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LINK MEDICAL INTERFACE

Quality of Life Profiles in Brain Stroke Survivors Versus Community Controls: A Case–Control Study from an Under-Resourced District Hospital

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ABSTRACT

Background: Brain stroke is a leading cause of disability and mortality globally, profoundly impacting quality of life (QOL), particularly in under-resourced settings like rural Pakistan where rehabilitation access is limited. Few studies provide case-control comparisons of QOL, cognitive function, and functional independence in district-level hospitals, leaving gaps in understanding localized deficits and screening strategies. Objective: To compare QOL, cognitive function, and functional independence between stroke survivors and community controls at a district hospital in Narowal, Pakistan, and identify simple screening thresholds for low QOL. Methods: In a case-control study from September to November 2023 at District Head Quarter Hospital Narowal, 100 stroke survivors and 100 community controls were assessed using the WHOQOL-BREF, Montreal Cognitive Assessment (MoCA), and Barthel Index (BI). Independent t-tests, two-way ANOVA for age-stratified effects, and ROC analyses were conducted to compare groups and derive cut-offs for low QOL (≤25th percentile of control scores). Results: Stroke survivors showed significantly lower scores across all WHOQOL-BREF domains ($p<0.01$, Cohen's $d=1.57–3.02$), MoCA (mean=15.35 vs. 29.15, $p<0.001$), and BI (mean=44.90 vs. 98.55, $p<0.001$), with older survivors (age >65) exhibiting steeper QOL declines ($p<0.05$). MoCA cut-offs (15–18) and BI cut-offs (45–55) achieved AUCs of 0.75–0.87 for detecting low QOL. Conclusion: Stroke survivors in rural Pakistan face substantial QOL, cognitive, and functional deficits, accentuated by age, necessitating accessible screening and targeted rehabilitation to improve outcomes. Keywords: Stroke, Quality of Life, Cognitive Impairment, Functional Independence, Case-Control Study, Pakistan

Keywords
Aphasia, Constraint-Induced Language Therapy, Stroke Rehabilitation, Neuroplasticity, Speech Therapy, Low-Resource Settings

INTRODUCTION

Brain stroke, also known as cerebrovascular accident (CVA), represents a major global health challenge, characterized by the sudden interruption of blood supply to the brain, leading to cell death and profound functional impairments (1). As the second leading cause of death and a primary contributor to long-term disability worldwide, stroke affects approximately 15 million individuals annually, with survivors often experiencing deficits in physical, psychological, social, and environmental domains of quality of life (QOL) (2). In low- and middle-income countries like Pakistan, the burden is exacerbated by high prevalence of risk factors such as hypertension, diabetes, and socioeconomic disparities, resulting in an estimated annual incidence of 250 per 100,000 population and over 350,000 new cases each year (3). Stroke survivors frequently report reduced autonomy, cognitive decline, and dependency in activities of daily living (ADLs), which collectively diminish their overall well-being and impose substantial societal costs (4). Despite advances in acute stroke management, post-stroke QOL remains suboptimal, particularly in under-resourced settings where access to rehabilitation is limited, highlighting the need for targeted assessments to inform resource allocation (5).

Existing literature underscores the multidimensional impact of stroke on QOL, with studies demonstrating associations between demographic factors like age and gender, clinical risks such as hypertension and diabetes, and functional outcomes including cognitive impairment and dependency (6). For instance, older age is linked to steeper declines in physical and cognitive recovery, while gender differences show women experiencing higher dependency and lower QOL due to biological and social factors (7). Cognitive deficits, assessed via tools like the Montreal Cognitive Assessment (MoCA), and functional independence, measured by the Barthel Index (BI), are strong predictors of poor QOL, with impairments in attention, memory, and ADLs correlating with reduced social engagement and emotional health (8). However, most evidence stems from high-income or urban hospital settings, with limited case-control comparisons from district-level facilities in resource-constrained regions like rural Pakistan, where stroke incidence is rising amid inadequate follow-up care (9). This gap is critical, as community-based controls can provide benchmarks for normative QOL, revealing the true extent of deficits and informing screening strategies without relying on complex multivariable models (10).

The current study addresses this knowledge deficit by employing a case-control design to profile QOL deficits in stroke survivors from an under-resourced district hospital in Pakistan, contrasting them with matched community controls. By focusing on domain-wise comparisons using the World Health Organization Quality of Life-BREF (WHOQOL-BREF), alongside MoCA and BI, we aim to quantify group differences, explore

age-stratified effects, and derive simple screening thresholds for low QOL. This approach justifies the need for pragmatic, clinic-friendly tools in low-resource environments, where early identification of at-risk survivors could prioritize rehabilitation and support services (11). Grounded in the PICO framework—Population: adult stroke survivors and community controls; Intervention/Exposure: post-stroke status; Comparison: controls without neurological disorders; Outcome: QOL domains, cognition, and independence—the study seeks to enhance understanding of stroke's localized impact in underserved areas.

The primary aim is to compare WHOQOL-BREF domain scores, MoCA, and BI between stroke survivors and community controls. Secondary aims include quantifying age-related gradients in QOL by group and identifying optimal cut-offs on MoCA and BI for discriminating low QOL in stroke survivors from a screening perspective. We hypothesize that stroke survivors will exhibit significantly lower scores across all measures compared to controls, with steeper age-related declines, and that simple thresholds will offer high utility for clinical triage.

MATERIAL AND METHODS

This case-control study was designed to compare quality of life (QOL) profiles, cognitive function, and functional independence between brain stroke survivors and community controls, providing a rationale for identifying domain-specific deficits and pragmatic screening thresholds in an under-resourced setting where such comparative data are scarce, thereby informing targeted rehabilitation strategies. The study was conducted at the District Head Quarter (DHQ) Hospital in Narowal, Punjab, Pakistan, located on Circular Road near Jassar Bypass, with participant recruitment and data collection occurring from September to November 2023. Cases comprised 100 adult brain stroke survivors selected consecutively from the hospital's neurology outpatient clinics and inpatient wards, while controls consisted of 100 community members drawn from family members of patients, hospital staff, neighbors, and university students in the same district to ensure geographic and socioeconomic comparability. Eligibility for cases required a confirmed diagnosis of brain stroke via clinical records or imaging, age above 18 years, and ability to provide informed consent or participate with proxy assistance; exclusion criteria included severe cognitive impairments precluding questionnaire completion, unconscious state, or comorbid terminal illnesses. Controls were eligible if aged above 18 years and free of any neurological disorders, with exclusions for self-reported history of stroke, dementia, or other conditions affecting cognition or QOL; selection aimed for broad representation across age ranges to mirror potential population norms without formal matching to preserve feasibility in a resource-limited environment.

Recruitment involved approaching eligible stroke survivors during routine follow-up visits or hospital admissions, with community controls identified opportunistically through referrals from hospital contacts to minimize selection bias, and all participants provided written informed consent after receiving verbal explanations of the study purpose, procedures, risks, and benefits in Urdu or Punjabi as needed. Data collection occurred in a single session per participant, lasting approximately 45-60 minutes, conducted in private hospital rooms for cases or neutral community settings for controls to ensure confidentiality and reduce environmental bias; trained researchers administered standardized instruments face-to-face, with proxies assisting for stroke survivors exhibiting mild communication difficulties. Key instruments included the World Health Organization Quality of Life-BREF (WHOQOL-BREF) scale, a 26-item tool assessing four QOL domains (physical, psychological, social, and environmental) on a 5-point Likert scale, with domain scores transformed to a 0-100 range where higher values indicate better QOL (12); the Montreal Cognitive Assessment (MoCA), a 30-point screening tool evaluating domains such as visuospatial abilities, naming, memory, attention, language, abstraction, delayed recall, and orientation, with scores below 26 denoting mild cognitive impairment and adjustments adding one point for education less than 12 years (13); and the Barthel Index (BI), a 10-item measure of functional independence in activities of daily living (e.g., feeding, bathing, grooming, dressing, bowel and bladder control, toilet use, transfers, mobility, and stairs), scored from 0-100 with higher scores reflecting greater independence (14). Demographic variables were captured via a structured questionnaire, operationally defining age as continuous years, gender as binary (male/female), socioeconomic status as categorical (low/middle/high based on monthly income thresholds of <20,000 PKR, 20,000-50,000 PKR, >50,000 PKR), hypertension as self-reported or medically confirmed blood pressure ≥140/90 mmHg, and diabetes as self-reported or confirmed fasting blood glucose ≥126 mg/dL; low QOL was defined post hoc as scores ≤25th percentile of the control group distribution per domain for analytical purposes.

To address potential biases, researchers standardized administration protocols across groups, trained interviewers to avoid leading questions, and conducted data collection blinded to preliminary hypotheses where feasible; confounding was assessed by stratifying analyses for key variables like age (banded as ≤55, 56-65, >65 years) and descriptively examining gender, socioeconomic status, hypertension, and diabetes distributions between groups. The sample size of 200 participants (100 per group) was calculated a priori using G*Power software, assuming a medium effect size (Cohen's d=0.5) for group differences in primary outcomes based on prior stroke QOL studies, with 80% power and alpha=0.05, yielding a minimum of 64 per group and inflated to account for 20% potential attrition or incomplete data (15). Statistical analyses were performed using SPSS version 25, with descriptive statistics summarizing means, standard deviations, and frequencies; group comparisons employed independent samples t-tests for continuous variables, reporting Cohen's d effect sizes and 95% confidence intervals; age-stratified effects were examined via two-way analysis of variance (ANOVA) testing group-by-age band interactions, with partial eta squared (η^2) for effect magnitude; receiver operating characteristic (ROC) curves evaluated MoCA and BI cut-offs for classifying low QOL in stroke survivors, reporting area under the curve (AUC), Youden-optimal thresholds, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV); missing data, anticipated at <5% based on pilot testing, were handled via listwise deletion for complete-case analysis, with sensitivity checks using multiple imputation if exceedance occurred; no adjustments for confounders were applied beyond stratification to maintain focus on descriptive contrasts.

Ethical approval was obtained from the Institutional Review Board of the DHQ Hospital Narowal and the Medical Superintendent, with all procedures adhering to the Declaration of Helsinki; participant data were anonymized using unique identifiers, stored securely on password-protected servers, and accessed only by the research team to protect privacy. Reproducibility was ensured through detailed protocol documentation, including instrument versions and scoring algorithms, with raw data archived for potential verification and all analytical syntax shared upon request to facilitate independent replication.

RESULTS

This case-control study compared quality of life (QOL), cognitive function, and functional independence between 100 brain stroke survivors and 100 community controls at the District Head Quarter (DHQ) Hospital in Narowal, Pakistan, from September to November 2023. Data were collected using the World Health Organization Quality of Life-BREF (WHOQOL-BREF), Montreal Cognitive Assessment (MoCA), Barthel Index

(BI), and a demographic questionnaire. All analyses were conducted using SPSS version 25, with significance set at $p<0.05$. Descriptive statistics revealed distinct group profiles, with stroke survivors being older on average (mean age 63.11 years, SD=13.46) compared to controls (mean age 52.72 years, SD=15.66). Gender distribution showed 68% males in the stroke group versus 42% in controls, while socioeconomic status was predominantly middle-class (61% stroke, 81% controls). Hypertension prevalence was higher in stroke survivors (80%) than controls (36%), and diabetes was reported in 48% of stroke survivors versus 10% of controls (Table 1).

Group comparisons using independent samples t-tests demonstrated significant differences across all WHOQOL-BREF domains, MoCA, and BI scores (Table 2). Stroke survivors exhibited markedly lower QOL scores: physical domain (mean=38.33, SD=20.70 vs. 83.52, SD=15.25; $p<0.001$, Cohen's d=2.45), psychological domain (mean=41.52, SD=18.96 vs. 84.59, SD=14.15; $p=0.011$, d=2.56), social domain (mean=68.13, SD=15.93 vs. 89.64, SD=10.65; $p=0.002$, d=1.57), and environmental domain (mean=49.87, SD=14.55 vs. 88.41, SD=11.04; $p=0.008$, d=2.96). Cognitive function, assessed by MoCA, was significantly impaired in stroke survivors (mean=15.35, SD=7.97) compared to controls (mean=29.15, SD=2.28; $p<0.001$, d=2.28). Functional independence, measured by BI, was also lower in stroke survivors (mean=44.90, SD=23.87) versus controls (mean=98.55, SD=6.04; $p<0.001$, d=3.02). These large effect sizes underscore the profound impact of stroke on QOL, cognition, and independence in this setting.

Age-stratified analyses via two-way ANOVA explored group-by-age band interactions (≤55, 56–65, >65 years) for physical and psychological QOL domains (Table 3). Significant main effects for group ($p<0.001$) and age band ($p<0.01$) were observed, with stroke survivors showing steeper declines across age bands compared to controls. The interaction term was significant for the physical domain ($F=4.12$, $p=0.017$, partial $\eta^2=0.04$) and psychological domain ($F=3.89$, $p=0.022$, partial $\eta^2=0.04$), indicating that older stroke survivors experienced disproportionately worse QOL declines, particularly beyond age 65, compared to controls, whose scores remained relatively stable.

Receiver operating characteristic (ROC) analyses identified screening thresholds for MoCA and BI to classify low QOL (defined as ≤25th percentile of control group scores per WHOQOL-BREF domain) among stroke survivors (Table 4). For the physical domain, a MoCA cut-off of 16 yielded an AUC of 0.82 (95% CI: 0.74–0.90), with sensitivity=0.78, specificity=0.76, PPV=0.70, and NPV=0.83; a BI cut-off of 50 had an AUC of 0.85 (95% CI: 0.78–0.92), with sensitivity=0.80, specificity=0.79, PPV=0.73, and NPV=0.85. For the psychological domain, a MoCA cut-off of 15 achieved an AUC of 0.84 (95% CI: 0.76–0.91), with sensitivity=0.81, specificity=0.77, PPV=0.72, and NPV=0.85; a BI cut-off of 45 had an AUC of 0.87 (95% CI: 0.80–0.93), with sensitivity=0.83, specificity=0.80, PPV=0.75, and NPV=0.87. Social and environmental domain thresholds showed slightly lower discrimination (AUC range: 0.75–0.80), with MoCA cut-offs of 18 and 17, and BI cut-offs of 55 and 50, respectively, balancing sensitivity and specificity. These cut-offs offer pragmatic tools for identifying stroke survivors at risk of low QOL in busy clinical settings.

Table 1: Baseline Characteristics of Stroke Survivors and Community Controls

Variable	Stroke Group (n=100)	Control Group (n=100)
Age (years), Mean (SD)	63.11 (13.46)	52.72 (15.66)
Gender, n (%)		
Male	68 (68%)	42 (42%)
Female	32 (32%)	58 (58%)
Socioeconomic Status, n (%)		
Low	39 (39%)	19 (19%)
Middle	61 (61%)	81 (81%)
High	0 (0%)	0 (0%)
Hypertension, n (%)	80 (80%)	36 (36%)
Diabetes, n (%)	48 (48%)	10 (10%)

Table 2: Group Differences in WHOQOL-BREF Domains, MoCA, and BI

Variable	Stroke Group Mean (SD)	Control Group Mean (SD)	p-value	Cohen's d (95% CI)
Physical Domain	38.33 (20.70)	83.52 (15.25)	<0.001	2.45 (2.07–2.83)
Psychological Domain	41.52 (18.96)	84.59 (14.15)	0.011	2.56 (2.17–2.95)
Social Domain	68.13 (15.93)	89.64 (10.65)	0.002	1.57 (1.25–1.89)
Environmental Domain	49.87 (14.55)	88.41 (11.04)	0.008	2.96 (2.55–3.37)
MoCA	15.35 (7.97)	29.15 (2.28)	<0.001	2.28 (1.91–2.65)
BI	44.90 (23.87)	98.55 (6.04)	<0.001	3.02 (2.60–3.44)

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Table 3: Two-Way ANOVA Results for Group and Age Band Effects

Domain	Effect	F	p-value	Partial η²
Physical Domain				
Group	112.45	<0.001	0.36	
Age Band	8.76	0.001	0.08	
Group × Age Band	4.12	0.017	0.04	
Psychological Domain				
Group	105.32	<0.001	0.34	
Age Band	7.89	0.001	0.07	
Group × Age Band	3.89	0.022	0.04	

Table 4: ROC Metrics for MoCA and BI in Classifying Low QOL in Stroke Survivors

Domain	Measure	Cut-off	AUC (95% CI)	Sensitivity	Specificity	PPV	NPV
Physical	MoCA	16	0.82 (0.74–0.90)	0.78	0.76	0.70	0.83
Physical	BI	50	0.85 (0.78–0.92)	0.80	0.79	0.73	0.85
Psychological	MoCA	15	0.84 (0.76–0.91)	0.81	0.77	0.72	0.85
Psychological	BI	45	0.87 (0.80–0.93)	0.83	0.80	0.75	0.87
Social	MoCA	18	0.75 (0.66–0.84)	0.70	0.68	0.65	0.73
Social	BI	55	0.78 (0.69–0.87)	0.72	0.70	0.67	0.75
Environmental	MoCA	17	0.77 (0.68–0.86)	0.71	0.69	0.66	0.74
Environmental	BI	50	0.80 (0.71–0.89)	0.74	0.72	0.68	0.77

DISCUSSION

This case-control study from an under-resourced district hospital in rural Pakistan reveals profound deficits in quality of life (QOL), cognitive function, and functional independence among stroke survivors compared to community controls, with large effect sizes underscoring the clinical magnitude of these impairments. Stroke survivors exhibited significantly lower scores across all WHOQOL-BREF domains—physical, psychological, social, and environmental—aligning with global evidence that stroke profoundly disrupts multidimensional well-being through mechanisms such as neuronal damage leading to motor and sensory deficits, emotional dysregulation, and social isolation (16). The observed cognitive impairments, as measured by the Montreal Cognitive Assessment (MoCA), reflect post-stroke vascular cognitive decline, often exacerbated by underlying hypertension and diabetes prevalent in this cohort, which impair neuroplasticity and recovery pathways (17). Similarly, reduced Barthel Index (BI) scores indicate heightened dependency in activities of daily living, consistent with theoretical models where physical limitations perpetuate a cycle of deconditioning and reduced autonomy, further compounded by limited rehabilitation access in low-resource settings (18). These findings extend prior research from urban Pakistani centers, such as a cross-sectional study of 350 stroke survivor-caregiver dyads reporting low QOL linked to functional disability and depression, by providing the first case-control comparison from a district-level facility, highlighting even greater disparities in rural contexts where socioeconomic barriers amplify vulnerability (16).bmcneurol.biomedcentral.com

In comparison to international literature, the large Cohen's d values (ranging from 1.57 to 3.02) for group differences exceed those reported in high-income settings, where effect sizes for QOL deficits post-stroke are typically moderate due to better post-acute care, suggesting that underdeveloped healthcare infrastructure in Pakistan intensifies stroke's impact (19). For instance, while a descriptive study from Islamabad noted moderate QOL impairments in survivors aged 40-70 years, our inclusion of controls reveals a stark contrast, with survivors' physical domain scores nearly half those of controls, potentially attributable to delayed diagnosis and absent community rehabilitation, conflicting with milder deficits seen in resource-rich environments but agreeing with LMIC patterns where financial burdens and caregiver stress predominate (17). The age-stratified analyses demonstrate steeper QOL declines in older stroke survivors, particularly in physical and psychological domains, supporting neurobiological mechanisms like reduced cerebral reserve and comorbid frailty that accelerate post-stroke deterioration, advancing beyond cross-sectional observations in earlier Pakistani research by quantifying interaction effects (partial η^2=0.04) and emphasizing the need for age-tailored interventions (18). Clinically, these results underscore the relevance of integrating brief screening tools like MoCA and BI in district hospitals, where ROC-derived cut-offs (e.g., MoCA ≤15-18, BI ≤45-55) offer high sensitivity (0.70-0.83) for detecting low QOL, facilitating early triage to

CONCLUSION

This case-control study at District Head Quarter Hospital Narowal demonstrates substantial quality of life (QOL) deficits, cognitive impairment, and functional dependency among brain stroke survivors compared to community controls, with significant group differences across WHOQOL-BREF domains ($p<0.01$, Cohen's $d=1.57–3.02$), pronounced age-related declines in older survivors, and practical MoCA (cut-offs 15–18) and BI (cut-offs 45–55) thresholds for identifying low QOL risk; these findings highlight the urgent need for accessible screening and tailored

rehabilitation in under-resourced Pakistani settings to mitigate stroke's multidimensional impact, while calling for future research to validate these cut-offs longitudinally and explore scalable interventions to enhance post-stroke well-being (20).

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