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A Study to Measure Prevalence of Post Stroke Shoulder Pain and Its Association with Sensorimotor Functions and ADL Impairment in Chronic Stroke Patients: A Cross Sectional Observational Study

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ABSTRACT

BACKGROUND: Stroke is a major Non-Communicable Disease which is responsible for 3.5% of Disability Adjusted Life Year (DALY) in India. Post-stroke shoulder pain is a most common impairment affecting patient's participation in rehabilitation by sensory motor impairment and limitation of daily living activity in chronic stroke patient.
OBJECTIVE: Numerous theories exist to explain the patho-mechanics behind development of Post-stroke shoulder pain, but its relationship with the sensory-motor function of the affected limb is needed to more elaborate. So it is important to study theprevalence of Post-stroke shoulder pain (PSSP) and its association with different factorswith post stroke shoulder pain (PSSP).
METHDOLOGY: Visual Analogue Scale was used to measure shoulder pain and Passive Range of Motion of shoulder joint was assessed by using a goniometer. Motorfunctions was assessed by using the upper limb subscale of the Motor Assessment Scale(UL-MAS), Somatosensory impairment of the upper extremity was assessed by Erasmus MC modifications to the(revised) Nottingham Sensory Assessment scale (EmNSA) and Activity of Daily Living impairment was assessed by Modified Barthel Index (MBI). Scores were examined and compared between the shoulder pain group (SPG) and the No Shoulder Pain Group (No-SPG).
CONCLUSION: Results from this study shows post stroke shoulder pain is associated with reduced upper extremity sensory motor functions, ADL and passive range of motion of shoulder joint. This emphasizes that prevention of shoulder pain will help in regaining upper extremity sensory motor functions, reduced range of motion ofshoulder joint and ADL.

Keywords: [Post-stroke shoulder pain, activity of daily living, Somatosensory impairment, upper arm motor function.]

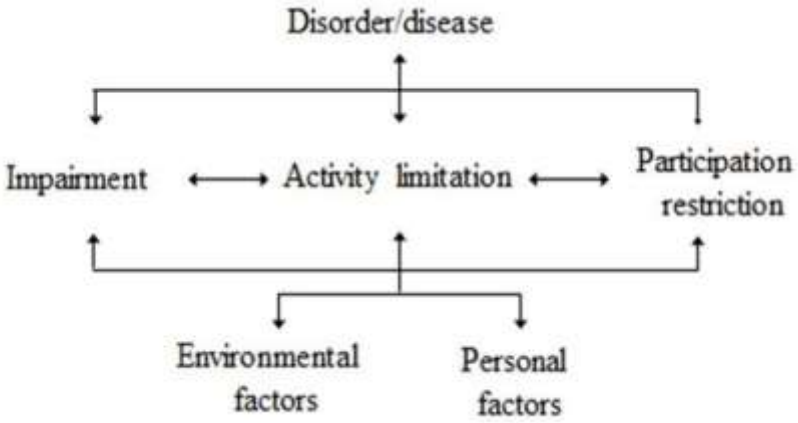
INTRODUCTION

Stroke is the third leading course of mortality in our society and the most common cause of long-term disabilities in the adult population. According to the World Health Organization (WHO), stroke is defined as an "Acute neurological dysfunction of vascular origin with sudden or at least rapid occurrence of symptoms or signs corresponding to involvement of focal areas of the brain". There are two main types of stroke; hemorrhagic (10-15%) and ischemic strokes (85%).[1] Hemiparesis or hemiplegia, i.e. the loss of some or all voluntary muscle activation on one side of the body, is a common impairment

following stroke. The reduced ability to move leads to prolonged periods of time spent immobile.[2]

Consequences after stroke:

Stroke often leads to consequences in the individual's daily life. These consequences can be described in the context of impairments (i.e. Problems in body functions and structures), activity limitations (i.e. problems in the execution of a task), participation restrictions (i.e. problems in involvement in life situations) as well as personal and environmental factors according to the International classification of functioning, disability and health (ICF) formulated by the (WHO 2001).[1]



Pain is a common impairment after stroke and has beenreported in more than one third of stroke survivors. Shoulder pain, here referred to as PSSP,

Pain after stroke: According to the International Association of Pain, IASP, pain is defined as "an unpleasant sensation and emotional experience which is associated with actual and potential tissue damage or is described in terms of such damage" and by ICF as "Sensation of unpleasant feeling indicating potential or actual damage to some body structure felt in aspecific part, or parts, of the body". Pain is a common impairment after stroke and has beenreported in more than one third of stroke survivors. Shoulder pain, here referred to as PSSP,

is one common pain type, other types are headache, central pain, spasticity related pain andmusculoskeletal pain (Fig 2).

Common types of chronic pain that can occur after stroke. Diagram of the complexity of PSSP. An individual can have a single pain type or a combination of pain types (overlapping areas).[3]

Numerous studies have reported a relationship between poststroke shoulder pain and limited shoulder external rotation range of motion (ROM), sensory impairment, adhesive capsulitis, impingement, subluxation, spasticity, and complex regional pain syndrome (CRPS).[4] Causes of Hemiplegic shoulder pain are often multifactorial and can be broadly classified into neurological (paralysis, spasticity, altered sensation and neuropathic pain) and mechanical factors (shoulder subluxation, soft tissue injuries such as rotator cuff tears, bicipital tendonitis, muscle imbalance, weakness and altered scapula position). PSSP, headache, spasticity and musculoskeletal pain are reported to occur in around 10-40%, central pain is reported to affect about 3-10 % of the stroke population. [5]

MATERIALS & METHODS

METHODOLOGY

STUDY DESIGN: Cross sectional Observational Study.

STUDY POPULATION: Patients of Post stroke shoulder pain with 40-75 years of age group.

SAMPLING TECHNIQUE: Purposive sampling.

STUDY DURATION: 1 Year.

SAMPLE SIZE: Sample size is calculated considering the proportion of stroke 15.2% from 3 months data records, Level of Confidence = 95%, Absolute precision is 5%. So, in this equation

P = proportion of Stroke patients from data

record /Pilot survey = 15.2%,

L= Absolute Precision = 5%,

$Z_{1-\alpha/2}$ = Level of Confidence =95%.

Equation for sample study is,

$$n_0 = \frac{z^2_{1-\alpha/2} PQ}{L^2}$$

So, study sample size is 198.

STUDY SETTING: SPB Physiotherapy College OPD and other clinical OPDs of Gujarat

INCLUSION CRITERIA:

- Patients willing to participate in the study were included if they met the following criteria:
- Age: 40 to 75 years.
- Duration 6 to 12 months post stroke.
- Subjects with who had sustained a first-ever cortical or subcortical unilateral stroke
- (Ischemic or haemorrhage) resulting in somatosensory and/or motor symptoms or signswere deemed eligible.
- Mini Mental State Examination Score ≥ 24.

EXCLUSION CRITERIA:

- History of neurologic disease other than stroke.
- Any known musculoskeletal problem.
- Gross visuospatial or visual field deficits.
- Any perceptual dysfunction.
- Severe dysarthria or aphasia.
- Any cognitive impairment or known Psychosomatic disorder.
- Any vestibular disorder that can affect balance.
- Patient were excluded with More than 3 Grade Spasticity.

PROCEDURE

All stroke patients who had sustained a first-ever cortical or subcortical unilateral stroke (infarction or haemorrhage) resulting in somatosensory and/or motor symptoms or signs were deemed eligible. Based on the screening total 402 patients were included in study. Based on inclusion and exclusion criteria 198 patients were finally approached for study. Patients received oral and written information about the study procedure and signed informed consent before participation. Prior to the commencement of the study, detailed procedure of the study was explained to the patients. Their

demographic data was taken by an assessment Proforma. Following measurements were taken from the patient for evaluation.

Shoulder pain: First the following data were recorded by the assessment proforma:

Pain examination: -

- Onset of pain.
- Type of pain.
- Site of pain.
- Duration of pain.

Patients were divided into 2 groups, those who had shoulder pain (shoulder pain group [SPG]) and those who did not have shoulder pain (no shoulder pain group [No- SPG]). For the measurement of shoulder pain Visual Analogue Scale (VAS) was used. VAS is usually a horizontal line, 10 cm in length, anchored by word descriptors at each end the patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in centimetres from the left -hand end of the line to the point that the patient marks. It is used to measure the amount of pain that a patient feels ranges across a continuum from none to an extreme amount of pain.[6]

198 patients were approached for participation. After the measurement of shoulder pain by Visual Analogue Scale (VAS) there were total 88 Patients included in No Shoulder Pain Group [No-SPG] and 110 Patients included in Shoulder Pain Group [SPG. Further measurements were taken from the patient for evaluation.

Upper Extremity Sensorimotor Functions:

Upper extremity sensorimotor functions were assessed by: -

(i) Passive Joint Range of Motion (ROM) of shoulder joint: The universal goniometer (or international standard goniometer) is the most commonly used tool for measuring ROM at large joints, such as the shoulder and hip. This goniometer is available in several sizes, and size does not affect reliability of measurements. So Passive ROM of shoulder joint were assessed by using a goniometer.[7]

(ii) Motor Function: Motor function in the upper arm and hand as well as advanced hand activities were assessed by using the upper limb subscale of the Motor Assessment Scale (UL-MAS) , which is a reliable and valid outcome measurement.28 The subscales range from 0-5, in which 5 is normal or almost normal motor function and zero is no motor function. The maximum total score for each arm is 15 points. Restrictions in motor function were reported here as “severe to moderate” (0-11 points) and “mild to no restriction” (12-15 points).

(iii) Sensory function : Somatosensory impairment of the upper extremity The Erasmus MC modifications to the(revised) Nottingham Sensory Assessment scale (EmNSA) .The EmNSA is a reliable screening tool to evaluate primary somatosensory impairments in neurological and neurosurgical inpatients with intracranial disorders.8 The intra-rater and interrater reliability of the EmNSA for the upper limb are predominantly good to excellent (κ = 0.62-1.00 intra-rater and κ = 0.48-1.00 interrater reliability) for patients with intracranial disorders. The EmNSA uses a 3-point ordinal scale and offers a reliable somatosensory assessment of the upper and lower limbs for patients with intracranial disorders. The testing procedure includes a pinprick test to assess tactile sensation, sharp-blunt discrimination to assess pain sensation, and measuring proprioception to assess gnostic sensibility. The maximum score of the EmNSA for the upper extremity (EmNSA-UE) is 40 points. A score of 39 points or lower has been described as a somatosensory impairment because the

measurement error of the EmNSA- UE has not been established, we considered a baseline score <38 points as indicating somatosensory impairment.[10]

(iv) ADL impairment: To measure the ADL impairment modified Barthel Index (MBI) will be used. MBI is used widely to assess behaviour relating to activities of daily living for stroke patients. The scores are distributed among 10 items as follows: grooming and bathing (five points each); feeding, toilet use, stair climbing, dressing, bowel management, and bladder management (10 points each); and chair/bed transfer and mobility (15 points each).[11]

STATISTICAL ANALYSIS

The data was entered using Microsoft Excel 2017 and it was analysed using SPSS 20 version. Demographic Data were analysed by mean, median and standard deviation. Normality of data was tested by Kolmogorov - Smirnov test.

- All the parameters of this study were not normally distributed. Based on that, data were analysed by non-parametric tests i.e., spearman's rank correlation coefficient test, Mann Whitney U test for co-relation and between group comparisons respectively.
- Absolute significant correlation coefficients were considered clinically relevant only if >30, according to the suggestion of Cohen (1992).
- The level of significance was set at a = 0.01 And for Mann Whitney U test significance level was kept 0.05 and confidence interval was set 95%.
- Prevalence of the stroke was measured by stroke patients who came to the different OPDsin last 6 months of study duration. The socio-demographic and pain data were analysed through descriptive statistics (frequencies and percentages).
- Prevalence of the stroke measured by stroke patients who came to the different OPDs in last 6 months of study duration. The socio-demographic and pain data were analysed through descriptive statistics (frequencies and percentages).

RESULT

- Total 198 chronic stroke patients were selected as sample to carry out this study. In this, itwas found that total 110 patients 56% of chronic stroke complained about post stroke shoulder pain and 88 patients 44% had no shoulder pain.
- Normality was checked to assess whether the data were normally distributed or not in table -1. After checking normality, non-parametric test was applied because all outcomes were not normally distributed. p value for age in no shoulder pain group was 0.032 and shoulder pain group 0.002. for UL - MAS in no shoulder pain group p=0.00 and shoulder pain group p=0.00. for Barthel-index in no shoulder pain group p=0.00 and in shoulder pain group p=0.00. p value for EMNSA in no shoulder pain group and shoulder pain groupwas 0.00.

TABLE 1 SHOWS NORMALITY DISTRIBUTION

	Kolmogorov-Smirnov[a]		
	Statistic	**df**	**Sig.**
Age -NSPG	0.099	88	0.032
Age -SPG	0.099	88	0.032
Pain - SPG	0.122	88	0.002
MAS-NSPG	0.150	88	0.000
MAS- SPG	0.180	88	0.000
Barthel-index NSPG	0.150	88	0.000
Barthel-index SPG	0.139	88	0.000
EMNSA-NSPG	0.215	88	0.000
EMNSA- SPG	.141	88	.000
VAS- SPG	.198	110	.000

TABLE 2: PATIENT'S DEMOGRAPHIC VARIABLES

Variables		Frequency		%	
		NSPG	SPG	NSPG	SPG
Gender distribution	Female	37	41	42%	38%
	Male	51	68	58%	62%
Age group(years)	40-45	22	34	25%	30.90%
	45-50	20	26	22.73%	23.63%
	50-55	17	24	19.32%	21.82%
	55-60	16	15	18.18%	13.63%
	60-65	8	7	9.09%	6.36%
	65-70	4	4	4.55%	3.63%
	70-75	1	0	1.37%	0
Type ofstroke	Haemorrhagic	42	46	47.73%	41.81%
	Ischemic	46	63	52.27%	57.27%
Dominance	Right	56	89	63.63%	80.90%
	Left	32	21	36.36%	19.09%

TABLE 3 BETWEEN GROUP COMPARISON OF ALL OUTCOMES

Between groupcomparison	MAS-UE	Modified - Barthel index	EMNSA
Mann-Whitney U	.000	378.500	1594.500
Wilcoxon W	6105.000	6483.500	7699.500
Z	-12.152	-11.156	-8.164
Sig. (2-tailed)	.000	.000	.000

Mann-Whitney test was applied for between group analysis, which shows that there is significant correlation between all outcomes. P value of all outcomes were 0.000, so there is significant correlation for all outcomes between group. For MAS-UE score, table shows
0.000 value. For, Modified Barthel index, table shows 378.500 value for between group analysis and for EMNSA, table shows 1594.500 value for between group analysis.

SPEARMAN'S CORRELATION IN PATIENTS WITH SPG:

Correlation of MAS and VAS - Firstly, as normality of MAS Score was 0.00, so data was not normally distributed therefore non parametric correlation test was used. i.e. Spearman's rho was used. so we verbally describe the strength of the correlation using the following guide for that value between .90 to 1.00 (-.90 to -1.00) = Very high positive (negative) correlation, .70 to .90 (-.70 to -.90) = High positive (negative) correlation, .50 to .70 (-.50
to -.70) = Moderate positive (negative) correlation, .30 to .50 (-.30 to -.50) = Low positive
(negative) correlation,.00 to .30 (.00 to -.30) = negligible correlation.[12] p value is 0.000 and the correlation between pain and motor functions in Upper-limb (UL) is -0.743. So, there is high negative correlation.

TABLE 4 -ILLUSTRATES THE CORRELATION OF VAS WITH UL-MAS IN SPG

Spearman's Correlations UL-MAS and VAS		Painful shoulder UL-MAS	VAS
Shoulder pain group –ULMAS	Correlation Coefficient	1.000	-0.743**
	Sig. (2-tailed)	.	0.00
VAS	Correlation Coefficient	-0.743**	1.000
	Sig. (2-tailed)	0.00	.

Correlation of MBI and VAS:

As normality of Barthel-index Score was 0.000, Non parametric correlation test was used.
i.e. Spearman's rho was used. p value is 0.00 and the correlation between pain and ADLsis -0.684 and so there is moderate negative correlation.

TABLE 5 - ILLUSTRATES CORRELATION BETWEEN VAS AND MODIFIEDBARTHEL-INDEX

Spearman's Correlations-Barthel-index and VAS		Painful shoulder Barthel-index	VAS
	Correlation Coefficient	1.000	-0.684**
Shoulder pain group – MBI			
	Sig. (2-tailed)	.	0.00
VAS	Correlation Coefficient	-0.684**	1.000
	Sig. (2-tailed)	0.00	.

****Correlation is significant at the 0.01 level (2-tailed).**

Correlation of VAS and EMNSA:

As normality of EMNSA was 0.000, Non parametric correlation test was used. i.e. Spearman's rho was used. p value is 0.00 and the correlation between pain and sensory function is -0.593 and so there is moderate negative correlation.

TABLE 6 - ILLUSTRATES CORRELATION BETWEEN VAS AND EMNSA.

Spearman's Correlations-EMNSA and VAS		Shoulder pain group - EMNSA	VAS
	Correlation Coefficient	1.000	-0.593**
Shoulder pain group - EMNSA	Sig. (2-tailed)	.	0.00
	Correlation Coefficient	-0.593**	1.000
VAS	Sig. (2-tailed)	0.00	.
	N	100	100

****Correlation is significant at the 0.01 level (2-tailed).**

So, it was found that shoulder pain has significantly moderate negative correlation with activity of daily living and high negative correlation with upper arm motor function and significantly moderate negative correlation with Somatosensory impairment which indicate that as the pain increases (increase VAS score), UL motor- sensory functions and ADLs decreases (UL-MAS, EMNSA and MBI score decreases.

TABLE 7 - ILLUSTRATES THE CORRELATION BETWEEN VAS AND PROM.

Spearman's Correlation-VAS andPROM		**flexion**	**extension**	**abduction**	**adduction**	**ER**	**IR**	**VAS**
	Correlation Coefficient	1.000	.108	.053	.053	-.044	-.067	-.174
flexion	Sig. (2-tailed)	.	.00**	.00**	.00**	.00**	.00**	.00**
	N	100	100	100	100	100	100	100
	Correlation Coefficient	.108	1.000	-.121	-.121	.180	.043	-.012
extension	Sig. (2-tailed)	.00**	.	.00**	.00**	.00**	.00**	.00**
	N	100	100	100	100	100	100	100
	Correlation Coefficient	.053	-.121	1.000	1.000**	-.026	-.092	-.026
abduction	Sig. (2-tailed)	.00**	.00**	.	.	.00**	.00**	.00**
	N	100	100	100	100	100	100	100
adduction	Correlation	.053	-.121	1.000	1.000	-.026	-.092	-.026
	Sig. (2-tailed)	.00**	.00**	.	.	.00**	.00**	.00**
	N	100	100	100	100	100	100	100
	Correlation Coefficient	-.044	.180	-.026	-.026	1.000	.079	-.122
ER	Sig. (2-tailed)	.00**	.00**	.00**	.00**	.	.00**	.00**
	N	100	100	100	100	100	100	100
	Correlation Coefficient	-.067	.043	-.092	-.092	.079	1.000	-.033
IR	Sig. (2-tailed)	.00**	.00**	.00**	.00**	.00**	.	.00**
	N	100	100	100	100	100	100	100
	Correlation Coefficient	-.174	-.012	-.026	-.026	-.122	-.033	1.000
VAS	Sig. (2-tailed)	.00**	.00**	.00**	.00**	.00**	.00**	.
	N	100	100	100	100	100	100	110

****Correlation is significant at the 0.01 level (2-tailed).**

Correlation of VAS with PROM: Non parametric correlation test was used. i.e. Spearman's rho was used. p value is 0.00 and the correlation between pain and PROM has low negative correlation.

Above result indicate that the VAS has low negative correlation with PROM of shoulder joint.

DISCUSSION

Prevention of shoulder pain in hemiplegic adults is fundamental to patient independence because the pain discourages patients from performing upper limb movements, which subsequently impairs functional recovery.[13] Shoulder pain is shown to affect around 70% of patients following Cerebrovascular accident (CVA), and is considered one of the most common impairments which a physiotherapist comes across. Almost 75% of patients complain of pain at some time in the first 12 months following a CVA. The shoulder pain and subsequent reduced participation in rehabilitation hinders recovery while simultaneously affecting functional rehabilitation negatively. Post stroke shoulder pain has been associated with poorer outcomes and increased length of stay in hospital.[14]

The main aim of this study is to provide more detailed data about post stroke shoulder pain its prevalence and association with sensorimotor functions and activity of daily living in chronic post stroke patients. To determine the proportion of persons with PSSP in chronic stroke in whom long-lasting shoulder pain develops and to assess the correlation with sensorimotor functions and activity of daily living.

In this study 198 patients were taken and after the measurement of shoulder pain by Visual Analogue Scale (VAS) finally total 88 Patients were included in No Shoulder Pain Group [No-SPG] and 110 Patients were included in Shoulder Pain Group [SPG]. After dividing the patients into 2 groups, shoulder pain group [SPG] and no shoulder pain group [No-SPG]. We tried to find PSSP and its association with sensorimotor function and activity of daily living in chronic post stroke patients. Between group analysis showed that there was significant correlation between all the outcomes.

In the result of the study, it was found that there was total 88 participants in no shoulder pain group among them 37 (42%) were female and 51(58%) were male. Most of the participants had age between 40-50 years with right side dominancy. In shoulder pain group total 110 participants were included among them 41(38%) were female and 68(62%) were male. Age of most of the participants fell between 40-50 years. So it can be concludedthat male were more prone for post stroke shoulder pain in this study as compared to female. In this study Passive Range of Motion of shoulder joint was assessed by using a goniometer. Motor functions were assessed by using the upper limb subscale of the Motor Assessment Scale (UL-MAS), Somatosensory impairment of the upper extremity was assessed by Erasmus MC modifications to the(revised) Nottingham Sensory Assessment scale (EmNSA) and ADL impairment was assessed by Modified Barthel Index (MBI). Scores were examined and compared between the shoulder pain group (SPG) and the No Shoulder Pain Group (No-SPG).Lindgren I. et al. A Study titled "Shoulder pain after stroke: prevalence, contributing factors and consequences in daily life." reported that prevalence of shoulder pain after stroke between 21% and 84% , while others reported 5% and 84% .The wide variation in the prevalence of post stroke shoulder pain reflects the inconsistency in the quality of care of these patients among diverse populations.[1] In our study prevalence of shoulder pain after stroke in chronic stroke 15.2% from 3 months data records with total number of 198 post stroke shoulder pain patients.

Range of motion decreases over time and the relationship to long- lasting PSSP have

rarely been described. A study conducted by Roosink M et al. Titled "Persistent Shoulder Pain in the First 6 Months After Stroke: Results of a Prospective Cohort Study." Found out that the presence of PSSP appeared to be more strongly associated with restricted ROM for shoulder abduction and elbow flexion than with impaired voluntary motor control, spasticity, or diminished proprioception. [15]In this study we found out that correlation between pain and PROM is low negative correlation. In that we also found that PSSP was having more low negative correlation with shoulder flexion and shoulder abduction ranges.

Motor function in the upper arm and hand as well as advanced hand activities were assessed by using the upper limb subscale of the Motor Assessment Scale (UL-MAS), which is a reliable and valid outcome measure .[16] In this study we found that correlation between pain and motor functions in Upper-limb (UL) is. -0.743. So, we concluded that there was a high negative correlation. As the shoulder pain increased we found that motor function in the upper arm and hand as well as advanced hand activities decreased. Our study is in line with the study done by Ingrid Lindgren et. Poststroke Shoulder Pain and Its Association With Upper Extremity Sensorimotor Function, Daily Hand Activities, Perceived Participation, and Life Satisfaction which found significant association of PSSP with upper extremity motor function.[17]

Somatosensory impairment of the upper extremity which was assessed by the Erasmus MC modifications to the(revised) Nottingham Sensory Assessment scale (EmNSA) is a reliable screening tool to evaluate primary somatosensory impairments in neurological and neurosurgical inpatients with intracranial disorders.[18] In our study we found that correlation between pain and sensory function was -0.593 and so there was moderate negative correlation in present study found. A study conducted by Roosink M. et al. also concluded that PSSP has been shown to be associated with the loss of tactile and thermal sensation at the affected side. At the affected side PSSP was associated with diminished proprioception, diminished sensation for touch and sharpness.[19]

To measure the ADL impairment modified Barthel Index (MBI) was used and it is widely used to assess behaviour relating to activities of daily living for stroke patients.[11] Lindgren I. et al. A Study titled "Shoulder pain after stroke: prevalence, contributing factors and consequences in daily life." They described that shoulder pain constantly or often had an impact on activities in daily life such as dressing (50%) and during ambulation (30%), and about 50% of the participants described shoulder pain when eating and dressing. The activity level as assessed with the BI and it was significantly lower in PSSP participants than those without PSSP four months post stroke.[1] In the present study we found that the correlation between pain and ADLs is -0.684 and so there is moderate negative correlation. So, we concluded that there is significant association between Shoulder pain and ADL impairment in chronic stroke patients.

This study will help in better understanding of PSSP and its association with sensorimotor functions and ADL impairment, why unsatisfactory pain relief are common despite active prevention and treatment strategies and may provide bases for improved rehabilitation of PSSP in chronic stroke patients.

CONCLUSION

Results of this study show that post stroke shoulder pain is associated with reduced upper extremity sensory motor functions, ADL and passive range of motion of shoulder joint. This emphasizes that prevention of shoulder pain will help in regaining upper extremity sensory motor functions, reduced range of motion of shoulder joint and Activity of Daily Living. Findings of this study would be helpful for

physiotherapists to plan rehabilitation strategies for relief of PSSP in chronic stroke patient.

Declaration by Authors

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