

Review Article

Validity and Reliability of the 6-Item Cognitive Impairment Test for Screening Cognitive Impairment: A Review

Dawn O'Sullivan Niamh A. O'Regan Suzanne Timmons

Centre for Gerontology and Rehabilitation, University College Cork, Cork, Ireland

Key Words

Six-Item Cognitive Impairment Test · Validity · Reliability

Abstract

Background: A large proportion of older adults with dementia remain undiagnosed, presenting to hospital with occult dementia, and are at risk for adverse outcomes, especially delirium. Routine screening for cognitive impairment among older adult patients presenting to acute hospitals could help alleviate this problem; however, this is hampered by time constraints, poor knowledge of screening instruments and lack of consensus as to which screening tool is best. Cognitive tests with attention items may be particularly useful in acute settings, given the importance of delirium detection. However, it is crucial that cognitive screening instruments are fast and reliable. **Summary:** The Six-Item Cognitive Impairment Test (6-CIT) is a feasible instrument for cognitive screening among older adults attending a general practitioner or hospital. Although researchers have investigated its accuracy in diagnosing cognitive impairment in primary and secondary care settings, its validity in primary care use has been questioned and there are limited validation studies on its use in secondary care. **Key Messages:** This paper presents a review of validation studies conducted on the 6-CIT. We recommend that larger studies, which test the psychometric properties of the 6-CIT in primary and acute care settings, are conducted to establish recommendations for routine screening use.

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Introduction

Individuals with dementia often present to acute care without a prior diagnosis [1]. There is, therefore, a need to screen for cognitive impairment among older adult patients attending hospital. Here, the benefits of quickly identifying possible cognitive impairment (even if a definitive diagnosis and disclosure of dementia are not possible or appropriate at that time)

Dawn O'Sullivan
Centre for Gerontology and Rehabilitation, University College Cork
St. Finbarr's Hospital
Cork (Ireland)
E-Mail dawn.osullivan@ucc.ie

are manifold. The approach of hospital staff to the person can be adapted (information can be simplified and supplemented by written information); the ability of the person to understand complex risk-benefits of treatment decisions is not assumed; carers are proactively included in the care of the person and potential safety issues on discharge are pre-empted. Schemes to encourage early detection of possible dementia and delirium include the Commissioning for Quality and Innovation (CQUIN) framework in the UK, where hospitals are financially incentivised to screen for dementia and delirium and appropriately refer within 72 h of admission [2]. Given the time pressure in acute settings, short, user-friendly and valid instruments are required. However, there is a lack of clarity surrounding the use of screening tools for dementia or cognitive impairment despite previous reviews on the topic [3–7]. Overall, there has been minimal validity testing of screening instruments for dementia in acute care [8].

The Six-Item Cognitive Impairment Test (6-CIT), originally called the Six-Item Orientation-Memory-Concentration Test, developed by Katzman et al. [9] by shortening Blessed et al.'s [10] Mental Status Test, was designed as a screening test for dementia. It is also known as the Short Orientation-Memory-Concentration Test and the Short Blessed Test. For consistency, it is referred to as 6-CIT throughout this paper. It involves three tests of temporal orientation (year; month; time), two tests of attention (counting backwards from 20 to 1; reciting the months of the year in reverse) and short-term memory (5-item address). It is scored out of 28; higher scores indicate greater impairment. It has been utilised in a broad range of settings, including screening for dementia in primary care [11], cognitive screening in acute care [12], in large population-based studies [13] and in studies of Alzheimer's disease [14, 15]. It has been used as a reference standard in evaluating other cognitive tools/assessments [16, 17] and recommended as a cognitive screening tool in hospitals [18]. It takes less than 5 min to complete [19] and requires minimal training. A patient's score on the 6-CIT is influenced by increasing age [20], similar to other cognitive tests, for example the Mini-Mental State Examination (MMSE) [21]. Because of its brevity and simplicity, the 6-CIT may be particularly useful for cognitive screening in busy primary and secondary care settings. In this paper, we review the existing literature on the use of the 6-CIT for this purpose.

Methods

The databases CINHAL, PubMed and the Cochrane Controlled Trials Register were searched using the following keywords: Six-Item Cognitive Impairment Test, 6-CIT, Short Orientation-Memory-Concentration Test, Short Blessed Test, Acute Care, Screening Dementia and Emergency Department. Additional Google searches were performed for relevant documents, reports and/or government publications using the same search terms.

Review of 6-CIT Use

6-CIT Screening in Primary Care

The 6-CIT is purported to have utility in dementia screening in primary care [22] but is infrequently used [22]. A study of 99 referrals from primary care to a neurology-led memory-based clinic in the UK in 2012 reported 'minimal use' (5.3%) by general practitioners (GPs) [23]. Only 1% of GPs used the 6-CIT as a stand-alone screen, while 6% used the 6-CIT with the MMSE, without indication as to why both tests were used and which was conducted first [24, 25]. Only 3 studies have evaluated the validity of the 6-CIT as a dementia screening instrument in primary care. In a UK study, the diagnostic accuracy of the 6-CIT was tested using dementia diagnosis and severity as a reference standard in mild dementia (n = 70; mean

age 68.1 years), severe dementia (n = 82; mean age 73.8 years) and healthy individuals recruited by local newspaper advertising (n = 135; mean age 81.7 years) [11]. A hospital database was used to identify patients with dementia, and the Global Deterioration Scale was used to assign dementia severity. Sensitivity and specificity for the 6-CIT at a cut-off of 7/8 (i.e. 7 is normal, 8 abnormal) were 78.6 and 100%, respectively. Obviously, for a screening tool, sensitivity should be favoured over specificity, as it is very important not to miss cases, and a second-step formal diagnosis can then identify any 'false-positive screen' cases. The reported results for the selected cut-off do not reflect this property of a good screening tool. 6-CIT and MMSE scores were found to be highly correlated ($r = -0.911$, $p < 0.01$). The 6-CIT was more sensitive in detecting mild dementia (sensitivity 80%) than the MMSE (sensitivity 51.43%; cut-off 23/24), demonstrating potential usefulness as a screening tool in primary care.

In a US study validating the Clock Completion Test as a screening instrument for Alzheimer-type dementia (n = 305), a subgroup of 53 subjects had an expert diagnosis of Alzheimer-type dementia (NINCDS-ADRDA criteria) [16]. In these, the 6-CIT demonstrated a sensitivity of 40% and a specificity of 89%, using a cut-off of 8/9 (i.e. 9 or higher indicated dementia), compared to expert diagnosis. Again, this cut-off, favouring specificity over sensitivity, is not in keeping with potential use of the 6-CIT as a screening tool. Of note, the investigators had planned to comprehensively assess >120 subjects (80 consecutive cases and anyone with an abnormal Clock Completion Test; n = 43), so the 53 subjects represent a potentially biased group – more had failed a cognitive screen than would occur by chance in the community, and less than 50% of the eligible cohort attended for assessment. Moreover, it is possible that some subjects had dementia other than Alzheimer-type, limiting the conclusions drawn from this study.

A more recent German study, the INVADE study (Intervention Project on Cerebrovascular Disease and Dementia), involving 72 GPs and 3,908 participants (mean age 67.7 years), found low reliability and validity, but good feasibility, for the 6-CIT [26]. Internal consistency (Cronbach's α) was relatively low at all assessment points (0.52–0.58). Using either a 6-CIT cut-off of 7/8 or 10/11, sensitivity in detecting dementia was poor at 49 and 32%, respectively, although specificity was >90% at each cut-off. Given this low sensitivity, the researchers caution against using the 6-CIT as a screening tool for dementia in primary care. It is possible that a higher sensitivity would have been achieved using lower cut-off scores, but said results are not presented. Despite the large sample, this study has important limitations. Firstly, no clinical reference standard for dementia was used, the diagnosis instead being obtained from health insurance records, which are often unreliable. Additionally, the time of diagnosis was unknown, so it is impossible to discern whether or not the patient had a diagnosis of dementia at the time of 6-CIT testing. Thus, further validation studies are necessary to inform the recommendation of the 6-CIT as a screening instrument for dementia among primary care practitioners.

The 6-CIT in Specialised Outpatient Settings

Two UK studies have specifically evaluated the 6-CIT in the outpatient setting. One group studied consecutive patients (n = 245; median age 59 years) referred to a neurology-led memory clinic in 1 year [27]. Patients were administered both the 6-CIT and the MMSE (Folstein version); and dementia or mild cognitive impairment (MCI) were diagnosed independently by a neurologist blinded to the screening test results, using DSM-IV criteria. The 6-CIT, cut-off 9/10, had good sensitivity (0.88) and specificity (0.78) in detecting dementia patients compared to normal controls, outperforming the MMSE (cut-off ≤ 22 ; sensitivity 0.59; specificity 0.85). However, suboptimal psychometrics were reported for the 6-CIT in detecting MCI patients (defined as 6-CIT score 5–9) compared to normal controls (sensitivity

0.66; specificity 0.70); again, the 6-CIT performed better than the MMSE (cut-off ≤ 25 ; sensitivity 0.51; specificity 0.75). The sensitivity for differentiating dementia from MCI using the 6-CIT was very good (0.88) with moderate specificity (0.61). There was a high negative correlation between 6-CIT and MMSE scores ($r = -0.73$, $t = 13.0$, d.f. = 148, $p < 0.001$), illustrating concurrent validity. Overall, the authors considered the 6-CIT a practicable alternative to the MMSE for cross-sectional assessment of cognitive disorders in the outpatient setting, although they recognise the potential for referral bias in their sample.

Another group retrospectively analysed 209 GP referrals to an Old Age Psychiatry outpatient dementia service over 5 years, in whom both the 6-CIT and the MMSE were completed [28]. Dementia diagnosis was based on diagnostic criteria from the ICD-10th Revision codes (WHO), but the cognitive scores were not independent of the expert diagnosis. In this study, the 6-CIT was slightly superior to the MMSE for dementia assessment. There was a high negative correlation between MMSE and 6-CIT scores ($r = -0.822$, $F = 432$, $p < 0.0001$). Sensitivity and specificity for the MMSE were 79.7 and 86.4% (cut-off 23/24) for dementia compared to no dementia; these values changed to 86.7 and 75.8% at a higher cut-off of 24/25. For the 6-CIT, the sensitivity and specificity were 82.5 and 90.9% (cut-off 10/11) and 90.2 and 83.3% at a lower cut-off of 9/10, suggesting this to be the desirable cut-off for initial assessment, where high sensitivity is the priority. The area under the curve (AUC) values for the 6-CIT were slightly better than for the MMSE, i.e. 0.92 and 0.9, respectively. Hence, overall, this retrospective study indicated that the 6-CIT may slightly outperform the MMSE for cognitive assessment at memory clinics.

6-CIT Screening in Secondary Care

The 6-CIT has many potential advantages as a cognitive screening tool in hospitalised patients. Because it is a completely verbal test, it can be used in the visually impaired [29] and in those with upper limb issues (such as poststroke or dominant upper limb injury). It can be performed without pen/paper or technology devices, which is significant considering the importance of infection control (although scoring the test afterwards requires the use of one of these means). It has less potential for interpretive error than other tests, such as interlocking pentagons and clock-drawing [30]. It has been used to assess cognitive status in research in acute care settings [31–34].

Although some training is required to score the 6-CIT accurately, it appears to be simpler to use than the MMSE. One study using the 6-CIT to screen for delirium in the acute setting showed high acceptability to nursing staff [35]. Queally et al. [36] compared the accuracy of the MMSE and the 6-CIT for scoring vignettes representing mild, moderate and severe delirium, following 10-min training sessions for each test, among 74 nursing students. Although the proportion of correctly scored cases was low to moderate using both tests, participants had greater success in accurately scoring the 6-CIT than the MMSE, which is important given that the MMSE is often the 'go-to' test for many health-care professionals.

The 6-CIT has been shown to be a fast, feasible method for screening for cognitive impairment in older adults in the emergency department (ED), with a mean completion time of 1.9 min [37]. In a US-based study involving 163 ED patients (mean age 78 years), the 6-CIT demonstrated excellent sensitivity at 95% and specificity at 65% (AUC = 0.930) for cognitive dysfunction based on MMSE scores of ≤ 23 [38]. However, this result was achieved using a lower 6-CIT cut-off of 4/5, and there was no randomisation between criterion standard testing and screening. Another US research group used the 6-CIT to screen for cognitive impairment in 271 older patients in an urban teaching hospital ED [39]. The psychometric properties of the instrument were not analysed; however, the researchers claimed to have discovered 46 from a total of 55 cases of cognitive impairment, where no previous history of cognitive impairment existed.

Tuijl et al. [30] tested the 6-CIT as a screening tool for cognitive impairment (diagnosed by MMSE scores of ≤ 23) in 253 older general inpatients and outpatients in two Dutch hospitals in 2009. Inpatients were either general medical or cardiac surgery patients ($n = 160$), and outpatients were targeted when attending the hospital for pre-operative screening ($n = 93$). There was a high negative correlation between the 6-CIT and the MMSE (-0.82 , $p \leq 0.001$). The AUC was 0.91, indicative of the 6-CIT's ability to predict dementia based on MMSE scores. The authors found that a cut-off of 10/11 was optimal to detect cognitive impairment compared to the MMSE pre-defined cut-off of ≤ 23 . Both the sensitivity and specificity of the 6-CIT in detecting the presence of cognitive impairment were $\geq 90\%$. In a comparable UK-based study, a 6-CIT cut-off of 10/11 was found optimal in detecting cognitive impairment in a sample of 153 acute hospital inpatients [12]. This study similarly used a standardised MMSE cut-off score of ≤ 23 as the reference standard for cognitive impairment and found a sensitivity of 85.6% and a specificity of 86.8% for the 6-CIT. Clearly, without formal neuropsychiatric assessment, it is impossible to ascertain if low scores on either test in this study were due to pre-existing dementia, reduced performance due to anxiety related to hospitalisation or the emergency presentation of delirium.

Other work has indicated that 6-CIT scores remained stable in a small sample of 20 non-delirious older medical inpatients (expert daily independent delirium assessment), when assessed twice daily (using alternate form addresses) over a period of up to 1 week [40], an important finding given that cognitive change during hospitalisation may indicate the emergence of delirium. Conversely, in the rehabilitation setting, Wade and Vergis [41] found that increases in 6-CIT scores of at least 6 points were associated with meaningful cognitive deterioration compared to scores on the Rivermead Behavioural Memory Test; however, this study was limited by small numbers, and all assessments were conducted by the same researcher [30, 37, 39, 42]. In a recent Italian study, a group of researchers compared documented delirium based on ICD-9th Revision codes to reports of neurocognitive issues by the same physician using combined items from the 6-CIT in acute medical/surgical patients ($n = 2,521$; age ≥ 65 years) [43]. Delirium diagnoses were documented for just 2.9% of cases based on ICD-9 criteria; however, 6-CIT items indicative of delirium, especially patterns of inattention, were reported more frequently (30.8% of all patients) and were highly correlated with in-hospital mortality ($p < 0.0001$). The validity of the 6-CIT as a screening instrument for delirium was not established in this study, but this study was the first we located that used or considered the 6-CIT in the identification of delirium in the acute hospital setting.

To our knowledge, there are no studies of the diagnostic accuracy of the 6-CIT in the detection of expert-diagnosed dementia or MCI in the acute setting. Studies of 6-CIT performance in the acute hospital have mainly focussed on detecting the broader concept of 'cognitive impairment' which can be due to many underlying causes. This is not surprising considering that the acute hospital is not the optimal place to diagnose dementia, given the potential confounding of acute illness and possible delirium.

Discussion and Conclusion

A large proportion of older adults with dementia remain undiagnosed. Timely diagnosis is important at individual and population-based levels; improving detection rates is a key goal of many recently published National Dementia Strategies [44, 45]. Understanding the true dementia prevalence is paramount to planning services for our ever-increasing population of older people. Notwithstanding this, it is well-recognised that the optimum setting to make a disclosure of dementia is usually in primary care or in the ambulatory care setting, given the

chronic progressive nature of the condition and the significant psychological and social impact of diagnosis on the person and their family.

The 6-CIT has been suggested as a useful dementia screening instrument in primary care. The 3 studies on the 6-CIT in primary care present conflicting results and all 3 have significant variations in their selection of cases/reference standards used. In addition, the cut-offs used in 2 of the studies favoured specificity over sensitivity, which is not desirable for a screening test. The 6-CIT has been validated against expert diagnosis in outpatient settings, and it demonstrated promising results, being more sensitive than the MMSE in both studies for dementia detection. Here, a cut-off of 9/10 was used, and a higher threshold may be appropriate in a population attending a memory clinic.

Given the under-recognition of dementia across health-care sectors, routine screening for dementia among older adult patients presenting to hospitals and EDs could help to address the problem of under-diagnosis, as reflected in the CQUIN financial incentivisation of UK hospitals to screen for and diagnose dementia. Equally, diagnosing unspecified 'cognitive impairment', be it for intellectual disability, stroke disease or dementia, is important, as any cognitive impairment implies vulnerability to delirium in hospital. A definitive diagnosis and disclosure of dementia or other can be made at a later stage, in an appropriate setting.

It is important that the cognitive screening instrument is reliable and efficient, with the 6-CIT identified as a potential alternative to the MMSE for use in hospital [18]. However, to date, there have been no well-designed validation studies of the 6-CIT for cognitive screening in the acute setting, where a formal neuropsychiatric diagnosis should be the reference standard for the diagnosis of dementia, MCI or other, rather than another cognitive test used as a surrogate diagnosis. It must be noted, however, that this reflects an overall lack of good quality validation studies of cognitive tests in a hospital-based population [8]. The 6-CIT has been found to be short, simple, feasible and acceptable to staff, can be used in the visually impaired and is less educationally and culturally biased, which are all very important test characteristics when considering a test for use in the ED and on busy clinical wards, although it still remains unclear which cut-off is the most appropriate for detecting cognitive impairment or possible dementia.

In summary, we believe that the 6-CIT shows promise as a potential cognitive screening test both in primary and secondary care settings; however, further robust validation studies of the instrument are required. In particular, comparison to a wide range of short cognitive assessments, especially the 4AT (Rapid Assessment Test for Delirium), which also tests attention and orientation, may be useful, with expert opinion for diagnosis. Also, the best cut-off of the 6-CIT needs clarification.

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