Poststroke Shoulder Pain and Its Association With Upper Extremity Sensorimotor Function, Daily Hand Activities, Perceived Participation, and Life Satisfaction.

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Post-stroke shoulder pain and its association with upper extremity sensorimotor function, daily hand activities, perceived participation and life satisfaction

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Running title: Post-stroke shoulder pain and the impact on daily life

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ABSTRACT

Objective: To assess the differences in upper extremity sensorimotor function, daily hand activities, perceived participation and life satisfaction between individuals with and without post-stroke shoulder pain (PSSP) and to determine how PSSP is associated with these variables.

Design: A cross-sectional study of a convenience sample.

Participants: Forty-nine community-dwelling individuals (mean ± standard deviation [SD]) age 64 ±9 years), 24 with PSSP and 25 without (non-PSSP) were assessed in mean ± SD15 ±8 months after stroke.

Methods: Upper extremity sensorimotor function was assessed and daily hand activities, perceived participation and life satisfaction were reported. Demographics were described and shoulder pain characteristics recorded in the PSSP group. Between-group differences and regression analyses were conducted.

Results: The PSSP group had significantly decreased passive shoulder abduction (P=.001) and upper extremity motor function (P=.03) in comparison to the non-PSSP group, but there were no significant differences between the groups in daily hand activities, perceived participation or life satisfaction. In the multivariate analyses, PSSP (P=.03, OR 4.42 95% CI 1.21-16.24) and proprioception (P=.04, OR 10.28, 95% CI 1.1-96.01) were associated with upper extremity motor function, whereas perceived participation was associated with life satisfaction (P=.002, OR 1.08, 95% CI 1.03-1.13). Passive shoulder abduction, resistance to passive movements and proprioception explained 45% of variance of daily hand activities while daily hand activities, vocational situation and sex explained 40% of variance of perceived participation.

Conclusions: This cross-sectional study indicates that there is an association between PSSP and upper extremity motor function, whereas the association between PSSP, daily hand activities, perceived participation and life satisfaction is less clear. PSSP is commonly described as a severely disabling condition, but our results imply that in individuals with mild to moderate upper extremity paresis, it may not have such a great impact on their life situation.

Key Words: shoulder pain; stroke; upper extremity; activities of daily living; participation; quality of life

INTRODUCTION

Stroke is one of the most common causes of life-long disability in the adult population. In the acute phase after stroke, reduced arm and hand function are seen in a majority of the patients and in about 40% in the chronic phase [1, 2]. Post-stroke shoulder pain (PSSP) is a common type of pain after stroke [3, 4], especially in those with reduced arm and hand function [5]. PSSP is associated with decreased motor function [5, 6], somatosensory function [6, 7], limited range of motion [8, 9] and spasticity [10]. Several studies have shown that PSSP could be a long lasting problem [5, 7] and is associated with depression [6] and longer hospital stay [11, 12].

Even if PSSP is common after stroke, it is unclear how it impacts on the individual's life situation. The international classification of functioning, disability and health, ICF, [13] can be used to describe the consequences of a disease in the context of impairments (i.e., body functions), activities (i.e., the execution of a task) and perceived participation (i.e., involvement in life situations). Few studies have investigated how PSSP is associated with the ability to perform activities, perceived participation and life satisfaction and the results differ depending on the study designs and the outcome measures used. Two studies reported that patients with PSSP in the subacute phase have more activity limitations, according to Barthel Index, than patients without shoulder pain (non-PSSP) [5, 11]. Other studies [6, 14-16] have not been able to confirm this finding. One study reported an association between PSSP and decreased participation [14], whereas another study did not find such a relationship [15]. Chae et al. [16] found that PSSP was associated with reduced quality of life, but the results are difficult to interpret as they did not include a control group. Thus, further studies are needed to understand how PSSP affects different domains according to ICF. Such knowledge would assist clinicians in the selection of appropriate rehabilitation interventions.

The aim of this study was to assess the differences in upper extremity sensorimotor function, daily hand activities, perceived participation and life satisfaction between individuals with and those without PSSP and to determine how PSSP is associated with these variables.

METHODS

Participants

A total of 49 community-dwelling individuals with stroke: 24 with and 25 without PSSP were included. The participants were recruited from Lund Stroke Register, the Department of Neurology and the Department of Rehabilitation at Skåne University Hospital by screening medical records. Inclusion criteria were: (i) stroke onset at least 5 months prior to study enrollment and (ii) decreased sensorimotor function in the affected arm, but ability to use the arm to some extent in daily activities. Exclusion criteria were: (i) difficulty to communicate or to understand test instructions, (ii) other conditions that caused pain (for example fibromyalgia and arthritis) and (iii) severe depression or other psychiatric symptoms. For participants with PSSP, the inclusion criteria were daily or almost daily pain in the affected shoulder for at least 4 months after stroke onset. At the time of data collection for this study, the participants were also included in another study regarding somatosensory functions assessed by Quantitative Sensory Testing, QST [17].

Procedures

In Figure I, a flow chart of the recruitment of participants is presented. Medical records for approximately 1350 potential participants with stroke onset between May 2009 and December 2011 were reviewed. Of a total of 167 potential participants, 98 persons were contacted by mail with information about the study and 1 to 2 weeks later by phone for an interview. The interview consisted of questions about independency in activities of daily living (including hand activities), walking ability, somatosensory functions, shoulder pain, general health, other diseases or conditions and current medication. After the interview, 45 persons were excluded, as they did not meet the inclusion criteria (22 persons), declined to participate (21 persons), or were unable to get in contact with (two persons). Fifty-three persons were assessed but another four did not meet the inclusion criteria. Finally, 49 persons were included and gave their informed consent to participate. The study was approved by the Regional Ethical Review Board in Lund, Sweden (Dnr 2011/471).

Demographics and characteristics

Before the assessments, age, gender, living situation, vocational situation and stroke specific characteristics (side of lesion, type of stroke, stroke onset and length of rehabilitation) were recorded. Participants were asked about the occurrence of shoulder pain before and after their stroke onset. Pain in other parts of the body than in the paretic shoulder was registered (i.e., pain in the lower extremities, the upper extremity, the back, neck or head) and prescribed pain medication was also recorded.

Assessments and outcome measures

All assessments were performed by a trained physical therapist, with long experience of stroke rehabilitation. The assessments for this study lasted approximately 30-45 minutes and were performed before the QST assessments. During the day of assessments, all the participants were instructed to use their daily medication as prescribed.

Shoulder pain

For the participants with PSSP (n=24), the following data were recorded before the assessments: duration of shoulder pain, pain intensity, pain when eating, dressing and raising the arm over the horizontal plane. Pain intensity was assessed by a 0-100 mm Visual Analogue Scale for Pain (VAS-P). AVAS-P more than 40 mm was considered as moderate-to-severe pain [18].

Upper extremity sensorimotor functions

Upper extremity sensorimotor functions were assessed by: (i) passive range of motion (ROM) in abduction and external rotation of the upper arm; (ii) motor function; (iii) resistance to passive movements in the elbow; (iv) light touch and (v) proprioception.

Passive ROM was measured with a goniometer [9], which has been shown to be a reliable method [19]. Motor function in the upper arm and hand as well as advanced hand activities were assessed using the Modified Motor Assessment Scale (M-MAS), which is a reliable and valid outcome measurement [20, 21]. The subscales range from 0 to 5, where 5=normal or almost normal motor function and 0=no motor function; the maximum total score for each arm is 15 points. Restrictions in motor function were here reported as 'severe to moderate' (0-11 points) and 'mild to no restriction' (12-15 points). Resistance to passive movements in the elbow was assessed according to the Modified Ashworth Scale (MAS) [22]. The scale ranges from 0 to 4, were 0=no increase in muscle tone, 1-3=increase in muscle tone, and 4=rigidity in flexion or extension; increased muscle tone was reported as ≥1. Light touch was assessed using a cotton swab on the upper arm and forearm, hands and fingers and recorded as 'normal', 'diminished' or 'absent'. Proprioception was assessed in the thumbs and wrists using a 3-point scale, where 2=all four attempts correct, 1=3 of 4 attempts correct, and 0=less than 3 of 4 attempts correct [23, 24]. During the assessments of light touch and proprioception the participants had their eyes closed. Light touch and proprioception were reported as 'normal, or 'diminished or absent'.

Self-reported hand activities

Ability to perform daily hand activities was assessed with the ABILHAND Questionnaire, which is a self-report outcome measurement [25]. ABILHAND measures self-perceived ability to perform complex hand activities in 23 daily situations. The participants rate their perceived difficulty in performing each activity based on a three-level response scale: 2=easy, 1=difficult or
0=impossible. Activities not performed during the past 3 months are scored as missing responses. The ABILHAND is Rasch analysed and has been shown to be valid [26] and reliable [26, 27] in persons with chronic stroke.

Perceived participation

Perceived participation was assessed with the Stroke Impact Scale (SIS) 3.0 domain 8 [28, 29]. This domain addresses the impact of stroke on work, social activities, quiet recreations, active recreations, role as a family member, religious activities, life control and ability to help others. The participants responded to the items in each domain using a 5-point rating scale from 5=none of the time to 1=all of the time. For each subject, the mean score of the items was calculated and converted into a percentage value using the following equation: 100 × (the mean value of the items–1)/(5–1) [28]. Higher scores indicate low restrictions in perceived participation, whereas low values indicate more restrictions in perceived participation. The SIS is a stroke specific outcome measure developed for persons with mild to moderate stroke. SIS has been Rasch analysed and is reported to be reliable, valid and sensitive to change [28, 29].

Life satisfaction

Life satisfaction was assessed with the Life Satistfaction 11 checklist (LiSat-11 checklist) [30], which is a self-administrated questionnaire that assesses global satisfaction with life in one item and domain-specific satisfaction in 10 items. Only the item that assesses level of global satisfaction with life (i.e., life as a whole) was used in this study. LiSat-11 uses a six-step ordinal self-rating scale ranging from 6=very satisfying to 1=very dissatisfying. The response options were dichotomized, with scores of 5-6 meaning 'satisfied', and scores 1-4 meaning 'dissatisfied' as described by Fugl-Meyer et al. [30]. The questionnaire has previously been used for patients after stroke using the global question (life as a whole) as a measure of life satisfaction [31].

Statistics

Data were analysed using the IBM SPSS Statistics version 21 (IBM Corporation, Armonk, New York, United States). Demographic data, clinical characteristics and assessments are presented as frequencies, mean ± SD or median (range). Raw scores from the ABILHAND questionnaire were entered into an online Rasch-based data analysis module (www.rehab-scales.org) which automatically converted the data into logits, i.e., interval measurements. The logits are expressed on an interval scale ranging from plus to minus with the centre of the scale set to zero [32], in which higher logit values represent better self-perceived ability to perform daily hand activities.

To assess differences between the PSSP group and the non-PSSP group, the Mann-Whitney U test was used for the continuous variables (age, stroke onset, passive shoulder abduction, passive shoulder external rotation, daily hand activities and perceived participation).The chi-square test was used for the categorical variables (gender, living situation, side of lesion, type of lesion, rehabilitation, vocational situation, upper extremity motor function, resistance to passive movements in the elbow, proprioception, light touch and life satisfaction).

To determine how PSSP was related to all the outcome measures, regression analyses were conducted. The following variables were selected as dependent variables: upper extremity motor function, daily hand activities, perceived participation and life satisfaction. Logistic regression analyses were used for upper extremity motor function and life satisfaction (binary outcomes), whereas linear regression analyses were used for perceived participation and daily hand activities (continuous outcomes).

Before the multivariate analyses were performed, correlations between all variables (i.e., post stroke shoulder pain, passive shoulder abduction and external rotation, upper extremity motor function, resistance to passive movements, proprioception and light touch, daily hand activities, perceived participation and life satisfaction as well as age, gender and vocational situation) were analysed using the Spearman rank correlation coefficient. If a correlation coefficient greater than 0.5 was detected between the independent variables [33], then the variable with the lowest p-value was selected. Variables with p-values less than .1 were then selected for the four regression models. Multiple linear and logistic regression analyses were used to determine which variables that best explained the dependent variables. From the full models, variables were omitted one by one starting with the variable with the highest p-value, until all remaining variables had a p-value less than .1. The variable PSSP was included in all regression models and was not omitted regardless of p-value. The fit of the linear regressions were checked by graphic presentations of the residuals. P-values less than .05 were considered statistically significant.

RESULTS

Demographics and characteristics

In Table 1, the demographics and characteristics for the PSSP and non-PSSP groups are presented. No significant differences were found between the groups regarding age, gender, living situation, side and type of lesion, stroke onset, length of rehabilitation or vocational situation. All except one participant in the non-PSSP group were independent walkers and all but three (two in the PSSP group and one in the non-PSSP group) reported that they were independent in personal activities of daily living (P-ADL). Four participants in the PSSP group and two participants in the non-PSSP group had experienced shoulder pain in the arm that later was affected by stroke. A total of 58 % in the PSSP group and 40% in the non-PSSP group reported pain in other parts of the body. Twelve participants in the PSSP group and eight in the non-PSSP group reported pain in the lower extremities. Seven (four in the PSSP group and three in the non-PSSP group) reported pain in the upper extremity other than the paretic shoulder. Four participants (one in the PSSP group and three in the non-PSSP group) reported pain in their back or neck and one participant in the PSSP-group reported headache. Four participants (17%) in the PSSP group and two participants (8%) in the non-PSSP group used pain medication prescribed by physicians. In addition, four participants in each group used antidepressant medications.

Assessments and outcome measures

Shoulder pain

In the PSSP group, the mean ± standard deviation time of shoulder pain was 13 ±8 months. VAS-P was median (IQR) 47 mm (23-68). Moderate-to-severe pain (≥40 mm according to VAS-P) during the past 48 hours was reported by 67%. Shoulder pain when eating and dressing was reported by 54%. A majority (88%) had pain when raising their arm up to horizontal plane or above.

Differences between the PSSP and non-PSSP group

In Table 2, the assessments of passive shoulder abduction and external rotation, upper extremity motor function, resistance to passive movements, proprioception and light touch, daily hand activities, perceived participation and life satisfaction are presented. Significantly reduced shoulder abduction (*P*=.001) and upper extremity motor function (*P*=.03) were seen in the PSSP group compared to the non-PSSP group. No significant differences in daily hand activities (*P*=.15), perceived participation (*P*=.11) and life satisfaction (*P*=.15) were found between the groups.

Correlations and multivariate regression analyses

In Table 3, correlations between the dependent and independent variables are presented. Moderate to strong correlations were found between the independent variables 'passive shoulder abduction' and 'external rotation' (r=0.59), 'age' and 'vocational situation' (r=0.58) and 'proprioception' and 'light touch' (r=0.65). The variables with the lowest p-values in the univariate analyses were selected for the multivariate analyses (i.e., vocational situation, passive shoulder abduction and proprioception) and thus presented in the table.

The results from the multivariate logistic and linear regression analyses are presented in Table 4. Post stroke shoulder pain (*P*=.03, OR 4.42, 95% CI 1.21-16.24) and proprioception (*P*=.04, OR 10.28, 95% CI 1.1-96.01) were associated with upper extremity motor function in the final model, whereas perceived participation was the only variable associated with life satisfaction (*P*=.002, OR 1.08, 95% CI 1.03-1.13). Passive shoulder abduction (*P*=.01, B [unstandardized coefficient] 0.02, 95% CI 0.003-0.03), resistance to passive movements (*P*=.03, B 0.86, 95% CI 0.1-1.62) and proprioception (*P*=.02, B 1.08, 95% CI 0.18-1.98) explained 45% of variance of daily hand activities. Daily hand activities (*P*<.001, B 5.12, 95% CI 2.39-7.85), vocational situation (*P*=.004, 14.17, 95% CI 4.85-23.50) and sex (*P*=.04, B 10.38, 95% CI 0.60 - 20.17) explained 40% of the variance of perceived participation.

DISCUSSION

In this study we assessed the differences in upper extremity sensorimotor function, daily hand activities, perceived participation and life satisfaction between individuals with and those without PSSP and determined how PSSP is associated with these variables. Overall, small differences were found between the groups and PSSP had only a weak association with daily hand activities, perceived participation and life satisfaction.

Despite that two-thirds of the PSSP participants in our study reported frequent and intense (moderate to severe) daily pain only two variables, passive shoulder abduction and upper extremity motor function, differed significantly between the groups. Previous studies have also described these differences in motor function [5, 6, 8, 34] and range of motion [8, 9, 34] between individuals with and those without PSSP. Furthermore, Gamble et al. [6] and Roosink et al. [7] have reported decreased light touch in individuals with shoulder pain and diminished proprioception is also described [7]. Pong et al. [10] found that spasticity was associated with PSSP in persons with chronic stroke, but this was not confirmed in the study by Aras et al. [34]. In our study, no association between PSSP and somatosensation or resistance to passive movements was found.

Because only small differences between the PSSP and the non-PSSP group were found in the univariate analyses in the present study, we chose to expand the analysis to increase the understanding of how PSSP influenced upper extremity sensorimotor function, daily hand activities, perceived participation and life satisfaction. The variable PSSP was therefore included in all the multivariate regression analyses, but a significant association was only found with upper extremity motor function. Moreover, when the multivariate regression analyses were performed we found that passive shoulder abduction, resistance to passive movements and proprioception rather than PSSP were associated with daily hand activities. Harris & Eng [15], Faria-Fontini et al. [14] and Chae et al. [16] did not find a relationship between pain in upper extremity and daily hand activities in persons with chronic stroke. Faria-Fontini et al. and Harris & Eng reported that muscle strength in the affected arm and hand is related to hand activities [14, 15] and perceived participation [15], but this could not be confirmed in our study because strength measurements were lacking.

One explanation why PSSP only has a small influence on daily hand activities might be that individuals over time adapt to the pain and use compensatory strategies in which the affected arm is less involved in daily activities. Another explanation could be that outcome measurements for assessing daily hand activities often consist of bimanual tasks, which allow the non-affected arm and hand being dominant and the affected arm being used in a pain-free position. This is actually the case for the ABILHAND Questionnaire, which consists of bimanual tasks, in which the individuals not have to raise their affected arm over the horizontal plane - a position where shoulder pain often occurs.

Daily hand activities, rather than PSSP, seem to be an important contributing factor for perceived participation. In our study, also gender and vocational situation were included in the final model, and together with daily hand activities these variables explained 40% of perceived participation. Faria-Fontini et al. [14] have reported a relationship between PSSP and perceived participation but they used another outcome measurement – the Stroke Specific Quality of Life Scale Scores, to assess participation.

In our study, no specific association between PSSP and life satisfaction was found. Few studies have investigated the relationship between life satisfaction and PSSP, but one previous study reported an association between shoulder pain and pain-related quality of life in persons with chronic stroke [16]. We found a relationship between perceived participation and life satisfaction, which has also been confirmed by other studies [35, 36]. Only 44% of the participants in our study reported that they were satisfied with life as a whole. More participants in the non-PSSP group (56%) than in the PSSP group (33%) were satisfied with their lives, but the difference did not reach statistical significance. The overall life satisfaction in our study is in agreement with the study by Hartman-Maeir et al., who reported that 39% of their participants were satisfied with life as a whole one year post-stroke [35]. The ability to cope with the new life situation and to find meaningful activities seems to be of importance to perceive a high life-satisfaction after stroke [36], and limited adaptation to the new situation could be a possible reason for a low satisfaction [31].

Taken together, our study and previous studies [14, 15] that assessed persons with mild to moderate upper extremity paresis or well-functioning persons living in their own homes, indicate that PSSP does not have a great impact on their daily life. Other factors than PSSP seem to influence the different domains of ICF. The ability to perform daily hand activities seems to influence perceived participation, which in turn is associated with life satisfaction, but the relationship is complex. Impairments following a stroke could lead to different activity limitations which often restrict participation, and shoulder pain is only one impairment among several others that needs attention. Even if our study showed small differences between the participants in the PSSP group and the non-PSSP group, shoulder pain can be bothering and long-lasting for the single individual. In the stroke care, both in the acute phase and in later phase, a comprehensive multidisciplinary approach is of importance for optimizing rehabilitation. In a previous study we showed that decreased passive range of motion in the shoulder is a predictor for long-lasting shoulder pain [9]. In clinical settings, careful handling, medical treatment for pain reduction as well as passive and active movements of the affected arm are therefore of importance. Professionals should encourage individuals with PSSP to use their arm as much as possible in daily activities to avoid a learned non-use behaviour, which, in turn, could lead to increased shoulder pain.

Strengths and limitations

An advantage of the present study is the well-defined study population and that all participants were in a stable phase post stroke (i.e., five months or more). Established outcome measurements with good psychometric properties were used, but it would have been desirable that an independent person had performed the assessments to reduce the risk of bias. It cannot be excluded that the result had differed if another design, other inclusion criteria, other variables or other outcome measures had been used. A limitation is the small sample size, and the small differences in outcome measures between the groups, which lead to an uncertainty about the effects of PSSP on daily life. If the sample had been larger and more individuals with severe upper extremity paresis had been included, it is possible that the effects of PSSP on daily life had been clearer. Furthermore, individuals with severe depression were excluded in our study, even though depression is reported to be related to post-stroke pain [6, 37]. Because the study is based on a rather small population and few participants with severe stroke deficits were included, the results cannot be generalized to the entire stroke population.

CONCLUSION

This cross-sectional study indicates that there is an association between PSSP and upper extremity motor function, whereas the association between PSSP, daily hand activities, perceived participation and life satisfaction is less clear. PSSP is commonly described as a severely disabling condition, but our results imply that in individuals with mild to moderate upper extremity paresis, it may not have such a great impact on their life situation.

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LEGEND

Figure 1: Flowchart of the recruitment procedure of the participants in the study.

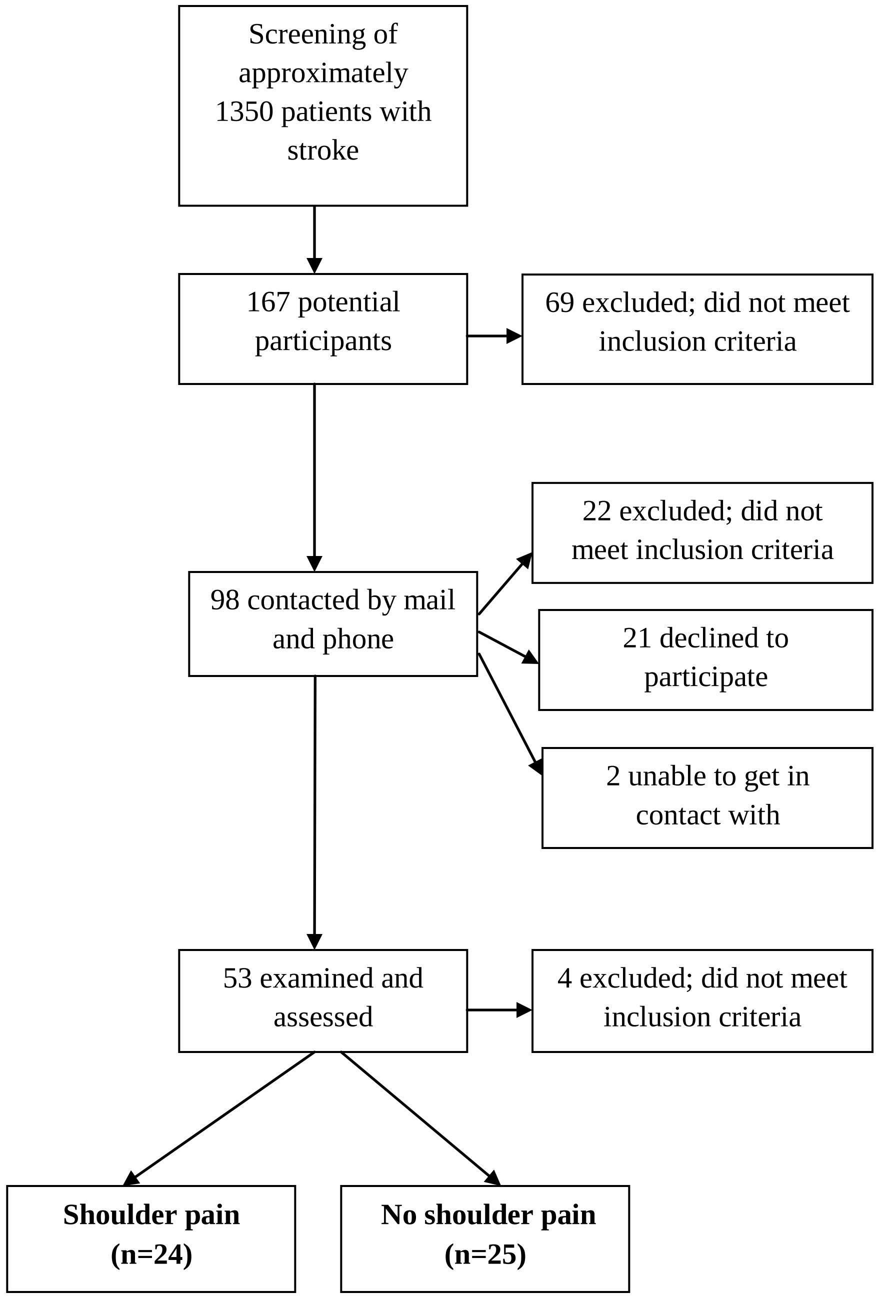
Screening of approximately 1350 patients with stroke
167 potential participants
69 excluded; did not meet inclusion criteria
98 contacted by mail and phone
22 excluded; did not meet inclusion criteria
21 declined to participate
2 unable to get in contact with
53 examined and assessed
4 excluded; did not meet inclusion criteria
Shoulder pain (n=24)
No shoulder pain (n=25)

Figure 1

Table 1. *Demographics and characteristics for participants with shoulder pain (PSSP) and without shoulder pain (non-PSSP)*

	PSSP (n=24)	**non-PSSP (n=25)**	**Difference between groups[a]**
Age, mean ± SD (range)	65 ± 10 (45-81)	63 ± 8 (44-77)	>.30
Male, n (%)	19 (79)	16 (64)	>.30
Living situation, alone, n (%)	11 (46)	10 (40)	>.30
Right-hemispheric lesion, n (%)	11 (46)	8 (32)	>.30
Cerebral infarction, n (%)	20 (83)	18 (72)	>.30
Stroke onset; months, mean ± SD (range)	14 ± 7 (5-33)	16 ± 8 (5-35)	.22
Rehabilitation up to 6 months after stroke, n (%)	24 (100)	24 (96)	>.30
Vocational situation, n (%)			.23
Sick leave ≥ 50%	10 (42)	7 (28)	
Working or pension ≥ 50%	14 (58)	18 (72)	

SD=standard deviation; [a]p-value; the Mann-Whitney U-test was used for age and stroke onset, the Chi-square test was used for gender, living situation, side of lesion, type of lesion, rehabilitation and vocational situation

Table 2. *Assessments of sensorimotor functions, daily hand activities, perceived participation and life satisfaction for participants with post stroke shoulder pain (PSSP) and participants without shoulder pain (non-PSSP)*

	PSSP (n=24)	**non-PSSP (n=25)**	**Difference between groups[h]**
Sensorimotor functions in the affected upper extremity			
Passive shoulder abduction ,degrees, median (range)[a]	90 (40-160)	130 (80-180)	.001
Passive shoulder external rotation, degrees, median (range)[a]	40 (0-70)	50 (10-60)	.12
Motor function (M-MAS), n (%)[b]			.03
0-11, severe-moderate restriction	18 (75)	11 (44)	
12-15, mild-no restriction	6 (25)	14 (56)	
Resistance to passive movements ≥1, n (%)[c]	11 (46)	7 (28)	.24
Proprioception absent or diminished in the arm and/or hand, n (%)[d,e]	5 (21)	5 (20)	>.30
Light touch absent or diminished in the arm and/or hand, n (%)[d]	6 (25)	6 (24)	>.30
Daily hand activities			
ABILHAND, logits, mean ± SD	1.8 ± 1.6	2.2 ± 1.6	.15
Perceived participation			
SIS (participation) [f], mean ± SD	56 ± 18	64 ± 18	.11
Life satisfaction			
LiSat-11 (life as a whole) [g], satisfied, n (%)	8 (33)	14 (56)	.15

[a] Goniometer; [b] Modified Motor Assessment Scale; [c] Modified Ashworth Scale; [d] According to Fugl-Meyer; [e] Data for one participant missing; [f] Stroke Impact Scale, domain 8; [g] Life Satisfaction check list, question number 1, satisfied = score 5 or 6; [h] p-value; the Mann-Whitney U-test was used for passive shoulder abduction, passive shoulder external rotation, ABILHAND and SIS(participation) and the Chi-square test for motor function, resistance to passive movements, proprioception, light touch and LiSat-11(life as a whole).

Table 3. *Correlations between the dependent and the independent variables*

Independent variables	Dependent variables							
	Upper extremity motor function		Daily hand activities		Perceived participation		Life satisfaction	
	Correlation coefficients	**p-value**	**Correlation coefficients**	**p-value**	**Correlation coefficients**	**p-value**	**Correlation coefficients**	**p-value**
Upper extremity motor function	-	-	0.48	**.001**	0.18	.21	0.25	**.08**
Daily hand activities	-	-	-	-	0.43	**.002**	0.31	**.03**
Perceived participation	-	-	-	-	-	-	0.54	**<.001**
Post stroke shoulder pain (PSSP)	0.32	**.03**	0.21	**.15**	0.23	**.11**	0.23	**.12**
Passive shoulder abduction	0.37	**.01**	0.46	**.001**	0.28	**.06**	0.27	**.06**
Resistance to passive movements	0.29	**.05**	0.43	**.002**	0.11	>.30	0.01	>.30
Proprioception	0.32	**.03**	0.48	**<.001**	0.19	.18	0.25	**.08**
Vocational situation	0.14	>.30	0.05	>.30	0.46	**.001**	0.28	**.05**
Sex	0.03	>.30	-0.19	**.20**	0.26	**.07**	-0.03	>.30

Upper extremity motor function was assessed by M-MAS, Modified Motor Assessment Scale (in Swedish); daily hand activities was assessed by ABILHAND questionnaire; perceived participation was assessed by Stroke Impact Scale (SIS domain 8); life satisfaction was assessed by Life Satisfaction checklist, LiSat-11 (life as a whole); Spearman rank correlation was used to describe correlations between the variables; the variable post stroke shoulder pain was selected for all analyses (bold), and also variables with p-values less than .1 (bold) were selected for the four regression models.

Table 4. *Results from the multivariate logistic regression analyses (n=49)*

Logistic regression analyses[a] **Dependent variable**	**Variables in the final model**	**p-value**	**OR**	**95% CI**
Upper extremity motor function	PSSP	.03	4.42	1.21-16.24
	Proprioception	.04	10.28	1.10-96.01
Life Satisfaction	Perceived participation	.002	1.08	1.03-1.13
	PSSP	.37	1.85	0.48-7.14

Abbreviations: PSSP= post stroke shoulder pain; upper extremity motor function assessed by M-MAS, Modified Motor Assessment Scale (in Swedish), life satisfaction assessed by Life Satisfaction checklist, (life as a whole); perceived participation assessed by Stroke Impact Scale (SIS domain 8); OR= Odds Ratio; CI = Confidence Interval; [a] Binary variables

Table 5. *Results from the multivariate linear regression analyses (n=49)*

Linear regression analyses[a] **Dependent variable**	**Variables in the final model**	**p-value**	**B**	**95% CI**	**Adj R^2 (%)**
Daily hand activities	Overall model				45
	Upper extremity motor function	.053	0.80	-0.11-1.60	
	PSSP	.23	-0.48	-1.28-0.31	
	Passive shoulder abduction	.01	0.02	0.003-0.03	
	Resistance to passive movements	.03	0.86	0.10-1.62	
	Proprioception	.02	1.08	0.18-1.98	
Perceived participation	Overall model				40
	Daily hand activities	<.001	5.12	2.39-7.85	
	PSSP	.61	2.18	-6.43-10.80	
	Vocational situation	.004	14.17	4.85-23.50	
	Gender	.04	10.38	0.60-20.17	

Abbreviations: PSSP= post stroke shoulder pain; daily hand activities assessed by ABILHAND questionnaire; perceived participation assessed by Stroke Impact Scale (SIS domain 8); upper extremity motor function assessed by M-MAS, Modified Motor Assessment Scale (in Swedish); B = unstandardized coefficient; CI = Confidence Interval Adj R^2 = determination coefficient; [a] Continuous variables