International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 20s, 2025
https://theaspd.com/index.php

Relationship Between Lower Extremity Motor Functions, Balance, Gait, And Activites Of Daily Living Among Subacute Stroke Patients

Parthiban Alagappan[1,2], Ramamoorthy Veyilmuthu[3], C.K.V. Bhuvaneswari[4], Dhanpal Singh[5], Balakrishnan[6], Balasubramaniyan[7]

[1,3]Department of Physical Medicine and Rehabilitation, PSG Institute of Medical Sciences and Research, Peelamedu – 641004, Coimbatore, Tamil Nadu, India

[2]Research Scholar, Division of Physical Medicine and Rehabilitation, Government Cuddalore Medical College (RMMCH), Annamalai University, Chidambaram, Cuddalore District, Tamil Nadu, India

[4,5]Department of Physiotherapy, Government Medical College and Hospital, Cuddalore District

[6]Department of Neurology, PSG Institute of Medical Sciences and Research, Peelamedu – 641004, Coimbatore, Tamil Nadu, India

[7]Department of Medicine, Government Medical College and Hospital, Cuddalore District

Corresponding author- Parthiban Alagappan, Email id- parthimpt13@gmail.com

Abstract

Background:*Stroke frequently hinders activities of daily living (ADL) by affecting both balance and motor capabilities. Conducting early assessments with appropriate tools facilitates development of tailored rehabilitation strategies aimed at improving functional independence.*

Objective: *This studies objective is to find the correlation between lower extremity motor functions, balance, and activities of daily living (ADL) during subacute stage in patients with stroke.*

Methods:*According to study criteria, 58 patients were recruited from PMR department, PSG Hospitals. Motor functions, balance, gait and activities of daily living (ADL) were assessed using Fugel-Meyer Assessment - Lower Extremity component (FMA - LE), Tinetti Performance - Oriented Mobility Assessment (POMA) Scale and Indian Stroke Scale respectively.*

Results:*Pearson coefficient of correlation analysis revealed a strong positive correlation with value of, $r = 0.0761$, $p < 0.0001$, between motor functions and activities of daily living (ADL), and $r = 0.0812$, $p < 0.001$, between balance and gait and activities of daily living (ADL).*

Conclusion:*The findings emphasize the vital role that recovery of the motor functions in lower extremity and balance plays in the rehabilitation process after a stroke. This highlights the need for rehabilitation programs that focus on activities involving weight bearing on the lower extremities, as well as balance, postural control, and movement coordination, to enhance functional independence.*

Keywords: *Activities of daily living (ADL), Fugl Meyer Assessment - Lower Extremity component (FMA - LE), Indian Stroke Scale (ISS), Stroke, Tinetti Performance - Oriented Mobility Assessment (POMA) Scale*

INTRODUCTION

A stroke is characterized by a sudden onset of localized brain dysfunction that lasts for more than 24 hours or leads to death, solely due to vascular factors. [1]. In India, it is the third highest cause of disability, with an annual rate of incidence between 123 and 145 per 100,000 people. The age-standardized prevalence for urban and rural areas varies from 84 to 262 per 100,000 and 334 to 424 per 100,000 respectively [2]. Impairments following stroke ranges from motor, speech and swallowing, cognitive and emotional deficits [3]. Sensorimotor function impairments of the lower limbs significantly diminish independence and overall quality of life. One of the most disabling effects for stroke survivors is their inability to walk independently, especially in outdoor environments [4]. Motor impairment reduces a patient's ability to coordinate movements of the face, arm, and leg on the side that has been affected [5]. Bohannon RW et al., found a notable link between the paretic lower limb muscles strength, balance in standing, and stair-climbing ability in individuals who have survived a stroke [6].

The Fugl-Meyer Assessment (FMA) is an extensive tool which is used to assess sensorimotor impairments following a stroke**.** The lower extremity component (FMA-LE) specifically measures motor recovery in the hip, knee, and ankle. Mubarak et al., (2020) identified a strong positive correlation coefficient, r = 0.820, between the Fugl-Meyer Assessment Lower Extremity component (FMA-LE) and the Barthel Index (BI).

Additionally, in the same study, he also found a significant positive correlation coefficient of r = 0.719 between the Fugl Meyer Assessment Lower Extremity component (FMA-LE) and the Functional Independence Measures (FIM) [19]. This indicates that improvements in the motor functions of the lower extremities were associated with increased independence in activities of daily living in post stroke patients.
Post stroke balance deficits are characterized by unsteadiness, uneven distribution of weight between both lower extremities, and poor dynamic control [7]. The disruption in the reflexive regulation of muscle tension, or automatic postural tone, compromises proximal joint and trunk stability. Consequently, patients usually displays postural malalignment, diminished balance, and higher risk of falls, especially when countering unexpected perturbations which are external or during self-initiated movements [8].
Falls rank among the most common complications following stroke [9]. Stroke survivors often exhibit asymmetrical weight distribution, favoring the unaffected side when seated or standing. Individuals with hemiplegia tend to topple toward their weaker side [10], and they also display increased postural sway while standing. Difficulties in maintaining balance while dressing increase the likelihood of falls for stroke survivors, and several studies show that the fear of falling can result in decreased participation in daily activities. [9,11].
Recent research has additionally demonstrated that falls adversely affect stroke patient's performance of activities of daily living [12]. Around three-quarters of stroke survivors struggle with ADL's, which in turn impedes their social reintegration. Earlier data also highlight trunk control, motor function, and balance as key factors underpinning effective ADL performance. [13].
The Tinetti Performance-Oriented Mobility Assessment (POMA) is a commonly utilized and easy-to-administer test. It provides a brief and dependable evaluation of both static and dynamic balance, consisting of two subtests: balance and gait. The balance components encompass static sitting, the sit to stand ability, and balance in standing, while the gait components include gait initiation, path tracking, missed steps, turning, and timed walking. Certain items utilize a two-point scale for scoring the timed walking [14].
Assessments using the Tinetti POMA—including its individual components—consistently show moderate to strong positive associations with ADL performance. For example, Canbek et al. (2013) discovered a correlation of r = 0.55 between Tinetti POMA scores and motor FIM scores at both admission and discharge in an inpatient rehabilitation setting. They also identified an even stronger association with gait speed (r = 0.82), emphasizing the importance of mobility in supporting daily functional abilities [18].
Research findings in developed nations can differ greatly from those in developing countries like India due to contextual variations. The Barthel Index (BI) and Functional Independence Measures (FIM) are commonly used to evaluate functional outcomes in developed countries; however, their applicability may be limited for stroke patients in India. This is primarily because their daily activities often involve unique tasks such as using public transportation, strolling within the community, sitting on the floor, and crouching [15, 16].
Prakash et al., newly developed the Indian Stroke Scale, a patient-reported outcome measure specifically validated for the Indian sociocultural context—evaluates stroke survivors' performance of daily activities requiring trunk stability, motor function, and balance. The landmark validation of the ISS revealed a statistically significant ($p < .001$) moderate-to-strong positive correlation (r = 0.59) with the Barthel Index, underscoring that the ISS, like established ADL measures, reliably reflects patient's functional independence [17].
The aim of this study is to investigate the connection between motor function, balance, and everyday activities in subacute stroke patients, considering the lifestyle and daily practices of Indians while highlighting their functional activities.

METHODOLOGY

This cross-sectional study included 58 post-stroke patients. The criteria for inclusion were first onset of unilateral supra-tentorial hemorrhagic or ischemic stroke (confirmed by computerized tomography), age group of 40 – 60 years in both males and females, Brunnstrom's stage of stroke recovery more than 3 for lower extremity, Functional Ambulatory Category > 3, able to follow verbal instructions and commands, scoring at least 25 in Montreal Cognitive Assessment (MOCA) and willingness to participate. Exclusion criteria were history of Neurological disorders impacting balance, apart from stroke, include conditions such as Parkinson's disease and vestibular lesions., diagnosed musculoskeletal disorders affecting the trunk and lower extremities, such as fractures, osteoarthritis, and ligament injuries in the lower limbs, which

impacted motor performance, Orthopedic or Rheumatic conditions interfering with walking, Co-morbidities (psychiatric illness, hearing and vision loss), patients with any cardiovascular disorders.

Materials and Outcome Measures

Fugl Meyer Assessment – Lower extremity (FMA-LE), Tinetti Performance - Oriented Mobility Assessment (POMA) Scale was used to, assess Motor function and Balance and Gait respectively. Patients completed the Indian Stroke Scale questionnaire, which quantified the limitations they faced in daily activities that are relevant and meaningful to them.

Method of Data Collection and Analysis

Then scores of Fugl Meyer Assessment – Lower extremity (FMA-LE), Tinetti Performance - Oriented Mobility Assessment (POMA) Scale was compared with the Indian Stroke Scale. The time taken to complete the entire assessment for each patient was 30-45 minutes. The Pearson Coefficient of Correlation was utilized to examine the relationships among the Fugl Meyer Assessment for Lower Extremities (FMA-LE), the Tinetti Performance-Oriented Mobility Assessment, and the Indian Stroke Scale. To check if the correlation between the variables was statistically significant, t-test was used. Data analysis was done using the SPSS – 16.0 software.

RESULTS

The data of 58 stroke patients were evaluated and the values of mean, standard deviation, percentage were found out. The correlation was analyzed using Pearson correlation in this study.

Table 1 represents the gender distribution of patients with 46 men and 12 women representing 79.31 % and 20.69 % respectively.

Table 1. Descriptive Statistics of Gender Distribution of Patients

GENDER OF PATIENTS	COUNT	PERCENTAGE (%)
MALE	46	79.31
FEMALE	12	20.69 %
TOTAL	58	100 %

Table 2 displays the descriptive statistics for the study participants, including the mean and standard deviation for age (mean ± SD = 51 ± 8.2), height (mean ± SD = 162.8 ± 7.9), weight (mean ± SD = 67 ± 7.3), BMI (mean ± SD = 25.28 ± 3.4), and duration of stroke onset in days (mean ± SD = 105 ± 18.3). It also includes the outcomes for the Fugl Meyer Assessment–Lower Extremity component (mean ± SD = 22 ± 7.6), the Tinetti Performance-Oriented Mobility Assessment (POMA) (mean ± SD = 18 ± 6.4), and the Indian Stroke Scale (mean ± SD = 69 ± 14.5).

Table 2. Descriptive Characteristics of Stroke and Outcome Measures of Patients

Variables	Mean (SD)
AGE	51 ± 8.2
HEIGHT	162.8 ± 7.9
WEIGHT	67 ± 7.3
BMI	25.28 ± 3.4
DURATION	105 ± 18.3
FUGL MEYER SCORE – LOWER EXTREMITY COMPONENT	22 ± 7.6
TINETTI PERFORMANCE ORIENTED MOBILITY ASSESSMENT (POMA)	18 ± 6.4
INDIAN STROKE SCALE	69 ± 14.5

Table 3 presents the correlation between motor functions and activities of daily living, as well as balance and gait functions with activities of daily living, evaluated through Pearson correlation analysis. This analysis revealed a strong positive correlation ($r = 0.0761$, $p < 0.00001$) between motor function and activities of daily living, as measured by the Fugl Meyer Assessment for Lower Extremities and the Indian Stroke Scale and a very strong positive correlation ($r = 0.0812$, $p < 0.00001$) between balance and gait functions and activities of daily living, as measure by the Tinetti Performance-Oriented Mobility

Assessment (POMA) and the Indian Stroke Scale (ISS).

Table 3. Pearson Coefficient of correlation between motor functions of the lower extremity, balance and gait performance with activities of daily living in patients with subacute stroke

VARIABLES	FUGL MEYER ASSESSMENT – LOWER EXTREMITY COMPONENT (FMA – LE)	TINETTI - PERFORMANCE ORIENTED MOBILITY ASSESSMENT (POMA)
INDIAN STROKE SCALE (ISS)	r = 0.0761 p < 0.0001	r = 0.0812 p < 0.0001

DISCUSSION

The present study investigated the relationships among motor functions of the lower-extremity (FMA-LE), performance of balance and gait (Tinetti POMA), and quality-of-life outcomes (Indian Stroke Scale) in patients during the subacute phase of stroke. Our findings of a significant strong positive correlation among all three variables are consistent with the interconnected nature of functional recovery post-stroke. These results highlight a crucial link between physiological motor recovery, functional mobility, and a patient's self-perceived quality of life.

Strong positive correlation between FMA-LE scores and Tinetti POMA underscores that, gains in fundamental motor function measured by the FMA-LE correspond to walking and balance improvements. Additionally, recent studies have reported a high level of correlation between FMA-LE and other mobility assessments—including the Berg Balance Scale— which highlights that motor recovery is a key contributor to enhanced balance and gait functions in the subacute phase of stroke recovery [21, 22].

The FMA-LE instrument, which is recognized well and utilized extensively for evaluating motor deficits based on its ability to measure motor functions focused on synergistic and isolated movements and recovery after a stroke [19]. Higher FMA-LE scores signify enhanced motor control and reduced impairments. Positive correlation observed in this study aligns with prior research that has shown a strong link between physical performance, as measured by the FMA, and functional measures like the Barthel Index (BI) and Functional Independence Measure (FIM) [22].

Our findings are especially pertinent to the subacute stage of stroke rehabilitation. The first six months post stroke onset, represents a vital window for neurological and motor restoration, during which targeted interventions can yield substantial gains. The observed positive relationship underscores that emphasizing motor functions in lower limb at this time will enhance not only physical capacity but also patients perceived quality of life. Collectively, these results support the notion that motor recovery underpins improved mobility and self-care, highlighting the need for holistic rehabilitation programs focused on lower extremity strength, coordination, balance, and gait to promote greater independence and engagement in activities of daily living.

The Tinetti POMA is a clinically validated tool used to evaluate balance, gait, and risk of falls in older adults and post stroke survivors [23]. Conversely, the ISS is developed for India's sociocultural setting, which is a self-reported outcome tool used to evaluate patient engagement in everyday activities such as mobility, personal care, household chores, and social interaction. [22]. The positive relationship identified in this study between Tinetti POMA and ISS, indicates that improvements in balance and gait functions are significantly linked to the patient's capability to engage in daily activities. The convergent validity of both scales within the Indian context are strongly supported by this study finding, suggesting that they assess the interconnected aspects of recovery in functions. Our findings align with the findings of a significant relationships between physical function and performance in activities of daily living (ADLs) by Canbek et al. (2013), who reported specifically that Tinetti POMA scores exhibited moderate to strong correlations with motor scores on the Functional Independence Measures (FIM), which is a widely recognized assessment tool for ADLs [18].

A key takeaway from our findings is that the POMA, which is relatively quick and simple to administer, can effectively act as a reliable indicator of a patient's overall functional participation as assessed by the more detailed ISS. For clinicians working in time-constraint environments, a high score on the POMA can instill confidence that the patient is likely to perform well in daily activities. Conversely, a low POMA

score may indicate the necessity for focused interventions to enhance balance and gait, potentially improving the patient's quality of life and their involvement in the community. This insight is especially pertinent in the subacute phase of stroke, during which a patient's recovery potential is often at its highest. The study limitations are that, the study design is cross-sectional, which prevents the establishment of causal relationships. Future studies which are longitudinal in nature should explore whether improvements in FMA-LE and POMA scores over time can predict enhancements in ISS scores. Additionally, further research could examine the impact of other factors such as spasticity, cognitive function, or psychological well-being on the connection between these scales. A larger sample size would improve the generalizability of these results. Despite these constraints, our study provides significant evidence that supports the combined application of the POMA and ISS for a thorough evaluation of functional recovery in subacute stroke patients in India.

CONCLUSION

A strong implication for clinical practice was obtained from the results of this study, especially in shaping targeted rehabilitation approaches. Interventions which focused on enhancing lower extremity motor function are likely to yield positive outcomes for a patient's balance, gait, and overall quality of life. Utilizing these three scales together offers a thorough assessment tool that can monitor progress from a physiological standpoint (FMA-LE) to a functional perspective (Tinetti POMA), and finally to the patient-centered approach (ISS), which provides a holistic view of the recovery journey.

Conflict of interest

The authors state that there are no conflicts of interest that may have affected the work presented in this paper.

Acknowledgement

The authors would like to acknowledge the rehabilitation team members and the research committee members for their continuing support.

REFERENCES

[1]. Langhorne P, Coupar F, Pollock A, 2009, Motor recovery after stroke: a systematic review. Lancet Neurol. 8(8), 741–754. https://pubmed.ncbi.nlm.nih.gov/19608100/

[2]. Singh V, Prabhakaran S, Chaturvedi S, Singhal A, Pandian J, 2017, An Examination of Stroke Risk and Burden in South Asians. J Stroke Cerebrovasc Dis., 26 (10), 2145–2153. https://pubmed.ncbi.nlm.nih.gov/28579510/

[3]. Ajith M, Meena. P, Karpagam K, Sindhu Ramalingam, Swallow Therapy to Improve Swallowing Ability in Patients with Dysphagia after a Cerebrovascular Accident: A Quantitative Study. Texila International Journal of Public Health, 13(2), 483 – 489. http://doi.org/10.21522/TIJPH.2013.13.02.Art044

[4]. Katan M, Luft A, 2018, Global Burden of Stroke. Semin Neurol.,38(2), 208-211. https://pubmed.ncbi.nlm.nih.gov/29791947/

[5]. Jorgensen HS, Nakayama H, Raaschou HO, Olsen TS, 1995, Recovery of walking function in stroke patients: the Copenhagen Stroke Study. Arch Phys Med Rehabil., 76(1), 27-32. https://pubmed.ncbi.nlm.nih.gov/7811170/

[6]. Bohannon RW, Walsh S, 1991, Association of paretic lower extremity muscle strength and standing balance with stair-climbing ability in patients with stroke. J Stroke Cerebrovasc Dis.,1(3):129-133. https://pubmed.ncbi.nlm.nih.gov/26486067/

[7]. F. Horak, 1997, Clinical assessment of balance disorders. Gait & Posture, 6(1), 76-84. https://doi.org/10.1016/S0966-6362(97)00018-0

[8]. Tyson SF, Hanley M, Chillala J, Selley A, Tallis RC, 2006, Balance disability after stroke. Phys Ther., 86(1), 30-38. https://pubmed.ncbi.nlm.nih.gov/16386060/

[9]. Rapport LJ, Hanks RA, Millis SR, Deshpande SA, 1988, Executive functioning and predictors of falls in the rehabilitation setting. Arch Phys Med Rehabil., 79(6), 629-633. https://pubmed.ncbi.nlm.nih.gov/9630140/

[10]. Harris JE, Eng JJ, Marigold DS, Tokuno CD, Louis CL, 2005, Relationship of balance and mobility to fall incidence in people with chronic stroke. Phys Ther., 85(2), 150-158. https://pubmed.ncbi.nlm.nih.gov/15679466/

[11]. Suzuki T, Sonoda S, Misawa K, Saitoh E, Shimizu Y, Kotake T, 2005, Incidence and consequence of falls in inpatient rehabilitation of stroke patients. Exp Aging Res., 31(4), 457-469. https://pubmed.ncbi.nlm.nih.gov/16147463/

[12]. Czernuszenko A, Członkowska A, 2009, Risk factors for falls in stroke patients during inpatient rehabilitation. Clin Rehabil., 23(2), 176-188. https://pubmed.ncbi.nlm.nih.gov/19164405/

[13]. Lord SE, McPherson K, McNaughton HK, Rochester L, Weatherall M, 2004, Community ambulation after stroke: how important and obtainable is it and what measures appear predictive? Arch Phys Med Rehabil., Feb, 85(2), 234-239. https://pubmed.ncbi.nlm.nih.gov/14966707/

[14]. Adrian Arranz-Escudero, Patricia Martin-Casas, Ester Carpio-Calatayud, Ibai Lopez-de-Uralde-Villanueva, 2025, Convergent validity of the Tinetti scale in subacute stroke patients. Revista Cientifica de la Sociedad de Enfermería Neurologica

(English ed.), 500168. https://doi.org/10.1016/j.sedeng.2025.500168

[15]. Prakash V, Ganesan M, 2021, What matters to patients with stroke in India and why: a qualitative study. Disabil Rehabil., 43(18), 2585-2592. https://pubmed.ncbi.nlm.nih.gov/31880184/

[16]. Prakash V, Ganesan M, Vasanthan R, Hariohm K, 2021, Do Commonly Used Functional Outcome Measures Capture Activities that Are Relevant for People with Stroke in India? Top Stroke Rehabil., 24(3), 200-205. https://pubmed.ncbi.nlm.nih.gov/27671020/

[17]. Prakash V, Ganesan M, 2021, The Indian Stroke Scale: Development and validation of a scale to measure participation in daily activities among patients with stroke in India. Int J Stroke, 16(7), 840-848. https://pubmed.ncbi.nlm.nih.gov/33342394/

[18]. Canbek J, Fulk G, Nof L, Echternach J, 2013, Test-retest reliability and construct validity of the tinetti performance-oriented mobility assessment in people with stroke. J Neurol Phys Ther., 37(1), 14-19. https://pubmed.ncbi.nlm.nih.gov/23389388/

[19]. Husnul Mubarak, Noor Idha, Bayu Santoso, 2020, Correlation of Fugl-Meyer Assessment Score with Barthel Index and Functional Independence Measure in Patients with Stroke. Indian Journal of Forensic Medicine & Toxicology, 14(2), 1609-1614. https://doi.org/10.37506/ijfmt.v14i2.3155

[20]. Adrian Arranz-Escuderoa, Patricia Martín-Casasa, Ester Carpio-Calatayudb, Ibai Lopez-de-Uralde-Villanuevaa, 2025, Convergent validity of the Tinetti scale in subacute stroke patients. Revista Científica de la Sociedad de Enfermería Neurológica (English ed.). http://doi.org/10.1016/j.sedeng.2025.500168

[21]. Wang H, Zhu Y, Xiong P, Liu M, 2025, The application of the IMB model combined with feedback-based health education in the rehabilitation of limb function in stroke patients. Medicine (Baltimore), 104(29), e43139. https://pmc.ncbi.nlm.nih.gov/articles/PMC12282753/

[22]. Liu, Wan-Ju, Li-Fong Lin, Shang-Lin Chiang, Liang-Hsuan Lu, Chao-Ying Chen, and Chueh-Ho Lin. 2021, Impacts of Stroke on Muscle Perceptions and Relationships with the Motor and Functional Performance of the Lower Extremities. Sensors 21, 14: 4740. https://doi.org/10.3390/s21144740

[23]. An S, Lee Y, Lee G, 2014, Validity of the performance-oriented mobility assessment in predicting fall of stroke survivors: a retrospective cohort study. Tohoku J Exp Med, 233(2), 79-87. https://pubmed.ncbi.nlm.nih.gov/24850058/