Disability and Rehabilitation

ISSN: 0963-8288 (Print) 1464-5165 (Online) Journal homepage: www.tandfonline.com/journals/idre20

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To cite this article: Kate Cowen, Faye Tabone, Sam Webb, Andrea Kusec, Ruth DaSilva, Revin Thomas, Nele Demeyere, Lisa Shaw & Kathleen Vancleef (16 Jul 2026): The Oxford visual perception screen detects visual perception difficulties in sub-acute adult stroke survivors: an early cross-sectional diagnostic accuracy study, Disability and Rehabilitation, DOI: 10.1080/09638288.2026.2693400

To link to this article: https://doi.org/10.1080/09638288.2026.2693400

DISABILITY AND REHABILITATION
https://doi.org/10.1080/09638288.2026.2693400

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ASSESSMENT PROCEDURES

The Oxford visual perception screen detects visual perception difficulties in sub-acute adult stroke survivors: an early cross-sectional diagnostic accuracy study

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ABSTRACT

Purpose: Post-stroke visual perception difficulties are common but often go undetected. The Oxford Visual Perception Screen (OxVPS) was developed to help clinicians identify these difficulties efficiently and in line with guidelines.

Materials and Methods: A prospective cross-sectional study recruited stroke survivors from three UK stroke rehabilitation units (June 2023–March 2024). Inclusion criteria were age ≥18, stroke within 6 weeks, ability to focus for 15 min, and following simple English instructions. Participants completed the index test, OxVPS, and the reference standard, Rivermead Perceptual Assessment Battery (RPAB), within 2 weeks. Early-phase diagnostic accuracy evaluation was assessed using Receiver Operator Curve analysis in complete data and in all data using random forest imputations for missing data. Completion time and rate were recorded for each test.

Results: In complete cases ($n = 33$), OxVPS showed an AUC of 0.83 (95% CI: 0.68–0.98), 85% sensitivity, and 77% specificity. Exploratory analysis of all data ($n = 62$) found an AUC of 0.88 (95% CI: 0.80–0.96), with 87% sensitivity and 80% specificity. On average, OxVPS was completed in 13 min with a higher completion rate (97% of subtests, $p = 0.03$) than RPAB.

Conclusions: OxVPS provides an accurate, efficient tool for identifying visual perception issues in stroke survivors.

➤ OXVPS IMPLICATIONS FOR REHABILITATION

- The Oxford Visual Perception Screen (OxVPS) offers clinicians a quick and accurate standardised assessment for visual perception difficulties, which, in combination with sensory screening, may support recent UK guidelines that all stroke survivors receive a visual screen as part of initial assessment.
- Using a cutoff of 2 or more impaired subtests, OxVPS detects 85%-87% of cases with visual perception difficulties and categorises 77%-80% of cases without visual perception issues correctly.
- The OxVPS completion time is on average 13 min.
- With an 84% completion rate, administration of OxVPS seems feasible with sub-acute stroke survivors in an inpatient stroke rehabilitation setting.

ARTICLE HISTORY
Received 8 July 2025
Revised 4 June 2026
Accepted 18 June 2026

KEYWORDS
Stroke; visual perception; diagnostic accuracy; sensitivity; specificity; screening

Background

Visual problems are common post-stroke, with the prevalence of perceptual difficulties ranging from 20.5% to 76% [1,2]. Visual perception is the dynamic process of perceiving the environment through the reception of sensory inputs and translating them into meaningful concepts associated with visual knowledge of the environment [3]. Examples of difficulties in visual perception include struggling to recognise objects (associative/apperceptive agnosia) and/or faces (prosopagnosia), or difficulty reading (alexia).

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/09638288.2026.2693400.

Visual perception difficulties can impact stroke survivors' quality of life, functional outcomes, participation, independence, and pose substantial risks (e.g., participation in traffic and cooking risks) [4–6]. Rehabilitation for visual perception difficulties can include training (e.g., online reading training), adaptations to the environment (e.g., remove distractions), or coping strategies (e.g., use memory or other senses) [7,8]. Improved identification (e.g., screening) can support care planning, reduce the need for additional care (e.g., supporting the performance of activities of daily living), avoid further medical issues (e.g., falls), and improve mental health (e.g., more social interactions) [9].

Standardised assessment instruments for visual perception difficulties in stroke survivors, such as the Rivermead Perceptual Assessment Battery (RPAB) and the Visual Object and Space Perception Battery (VOSP), are too time-consuming (40–120 min) for screening in clinical practice, unsuitable for patients with communication difficulties, and assess only a limited range of visual perceptual functions [10]. While individual subtests of standardised assessments may be utilised as necessary to reduce the administration time, such deviations might undermine the psychometric properties of the test, the applicability of normative data, and would require separate validation research [11,12]. Unsurprisingly, a recent survey reported that 94% of clinicians rely on patient self-report and clinical observation for the diagnosis of visual perception difficulties [10] despite national clinical guidelines recommending the use of standardised assessments in evaluations of visual perception difficulties after stroke [13]. Additionally, research with 214 clinicians has confirmed the need for training and for a quick, evidence-based screening tool suitable for stroke survivors that can identify a range of visual perception difficulties [10,14].

In response to this clinical need, the Oxford Visual Perception Screen (OxVPS) has been developed [15]. The OxVPS is a paper-and-pencil test that screens for 15 visual perception difficulties in under 15 min through 10 subtests. The subtests include tasks such as picture naming, item counting, and a figure copy, which has been standardised using normative data in neurologically healthy volunteers [15]. The OxVPS aspires to support clinicians' practices by resolving some of the challenges clinicians face with current standardised assessment instruments. Demonstrating early-phase diagnostic accuracy evaluation to detect visual perception impairments is essential before OxVPS can be used by clinicians to assess stroke patients for visual perception difficulties in sub-acute and rehabilitation settings.

The current study aimed to evaluate the early-phase diagnostic accuracy of the OxVPS in detecting visual perception difficulties in stroke survivors. Because this is the first study into the accuracy of OxVPS, we focus on establishing an optimal cutoff point for detection based on the Receiver Operating Curve.

Methods

Participants

This was a prospective cross-sectional study that conforms to STARD guidelines in its design and reporting [16]. A convenience sample ($n = 62$) of stroke survivors was recruited at three stroke rehabilitation units in the North East and in the South East of England, United Kingdom, between June 2023 and March 2024. The inclusion criteria were: 18 years or older and a clinical diagnosis of stroke (ischaemic stroke and/or intracerebral haemorrhage) in the past 6 weeks. Patients were excluded if they had insufficient understanding of English, had no capacity to provide informed consent, or were unable to follow instructions or concentrate for 15 min. All patients admitted with a stroke at each participating site were systematically screened against the study eligibility criteria by trained members of the clinical multidisciplinary team. Consent for study procedures and data collection was subsequently sought by a member of the research team.

Instruments

Index test

The index test, the Oxford Visual Perception Screen (OxVPS) [15], screens for visual perception difficulties following stroke [17]. OxVPS aims to meet clinical requirements [10]: it is designed to be quick to learn, easy to administer, and suitable for stroke survivors with communication difficulties [15], which was confirmed in a follow-up study with users [18]. The OxVPS is described in detail in Vancleef et al. 2025 [15].

Reference standard

The Rivermead Perceptual Assessment Battery (RPAB) [19] is a standardised assessment developed for assessing and quantifying deficits in visual perception following a stroke. In 45–120 min, RPAB evaluates eight visual functional categories across 16 subtests: form constancy, colour constancy, sequencing, object completion, figure-ground discrimination, body image, spatial awareness, and inattention.

The clinical usefulness of the RPAB was established since its inception in 1985 [19] and is currently still the most widely used assessment tool for visual perception difficulties in the United Kingdom and Ireland [10]. All subtests demonstrate excellent inter-rater reliability (correlations between 0.72 and 1, >0.90 in 14 of 16 subtests) and fair test-retest reliability (correlations between 0.27 and 1, >0.70 in 10 of 16 subtests) [19]. Concurrent validity was established by comparing scores of patients with a brain injury and healthy volunteers, and except for one subtest (Series: measuring form constancy and object matching), the scores between both groups are significantly different. The group effect (stroke participants) explained between 3% and 23% of the variance in scores on each of the subtests [20]. Furthermore, Friedman and Leong [21] found that RPAB is a significant predictor of functional outcomes at 6 months as measured with the Barthel index ($r = 0.4$) and a better predictor than arm strength, hemisensory loss, hemianopia, age, or visual inattention, suggesting strong predictive validity. The clinical utility and the good psychometric properties of RPAB made it an appropriate choice as a reference standard.

Procedures

The research team were guided by a steering committee (academics, medical doctors, occupational therapists, and stroke survivors) and a patient and public involvement panel to establish appropriate and acceptable procedures. There was a 2-week maximum limit observed between OxVPS and RPAB to avoid performance changes due to potential recovery [22,23], and the tests were administered in no particular order based on logistics: for example, room availability (RPAB difficult to administer bedside), participant energy level, time constraints of researcher and participant (patient's therapy/visitors) and other practical considerations when collecting data in a clinical setting. To reduce any bias, research team members administering OxVPS were masked to the outcome of RPAB and vice versa. In addition, the research team only collected demographic information (age, gender, ethnicity, education, etc.) and details about a participant's stroke (e.g., type, severity, location) after completion of the assessments.

Data collection of OxVPS and RPAB was conducted by neuropsychologists (KV, FT, SW, and AK) and an occupational therapist (KC). The team was trained by the OxVPS developers and the RPAB manual with assistance from a stroke occupational therapist (RD) experienced in administrating RPAB. Demographic information was collected from medical notes by research nurses at each site. Beyond general encouragement, stroke survivors received no assistance to complete the assessments, and time was recorded through mobile devices' timekeeping applications, for example, the iPhone clock application, which has a stopwatch.

Sample size

The sample size was determined based on the pre-specified receiving operator curve (ROC) analysis with a probability of a Type 1 error of 0.05 and minimum power of 0.90. The minimum area under the curve (AUC) that would make OxVPS clinically meaningful was set at 0.80, which is generally considered excellent [24]. Previous research into the frequency of visual perception difficulties in the first month after a stroke ranges from 20.5% to 76% [2,3]. Sensitivity analyses showed that the required sample size varied between 34 (for prevalence of 50%) and 54 (for prevalence of 20.5%, a prevalence of 76% required a sample size of 45). Based on these calculations, the minimum sample size was set at 54. High attrition was expected because of the long duration (120 min) of RPAB, the need to complete both assessments within 2 weeks, and conflicts between participants' therapy schedule and availability of researchers on the stroke unit. Therefore, over-recruitment was intentional. Note that the study was not powered for sensitivity or specificity.

Analysis

In a pre-specified analysis including only complete cases, the AUC of the ROC was constructed empirically, and 95% confidence intervals (CIs) were calculated with the DeLong method [25]. The optimal cut-off point for OxVPS was determined through the Youden Index J, for which the sensitivity, specificity, and positive and negative predictive values were calculated. The 95% CIs of these four values were calculated through bootstrapping with 10 000 iterations.

Inspection of the data revealed that a small proportion of missing data in RPAB or OxVPS per participant was common. Hence, an exploratory secondary analysis was conducted for which the missing subtest scores of RPAB and OxVPS were replaced by random forest imputation. In this secondary analysis, a modified Youden index was calculated in which sensitivity was given up to four times more weight than specificity (compared to equal weight in the traditional Youden index) because, for a screening test, high sensitivity (few false negatives) is more important than high specificity (few false positives) [26]. A sensitivity analysis further explored the effect of different weights for sensitivity and specificity.

Results

Throughout recruitment (see Figure 1), 766 stroke patients were screened against the inclusion criteria, of which 250 were eligible for participation in the study. Of these, 116 engaged with test administration of the OxVPS (index test). However, 54 of the 116 participants were not able to engage with the RPAB for various reasons, such as fatigue, discharge, participating in therapy, or having visitors when the researchers were on the stroke unit. This meant 62 of 116 took part in both OxVPS (index test) and RPAB (reference standard). Of these 62 participants, 26 (42%) completed OxVPS before RPAB, while 36 (58%)

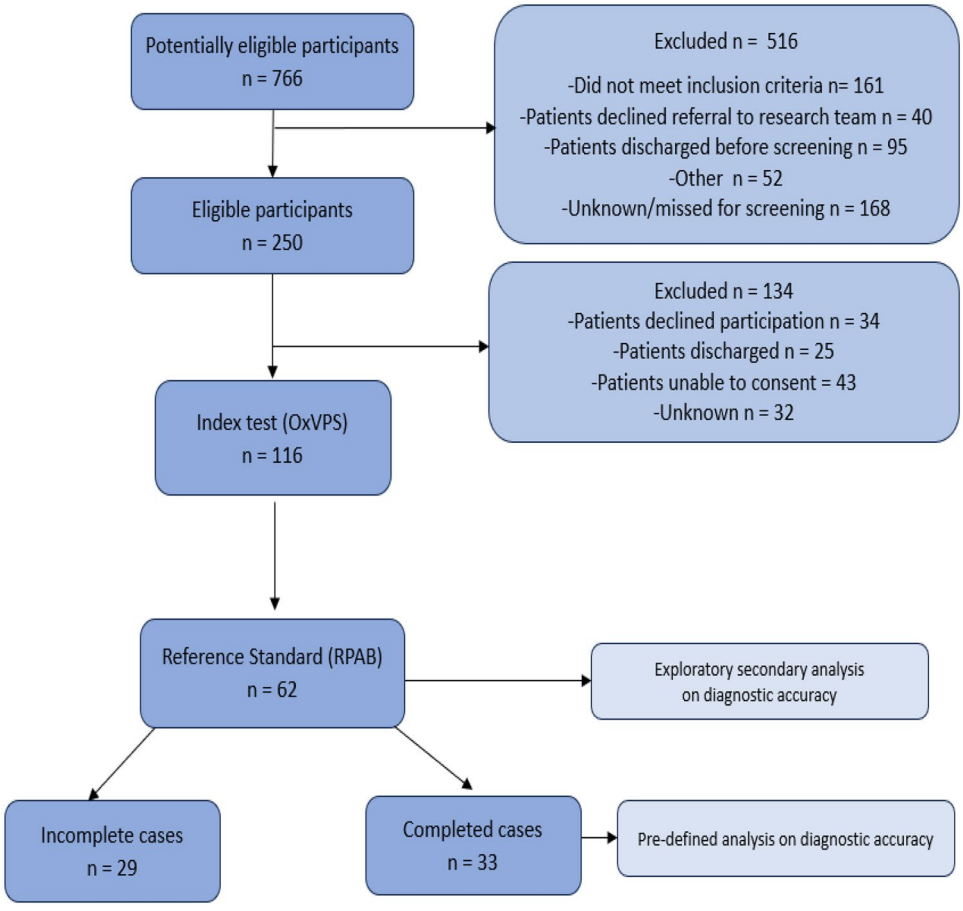

Figure 1. Participant flow chart of all participants who took part in the study. Not all participants completed all subtests of OxVPS and RPAB. Two analyses were performed: a predefined analysis on the complete cases only ($n = 33$) and an exploratory secondary analysis on all cases ($n = 62$).

completed RPAB before OxVPS. The average time interval between OxVPS and RPAB was 6.34 days (SD = 3.96).

Forty-seven percent of participants ($n = 29$) could not complete all subtests of either OxVPS or RPAB due to aphasia, fatigue, inability to hold a pen, or difficulties understanding the instructions. This was more common for the RPAB than for the OxVPS: 26 did not complete RPAB, and 10 did not complete OxVPS. The average percentage of incomplete RPAB subtests was 4.7% and significantly higher than the average percentage of incomplete OxVPS subtests, which was 2.98% (Wilcoxon test, $V = 118$, $p = 0.03$). Further details about missing data are provided in the supplementary materials.

Reports of baseline demographic and clinical characteristics of participants for the whole sample ($n = 62$) and both subsamples of complete ($n = 33$) and incomplete cases ($n = 29$) can be viewed in Table 1. To avoid inflating the Type I error, only statistical tests for the difference between subsamples on the key outcome, visual perception difficulties, were performed. Participants who completed all subtests had, on average, higher RPAB scores (mean number of subtests passed = 11) than participants who did not complete all subtests (mean number of subtests passed = 6.9, 95% CI for difference = [2.27, 5.94], t(51.74) = 4.49, $p < 0.001$, Figure 2). The same pattern was observed for scores on OxVPS (95% CI for difference = [1.28, 3.73], t(52.81) = 4.10, $p < 0.001$). This suggests that the sample of participants who completed all subtests is biased towards participants with less severe visual perception difficulties. Across the whole sample, severity of visual perception difficulties ranged from very severe (0 of 16 subtests passed on the RPAB) to negligible (a score of 15 of 16 on RPAB), with an average score on RPAB of 9.08 (SD = 4.06).

Table 1. Participant baseline demographics.

Variables	All participants ($n = 62$)	Complete cases ($n = 33$)	Incomplete cases ($n = 29$)
Age in years *[mean (SD)]*	74.13 (12.43)	74.19 (13.68)	74.05 (11.08)
Gender *[count (percentage)]*			
Female	34 (55%)	20 (61%)	14 (48%)
Male	28 (45%)	13 (39%)	15 (52%)
Ethnicity *[count (percentage)]*			
White	61 (98%)	32 (97%)	29 (100%)
Other	1 (2%)	1 (3%)	0 (0%)
Handedness *[count (percentage)]*			
Right-handed	59 (95%)	33 (100%)	26 (90%)
Left-handed	3 (5%)	0 (0%)	3 (10%)
Qualifications *[count (percentage)]*			
Information not available	24 (39%)	11 (33%)	13 (45%)
No qualifications	8 (13%)	5 (15%)	3 (10%)
GCSE/CSE	16 (26%)	12 (36%)	4 (14%)
A/O level	4 (6%)	2 (6%)	2 (7%)
University	2 (3%)	0 (0%)	2 (7%)
Other	8 (13%)	3 (9%)	5 (17%)
Days since stroke *[mean (SD)]*	28.74 (10.94)	27.97 (10.59)	29.62 (11.44)
Stroke severity *[count (percentage)]*			
Minor (NIHSS 1–4)	20 (32%)	14 (42%)	6 (21%)
Moderate (NIHSS 5–15)	35 (56%)	16 (48%)	19 (66%)
Severe (NIHSS 16–20)	4 (6%)	3 (9%)	1 (3%)
Information not available	3 (5%)	0 (0%)	3 (10%)
Type of stroke *[count (percentage)]*			
Ischaemic	46 (74%)	27 (82%)	19 (66%)
Haemorrhagic	16 (26%)	6 (18%)	10 (34%)
Oxford stroke classification *[count (percentage)]*			
TACS	15 (24%)	5 (15%)	10 (34%)
PACS	22 (35%)	14 (42%)	8 (28%)
POCS	6 (10%)	4 (12%)	2 (7%)
LACS	19 (31%)	10 (30%)	9 (31%)
Side of stroke *[count (percentage)]*			
Left	19 (31%)	11 (33%)	8 (28%)
Right	41 (66%)	20 (61%)	21 (72%)
Bilateral	2 (3%)	2 (6%)	0 (0%)
Other neurological conditions *[count (percentage)]*			
None	50 (81%)	28 (85%)	22 (76%)
Other	12 (19%)	5 (15%)	7 (24%)

GCSE: General Certificate of Secondary Education; CSE: Certificate of Secondary Education; A-level: Advanced Level qualification; O-Level: Ordinary Level qualification; NIHSS: National Institute of Health Stroke Scale; TACS: Total Anterior Circulation Stroke; PACS: Partial Anterior Circulation Stroke; POCS: Posterior Circulation Syndrome; LACS: Lacunar Stroke.

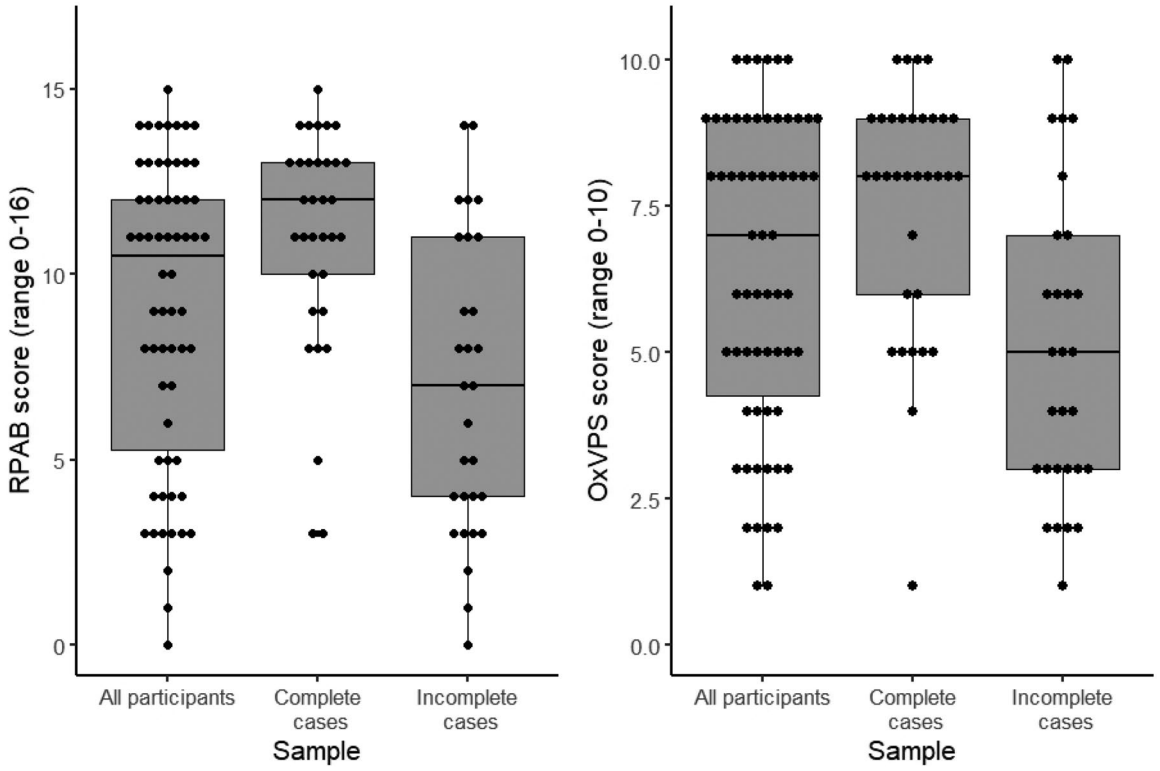

Figure 2. Scores on RPAB (left panel) and OxVPS (right panel) for the full sample ($n = 62$) and subsamples ($n = 33$ and $n = 29$). Performance is expressed as a criterion score of passed subtests. A passed subtest is a subtest with a score above the cutoff value for normal performance based on a sample of healthy volunteers. Therefore, a higher score means better visual perception. Boxplots for each (sub) sample show the median score as the horizontal line inside the box and the first and third quantiles as the lower and upper hinges of the box. The whiskers extend from the hinge to the highest/lowest value, no further than 1.5 times the interquartile range from the hinge. All individual data points are superimposed on the boxplots. In the left boxplot of each panel, missing data on a subtest were replaced by random forest imputations.

Early-phase diagnostic accuracy

The estimated AUC in the ROC analysis on complete cases ($n = 33$, pre-specified analysis) was 0.83 (Figure 3A) with the 95% CI ranging from 0.68 to 0.98. The Youden index indicated an optimal cutoff point for visual perception difficulties at two or more failed subtests on OxVPS. At this cutoff, OxVPS has an estimated sensitivity of 0.85 (95% CI: 0.54 – 1), an estimated specificity of 0.77 (95% CI: 0.54 – 1), an estimated positive predictive value of 0.85 (95% CI: 0.68 – 1), and an estimated negative predictive value of 0.77 (95% CI: 0.48 – 1, Table 2). Note that the study was powered for AUC and not for sensitivity, specificity, or positive or negative predictive value; hence, the wide CIs for these measures.

The exploratory secondary analyses on all data ($n = 62$) estimated the AUC at 0.88 (Figure 3B) with a 95% CI ranging from 0.80 to 0.96. The modified Youden index, which puts more weight on sensitivity compared to specificity, indicated an optimal cut-off point at two or more failed subtests on OxVPS. At this cut-off point, sensitivity is estimated at 0.87 (95% CI: 0.62 – 1), specificity at 0.80 (95% CI: 0.67 – 1), positive predictive value at 0.93 (95% CI: 0.88 – 1), and negative predictive value at 0.67 (95% CI: 0.37–0.88, Table 3). Sensitivity analyses revealed that varying the weights for sensitivity and specificity did not change these results as long as sensitivity was given at least equal weight to specificity (see supplementary materials).

Completion time and adverse events

The average time to complete OxVPS was 13 min (range: 9–27 min, IQR: 11–15 min, median: 13 min), while the average time to complete the RPAB was 53 min (range: 25–96 min, IQR: 45–60 min, median:

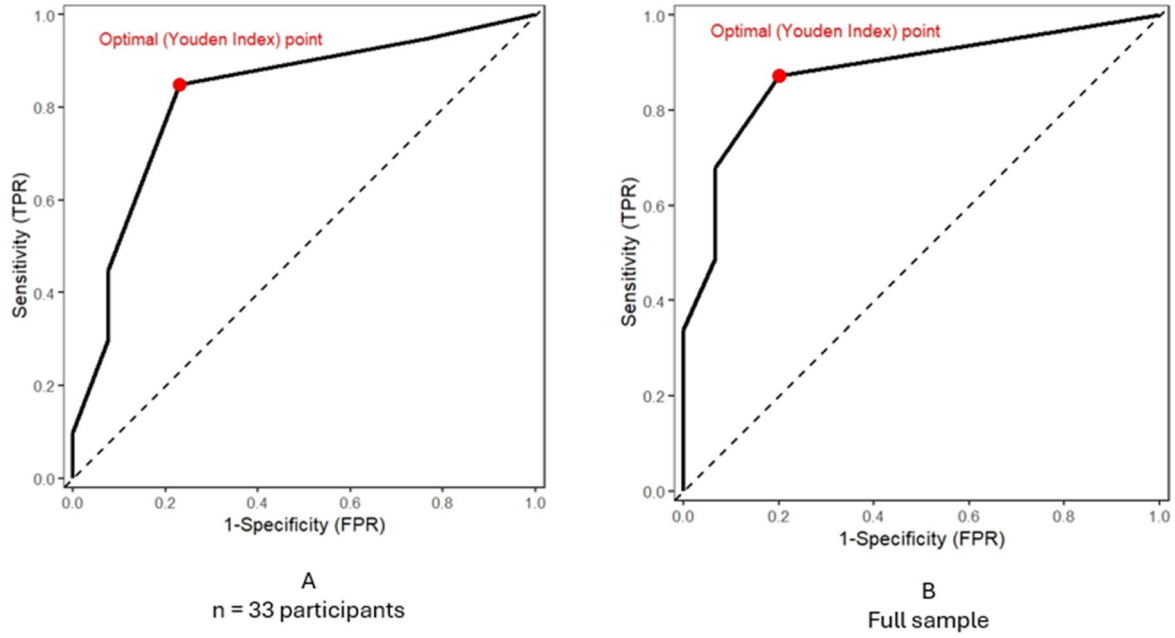

Figure 3. Receiver Operating Curve of OxVPS for the detection of visual perception difficulties as indicated by the RPAB in the sample of participants who completed all subtests, panel A, and the full sample, panel B. The solid line represents the empirical ROC. The dashed line shows the chance line. At the optimal Youden index point (dot). In panel A, the sensitivity is estimated at 0.85 and the specificity at 0.77; in panel B, the sensitivity is estimated at 0.87 and the specificity at 0.80.

Table 2. Accuracy of OxVPS for screening of visual perception difficulties in the sample of participants who completed all subtests.

	RPAB results		
OxVPS results	Visual perception difficulties	No visual perception difficulties	Total
Visual perception difficulties	17	3	20
No visual perception difficulties	3	10	13
Total	20	13	33

Table 3. Accuracy of OxVPS for screening of visual perception difficulties for the full sample.

	RPAB results		
OxVPS results	Visual perception difficulties	No visual perception difficulties	Total
Visual perception difficulties	41	3	44
No visual perception difficulties	6	12	18
Total	47	15	62

55 min, complete cases only). In conjunction with the data on missingness, this suggests that compared to the RPAB, patients are more likely to complete OxVPS and within a shorter time. There were no adverse events from participants completing either the reference standard or index test.

Discussion

This study evaluated the early-phase diagnostic accuracy of the OxVPS, a novel screening tool for visual perception difficulties following stroke. Participants' performance on the OxVPS and RPAB was closely related. The results of the predefined analysis in a subsample completing all OxVPS and RPAB subtests suggest good sensitivity [27], with the OxVPS identifying 85% of participants with visual perception difficulties and good specificity, categorising 77% of participants without visual perception difficulties correctly [28]. However, the wide confidence intervals recommend cautious interpretation. In addition, the predefined analysis is likely biased because patients who completed all tasks had fewer visual perception difficulties than patients with missing data. In an exploratory secondary analysis of the whole sample, sensitivity increased to 87% and specificity to 80%. Although defined post hoc, this analysis has higher

external validity because it includes participants with more severe strokes and more severe visual perception difficulties. In addition, the confidence intervals are narrower because of the larger sample size.

The results of the current study are comparable with other visual perception screening tools that have undergone similar accuracy studies with stroke survivors. For example, the five subdomain scores of the Occupational Therapy Assessment for Perceptual Screening Test (OT-APST) had estimated sensitivity ranging from 30.8% to 90.4% and specificity ranging from 68% to 95.7% against the Lowenstein Occupational Therapy Assessment standard and geriatric version as the reference standard [28].

In the full sample, the prevalence of participants found to have visual perception problems as identified by the RPAB was 76%. This finding is in line with earlier reports using RPAB in a similar population [2] but in stark contrast to more recent reports with Rowe et al. [3], finding only 20.5% of stroke survivors had visual perception issues following stroke. Rowe et al. [3] relied on self-report and observations in functional tasks except when assessing inattention (using cancellation/line bisection tests), which better reflects current clinical practice in the United Kingdom [10]. In contrast, both the RPAB and the OxVPS assess a range of visual perception difficulties through standardised performance-based assessments with cut-off scores supported by normative data. This suggests that standard assessments, including the OxVPS, can identify visual perception problems that patients may not typically report, leading to them being missed in standard clinical practice. This does not imply that these visual perception problems lack clinical relevance. Such difficulties may be unrecognised or masked, either because patients do not interpret them as vision-related or because stroke-related factors such as reduced insight or anosognosia limit awareness of the underlying impairment. Even when not consciously noticed, these difficulties can increase cognitive load, affect engagement in rehabilitation activities, or contribute to safety risks such as confusion or falls [9].

OxVPS is designed as a brief screening tool to support early identification of possible visual perceptual difficulties after a stroke. Within the context of recent changes to the visual screening guidance within the UK's National Health Service (NHS) stroke care pathway [29] that require a vision screen for all stroke patients, a short, accessible screening tool may contribute towards meeting this requirement. It can support referrals to specialist services (e.g., neuropsychology) or inform clinical care plans (e.g., setting goals/providing outcome measures) and facilitate communication across multidisciplinary teams [18]. A positive screen would typically indicate that more detailed neuropsychological or orthoptic evaluation may be warranted, whereas a negative screen suggests that such assessment may not be immediately necessary. As with all screening tools, false positives may lead to unnecessary follow-up assessment, and false negatives may delay identification of difficulties requiring support. Although this study was not designed to assess downstream clinical actions, these general principles outline the intended role of the OxVPS within routine care while emphasising the need for future research examining its impact on clinical pathways.

The argument of interplay and overlap between visual perception and cognition has been debated for some time [30]. We note that some cognitive penetration within visual perception always occurs [31], and the impact of cognition becomes more profound at later stages of the visual perception process [32]. Some of the tasks within the OxVPS and RPAB focus on these later stages, such as spatial inattention and visuomotor abilities or praxis. In addition, completion of OxVPS and RPAB relies on sustained attention, organization, and planning [33]. Like many early-phase diagnostic accuracy evaluation studies in neuropsychology, finding a single gold standard measure that measures a brain function in isolation is often unattainable [34]. We reviewed a range of candidate reference standards, including VOSP [35], OT-APST [28], the Cortical Vision Screening Test (CORVIST) [36], and the Lowenstein Occupational Therapy Cognitive Assessment-Geriatric (LOCTA-G) [37], but none covered the full range of visual perceptual functions that OxVPS screens for. The VOSP [35] primarily targets object recognition and spatial perception and does not include face recognition, visual inattention, visuoconstructive skills, colour perception, and reading. The CORVIST [36] provides broader coverage but lacks published normative data, and its psychometric properties have not been established. Therefore, in accordance with STARD guidelines [38], the best available assessment was used as the reference standard. The longevity, clinician perceptions about usefulness in stroke settings [20,21,23], and the overlap in measurement domains with OxVPS made RPAB the most suitable choice.

The key limitations of the study are the imprecise estimates of sensitivity and specificity and the lack of education and intelligence measures, which may have impacted scores on RPAB and OxVPS [39,40]. Although a large number of stroke survivors were screened, only a small subset contributed to the complete-case analysis. This attrition was largely driven by factors unrelated to the OxVPS itself, including patients not meeting

our inclusion criteria (e.g., stroke mimic, patient not conscious), early discharge, limited capacity to consent, and logistical constraints inherent to multi-site recruitment with restricted researcher availability. In particular, the long duration (45–120 min) and multi-visit requirements of the RPAB frequently prevented completion within the predefined 2-week window. This means a large number of patients missed reference standard data despite successful completion of the OxVPS (see supplementary materials for details on the percentage of missing data). The limitation of RPAB for routine screening of stroke patients was indeed known and provided the rationale for developing OxVPS. Our findings highlight the practical challenges of conducting prospective early-phase diagnostic accuracy evaluations in early stroke rehabilitation and the need for continuous screening and recruitment processes to maximise inclusion. As such, we would argue that the OxVPS may be more feasible, given that a wider range of patients were able to complete it compared to the RPAB, which could only be completed by patients with less severe strokes.

As the first study into early-phase diagnostic accuracy, the aim was to determine a cutoff point for the OxVPS overall score; the study was powered for AUC and not for estimates of sensitivity and specificity. The estimation of sensitivity and specificity is therefore imprecise, especially in the predefined analysis which uses a smaller sample. In addition, the estimates were likely biased towards patients with less severe strokes, especially in the complete-case analysis. The estimates from this early-stage study can be used to plan a larger follow-up study to determine the sensitivity and specificity of OxVPS with higher precision in stroke survivors with a wider range of severity levels.

The study's strengths include representativeness of the sample, inclusive recruitment, and strategies to minimise bias and increase generalisability. The sample is similar in age, gender, and stroke severity to the Sentinel Stroke National Audit Programme (SSNAP) [41]. SSNAP reports that 42.5% of stroke survivors present with minor stroke severity (compared with 32% in our sample), 35% with moderate severity (56% in our sample), 7% with severe severity (6% in our sample), and 7.4% with very severe strokes (none in our sample). Patients with very severe strokes were indeed unlikely to meet our inclusion criteria of being able to concentrate for 15 min. However, severe cases were not systematically excluded in our sample, as suggested by the close match in percentage of stroke survivors (7% and 6%). Minor strokes appear under-represented in our sample, likely because, although eligible, these patients were discharged before they could be recruited into the study. This suggests that the OxVPS may be a feasible assessment in the general stroke population, although feasibility is unknown for patients who had a very severe stroke. To minimise bias, the results of OxVPS and RPAB were concealed from the members of the team administering the tests, and information from the participant's medical notes was only recorded after test administrations. Additionally, inclusion of variation of perspectives and expertise (patient and public engagement and the steering committee) has ensured the rigorous and inclusive nature of the study design, prioritised participant experience, and empowered stroke survivors [42]. For example, patient and public involvement resulted in accessible forms for patients with communication difficulties, which enhanced inclusivity for recruitment and study closure at the earliest opportunity, given the onerous nature of some RPAB tasks for the patients and high prevalence of fatigue following stroke [43].

Conclusions

The results of the study indicate that the OxVPS can distinguish between stroke survivors with and without visual perception difficulties, suggesting strong clinical utility. Given that most participants were able to complete all subtests of the OxVPS within 15 min, the OxVPS may be a more feasible assessment within the stroke population compared to the more time-intensive reference standard, RPAB (40–60 min), and offers a resource to efficiently screen for visual perception difficulties following stroke.

Acknowledgements

The research team would like to acknowledge and thank the study's steering committee for their advice and expertise: Hazel Hammond, Steve Darcy, Dr Amanda Ellison, Dr Alison Lane, and Kirsty Forrester. Our gratitude also extends to the NHS principal investigators Emma Garrett and Vivienne Southcott and research nurses Vivienne Rudge and Beverley McClelland. Furthermore, we appreciate the valuable insight from the North East and Cumbria Stroke patient and carers panel and the support from the research assistants of the Visual Neuropsychology Research Group at Durham University.

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Disclosure statement

KV and ND are developers of the Oxford Visual Perception Screen but do not receive any remuneration from its use.

Ethical approval and informed consent statement

Ethical approval was obtained from the Health Research Authority, REC reference 23/EM/0086, by the Derby Research Ethics Committee. All participants have provided written informed consent for all aspects of the study, including dissemination.

Study registration and protocol

The trial has been registered with ClinicalTrials.gov: ID NCT05981482 on 27/07/2023. The process was initiated prior to recruitment. Registration was completed following the recruitment of 16 participants.

The full study protocol can be accessed at https://clinicaltrials.gov/study/NCT05981482.

Funding

Kathleen Vancleef, National Institute for Health and Care Research (NIHR) Advanced Fellow (NIHR301715), is funded by the NIHR for this research project. Although they have no affiliation to the current project, Andrea Kusec and Nele Demeyere are supported by NIHR fellowships (AK NIHR Development and Skills Enhancements Award NIHR305153, ND NIHR Advanced Fellowship – NIHR302224), and Sam Webb is funded by the Stroke Association Postgraduate Fellowship (PGF 21100015). The views expressed in this publication are those of the author(s) and not necessarily those of the NIHR, NHS, or the UK Department of Health and Social Care.

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Data availability statement

The dataset and analysis code are available: https://osf.io/2kd7s/?view_only=fb3f27c55a6e4dcbb98cfb8ce923903b.

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