

ACTIVE LIVING AFTER STROKE: DEMOGRAPHIC AND CLINICAL DETERMINANTS OF PHYSICAL ACTIVITY LEVELS

Jalwa Zahid¹, Syed Aqil Hussain Shah², Samra Javed³, Kamran Akbar⁴, Azlan Khan^{*5},
Sidra Karim⁶

¹MS-NMPT, Lecturer, CECOS University Peshawar

²DPT, MBA (Nutrition Management), MSPT, Senior Lecturer, Prime Institute of Health Sciences (PIHS), Islamabad, Pakistan

³DPT, MS-SPT, Demonstrator at Prime Institute of Health Sciences (PIHS), Islamabad, Pakistan

⁴DPT, MSPT-MSK, Lecturer at Institute of Physical Medicine and Rehabilitation, Khyber Medical University, Peshawar

⁵DPT PEF Post Graduate College Peshawar, Physiotherapist at Dr Ali Therapy Center, Islamabad

⁶DPT, MSPT, MS Scholar at Ibadat University, Islamabad

¹iamjalwa@gmail.com, ²syedaqilhussain@pihs.edu.pk, ³javedsamra487@gmail.com,

⁴kamranakbar.pt@gmail.com, ⁵azlankhan3632@gmail.com, ⁶sidrakarim328@gmail.com

²0009-0003-0089-776X, ³0009-0004-9363-2871, ⁴0009-0002-3940-1381, ⁶0009-0006-4885-8315

DOI: <https://doi.org/10.5281/zenodo.21700365>

Keywords

Stroke; Physical activity; Stroke rehabilitation; Global Physical Activity Questionnaire; Physiotherapy; Pakistan.

Article History

Received: 31 January 2026

Accepted: 16 March 2026

Published: 30 March 2026

Copyright @Author

Corresponding Author: *

Azlan Khan

Abstract

Background: Regular physical activity is a key component of stroke rehabilitation, contributing to improved functional recovery, cardiovascular health, and reduced risk of recurrent stroke. However, evidence regarding physical activity patterns among stroke survivors in Pakistan remains limited. This study aimed to determine the frequency of physical activity among stroke patients and examine its association with selected demographic and clinical characteristics.

Methods: A hospital-based cross-sectional study was conducted among 54 stroke patients attending the Outpatient Physiotherapy Department of Lady Reading Hospital (LRH), Peshawar. Eligible participants were recruited using a non-probability convenience sampling technique. Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ) and categorized as low, moderate, or High. Associations between physical activity level and gender, stroke type, and stroke phase were evaluated using the Chi-square test. Statistical analyses were performed using IBM SPSS version 27, with a significance level of $p < 0.05$.

Results: Among the 54 participants, moderate physical activity was the most prevalent category (40.7%, $n = 22$), followed by low physical activity (33.3%, $n = 18$) and High physical activity (25.9%, $n = 14$). No statistically significant associations were observed between physical activity level and gender ($p = 0.839$), stroke type ($p = 0.746$), or stroke phase ($p = 0.650$).

Conclusion: Moderate physical activity was the predominant activity level among stroke survivors receiving outpatient rehabilitation; however, one-third of participants demonstrated insufficient physical activity. Physical activity was not

significantly associated with gender, stroke type, or stroke phase, suggesting that exercise participation is influenced by factors beyond basic demographic and clinical characteristics. Rehabilitation programs should emphasize individualized exercise prescription and long-term physical activity promotion to optimize recovery following stroke.

INTRODUCTION

Stroke remains one of the leading causes of mortality and long-term disability worldwide, imposing a substantial clinical, social, and economic burden on healthcare systems. It is characterized by the sudden interruption of cerebral blood flow resulting from either arterial occlusion (ischemic stroke) or rupture of cerebral vessels (hemorrhagic stroke), leading to irreversible neuronal injury and varying degrees of neurological impairment (1, 2). According to the Global Burden of Disease Study, approximately 13.7 million new stroke cases occur annually, resulting in nearly 5.5 million deaths and making stroke the second leading cause of death and one of the major contributors to disability-adjusted life years (DALYs) globally (2, 3). Despite advances in acute stroke management, the global burden continues to increase owing to population ageing, urbanization, and the growing prevalence of modifiable vascular risk factors. Nearly 70% of all stroke events and more than 85% of stroke-related deaths occur in low- and middle-income countries (LMICs), where access to specialized stroke care and rehabilitation services remains limited (3). Consequently, improving long-term functional recovery has become a major public health priority.

Pakistan is among the LMICs experiencing a rapid rise in stroke incidence and disability. Epidemiological studies consistently report ischemic stroke as the predominant subtype, accounting for nearly three-quarters of all stroke admissions, while hypertension, diabetes mellitus, dyslipidemia, smoking, obesity, and physical inactivity remain the principal modifiable risk factors (4-6). Improvements in emergency medical care have increased survival after stroke; however, many survivors continue to experience persistent neurological deficits requiring prolonged rehabilitation. As the number of stroke survivors

increases, the emphasis of stroke management has shifted beyond survival toward maximizing functional independence, preventing recurrent cerebrovascular events, and improving health-related quality of life.

Stroke frequently produces long-term impairments affecting motor, sensory, cognitive, and psychosocial domains. Common residual deficits include hemiparesis, impaired balance, reduced gait speed, decreased cardiovascular endurance, impaired upper-limb function, cognitive dysfunction, and limitations in activities of daily living (7, 8). These impairments substantially reduce community participation, increase caregiver burden, and contribute to long-term disability. Contemporary stroke rehabilitation therefore extends beyond restoring motor function and aims to optimize physical performance, enhance participation, minimize complications, and facilitate reintegration into society through multidisciplinary rehabilitation approaches (7, 8).

Among the various components of stroke rehabilitation, physical activity has emerged as one of the most influential modifiable determinants of recovery. The World Health Organization defines physical activity as any bodily movement produced by skeletal muscles that require energy expenditure (9). Beyond structured exercise, physical activity encompasses walking, occupational tasks, household activities, recreational pursuits, and routine daily movements. Increasing evidence demonstrates that regular physical activity promotes activity-dependent neuroplasticity by facilitating cortical reorganization, enhancing synaptic plasticity, stimulating angiogenesis and neurogenesis, and increasing the production of neurotrophic factors such as brain-derived neurotrophic factor (BDNF). These neurophysiological adaptations enhance motor relearning, improve gait performance,

increase muscle strength and cardiovascular fitness, and promote greater independence in activities of daily living (7, 8, 10, 11). Consequently, physical activity is now recognized not merely as preventive health behavior but also as a fundamental therapeutic component of post-stroke rehabilitation.

Physical activity among adults is commonly assessed using the Global Physical Activity Questionnaire (GPAQ), a standardized instrument developed by the World Health Organization (WHO) for global surveillance of physical activity (12, 13). The GPAQ evaluates physical activity across three domains—work, transport, and recreational activities—and captures sedentary behavior. It was specifically designed to provide internationally comparable estimates of physical activity across diverse cultural and socioeconomic settings, particularly in low- and middle-income countries. The questionnaire has been translated into multiple languages and adopted in more than 100 countries through the WHO STEPwise approach to noncommunicable disease (STEPS) surveillance (14). Validation studies have demonstrated acceptable reliability and moderate concurrent validity, supporting its use in epidemiological and clinical research for assessing physical activity patterns in adult populations.

The benefits of physical activity extend well beyond functional recovery. Regular participation in moderate-to-High physical activity contributes to improved blood pressure regulation, glycemic control, lipid metabolism, body composition, and cardiorespiratory fitness while simultaneously reducing recurrent stroke risk and cardiovascular mortality (15-17). Large epidemiological investigations have consistently demonstrated inverse relationships between physical activity and stroke incidence. Jeong et al. reported that individuals engaging in moderate-to-High physical activity one to two times per week experienced a significantly lower risk of stroke than physically inactive individuals (18). Likewise, Lee et al., in a comprehensive meta-analysis, demonstrated that highly active adults exhibited approximately a 25–27% lower risk of stroke incidence and mortality,

whereas even moderate levels of physical activity conferred measurable protective benefits (19). Yang et al. similarly reported that greater frequency, duration, and overall volume of moderate-to-High physical activity were independently associated with reduced stroke risk among middle-aged and older adults (20). These findings emphasize the central role of physical activity in both primary and secondary stroke prevention.

Recognizing the substantial benefits of physical activity, international organizations recommend its routine incorporation into stroke rehabilitation. The American Heart Association and the American Stroke Association advocate moderate-intensity aerobic exercise for 20–60 minutes per session, three to seven days per week, complemented by progressive resistance, flexibility, and balance training according to patients' functional capacity (10). Similarly, the World Health Organization recommends regular physical activity for adults living with chronic conditions to reduce disability, prevent recurrent cardiovascular events, and improve overall quality of life (9). Nevertheless, adherence to these recommendations remains disappointingly low, particularly among stroke survivors living in resource-limited settings.

Despite overwhelming evidence supporting exercise-based rehabilitation, physical inactivity remains highly prevalent following stroke. Physical impairments, fatigue, depression, fear of falling, reduced mobility, inadequate social support, transportation difficulties, and limited access to rehabilitation services collectively restrict participation in daily physical activities (9). Consequently, stroke survivors spend a substantial proportion of their waking hours engaged in sedentary behavior, which independently contributes to reduced cardiovascular fitness, muscle deconditioning, metabolic dysfunction, poorer functional recovery, and increased risk of recurrent stroke. Reducing sedentary time has therefore become an important therapeutic target alongside increasing structured exercise participation.

Studies conducted across diverse rehabilitation settings consistently demonstrate low physical activity among stroke survivors. Alzahrani et al. observed that individuals with stroke accumulated significantly fewer physical activity counts and spent less time standing than healthy controls, indicating substantial reductions in free-living physical activity after stroke (21). Similarly, West et al. reported that hospitalized stroke patients spent almost half of their day inactive and participated in relatively little moderate-to-High physical activity, even during formal rehabilitation sessions (22). Community-based investigations have produced comparable findings. Paul et al. found that community-dwelling stroke survivors accumulated significantly fewer daily steps and exhibited markedly greater sedentary behavior than healthy adults (23).

Although the burden of stroke in Pakistan has been increasingly documented, relatively few studies have evaluated physical activity behavior during stroke rehabilitation. Existing research has largely focused on stroke subtype distribution, vascular risk factors, and psychological consequences rather than rehabilitation behaviors (24).

Although substantial international evidence supports the role of physical activity in improving neurological recovery and reducing recurrent stroke risk, most available studies originate from high-income countries with well-established rehabilitation systems. Differences in healthcare infrastructure, accessibility of physiotherapy services, socioeconomic conditions, cultural practices, and patient adherence may substantially influence physical activity behavior in Pakistan. Therefore, findings from developed countries cannot be directly generalized to the local population. Furthermore, the scarcity of Pakistani studies examining physical activity patterns among stroke survivors limits the ability of clinicians and policymakers to develop context-specific rehabilitation strategies. Assessing physical activity levels among stroke patients is essential for identifying individuals at risk of inactivity, optimizing rehabilitation planning, promoting evidence-based exercise prescription, and

informing future public health interventions aimed at improving long-term stroke outcomes.

Objective

Primary Objective

To determine the frequency of physical activity among stroke patients attending the Physical Therapy Department of Lady Reading Hospital (LRH), Peshawar, using the Global Physical Activity Questionnaire (GPAQ).

Secondary Objectives

- To compare physical activity categories between male and female stroke patients.
- To determine the association between physical activity categories and stroke type (ischemic and hemorrhagic).
- To determine the association between physical activity categories and stroke phase.

MATERIALS AND METHODS

Study Design

A hospital-based analytical cross-sectional study was conducted to determine the frequency of physical activity among stroke patients receiving physiotherapy services at the Physical Therapy Department of Lady Reading Hospital (LRH), Peshawar, Pakistan. The study also examined the association between physical activity levels and selected demographic and clinical characteristics of stroke patients.

Study Setting

The study was carried out at the Physical Therapy Department of Lady Reading Hospital (LRH), Peshawar, one of the largest tertiary care teaching hospitals in Khyber Pakhtunkhwa, Pakistan. The department provides comprehensive rehabilitation services to patients with neurological, musculoskeletal, and cardiopulmonary disorders and receives referrals from both inpatient and outpatient departments across the province. Data was collected over a six-month period following institutional approval.

Study Population

The target population comprised adult patients with a confirmed clinical diagnosis of stroke who attended the Physical Therapy Department of Hayatabad Medical Complex during the study period. Patients diagnosed with either ischemic or hemorrhagic stroke and referred for rehabilitation were considered eligible for participation.

Sample Size and Sampling Technique

The sample size was calculated using the Raosoft Sample Size Calculator assuming a 95% confidence level, 5% margin of error, 50% response distribution, and the estimated population of eligible stroke patients attending the department during the study period, resulting in a required sample size of 54 participants.

Eligibility Criteria

Inclusion Criteria

Participants were eligible if they:

- were 40 years of age or older
- had a confirmed diagnosis of ischemic or hemorrhagic stroke established by a neurologist or physician;
- were attending the Physical Therapy Department for rehabilitation; and
- were willing to participate in the study.

Exclusion Criteria

Patients were excluded if they:

- were older than 80 years
- had unstable angina or another medical condition contraindicating physical activity assessment;
- were medically unstable or unable to complete the assessment procedure.

Data Collection Procedure

Following ethical approval and institutional permission, eligible participants were identified through the outpatient and inpatient physiotherapy services at Lady Reading Hospital (LRH) Peshawar. The objectives and procedures of the study were explained to each participant, and written informed consent was obtained before data collection. A structured data collection form

was used to record demographic and clinical characteristics, including age, gender, stroke type, and stroke phase. Physical activity was subsequently assessed using the Global Physical Activity Questionnaire (GPAQ) administered through face-to-face interviews by the principal investigator. All assessments were performed under standardized conditions to ensure consistency in data collection. Completed questionnaires were reviewed immediately to minimize missing or incomplete responses before being entered into the study database.

Outcome Measure

Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), a standardized instrument developed by the World Health Organization (WHO). The GPAQ assesses physical activity performed in three domains: work-related activity, transport-related activity, and recreational activity, while also recording sedentary behavior during a typical day. Responses were scored according to the WHO GPAQ Analysis Guide and expressed as metabolic equivalent (MET)-minutes per week. Based on the standardized WHO scoring protocol, participants were classified into low, moderate, or high physical activity levels. The categorized physical activity level served as the primary outcome variable of the study.

Study Variables

The primary dependent variable was physical activity level, categorized as low, moderate, or high (High) according to the standardized Global Physical Activity Questionnaire (GPAQ) scoring protocol. The independent variables included age, gender, stroke type (ischemic or hemorrhagic), and stroke phase (3 months, 6 months, and >6 months). These variables were selected to examine their potential association with physical activity levels among stroke survivors.

Data Management and Statistical Analysis

Data was coded, entered, cleaned, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 27.0. Data accuracy was verified

through double-checking before analysis. Descriptive statistics were used to summarize participant characteristics. Continuous variables were presented as mean $\pm$ standard deviation (SD) or median with interquartile range (IQR) depending on data distribution, whereas categorical variables were expressed as frequencies and percentages. Associations between physical activity categories and categorical variables, including gender, stroke type, and stroke phase, were evaluated using the Pearson Chi-square test. Statistical significance was determined at a two-tailed p-value <0.05 , and 95% confidence intervals

(95% CI) were considered where appropriate.

RESULTS

Participant Characteristics

Following eligibility screening, 54 stroke patients who met the predefined inclusion and exclusion criteria were recruited from the Outpatient Physiotherapy Department of Lady Reading Hospital (LRH), Peshawar, and included in the final analysis. The participant recruitment process, eligibility assessment, exclusions, and final study population are presented in **Figure 1**.



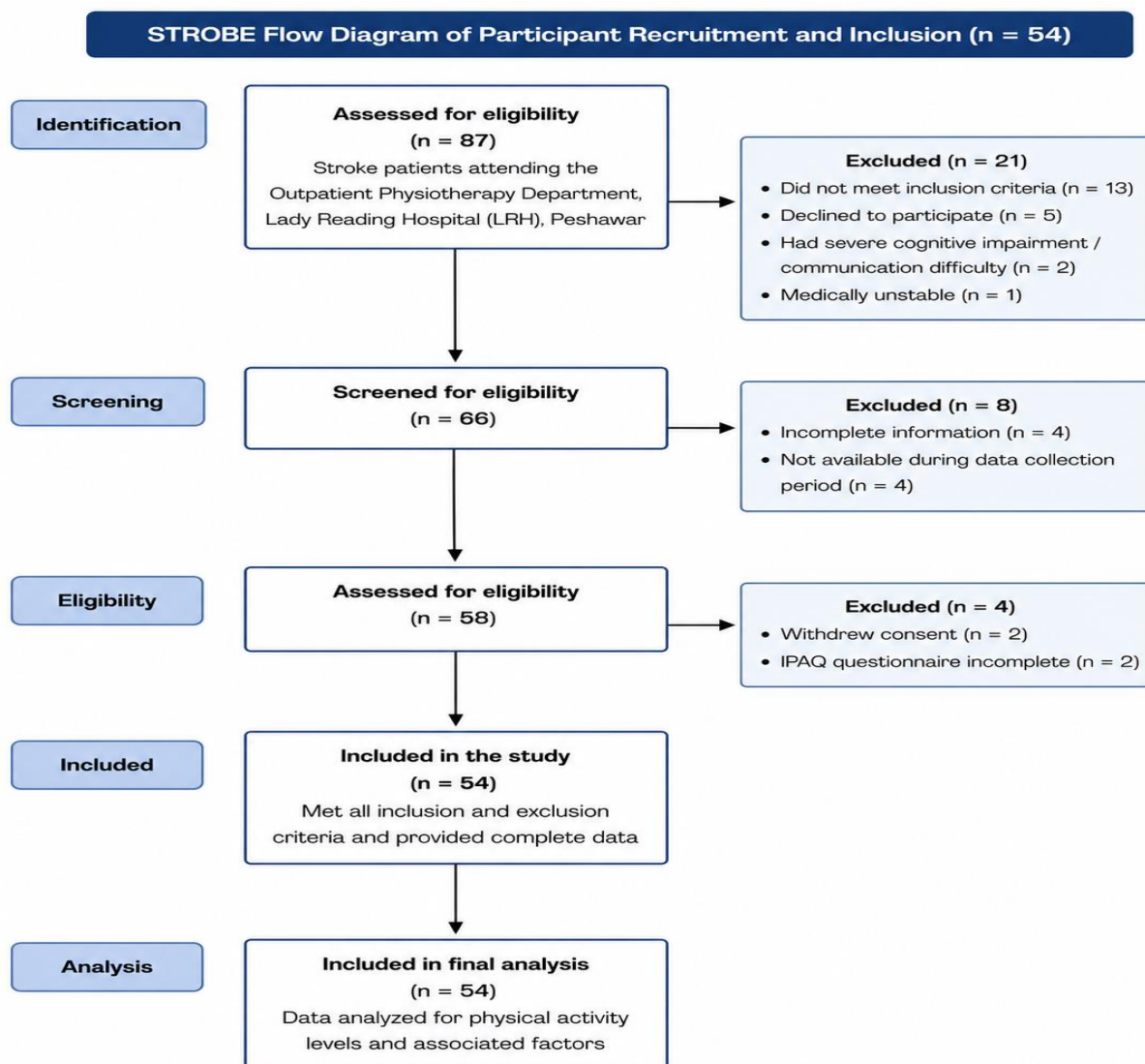


Figure 1: *STROBE flow diagram illustrating participant recruitment, eligibility assessment, exclusion process, and inclusion in the final analysis.*

Physical Activity Levels Among Stroke Patients

The distribution of physical activity levels is presented in Table 1. Moderate physical activity was the predominant category, observed in 22 participants (40.7%), followed by low physical activity in 18 participants (33.3%) and High

physical activity in 14 participants (25.9%). Overall, nearly three-quarters of the study population demonstrated either low or moderate physical activity levels, whereas only approximately one-quarter achieved High physical activity.

Table 1. Distribution of physical activity levels among stroke patients (n = 54)

Physical Activity Level	n	%
High	14	25.9
Moderate	22	40.7
Low	18	33.3

Total	54	100.0
-------	----	-------

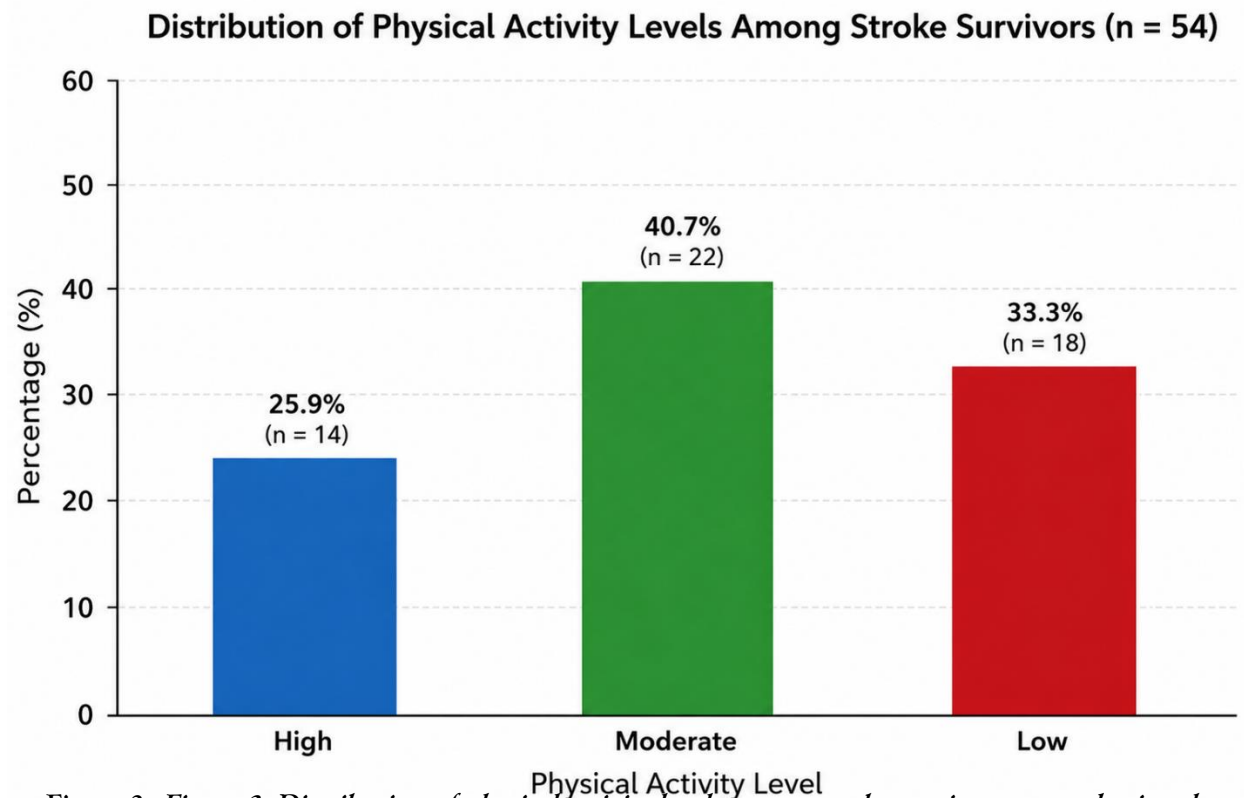


Figure 2: *Figure 2. Distribution of physical activity levels among stroke survivors assessed using the Global Physical Activity Questionnaire (GPAQ) (n = 54).*

Gender Distribution and Association with Physical Activity

Among the study participants, 39 (72.2%) were male and 15 (27.8%) were female. Moderate physical activity was the most frequently observed category in both sexes. Among male participants, 17 (43.6%) demonstrated moderate physical activity, while 12 (30.8%) and 10 (25.6%)

exhibited low and High physical activity, respectively. Similarly, among female participants, 6 (40.0%) demonstrated low physical activity, 5 (33.3%) moderate physical activity, and 4 (26.7%) High physical activity. Pearson's Chi-square analysis demonstrated no statistically significant association between gender and physical activity categories ($p = 0.839$) (Table 2).

Table 2. Association between gender and physical activity categories

Gender	High n (%)	Moderate n (%)	Low n (%)	Total
Male	10 (25.6)	17 (43.6)	12 (30.8)	39
Female	4 (26.7)	5 (33.3)	6 (40.0)	15
Total	14	22	18	54

Pearson's Chi-square test: $p = 0.839$

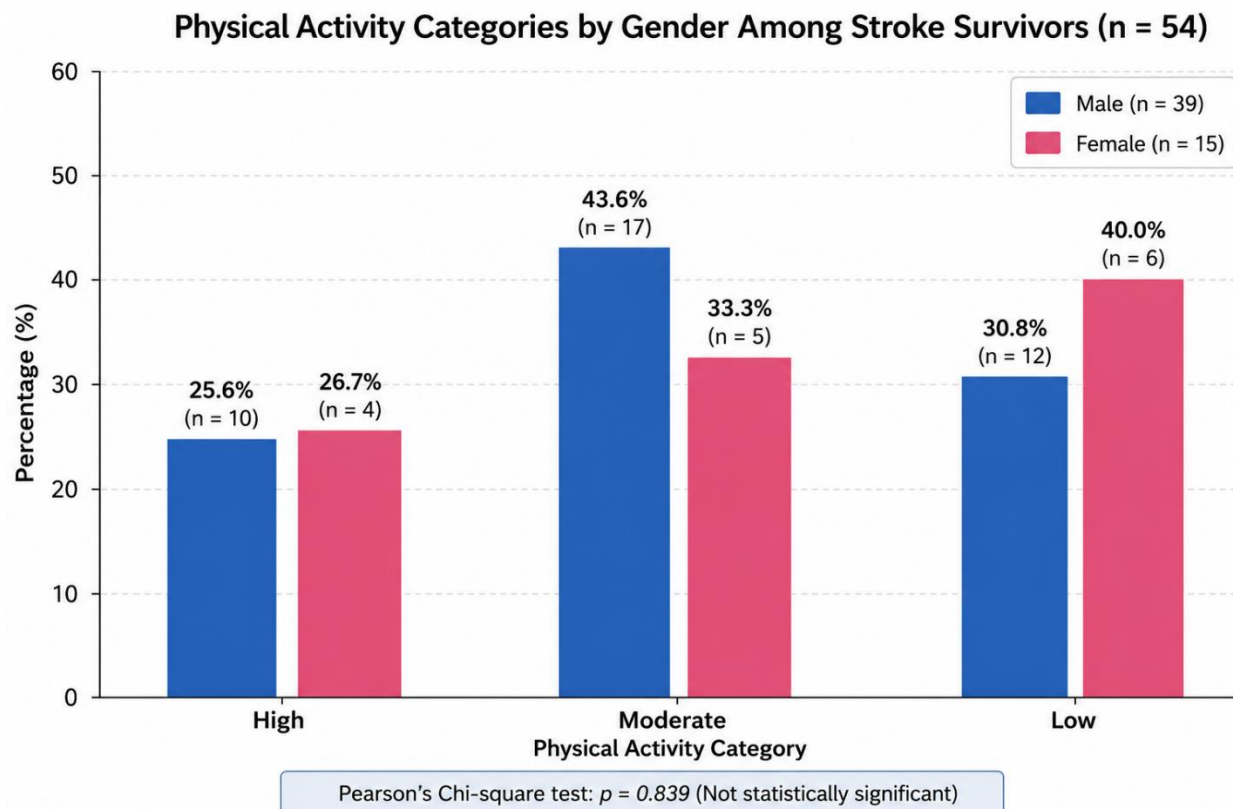


Figure 3: Distribution of Physical Activity categories according to gender among stroke survivors (n=54)

Stroke Type and Association with Physical Activity

Of the 54 participants, 29 (53.7%) had hemorrhagic stroke and 25 (46.3%) had ischemic stroke. Moderate physical activity was the most prevalent category among participants with hemorrhagic stroke (13 of 29; 44.8%), whereas

participants with ischemic stroke showed a relatively balanced distribution across High, moderate, and low physical activity categories. There was no statistically significant association between stroke type and physical activity category according to Pearson's Chi-square analysis ($p = 0.746$) (Table 3).

Table 3. Association between stroke type and physical activity categories

Stroke Type	High n (%)	Moderate n (%)	Low n (%)	Total
Hemorrhagic	7 (24.1)	13 (44.8)	9 (31.0)	29
Ischemic	7 (28.0)	9 (36.0)	9 (36.0)	25
Total	14	22	18	54

Pearson's Chi-square test: $p = 0.746$

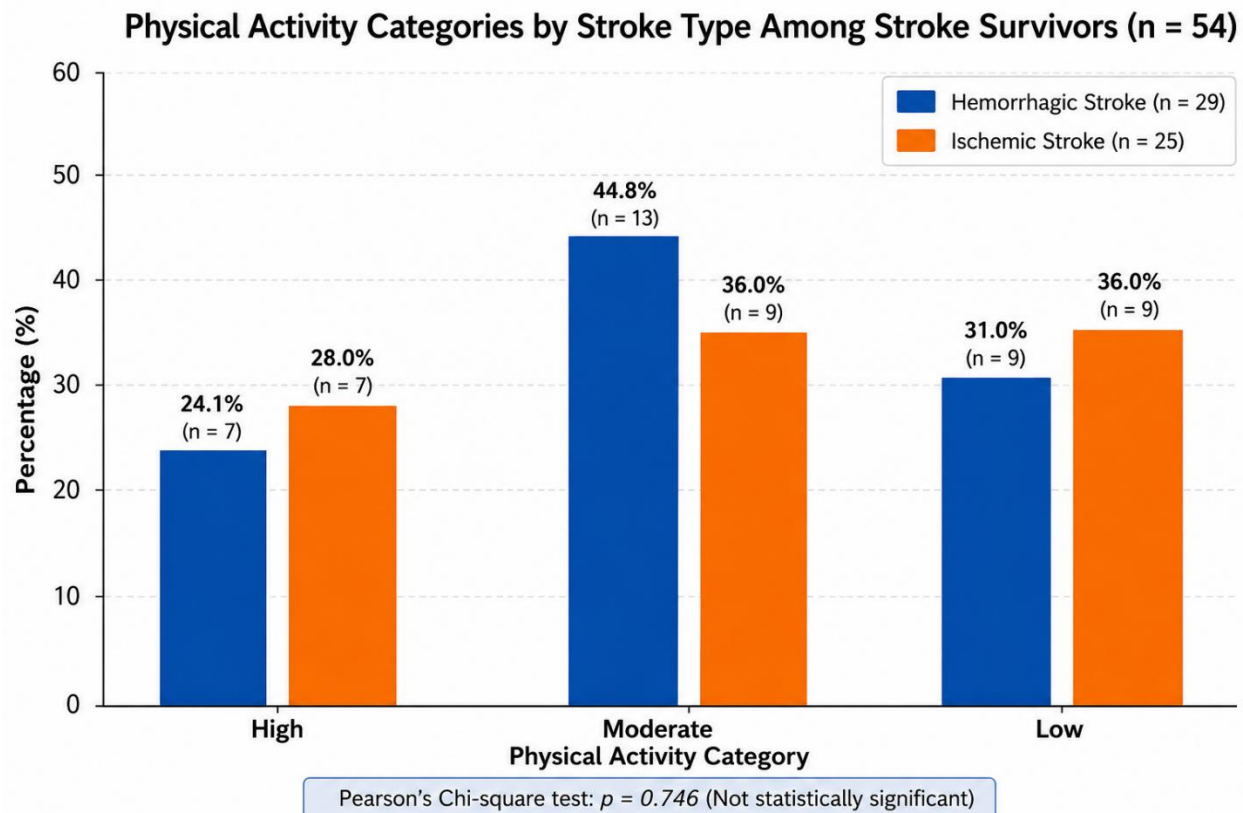


Figure 4: Distribution of physical activity categories according to stroke type among stroke survivors (n = 54)

Stroke Phase and Association with Physical Activity

Participants were further categorized according to stroke phase. The largest proportion of patients (30; 55.6%) were assessed at 6 months following stroke, whereas 18 (33.3%) participants were assessed at 3 months, and 6 (11.1%) were assessed more than 6 months after stroke. Across all stroke phases, moderate physical activity remained the

predominant category. Among participants evaluated at six months, 14 (46.7%) demonstrated moderate physical activity, compared with 6 (33.3%) participants assessed at three months and 2 (33.3%) participants assessed beyond six months. Pearson's Chi-square analysis showed no statistically significant association between stroke phase and physical activity category ($p = 0.650$) (Table 4).

Table 4. Association between stroke phase and physical activity categories

Stroke Phase	High n (%)	Moderate n (%)	Low n (%)	Total
3 months	5 (27.8)	6 (33.3)	7 (38.9)	18
6 months	8 (26.7)	14 (46.7)	8 (26.7)	30
> 6 months	1 (16.7)	2 (33.3)	3 (50.0)	6

Pearson's Chi-square test: $p = 0.650$

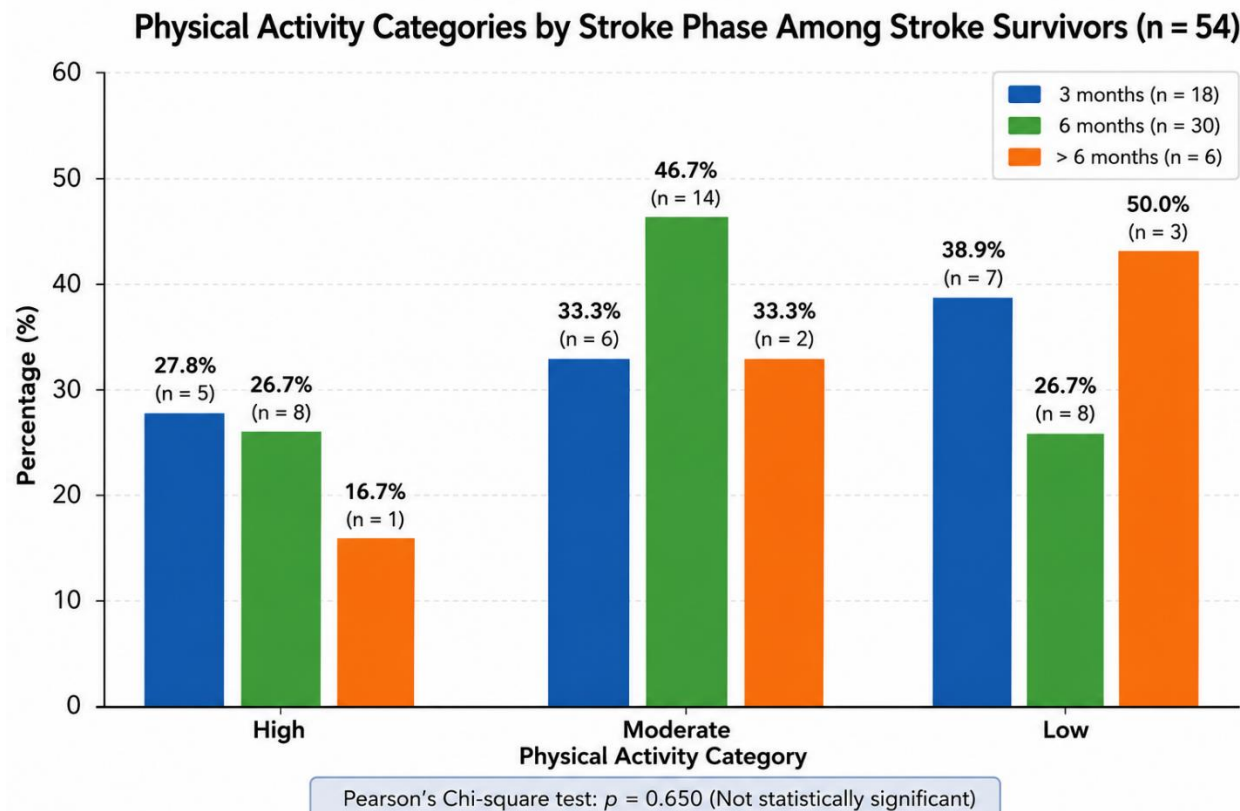


Figure 5: Distribution of physical activity categories according to stroke recovery phase among stroke survivors (n = 54)

Overall Findings

Moderate physical activity was the most frequently observed category among stroke patients, accounting for 40.7% of the study population, whereas 33.3% and 25.9% of participants demonstrated low and High physical activity, respectively. Male participants constituted the majority of the sample, and hemorrhagic stroke was slightly more prevalent than ischemic stroke. However, no statistically significant associations were identified between physical activity category and gender ($p = 0.839$), stroke type ($p = 0.746$), or stroke phase ($p = 0.650$), indicating that physical activity levels were similarly distributed across these demographic and clinical variables within the study population.

DISCUSSION

Principal Findings

The present cross-sectional study investigated the physical activity levels among stroke survivors

attending the Physical Therapy Department of Lady Reading Hospital (LRH), Peshawar, and examined their association with selected demographic and clinical characteristics. The findings demonstrated that moderate physical activity was the most prevalent category (40.7%), followed by low physical activity (33.3%) and High physical activity (25.9%). Furthermore, no statistically significant associations were identified between physical activity level and gender, stroke type, or stroke phase. These findings suggest that although the largest proportion of stroke survivors engaged in moderate levels of physical activity, approximately one-third remained physically inactive or insufficiently active, emphasizing the need for targeted rehabilitation strategies that encourage regular physical activity to optimize functional recovery and long-term health outcomes.

The predominance of moderate physical activity observed in the present study may reflect the

characteristics of patients receiving routine outpatient physiotherapy. Moderate-intensity activities are generally more achievable for stroke survivors because they require lower cardiovascular and neuromuscular demands than High exercise while still providing meaningful physiological and functional benefits. Current stroke rehabilitation guidelines recommend progressive moderate-intensity aerobic exercise as a cornerstone of post-stroke rehabilitation because it improves walking endurance, cardiorespiratory fitness, muscle strength, balance, and overall functional independence while reducing the risk of recurrent cardiovascular events (9, 10). Consequently, the predominance of moderate physical activity within this cohort may indicate partial adherence to rehabilitation recommendations, although the substantial proportion of participants with low physical activity suggests that many patients remain below the recommended level of activity necessary to maximize recovery.

The finding that one-third of participants demonstrated low physical activity deserves particular attention. Physical inactivity following stroke has consistently been identified as a major barrier to neurological recovery and long-term functional independence (24). Reduced physical activity may arise from persistent motor impairments, impaired balance, fatigue, depression, fear of falling, cognitive dysfunction, reduced self-efficacy, transportation difficulties, financial constraints, and limited accessibility to structured rehabilitation services (5). These factors are particularly relevant in low- and middle-income countries such as Pakistan, where specialized rehabilitation facilities and community-based exercise programs remain limited. Consequently, stroke survivors often experience prolonged sedentary behavior, delayed functional recovery, and increased risk of secondary cardiovascular complications.

From a neurophysiological perspective, maintaining regular physical activity following stroke is fundamental for promoting activity-dependent neuroplasticity. Repetitive movement and task-oriented physical activity stimulate

cortical reorganization, enhance synaptic plasticity, increase angiogenesis, and facilitate the release of neurotrophic factors such as brain-derived neurotrophic factor (BDNF), all of which contribute to motor relearning and functional recovery (23). Conversely, prolonged inactivity may limit these adaptive mechanisms and contribute to muscle deconditioning, cardiovascular decline, reduce mobility, and diminished quality of life (22). Therefore, encouraging regular participation in moderate physical activity should be considered an essential component of comprehensive stroke rehabilitation rather than merely a recommendation for secondary prevention.

Overall, the findings of the present study provide important baseline evidence regarding physical activity behavior among stroke survivors receiving rehabilitation in a tertiary care hospital in Pakistan. Although most participants achieved moderate levels of physical activity, the relatively high proportion of individuals with low physical activity indicates that further efforts are required to optimize rehabilitation programs and encourage long-term engagement in physical activity. These observations provide the foundation for comparison with previous national and international studies discussed in the following sections.

Physical Activity Levels Among Stroke Survivors

The present study demonstrated that moderate physical activity was the predominant activity category (40.7%), whereas 33.3% of participants reported low physical activity and only 25.9% achieved High physical activity. These findings suggest that although many stroke survivors are able to participate in routine physical activities during rehabilitation, a substantial proportion remain insufficiently active to attain the physiological and functional benefits recommended for secondary stroke prevention (9, 10). This pattern reflects the persistent challenge of maintaining adequate physical activity following stroke despite improvements achieved through supervised rehabilitation.

The predominance of moderate physical activity observed in the present study is consistent with current international recommendations advocating moderate-intensity aerobic exercise as a core component of stroke rehabilitation. The World Health Organization (WHO) recommends that adults living with chronic conditions, including stroke, engage in regular moderate-intensity physical activity to improve functional capacity, reduce disability, and decrease cardiovascular risk (9). Similarly, the American Heart Association/American Stroke Association (AHA/ASA) recommends progressive aerobic exercise combined with resistance, balance, and flexibility training to enhance walking ability, cardiorespiratory fitness, functional independence, and quality of life while reducing the likelihood of recurrent cerebrovascular events (10). The predominance of moderate physical activity in the present cohort therefore suggests that many participants may have benefited from structured physiotherapy programs promoting gradual progression toward recommended activity levels.

Despite these encouraging findings, approximately one-third of participants demonstrated low physical activity, highlighting an important clinical concern. Physical inactivity after stroke remains one of the strongest modifiable risk factors for poor functional recovery, recurrent stroke, cardiovascular disease, and premature mortality (24). Previous research has shown that stroke survivors frequently spend a large proportion of their waking hours in sedentary behaviors, with limited participation in moderate-to-High physical activity (25). Persistent inactivity may lead to progressive muscle weakness, reduced cardiorespiratory fitness, impaired mobility, decreased participation in activities of daily living, and deterioration in overall quality of life (4).

The present findings are comparable with those reported by West et al., who observed that stroke survivors admitted to rehabilitation units spent nearly half of their daytime hours inactive and accumulated very little moderate-to-High physical activity outside scheduled therapy sessions (22). Likewise, Alzahrani et al. demonstrated

significantly reduced daily physical activity among community-dwelling stroke survivors compared with healthy adults, emphasizing that sedentary behavior often persists long after completion of formal rehabilitation (26). These studies support the current findings by indicating that participation in rehabilitation alone does not necessarily translate into sustained engagement in regular physical activity.

Similarly, Paul et al. reported that community-dwelling stroke survivors accumulated significantly fewer daily steps and exhibited substantially higher levels of sedentary behavior than age-matched healthy individuals (23). Although the overall pattern of findings is consistent with previous literature, the proportion of participants achieving moderate physical activity in the present study appears slightly higher than that reported in several international observational studies (25). A plausible explanation is that all participants were recruited from the outpatient physiotherapy department of a tertiary care hospital where they were actively engaged in rehabilitation programs. Regular attendance at supervised physiotherapy sessions may encourage greater participation in moderate-intensity activities through structured gait training, strengthening exercises, aerobic conditioning, and individualized home exercise programs. Furthermore, more than half of the participants were evaluated during the subacute stage of stroke recovery, a period characterized by rapid neurological and functional improvement, which may have facilitated greater participation in moderate physical activity.

Another possible explanation relates to cultural and healthcare differences. In Pakistan, family members often play a central role in supporting individuals recovering from stroke by assisting with transportation, home exercises, and daily activities. Such social support may encourage continued participation in prescribed rehabilitation despite limited availability of community-based exercise programs. Conversely, barriers including financial limitations, restricted access to rehabilitation services, inadequate public transportation, and the absence of structured post-

discharge exercise programs may explain why a considerable proportion of participants remained insufficiently active (27).

The relatively low proportion of participants achieving High physical activity is also clinically understandable. High exercise requires greater cardiovascular endurance, muscle strength, postural stability, and confidence than moderate-intensity activity, all of which may remain compromised following stroke. In addition, physiotherapists frequently prescribe moderate-intensity exercise because it provides substantial improvements in functional capacity while minimizing excessive fatigue, cardiovascular stress, and fall risk (10). Consequently, the predominance of moderate rather than High physical activity observed in the present study is consistent with contemporary stroke rehabilitation principles and reflects realistic rehabilitation goals for many stroke survivors.

Overall, these findings highlight the importance of extending physical activity promotion beyond supervised hospital-based rehabilitation. Structured home exercise programs, caregiver education, community-based rehabilitation initiatives, tele-rehabilitation, wearable activity monitoring, and behavioral interventions designed to improve long-term exercise adherence may help reduce sedentary behavior and increase sustained participation in physical activity (4). Implementing such strategies is particularly important in low- and middle-income countries, where rehabilitation resources remain limited and long-term follow-up services are often inadequate. Promoting sustained physical activity should therefore be considered a central objective of comprehensive stroke rehabilitation to optimize neurological recovery, prevent recurrent stroke, and improve long-term health-related quality of life.

Association of Physical Activity with Gender, Stroke Type, and Stroke Phase

An important finding of the present study was that physical activity levels were not significantly associated with gender, stroke type, or stroke phase. Although males represented most of the

study population and hemorrhagic stroke was slightly more prevalent than ischemic stroke, the distribution of High, moderate, and low physical activity categories remained comparable across all demographic and clinical subgroups. These findings suggest that participation in physical activity after stroke is influenced by multiple interrelated factors beyond basic demographic characteristics or disease classification, emphasizing the multifactorial nature of post-stroke rehabilitation (10, 24).

Gender and Physical Activity

The absence of a significant association between gender and physical activity observed in the present study indicates that male and female stroke survivors demonstrated similar patterns of physical activity while attending outpatient rehabilitation. This finding suggests that gender alone may not be an independent determinant of physical activity participation when individuals have comparable access to rehabilitation services and structured physiotherapy. Instead, physical activity behavior appears to depend more strongly on functional capacity, mobility status, exercise tolerance, psychological well-being, and social support than on biological sex (5). The present findings are consistent with those reported by English et al., who demonstrated that walking capacity, balance performance, and functional independence were stronger predictors of physical activity than demographic variables such as age or sex (5).

Stroke Type and Physical Activity

Similarly, the present study found no significant association between stroke type and physical activity level, with comparable distributions of activity observed among participants with ischemic and hemorrhagic stroke. Although these stroke subtypes differ in pathophysiology, acute management, and early prognosis, their influence on long-term physical activity appears to diminish once patients enter structured rehabilitation programs (10).

Functional recovery after stroke is largely determined by the severity and location of

neurological impairment, motor recovery, balance deficits, cognitive function, and participation in rehabilitation rather than by stroke subtype alone (21). Consequently, individuals with ischemic and hemorrhagic stroke who achieve similar levels of functional recovery are likely to demonstrate comparable participation in physical activity. This interpretation is supported by previous rehabilitation studies showing that gait performance, balance ability, muscle strength, and independence in activities of daily living are stronger predictors of long-term physical activity than stroke classification itself (21).

Another possible explanation relates to participant selection. The present study included only individuals attending outpatient physiotherapy services. Patients with severe neurological deficits, profound cognitive impairment, or significant medical instability were less likely to participate in outpatient rehabilitation and therefore were not well represented in the study population. Consequently, the functional differences often observed between ischemic and hemorrhagic stroke survivors during the acute stage may have been substantially reduced within this outpatient cohort.

Stroke Phase and Physical Activity

No statistically significant association was identified between stroke phase and physical activity level, despite moderate physical activity being slightly more common among participants assessed six months after stroke. These findings suggest that the passage of time following stroke does not necessarily result in increased participation in physical activity. Instead, recovery appears to depend on individual rehabilitation trajectories, functional improvement, and long-term engagement in exercise rather than chronological recovery stage alone.

Recovery after stroke is highly heterogeneous. Although spontaneous neurological recovery occurs predominantly during the first three to six months, continued improvements in motor performance, balance, and mobility can occur for several years through repetitive practice, aerobic

exercise, strength training, and task-specific rehabilitation (23). Consequently, patients at similar post-stroke intervals may exhibit markedly different physical activity levels depending on stroke severity, rehabilitation intensity, comorbid conditions, psychological status, caregiver involvement, and environmental opportunities for physical activity (28). These findings are consistent with contemporary rehabilitation research emphasizing that physical activity is determined by a combination of biological, behavioral, environmental, and psychosocial factors rather than recovery duration alone (28).

Clinical Interpretation

Collectively, the absence of significant associations between physical activity and gender, stroke type, or stroke phase suggests that these characteristics alone are insufficient to explain variations in post-stroke physical activity. Rather, physical activity appears to be influenced by a broader interaction of functional ability, psychological health, behavioral motivation, caregiver support, socioeconomic status, environmental accessibility, and rehabilitation intensity. This observation reinforces the growing emphasis on patient-centered rehabilitation, in which exercise prescription is individualized according to each patient's functional capacity, personal goals, and contextual barriers instead of demographic characteristics or stroke subtype (10).

For physiotherapists, these findings highlight the importance of conducting comprehensive functional assessments before prescribing physical activity interventions. Measures of gait speed, balance performance, endurance, cardiovascular fitness, fatigue, depression, cognitive status, and self-efficacy may provide more clinically meaningful information than demographic variables when developing individualized rehabilitation programs. Incorporating these multidimensional assessments into routine stroke rehabilitation may facilitate more effective exercise prescription, enhance long-term adherence to physical activity, and ultimately improve functional recovery and quality of life among stroke survivors (4, 24).

Clinical Implications

The findings of the present study have important implications for clinical practice, rehabilitation service delivery, and public health policy. Although moderate physical activity was the most frequently observed level among stroke survivors, approximately one-third of participants remained insufficiently active. This observation highlights a persistent gap between participation in supervised rehabilitation and the achievement of recommended physical activity levels necessary to optimize neurological recovery, improve cardiovascular health, and prevent recurrent stroke (9). Consequently, physiotherapy should extend beyond restoring physical function during hospital-based treatment and place greater emphasis on promoting sustainable physical activity behaviors that continue after discharge. Current international guidelines consistently recommend that stroke rehabilitation should integrate aerobic exercise, progressive resistance training, balance exercises, flexibility training, and task-specific functional activities throughout the continuum of recovery (9). These interventions not only improve mobility and functional independence but also enhance cardiorespiratory fitness, muscle strength, cognitive performance, and quality of life while reducing the risk of secondary cardiovascular events (4). The predominance of moderate physical activity observed in the present study suggests that rehabilitation programs are facilitating engagement in appropriate exercise intensity; however, the substantial proportion of participants with low physical activity indicates that current rehabilitation strategies may be insufficient to maintain long-term exercise participation outside supervised clinical settings. An important finding of this study was the absence of significant associations between physical activity and gender, stroke type, or stroke phase. This suggests that rehabilitation professionals should avoid making assumptions regarding an individual's likelihood of engaging in physical activity based solely on demographic or clinical characteristics. Instead, exercise prescription should be individualized according to functional

status, mobility limitations, cardiovascular fitness, cognitive function, psychosocial factors, and patient-centered rehabilitation goals (10). Such an individualized approach is consistent with contemporary rehabilitation models that emphasize personalized care rather than standardized treatment protocols.

These recommendations are particularly relevant within the Pakistani healthcare system. Rehabilitation services in Pakistan remain concentrated within tertiary care hospitals, while structured post-discharge rehabilitation and community-based physical activity programs are still developing. Financial limitations, transportation difficulties, shortages of specialized rehabilitation professionals, and inadequate public awareness frequently reduce long-term participation in rehabilitation following hospital discharge. Consequently, many stroke survivors become increasingly sedentary despite achieving satisfactory functional recovery during inpatient or outpatient rehabilitation. Strengthening referral pathways to community rehabilitation services, increasing caregiver involvement, and incorporating culturally appropriate home-based exercise programs may substantially improve long-term physical activity participation and functional outcomes.

From a broader public health perspective, increasing physical activity among stroke survivors has implications that extend beyond individual rehabilitation outcomes. Regular physical activity has been associated with reduced rates of recurrent stroke, improved cardiovascular health, better metabolic control, enhanced psychological well-being, lower healthcare utilization, and improved health-related quality of life (9, 10). Considering the increasing burden of stroke in Pakistan and other low- and middle-income countries, integrating structured physical activity promotion into national stroke rehabilitation policies may contribute to reducing disability, improving long-term independence, and alleviating the economic burden associated with stroke-related morbidity. Finally, the present study provides valuable local evidence regarding physical activity patterns among stroke survivors receiving rehabilitation in

Pakistan. Most existing evidence has been generated in high-income countries with well-established rehabilitation systems, limiting its direct applicability to countries with different healthcare infrastructures and socioeconomic contexts. By providing context-specific data, this study contributes to the growing body of evidence supporting the development of rehabilitation programs that are responsive to local healthcare needs. Future national rehabilitation strategies should therefore prioritize sustained physical activity promotion as a central component of comprehensive stroke care.

Strengths and Limitations

The present study has several methodological strengths that enhance its contribution to the existing evidence on physical activity among stroke survivors. First, it provides one of the few contemporary investigations evaluating physical activity among patients receiving physiotherapy in Pakistan, thereby addressing an important gap in the national rehabilitation literature. Most published studies on post-stroke physical activity originate from high-income countries with well-established rehabilitation systems. Consequently, the present findings provide valuable context-specific evidence that may better reflect the realities of stroke rehabilitation in low- and middle-income countries, where healthcare infrastructure, rehabilitation accessibility, and socioeconomic conditions differ substantially from those of developed nations.

Second, physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), a standardized and internationally validated instrument developed by the World Health Organization for the surveillance of physical activity across diverse populations(12, 13). The use of a validated assessment tool enhances the methodological rigor of the study, ensures standardized measurement of physical activity,(14) and facilitates meaningful comparison with findings from previous national and international research. Furthermore, the inclusion of participants with both ischemic and hemorrhagic stroke across different stages of recovery provides

a more comprehensive representation of the outpatient stroke rehabilitation population, thereby improving the generalizability of the study findings.

Despite these strengths, several limitations should be acknowledged. The cross-sectional study design limits the ability to establish causal relationships between participant characteristics and physical activity levels. Consequently, it cannot be determined whether higher physical activity contributed to improved recovery or whether individuals with better functional recovery were simply more capable of engaging in physical activity. Longitudinal cohort studies are therefore required to examine temporal changes in physical activity and their influence on neurological and functional recovery.

Another important limitation is that the study was conducted at a single tertiary care rehabilitation center, which may restrict the generalizability of the findings to other healthcare settings, particularly rural communities, primary healthcare facilities, and private rehabilitation centers. Rehabilitation resources, patient characteristics, and accessibility to physiotherapy services may vary considerably across different regions of Pakistan. Therefore, caution should be exercised when extrapolating these findings to the wider stroke population.

The assessment of physical activity relied on the self-reported Global Physical Activity Questionnaire (GPAQ), which is inherently susceptible to recall bias and social desirability bias. Participants may unintentionally overestimate or underestimate their habitual physical activity, thereby influencing the accuracy of the reported activity levels. Future investigations should combine self-reported questionnaires with objective monitoring tools, including accelerometers, pedometers, wearable activity monitors, or smartphone-based activity tracking systems, to obtain more precise measurements of habitual physical activity and sedentary behavior.

Finally, although the study achieved its planned sample size, the relatively modest number of participants may have reduced the statistical power

to detect small associations between demographic characteristics and physical activity levels. Larger multicenter studies with more diverse participant populations would increase statistical precision and improve the external validity of future findings.

Future Research

Future research should employ prospective longitudinal study designs to investigate changes in physical activity throughout the continuum of stroke recovery and to determine how activity patterns influence long-term neurological, functional, and psychosocial outcomes. Such studies would provide stronger evidence regarding causal relationships between physical activity and functional recovery than is possible through cross-sectional investigations.

Future studies should also incorporate objective measures of physical activity, including accelerometers, wearable activity trackers, pedometers, and smartphone-based digital health technologies, alongside validated self-reported questionnaires to improve measurement accuracy and reduce reporting bias. Combining objective activity monitoring with standardized assessments of gait performance, balance, cardiorespiratory fitness, functional independence, participation, and quality of life would provide a more comprehensive evaluation of rehabilitation outcomes.

Large-scale multicenter studies conducted across different provinces and rehabilitation settings in Pakistan are also needed to improve the generalizability of findings and capture regional variations in healthcare delivery, rehabilitation accessibility, and socioeconomic factors. Future investigations should further examine psychosocial and environmental determinants of physical activity, including depression, fatigue, self-efficacy, caregiver support, financial status, environmental accessibility, and cultural influences, all of which have been recognized as important predictors of long-term exercise participation after stroke.

Finally, well-designed randomized controlled trials should evaluate interventions specifically designed

to increase physical activity among stroke survivors. Community-based rehabilitation programs, structured home exercise interventions, behavioral counselling, motivational interviewing, tele-rehabilitation, wearable technologies, and caregiver-supported exercise programs represent promising strategies that warrant further evaluation, particularly within low- and middle-income countries where long-term rehabilitation resources remain limited.

Conclusion

The present study demonstrated that moderate physical activity was the predominant level of physical activity among stroke survivors receiving outpatient rehabilitation, although approximately one-third of participants continued to exhibit low levels of physical activity. Furthermore, gender, stroke type, and stroke phase were not significantly associated with physical activity, indicating that participation in physical activity following stroke is influenced by factors beyond basic demographic and clinical characteristics. These findings reinforce the multifactorial nature of physical activity behavior and emphasize the importance of individualized rehabilitation approaches tailored to each patient's functional abilities, psychological status, environmental context, and rehabilitation goals.

Given the well-established role of physical activity in promoting neuroplasticity, improving functional recovery, reducing cardiovascular risk, and preventing recurrent stroke, rehabilitation programs should prioritize long-term physical activity promotion throughout the continuum of stroke care. Strategies such as individualized exercise prescription, structured home exercise programs, community-based rehabilitation, behavioral counselling, caregiver engagement, and tele-rehabilitation should be integrated into routine physiotherapy practice to improve adherence and sustain physical activity beyond supervised clinical settings.

Overall, the present study contributes important evidence regarding physical activity patterns among stroke survivors within the Pakistani rehabilitation context and addresses a significant

gap in the national literature. These findings provide a foundation for future multicenter longitudinal studies and intervention trials aimed at optimizing physical activity participation and improving long-term rehabilitation outcomes among individuals living with stroke

REFERENCES

- Shakir R. The struggle for stroke reclassification. *Nature Reviews Neurology*. 2018;14(8):447-8.
- Wahid E, Ahmad S, Khalil S, Khan MS, Bibi N, Humayoon N. Effectiveness of Virtual Reality-Based Telerehabilitation for Stroke Patients in Pakistan: A Randomized Controlled Trial. *The Healer Journal of Physiotherapy and Rehabilitation Sciences*. 2025;5(4):38-46.
- Johnson CO, Nguyen M, Roth GA, Nichols E, Alam T, Abate D, et al. Global, regional, and national burden of stroke, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Neurology*. 2019;18(5):439-58.
- Haider Z, Hussain SS. PREVELANCE OF ISCHEMIC AND HEMORRHAGIC STROKE AMONG GERAITIC PATIENTS ADMITTED IN THE PUBLIC TERTIARY CARE HOSPITALS OF PESHAWAR. *medRxiv*. 2023:2023.03.30.23287970.
- Kamal AK, Majeed F, Pasha O, Rehman H, Islam M, Azam I, et al. Clinical, lifestyle, socioeconomic determinants and rate of asymptomatic intracranial atherosclerosis in stroke free Pakistanis. *BMC neurology*. 2014;14(1):155.
- Wahid E, Ahmad S, Humayoon N. Lack of multidisciplinary collaboration in stroke rehabilitation in Pakistan: a call for integrated care models. *Pakistan Journal of Neurological Sciences*. 2025;20(02).
- Bevan S, Traylor M, Adib-Samii P, Malik R, Paul NL, Jackson C, et al. Genetic heritability of ischemic stroke and the contribution of previously reported candidate gene and genomewide associations. *Stroke*. 2012;43(12):3161-7.
- Kuriakose D, Xiao Z. Pathophysiology and treatment of stroke: present status and future perspectives. *International journal of molecular sciences*. 2020;21(20):7609.
- Mendes CLG, Martins JC, Ferreira DdS, Souza DRd, Velloso M, Faria CDCdM. Physical activity level of post-stroke individuals that use the Brazilian public health system. *Fisioterapia em Movimento*. 2022;35:e35102.
- Field MJ, Gebruers N, Sundaram TS, Nicholson S, Mead G. Physical activity after stroke: a systematic review and meta-analysis. *ISRN stroke*. 2013:464176.
- Khan SA, Khan SA, Rasheed A, Ahmad W, Fatima M, Humayoon N, et al. HYBRID MACHINE LEARNING AND FEDERATED LEARNING FRAMEWORK WITH EXPLAINABLE AI FOR PERSONALIZED STROKE TELEREHABILITATION IN RESOURCE-CONSTRAINED SETTINGS. *Spectrum of Engineering Sciences*. 2026;4(5):398-410.
- Armstrong T, Bull F. Development of the world health organization global physical activity questionnaire (GPAQ). *Journal of Public Health*. 2006;14(2):66-70.
- Organization WH. Global physical activity questionnaire (GPAQ) analysis guide. Geneva: World Health Organization. 2012:1-22.
- Organization WH. STEPwise approach to NCD risk factor surveillance (STEPS). 2021.
- O'donnell MJ, Xavier D, Liu L, Zhang H, Chin SL, Rao-Melacini P, et al. Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *The Lancet*. 2010;376(9735):112-23.

- Romero JR, Morris J, Pikula A. Stroke prevention: modifying risk factors. *Therapeutic advances in cardiovascular disease*. 2008;2(4):287–303.
- Khurshid H, Khan U, Ishaq K, Rafique A, Nisa MU, Khan W, et al. Effect of Task-Oriented Motor Training on Upper Limb Functional Recovery in Post-Stroke Patients: A Randomized Controlled Trial. *Link Medical Journal*. 2025:1–13.
- Bernhardt J, Langhorne P, Lindley RI, Thrift AG, Ellery F, Collier J, et al. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet*. 2015;386(9988):46–55.
- Lee CD, Folsom AR, Blair SN. Physical activity and stroke risk: a meta-analysis. *Stroke*. 2003;34(10):2475–81.
- Yang D, Bian Y, Zeng Z, Cui Y, Wang Y, Yu C. Associations between intensity, frequency, duration, and volume of physical activity and the risk of stroke in middle-and older-aged Chinese people: a cross-sectional study. *International journal of environmental research and public health*. 2020;17(22):8628.
- Kaur G, English C, Hillier S. How physically active are people with stroke in physiotherapy sessions aimed at improving motor function? A systematic review. *Stroke research and treatment*. 2012;2012(1):820673.
- West T, Bernhardt J. Physical activity in hospitalised stroke patients. *Stroke research and treatment*. 2012;2012(1):813765.
- Paul L, Brewster S, Wyke S, Gill JM, Alexander G, Dybus A, et al. Physical activity profiles and sedentary behaviour in people following stroke: a cross-sectional study. *Disability and rehabilitation*. 2016;38(4):362–7.
- Hussain SS, Ullah Z, Bacha M, Khalil SU. PREVALENCE OF POST STROKE DEPRESSION AND ANXIETY AMONG PATIENTS ADMITTED IN KHYBER TEACHING HOSPITAL PESHAWAR. *medRxiv*. 2023:2023.04.10.23288355.
- Shah SMA, Shah SMS, Khan S, Rehman SU, Khan ZA, Ahmed W, et al. “Addressing the impact of stroke risk factors in a case control study in tertiary care hospitals”: a case control study in Tertiary Care Hospitals of Peshawar, Khyber Phukhtoonkhwa (KPK) Pakistan. *BMC research notes*. 2013;6(1):268.
- Alzahrani MA, Ada L, Dean CM. Duration of physical activity is normal but frequency is reduced after stroke: an observational study. *Journal of physiotherapy*. 2011;57(1):47–51.
- Åstrand A, Saxin C, Sjöholm A, Skarin M, Linden T, Stoker A, et al. Poststroke physical activity levels no higher in rehabilitation than in the acute hospital. *Journal of Stroke and Cerebrovascular Diseases*. 2016;25(4):938–45.
- Sharif F, Ghulam S, Sharif A. Prevalence of risk factors associated with stroke. *Pakistan Heart Journal*. 2019;52(1).