Development and validation of ‘Cognitive Assessment Scale for Stroke Survivors’

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Abstract

Background & Objectives: Stroke is a leading cause of death and it causes significant long-term disabilities. It affects cognition and physical impairment in the patients. Cognitive impairments caused by stroke include loss of memory, disorientation, impaired attention, reasoning, and social perception. It may also lead to interaction deficit and inability to problem-solving, etc. The precise knowledge about the degree of cognitive impairment is essential to address the issue with appropriate measures. We aimed to develop a cognitive measurement scale for stroke patients.

Methodology: The phenomenon was explored through in-depth interviews of 12 stroke survivors in different hospitals in Lahore, Pakistan. Seventeen items were generated. After factor analysis, 15 items were included in the scale and a pilot study was conducted on 15 participants. A sample of 106 patients was selected to administer the scale Cognitive Assessment Scale for Stroke Survivors (CASS) and Mini-Mental State Examination (MMSE) scale for concurrent validity.

Results: The Principal Component Factor Analysis through Varimax rotation yielded three factors, e.g., ‘Social Cognition’, ‘Focus and Attention’, and ‘Orientation’. The results have shown significant values with good psychometric properties. The Cronbach’s Alpha value of the developed scale is 0.88 which indicates it as a highly reliable scale.

Conclusion: This research reported that stroke survivors experience cognitive impairment after the stroke incidents. The developed scale to measure cognitive impairment after a stroke incident was proved to be valid and reliable, and can be used in medical practice.

Abbreviations: CASS – Cognitive Assessment Scale for Stroke Survivors; MMSE – Mini-Mental State Examination.

Key words: CASS; Cognitive Assessment Scale for Stroke Survivors; Cognition; Cognition Disorders / epidemiology; Cognition Disorders / etiology; Cognition / Measurement; Humans; Male; MMSE; Mini-Mental State Examination Scale Development; Stroke / complications; Stroke / epidemiology


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Cognition includes memory, perception, attention, reasoning, problem-solving, etc. These faculties are not separately examined.\textsuperscript{4} Attention is the basic cognitive function needed in daily activities. In the early days and weeks after a stroke incident, attention is highly affected due to damage in the right hemisphere. It includes focusing, concentration, and sustained attention that is influenced by a stroke incident. It also generates general slowness in activities and mental processing, and mood disturbance, fatigue, and inability to live independently.\textsuperscript{4}

Memory is also affected by stroke, which is generally measured through formal assessment tools. Memory loss has consequences on patients' recovery because it causes personal safety issues, and distress to patients and their families. Almost 20\% of the stroke survivors experience dementia within 6 months after a stroke incident.\textsuperscript{4}

Perception is the process of analyzing the approaching sensation that is required to perform daily activities. It includes the awareness of things, recognition, and orientation. Impairment in perception is expected in stroke patients, specifically in the starting months after stroke.\textsuperscript{2}

It was all this information in the mind, which compelled us to develop a cognitive measurement scale and to prove its validity in measurable terms.

2. Methodology

There are two major parts of this study, the first part is the brief information about developing a cognitive measurement scale and the second part consist of measuring the scale’s validity.

Section I: Scale Development

Step 1: Gathering problem

The first step of developing a scale is exploring phenomenology through in-depth interviews with stroke survivors who faced cognitive impairment. These phenomenological interviews were conducted in different hospitals of Lahore, Pakistan. In total, 12 semi-structured in-depth interviews were conducted with stroke survivors of both genders, to get information about cognitive decline.

Step II: Item generation

Raw data was collected and items were generated on the basis of information received from the stroke survivors. Verbatim of the stroke survivors were used to generate items that were relevant to cognitive decline and exclude irrelevant information. Items were generated by considering different domains of cognition.

Step III: Empirical validation through experts
After creating a rough scale, the next step was expert validation. In which experts analyzed the scale and made items more reliable by using suitable information and precise words. Expert analysis was conducted by four experts, two of them were clinical psychologists with more than 6 years of experience. The other two experts were Urdu language specialists who analyzed items according to the most relevant and specific words. The Likert scale was developed consisting of 17 items with 4 points Likert scale, value of each item from 0 to 3 where 0 = ‘Never’, 1 = ‘Sometimes’, 2 = ‘Often’ and 3 meant ‘Every time’.

### Section II: Scale Validation

Scale validation is required to find out the relevancy of the scale. Scale validation is a process to find out the validity of the scale, which means to ascertain that the scale is measuring what it is supposed to measure. There were two steps in scale validation, first was a pilot study in which data was collected from a small number of samples to find out if, the scale was finding relevant results and the second step was the actual study in which data was collected from a large number of population to compare already existed cognitive measurement scale with newly developed scale.

### Step I: Pilot Study

The pilot study was conducted after the construction of the scale to find out the user amiability of the newly developed scale. It was conducted on 15 participants with a 1-year post-stroke period. Data were collected on two scales, Mini-Mental State Examination (MMSE) and CASS (CASS). The patients were asked to rate the issues according to their current situation after the stroke incident. Both scales were administered with proper attention and concentration. The main objectives of the study were explained to all participants and asked for their consent to participate.

### Step II: Main Study

The main study had two objectives; the first one was to measure the psychometric properties of the scale and the second was to find out the concurrent validity of the developed scale.

The institute ethical committee approval was obtained to conduct the study and permission was taken from all participants. The study was conducted on 106 participants from different hospitals. Concurrent validity was used for scale validation that was measured by an already existing cognitive scale (MMSE) and was compared with the newly developed CASS scale. Factor analysis was used to analyze the data and report the validation of the scale. The exploratory factor analysis (EFA) was used for this process and 15 items were included after factor analysis. The maximum score on the scale was 45 and the minimum score was 0.

### 3. Results

Results of this study consist of psychometric properties of the developed scale – CASS, and its validity by comparing with the already existing scale MMSE. Exploratory factor analysis was used on a scale with Kaiser-Meyer-Olkin (KMO) and Bartlett’s test of specificity. Factor analysis was also used in this study to find out factorial validity, principal component analysis along with Varimax rotation method of 106 responses of

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**Table 1: Factor Loadings of CASS with Varimax Rotation (N=106). Note: Factor loading > .40.**

<table>
<thead>
<tr>
<th>Item No</th>
<th>F1</th>
<th>F2</th>
<th>F3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>.613</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>.602</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>.739</td>
</tr>
<tr>
<td>4</td>
<td>.555</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>.518</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>.747</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>.730</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>.567</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>.789</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>.718</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>.639</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>.842</td>
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<tr>
<td>13</td>
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<td></td>
<td>.846</td>
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<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>.642</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>.538</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Eigen Values | 6.02 |
| % of Variance | 37.66 |
| % of Total Variance | 37.66 |

**Table 2: Cronbach’s Alpha of Total of CASS (N=106)**

<table>
<thead>
<tr>
<th>Factors</th>
<th>No of items</th>
<th>Α</th>
</tr>
</thead>
<tbody>
<tr>
<td>F-1. Social Cognition</td>
<td>7</td>
<td>.82</td>
</tr>
<tr>
<td>F-2. Focus and Attention</td>
<td>4</td>
<td>.76</td>
</tr>
<tr>
<td>F-3. Orientation</td>
<td>4</td>
<td>.80</td>
</tr>
<tr>
<td>CASS</td>
<td>15</td>
<td>.88</td>
</tr>
<tr>
<td>MMSE</td>
<td>11</td>
<td>.85</td>
</tr>
</tbody>
</table>

*Note: α = Cronbach’s Alpha, CASS= Cognitive Assessment Scale for Stroke Survivors, MMSE= Mini-Mental State Examination.*
the sample to bring of indigenous scale. In order to keep factors, the Eigen value was tested to be greater than 1. The Eigen value that is shown in the result was inspected on a Scree plot that identifies the structure of the factors and the number of factors in the scale. In these analyses correlation of the items and total scale, Alpha reliability, and internal consistency were also included in the psychometric properties of the scale. The result shows a KMO value of 0.82 at $P < 0.001$.

Figure 1 consists of the three-factor on the CASS having cross-loading items greater than .40. Three factors were constructed after the extraction of items based on the theme and content of each item.

**Factor Description**

Three factors were constructed after factor analysis and these factors emerged in an in-depth study of the theme originated by items. These were named according to the themes that appeared by the researcher.

**Factor 1: Social cognition:** ‘Social cognition’ is the first factor that includes 7 items. This factor has emerged on the basis of a common theme. In this factor, items are related to ‘social cognition’, such as attitude, behavior, and social perception.

**Factor 2: Focus and attention:** This factor includes 4 items. These items are related to ‘social cognition’, such as attitude, behavior, and social perception.

**Factor 3: Orientation.** The third factor is orientation and it contains 4 items. This factor is also constructed on the common theme that is ‘orientation’.

**Inter-factor correlation**

Inter-factor correlation is the statistical technique to find out the correlation between factors of the scale. The inter-factor correlation was used to find out the relationship between three factors of the CASS and the total of the CASS.

**Psychometric Properties**

Psychometric properties of the developed scale (CASS) is shown in Tables 2, 3 and 4.

**Age and Cognitive Impairment**

The result shows that age group 51–82 y revealed more cognitive impairment as compared to age group 28–50 y. Cognitive
impairment is common in old age people as compared to young one. The result is shown in Table 5.

4. Discussion

This research is about the development of a new scale for the cognitive impairment and finding out its validity. For this purpose, a scale was developed through the scale construction process and factor analysis was used to find out the internal consistency of the scale. The developed scale measures cognitive impairment in stroke survivors. Factor analysis distributed the scale into three factors. These are ‘Social Cognition’, ‘Focus & Attention’, and ‘Orientation’. These three factors show a positive correlation with each other and with overall cognitive impairment. The result shows a significant relationship and shows high reliability that is .88. The developed scale CASS showed a negative moderate correlation with MMSE. It showed a negative correlation because MMSE has the reverse scoring. The results displayed that the developed scale is valid.

An earlier study reported that people older than 45 y of age experience stroke incidents more as compared to young adults. This study reported that one man out of four experiences stroke incidents and one woman out of five experiences stroke incidents once in their lifetime after 45 y of age and if they live to 85 y of age. The results of our research also report that older people experience more stroke incidents as compared to young adults. In this research, the age category was divided from 28-50 y and 51-82 y. The results revealed that people in 51-82 y of age were more prone to stroke incidents.

We discovered three factors of the scale, e.g., Social Cognition, Focus & Attention, and Orientation. These three factors showed a positive correlation with each other and had Cronbach’s Alpha values greater than .76 which showed highly reliable factors. A study by Coco DL et al. reported that the major domains affected by the stroke incidents are memory, attention, orientation, and social perception. These areas of cognition are needed to be considered for cognitive impairment improvement in stroke survivors.

The results showed overall CASS reliability of Cronbach’s Alpha was 0.88, which proved its good reliability. Cronbach’s Alpha values for three factors of this scale were Social Cognition 0.82, Focus and Attention 0.76, and Orientation 0.80. These values indicate that all three factors are reliable. Brown JD in his study, explained that Cronbach’s Alpha is an important tool to find out the reliability of the scale.12 It also gives us the consistency of the items that were administered to the participants. It is also known as internal consistency reliability. Its value is between .00 to 1.00. If the scale Cronbach’s Alpha value is .88 that means the scale is 88% reliable which shows good reliability.

5. Limitations

The data was collected from hospitals of one city of Pakistan only. A large, multi-centered and multi-ethnic study is needed to confirm the validity of the scale across the board.

6. Conclusion

There was no specific tool to measure cognitive impairment caused by the stroke in the stroke survivors, hence we developed Cognitive Assessment Scale for Stroke Survivors (CASS) for this purpose. The factor analysis process distributed scale into three factors, these are ‘Social Cognition’, ‘Focus and Attention’, and ‘Orientation’. These factors are also reliable as Cronbach’s Alpha values were high. The developed scale is reliable and valid, and its indigenous property makes it helpful for healthcare professionals to measure cognitive impairment in stroke survivors and manage accordingly.

7. Conflict of Interest

The authors declare no conflict of interest.

8. Data availability

Data generated during this research is available with the authors.

Table 5: Independent sample t-test for age on CASS (N = 106)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Age (y)</th>
<th>Mean ± SD</th>
<th>t</th>
<th>P</th>
<th>95% Lower limit</th>
<th>95% Upper limit</th>
<th>Cohen's d</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASS</td>
<td>28-50</td>
<td>17.43 ± 7.95</td>
<td>3.28</td>
<td>.001***</td>
<td>−7.74</td>
<td>−1.91</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>51-82</td>
<td>22.27 ± 7.12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

***P < .001
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10. Authors’ contribution
SQ: Concept, data collection, manuscript drafting
MNI: Conceptualize, statistical analyses
MR: Expert review, methodology
IUC: Expert review, conceptualize
KM: Data collection

11. References