Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

ASSESSMENT OF SENSORIMOTOR FUNCTIONS IN LEFT MIDDLE CEREBRAL ARTERY STROKE SURVIVORS

Dr Syed Asad Ali
Demonstrator Physical Therapy PSRD- CRS
thisisasadali01@gmail.com
Iqra Sadiq
Demonstrator Physical Therapy PSRD- CRS
iqrasadiq586@gmail.com
Arfa Asif
Demonstrator Physical Therapy PSRD- CRS
arfaasif025@gmail.com
Farzeen Nazir
Demonstrator Physical Therapy PSRD- CRS
malikhani404@gmail.com
Seerat Jehangir
Demonstrator Physical Therapy PSRD- CRS
jehangirseerat@gmail.com
Aleeza Bukhari
Demonstrator Physical Therapy PSRD- CRS
aleezabokhari660@gmail.com
Dr Zeeshan Saeed
Assistant Professor Lahore University of Biological and Applied Sciences
zeeshans475@gmail.com
Dr Attia Mehboob
Demonstrator PSRD-CRS
attiakhan455@gmail.com

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

Author Details

Keywords:

Fugal Mayer Scale, Left Middle Cerebral Artery, Sensory Function, Stroke.

Received on 24 Apr 2026

Accepted on 06 Jun 2026

Published on 21 Jun 2026

Corresponding E-mails & Authors*:

Dr Syed Asad Ali

thisisasadali01@gmail.com

Abstract

Stroke is a major global disability, causing upper limb movement abnormalities due to middle cerebral artery infarctions. The ICF model categorizes stroke-related impairments into those affecting body functions and structures. These impairments, particularly in shoulder muscles, hinder daily activities and worsen recovery. Up to 85% of stroke survivors experience sensory deficits, extending hospital stays. In Pakistan, stroke prevalence varies, with a study in KPK reporting a prevalence of 1.2. Motor recovery post-stroke is linked to corticospinal tract integrity, while proprioceptive recovery mechanisms are less understood. Sensory motor adaptation involves neural responses to discrepancies between intended and actual movements, with key roles played by the cerebral motor cortex, basal ganglia, and striatum. Around 80% of stroke survivors experience upper limb motor instability, characterized by loss of dexterity, coordination, muscle tone abnormalities, and sensory loss. Effective rehabilitation requires evaluating post-stroke sensorimotor dysfunction, and the Fugl-Meyer Assessment-Upper Extremity (FMA-UE) is a reliable tool for assessing motor and sensory function in stroke patients.

OBJECTIVE: To assess and observe sensory-motor functions in left cerebral artery stroke survivors.

METHODS: This descriptive cross-sectional study took place in Ghurki Trust and Teaching Hospital. Non-probability convenient sampling was done. Sample size was calculated using WHO calculator. A total of 51 participants signed the consent forms and took part in the study. Comprehensive assessment was done using the Fugl-Meyer Assessment (FMA) which is a stroke-specific, performance-based impairment index. Data was analyzed using SPSS software version 26 and was presented in the form of mean and standard deviation. Categorical variables were presented in the form of frequency tables.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

RESULTS: The categorization of UE sensorimotor impairments using Fugal Mayer tool in post subacute to chronic left middle cerebral artery stroke was as follows: out of 51 patients, 12 were categorized into mild, while 23 were in moderate, 16 in severe and none fell into very severe.

CONCLUSION: The findings indicate that among post-subacute to chronic left middle cerebral artery (MCA) stroke patients, the majority exhibited moderate upper extremity sensorimotor impairments as assessed by the Fugl-Meyer tool. A smaller proportion demonstrated mild or severe impairments, while no patients presented with very severe deficits, suggesting a relative preservation of sensorimotor function within this cohort. This distribution implies a potential for functional recovery and responsiveness to rehabilitation interventions in most patients within this stage of stroke recovery.

INTRODUCTION

Stroke is a leading cause of disability globally, often resulting in upper limb movement abnormalities due to middle cerebral artery infarctions that affect the primary motor cortex and corticospinal tract (1). The International Classification of Functioning, Disability, and Health (ICF) model categorizes stroke-related impairments into those affecting body functions and structures. Upper limb impairments, such as muscle weakness and altered synergies, particularly in the shoulder muscles, significantly hinder daily activities and worsen in the chronic recovery stage. Up to 85% of stroke survivors also experience sensory deficits, impacting touch, warmth, pain, and proprioception, and extending hospital stays. In Pakistan, stroke prevalence varies, with a study in KPK reporting a prevalence of 1.2%. From 2000 to 2016, the crude incidence was 95 per 100,000 people per year, highest among those aged 75-89. Major risk factors include advanced age, sedentary lifestyle, hypertension, diabetes, and cardiovascular diseases, which affect 17.5% of Punjab's population.

Motor recovery post-stroke is linked to corticospinal tract integrity, while mechanisms for proprioceptive recovery are less understood. Sensory motor adaptation involves neural responses to discrepancies between intended and actual movements, with key roles played by the cerebral motor

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

cortex, basal ganglia, and striatum. Around 80% of stroke survivors experience upper limb motor instability, mainly due to paresis or plegia, characterized by loss of dexterity, coordination, muscle tone abnormalities, and sensory loss. The severity of these deficits depends on the lesion size and location, typically involving the primary motor cortex, somatosensory cortex, and corticospinal tract. Effective rehabilitation requires evaluating post-stroke sensorimotor dysfunction. The Fugl-Meyer Assessment-Upper Extremity (FMA-UE) is a validated, reliable tool for assessing motor and sensory function in stroke patients, supporting a classification system for disability levels to facilitate accurate evaluation and targeted treatment planning.

MATERIALS AND METHODS

Prior to the commencement of this study, necessary approvals were granted by the institutional ethical review board. Participants provided informed consent, fully understood the study's purpose and their involvement. Confidentiality of participants' details was maintained. The study involved participants of both sexes, aged 40 to 60, diagnosed with diagnosed cases of middle cerebral artery stroke by neurologist.

Sample size was calculated using WHO calculator; i.e. $n= Z^2_{1-\alpha} P(1-P) / d^2$, the sample size (n) calculated from this formula was n=51, which was the minimum sample size. For this study a maximum sample of n=51 participants were used, via non-probability convenient sampling. Data collection was done using the Fugl-Meyer Assessment (FMA) which is a stroke-specific, performance-based impairment index. It is designed to assess motor functioning, balance, sensation and joint functioning in patients with post-stroke hemiplegia. It is applied clinically and in research to determine disease severity, describe motor recovery, and to plan and assess treatment. Scoring is based on direct observation of performance. Scale items are scored on the basis of ability to complete the item using a 3-point ordinal scale where 0=cannot perform, 1=performs partially and 2=performs fully. The total possible scale score is 226. Once the consent was taken and the test was performed on the patients. Demographics were added prior to filling of the scale by the patient.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

Data was analyzed using SPSS (Statistical Package for Social Sciences) software version 26 and was presented in the form of tables of mean and standard deviation. Categorical variables were presented in the form of frequency tables.

To establish a relationship between sensory motor function on Fugl-Meyer Scale and along with motor score, sensation, joint range, joint pain and cognition statistical analysis of the data was calculated, confirming the significance of the observed values.

RESULTS

Table 1: descriptive characteristics of Demographics

	Mean	Std. Deviation
Age	22.45	2.075

Gender	Frequency	Percentage %
Male	27	52.9
Female	24	47.1

UPPER EXTREMITY

	MEAN	S.D
UPPER EXTREMETY	26.66	4.62
WRIST	7.37	2.20
HAND	8.66	2.74
COORDINATION	2.60	1.05
TOTAL MOTOR FUNCTION	45.31	8.54

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

SENSATION

		FREQUENCY	PERCENTAGE
LIGHT TOUCH			
	ANESTHESIA	4	7.8%
	HYPOESTHESIA	17	33.3%
	NORMAL	30	58.8%
POSITION			
	3/4 CORRECT	15	29.4%
	100% CORRECT	36	70.6%

JOINT PAIN

			FREQUENCY	PERCENTAGE
SHOULDER				
	FLEXION	MARKED PAIN	0	0
		SOME PAIN	11	21.6%
		NO PAIN	40	78.4%
	ABDUCTION	MARKED PAIN	0	0
		SOME PAIN	5	9.8%
		NO PAIN	46	90.2%
	EXTERNAL ROT.	MARKED PAIN	0	0
		SOME PAIN	15	29.4%
		NO PAIN	36	70.6%
	INTERNAL ROT.	MARKED PAIN	0	0
		SOME PAIN	7	13.7%

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

		NO PAIN	44	86.3%
ELBOW				
	FLEXION	MARKED PAIN	0	0
		SOME PAIN	5	9.8%
		NO PAIN	46	90.2%
	EXTENTION	MARKED PAIN	0	0
		SOME PAIN	5	9.8%
		NO PAIN	46	90.2%
WRIST				
	PRONATION	MARKED PAIN	0	0
		SOME PAIN	4	7.8%
		NO PAIN	47	92.2%
	SUPINATION	MARKED PAIN	0	0
		SOME PAIN	3	5.9%
		NO PAIN	48	94.1%
	FLEXION	MARKED PAIN	0	0
		SOME PAIN	9	17.6%
		NO PAIN	42	82.4%
	EXTENTION	MARKED PAIN	0	0
		SOME PAIN	11	21.6%
		NO PAIN	40	78.4%
FINGERS				
	FLEXION	MARKED PAIN	0	0
		SOME PAIN	7	13.7%
		NO PAIN	44	86.3%

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

	EXTENSION	MARKED PAIN	0	0
		SOME PAIN	14	27.5%
		NO PAIN	37	72.5%

PASSIVE JOINT MOTION

			FRQUENCY	PERCENTAGE
SHOULDER				
	FLEXION	ONLY FEW DEGREE	2	3.9%
		DECREASED	16	31.4%
		NORMAL	33	64.7%
	ABDUCTION	ONLY FEW DEGREE	1	2%
		DECREASED	12	23.5%
		NORMAL	38	74.5%
	EXTERNAL ROT.	DECREASED	22	43.1%
		NORMAL	29	56.9%
	INTERNAL ROT.	DECREASED	15	29.4%
		NORMAL	36	70.6%
ELBOW				
	FLEXION	DECREASED	15	29.4%
		NORMAL	36	70.6%
	EXTENTION	DECREASED	20	39.2%
		NORMAL	31	60.8%

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387 Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/10.5281/zenodo.21127823

WRIST				
	PRONATION	DECREASED	18	35.3%
		NORMAL	33	64.7%
	SUPINATION	DECREASED	17	33.3%
		NORMAL	34	66.7%
	FLEXION	ONLY FEW DEGREE	5	9.8%
		DECREASED	12	23.5%
		NORMAL	34	66.7%
	EXTENSION	ONLY FEW DEGREE	5	9.8%
		DECREASED	12	23.5%
		NORMAL	34	66.7%
FINGERS				
	FLEXION	ONLY FEW DEGREE	3	5.9%
		DECREASED	16	31.4%
		NORMAL	32	62.7%
	EXTENSION	ONLY FEW DEGREE	5	9.8%
		DECREASED	13	35.5%
		NORMAL	33	64.7%

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/

Descriptive Statistics of Total Fugal Meyer Scoring

51 chronic stroke patients were observed and the minimum scoring comes out to be 56 while

maximum is 110 from the total score of 226. The mean is calculated as 96.2 with standard deviation of 12.6.

Total Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Fugal Total	51	56.00	110.00	96.2941	12.60364

DISCUSSION

The results indicate that after a stroke, sensory deficiencies in the upper limb (UL) significantly impact rehabilitation outcomes and quality of life for survivors. About 85% of stroke victims experience sensory deficits in touch, pain, temperature perception, and proprioception, which hinder daily activities and prolong hospital stays. These impairments are closely linked to stroke severity and motor function deficits, highlighting the need for targeted rehabilitation. Despite the evident impact on daily life, there is a lack of specialized therapy for these sensory deficits. Tailored interventions, including sensory training programs, are crucial for improving functional outcomes and quality of life for stroke survivors.

In a study of 51 stroke patients, variations in hand movement abilities were observed, with some individuals struggling with specific actions like flexion, extension, and different grasps. This underscores the need for individualized rehabilitation strategies to address specific motor deficits. Stroke patients also showed impairments in grip force adjustments and maintaining object orientation, with certain grasp designs aiding in grip force control.

Vol. 5 No. 2 (2026)

Pakistan Journal of Medical & Cardiological Review

https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387

Print ISSN 3007-2379

Ali et al - 2026

DOI: http://doi.org/

Research on sensory deficits in the upper limb post-stroke reveals their prevalence, affecting 85% of survivors and significantly impacting daily functioning. These impairments are closely tied to stroke severity and impaired motor function, often predicting treatment outcomes. However, despite their common occurrence, there's a noticeable lack of specialized therapy addressing these deficits. The study highlights the significance of upper extremity sensorimotor impairments in stroke survivors, categorizing patients based on these impairments. This categorization suggests a step towards tailored interventions, potentially addressing the lacking specialized therapy, and aiming to improve functional outcomes and quality of life for stroke survivors.

The results of the study may suggest that after stroke, majority of the patients sensori-motor function impairment of the upper limb in which their movements and sensations are impaired. It aligns with a study that had assessed hand function loss after a stroke which often overlooks subtle changes impacting object manipulation. Effective lifting requires predicting forces (sensorimotor integration), adjusting for unexpected demands (sensorimotor memory), and modulating fingertip forces—areas not well measured by current clinical tools. This study analyzed these components in 60 chronic unilateral middle cerebral artery stroke patients compared to age-matched controls. Most stroke patients performed below controls in at least one task, with varied deficits regardless of hemisphere affected. Right hemisphere damage impaired distal force adjustment and sensorimotor integration, while left hemisphere patients did not show these issues. In memory tasks, both groups initially performed similarly to controls, but right hemisphere patients struggled with later lifts, indicating challenges in learning new object associations. This highlights the need for targeted rehabilitation strategies for stroke survivors.

The study offers fresh perspectives on the connection between subacute to chronic stroke patients and their upper sensorimotor deficits. It underscores the importance of identifying and categorizing these impairments among stroke survivors. This classification could pave the way for more personalized treatment approaches, addressing the gap in specialized therapy and aiming to enhance functional recovery and overall quality of life for stroke survivors. By categorizing patients based on

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

DOI: http://doi.org/

the severity and nature of these impairments, the study highlights the potential for more customized treatment plans. Such personalized interventions could be more effective in improving the functional abilities of stroke survivors, thereby enhancing their quality of life. The study points out the need for specialized therapies that can target these specific impairments, addressing a current shortfall in stroke rehabilitation.

CONCLUSION

The findings indicate that among post-subacute to chronic left middle cerebral artery (MCA) stroke patients, the majority exhibited moderate upper extremity sensorimotor impairments as assessed by the Fugl-Meyer tool. A smaller proportion demonstrated mild or severe impairments, while no patients presented with very severe deficits, suggesting a relative preservation of sensorimotor function within this cohort. This distribution implies a potential for functional recovery and responsiveness to rehabilitation interventions in most patients within this stage of stroke recovery.

REFERENCES

1. Yoon S, Rhee M-H. Effect of physical therapy scoliosis specific exercises using breathing pattern on adolescent idiopathic scoliosis. Journal of physical therapy science. 2016;28(11):3261-3.
2. Alexandre AS, Sperandio EF, Yi LC, Davidson J, Poletto PR, Gotfryd AO, et al. Photogrammetry: a proposal of objective assessment of chest wall in adolescent idiopathic scoliosis. Revista Paulista de Pediatria. 2019;37:225-33.
3. Toombs C, Lonner B, Fazal A, Boachie-Adjei O, Bastrom T, Pellise F, et al. The adolescent idiopathic scoliosis international disease severity study: do operative curve magnitude and complications vary by country? Spine Deformity. 2019;7(6):883-9.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about

Online ISSN 3007-2387
Print ISSN 3007-2379

Ali et al - 2026
DOI: http://doi.org/

4. Katsaris G, Loukos A, Valavanis J, Vassiliou M, Behrakis P. The immediate effect of a Boston brace on lung volumes and pulmonary compliance in mild adolescent idiopathic scoliosis. European Spine Journal. 1999;8:2-7.
5. Ran B, Fan Y, Yuan F, Guo K, Zhu X. Pulmonary function changes and its influencing factors after preoperative brace treatment in patients with adolescent idiopathic scoliosis: A retrospective case–control study. Medicine. 2016;95(43).
6. Farrell J, Garrido E. Predicting preoperative pulmonary function in patients with thoracic adolescent idiopathic scoliosis from spinal and thoracic radiographic parameters. European Spine Journal. 2021;30:634-44.
7. Yagci G, Demirkiran G, Yakut Y. In-brace alterations of pulmonary functions in adolescents wearing a brace for idiopathic scoliosis. Prosthetics and Orthotics International. 2019;43(4):434-9.
8. Ledonio CGT, Rosenstein BE, Johnston CE, Regelmann WE, Nuckley DJ, Polly Jr DW. Pulmonary function tests correlated with thoracic volumes in adolescent idiopathic scoliosis. Journal of Orthopaedic Research. 2017;35(1):175-82.
9. Abdelaal AAM, Abd El Kafy EMAES, Elayat MSEM, Sabbahi M, Badghish MSS. Changes in pulmonary function and functional capacity in adolescents with mild idiopathic scoliosis: observational cohort study. Journal of International Medical Research2018. p. 381-91.
10. Weiss H-R, Kleban A. Development of CAD/CAM based brace models for the treatment of patients with scoliosis-classification based approach versus finite element modelling. Asian spine journal. 2015;9(5):661.
11. Yu B, Wang Y, Qiu G, Shen J, Zhang J, Lao L. The influence of preoperative brace treatment on the pulmonary function test in female adolescent idiopathic scoliosis. Clinical Spine Surgery. 2013;26(6):E254-E8.

Pakistan Journal of Medical & Cardiological Review
https://pakjmcr.com/index.php/1/about
Online ISSN 3007-2387
Print ISSN 3007-2379

DOI: http://doi.org/

12. Sperandio EF, Alexandre AS, Liu CY, Poletto PR, Gotfryd AO, Vidotto MC, et al. Functional aerobic exercise capacity limitation in adolescent idiopathic scoliosis. The Spine Journal. 2014;14(10):2366-72.
13. Nakashima H, Kawakami N, Matsumoto H, Redding GJ. Preoperative 6-minute walk performance in children with congenital scoliosis. Journal of Pediatric Orthopaedics. 2020;40(9):e818-e21.
14. Di Maria F, Vescio A, Caldaci A, Vancheri A, Di Maria C, Sapienza M, et al., editors. Immediate effects of sforzesco® bracing on respiratory function in adolescents with idiopathic scoliosis. Healthcare; 2021: MDPI.
15. Li AM, Yin J, Yu C, Tsang T, So H, Wong E, et al. The six-minute walk test in healthy children: reliability and validity. European Respiratory Journal. 2005;25(6):1057-60.