

PREVALENCE OF POST-STROKE SHOULDER PAIN AND ITS ASSOCIATION
WITH UPPER-LIMB MOTOR DYSFUNCTION: A NARRATIVE REVIEW OF THE
PUBLISHED LITERATURE

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Abstract

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Background: Post-stroke shoulder pain (PSSP) is a frequent complication of stroke that can limit upper-limb recovery and participation in rehabilitation. Reported prevalence varies widely between studies, and the contribution of upper-limb motor dysfunction to PSSP is still incompletely understood. **Objective:** To synthesise published evidence on the prevalence of PSSP and on its association with upper-limb motor dysfunction in adult stroke survivors.

Methods: A narrative review with structured data extraction was conducted. Published systematic reviews, meta-analyses and observational studies on PSSP were identified, and pooled prevalence and incidence estimates, regional variation, and studies relating shoulder pain to upper-limb motor function (including the Fugl-Meyer Assessment of the Upper Extremity) were extracted and tabulated. No new patient data were collected. **Results:** One meta-analysis of 10 cross-sectional studies (3,701 patients) reported a pooled PSSP prevalence of 33% (95% CI 22–43%), with very

high heterogeneity ($I^2 = 98.8\%$); pooled incidence from 11 cohort studies (3,496 patients) was 29% (95% CI 21–36%). Regional prevalence estimates ranged from 14% in Europe to 75% in a single African study. A second systematic review reported incidence of 10–22% and prevalence of 22–47%. A meta-analysis of prospective cohorts identified reduced upper-limb motor function, diabetes (OR 2.09) and a history of shoulder pain (OR 2.78) as significant risk factors for PSSP within the first year after stroke, whereas sex and laterality were not significant. In a cross-sectional study of 122 hemiplegic patients, those with shoulder pain ($n = 76$) had significantly worse Fugl-Meyer upper-extremity motor scores and proprioception than those without ($n = 46$), and pain severity correlated with motor dysfunction. **Conclusion:** PSSP affects roughly one in three stroke survivors in pooled estimates, although figures differ markedly by region, setting, definition and timing. The available evidence links upper-limb motor dysfunction with PSSP, but the cross-sectional nature of much of it prevents conclusions about causal direction. Physiotherapy assessment after stroke should record shoulder pain and upper-limb motor function together, and prospective studies with standardised definitions are needed.

Keywords: stroke; shoulder pain; hemiplegic shoulder pain; prevalence; upper extremity; Fugl-Meyer Assessment; physiotherapy

1. Introduction

Stroke is a leading cause of long-term disability, and many survivors live with impaired movement of the arm on the affected side. Among the complications that follow stroke, pain in the hemiplegic shoulder is one of the most common. Post-stroke shoulder pain (PSSP) usually appears within two weeks to two months after the stroke [1]. It has been linked with poorer recovery of motor and sensory function and reduced quality of life, with psychological consequences such as depression, anxiety and sleep disturbance, and with longer hospital stay and higher costs of care [1].

The mechanisms behind PSSP are multifactorial. Motor control impairment with altered muscle tone, peripheral and central nervous system changes, and soft-tissue injury have all been proposed, and these may occur together or trigger one another [1]. Neurological contributors such as impaired sensation, hemispatial neglect, spasticity and flaccid paralysis, and mechanical contributors such as glenohumeral subluxation and rotator cuff injury, have also been described [2]. Because upper-limb weakness, abnormal tone and impaired motor control are central features of hemiparesis, the relationship between PSSP and upper-limb motor dysfunction is of direct interest to neurological physiotherapists. Pain can also restrict the movement that rehabilitation depends on, so the relationship may run in both directions.

Estimates of how often PSSP occurs differ considerably across the literature. Pooled analyses report incidence and prevalence figures that vary with geography, study setting, diagnostic criteria and the time point at which pain is assessed [1,2]. A clear picture of both the frequency of PSSP and its relationship with motor impairment is needed to guide assessment and rehabilitation planning, particularly in settings where primary data are limited.

This review therefore aimed (i) to summarise published estimates of the prevalence of PSSP among stroke survivors, and (ii) to examine the evidence for an association between PSSP and upper-limb motor dysfunction, with attention to studies that used the Fugl-Meyer Assessment of the Upper Extremity.

2. Methods

2.1 Review design

This was a narrative review with structured data extraction, based entirely on previously published literature. No new participant data were collected. Because the review was not registered and did not follow a full systematic protocol, it is not presented as a PRISMA-compliant systematic review.

2.2 Information sources and search

Published literature was searched using combinations of the terms post-stroke shoulder pain, hemiplegic shoulder pain, prevalence, incidence, risk factors, upper extremity and Fugl-Meyer. Priority was given to systematic reviews and meta-analyses reporting pooled epidemiological estimates, and to observational studies that related shoulder pain to upper-limb motor function.

2.3 Eligibility

Studies were eligible if they involved adult stroke survivors with hemiplegic or post-stroke shoulder pain and reported at least one of the following: the prevalence or incidence of shoulder pain; risk or associated factors for shoulder pain; or a comparison or correlation between shoulder pain and upper-limb motor function. Intervention trials, conference abstracts and papers on shoulder pain unrelated to stroke were not considered.

2.4 Data extraction

For each included source the following were extracted: authors and year, design, number of studies or participants, pooled or individual prevalence and incidence with 95% confidence intervals, heterogeneity statistics, regional estimates, risk factors with effect sizes, and the instruments used to measure pain and motor function. Numerical values are reported exactly as published in the source articles and were not recalculated,

except where a proportion was derived directly from reported group sizes, which is stated in the text.

Figures were drawn from the published numbers. Where a figure shows study-level or time-point proportions, these were calculated by dividing the reported number of patients with shoulder pain by the reported sample size, and the 95% confidence intervals in Figure 2 are Wilson score intervals calculated from those counts. Pooled estimates and their confidence intervals in Figures 1 and 4 are those published by the source reviews and were not recalculated.

2.5 Outcome measures reported in the literature

Upper-limb motor function in the reviewed studies was most often measured with the Fugl-Meyer Assessment of the Upper Extremity (FMA-UE) [6]. The FMA-UE is a stroke-specific, performance-based impairment index in which each item is scored 0 (cannot perform), 1 (performs partially) or 2 (performs fully); the upper-extremity motor domain has a maximum score of 66, with higher scores indicating less impairment. Shoulder pain was measured with visual analogue scales, numeric rating scales, pain diagrams, questionnaires or clinical examination, and definitions of PSSP differed between studies [1].

2.6 Quality considerations

Formal risk-of-bias scoring was not repeated. The methodological quality ratings reported by the source reviews were used instead: in the largest epidemiological meta-analysis, cohort studies scored 6 to 9 on the Newcastle–Ottawa Scale and cross-sectional studies scored 10 to 11 on the Agency for Healthcare Research and Quality tool [1]. The consequences of this approach are discussed under limitations.

2.7 Ethical considerations

As the review used only published data, ethical approval and informed consent were not required.

3. Results

3.1 Evidence base

The evidence comprised two systematic reviews of the epidemiology of PSSP [1,2], one systematic review and meta-analysis of risk factors [3], one cross-sectional comparison of stroke survivors with and without shoulder pain [4], and one prospective cohort study of early and follow-up incidence [5]. The largest epidemiological meta-analysis searched PubMed, Embase, the Cochrane Library and Web of Science from inception to 31 December 2020 and included 21 studies, comprising 11 cohort studies and 10 cross-sectional studies [1].

3.2 Prevalence and incidence

The pooled prevalence of PSSP across 10 cross-sectional studies including 3,701 stroke patients was 33% (95% CI 22–43%), with very high heterogeneity ($I^2 = 98.8\%$). The pooled incidence across 11 cohort studies including 3,496 patients was 29% (95% CI 21–36%; $I^2 = 97.3\%$). Funnel plots were asymmetric and Egger’s test was significant for both outcomes, indicating possible publication bias [1]. A separate systematic review reported an incidence of 10–22% across eight studies and a prevalence of 22–47% across 11 studies [2]. Table 1 summarises these estimates.

Table 1. Pooled estimates of the occurrence of post-stroke shoulder pain

Source	Outcome	Studies (n)	Estimate	Heterogeneity
Zhang et al., 2021 [1]	Prevalence	10 cross-sectional (3,701 patients)	33% (95% CI 22–43%)	$I^2 = 98.8\%$
Zhang et al., 2021 [1]	Incidence	11 cohort (3,496 patients)	29% (95% CI 21–36%)	$I^2 = 97.3\%$
Anwer & Alghadir, 2020 [2]	Incidence	8 studies	10–22%	Not stated in abstract
Anwer & Alghadir, 2020 [2]	Prevalence	11 studies	22–47%	Not stated in abstract

Values are as reported by the source reviews. Estimates are not directly comparable because the reviews used different inclusion criteria and analytic approaches.

Figure 1 places the pooled estimates from the two reviews side by side. The incidence and prevalence intervals from the meta-analysis overlap with each other and with the ranges reported by the second review, although that review’s incidence range (10–22%) lies mostly below the meta-analytic interval.

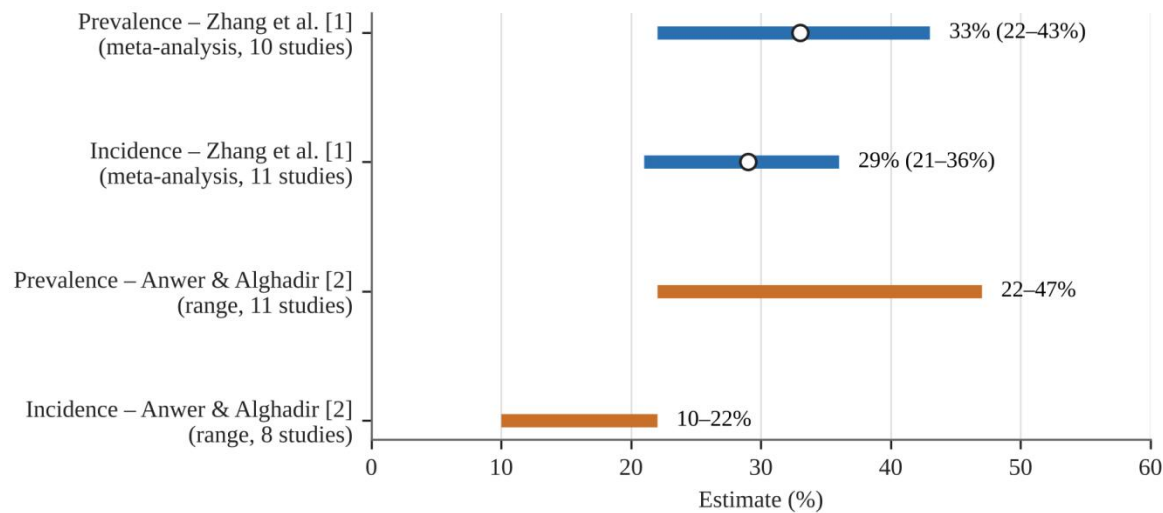


Figure 1. Pooled estimates and reported ranges for the incidence and prevalence of post-stroke shoulder pain. Circles mark pooled estimates from the meta-analysis of Zhang et al. [1] with 95% confidence intervals; orange bars show the ranges reported by Anwer and Alghadir [2].

Prevalence in the individual cross-sectional studies, calculated from the reported counts of patients with shoulder pain, ranged from 4.1% (Menoux et al., France) to 75.5% (Hamzat and Osundiya, Nigeria) (Figure 2). Six of the ten studies reported prevalence below 30% and three reported 60% or more, with only one study (37.0%, Dromerick et al.) falling between 30% and 60% (Figure 3). This spread is consistent with the very high heterogeneity ($I^2 = 98.8\%$) of the pooled estimate.

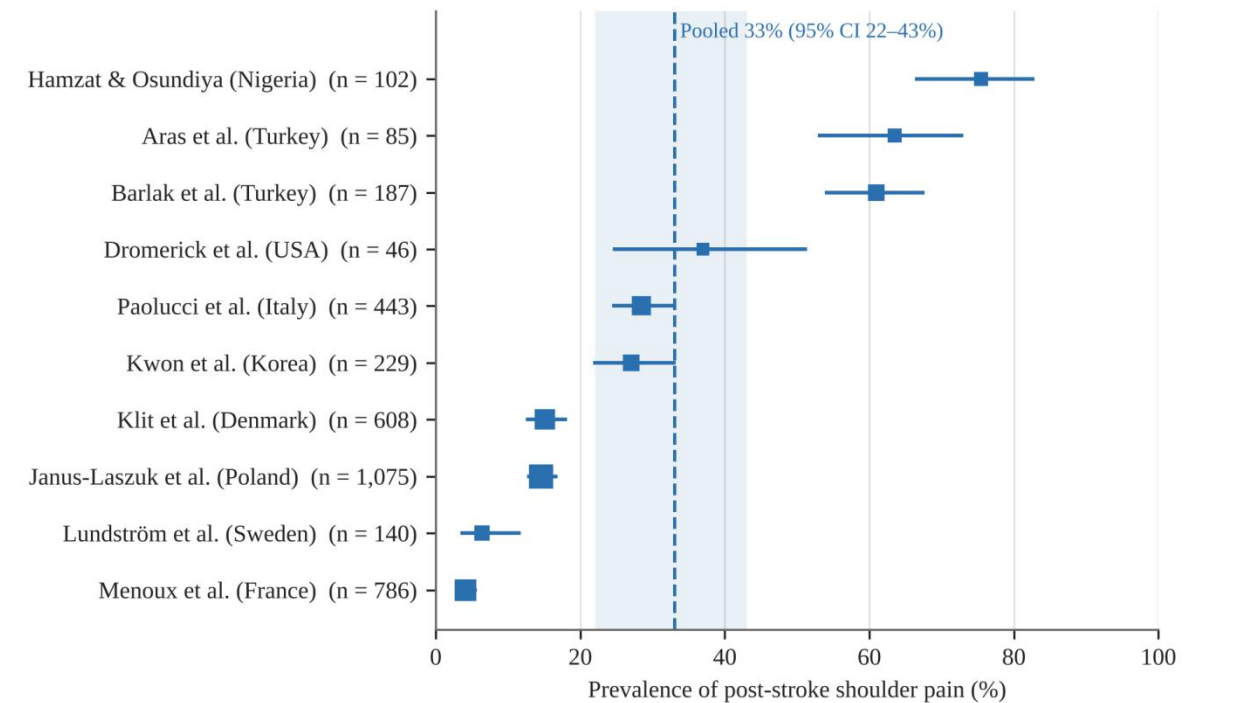


Figure 2. Study-level prevalence of post-stroke shoulder pain in the ten cross-sectional studies included in the meta-analysis of Zhang et al. [1]. Squares show prevalence calculated from reported counts (square size reflects sample size) with Wilson 95% confidence intervals; the dashed line and shaded band show the published pooled prevalence of 33% (95% CI 22–43%).

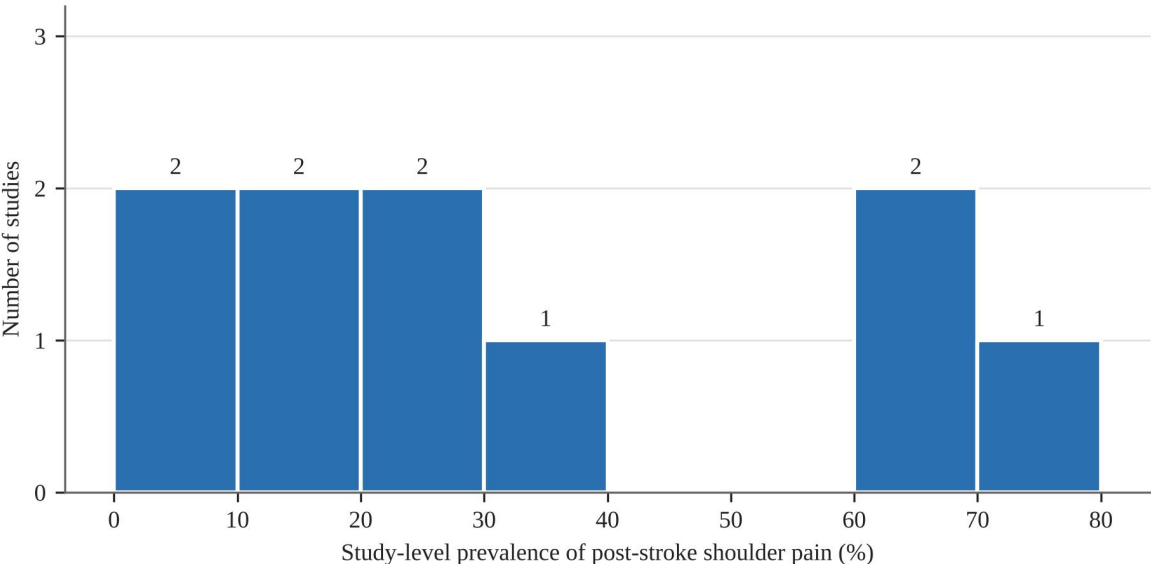


Figure 3. Distribution of study-level prevalence of post-stroke shoulder pain. Histogram of the ten prevalence values shown in Figure 2, grouped in 10-percentage-point bins.

3.3 Regional and temporal variation

Prevalence differed significantly between regions and countries [1]. Table 2 shows the regional estimates; the African and North American estimates each rest on a single study. Country-level prevalence ranged from 4% in France and 6% in Sweden to 62% in Turkey (two studies) and 75% in Nigeria (one study). Population-based studies generally reported lower figures than studies conducted in rehabilitation settings. The authors also noted that incidence fluctuated around 30% over time while prevalence showed a downward trend, and attributed this tentatively to better early intervention and rehabilitation [1].

Table 2. Pooled prevalence of post-stroke shoulder pain by region (Zhang et al., 2021 [1])

Region	Studies (n)	Participants (n)	Prevalence (95% CI)
Europe	5	3,052	14% (6–21%)
Asia	3	501	50% (25–76%)
North America	1	46	37% (23–51%)
Africa	1	102	75% (67–84%)

Region-level estimates with a single contributing study should be interpreted cautiously. The regional differences are shown in Figure 4. Europe had the lowest pooled prevalence (14%) and Africa the highest (75%), while the overall pooled estimate (33%)

lay between them. The wide intervals for Asia and for the single-study regions underline the uncertainty of the regional comparisons.

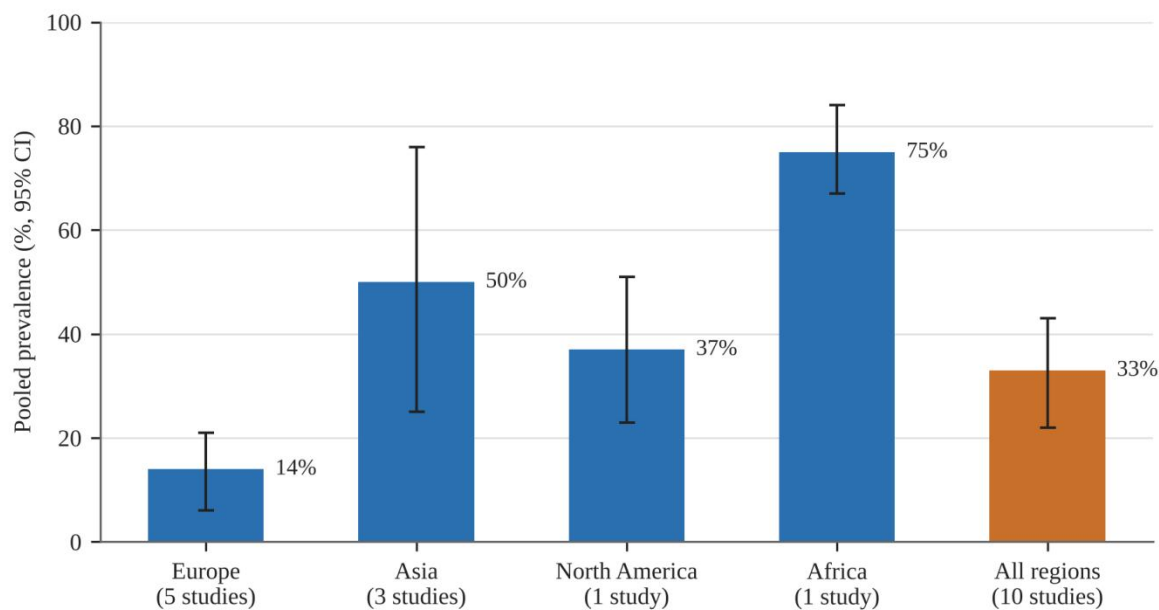


Figure 4. Pooled prevalence of post-stroke shoulder pain by region. Bars show the pooled prevalence and error bars the 95% confidence interval as published by Zhang et al. [1]; the orange bar is the overall pooled estimate.

3.4 Natural history in the early post-stroke period

In a prospective cohort of 121 patients followed from within 72 hours of stroke to 8–10 weeks, 35% had hemiplegic shoulder pain within 72 hours, rising to 44% (53/121) at follow-up. Of the 42 patients with pain at baseline, pain persisted in 32 and resolved in 10, and 21 patients developed new pain during follow-up [5]. These data show that PSSP can be present very early and that it frequently persists during the first two months. Figure 5 plots the proportion of patients with shoulder pain at each follow-up point in the cohorts that reported more than one time point. The trajectories were not uniform. The proportion rose over time in the cohorts of Sackley et al. (36% at 3 months to 47% at 12 months), Ratnasabapathy et al. (17% at 1 week to 24% at 6 months), Lindgren et al. (22% at 4 months to 24% at 16 months) and Nadler et al. (35% to 44%), but fell in the cohorts of Wanklyn et al. (53% at 8 weeks to 33% at 6 months) and Langhorne et al. (15% at 6 months to 11% at 18 months and 12% at 30 months). These are crude proportions: sample sizes differed between time points in several cohorts, and the cohorts differed in setting and in how pain was defined.

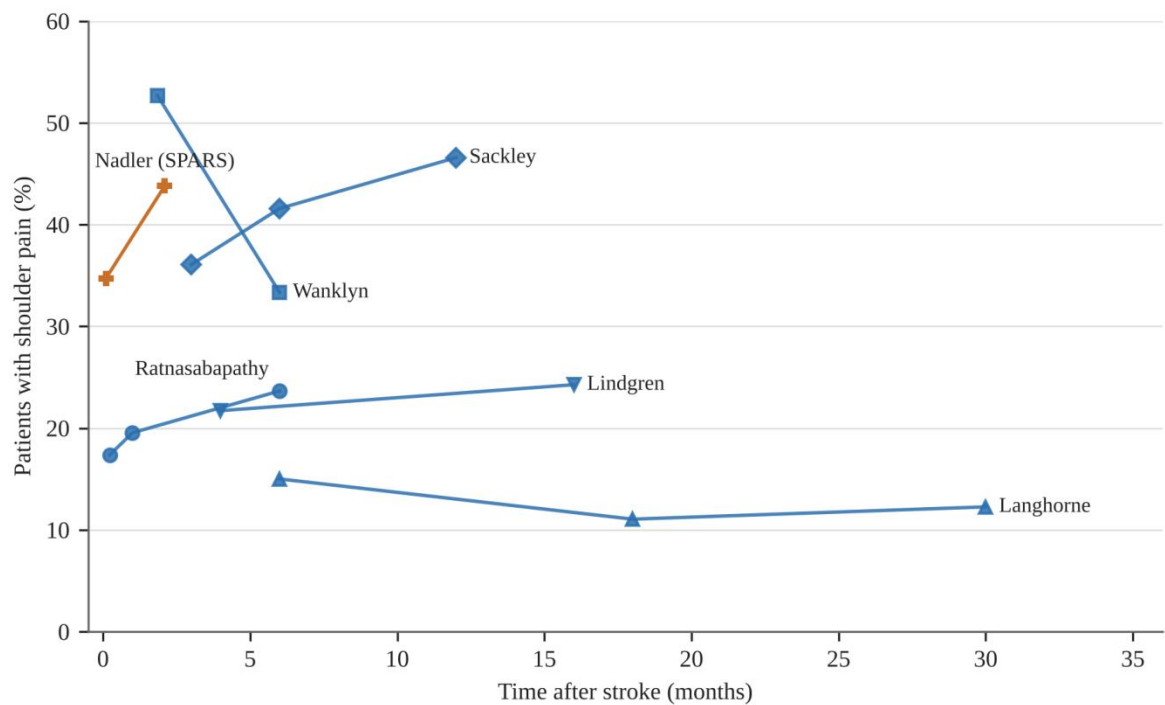


Figure 5. Proportion of stroke patients with shoulder pain at successive follow-up points in six cohorts. Proportions were calculated from the counts reported in the cohort studies summarised by Zhang et al. [1] and by Nadler et al. [5]; time points are shown in months after stroke (1 week = 0.23 months, 8 weeks = 1.85 months, 72 hours = 0.1 months, 9 weeks = 2.1 months). The Nadler et al. cohort is highlighted in orange.

3.5 Association with upper-limb motor dysfunction

A systematic review and meta-analysis of prospective cohort studies examined factors measured within one month of stroke that predicted PSSP in the first year. Reduced upper-limb motor function, diabetes (OR 2.09, 95% CI 1.16–3.78) and a history of shoulder pain (OR 2.78, 95% CI 1.29–5.97) were identified as significant risk factors, whereas sex (OR 0.93, 95% CI 0.75–1.15) and laterality (OR 0.78, 95% CI 0.59–1.05) were not significant [3].

A cross-sectional study of 122 patients with hemiplegia used the visual analogue scale to divide participants into those with hemiplegic shoulder pain (n = 76, which corresponds to 62% of the sample) and those without (n = 46). Upper-extremity motor function, measured with the Fugl-Meyer scale, and shoulder proprioception at 45°, 60° and 90° of flexion were significantly worse in the pain group ($p \leq 0.005$), and pain severity correlated significantly with upper-extremity motor dysfunction and proprioceptive impairment ($p < 0.005$) [4]. Figure 6 shows the composition of the two

samples described above: of the 53 patients with pain at 8–10 weeks in the cohort of Nadler et al. [5], 60% had pain that persisted from the early assessment and 40% had developed it later, and 62% of the 122 hemiplegic patients studied by Duray and Baskan [4] had shoulder pain. Table 3 summarises the evidence on association.

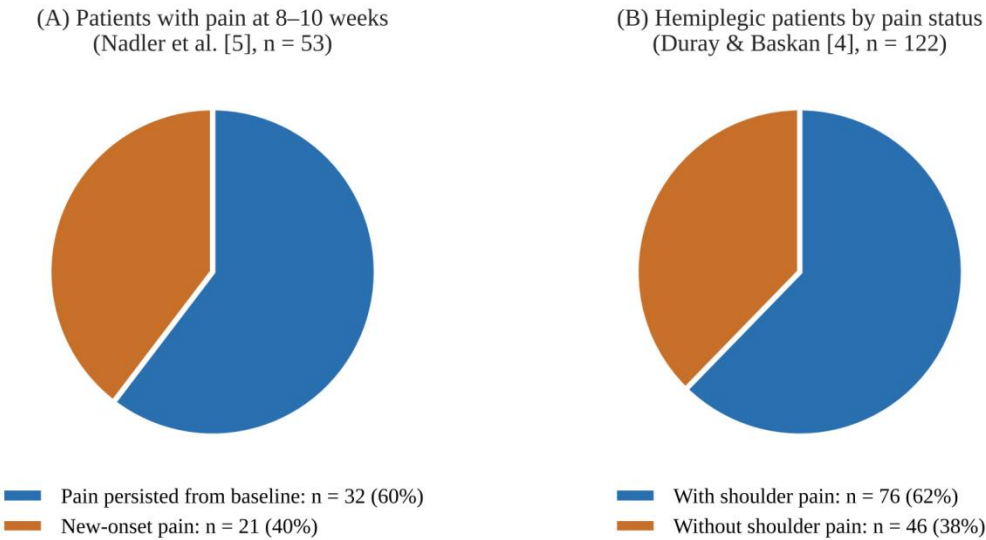


Figure 6. Composition of two samples of stroke patients by shoulder-pain status. (A) Patients with pain at 8–10 weeks, by whether pain persisted from the 72-hour assessment or was new [5]. (B) Hemiplegic patients with and without shoulder pain [4]. Percentages were calculated from the reported counts.

Table 3. Evidence relating post-stroke shoulder pain to upper-limb motor dysfunction

Source	Design	Key finding	Interpretation
Holmes et al., 2020 [3]	Systematic review and meta-analysis of prospective cohorts; risk factors measured within 1 month	Reduced upper-limb motor function, diabetes (OR 2.09) and prior shoulder pain (OR 2.78) were significant risk factors; sex and laterality were not	Early motor impairment predicts later PSSP
Duray & Baskan, 2020 [4]	Cross-sectional comparison, n = 122 (76 with and 46 without HSP)	Fugl-Meyer motor and proprioception scores worse with HSP (p ≤ 0.005);	Pain and motor/proprioceptive deficit coexist; direction cannot be

Source	Design	Key finding	Interpretation
Anwer & Alghadir, 2020 [2]	Systematic review	pain severity correlated with motor dysfunction (p < 0.005) Impaired sensation, hemispatial neglect, spasticity and flaccid paralysis described as neurological contributors; subluxation and rotator cuff injury as mechanical contributors	inferred Motor impairment is one of several contributing factors
Zhang et al., 2021 [1]	Systematic review and meta-analysis	Etiology described as multifactorial: motor control impairment (altered tone), peripheral and central nervous changes, soft-tissue injury	Mechanisms may interact and trigger one another

HSP, hemiplegic shoulder pain; PSSP, post-stroke shoulder pain; OR, odds ratio.

4. Discussion

4.1 Principal findings

The pooled evidence indicates that PSSP affects about one in three stroke survivors, with a pooled prevalence of 33% and a pooled incidence of 29% in the largest meta-analysis [1]. Reported ranges in another review (incidence 10–22%, prevalence 22–47%) are somewhat lower in places but overlap with these figures [2]. The upper-limb motor evidence is consistent in direction: reduced upper-limb motor function early after stroke predicted later PSSP [3], and patients with hemiplegic shoulder pain had worse Fugl-Meyer motor scores and proprioception than those without [4].

4.2 Why the reported prevalence varies

The very high heterogeneity (I^2 near 98%) shows that the pooled figure should be read as an average over quite different circumstances rather than a single true rate. Several explanations were identified in the source literature. Study setting matters, because PSSP is more common among people with hemiparesis in rehabilitation settings than in

the general stroke population, and the population-based studies reported lower figures. Inclusion criteria also differ: some studies restricted participants by age, ambulatory status or ability to follow instructions. Definitions of pain ranged from any self-reported discomfort in the affected shoulder to pain requiring analgesia on consecutive days, and assessment methods ranged from self-report to clinical examination. Finally, timing is important, since PSSP typically appears within two weeks to two months and may later resolve, so an assessment made too early or too late can under-estimate occurrence [1]. Regional differences may partly reflect differences in health-care access and diagnostic practice, although this explanation is speculative [1]. Cohort data from the early post-stroke period illustrate the dynamic picture: pain was already present in about a third of patients within 72 hours and was present in 44% at 8–10 weeks, with both persistence and new onset [5].

4.3 Upper-limb motor dysfunction and shoulder pain

The meta-analysis of prospective cohorts is the strongest design among the sources reviewed for this question, because the risk factors were measured within a month of stroke and the outcome later. It supports the view that motor impairment precedes and predicts PSSP [3]. The cross-sectional comparison adds that, once pain is present, it travels with greater motor and proprioceptive impairment [4]. Taken together, these findings are compatible with a two-way relationship in which weakness, abnormal tone and impaired sensorimotor control predispose the shoulder to pain, and pain in turn limits active use of the arm and participation in therapy, although the present evidence cannot separate these pathways.

Reduced upper-limb motor function was not the only associated factor. A history of shoulder pain and diabetes were also significant, while sex and laterality were not [3]. Neurological factors such as impaired sensation, neglect, spasticity and flaccid paralysis, and mechanical factors such as subluxation and rotator cuff injury, have also been implicated [2]. Motor dysfunction should therefore be seen as one important contributor within a multifactorial picture [1], which also explains why an association with motor scores may differ in strength between samples with different stroke severity and time since stroke.

4.4 Implications for physiotherapy practice

Because PSSP can appear within days of stroke and often persists, shoulder pain screening appears warranted from the early post-stroke period. The evidence reviewed supports recording pain intensity (for example with a visual analogue or numeric rating scale) alongside upper-limb motor function (for example with the FMA-UE) at the same assessment, so that patients with severe motor impairment, a history of shoulder pain or

diabetes can be identified as higher risk and monitored more closely [3]. Clinicians should also bear in mind that pain may itself reduce measured motor performance [4].

4.5 Strengths and limitations

The review draws on a large pooled epidemiological evidence base and on a prospective risk-factor meta-analysis, and it reports published figures without recalculation. Its limitations are as follows.

- It is a narrative review without a registered protocol or a full systematic search, so relevant studies may have been missed and selection bias cannot be excluded.
- Quality appraisal relied on the source reviews rather than being repeated, and the pooled estimates carry very high heterogeneity and signs of publication bias [1].
- Only a small number of sources directly examined the link between shoulder pain and upper-limb motor function, and the one cross-sectional comparison cannot establish causal direction.
- Several regional prevalence estimates rest on a single study.
- The effect size for reduced upper-limb motor function in the risk-factor meta-analysis is not reported here because it was not available in the sources accessed; authors should add it from the full text before submission.

4.6 Directions for future research

Prospective studies with standardised definitions of PSSP, repeated assessment at fixed time points, and consistent use of the FMA-UE would allow the temporal relationship between motor recovery and shoulder pain to be examined directly. Reporting of stroke severity, tone, subluxation and sensory status alongside motor scores would help separate the contribution of motor impairment from that of other factors.

5. Conclusion

Published evidence indicates that post-stroke shoulder pain is common, with a pooled prevalence of about 33% and a pooled incidence of about 29%, although estimates vary widely with region, setting, definition and timing. Reduced upper-limb motor function early after stroke is associated with later shoulder pain, and patients with shoulder pain show poorer Fugl-Meyer motor scores and proprioception, but the causal direction and the relative weight of other contributors remain unresolved. Physiotherapists should assess shoulder pain and upper-limb motor function together from the early post-stroke period, and future prospective studies should use standardised definitions and measures.

Declarations

Ethical approval: Not applicable; this review used only published data.

Data availability: All data analysed are from the cited published articles.

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