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Critical Review:
Psychometric properties of cognitive assessments for persons with aphasia

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Cognitive impairment post-stroke is common and can have many negative functional outcomes. Cognitive assessment may be complicated by other sequelae of stroke, such as aphasia. This critical review examines the psychometric properties of assessment measures following a stroke in studies that include persons with aphasia. A literature search resulted in four articles that met the selection criteria. Of these studies, three were validation studies on existing or new cognitive assessment measures, and one was a study of the feasibility of a new assessment measure. The psychometric properties of each assessment measure are discussed as well as clinical recommendations.

Introduction

Cognitive impairment post stroke is a common occurrence, although estimates of prevalence vary greatly. A review by Eskes and Lanctot (2015) suggests the prevalence ranges from 8%-60%. When cognitive impairment occurs following a stroke, it is associated with many negative outcomes, including: increased functional impairment, decreased independence in instrumental activities of daily living, decreased participation in a variety of domains, increased risk of dependency, dementia, and mortality, as well as other factors. It is therefore important to promptly identify cognitive impairment in individuals who have had a stroke in order to intervene effectively. Cognitive status may also affect rehabilitation and discharge planning. Screening for cognitive impairment is recommended following a stroke as part of the Canadian Stroke Best Practice Recommendations (Eskes & Lanctot, 2015).

For various reasons, cognitive assessment post stroke may be problematic. Stroke may result in visual neglect and motor difficulties, which could impact performance on visual tasks and tasks that require writing. Another sequela of stroke is aphasia, which may include impairments to verbal expression and comprehension. Persons with aphasia (PWAs) may have difficulties responding verbally, or may not be able to understand complex instructions. These impairments may impact cognitive assessment using the existing tools, as most tools require verbal responses. Results of cognitive assessments therefore may be negatively impacted by visual neglect, motor involvement, and the language deficits associated with aphasia.

Accurately detecting cognitive impairment relies on use of assessment measures with adequate psychometric properties, including sensitivity, specificity, and positive predictive value. Maximizing these properties will allow clinicians to more accurately identify whether an individual does or does not have a cognitive impairment. Most measures of cognitive impairment were not specifically designed to identify cognitive impairment following a stroke. It is therefore important to separately assess the psychometric properties of these tests to determine their validity in this population. Cognitive assessments designed to detect cognitive impairment post-stroke must also be validated with an appropriate sample. Efforts are being made to determine the psychometric properties of cognitive assessment measures post-stroke, however, many of these studies exclude PWAs.

Objectives

The primary objective of this paper is to critically evaluate the psychometric properties of cognitive assessment measures for individuals post-stroke, specifically in PWAs, in order to provide recommendations for clinical practice.

Methods

Search Strategy

The computerized data bases PubMed and Scopus were searched to find articles related to the topic of interest using the following search term: "(aphasia AND cognitive screening) NOT progressive". The search was limited to articles written in English between 1990 and 2016.

Selection Criteria

To be included in the current appraisal, studies had to: 1) investigate the psychometric properties of cognitive assessment tools for administration to

individuals following a stroke; 2) include individuals with aphasia of any severity

Data Collection

The results of the literature search produced three validation studies of cognitive tests used in the assessment individuals following a stroke, and one feasibility study of a cognitive assessment tool. Two studies examined existing cognitive assessment tools, and two studies examined relatively new assessment tools specifically designed to be used post-stroke.

Results

Demeyere and colleagues (2015) conducted a study on the psychometric properties of the Oxford Cognitive Screen (OCS). The OCS is a tool developed specifically to assess the cognitive status of individuals following a stroke. It assesses the following domains: Attention and Executive Function, Language, Memory, Number Processing, and Praxis. The authors suggest that the OCS is suitable for individuals with aphasia and neglect, and that it is not confounded by impairments in these areas. The authors report that administration of the OCS takes 15-20 minutes.

Data for the validation study were collected from a consecutive sample of 208 individuals post-stroke. Use of a consecutive sample reduces selection bias. Selection criteria were broad, and included: confirmed stroke within 3 weeks of testing, being able to concentrate for 15 minutes, and being able to provide informed consent. No language-related exclusion criteria were reported. Participants had a wide age range and varying sites of lesion: some left, right, or bilateral. Severity of stroke and aphasia were not reported.

The OCS subtests were validated against subtests of existing cognitive or neuropsychological tests. Although the statistical treatment was appropriate, the gold-standard reference standard, comprehensive neuropsychological evaluation, was not used. Low to moderate correlations were calculated between OCS subtests and previously established tests. Sensitivity was below 80% for all but one of the Attention subtests. Specificity ranged from 70.10-98.31%. A low sensitivity could result in individuals with aphasia who have a cognitive impairment not being appropriately identified. Specifically, an individual who has a cognitive impairment may be identified as unimpaired.

The test-retest reliability was reported based on a sample of 53, and was low for some subtests. ICCs for the subtests ranged from .331-.776. The average initial administration one test form was 6.6 days post stroke, and the alternate test form was administered, on average, 3.3 days after the first. Low test-retest reliability could be attributed to spontaneous recovery in some domains. This is likely less of a methodological concern, and may be attributed to the nature of stroke recovery.

The OCS was designed to be inclusive for individuals with various impairments following a stroke. Use of an individual's non-dominant hand does not negatively impact test scores. Patients with expressive language difficulties could complete the majority of subtests on the OCS. Some individuals with expressive language difficulties were not able to complete two of the tasks, reportedly due to difficulty of instructions, which assumes concurrent receptive language impairments.

Despite the compelling clinical importance of the OCS, there is suggestive evidence that the psychometric properties of this test are not sufficient for use in clinical practice. The sensitivity and specificity are low. The validity of this measure is also reduced as the ideal reference standard was not used. The OCS is therefore not recommended for assessment of the cognitive status of individuals with aphasia, unless further validations studies are completed.

Wilde and colleagues (2006) examined the validity of the subtests of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (Randolph et al., 1998) in patients in an in-patient rehabilitation facility following a stroke. The RBANS includes the following standardized index scores: Immediate Memory, Visuospatial/ Constructional, Language, Attention, and Delayed Memory.

The study included 210 stroke patients who were administered the RBANS, as well as other cognitive and neuropsychological tests by a neuropsychologist. Only tests deemed necessary by the neuropsychologist during the patient's care were administered. As such, not every patient completed each test, which is a methodological concern. Patients were excluded if they were disoriented, had significant visual impairment, or if they could not verbally respond in a way that allowed standardized administration. Although the authors did not exclude participants based on having aphasia, limiting the sample to those who could respond verbally would likely eliminate participants with global aphasia, and potentially severe aphasia, limiting the generalizability of these findings.

Sensitivity and specificity of the RBANS were not investigated. Conventional statistical treatment for examination of an assessment were not used, however, the data presented do provide information on the validity of the RBANS. Correlations between sections of the RBANS were calculated. Notably, the Language index score was correlated with the Attention and Delayed Memory index scores. Factor analysis was also completed to determine the factorial validity of the RBANS. Two factors, Language/Verbal Memory and Visuospatial/Visual Memory, accounted for 61% of the variance. Correlations between these factors and the established cognitive and neuropsychological tests were calculated to externally validate the factors. The Language/Verbal Memory factor was correlated with a test of generative naming, but not a receptive language test, and with an established cognitive screening test, but not with visual discrimination tests, or the presence of neglect. T-tests suggested that individuals with left hemisphere damage had lower scores for the Language/Verbal Memory factor than those with right hemisphere lesions. The opposite was true for the Visuospatial/Visual Memory factor.

This study presents equivocal evidence of the validity of the RBANS in stroke patients. Patients with severe or global aphasia are not likely represented in the sample, as patients who could not verbally respond were excluded. The correlation between the Language and Attention, and Delayed Memory index scores suggest an undue influence of language on other index scores, which may negatively impact the total score of individuals with aphasia.

Factor analysis indicated that the five domains of the RBANS are not valid in stroke patients. The two factors that were validated appear to be able to differentiate between left and right hemisphere damage, but this is of little clinical utility given that neuroimaging is generally available to determine the location of the lesion. Due to the correlations between language and other domains, and the inseparability of the domains of the test, the RBANS is not recommended for use in individuals with aphasia.

Godefroy and colleagues (2010) report the sensitivity and specificity of the Montreal Cognitive Assessment (MoCA) (Nasreddine, et al., 2005) and Mini Mental State Examination (MMSE) (Folstein et al., 1975) for individuals post stroke compared to a comprehensive neurological test battery. Participants included 95 individuals less than 3 weeks post-stroke. Participants were excluded if they were not sufficiently conscious, if they could not verbally respond to two orientation questions, and if they were globally aphasic. Each participant was administered the MMSE and MoCA in counterbalanced order. Further, comprehensive neuropsychological testing was completed for most participants, which is an appropriate reference standard. The first 15 participants who scored less than 23 on the MMSE were tested using the full neuropsychological battery. All were determined to be cognitively impaired. Following these 15 participants, participants who scored less than 23 on the MMSE were determined to have cognitive impairment. Not administering the reference standard to all participants reduces the validity.

The statistical treatment used in this study was appropriate. The MoCA had 0.94 sensitivity, 0.42 specificity, and 0.77 positive predictive value. The MMSE had 0.66 sensitivity, 0.97 specificity, and 0.98 positive predictive value. The authors further calculated cut-off points for the MoCA (19 points) and MMSE (24 points) that optimize sensitivity, specificity, and positive predictive value.

This study provides suggestive evidence that the published cut-off scores for the MoCA do not have sufficient psychometric properties for use with individuals following a stroke. The psychometric properties of the MMSE were more favourable. Godefroy and colleagues (2010) suggest new cut-off scores, however, further corroborating studies would be needed to employ these new cut-off scores in clinical practice.

Barnay and colleagues (2014) report a feasibility study of the French version of the Cognitive Assessment scale for Stroke Patients (CASP) (Barnay et al., 2012) compared to the MMSE (Folstein et al., 1975) and the MoCA (Nasreddine et al., 2005). The CASP is a cognitive screening designed to be used for individuals who have had a stroke. The CASP assesses the following cognitive functions: language, praxis, short-term memory, temporal orientation, spatial/visuo-construction neglect and executive functions. It was designed to be possible to administer to individuals with aphasia and visual neglect, and to be appropriate for bedside examination. The items of the CASP can be responded to non-verbally, except the test item examining verbal expression.

Only participants who had a left hemisphere stroke and presented with aphasia were included in the study. The 44 participants were administered the CASP, the MMSE, and the MoCa by the same

examiner. Use of one examiner may have biased test results. The time between the stroke and administration of the cognitive assessments varied from 11 to 100 days. All items of the CASP could be administered to individuals with deficits in verbal expression but not comprehension (n = 3), however, the other cognitive screenings could not be fully administered to these individuals. The CASP could not be fully administered to 8 individuals with expressive and receptive impairments, compared to 13 for the MMSE and 10 for the MoCA.

The authors also investigated the correlation between scores on the cognitive screenings and a gold-standard test of aphasia. The authors report that the scores on the aphasia battery significantly influenced scores on the MoCA and MMSE, but not the CASP. Significant p values are reported, but it is not clear to the reviewer what statistical method was used in these calculations.

There is compelling evidence for the clinical importance of the CASP. It appears to be possible to administer the CASP to individuals with expressive aphasia, although the sample size is too small to draw firm conclusions. The CASP also appears to be less influenced by scores on an aphasia battery than the MoCA and MMSE. These two factors are crucial for a cognitive screening that is to be administered to individuals with aphasia. The validity of the CASP, at this point, is equivocal, as the investigations of the reliability, validity, have not yet been completed. Given the current state of the evidence for the CASP, it is not recommended for clinical use, however, if the CASP is determined to be reliable and valid in further studies, it would be a clinically useful tool.

Discussion

The studies included in this review provide equivocal to suggestive evidence regarding the psychometric properties of the new and established cognitive assessments. The relatively current assessment tools designed to be administered post-stroke do not have sufficient psychometric properties to be recommended for implementation. The sensitivity and specificity of the OCS are not adequate to correctly identify cognitive impairment at this point. Similarly, the psychometric properties of the CASP have yet to be determined. While the design of these two assessments address clinically important variables following a stroke, such as praxis, and use of non-verbal responses, the level of evidence for these measures is equivocal.

The established cognitive assessment measures may not have sufficient psychometric properties to accurately identify cognitive impairment post-stroke. The limited data regarding the psychometric properties of the RBANS suggests that it is not valid for use post-stroke since its subtests are not all valid post-stroke, and scores on language subtests are correlated with other subtests. The published cut-off score of the MoCA may not have adequate psychometric properties post stroke. The MMSE may be more favourable in this regard. The revised cut-off scores may be more ideal for correctly identifying cognitive impairment post-stroke. Overall, there is equivocal evidence for the use of the RBANS, and suggestive evidence for the use of the MMSE and MoCA using the revised cut-off scores. It is also notable, however, that Barnay and colleagues (2014) found that scores on an aphasia battery influenced MoCA and MMSE scores.

During the literature review, it was noted that many studies of cognitive screening excluded PWAs. As such, further research in this area is needed to validate cognitive assessment measures in this population. Future research should include a determination of whether scores on an aphasia battery or other measure of language influence scores on cognitive assessment measures. Language scores should not be correlated with scores on a cognitive test, as these are two separate constructs. Any such correlation may result in individuals with aphasia being identified as cognitively impaired due to their language deficits. Future validation studies of cognitive assessments should also include individuals with varying types and severities of aphasia.

Clinical Implications

The limited strength of evidence in the reviewed studies does not allow for a definite determination of whether each cognitive assessment is suitable for use with PWAs, however, guarded clinical recommendations are possible. When considering the tests designed to be administered post stroke, the psychometric properties of the OCS are not sufficient for clinical use, and those of the CASP have yet to be determined. Of the established cognitive assessments, the RBANS does not have sufficient psychometric properties when administered post-stroke. The published cut-off scores of the MoCA and MMSE may underestimate the cognitive abilities of individuals post-stroke.

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References

Barnay JL, Wauquiez G, Rousseaux M, Bonnin-Koang HY, Dischler F, De Boissezon X, Lucas-Pineau, C., & Benaim, C. (2012). Presentation of the cognitive assessment scale for stroke patient (CASP). *Annals of Physical Rehabilitation Medicine, 55*, e188.

Barnay, J. L., Wauquiez, G., Bonnin-Koang, H. Y., Anquetil, C., Pérennou, D., Piscicelli, C., Lucas-Pineau, C., Muja, L., le Stunff, E., de Boissezon, X., Terracol, C., Rousseaux, M., Bejot, Y., Binquet, C., Antoine, D., Devilliers, H., & Benaim, C. (2014). Feasibility of the Cognitive Assessment scale for Stroke Patients (CASP) vs. MMSE and MoCA in aphasic left hemispheric stroke patients. *Annals of physical and rehabilitation medicine*, *57*(6), 422-435.

Demeyere, N., Riddoch, M. J., Slavkova, E. D., Bickerton, W. L., & Humphreys, G. W. (2015). The Oxford Cognitive Screen (OCS): Validation of a stroke-specific short cognitive screening tool. *Psychological assessment*,*27*(3), 883.

Eskes G, Lanctot K on behalf of the Mood, Cognition and Fatigue following Stroke Writing Group. Mood, Cognition and Fatigue following Stroke Module 2015. In Lindsay MP, Gubitz G, Bayley M, and Smith EE (Editors), on behalf of the Canadian Stroke Best Practices and Advisory Committee. Canadian Stroke Best Practice Recommendations, 2015; Ottawa, Ontario Canada: Heart and Stroke Foundation.

Folstein, M.F., Folstein, S.E., McHugh, P.R. (1975). Mini-Mental State. A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12*, 189 –198.

Godefroy, O., Fickl, A., Roussel, M., Auribault, C., Bugnicourt, J. M., Lamy, C., Canaple, S., & Petitnicolas, G. (2011). Is the Montreal Cognitive Assessment superior to the Mini-Mental State Examination to detect poststroke cognitive impairment? A study with neuropsychological evaluation. *Stroke*, *42*(6), 1712-1716.

Nasreddine, Z.S., Phillips, N.A., Bedirian, V., Charbonneau, S., Whitehead, V., Collin, I., Cummings, J.L., Chertkow, H. (2005). The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *Journal of American Geriatric Society*, *53*, 695– 699.

Randolph, C., Tierney, M. C., Mohr, E., & Chase, T. N. (1998). The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS): preliminary clinical validity. *Journal of clinical and experimental neuropsychology*, *20*(3), 310-319.

Wilde, M. C. (2006). The validity of the repeatable battery of neuropsychological status in acute stroke. *The Clinical Neuropsychologist*,*20*(4), 702-71