] Screening tests, such as the Mini-Mental State Examination (MMSE),[4] the Montreal Cognitive Assessment (MoCA),[5] and the Addenbrooke's Cognitive Examination-Revised,[6] have served as the main instruments used in clinical practice. Other tests have been developed to assess specific cognitive domains, such as the Sydney Language Battery[7] for the assessment of language skills, and the DAPHNE (Disinhibition, Apathy, Perseverations, Hyperorality, personal Neglect and loss of Empathy) which focuses on the assessment of behavioural symptoms in the behavioural variant frontotemporal dementia (bvFTD).[8]

Unfortunately, a number of shortcomings have been reported with screening instruments.[9-11] Moreover, dementia classifications have flourished, with several updated diagnostic criteria published in 2011. For example, Alzheimer's disease (AD) has been reconceptualized as a spectrum with distinct clinical phenotypes (i.e., amnestic, visual, language, and frontal/dysexecutive variants).[12] The Primary Progressive Aphasias (PPA) have been classified into three main subtypes (i.e., non-fluent/agrammatic, semantic, and logopenic),[13] and improved criteria for the diagnosis of bvFTD have been published.[14] None of the major cognitive screening tests currently available have kept pace with these clinical and nosological changes. In addition, none have integrated behavioural aspects of dementia in their screening format, making them less relevant for the detection of atypical presentations of AD, PPA or the frontotemporal lobar degeneration (FTLD) spectrum.

The *Dépistage Cognitif de Québec* (DCQ; www.dcqtest.org), is a newly developed cognitive screening test[15] based on updated diagnostic criteria for AD, PPA, and the FTLD

spectrum. The DCQ was recently validated in a large adult population (n = 410 participants) aged between 50 and 89 years old,[15] and we also demonstrated its superiority over the MoCA in detecting atypical dementia in a cohort of 195 patients.[16] However, the oldest old were largely under-represented in our previous studies, as they comprised only about 10% of the normative sample.

We aimed to validate the DCQ in the oldest old, that is, in a cohort of cognitively healthy French-speaking Canadians aged 80 and above. Similar to our previous work, we hoped the DCQ would allow better detection of typical and atypical presentations of dementia, and address limitations of the current cognitive screening tools available.

METHODS

Subjects

We prospectively recruited cognitively healthy French-speaking Canadians aged 80 years and older via public advertisements and/or patients' relatives. This study was approved by the local Ethics Review Committee and all participants provided written informed consent. Subjects were excluded if they reported a history of traumatic brain injury, delirium, brain surgery, neurological disease (e.g., multiple sclerosis, stroke), encephalitis or meningitis, an untreated metabolic, psychiatric illness, brain oncological therapy, active alcohol and drug abuse, disabling visual and hearing disorders, experimental therapy, incapacity and illiteracy or if they obtained a MoCA score < 24. A total of 53 community-dwelling individuals with a MoCA ≥ 24 took part in this validation study. While a MOCA score of ≥ 26 was suggested as the cut-off to identify 'normal' from 'impaired' in the initial validation study,[5] it has been suggested by several researchers that this cut-off is too stringent and often leads to exclusion by misclassification of 50% of the sample.[17-19] In order to enhance inclusion of the oldest old in our normative study, we set a MoCA cut-off ≥ 24, which is in line with a large normative study for the MoCA in elderly Quebec-French population.[20] Participants had no cognitive complaints and preserved activities of daily living according to both self-report and brief interview with a significant other who spent over 25 hours/week with the participant.

Materials and Procedure

The DCQ test (www.dcqtest.org) was developed at *La Clinique Interdisciplinaire de Mémoire* (CIME) of the *Centre Hospitalier Universitaire de Québec*, the oldest tertiary Memory Clinic in Canada, by a group of experienced behavioural neurologists, clinical neuropsychologists, and a speech language pathologist (RL, LV, RB, SP, MH, MPF, MR, JM, CH). It targets five relevant cognitive domains: Memory, Visuospatial, Executive, Language, and Behaviour (see Figure 1) through five specific indexes. The Memory Index (out of 30)
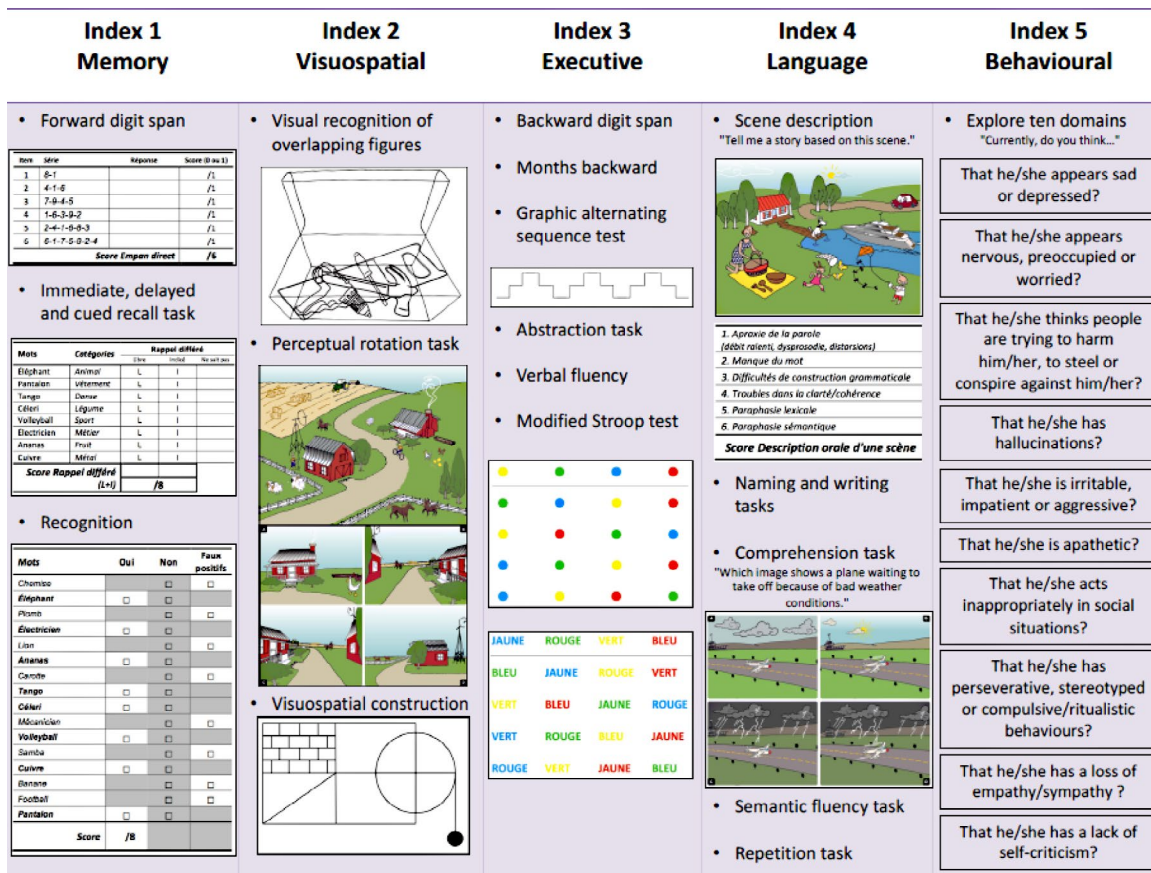

FIGURE 1. Illustrative summary of the subtests composing the five DCQ indexes

comprises an eight-word recall/recognition task in immediate and delayed format administered using the Dubois paradigm. The Visuospatial Index (out of 7) tests visual recognition of overlapping figures, as well as spatial rotation (see Figure 1). This test also includes a geometric figure-drawing test. The Executive Index (out of 10) includes backward digit span, months backward, an alternating graphic sequence test, a two-item verbal abstraction task, phonemic fluency (letter A, 60 sec) and a modified Stroop test. The Language Index (out of 33) comprises a scene description task for assessing spontaneous speech, naming and single-word writing tasks, a multi-sentence writing test, an assessment of comprehension with a sentence–picture matching test, a semantic verbal fluency task, and a task requiring the participant to repeat sentences of various lengths and complexity. Finally, the Behavioural Index (out of 20) explores 10 domains (depression, anxiety, delusions, hallucinations, irritability and aggression, apathy, disinhibition and impaired judgment, perseverations and compulsions, loss of empathy/sympathy, and self-criticism) as reported by a significant other.

All participants completed both the DCQ (25–30 min) and the MoCA in a random order, on the same day. These tests were administered by trained psychometricians. The Behavioural Index was completed face to face or by telephone with a significant other who spent over 25 hours/week with the participant.

Statistical Analysis

Basic descriptive analyses, including means and standard deviations, were performed. Validity was established through correlations between DCQ total score (out of 100) and MoCA total score (out of 30), using Pearson's correlation coefficient. Statistical analysis was performed using SPSS software (version 24.0) with the alpha level set at 0.05.

RESULTS

Demographics

Demographics are presented in Table 1. Mean age was 84.3 yrs (SD = 3.49). There were more men than women (62.3% vs. 37.7%). The average number of years of education was 12.9 (SD = 3.9). Mean MoCA total score was 25.93 (SD = 1.63), while mean DCQ total score was 84.65 (SD = 6.33). There was no difference in the DCQ total score between males (84.05, SD = 7.00) and females (85.63, SD = 5.09). Correlation between age and DCQ total score was not statistically significant (r = -0.23, $p < .1$), but the total DCQ score was significantly correlated with education (r = 0.48, $p < .01$).

Normative Data

Scores for the DCQ were stratified according to the number of years of education ($\leq$ 12 and >12 years) to provide normative tables. Table 2 presents the percentile ranks for total DCQ score. For example, an 82-year-old man with 10 years of education who obtained a total score on the DCQ of 87/100 would be at the 75th percentile. Separate percentiles for each of the five

DCQ indexes are provided in Table 3. Scores on the Behavioural Index were missing for one subject (non-availability of a significant other to answer the questionnaire; N = 52).

Validity and Reliability

Validity was assessed by correlating the DCQ total score with the MoCA total score. Pearson's correlation coefficient was moderate but significant (r = 0.36, $p < .01$) (see Figure 2). The test was well-tolerated by the participants, and the behavioural questionnaire was easily understood by the significant other. Validity of DCQ test with existing screening instruments has been measured previously in our validation study, along with Cronbach's alpha coefficient for internal consistency, test-retest reliability, practice effect, and interrater reliability.[15]

DISCUSSION

In this study, we validated the DCQ on a subgroup of 53 cognitively healthy individuals aged $\geq$ 80 years old, hence providing clinicians with normative data for the oldest old on this test. This is a subgroup of elderly individuals for which there is often a paucity of normative data. Previous validation of the DCQ on 410 healthy individuals was lacking observations in individuals aged older than 80 years old (n = 29).[15] Given that the DCQ has already shown a superiority over the MoCA for the detection of atypical neurodegenerative diseases (AD variants, PPAs, and the FTLD spectrum),[16] we believe these normative data in the oldest old will help better detect such conditions in this subgroup of the population.

The five DCQ indexes were specifically designed to provide advanced information on specific cognitive domains. For example, the Language Index assesses semantic knowledge through confrontation naming and comprehension tasks. It also detects surface dyslexia/surface dysgraphia by testing the writing and spelling of irregular words. Such features are hallmarks of deficits found in the semantic variant of PPA. Other salient language deficits, such as poor word retrieval and impairment in the repetition of long and complex sentences, are seen in the logopenic variant of PPA, agrammatism in

TABLE 1.
Demographics data: normative sample (*N*=53)

	Mean	Standard Deviation
Age, years	84.28	3.49
Education, years	12.89	3.88
	Frequency	%
Age groups, years		
80-84	31	58.5
85-89	17	32.1
90-94	5	9.4
Gender		
Male	33	62.3
Female	20	37.7

spoken and written production is seen in nfvPPA, as well as the rating of speech apraxia in spontaneous spoken production,[13] are also tested within this index. The Visuospatial

Index includes subtests that explore visual orientation and spatial perception without the interference of executive and/or visuoconstructive skills. Failure to carry out cube drawing

TABLE 2.
Percentile norms for the DCQ total score

Age	Education	N=52[a]	Percentiles												
			1	2	5	10	15	25	50	75	85	90	95	98	99
80+	≤12	25	67	67	69	73	74	78	82	87	90	90	93	-	-
	≥12	27	72	72	73	81	82	85	87	92	93	94	94	-	-

[a]Data were missing for one participant on the Behavioural Index.

TABLE 3.
Percentile norms for the five DCQ indexes

| Index	Age	Education	n	Percentiles												
				1	2	5	10	15	25	50	75	85	90	95	98	99
Memory	80+	≤12	26	15	15	16	22	23	24	26	28	29	29	30	-	-
		>12	27	19	19	20	21	22	25	26	28	29	29	29	-	-
Visuospatial	80+	≤12	26	3	3	3	3	4	4	5	6	7	7	7	-	-
		>12	27	5	5	5	5	5	6	7	7	7	7	7	-	-
Executive	80+	≤12	26	4	4	4	4	4	4	6	7	8	9	9	-	-
		>12	27	4	4	4	5	5	6	7	9	9	9	10	-	-
Language	80+	≤12	26	22	22	23	25	26	26	28	30	30	31	31	-	-
		>12	27	22	22	23	27	28	29	30	31	31	32	32	-	-
Behaviour	80+	≤12	25	8	8	9	13	16	16	18	20	20	20	20	-	-
		>12	27	14	14	14	14	15	18	18	20	20	20	20	-	-
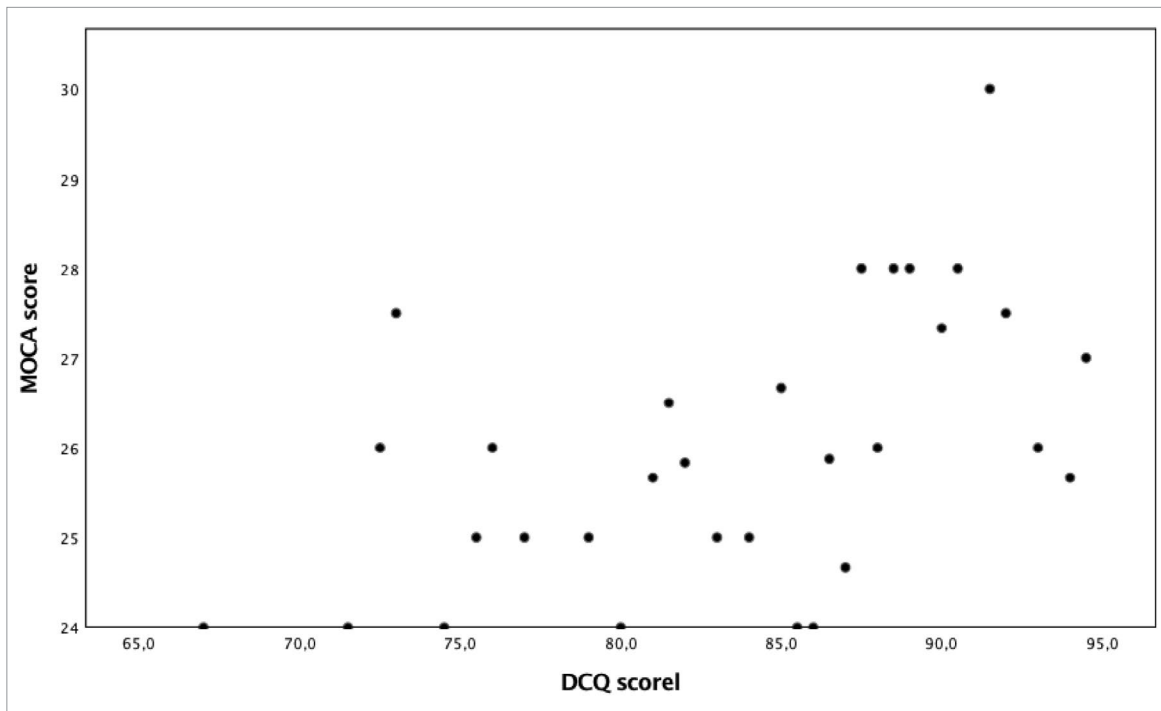
FIGURE 2. Scatter plot illustrating the correlation between DCQ and MoCA total scores

or clock drawing, for instance, may reflect combined executive and visuospatial impairments, preventing assessment of pure visuospatial impairment.[21] Following this rationale, the DCQ's Visuospatial Index may allow for better screening of the deficits associated with the visual variant of AD (also known as Posterior Cortical Atrophy).[22] The Memory index includes immediate, delayed, and cued recall tasks using the Dubois paradigm.[23] This approach has proven more efficient to discriminate memory consolidation impairments associated with amnestic AD from other memory disorders. Finally, we believe that specific patterns of behavioural changes may help differentiate certain types of dementia, such as FTD.[24] The Behavioural Index was developed and integrated in the DCQ, and represents a great addition to standard cognitive screening measures. This index includes, among other items, the core behavioural features of bvFTD criteria.[14]

Similar to previous authors, we found that participants with greater years of education performed better than their less-educated counterparts. Normative values were developed accordingly. Similar impact of prior education on cognitive score was noted in other cognitive screening test such as the MMSE and the MoCA. Several studies across countries have shown that cognitive performance is influenced by sociodemographic variables such as age and education.[20,25] This is thought to explain as much as 49% of the variance in the MoCA.[26] In our study, there was no significant correlation between the DCQ total score and age. This contrasted with the findings of our initial validation study on individuals aged between 50 and 89 years old where the DCQ total score was significantly and inversely proportional to age.[15] One could hypothesize that the impact of age on cognition eventually reaches a plateau in the oldest old. This may also be due to small sample size.

This study has some limitations. First, power is limited by sample size, although this size compares with many recently published works. Also, there might be overrepresentation of highly educated subjects when we compare to recent Quebec demographics.[27] In addition, DCQ norms were derived using a francophone-based sample, and caution should be observed when using theses norms in culturally, ethnically, and linguistically diverse populations. English validation of the DCQ is currently completed (paper in preparation) and results are similar to the initial validation study.[15]

CONCLUSION

In conclusion, we validated and provided normative data for the DCQ in the oldest old. The DCQ is a new cognitive screening test which was developed based on the updated dementia criteria for AD variants, PPAs, and bvFTD, and which has been validated on 410 healthy individuals[15] and in a sample of 195 patients with atypical syndromes.[16] It has proven to be superior to the MoCA in detecting atypical dementias.[16] We are confident that this instrument will be useful to expand the cognitive tool kit in the clinical setting of a memory clinic. A multicenter joint Canadian (Montreal, Calgary, Toronto, Sherbrooke, New Brunswick, and Vancouver) and USA (California) effort to validate the English version of the DCQ is now completed (paper in preparation) and results are similar to the French version of the DCQ. Finally, in the investigative sequence of tests performed in a tertiary memory clinic, we position the DCQ as a complement to existing cognitive screening tests (see Figure 3). We propose that this test be used à la carte when MMSE and MoCA have fallen short of helping clinicians establish their differential diagnosis. The DCQ should be used to explore further a clinical suspicion that was unanswered by standard screening tests. This in turn may avoid exposing patients to unnecessarily lengthy neurocognitive assessment when not needed. As behavioural neurologists and clinical neuropsychologists ourselves, we suggest that comprehensive neuropsychological assessment be kept for patients with complex psychiatric comorbidities, highly educated young individuals, patients with mental retardation, or others suspected of malingering.
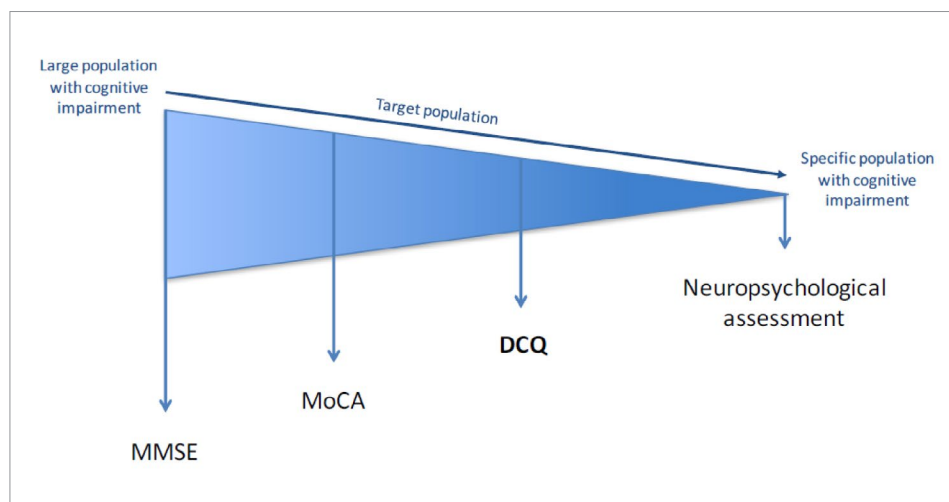

FIGURE 3. Positioning the DCQ amongst other cognitive screening measures

ACKNOWLEDGEMENTS

CONFLICT OF INTEREST DISCLOSURES

The authors declare that no conflicts of interest exist.

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