Adaptation and validation into Portuguese language of the Six-Item Cognitive Impairment Test (6CIT)

Apóstolo, João Luís Alves*; Paiva, Diana dos Santos**Silva, Rosa Carla Gomes da***; Santos, Eduardo José Ferreira dos ****

* Health Sciences Research Unit: Nursing (UICISA: E), Nursing School of Coimbra, Portugal. apostolo@esenfc.pt.
** MNsC, RN, Centro Hospitalar e Universitário de Coimbra, Portugal.
*** PhD Student, MNsC, RN, and Assistant Professor at School of Nursing - Porto, Catholic University of Portugal, Porto. rcgsilva@porto.ucp.pt.
**** Health Sciences Research Unit: Nursing (UICISA: E), Nursing School of Coimbra, Portugal. ejf.santos87@gmail.com.

ABSTRACT

Background: The six-item cognitive impairment test (6CIT) is a brief cognitive screening tool, so with great clinical utility. At the moment, further explored and applied in primary care settings.

Aim: To adapt the 6CIT for the European Portuguese and determine its normative values based on a sample selected in different contexts (institutionalized in nursing homes and in community setting: users of senior universities, day centers or just living in your home).

Methods: For the cross-cultural adaptation of 6CIT we opted for a methodology that tested its psychometric conditions in the new cultural context. The original version of 6CIT was submitted to translation and adaptation, and version Portuguese’s Mini-Mental State Examination (MMSE) served as measure gold standard. Sampling is accidental by non-probability selection with dispersion for various geographic locations of the North and Centre of the country.

Results: The cutting operating values proposed for the Portuguese population, from which it distinguishes the presence of cognitive impairment is 10 for 6CIT. For a sensitivity of 82.78% and specificity of 84.84%. When it take into account the division in three educational groups, of according with cutoff values of the version Portuguese’s MMSE, the cutoff values for 6CIT are: ≥12 for 0 to 2 years of literacy, ≥ 10 for 3 to 6 years of literacy and ≥ 4 for literacy equal to or greater than 7 years.

Conclusions: The adaptation process showed that the 6CIT Portuguese version has high reliability, a strong potential for reproducibility and a strong correlation with criterion measure of the concurrent validation. This version of the instrument has good measures of the diagnostic accuracy for cognitive deterioration.
**Key words:** cognition; neurocognitive disorder; dementia, 6 Item Cognitive Impairment Test; 6 Item Orientation-Memory-Concentration Test; Mini-Mental State Examination; screening; position statement.

**INTRODUCTION**

Neurocognitive Disorder (NCD) is a clinical syndrome caused by cognitive impairment, with different degrees of severity, ranging from mild to major. There are different aetiologies which contribute to this impairment, such as Alzheimer’s disease, Lewy’s disease, Parkinson’s disease, Frontotemporal Lobar Degeneration, among others(1). Minor NCD, usually referred to as Mild Cognitive Impairment (MCI), is the initial stage of the deterioration affecting no more than two cognitive domains and has an estimated prevalence of 2.48% to 15.6% (2-4). Major NCD (or dementia)(1) is characterised by a progressive deterioration in cognitive domains (for example complex attention, executive function, learning, and memory) and ability for independent living. The estimated prevalence in Western Europe is estimated to be around 7.2% (3–5).

A cognitive screening is paramount in the early detection of cognitive impairment. This approach is important to achieve a timely diagnosis and referral to specialist services, therefore allowing these patients an appropriate treatment and consequently an improvement in quality of life(6). Many clinical guidelines for cognitive impairment support these orientations in clinical practice (7). For example, the National Institute for Health and Care Excellence (NICE) recognises the wide use of the Mini-Mental State Examination (MMSE) but suggests another brief cognitive screening test - the 6-Item Cognitive Impairment Test (6CIT) (7).

There are many cognitive screening instruments available for use in the clinical context, aiming at assessing individuals' cognitive function with complaints of memory loss (8). The MMSE(9), is an 11-item tool designed to evaluate several cognitive domains, such as time and space orientation, short-term memory, attention, mental calculation, recall, perception, language, and visuospatial perception. It takes about eight minutes (ranging from four to 21 minutes) to be applied. Although time consuming, it is the 'gold standard' cognitive test (8), and hence an accepted method of screening and monitoring the progression of cognitive deterioration(9). The educational level has also been reported to influence the score of this test(10). Thus, operational cutoff values of the Portuguese version are according with literacy
years: 22 for zero to two years; 24 for three to six years and 27 for seven or more years of literacy(10).

The 6CIT is a brief and simple cognitive screening instrument, which allows assessment of the following cognitive domains: orientation, learning, memory and calculation(6,11–13). Furthermore, studies have shown that the 6CIT is a suitable screening instrument with good diagnostic accuracy for cognitive deterioration(14,15), particularly in the screening of the milder states(12).

The initial names this instrument were: 6 item or Short Orientation-Memory-Concentration test (OMCT) described by Katzman et al., in 1983; and Short Blessed Test (SBT), that is an abbreviation of the 26-Item Blessed Information-Memory-Concentration Scale (BIMC) developed by Blessed et al. (1968)(12,14).

It includes six simple questions about the current date (year, month and day), memorising five components (name and address), mental reversal of numbers (20 to one) and the months of the years (December to January). Therefore, it involves non-cultural and simple questions that do not require a complex interpretation(15). The estimated response total time is two to three minutes(13,15). The 6CIT, unlike most of the cognitive screening instruments, uses a reverse scoring system. The results may assume values from zero to 28, the higher scores corresponding to a higher cognitive impairment(15).

The 6CIT has demonstrated that it has better sensitivity to detect mild and major NCD than the MMSE(15). For this reason, the 6CIT has been recommended as a reliable alternative compared to the MMSE in diverse contexts, including not only primary care but also at the patient’s bedside(15).

A previous study for validation and adaptation of the 6CIT to Portuguese, using as gold standard instrument the MMSE, found a strong internal consistency, strong potential for reproducibility, and strong correlation with this concurrent validation criterion measure (16). However, the low educational level of this sample was a significant limitation(16). In order to reduce the weaknesses of this research(16), it follows this study.

This research team believes that by making the 6CIT available for clinical use is an opportunity to contribute to the improvement of practices in the area of cognitive screening. Our aims are to: (i) Adapt the 6CIT to European Portuguese language, with satisfactory psychometric characteristics; and (ii) Determine the normative values of the 6CIT, based on a
sample selected in different contexts, in order to ensure the representation of different groups of elderly.

METHODS
The methodological option is part of a quantitative approach, giving relevance to an instrument validation study.

For the cross-cultural adaptation guidelines for the cross-cultural adaptation process(17) and validation of the 6CIT we chose a methodology that tests its psychometric conditions in the new cultural context.

Stage 1 – The English version of the 6CIT was translated into Portuguese language by two native Portuguese speakers with English language knowledge. Stage 2 – Synthesis. The two independent translations were compared with each other and with the original English version to produce a synthesis. They were aware of the objectives of the study and a consensus was obtained therefore originating the initial Portuguese version of the 6CIT. Stage 3 – Back-translation. Two native English speakers, a nurse and professional translator performed back-translations of the synthesis. The translations were carried out independently and blind to the original instrument. Stage 4 – Expert Committee. The translations were then discussed by the experts in Mental Health and Psychiatry for the cross-cultural equivalence, and these experts reached a consensus, assured the semantic, idiomatic, experiential and conceptual equivalence. Stage 5 – Test of the pre-final version. In the last step of the cultural adaptation process, the pre-final version was submitted to pre-test, to allow the analysis of the responsiveness of their statements. The pre-final version was administered to 116 elderly. No difficulties in understanding the statements presented or questions regarding the format and content were noted, and the final version was approved and released.

In order to achieve the quality of the proposed measuring instrument, the reliability and the validity of the obtained sample was determined. We estimated the temporal stability of the 6CIT, by the use of test-retest, applied to 54 participants of the different setting, proceeding to a new measurement after a two-week period. The assessment was undertaken by two investigator in each time. Internal consistency was assessed by correlating each item with the total score of the instrument, using the Pearson correlation coefficient. Cronbach's alpha coefficient of was used to determine the internal consistency between the different items. The criterion validity was analyzed by correlating the 6CIT with the Portuguese version of the MMSE, which was considered an independent and equivalent instrument and used here as the
gold standard. The MMSE Portuguese version adopted was established by Morgado et al. (2009) and organised according in three educational groups: 22 for zero to two years of literacy; 24 for three to six years and 27 for more than six years of literacy.

Receiver operating characteristic (ROC) curves were used as an overall measure of diagnostic accuracy and generated using the MedCalc® statistical software. Optimal cutpoints along ROC curves were calculated using the Youden index.

Participants

In order to obtain a representative sample the research was undertaken in different rural and urban contexts from the northern and mid-regions of the country and population was recruited: (i) Nursing homes; (ii) Senior universities; (iii) Day centers; and (iv) Living at home. Accidental, non-probabilistic sampling techniques were used in the selection of the participants.

The participants were selected according to the following inclusion criterion: (a) Participants above 60 years of age; (b) Being able to communicate orally; (c) Not depressed (Geriatric Depression Scale-15 below six points); and (d) Agree to participate in the study. It was selected accidentally different institutions (nursing homes, day centers, senior universities, and primary health care for obtain the authorization to collect date in their own home) and proceeded to the formal request. After institutional consent was selected the participants according to the criteria of inclusion. Individuals who did not fit the inclusion criteria were excluded from the study.

The data collection process was cross-sectional, at more than 17 setting, took two years and was completed in May 2016. The socio-demographic characteristics of the sample were collected (age, gender, marital status and education). After the completion of these data, the Geriatric Depression Scale(18), the MMSE(10) and the 6CIT questionnaires were administered. These tests were administered on the same day and all researcher underwent instruction in administering and scoring the tests.

This study was approved by the Health Sciences Research Unit Ethics Committee (Opinion P12-11/2010).

RESULTS

The final sample included 550 participants, with an average of 76.71(±9.66) years, ranging from 60 to 103 years, with a vast majority of females (387; 70.36%). With regards to the
marital status, 247 (44.90%) participants were widowed, 216 (39.27%) were married or in a de facto relationship, 56 (10.18%) were single and the remaining 31 (5.64%) were divorced.

152 (27.64%) participants were institutionalized in nursing homes (six institutions were involved) and 398 (72.36%) of the respondents were in a community setting. Out of these, 92 (16.72%) were users of senior universities (involving two universities), 180 (32.72%) were from nine day centers, and the remaining 126 (22.90%) elderly were interviewed in their own home.

The analysis relating to the educational level of participants shows that the education varies between zero and 18 years, with an average of 4.8 (±4.6) years. Grouping this sample in educational intervals, we verified that 30.73% of them are between 0-2 years, 43.27% are between 3-6 years and 26.00% with education level equal or superior to 7 years.

Table I - Summarises the demographic, social and clinical characteristics of the sample (n=550)

| Women, n (%) | 387 (70.36) |
| Age, mean (SD), in years | 76.71 (9.66) |
| Widowed, n (%) | 247 (44.90) |
| Institutionalized, n (%) | 152 (27.64) |
| Living in the community, n (%) | 398 (72.36) |
| Day centers | 180 (32.72) |
| Senior universities | 92 (16.72) |
| Own house | 126 (22.90) |
| Educational level (years), n (%) | 169 (30.73) |
| 0 – 2 | 238 (43.27) |
| 3 – 6 | 143 (26.00) |

6CIT Reliability

The 6CIT revealed a strong internal consistency (α =0.876) and the corrected item total ranged between 0.317 and 0.891, which represent a moderate to strong correlation between the various items in the instrument. Retesting the instrument revealed a strong internal consistency (α = 0.823), with weighting correlation values of the total item ranging between
0.307 and 0.748, also indicators of a moderate to a strong correlation between the instrument items.

**Temporal stability**

The stability of the 6CIT was evaluated by the ‘test-retest’ technique in order to assess the extent to which this instrument provides stable results, having been applied to 54 participants from different contexts under review, with a break of two weeks between measurements.

The results of the paired t-test (t=1.487; p=0.143) and the correlation between the two time points (r=0.95; p<0.000) show the temporal stability of the 6CIT and support its reliability.

**Validity of Criterion**

As criterion of concurrent validity, the MMSE was used in order to provide an opportunity to compare the performance of the 6CIT. A statistically significant (p <0.000) strong negative correlation was found (r = -0.895), between the 6CIT and the MMSE.

**Study of the sensitivity and specificity of the instrument**

The values for which there is greater optimization of sensitivity according to its specificity were estimated, shown in the form of graphical representation called the receiver operating characteristic (ROC) curve (Figure 1).

Figure 1 – ROC curves for 6CIT
A measure of diagnosis accuracy, area under the ROC curve, is 0.90 for the diagnosis of cognitive impairment versus no cognitive impairment, when level education is not considered. If we consider education level, AUCs are 0.94, 0.95 and 0.84 for literacy from zero to two years, from three to six, and more than 6 years, respectively.

To choose the cutoff point of the 6CIT, it was decided to enhance the considerations of the sensitivity on the specificity and proceed to the selection of the cutoff point where the average of these two measures is maximum using Youden index (Table 2).

Table 2 - Youden Index and Optimal Cut-Point for 6CIT with representation of the educational groups
<table>
<thead>
<tr>
<th>Method</th>
<th>Youden Index (J)</th>
<th>Optimal cutoff point</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 CIT (global)</td>
<td>0.67 (0.60-0.72)</td>
<td>10 (8-11)</td>
<td>82.78</td>
<td>84.84</td>
</tr>
<tr>
<td>6CIT in literacy group from 0 to 2 years</td>
<td>0.76 (0.66-0.82)</td>
<td>12 (4-15)</td>
<td>93.44</td>
<td>68.09</td>
</tr>
<tr>
<td>6 CIT in literacy group from 3 to 6 years</td>
<td>0.74 (0.65-0.82)</td>
<td>10 (9-12,03)</td>
<td>88</td>
<td>86.23</td>
</tr>
<tr>
<td>6CIT in literacy group ≥ 7 years</td>
<td>0.50 (0.34-0.60)</td>
<td>4 (0-8)</td>
<td>72.55</td>
<td>78.26</td>
</tr>
</tbody>
</table>

*Numbers in parenthesis are 95% confidence intervals.

Initially, we calculate a cutoff point for the 6CIT taking only in consideration the presence or absence of cognitive impairment, and no the education level. By analyzing Table 2, the cutoff point 10 is assumed as the best result, with sensitivity values of 82.78% and specificity of 84.84%. Therefore, the cutoff point value proposed for the Portuguese population is 10 on the 6CIT, comparing to the gold-standard, by criterion of the presence or absence of cognitive impairment.

Thus to ensure the representation of the educational groups, the number of individuals with the presence (assumed to be positive diagnose) or absence (assumed to be negative diagnose) of cognitive impairment, according to the scores obtained in the version Portuguese’s MMSE (three educational groups)(10) were taken into account.

For the group of individuals between 0-2 years of literacy, the cutoff point 12 is assumed as the optimal cutting point, with sensitivity values of 93.44% and specificity of 68.09%.

For the literacy group between 3-6 years, the optimal cutoff point is located at a score of 10, which displays sensitivity and specificity values of 88.0% and 86.2%, respectively. After analyzing the different considerations of the sensitivity on the specificity and is using Youden index for the education group ≥ 7 years, the optimal cutoff point is 4, with a sensitivity of 72.55% and specificity of 78.26%.

**DISCUSSION**

The cross-cultural adaptation of the 6CIT was easily processed after translated into European Portuguese. The 6CIT was an easily accepted test by the elderly and the researchers. The test-retest reliability indicated a high correlation at two week interval, as other studies showed(14) Here, with safety of having different researches in each time of assessment.

The 6CIT had a very high negative correlation with the MMSE scores (r = -0.895; p < 0.000), suggesting a strong concurrent validity(12–15)The negative correlation obtained confirms that
the variables vary in the opposite direction, revealing that the individuals who have a higher value in the MMSE have a lower value in 6CIT. Hence, the results attest to the validity criterion in analysis.

The test used also shown good sensitivity and specificity values (82.78% and 84.84% respectively) for screening cognitive deterioration. Similar values are described in literature, evidencing its psychometric properties (12–16,19). However, at the group from zero to two years, the 6 CIT was less specific (68.09%), but more sensitive (93.44). The group more than 7 years was marginally the less sensitive and specific (72.55% and 78.26).

Using the global 6CIT, we found high diagnostic accuracy: sensitivity and specificity ≥ 80; the AUC was excellent (AUC= 0.90; 95% CI=0.88-0.93; p<0.000).Our results are similar to other published data(13,16). The 6CIT showed a strong internal consistency, a strong potential for reproducibility and a strong correlation with the criterion measure of the concurrent validation, comparable to the previous study developed for the Portuguese population(16).

Optimal comparability was found at a cutoff point of ≥ 10 on the 6CIT. The effect of educational level on cognitive tests scores can be adjusted in the cutoff points. The cutoff point proposed for the Portuguese population, according education level, are the following: ≥ 12 for zero to two years of literacy; ≥ 10 for three to six years of literacy, and ≥ 4 for literacy equal or superior to 7 years. So, the cutoffs on the 6CIT showed to be sensitive to education level (6), but the opposite was also reported (13).

The low education level global of the Portuguese population implied adjust the cutoff points of the 6CIT according to educational level. Different cutoff points can be an obstacle to the use of routinely screening tools, but surmountable in the coming years due to the higher level of literacy of the Portuguese elderly population.

The 6CIT proved to be a cognitive screening instrument of excellence in different clinical settings (nursing homes, senior universities, day centers, living at home), as in others setting: primary care, hospital(11–13,19). The absence of visuospatial and interpretative items (e.g. writing a sentence) also facilitates the evaluation of visually impaired patients(12,15,20,21). Furthermore, it includes cognitive domains that satisfactorily respond to the evaluation criteria of cognitive status. Hence, whereas the 6CIT focuses more on cognition, the MMSE covers other domains such as language and visual-spatial skills(20). We consider these
characteristics of the 6CIT are an advantage in assessment of the elderly's cognition, due their sensory disabilities and their low level of literacy, such as in the Portuguese elderly population(10,22).

The advantage of being a brief cognitive screening instrument allowed a quick administration. So shorter cognitive screening tests such as the 6CIT may allow a quick assessment and are not inferior when compared to other alternatives like the MMSE (12–14,16).

In conclusion, the 6CIT, after being submitted to a process of cross-cultural adaptation and subsequent validation to Portuguese language, showed high validity and reliability and therefore highly satisfactory and auspicious results.

It is expected that these results prove advantageous for the care that lend themselves to the Portuguese elderly population. Once that happens, the 6CIT brevity offers considerable advantages and although there are few studies in the Portuguese context, it is important to highlight the importance of the 6CIT as a suitable screening tool. Evidencing its psychometric properties, the 6CIT showed a strong internal consistency, a strong potential for reproducibility and a strong correlation with the criterion measure of the concurrent validation, similar to the previous study developed for the Portuguese population.

Similarly it is important that further research is conducted in this area, particularly with studies on the applicability of the 6CIT, with presentation of new research and proposals in different population settings. This way, further studies will be required to assess the reliability of the 6CIT in secondary care settings like hospitals.

**Limitation**

The sampling process used (accidental, non-probabilistic) is an approach with limitations, particularly when the goal is to maximize the results for a greater representation. So, by the impossibility to access the all population and, in order to maximise the generalization of the results, were involved several settings, with geographical dispersion between North and Centre of the country.

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