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REVIEW

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Assessment approaches for hemiplegic shoulder pain in people living with stroke – A scoping review

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ABSTRACT

Purpose: Hemiplegic shoulder pain (HSP) is reported in up to 40% of people with stroke. Causes of HSP are often multifactorial. To inform appropriate treatment, reliable/valid assessments are critical. The aim of this scoping review was to collate assessment approaches used in studies where the primary outcome was HSP, and to identify how frequently each assessment approach was used.

Methods: A systematic search, including studies from 2000-2023 was conducted of the MEDLINE, EMBASE, CINAHL, AMED, Biomed Central, and Cochrane Library databases, with four key terms used: "assess", "stroke", "pain" and "shoulder". All primary studies published in English language fulfilling the reviews inclusion criteria were included. Six reviewers extracted the data.

Results: A total of 29 assessment methods for HSP were identified from 124 studies. The common assessments were: Visual Analogue Scale ($n = 75$, 60%), Passive Range of Movement ($n = 65$, 52%), Fugl-Meyer Assessment ($n = 32$, 26%), glenohumeral subluxation ($n = 30$, 24%) and Numerical Rating Scale ($n = 27$, 22%).

Conclusion: A wide range of assessment approaches was identified for HSP, and some are used more than others. A fully comprehensive assessment that considers different aspects of pain including severity and timing, functioning, and the psychological burden, is needed in this area of practice to be able to guide appropriate treatment.

> IMPLICATIONS FOR REHABILITATION

- Hemiplegic shoulder pain is reported in up to 40% of people with stroke and a wide range of assessments approaches are reported in the literature.
- Simple questioning about shoulder pain may not be adequate for providing the best clinical care to patients and an ideal assessment approach would be one that takes into consideration both quantitative and qualitative information.
- Until a new measure is developed, the four common assessments reported (Visual Analogue Scale; Passive Range of Movement; Fugl-Meyer Assessment and Numerical Rating Scale) should be used in combination.

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Introduction

According to the recent Global Burden of Disease report, stroke is the third leading cause of death and disability [1]. The most common residual deficit pattern after stroke is hemiplegia [2]. Loss of voluntary motor control following stroke leads to secondary musculoskeletal complications in the shoulder region [3].

Hemiplegic shoulder pain (HSP) is one of the most common post-stroke complications [4]. Prospective longitudinal studies report that HSP is prevalent in 17% of people one week after stroke [5] and this can increase up to 40% at 6 months [6]. Pathophysiological factors contributing to HSP include glenohumeral subluxation, rotator cuff lesions, sensory-motor dysfunction, spasticity, and biceps-tendinosis [7,8]. HSP can restrict activities of daily living leading to poorer functional outcomes when compared to people with stroke (PwS) without HSP [9–11]. Therefore, the management of HSP is an important part of upper extremity rehabilitation in PwS [12].

Several interventions have been reported for HSP in PwS including physiotherapy, massage therapy, strapping, and local interventions such as nerve blocks and botulinum toxin [13]. However, the effectiveness of these treatment modalities remains unclear in the literature [12,14]. Potential reasons for a lack of evidence of the effectiveness of interventions could be, in part, due to differences in the populations studied, time frames of assessment, and methods of assessment used [8,9]. Recently updated stroke guidelines in the UK (2023) [15] recommend that people with stroke and HSP should be assessed for causes, be regularly monitored for these, and are managed accordingly.

Given the multi-factorial nature of pain, several assessment approaches for HSP have been reported in the literature. According to a recent UK-wide survey of therapists, routine screening for HSP

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was undertaken by 59/67 (89%) respondents, patient-reported pain was used for assessment of HSP by 66/67 (99%) respondents, and a wide range of assessments were considered for evaluating HSP [16]. For informing appropriate treatment, appropriate assessment is critical.

A scoping review can summarise information as well as identify gaps in the research and can therefore be used to inform future systematic reviews. The aim of this scoping review was to collate assessment approaches used in studies where the primary outcome was HSP, and to identify how frequently each assessment approach was used.

Methods

Search strategy

A systematic literature search was conducted using the electronic search platforms OVID online, EBSCO, and Science Direct. Included databases were MEDLINE, EMBASE, CINAHL, AMED, Biomed Central, and the Cochrane Library and records were searched up to September 2023. A starting date was not initially set in the search strategy to allow the inclusion of any relevant studies published in the subject area. Upon further discussion, the research team reached a decision to only include studies from 2000 onwards, which is the first-year UK stroke guidelines were introduced. A search string was constructed combining the key terms: assess* OR examinat* OR measure* OR investigat* **AND** stroke OR cerebr* accident OR cerebr* event OR cerebr* hemorrhage OR ischemic attack or hemiplegia or hemiparesis **AND** pain OR discomfort OR ache OR irritation **AND** shoulder OR glenohumeral. Truncations specific to the databases were also used to widen the search and to ensure that all forms of searched words were returned by the search engine. Finally, references presented in relevant publications were examined to identify further relevant studies.

Selection criteria

Articles were screened and selected based on the following inclusion criteria: (1) primary data collection studies with any study design; (2) published in the English language; (3) included adult patients (age 18 years and above) with a medical diagnosis of stroke (including ischemic or haemorrhagic stroke), and included patients with HSP; (4) studies investigating any measurement tool to assess hemiplegic shoulder pain in PwS. Studies were excluded if their sample contained patients with other neurological conditions or traumatic shoulder injuries.

Study selection process

Six researchers were involved in the study selection process. The researchers read the titles and abstracts independently to determine relevance. Relevant full text papers were then independently scrutinised, and the inclusion and exclusion criteria were applied again at this stage for confirming final inclusion into the review. Any disagreements were discussed until a consensus was reached. Data extraction included: the aims of the study, population studied, sample size, study design, assessment approach, and key findings.

Results

The database search returned a total of 963 studies with a title that related to shoulder pain in patients with stroke. Studies were screened based on the inclusion criteria. Duplicates, abstract only, and papers that were published before 2000 were removed. A total of 124 studies [8–10,17–137] were deemed suitable for inclusion in this scoping review (supplementary material).

Description of studies

Research designs varied considerably across the studies. Most of the included studies were randomised controlled trials ($n = 70$) [17,18,20,21,25,30,34–38,41,44–46,49–51,53,54,57,58,59,68,72,75–82,89–91,93,95,100,102,103,105,106,108,109,111,114,115,118,119,121–131,133,134,136–137]. Less prevalent were observational studies ($n = 20$) [8–10,19,22,23,27,31,33,43,52,64,65,69,86,88,113,116,117,135], cohort studies ($n = 9$) [24,32,55,56,63,66,67,73,74], cross-sectional design ($n = 7$) [28,29,40,61,84,85,132], case series ($n = 5$) [26,62,71,107,110], retrospective studies ($n = 3$) [39,60,112], diagnostic studies ($n = 5$) [42,70,83,92,101], and other designs ($n = 6$) [47,48,87,94,104,120]. Nearly 72 (37%) studies had been published in the last decade (2013–2023). Fifty-four studies had been conducted in Europe of which 37% were carried out in the UK, 42 in Asia, and 8 in Australia/New Zeeland, with the remaining studies conducted in other regions including Brazil, Canada, Colombia, and Africa.

Participants

Although all studies included patients with stroke, several did not specify the type of stroke (infarction or haemorrhage). Sample size varied considerably, with the largest sample consisting of 1474 patients [27] and the smallest consisting of 1 patient [120]. Please refer to the supplementary material for a detailed description of the selected literature.

Outcomes

A total of 29 assessment approaches used for HSP were reported across relevant studies. Measures of pain selected from the literature search, with details of the type of measure and its frequency of usage in the studies, is illustrated in Table 1. The most used primary assessment approach to assess HSP was the Visual Analogue Scale (VAS), which was used in a total of 75 studies (60%). Other common assessment approaches included: Passive Range of Movement (PROM), reported in 65 (52%) studies; Fugl–Meyer Assessment (FMA), reported in 32 (26%) studies; Glenohumeral subluxation (GHS), which is frequently associated with HSP, was reported in 30 (24%) studies; and Numerical Rating Scale (NRS), reported in 27 (22%) studies. Active Range of Movement (AROM) and Brief Pain Inventory were each reported in 11 (9%) studies. The relationship of reported assessment approaches to the International Classification of Disability, Health, and Function (ICF) is illustrated in Table 2.

Discussion

This scoping review identified a wide range of assessment approaches used for the assessment of HSP. The most reported were: Visual Analogue Scale (VAS) (60%), Passive Range of Movement (PROM) (52%), Fugl–Meyer Assessment (FMA) (26%), Glenohumeral subluxation (GHS) (24%) and Numerical Rating Scale (NRS) (22%).

A VAS was the most frequently used OM reported in our scoping review, which is consistent with findings from a recent survey

Table 1. Reported of assessment approaches for Hemiplegic shoulder pain (HSP) and associated factors: Type, description and frequency as reported from the literature.

Outcome measure / Frequency (n)	Type of Measure
Visual Analogue Scale (VAS) Horizontal/Vertical **(*n* = 74)** [8–10,17–24,30,32,36,43–46,50–52,54,55,57–59,61,62,68,69,72–77,80,82,84,88,90,91,94,95–104,106,110–114,117,119,120,122,125–130,33–135,137,138]	It consists of a horizontal/vertical straight line with the endpoints defining extreme limits such as 'no pain at all' (0) and 'worst possible pain' (10 cm). The patients are asked to mark their pain level on this 10 cm line between the two endpoints. There are no specified time scale. Pain: VAS (100 points). Degree of pain: non-existent (0), mild (10–39), moderate (40–79), or severe (80–100).
Passive Range of Movement (PROM) **(*n* = 64)** [9,18,20–22,25,26,29,33–36,38,40–44,48,50–55,57,60,61,66–68,72–74,77,79–81,84,87–88,90,95,96,98–99,103–105,107–108,111,114,115,119–122,125–127,131,137,138]	Shoulder PROM is assessed clinically in the standardised starting position of supported sitting. Flexion and abduction measurements are assessed with the shoulder in neutral. External rotation range is measured with the shoulder abducted to 45°, and the elbow flexed to 90°. Patients are asked for any pain in the shoulder during movement.
Numerical Rating Scale (NRS) **(*n* = 32)** [33,34,35,40,48,53,56,59,63,64,65,66,67,69,70,71,77,81,83,86,90,92,98,105,108,109,116,118,121,123,124,132]	In an NRS, patients are asked to rate the severity of their pain between 0–10, or 0–100 that fits best to their pain intensity. Zero represents 'no pain at all' whereas the upper limit represents 'the worst pain ever possible'.
Glenohumeral Subluxation (GHS) **(*n* = 30)** [8,17,22,25,28,33,34,35,40,41,47,55,60,61,67,73,74,79,82,85,86,93,94,97,103,113,115,116,127,130]	A range of methods are used. (1) Palpation – A palpable increase in the vertical distance between the acromion and the head of the humerus. (2) Anterior-posterior radiographs (x-rays) – GHS is measured on true anteroposterior radiographs by using the vertical distance between the centre of the glenoid fossa to the centre of the humeral head. The frame of reference was defined as the superior, inferior, medial, and lateral aspects of the glenoid fossa, which accounted for scapular rotation in the hemiplegic shoulder. Changes in GHS were evaluated in millimetres as measured through comparison of radiographs of the affected side and the unaffected side. (3) AP radiographs, graded on a 5-point scale (0–4). (4) Calliper method: Acromio-humeral distance (AHD), using a digital vernier calliper. The measurement is taken in centimetres (cm) from the inferior aspect of the acromion to the superior aspect of the humeral head. The patient is seated with the effected UE in a non-supported position. Ultrasound measurements of acromion-greater tuberosity distance (AGT) distance is defined as the relative distance between the lateral edge of the acromion process of the scapula and the nearest margin of the superior part of the greater tuberosity of the humerus
Fugl–Meyer Assessment (FMA) **(*n* = 27)** [21–22,33,34–35,38,41–42,53,70,72,76,79,85,97,99–101,105,106,112,114,125,132,133,136,138]	Is an impairment measure used to assess locomotor function and control of the upper and lower extremities, including balance, sensation, and joint pain in patients with stroke. A maximum 44 points passive joint motion and joint pain section, with each item rated on a three-point ordinal scale.
Active Range of Movement (AROM) **(*n* = 11)** [18,26,31,37,45,46,68,75,87,97,113]	Shoulder AROM is assessed clinically in the standardised starting position of supported sitting. Flexion and abduction measurements are assessed with the shoulder in neutral. External rotation range is measured with the shoulder abducted to 45°, and the elbow flexed to 90°. Patients are asked for any pain in the shoulder during movement.
Brief Pain Inventory (BPI) **(*n* = 11)** [33,34,35,40,41,56,70,71,91,105,107]	Is a self-administered questionnaire designed to measure pain intensity and the extent to which pain interferes in the lives of pain sufferers. Items scored on a numeric rating scale (0–10) and then a composite (averaged) score of all the items is calculated. 7 items (the original tool) ask about the impact of pain on general activity, mood, mobility, work, relationships, sleep, and enjoyment of life over the previous week.
Pain History (location, duration, frequency) **(*n* = 9)** [19,23,24,26,31,69,74,79,88]	Pain characteristics included pain intensity during rest and during movement (0, no pain; 10, maximum conceivable pain), and pain distribution, frequency, and pattern. 'Bothersomeness' scores, pain characteristics at rest and active movement, previous pain history.
Shoulder Q **(*n* = 7)** [28,39,58,79,91,116,136]	It is a questionnaire with both visual graphic rating scales, and verbal questions that is designed to assess the timing and severity of hemiplegic shoulder pain. Two items are scored with a 4-point Likert scale, four items are scored with a 3-point Likert scale, one item is scored on a 5-point Likert scale. Three items scored on a numeric rating scale (0–10) regarding severity of pain at rest, on movement, and at night. Final two items provide choice for two questions: 'which tasks increase your pain?' and 'which interventions relieve your pain?'
McGill Pain Questionnaire **(*n* = 4)** [65,72,77,81]	A short form version of the McGill Pain Questionnaire contains a total of 15 descriptors (4 affective and 11 sensory) which are rated on an intensity scale: 0 = None, 1 = Mild, 2 = Moderate, 3 = Severe. In total, three pain scores are derived: The sum of the intensity rank values for sensory words chosen, The sum of the intensity rank values for the affective words chosen, The total of the descriptors. In addition, the Present Pain Intensity (PPI) index is present as in the standard McGill Pain Questionnaire, and a visual analogue scale.
Pain Present/Absent at Rest **(*n* = 5)** [27,29,47,60,85]	Shoulder pain is considered to be present if the patient localized discomfort to any aspect of the affected shoulder, either at rest or with passive or active movement.
Faces Pain Scale (FPS) **(*n* = 4)** [59,83,90,92]	FPS is a seven-item horizontal scale that defines the patients' feelings due to pain with seven facial expressions. The first face represents 'no pain' and the seventh face represents 'the worst possible pain,' and the patients are asked to mark the face that expresses their level of pain. Face figures are scored between 0 and 6, the least score representing 'no pain'.
Shoulder Pain and Disability Index (SPADI) **(*n* = 4)** [63,80,127,128]	Is a 13-item questionnaire that consists of 2 subscales that assess pain (5 items) and disability (8 items). The score is determined by taking an average of the 2 subscales, and scores can range from 0 to 100, with a higher score indicating greater pain and disability.
Ritchie Articular Index (RAI) **(*n* = 3)** [36,37,93]	This is a four-point scale assessing shoulder joint tenderness during passive shoulder external rotation and abduction. Patient's response to passive movement of the shoulder joint is recorded on a 4-point single-item scale: 0 = no pain; 1 = complains of pain; 2 = complains of pain and winces; 3 = complains of pain, winces, and withdraws. The Ritchie Articular Index is performed with the subject positioned supine, their arm abducted to 30 degrees and the elbow flexed to 90 degrees. The shoulder is then externally rotated to full range or until a response is elicited.

(*Continued*)

Table 1. Continued.

Outcome measure / Frequency (n)	Type of Measure
Chedoke McMaster Stroke Assessment (CMSA) **(*n* = 2)** [89,123]	The Chedoke-McMaster Stroke Assessment is a performance-based measure that consists of two inventories: the Impairment Inventory and the Activity Inventory. The Impairment Inventory is used to determine the presence and severity of common physical impairments. It has six dimensions (recovery stage of the arm, hand, leg, foot, postural control, and shoulder pain). Each dimension is measured on a 7-point scale. The 7-point scale corresponds to seven stages of motor recovery. The 7-point scale for shoulder pain is based on pain severity
The Disabilities of the Arm, Shoulder and Hand (DASH) **(*n* = 1)** [49]	The DASH is a self-report questionnaire that measures physical function and symptoms of the upper limb. The DASH consists of 30 items that measure: (a) physical function (21 items); (b) symptom severity (5 items); and (c) social or role function (4 items). The DASH uses a 5-point Likert scale that rates the individual's difficulties the preceding week. Lower scores indicate no difficulty, limitations or symptoms whereas higher scores indicate inability to perform tasks or extreme difficulties or symptomatology.
Shoulder Disability Questionnaire **(*n* = 1)** [75]	Is a measure of shoulder disability that consists of 22 self-reporting items to which participants respond with either yes or no. The score ranges from 0 to 22, with a higher score indicating a greater degree of disability. The measure has strong associations with quality-of-life measures and has proven levels of validity in stroke patients.
Pain Behaviours scale **(*n* = 1)** [87]	The assessor evaluates how frequently the patient displays the following pain behaviours: verbal complaints, nonverbal complaints, facial grimaces, standing posture, mobility, body language, the use of visible sup-port equipment, stationary movement, and self-reported downtime and medication. These 10 pain behaviour items are scored on a 3-point scale: 0 = None, 0.5 = Occasional, and 1 = Frequent, and the total score ranges be-tween 0 to 10.
Severity of Degree of painful shoulder **(*n* = 1)** [115]	The severity degree of the painful shoulder is defined in four grades. Severe (0), pain and functional limitation while rest with all movements limited. Moderate (1), pain that intensifies with movement and very light while resting, the movements are painful, but there is no limitation in the joint range. Light (2) without pain at rest, only occurs with rapid movements or under active mobilization and almost normal (3), where only pain appears or limitation to active movements resisted.
Likert Pain Scale (LPS) **(*n* = 1)** [59]	LPS is a five-point (0–4) scale in which zero represents 'no pain' and four represents 'insufferable pain'. The patients are asked to point out the number that displays their pain level.
Croft Disability Questionnaire **(*n* = 1)** [58]	Is a 22-item questionnaire that evaluates shoulder disability. The measure consists of 22 items which can be answered "yes" or "no", and positive responses are summed to give a score. A higher score indicates severe disability, with 22 being the highest score possible.
Constant-Murley Shoulder Score **(*n* = 1)** [100]	Is a measure of shoulder joint function that assesses pain intensity (15 points), mobility of shoulder joint measured *via* range of motion (20 points), activities of daily living (40 points), and muscle power (25 points). The total score adds up to be a number out of 100, where a higher score indicates greater shoulder joint function.
Musculoskeletal Tests	
Neer's Test **(*n* = 7)** [9,48,53,57,76,77,116]	In the Neer impingement test, the therapist performs the test with patient in sitting position, by limiting each patient's scapular rotation while internally rotating the affected arm in a passive mode through elevation in the scaphoid plane. Shoulder pain during this test is suggestive of subacromial impingement or injury to the supraspinatus muscle.
Combined Upper Limb Movements: Hand Behind Neck (HBN) and Hand Behind Back (HBB) **(*n* = 5)** [9,48,70,76,77]	The performance of dorsum of hand to lumbosacral junction (hand-behind-back [HBB]) manoeuvre reflects the combination of shoulder internal rotation and extension, whereas hand-behind-neck (HBN) manoeuvre is a combination of shoulder external rotation and abduction. The therapist places patient's affected arm passively in both positions, one at a time, while patients report the intensity of shoulder pain they experience.
Acromioclavicular Shear Test **(*n* = 2)** [53,77]	The acromioclavicular shear test is said to indicate pathology at the Acromioclavicular joint (ACJ). This manoeuvre is performed with the subject sitting; the examiner cups his/her hands anteriorly on the clavicle and posteriorly on the spine of scapula. Squeezing the heel of the hands together elicits pain in the presence of ACJ inflammation.
Rowe test **(*n* = 2)** [53,77]	The Rowe test is to show multidirectional instability in the shoulder. In this test, the patient is seated in bed with the waist flexed at a 45° angle while the examiner holds the head of the humerus by placing 1 hand over the shoulder so that the index and the middle fingers sat over the anterior aspect of the humeral head and the thumb on the posterior aspect of the humeral head. The examiner then exerts anterior and posterior force to elicit instability in either direction.
Speeds test **(*n* = 2)** [53,77]	In the Speed test, the examiner actively resists the shoulder elevated in forward flexion at the plane of the scapula in a completely extended elbow with the forearm medially rotated by the patient. Pain in the bicipital groove is said to be indicative of bicipital tendon involvement.
Palpation **(*n* = 2)** [53,116]	Physical examination of the affected shoulder begins with a structured musculoskeletal examination to identify sites of tenderness on palpation. Specific sites to be palpated include: Anteriorly, the tendon of the long head of the biceps is palpated between the lesser and greater tuberosity of the humeral head. The supraspinatus tendon is palpated anteriorly over its insertion at the greater tuberosity of the humerus, with the arm at 30° of shoulder extension. The subacromial area is examined by palpating the gap between the acromial process and head of the humerus on the superolateral aspect of shoulder. Pain in the subacromial region is usually attributed to inflammation of the subacromial bursa. The acromioclavicular joint, coracoid process, and surrounding soft tissues are also examined for any localized or diffuse tenderness. Diffuse tenderness is defined as generalized shoulder girdle tenderness without localizing features.

(*Continued*)

Table 1. Continued.

Outcome measure / Frequency (n)	Type of Measure
Apprehension Test **(*n* = 1)** [48]	The apprehension test is performed by placing the patient in supine position with their arm externally rotated, in abduction and slight extension. Reporting of shoulder pain or signs of apprehension during the test suggest the likelihood that the patient may have signs of anterior shoulder instability
Hawkins-Kennedy Test **(*n* = 1)** [57]	The clinician places one hand on top of the shoulder being tested to stabilize the girdle while elevating the humerus to 90° in the plane of the scapula. The clinician then passively internally rotates the humerus to end range of motion or until reports of pain. The test is positive if pain is reported in the superior-lateral aspect of the shoulder.

Key: VAS: Visual Analogue Scale; PROM: Passive Range of Movement; NRS: Numerical Rating Scale; GHS: Glenohumeral subluxation; AHD: Acromio-humeral distance; AGT: acromion-greater tuberosity distance; FMA: Fugl-Meyer Assessment; AROM: Active Range of Movement; BPI: Brief Pain Inventory; SPADI: Shoulder Pain and Disability Index; RAI: Ritchie Articular Index; CMSA: Chedoke McMaster Stroke Assessment; DASH: The Disabilities of the Arm, Shoulder and Hand; HBN: hand-behind-neck; HBB: hand-behind-back; ACJ: Acromioclavicular joint.

Table 2. A table illustrating the reported HSP assessment approaches in the studies and their frequency (n) within the ICF framework.

Body Structure and Function *impairments*	Activity *limitations*	Participation *restrictions*
Visual Analogue Scale (*n* = 75)	Brief pain inventory (23) (*n* = 11)	Brief pain inventory (23) (*n* = 11)
Passive range of movement (*n* = 65)	Pain behaviour scale (*n* = 1)	Constant murley score (*n* = 1)
Numerical rating scale (*n* = 32)	Shoulder pain and disability index (*n* = 4)	Croft disability questionnaire (*n* = 1)
Glenohumeral subluxation (*n* = 30)	Chedoke Mcmaster Stroke Assessment (*n* = 2)	The Disabilities of the Arm, Shoulder and Hand pain severity (*n* = 1)
Fugl-Meyer Assessment (*n* = 27)	Constant murley score (*n* = 1)	Shoulder Disability Questionnaire (*n* = 1)
Active range of movement (*n* = 11)	Croft disability questionnaire (*n* = 1)	Severity of Degreof Painful Shoulder (*n* = 1)
Brief pain inventory (12) (*n* = 11)	The Disabilities of the Arm, Shoulder and Hand- pain severity (*n* = 1)	
Pain History (*n* = 9)		
Shoulder Q (*n* = 7)		
Pain Present /Absent (*n* = 5)		
McGill Pain Questionnaire (*n* = 4)		
Faces pain rating scale (*n* = 4)		
Shoulder pain and disability index (*n* = 4)		
Ritchie Articular Index (*n* = 3)		
Chedoke Mcmaster Stroke Assessment (*n* = 2)		
Likert pain scale (*n* = 1)		
Constant murley score (*n* = 1)		
Croft disability questionnaire (*n* = 1)		
Pain behaviour scale (*n* = 1)		
The Disability of the arm, shoulder and Hand (*n* = 1)		
Musculoskeletal tests:		
Neer's test (*n* = 7)		
Hand behind neck and hand behind back test (*n* = 5)		
Rowe test (*n* = 2)		
Speeds test (*n* = 2)		
Acromioclavicular sheer test (*n* = 2)		
Palpation (*n* = 2)		
Apprehension test (*n* = 1)		
Hawkins-Kennedy test (*n* = 1)		

of UK-based therapists (*n* = 67) [16]. This prior survey found that VAS was used 'Always' by 11 respondents (20%), 'Frequently' by 22 (39%), 'Sometimes' by 12 (21%), 'Rarely' by 2 (4%), and 'Never' by 9 (16%) respondents. A potential reason is that VAS is a subjective, self-reporting unidirectional measurement, and is a well-known measure for pain. A 'traditional' VAS consists of a horizontal/vertical straight line with the endpoints defining extreme limits such as 'no pain at all' (0) and 'worst possible pain' (10 cm). Patients are asked to mark their pain level on this 10 cm line between the two endpoints.

However, simple questioning about shoulder pain may not be adequate for providing the best clinical care to patients. A cohort study [9] reported that 'objective passive range of motion' tests were associated with higher incidences of pain reports than when pain intensity was assessed by self-reporting alone. In another study, 37% of patients self-reported pain, but therapist-led clinical examinations revealed pain in a further 11%–17% of patients [51]. Furthermore, the reliability and validity of VAS tools are limited, although one study reported both good intra-rater reliability (Intraclass Correlation Coefficient (ICC) = 0.72) and good inter-rater reliability (ICC = 0.78) for patients with left HSP (LHSP). Corresponding values for patients with right HSP (RHSP) were ICC = 0.86 and ICC = 0.90 respectively [138]. Measuring pain in people with stroke is a challenge because of its inherently subjective nature and therapists may show marked disagreement on the scores for individual patients [139].

The NRS is another unidirectional measure for pain. Participants report their pain level at rest and during the movement of the shoulder joint in all directions. In a recent UK wide survey (*n* = 50), it was reported to be used by 80% of respondents ('Always' by 7 (14%), 'Frequently' by 28 (56%), and 'sometimes' by 5 (10%) of respondents [16]. However, an NRS only evaluates pain intensity and does account for past pain experiences. Furthermore, the reliability and validity of NRSs has not been reported in people with stroke.

PROM was reported as an assessment approach in 39% of the studies included in this scoping review and, in general, studies assessed PROM to the point of pain. Several studies have reported an association between HSP and reduced ROM [59,74]. One study (*n* = 58) found that patients with left sided hemiplegia demonstrated decreased passive range of abduction movement at 4 months, and those with pain at 4 months were at risk of having persistent shoulder pain at 1 year [74]. Another recent study reported that shoulder pain during movement at 2 weeks was a predictor of HSP during

movement at 6 and 12 weeks after stroke [140]. Similarly, another study reported that pain during the performance of the 'Hand behind Head' manoeuvre, and a difference of greater than 10° of passive external rotation provided a 98% probability of a provisional diagnosis of HSP [47]. Given the significance, ROM is the most commonly used assessment approach in clinical practice as reported by the UK wide survey [16]. Of the 66 respondents in that survey, ROM was used 'Always' by 31 (47%), 'Frequently' by 27 (41%) and 'sometimes' by 7 (11%) [16].

FMA is a stroke-specific, performance-based impairment index. It is used as a measure of function after stroke rather than as a specific measurement for pain. Pain is, however, incorporated into FMA during PROM of the upper extremity. However, pain in the shoulder on movement will result in patients using their arm less and therefore leads to a decrease in arm function [51]. Pain could be elicited due to various structural changes such as muscle shortening, and tightness leading to myofascial trigger points (MTrPs) – an increasingly common feature in PwS [141]. In a cross-sectional study of 33 men and 17 women, aged 30–85 years (mean 68.5, SD 10.7 years), with poststroke shoulder pain, the prevalence of latent MTrPs was 68%, 92%, 40%, and 62% for supraspinatus, infraspinatus, teres minor, and upper trapezius muscle, respectively. The prevalence of active MTrPs was 34%, 50%, 12%, and 20% for supraspinatus, infraspinatus, teres minor, and upper trapezius muscle, respectively. Another study reported that the application of a trigger point blockade with lidocaine can reduce pain perception in the spastic hemiplegic shoulder in as much as 50% of stroke survivors for four months [111].

Many of the studies included in this scoping review also reported a range of other assessment approaches. GHS has often been associated with HSP and a recent systematic review reported it as one of the potential risk factors for HSP (OR 2.48–3.5, 95% CI 1.38–9.37) [16]. The rotator cuff muscles provide dynamic stability and maintain the humeral head in the glenoid fossa during shoulder movements [142]. Due to muscle weakness following stroke, there is lack of stability to the shoulder region causing passive overstretching to ligaments and capsule, resultant injury, and pain [74]. According to the latest National Clinical Guidelines for stroke [15], people who develop shoulder pain after stroke should be assessed for causes and these should be managed accordingly, including musculoskeletal issues such as GHS. This suggests a strong association between GHS and HSP, and supports incorporation of GHS as a component of HSP assessment. This is widely endorsed as demonstrated in a UK-based survey of therapists, where GHS was reported as a component of HSP assessment by 93% ($n = 63$) of respondents [16].

Most of the pain related assessment approaches (VAS, NRS, PROM, AROM, GHS) reported in this scoping review relate to 'Body Structure and Function impairments' of the ICF framework. Although these approaches are important, functional improvement is paramount for patients. There is a need for a comprehensive tool that incorporates a multidimensional assessment process, and this should incorporate physical and psychological pathologies associated with HSP [143]. An ideal assessment approach would be one considers both quantitative and qualitative information. This should be co-developed with PwS with lived experience of HSP such that the assessment can facilitate a shared clinical decision-making process.

Limitations

The current scoping review included all types of study design that were relevant to the aims of the review. Although this review found a range of outcome measures, psychometric properties of identified assessment tools were not critically appraised. Future research should include a systematic literature review for assessing the quality of studies available, and recommendations to guide clinical practice on which outcome measures should be used to assess HSP. Grey literature (theses, conference proceedings, un-published studies) and articles published in a language other than English were not included in the current study, and the authors acknowledge this could have potentially added to the existing knowledge base. Publication bias, therefore, cannot be excluded.

Conclusions

In this scoping review, a wide range of generic assessment approaches was identified for HSP, with some used more than others. A fully comprehensive assessment that considers different aspects of pain, such as severity and timing, and including functioning and the psychological burden, is needed in this area of practice to be able to guide appropriate treatment.

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Ethical statement

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