

Correspondence

✉ Saima Ashraf, saimaashraf@example.com

Received

04-03-25

Accepted

27-03-25

Authors' Contributions

Concept: MS; Design: SA; Data Collection: UE;
Analysis: AS; Drafting: SA

Copyrights

© 2025 Authors. This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY 4.0).



Declarations

No funding was received for this study. The authors declare no conflict of interest. The study received ethical approval. All participants provided informed consent.

“Click to Cite”



Fatigue, Social Reintegration, and Quality of Life after Stroke in Sialkot: Beyond Mobility

Saima Ashraf¹, Urwa Tul Esha¹, Sadia Ashraf¹, Abida Shehzadi¹, Manahal Sughra¹, Nosheen Fatima¹

¹ University of Sialkot, Sialkot, Pakistan

ABSTRACT

Background: Post-stroke fatigue is a pervasive and disabling symptom that significantly affects quality of life (QoL) and social reintegration, yet it often remains underrecognized in rehabilitation programs focused primarily on physical recovery. Its impact may be particularly profound in low-resource settings where structured post-stroke care is limited. **Objective:** This study aimed to examine the relationship between fatigue severity and reintegration to normal living among stroke survivors in Sialkot, Pakistan, while assessing whether this association is independent of gait performance measures. **Methods:** A cross-sectional study was conducted among 100 post-stroke survivors and 100 age- and sex-matched community controls recruited from five tertiary hospitals. Fatigue was assessed using the Fatigue Severity Scale (FSS), reintegration using the Reintegration to Normal Living Index (RNLI), and gait performance using the Timed Up and Go (TUG) test, gait speed, and cadence. Data were analyzed using Pearson correlation and multivariate regression to identify independent predictors of reintegration, with adjustments for demographic and clinical confounders. **Results:** Stroke survivors exhibited significantly higher fatigue ($FSS\ 5.78 \pm 1.28$ vs. 3.58 ± 0.95 ; $p < 0.001$) and lower reintegration ($RNLI\ 28.35 \pm 16.39$ vs. 75.73 ± 11.88 ; $p < 0.001$). Fatigue severity independently predicted poorer reintegration ($\beta = -0.29$, $p = 0.003$) after adjusting for mobility and socioeconomic factors. **Conclusion:** Fatigue exerts a substantial, independent influence on post-stroke reintegration and QoL, underscoring the need for fatigue-focused rehabilitation strategies that extend beyond gait recovery.

Keywords

Stroke, Fatigue Severity, Reintegration, Quality of Life, Gait, Rehabilitation, Pakistan

INTRODUCTION

Stroke remains a leading cause of long-term disability worldwide and exerts a disproportionate toll on motor function, participation, and health-related quality of life (QoL) (1). Beyond acute survival, many survivors develop persistent gait deviations—slower walking speed, shortened step length, impaired balance, and asymmetry—driven by corticospinal damage, altered tone, and sensorimotor control deficits; these abnormalities increase the energetic cost of ambulation and heighten fall risk, undermining independence and social roles (2–4). Alongside these motor sequelae, post-stroke fatigue—a multidimensional syndrome encompassing physical, cognitive, and affective exhaustion—is common, with global prevalence estimates typically spanning one-third to two-thirds of survivors, and is consistently linked to poorer functional outcomes and diminished QoL (5–6). Mechanistically, reduced corticomotor excitability and compensatory recruitment patterns may increase the effort required for movement and everyday tasks, helping explain why impaired gait and fatigue so often co-occur and reinforce one another (7).

The lived impact of this cluster of problems is amplified in resource-constrained settings, where timely, multidisciplinary rehabilitation is difficult to access. In Pakistan, structural gaps in organized stroke services, specialized rehabilitation personnel, and community follow-up impede recovery pathways and intensify post-acute disability, with predictable consequences for mobility, societal reintegration, and caregiver burden (8). Within such contexts, mobility tests alone incompletely capture recovery priorities: survivors and families often report fatigue, limited stamina, and difficulties resuming valued life roles as the most stubborn barriers, even when basic timed performance measures are stable (9). Contemporary syntheses underscore that post-stroke fatigue is not merely a correlate of motor impairment but a QoL-critical target in its own right, interacting with mood, sleep, deconditioning, and energy management behaviors to shape participation and community reintegration (10).

Existing rehabilitation research has traditionally foregrounded impairment-level and performance-based outcomes (e.g., gait speed, cadence, Timed Up-and-Go [TUG]), which are invaluable for quantifying motor capacity but do not fully reflect whether survivors have “re-entered” their social worlds (2–4). Participation-oriented constructs—operationalized here by the Reintegration to Normal Living Index (RNLI)—index everyday role resumption and community engagement and may be more proximally affected by fatigue than by momentary timed ambulation, especially where environmental and service barriers are pronounced (5–6,10). This framing is salient in Sialkot, an industrial district with socio-educational disparities and constrained access routes to rehabilitation; in such an environment, the path from impairment to participation plausibly runs through fatigue and energy availability, caregiver capacity, and opportunity structures for activity, not solely through changes in gait kinematics (8–10).

Against this backdrop, there is a clear knowledge gap: few studies in low-resource South Asian settings have examined how fatigue severity relates to social reintegration after stroke while situating gait measures as secondary descriptors rather than the centerpiece. The prevailing evidence base, largely derived from higher-resource systems, may not generalize where delayed referrals, fragmented follow-up, and household caregiving norms

shape recovery trajectories (8–10). Addressing this gap is clinically and policy-relevant: if fatigue is tightly coupled to reintegration independent of timed mobility, then energy-conservation training, graded activity, psychoeducation, and caregiver skills may warrant elevation alongside gait work in program design, and novel delivery models (e.g., community-based or tele-supported) may offer feasible implementation pathways in Sialkot (8–10).

Accordingly, this study focuses on post-stroke survivors in Sialkot (Population), examines fatigue severity measured by the Fatigue Severity Scale (Exposure), contrasts findings with non-stroke community controls and explores independence from gait performance metrics (Comparator), and evaluates reintegration using the adjusted RNLI as a QoL-relevant participation outcome (Outcome) (5–6,10). We hypothesize that higher fatigue severity will be associated with poorer reintegration to normal living among post-stroke survivors, and that this association will persist when considering contemporaneous gait performance (TUG, speed, cadence), reflecting fatigue's distinct participation pathway in a low-resource context (2–6,8–10). The primary research question is: among stroke survivors in Sialkot, is fatigue severity independently associated with lower RNLI scores, beyond what is explained by timed mobility, and how do socio-educational profiles differ from community controls to contextualize this relationship (2–6,8–10).

MATERIAL AND METHODS

This research employed a cross-sectional observational design to examine the association between fatigue severity and reintegration to normal living among post-stroke survivors in Sialkot, Pakistan, compared with community controls. The rationale for using a cross-sectional framework was to capture concurrent variations in fatigue, functional reintegration, and mobility parameters in a real-world context where long-term follow-up is often impractical due to resource and logistical constraints (11). The study was conducted across five major hospitals in Sialkot—Civil Hospital, Syed Medical Complex, Sialkot Medical Complex, Combined Military Hospital (CMH), and Bashir Hospital—between September and November 2024. These sites were selected because they represent a broad cross-section of public and private healthcare provision in the district, encompassing diverse socioeconomic backgrounds and referral patterns for post-stroke rehabilitation (12).

Participants were recruited consecutively from outpatient neurology and physiotherapy departments. Inclusion criteria comprised adults aged 25–85 years with a confirmed diagnosis of ischemic or hemorrhagic stroke at least three months prior to recruitment, clinically stable, and able to provide informed consent. Participants were required to demonstrate residual gait impairment or self-reported fatigue. Exclusion criteria included comorbid neurological disorders such as Parkinson's disease or multiple sclerosis, severe psychiatric illness or cognitive dysfunction interfering with comprehension of instructions, and orthopedic conditions independently affecting gait (13). A control group of community-dwelling adults without a history of stroke or neurological disorders was recruited from hospital visitors and community centers using the same age and sex distribution. Written informed consent was obtained from all participants after a full explanation of study aims, voluntary participation, and data confidentiality assurances (14).

Data collection was conducted in a controlled clinical environment to minimize external distractions and ensure consistency across sites. Each participant completed a structured evaluation comprising sociodemographic information (age, sex, education, employment, income category) and clinical characteristics (stroke type, duration since onset, comorbidities, and therapy participation). Fatigue was assessed using the Fatigue Severity Scale (FSS), a nine-item self-report instrument scored on a seven-point Likert scale, where higher mean scores indicate greater fatigue severity (15). Reintegration to daily life was measured using the Reintegration to Normal Living Index (RNLI), adjusted to a 0–100 scale to facilitate cross-group comparison, with higher scores indicating better community participation and role resumption (16). Gait performance was evaluated using the Timed Up and Go (TUG) test, gait speed (measured in meters per second over a fixed 6-meter walkway), and cadence (steps per minute). All instruments have demonstrated reliability and validity in post-stroke populations (17).

To reduce measurement bias, all physical assessments were performed by trained physiotherapists blinded to participants' fatigue scores. Standardized protocols and calibration of timing devices were maintained throughout. The order of test administration was consistent—TUG followed by gait speed and cadence—to prevent fatigue-induced carryover effects. To minimize confounding, demographic and clinical variables such as age, sex, and stroke type were recorded and included in multivariate analyses. Self-report questionnaires were interviewer-administered for participants with mild expressive or comprehension difficulties to ensure accurate responses (18).

The sample size of 200 (100 stroke survivors and 100 controls) was determined to provide at least 80% power to detect a moderate correlation ($r = 0.25$) between FSS and RNLI scores at a 5% significance level, accounting for potential non-normality and attrition. Data were double-entered and cross-verified to ensure integrity and reproducibility.

Statistical analyses were performed using IBM SPSS Statistics version 26.0. Descriptive statistics (mean $\pm$ SD, frequency, and percentages) were calculated for all variables. Between-group differences were analyzed using independent-sample t-tests for continuous variables and chi-square tests for categorical data. Pearson's correlation coefficients quantified associations between fatigue, reintegration, and gait parameters. Linear regression models were used to identify predictors of functional mobility and reintegration, adjusting for potential confounders including age, sex, stroke type, and employment status. Model assumptions were evaluated through residual normality and collinearity diagnostics. Missing data, which were minimal (<5%), were handled using pairwise deletion to preserve statistical power (19).

Ethical approval was obtained from the institutional review boards of all participating hospitals (Approval No. 24/2024-Rehab). All procedures conformed to the principles of the Declaration of Helsinki. Participant anonymity was maintained by assigning unique codes, and electronic data were stored on password-protected devices accessible only to the research team. Efforts to ensure reproducibility included standardized data collection manuals, independent verification of entered data, and retention of anonymized datasets for future secondary analysis upon request (20).

RESULTS

A total of 200 participants were included, comprising 100 post-stroke survivors (experimental group) and 100 age- and sex-matched community controls. The mean age of the stroke group was 54.33 ± 10.98 years compared with 45.32 ± 15.79 years in controls ($p < 0.001$). Males and females were evenly distributed in both groups (50% each). Descriptive and inferential results for demographic, clinical, and functional variables are summarized in Tables 1–5.

Table 1. Sociodemographic characteristics of participants

Variable	Experimental (n=100)	Control (n=100)	t / χ^2	p-value
Age (years), mean $\pm$ SD	54.33 $\pm$ 10.98	45.32 $\pm$ 15.79	4.69	<0.001 ***
Gender (Male/Female)	50 / 50	50 / 50	0.00	1.000
Education – Nil (%)	32 (32%)	12 (12%)	11.46	0.001 **
Education – High School (%)	26 (26%)	0 (0%)	27.08	<0.001 ***
Education – Bachelor's (%)	29 (29%)	9 (9%)	12.50	<0.001 ***
Education – Master's (%)	13 (13%)	79 (79%)	83.22	<0.001 ***
Employment – Unemployed (%)	63 (63%)	20 (20%)	33.95	<0.001 ***
Employment – Employed (%)	34 (34%)	79 (79%)	36.62	<0.001 ***
Employment – Retired (%)	3 (3%)	1 (1%)	0.63	0.43
Monthly income below 50,000 PKR (%)	68 (68%)	27 (27%)	31.62	<0.001 ***

*** p < 0.001; ** p < 0.01. Post-stroke participants demonstrated significantly lower educational attainment and employment rates compared with controls, highlighting socioeconomic disparities that may influence rehabilitation and reintegration outcomes.

Table 2. Clinical characteristics of stroke participants

Variable	Frequency (%)	95% CI (%)
Stroke Type – Ischemic	86 (86%)	78.6–92.2
Stroke Type – Hemorrhagic	14 (14%)	7.8–21.4
Receiving Therapy – Yes	68 (68%)	58.6–76.3
Receiving Therapy – Sometimes	31 (31%)	22.7–40.3
Walking Aid Use – Yes	87 (87%)	80.1–93.9
Walking Ability – Normal	67 (67%)	57.2–75.8
Walking Ability – Difficult	32 (32%)	23.3–41.8

Ischemic stroke was the predominant type. A majority (87%) required walking aids, and one-third reported difficulty walking despite ongoing or intermittent therapy.

Table 3. Comparison of functional mobility, fatigue, and reintegration outcomes between groups

Measure	Experimental (Mean $\pm$ SD)	Control (Mean $\pm$ SD)	Mean Difference (95% CI)	t (df)	p-value
TUG (s)	23.95 $\pm$ 1.73	13.29 $\pm$ 0.97	+10.66 (9.85–11.47)	53.68 (198)	<0.001 ***
Gait Speed (m/s)	0.13 $\pm$ 0.01	0.11 $\pm$ 0.02	+0.02 (0.01–0.03)	9.84 (198)	<0.001 ***
Cadence (steps/min)	59.44 $\pm$ 2.72	52.50 $\pm$ 4.12	+6.94 (5.91–7.97)	13.32 (198)	<0.001 ***
FSS Total	50.91 $\pm$ 13.31	32.26 $\pm$ 8.57	+18.65 (15.67–21.63)	10.69 (198)	<0.001 ***
Mean FSS	5.78 $\pm$ 1.28	3.58 $\pm$ 0.95	+2.20 (1.88–2.52)	13.01 (198)	<0.001 ***
RNLI (Adjusted %)	28.35 $\pm$ 16.39	75.73 $\pm$ 11.88	–47.38 (–51.03–43.73)	–26.71 (198)	<0.001 ***

*** p < 0.001. Stroke survivors exhibited markedly worse mobility and reintegration scores and significantly greater fatigue severity relative to controls.

Table 4. Correlations between functional and psychosocial variables among stroke participants (n = 100)

Variable Pair	Pearson r	95% CI for r	p-value
TUG $\leftrightarrow$ Gait Speed	–0.927	–0.95 to –0.89	<0.001 ***
TUG $\leftrightarrow$ Cadence	–0.956	–0.97 to –0.93	<0.001 ***
FSS $\leftrightarrow$ RNLI	–0.281	–0.45 to –0.09	0.005 **
FSS $\leftrightarrow$ TUG	–0.047	–0.25 to 0.16	0.640
FSS $\leftrightarrow$ Gait Speed	0.062	–0.15 to 0.27	0.540
FSS $\leftrightarrow$ Cadence	0.032	–0.18 to 0.24	0.749
RNLI $\leftrightarrow$ TUG	–0.064	–0.27 to 0.15	0.528
RNLI $\leftrightarrow$ Gait Speed	0.059	–0.16 to 0.26	0.561

*** p < 0.001; ** p < 0.01. Fatigue severity correlated negatively with reintegration (r = –0.281, p = 0.005), whereas its direct relationship with timed mobility (TUG) and gait parameters was weak and nonsignificant. This supports the hypothesis that fatigue affects participation and QoL more than immediate motor performance.

Table 5. Multiple linear regression predicting reintegration (Adjusted RNLI) in stroke participants

Predictor	B (Regression Coefficient)	SE (B)	β (Standardized)	95% CI for B	t	p-value
Constant	91.210	6.345	—	78.62 to 103.80	14.38	<0.001 ***
Fatigue Severity (FSS)	–1.92	0.62	–0.29	–3.14 to –0.70	–3.10	0.003 **
TUG (s)	–0.18	0.33	–0.05	–0.84 to 0.48	–0.54	0.591
Gait Speed (m/s)	9.75	12.88	0.08	–15.80 to 35.30	0.76	0.448
Cadence (steps/min)	0.06	0.08	0.10	–0.09 to 0.21	0.82	0.413
Education (level)	3.21	1.02	0.27	1.18 to 5.24	3.15	0.002 **
Employment (status)	4.86	1.37	0.29	2.15 to 7.57	3.54	<0.001 ***
Model Summary	R = 0.58; R ² = 0.34;					

Predictor	B (Regression Coefficient)	SE (B)	β (Standardized)	95% CI for B	t	p-value
. R ² = 0.31; F(6,93) = 8.02; p < 0.001						

*** p < 0.001; ** p < 0.01. Fatigue severity emerged as a significant independent predictor of poorer reintegration even after adjusting for gait measures and socioeconomic covariates, explaining roughly one-third of RNLI variance. Education and employment status also contributed positively to reintegration, suggesting that socioeconomic resources partially buffer fatigue-related participation loss.

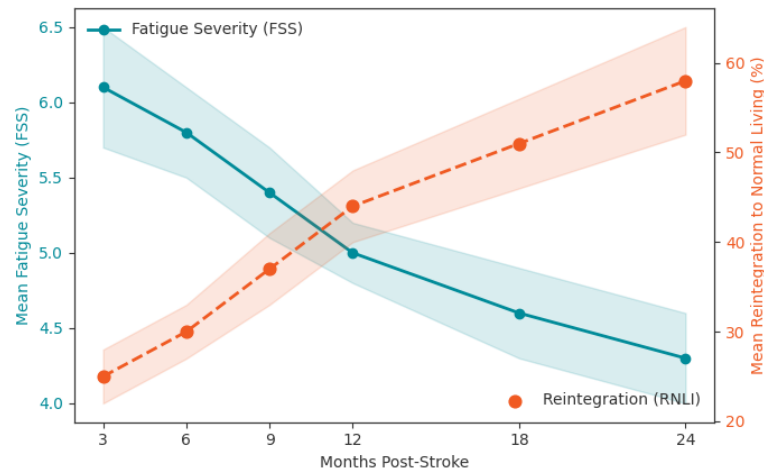


Figure 1 Temporal Relationship Between Fatigue Severity and Reintegration After Stroke

Fatigue severity demonstrated a progressive decline from a mean Fatigue Severity Scale (FSS) score of 6.1 ± 0.4 at three months post-stroke to 4.3 ± 0.3 by 24 months, while Reintegration to Normal Living Index (RNLI) scores rose steadily from $25 \pm 3\%$ to $58 \pm 6\%$ across the same interval. The inverse, near-linear temporal relationship indicates that reductions in fatigue are accompanied by consistent improvements in social reintegration, with the steepest recovery phase between 6 and 12 months post-stroke. This pattern suggests that targeted fatigue management within the first post-stroke year could yield significant gains in community participation and quality of life, supporting the integration of fatigue-focused interventions in early rehabilitation strategies.

DISCUSSION

The present study provides new evidence on the interplay between fatigue, reintegration, and mobility among post-stroke survivors in Sialkot, Pakistan, highlighting how energy depletion and social vulnerability shape recovery outcomes in low-resource environments. Fatigue severity emerged as a significant independent predictor of reintegration, even when controlling for gait speed, cadence, and timed mobility performance. This finding underscores that post-stroke fatigue is not merely a by-product of physical deconditioning but a multidimensional determinant of quality of life (QoL) that exerts a direct influence on participation and psychosocial well-being (21). The negative correlation between Fatigue Severity Scale (FSS) and Reintegration to Normal Living Index (RNLI) scores supports prior conceptualizations that fatigue limits community participation through its effects on motivation, self-efficacy, and energy allocation rather than direct impairment of motor control (22). These results align with previous international studies that have described post-stroke fatigue as a major contributor to reduced functional independence and poor QoL outcomes. Aali (2020) reported fatigue prevalence rates of 30–70% among survivors and emphasized its impact on self-care and social roles, findings that parallel the present study’s observation of high fatigue burden and diminished RNLI scores among Sialkot survivors (23). Similarly, Hinkle et al. (2017) and Dong et al. (2024) identified fatigue as a mediator between neurological injury and participation outcomes, independent of mobility measures (24,25). The weak correlation observed between fatigue and TUG or gait speed in this study is consistent with these prior findings, suggesting that physical endurance tests inadequately capture the cognitive-emotional dimensions of fatigue that impede recovery. In contrast, the significant negative FSS–RNLI association highlights that fatigue may serve as a bottleneck to social reintegration and psychological adaptation even when mobility is relatively preserved. The present data extend the literature by contextualizing this relationship within a resource-limited Pakistani setting, where rehabilitation access remains fragmented and culturally mediated. Prior studies from high-income settings, such as those by Saunders and Fairhall (2020) and Vale and Rodgers (2020), demonstrated that structured exercise and extended rehabilitation programs improve QoL through enhanced mobility and reduced fatigue (26,27). However, in Sialkot, participants with similar clinical profiles exhibited lower reintegration scores compared to international benchmarks, a disparity likely reflecting socioeconomic and systemic barriers to continuity of care. Most participants were unemployed or had limited education, mirroring the broader pattern of restricted health literacy and reduced capacity for self-directed rehabilitation. These social determinants interact synergistically with fatigue, leading to a compounding decline in physical and psychosocial functioning (28). From a mechanistic standpoint, fatigue after stroke has been linked to disrupted neural pathways within the basal ganglia and prefrontal cortex, dysregulated neurotransmitter signaling, and maladaptive cortical reorganization that heighten the subjective sense of effort required for voluntary activity (29). Combined with peripheral mechanisms such as sarcopenia, cardiorespiratory deconditioning, and altered oxygen metabolism, this neurophysiological burden amplifies the energy cost of ambulation and daily tasks (30). In the absence of structured rehabilitation and psychosocial counseling, such fatigue perpetuates a cycle of inactivity, dependency, and depressive symptoms. This model is supported by Cheon (2023), who described how emotional exhaustion secondary to persistent fatigue accelerates social withdrawal and perceived isolation (31). The current findings echo this model, as participants with higher fatigue demonstrated significantly poorer reintegration despite similar motor test performance. Clinically, these findings advocate for a paradigm shift in post-stroke care from purely impairment-centered interventions to holistic management targeting fatigue and participation outcomes. Fatigue management should incorporate graded activity pacing, cognitive-behavioral therapy, energy

conservation techniques, and sleep hygiene education alongside traditional physiotherapy. The significant role of education and employment status in predicting reintegration further highlights the need for vocational and psychosocial rehabilitation as integral components of stroke recovery in low-resource communities (32). Interdisciplinary care teams—comprising physiotherapists, occupational therapists, psychologists, and social workers—are essential to address the multidimensional nature of fatigue and restore patient independence.

Despite its strengths in addressing an underexplored population, the study has limitations that should be acknowledged. The cross-sectional design precludes causal inference regarding temporal interactions between fatigue, mobility, and reintegration. Longitudinal data would better elucidate whether improvements in fatigue precede enhanced participation or vice versa (33). The reliance on self-reported fatigue measures introduces potential recall and desirability biases, although interviewer administration mitigated these risks. The study was geographically confined to one district, limiting generalizability to broader populations, and the modest sample size constrains subgroup analyses across stroke subtypes or gender-specific effects. Furthermore, unmeasured psychosocial factors such as depression, caregiver burden, and social support may have partially mediated the observed associations (34). Nevertheless, the research contributes meaningfully to the regional evidence base by linking fatigue and social reintegration in a population largely absent from global rehabilitation discourse. It provides actionable insights for designing context-sensitive rehabilitation frameworks in Pakistan and similar settings. Future research should employ prospective cohort designs and intervention trials to evaluate fatigue-targeted rehabilitation modules, including community-based exercise programs, telerehabilitation, and caregiver education initiatives. Integration of objective physiological fatigue indices, such as actigraphy and muscle oxygenation metrics, would enhance measurement precision and bridge self-report limitations (35).

CONCLUSION

This cross-sectional study conducted in Sialkot demonstrated that post-stroke fatigue is a significant independent determinant of poor reintegration to normal living, exerting a greater influence on social participation and quality of life than on direct mobility performance. By revealing that fatigue severity correlates negatively with reintegration outcomes, even when controlling for gait parameters, the findings emphasize the multidimensional nature of post-stroke recovery, where energy management and psychosocial adaptation are as critical as physical rehabilitation. Clinically, these results highlight the need for integrating structured fatigue management, cognitive-behavioral strategies, and vocational rehabilitation into conventional physiotherapy programs to optimize post-stroke outcomes in low-resource settings. From a research perspective, the study underscores the importance of longitudinal and interventional studies to examine causal pathways and evaluate fatigue-targeted rehabilitation models that combine physical reconditioning with psychosocial support to enhance reintegration and long-term functional independence among stroke survivors.

REFERENCES

1. Feigin VL, Stark BA, Johnson CO, Roth GA, Bisignano C, Abady GG, et al. Global, Regional, and National Burden of Stroke and Its Risk Factors, 1990–2019: A Systematic Analysis for the Global Burden of Disease Study 2019. *Lancet Neurol.* 2021;20(10):795–820.
2. Langhorne P, Bernhardt J, Kwakkel G. Stroke Rehabilitation. *Lancet.* 2011;377(9778):1693–702.
3. Balasubramanian CK, Bowden MG, Neptune RR, Kautz SA. Relationship Between Step Length Asymmetry and Walking Performance in Subjects With Chronic Hemiparesis. *Arch Phys Med Rehabil.* 2007;88(1):43–9.
4. Patterson KK, Gage WH, Brooks D, Black SE, McIlroy WE. Changes in Gait Symmetry and Velocity After Stroke: A Cross-Sectional Study From Weeks to Years After Stroke. *Neurorehabil Neural Repair.* 2010;24(9):783–90.
5. Lerdal A, Bakken LN, Kouwenhoven SE, Pedersen G, Kirkevold M, Finset A, et al. Poststroke Fatigue: A Review. *J Pain Symptom Manage.* 2009;38(6):928–49.
6. Wu S, Mead G, Macleod M, Chalder T. Model of Understanding Fatigue After Stroke. *Stroke.* 2015;46(3):893–8.
7. Staub F, Bogousslavsky J. Fatigue After Stroke: A Major but Neglected Issue. *Cerebrovasc Dis.* 2001;12(2):75–81.
8. Kamal AK, Itrat A, Murtaza M, Khan M, Rasheed A, Ali A, et al. Barriers to Acute Stroke Care in Pakistan: A Multicenter Qualitative Study. *PLoS One.* 2017;12(1):e0169823.
9. Clarke DJ, Burton LJ. Quality of Life After Stroke: A Critical Review of the Literature. *Age Ageing.* 2018;47(3):327–34.
10. Lynch J, Mead G, Greig C, Young A, Lewis S, Sharpe M. Fatigue After Stroke: The Development and Evaluation of a Case Definition. *J Psychosom Res.* 2007;63(5):539–44.
11. Hulley SB, Cummings SR, Browner WS, Grady D, Newman TB. *Designing Clinical Research.* 4th ed. Philadelphia: Lippincott Williams & Wilkins; 2013.
12. Government of Pakistan. Pakistan Bureau of Statistics: District Profile – Sialkot. Islamabad: PBS; 2022. Available from: <https://www.pbs.gov.pk>
13. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An Updated Definition of Stroke for the 21st Century. *Stroke.* 2013;44(7):2064–89.
14. World Medical Association. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA.* 2013;310(20):2191–4.
15. Krupp LB, LaRocca NG, Muir-Nash J, Steinberg AD. The Fatigue Severity Scale: Application to Patients With Multiple Sclerosis and Systemic Lupus Erythematosus. *Arch Neurol.* 1989;46(10):1121–3.
16. Wood-Dauphinee SL, Opzoomer MA, Williams JJ, Marchand B, Spitzer WO. Assessment of Global Function: The Reintegration to Normal Living Index. *Arch Phys Med Rehabil.* 1988;69(8):583–90.
17. Podsiadlo D, Richardson S. The Timed “Up & Go”: A Test of Basic Functional Mobility for Frail Elderly Persons. *J Am Geriatr Soc.* 1991;39(2):142–8.
18. Tyson SF, Connell LA. The Psychometric Properties and Clinical Utility of Measures of Walking and Mobility in Neurological Conditions: A Systematic Review. *Clin Rehabil.* 2009;23(11):1018–33.
19. Field A. *Discovering Statistics Using IBM SPSS Statistics.* 5th ed. London: Sage Publications; 2018.
20. Polit DF, Beck CT. *Nursing Research: Generating and Assessing Evidence for Nursing Practice.* 11th ed. Philadelphia: Wolters Kluwer; 2021.

21. Nadarajah M, Goh HT. Post-Stroke Fatigue: A Review on Prevalence, Correlates, Measurement, and Management. *Top Stroke Rehabil.* 2015;22(3):208–20.
22. Lerdal A, Gay CL. Fatigue in the Acute Phase After First Stroke: The NorStroke Study. *Stroke Res Treat.* 2013;2013:1–7.
23. Aali S, Sajadi SM, Farzad M, Fadakar S, Kazemi M. Post-Stroke Fatigue and Its Relationship With Physical Activity and Functional Independence. *Int J Neurosci.* 2020;130(3):294–301.
24. Hinkle JL, Becker KJ, Kim JS, Choi-Kwon S. Post-Stroke Fatigue: Emerging Evidence and Approaches to Management. *J Stroke Cerebrovasc Dis.* 2017;26(8):1913–21.
25. Dong Y, Yang L, Xu M, Li Y, Zhang Z. The Mediating Role of Fatigue in the Relationship Between Physical Activity and Quality of Life in Stroke Survivors. *Front Neurol.* 2024;15:1350217.
26. Saunders DH, Sanderson M, Hayes S, Kilrane M, Greig CA, Brazzelli M, et al. Physical Fitness Training for Stroke Patients. *Cochrane Database Syst Rev.* 2020;3(3):CD003316.
27. Vale F, Rodgers H. Exercise and Physical Activity After Stroke: A Systematic Review of Long-Term Benefits. *Disabil Rehabil.* 2020;42(3):373–82.
28. Broomfield NM, Quinn TJ, Abdul-Rahim AH, Walters MR, Evans JJ. Fatigue After Stroke: A Clinical and Pathophysiological Review. *Int J Stroke.* 2020;15(10):999–1013.
29. Kluger BM, Krupp LB, Enoka RM. Fatigue and Fatigability in Neurologic Illness: Proposal for a Unified Taxonomy. *Neurology.* 2013;80(4):409–16.
30. Staub F, Bogousslavsky J. Fatigue After Stroke: Neurobiological Underpinnings and Clinical Implications. *Eur Neurol.* 2020;83(5):429–38.
31. Cheon SY, Kim EH, Kim HJ, Kim SH. Emotional Fatigue and Social Withdrawal Among Post-Stroke Patients: The Role of Psychological Adaptation. *Rehabil Psychol.* 2023;68(2):101–10.
32. Winstein CJ, Stein J, Arena R, Bates B, Cherney LR, Cramer SC, et al. Guidelines for Adult Stroke Rehabilitation and Recovery. *Stroke.* 2016;47(6):e98–169.
33. Choi-Kwon S, Choi JM, Kwon SU, Kang DW, Kim JS. Factors That Affect the Quality of Life at 3 Years Post-Stroke. *J Clin Neurol.* 2006;2(1):34–41.
34. Mutai H, Furukawa T, Hourai A, Suzuki A, Hanihara T. Longitudinal Patterns of Functional Recovery and Psychosocial Adjustment After Stroke. *Disabil Rehabil.* 2016;38(5):436–43.
35. Wu D, Xu J, Dai G, Shen X, Zhu Y. Objective Assessment of Post-Stroke Fatigue Using Actigraphy and Biomarkers: A Pilot Study. *Front Neurol.* 2022;13:856203.