BRIEF COMMUNICATION

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Validating the OCS-Plus against a clinical standard: A brief report

Rebecca Roberts[1,2] ⓘ | **Reena Vohora**[2,3] | **Sam S. Webb**[3] ⓘ |
Nele Demeyere[4] ⓘ

[1]Oxford University Hospitals NHS Foundation Trust, Oxford, UK

[2]Oxford Institute of Clinical Psychology Training and Research, Isis Education Centre, Warneford Hospital, Oxford, UK

[3]Department of Experimental Psychology, Oxford University, Oxford, UK

[4]Nuffield Department of Clinical Neurosciences, OUH John Radcliffe Hospital, Oxford, UK

Correspondence
Nele Demeyere, University of Oxford, Oxford, UK.
Email: nele.demeyere@ndcn.ox.ac.uk

Abstract

This research aimed to determine the sensitivity and clinical validity of the OCS-Plus, a stroke-specific tablet-based cognitive screening tool, in comparison with the MoCA, a routinely used screening tool, after stroke. Eighty-six patients were recruited from Oxfordshire stroke wards over a 22-month period and completed both screens. Overall, we found that the OCS-Plus has good convergent validity and excellent sensitivity when compared with the MoCA. The OCS-Plus is therefore of potential benefit to those seeking a sensitive screening tool.

KEYWORDS

cognitive impairment, cognitive screening, neurorehabilitation, stroke, validation

INTRODUCTION

Cognitive impairment is common after stroke; with almost all acute stroke patients demonstrating difficulties in at least one cognitive domain (Milosevich et al., 2023). Post-stroke cognitive impairment (PSCI) encapsulates both domain-specific impairments (e.g., perception, aphasia and neglect) and domain-general deficits (e.g., memory, attention and executive function), in line with the complexity of a focal infarct in the presence of often pre-stroke brain health degeneration (Rost et al., 2022). Subsequently, post-stroke cognitive trajectories include both recovery and decline. Cognitive screening is now widely recommended in clinical guidelines (e.g., Quinn et al., 2021), as impaired cognition can impact neurorehabilitation, is associated with poorer outcomes (Barker-Collo et al., 2010), and early cognitive impairment predicts longer-term difficulties (Filler et al., 2023; Milosevich et al., 2023).

Whilst the Oxford Cognitive Screen (Demeyere et al., 2015) was developed as a stroke-specific screening tool to detect focal domain impairments in acute stroke, the OCS-Plus was subsequently designed to be a more sensitive domain-general screening tablet-based measure, focused on executive function and memory (Demeyere et al., 2021). This measure has recently been normed and validated in

a healthy ageing cohort and was validated in subacute and chronic stroke samples against extensive neuropsychological assessments (Webb et al., 2022). Given previous findings that this is an effective tool for sensitive detection of subtle cognitive problems, it is important for the tool to be directly compared with current standard clinical assessments.

Aims of this research

This research aimed to compare the ability to detect cognitive impairments on the OCS-Plus to a current standard clinical screening tool, the MOCA (Nasreddine et al., 2005), in terms of convergent validity, and sensitivity and specificity in a subacute stroke population.

METHODS

Design

A cross-sectional design was used, and reporting is in line with the STROBE checklist.

Participants

Participants were recruited from the John Radcliffe acute stroke (10.5%) and Oxfordshire Stroke Rehabilitation (89.5%) units, consecutively over 22 months (November 2020 to August 2022).[1] Assessments were typically conducted by the research team at the hospital bedside and on some occasions, at home after discharge. Inclusion criteria included were as follows: (i) over 18 years old and had suffered a stroke in the last 6 months; (ii) willing and able to give informed consent to participate; and (iii) able to concentrate for a 30- to 60-min assessment. Exclusion criteria included as follows: (i) having a diagnosed intellectual disability (DSM-5); (ii) having insufficient English language skills to comprehend the OCS-Plus orienting questions; and (iii) being judged by the care team to be too unwell to participate (e.g., fatigue, delirium or medical complications). Participants gave informed consent under NHS ethics (OCS-Recovery study, NREC Reference: 18/SC/05501). A priori power analysis indicated that a sample of at least 64 participants would ensure sufficient power (80%) to detect a correlation of at least .30.

Measures

Cognition

Cognition was assessed using the OCS-Plus (Webb et al., 2022), administered on a tablet, and the MoCA (Nasreddine et al., 2005), administered using pen and paper.[2]

Additional descriptive measures

Physical disability was approximated using the Barthel Index at the start of rehabilitation. Stroke severity at onset was assessed using the National Institutes of Health Stroke Scale (NIHSS), and degree of disability was assessed using the modified Rankin Scale (mRS).

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[1]A proportion of this sample also took part in a previous validation study (Webb et al., 2022).
[2]Median time between administration of these assessments was 3 days (range: 0–34).

Data analysis

To determine convergent validity, the OCS-Plus was compared with the MoCA. It was predicted that there would be at least a moderate negative correlation ($r > -.4$) between the number of impairments on the OCS-Plus tasks and total MoCA score. Divergent validity was determined through anticipated lack of significant correlations with physical disability measures (Barthel and mRS), though some weaker associations may still be present.

Next, to assess sensitivity and specificity, the presence of impairments on the OCS-Plus was compared with overall categorisation of impairment on the MoCA (i.e., a score < 26). True positives and true negatives (i.e., impaired or not impaired participants) were calculated using the MoCA as an approximated 'truth'. It was anticipated that receiver operating characteristic (ROC) analysis would generate an area under the curve (AUC) of at least .7.

RESULTS

Analyses were carried out in R Studio (R version 4.2.1).

Demographics

Eighty-six participants[3] were recruited for this research (Table 1). One participant had a prior diagnosis of dementia, three were reported to have mild cognitive impairment (MCI),[4] and 31 had at least one previous stroke.

Analysis

Convergent validity

Using the OCS-Plus, 98.8% of the samples were considered to have an impairment in at least one domain. 85.9% were identified as having an impairment using the MoCA. There was a strong negative correlation between proportion of impairments on the OCS-Plus and overall score on the MoCA; $r(84) = -.77$, $p < .01$.[5]

Divergent validity

There was a moderate correlation between scores on Barthel and proportion of impairments on the OCS-Plus; $r(84) = -.33$, $p = <.01$.[6] OCS-Plus impairments were additionally compared with the mRS and found not to correlate; $r(69) = .17$, $p = <.01$.

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[3]Some participants' data for the MoCA and the OCS-Plus were incomplete due to severity of pre-existing visual impairment (e.g., macular degeneration) or unavoidable interruptions where clinical rehabilitation took priority (e.g., therapy and family visits). Incompleteness on the OCS-Plus was handled by scoring the level of impairments as a proportion of the tasks completed for all.

[4]MCI is defined as cognitive decline greater than expected for a person's age and education that does not significantly impact activities of daily living.

[5]Normality assumed due to large sample size.

[6]Assumptions of normality assumed due to large sample size.

T A B L E 1 Demographic information.

	Mean (SD, range)	Percentage
Age (years)	72.39 (12.86, 42–94)	<60: 16.28%; 60–70: 29.07%: >70: 54.65%
Education (years)	13.70 (3.37, 9–22)	≤12 years: 39.53%, >12 years: 60.47%
Sex	–	F: 38.37%; M: 61.63%
Handedness	–	L: 15.12%; R: 83.72%; A: 1.16%
Ethnicity	–	White British: 91.86%; Asian British: 2.33%; White Other: 3.49%; Black African: 1.16%; Black Caribbean: 1.16%
Time since stroke (days)	30.76 (20.53, 2–97)	–
Stroke type	–	Ischemic: 80.23%; Haemorrhagic: 16.28%; Other/Unspecified: 3.49%
Stroke side	–	L: 31.40%; R: 56.98%; B:11.63%
Stroke severity (NIHSS Score)	7.75 (4.87, 0–25)	No Symptoms: 1%; Minor: 28%; Moderate: 62%; Moderate–Severe: 8%; Severe: 1%
Degree of physical difficulty (Barthel)	9.95 (5.89, 0–20)	–
Degree of disability (mRS)	3.30 (.87, 1–5)	
Past history of stroke	–	None: 65.11%; One: 25.58%; Multiple: 4.65%; Unknown: 4.65%

Note: Only 76/86 participants completed the NIHSS as this was collected from patient records where available. NIHSS is scored from 0 to 42, where 0 is considered no symptoms, 1 to 4 minor, 5–15 moderate, 16–20 moderate to severe and >21 severe. Barthel is scored from 0 to 20. mRS is scored from 0 to 6. Across all measures, higher scores indicate greater severity.

Sensitivity and specificity

Sensitivity was calculated as 100% (73 true positives and 0 false negatives) and specificity was calculated as 7.69% (1 true negative and 12 false positives). As shown in Figure 1, a ROC curve analysis was suggestive of excellent discrimination between those with and without cognitive impairment; AUC = .93.

DISCUSSION

This research demonstrated that the OCS-Plus can be used to detect cognitive difficulties at least as successfully as the MoCA. Impairments on the OCS-Plus were strongly correlated with scores on the MoCA, at a similar strength to correlations between the OCS and the MoCA ($r = -.73$) (Demeyere et al., 2015). Sensitivity analysis showed the OCS-Plus to have excellent discrimination between those with and without cognitive impairment. Furthermore, a greater number of participants were identified as having at least some degree of PSCI as measured by the OCS-Plus, which is in line with prevalence estimates in the early stages post-stroke (e.g., Demeyere et al., 2015).

 The sensitivity of the OCS-Plus did come at a cost to specificity. It is possible that—at least in part—this is an artefact of very few people in this sample having no cognitive impairment, with false positives artificially high due to missed cases in the comparison standard (MoCA). Further research could address this by including a greater proportion of milder strokes or investigating the use of this measure in the chronic stroke population. With regard to discriminative validity, no significant relationship between OCS-Plus impairments and overall level of disability was found. The mild correlation between the OCS-Plus and Barthel Index could be suggestive of weaker discriminative validity, though cognitive impairment may have impacted some items on the Barthel and overall stroke severity would be expected to relate to some extent to both cognitive and physical impairment.
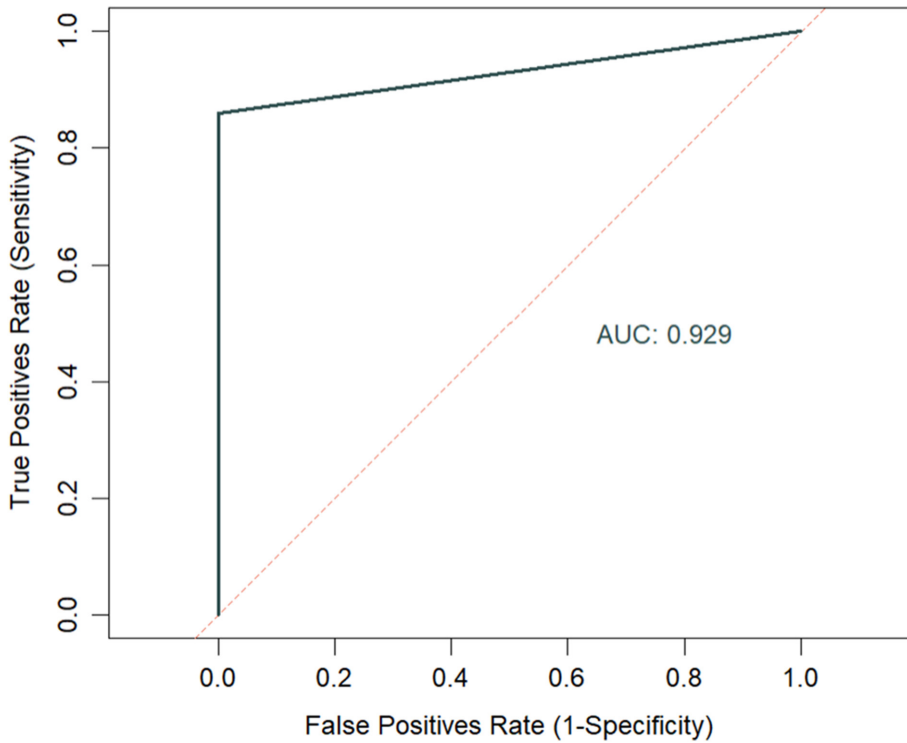
FIGURE 1 A receiver operating characteristic (ROC) curve visualization of the relationship between the sensitivity and specificity of the OCS-Plus.

Given the discrepancy in the rate of impairment identified by the MoCA and OCS-Plus, subtle cognitive changes may be missed in clinical settings. Especially for people returning to demanding occupations, sensitive screening for milder cognitive impairment is warranted. Sensitive screening with the OCS-Plus could be helpful in developing robust formulations of post-stroke difficulties and managing patient expectations when returning to tasks of daily living which could be impacted by subtle changes.

Strengths and limitations

A large sample of participants was recruited for this study directly from a clinical setting which is likely to have reduced sources of bias. The population studied reflects a realistic representation with regard to stroke characteristics, stroke history and severity present in the general clinical populations on the stroke rehabilitation pathway in the UK, though we note that sampling in Oxfordshire meant that the recruited sample was not representative of the wider UK in terms of ethnicity and education.

CONCLUSIONS

This research demonstrated that the OCS-Plus is a valid screen for identifying more subtle cognitive impairment after stroke and was found to be more sensitive than the MoCA. It may therefore be useful to clinicians seeking a more sensitive screen of PSCI, with the additional advantages of tablet-based administration, such as automatic scoring.

AUTHOR CONTRIBUTIONS

Rebecca Roberts: Conceptualization; methodology; investigation; writing – original draft; formal analysis; data curation; writing – review and editing; visualization. **Reena Vohora:** Conceptualization; methodology; writing – review and editing; supervision. **Sam S. Webb:** Conceptualization; methodology; investigation; writing – review and editing; data curation. **Nele Demeyere:** Conceptualization; methodology; writing – review and editing; supervision; project administration; funding acquisition.

ACKNOWLEDGEMENTS

FUNDING INFORMATION

CONFLICT OF INTEREST STATEMENT

Nele Demeyere is a developer of the Oxford Cognitive Screen-Plus but does not receive any remuneration from its use.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Rebecca Roberts 🄳 https://orcid.org/0000-0001-8081-9590
Sam S. Webb 🄳 https://orcid.org/0000-0002-0029-4665
Nele Demeyere 🄳 https://orcid.org/0000-0003-0416-5147

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