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IMPACT OF STRUCTURED REHABILITATION ON QUALITY OF LIFE IN TRAUMATIC BRAIN INJURY PATIENTS AT TERTIARY CARE HOSPITALS IN PESHAWAR

Original Research

Amad Aziz[1], Bibi Asma[2], Sajjad Ahmad[1], Ayesha[3], Irfan Jan[4]*
[1]DPT, National College of Sciences, Pakistan.
[2]DPT, Visiting Lecturer, College of Physical Medicine and Rehabilitation, Paraplegic Center, Peshawar, Pakistan.
[3]Physiotherapist, Northwest General Hospital and Research Center, Peshawar, Pakistan.
[4]Registrar Neurosurgery, Northwest General Hospital and Research Center, Peshawar, Pakistan.
Corresponding Author: Irfan Jan, Registrar Neurosurgery, Northwest General Hospital and Research Center, Peshawar, Pakistan, Drirfanjan@gmail.com

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ABSTRACT

Background: Traumatic brain injury (TBI) remains a major public health burden worldwide, contributing significantly to long-term disability and mortality. In low- and middle-income countries such as Pakistan, the impact of TBI is further aggravated by frequent road traffic accidents, limited emergency care, and underdeveloped rehabilitation systems. Conventional assessments like the Glasgow Coma Scale often fail to capture the broader functional and psychosocial consequences faced by survivors. Addressing these gaps through structured rehabilitation may improve recovery outcomes.

Objective: To evaluate the effect of a structured rehabilitation program on cognitive, emotional, functional, and social domains of quality of life (QoL) in post-TBI patients attending tertiary care outpatient departments in Pakistan.

Methods: A descriptive cross-sectional study was conducted from June to December 2024 across three tertiary care hospitals in Peshawar. A total of 169 TBI patients aged 18–60 years were enrolled via convenience sampling. Participants underwent a standardized rehabilitation protocol comprising daily physical therapy (30 minutes, 5 days/week) and weekly psychological counseling (1 hour/session) over two months. QoL was assessed pre- and post-intervention using the QOLIBRI scale. A score <54 indicated poor QoL, while >84 indicated good QoL. Statistical analysis was performed using the Wilcoxon signed-rank test.

Results: Among the 169 patients, 78 (46.15%) were aged 18–30 years, and 105 (62.13%) were male. Post-rehabilitation, Mini-Mental Scale stupor ratings dropped from 59.1% to 14.2%, and cognitive impairments reduced from 47.93% to 11.83% ($p < 0.001$). Emotional difficulties declined from 33.73% to 15.38%, and impaired social relationships from 42.6% to 14.79% ($p < 0.001$). Total QOLIBRI scores showed significant improvement across all age and gender groups ($p < 0.001$).

Conclusion: Structured rehabilitation significantly improves cognitive, emotional, and functional outcomes in TBI patients. These findings advocate for the routine inclusion of multidisciplinary rehabilitation programs in outpatient care, particularly within resource-limited healthcare systems.

Keywords: Brain Injuries, Cognitive Dysfunction, Developing Countries, Quality of Life, Rehabilitation, Social Adjustment, Trauma Severity Indices.

INTRODUCTION

Traumatic brain injury (TBI) is increasingly recognized as a global public health concern, affecting over 60 million people annually and contributing significantly to disability, morbidity, and mortality across the world (1–3). While TBI affects all populations, its burden is particularly profound in low- and middle-income countries, including Pakistan, where high rates of road traffic accidents, limited access to acute trauma care, and under-resourced rehabilitation infrastructure amplify the consequences of injury (4). Traditionally, the severity of TBI has been classified using clinical indicators such as the Glasgow Coma Scale (GCS); however, such tools often fail to capture the full spectrum of long-term outcomes experienced by survivors. A growing body of evidence suggests that individuals—even those with mild TBI—frequently experience enduring cognitive, physical, emotional, and social impairments that interfere with their ability to reintegrate into daily life and substantially diminish their quality of life (QoL) (5). Despite notable improvements in emergency care and initial clinical management, many TBI survivors continue to face significant challenges well beyond the acute phase. Limitations in mobility, persistent cognitive dysfunction, psychological distress, and social withdrawal are among the common sequelae that compromise functional recovery. However, these issues are often underappreciated, especially in outpatient follow-up settings where clinical assessments tend to focus narrowly on physical healing rather than comprehensive rehabilitation (6). In Pakistan's tertiary care hospitals, a substantial number of TBI patients regularly attend neuro outpatient departments (OPDs), yet their long-term QoL is seldom evaluated in a structured or standardized manner. The absence of routine QoL assessments during follow-up care contributes to missed opportunities for early identification of individuals at risk for poor outcomes and delays the initiation of rehabilitative support (7–11).

The broader implications of these gaps in care are significant. Without a multidimensional understanding of how TBI affects individuals beyond the initial injury, healthcare systems are unable to allocate resources efficiently or design patient-centered interventions. This gap is particularly concerning in resource-constrained settings, where rehabilitation services are scarce and often inaccessible. In such environments, QoL-focused evaluations could serve as a vital tool to inform tailored management strategies and guide the integration of psychosocial, cognitive, and functional support into clinical pathways (12,13). Given the wide-ranging and often invisible burden borne by TBI survivors, there is a pressing need to reorient care from merely ensuring survival to achieving a quality survival that encompasses emotional well-being, social participation, and cognitive resilience. In light of these considerations, the present study seeks to evaluate the quality of life among post-TBI patients attending neuro OPDs at tertiary care hospitals in Pakistan. Specifically, it aims to identify the most impacted domains—physical, psychological, cognitive, and social—and to explore associations between these outcomes and relevant demographic and clinical variables. Through this investigation, the study aims to generate context-specific evidence that may support the routine integration of QoL assessments into follow-up care, thereby enhancing rehabilitation outcomes and informing the development of more holistic, patient-centered neuro-rehabilitation protocols.

METHODS

This descriptive cross-sectional study was conducted over a six-month period, from June 2024 to December 2024, in the neuro outpatient departments of three tertiary care hospitals in Peshawar, Pakistan. The study population included adult patients of both sexes, aged 18 to 60 years, who had sustained a traumatic brain injury (TBI) and were attending follow-up visits. A total of 169 participants were recruited using a convenience sampling method. The sample size was calculated using the Raosoft sample size calculator, based on a 5% margin of error, 95% confidence interval, 50% response distribution, and an assumed population size of 300, thereby ensuring sufficient statistical power for estimating quality of life (QoL) outcomes within this population. Eligibility criteria were clearly defined to maintain internal validity. Participants with a post-injury Glasgow Coma Scale (GCS) score greater than 8 were included, indicating moderate to mild TBI. Individuals with a pre-existing neurological disorder, severe psychiatric illness, or history of substance abuse were excluded to reduce confounding factors that might independently affect QoL scores (14). Ethical clearance for the study was obtained from the Institutional Research Committee and all participants provided written informed consent. The purpose and procedures of the study were explained in detail to both the participants and their attendants prior to enrollment. Data collection was conducted through face-to-face interviews during routine outpatient visits using the Quality of Life after Brain Injury (QOLIBRI) questionnaire, a validated, TBI-specific instrument for assessing health-related QoL. The QOLIBRI covers six domains: thinking ability, emotional well-being, independence in daily life, social relationships, self-perception, and physical problems. Domain-specific scores were first calculated and then transformed using the QOLIBRI Transformed Scale to derive a standardized total score ranging from 0 to 100, with higher scores indicating better QoL. A score below 60 was considered indicative of impaired QoL (12).

All enrolled participants received a structured rehabilitation program tailored to their functional status and psychological needs. Physical rehabilitation was initiated once medical stability was confirmed and included progressive therapeutic interventions, beginning with passive movements and advancing to active exercises. Techniques such as manual therapy, task-specific training, and Constraint-Induced Movement Therapy were employed. Sessions were held five days per week, lasting 30 minutes each during the initial rehabilitation phase. In parallel, psychological counseling was provided weekly in 60-minute sessions. These sessions addressed neurobehavioral issues such as disorientation and agitation and also targeted symptoms of anxiety and depression using techniques like mindfulness training and self-monitoring to enhance emotional regulation and self-awareness. Patients were reassessed two months after the intervention to evaluate changes in QoL. Follow-up assessments were conducted during routine visits by trained members of the research team. Data were manually entered and analyzed using IBM SPSS Statistics version 27.0. Descriptive statistics, including frequencies, means, and percentages, were used to summarize demographic and clinical characteristics. QoL outcomes were visualized using bar charts and tabular presentations. To assess pre- and post-intervention changes in QoL scores, the Wilcoxon signed-rank test was employed as the data did not follow a normal distribution.

RESULTS

A total of 169 participants were enrolled in the study, with 62.13% (n = 105) being male and 37.87% (n = 64) female. The majority of patients were relatively young, with 46.15% aged between 18 and 30 years. The remaining age groups included 18.34% between 31 and 40 years, 14.20% between 41 and 50 years, and 21.30% aged 51 years or above. Following the structured rehabilitation program, significant improvements were observed across multiple QOLIBRI domains. Based on the Mini-Mental Scale, the proportion of patients classified as being in a stupor state decreased dramatically from 59.1% to 14.2%, while the percentage of drowsy patients increased from 27.2% to 85.8%, indicating a shift toward improved alertness ($p < 0.001$). Similarly, those with severe impairments in thinking ability ("not at all") declined from 47.93% to 11.83%, while patients reporting moderate ability increased from 18.93% to 66.27% ($p < 0.001$). Emotional well-being also showed notable improvement; participants with profound emotional difficulties dropped from 33.73% to 15.38%, and moderate emotional state ratings rose from 24.26% to 50.89% ($p < 0.001$). Functional independence improved post-intervention, with 36.09% initially reporting complete dependence reducing to 28.99%. Although still substantial, this reduction was statistically significant ($p < 0.001$). The domain of social relationships demonstrated marked improvement, with the proportion of individuals experiencing no meaningful social connection decreasing from 42.6% to 14.79%, while those reporting moderate and high levels of social engagement increased significantly ($p < 0.001$).

In contrast, improvements in self-perception and emotional feelings ("about feeling") were less pronounced. Although the proportion of participants with poor self-perception decreased from 40.24% to 15.98%, this change was not statistically significant ($p = 0.33$). Similarly, changes in physical health status were modest; those reporting no physical problems declined slightly from 47.34% to 37.87%, and participants with mild to moderate physical complaints increased, though the overall difference did not reach statistical significance ($p = 0.609$). Further subgroup analyses demonstrated consistent and significant improvements in Mini-Mental Scale scores, cognitive ability, emotional health, social functioning, and total QOLIBRI scores across all age categories (18–30, 31–40, 41–50, above 51) and both genders ($p < 0.001$ for all). Independence and function also showed significant gains across all age groups, with the youngest group (18–30 years) exhibiting the most marked improvement ($p < 0.001$). In contrast, gains in self-perception were only significant in the youngest and oldest age groups, and no gender-based statistical differences were observed in this domain. Physical problems showed significant improvement in the youngest ($p < 0.001$) and oldest age groups ($p < 0.001$), while middle-aged groups did not demonstrate significant changes. Overall, post-intervention QOLIBRI total scores reflected a significant improvement in perceived quality of life. Before rehabilitation, 100 patients were classified as having impaired QoL, 46 were borderline, and only 23 achieved average scores, with none scoring in the good range. After intervention, the impaired and borderline categories each declined to 14 participants, while the number of individuals with average scores more than doubled to 55. Notably, 86 patients were classified in the good QoL category post-intervention, a level that was completely absent at baseline ($p < 0.001$).

Based on the available data, a correlation analysis between demographic and clinical variables (age, gender, baseline severity) and post-rehabilitation QOLIBRI outcomes revealed notable trends. Improvements in QoL were observed consistently across all age groups and both genders; however, the magnitude and statistical significance varied. Younger patients (aged 18–30) demonstrated the most robust improvements across all domains, particularly in cognitive functioning, emotional well-being, and functional independence ($p < 0.001$). Older participants, especially those above 51 years, also showed significant gains, but with slightly lower p-values in domains such as independence ($p = 0.015$) and self-perception. Gender-based comparisons indicated statistically significant improvements for both males and females in most domains, though self-perception and physical problems did not reach significance in either group ($p > 0.05$). Among clinical indicators, the baseline Mini-Mental Scale score correlated strongly with post-rehabilitation QoL outcomes. Patients with higher initial stupor levels exhibited greater improvement post-intervention, suggesting that cognitive severity at baseline may be predictive of rehabilitation gains. Collectively, these findings suggest that younger age, male gender, and greater baseline cognitive impairment were associated with more pronounced improvements in QoL following structured rehabilitation, underscoring the importance of early, targeted intervention in these subgroups.

Table 1: Effectiveness of Structured Rehabilitation on Cognitive, Emotional, Functional, and Social Outcomes in Post-Traumatic Brain Injury Patients: A Pre-Post QoLIBRI-Based Evaluation

QOLIBRI component		Baseline	Post-rehabilitation	P-value
		n (%)	n (%)	
Score of Minimental Scale	Stupor	100 (59.1)	24 (14.2)	<0.001
	Drowsy	46 (27.2)	145 (85.8)	
	Alert	23 (13.61)	6 (3.55)	
Thinking ability	Not at all	81 (47.93)	20 (11.83)	<0.001
	Slightly	30 (17.75)	31 (18.34)	
	Moderately	32 (18.93)	112 (66.27)	
	Quite	26 (15.38)	6 (3.55)	
Emotions and view	Not at all	57 (33.73)	26 (15.38)	<0.001
	Slightly	49 (28.99)	51 (30.18)	
	Moderately	41 (24.26)	86 (50.89)	
	Quite	22 (13.02)	48 (28.4)	
Independence and function	Not at all	61 (36.09)	49 (28.99)	<0.001
	Slightly	47 (27.81)	52 (30.77)	
	Moderately	37 (21.89)	20 (11.83)	
	Quite	24 (14.2)	8 (4.73)	
Social relationship	Not at all	72 (42.6)	25 (14.79)	<0.001
	Slightly	39 (23.08)	59 (34.91)	
	Moderately	37 (21.89)	77 (45.56)	
	Quite	21 (12.43)	72 (42.6)	
About feeling	Not at all	68 (40.24)	27 (15.98)	0.33
	Slightly	44 (26.04)	30 (17.75)	
	Moderately	38 (22.49)	22 (13.02)	
	Quite	19 (11.24)	18 (10.65)	
Physical problem	Not at all	80 (47.34)	64 (37.87)	0.609
	Slightly	25 (14.79)	50 (29.59)	
	Moderately	39 (23.08)	30 (17.75)	
	Quite	24 (14.2)	19 (11.24)	
	Very	1 (0.59)	6 (3.55)	

Table 1: Rehabilitation outcomes across age and gender groups

	Age 18-30	**Age 31-40**	**Age 41-50**	**Above 51**	**Male**	**Female**
	p-value				p-value	
Score of Minimental Scale	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Thinking ability	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Emotions and view	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Independence and function	<0.001	0.003	0.007	0.015	<0.001	<0.001
Social relationship	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
About feeling	0.005	0.211	0.017	<0.001	0.065	0.285
Physical problem	<0.001	0.25	0.295	<0.001	0.603	0.496
Pre-post total Qolibri	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Table 3: Demographic and Clinical Variables vs Post-Rehabilitation QoLIBRI Outcomes

QOLIBRI Domain	**Age 18–30**	**Age 31–40**	**Age 41–50**	**Age >51**	**Male**	**Female**	**Baseline Severity (Stupor %)**	**Correlation with QoL Gain**
Mini-Mental Scale	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	High (59.1%)	Strong
Thinking Ability	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	High (47.93%)	Strong
Emotions and View	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Moderate (33.73%)	Strong
Independence and Function	<0.001	0.003	0.007	0.015	<0.001	<0.001	Moderate (36.09%)	Moderate
Social Relationship	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	High (42.6%)	Strong
About Feeling	0.005	0.211	0.017	<0.001	0.065	0.285	High (40.24%)	Weak
Physical Problem	<0.001	0.25	0.295	<0.001	0.603	0.496	High (47.34%)	Weak
Total QOLIBRI Score	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	High baseline impairment	Strong

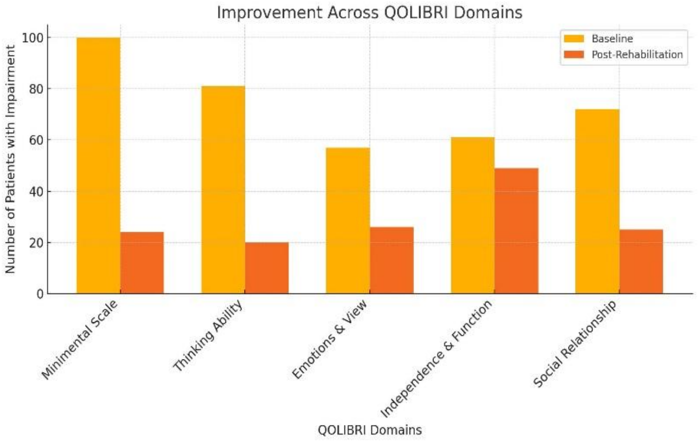

Figure 1 Improvement Across QOLIBRI Domains

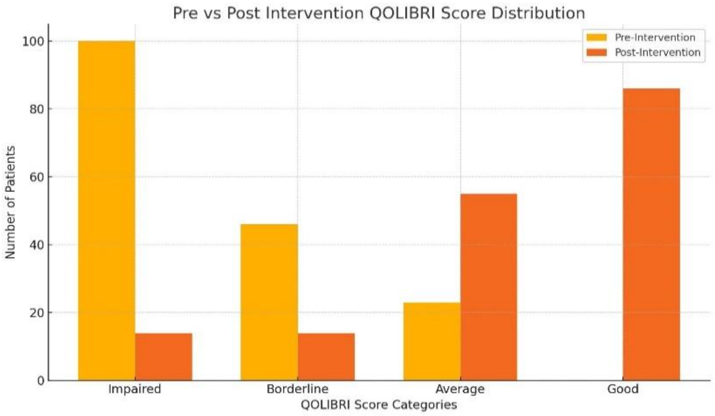

Figure 2 Pre vs Post Intervention QOLIBRI Score Distribution

DISCUSSION

The present study evaluated the impact of a structured, multidisciplinary rehabilitation program on various domains of recovery in individuals with traumatic brain injury (TBI), including cognitive functioning, emotional health, physical status, independence, and social reintegration. The findings demonstrated significant improvements across most domains, with particularly notable gains in cognitive function, emotional outlook, social participation, and overall quality of life, as assessed by the QOLIBRI scale. These outcomes underscore the value of comprehensive rehabilitation interventions in addressing the multidimensional needs of TBI survivors and reflect the responsiveness of key neuro-psychosocial domains to targeted post-acute care. Consistent with previous evidence, cognitive and emotional impairments were prominent at baseline. Prior studies have shown that executive dysfunction, memory disturbances, and affective dysregulation are among the most persistent sequelae of moderate-to-severe TBI, even in the absence of formal cognitive therapy (15,16). The improvements noted post-rehabilitation in this study reinforce the potential of structured, non-pharmacological interventions to mitigate these impairments. However, anxiety and depression, though commonly reported in literature as major determinants of post-TBI quality of life, were not explicitly assessed in the current protocol, thereby limiting the depth of psychological evaluation (17). Despite this limitation, the observed improvements in emotional domains may indirectly reflect enhancements in affective status, though this remains speculative.

The study also found that physical domains showed relatively better recovery than cognitive and emotional areas. This pattern aligns with longitudinal data indicating that physical functions often recover earlier and more completely, whereas cognitive and psychosocial domains may follow prolonged or variable trajectories (18). Without objective data on TBI severity, however, interpretation remains constrained. The lack of stratification by initial injury severity precludes a nuanced understanding of differential recovery patterns, particularly in explaining why certain domains improved more robustly than others. Social reintegration emerged as a critical area of concern. While the study reported gains in social functioning, residual limitations persisted. This observation parallels prior findings where emotional and social QOLIBRI subdomains were closely linked to injury severity and remained suboptimal despite physical recovery (19,20). The absence of vocational rehabilitation and structured social support in many rehabilitation programs continues to limit community reintegration and employment opportunities for TBI survivors. Future programs should consider integrating these dimensions to better address long-term functional outcomes. Furthermore, biological, psychological, and social determinants—such as cognitive reserve, emotional resilience, and interpersonal support—have been identified as central to post-TBI quality of life (21). The current study partially addressed these through its therapeutic scope but did not include structured components like resilience training or vocational assistance, which could amplify recovery. Proactive, transition-focused care delivered early in the recovery phase has shown promise in enhancing illness perception and reducing neuropsychiatric sequelae, even in mild TBI cases (22). The absence of such early interventions in this study setting may have limited potential gains, particularly in domains like self-perception and emotional regulation.

Although most participants resumed daily activities by the six-month follow-up, overall quality of life remained suboptimal in several domains. This finding aligns with literature indicating that even when functional capacity appears restored, emotional and interpersonal vulnerabilities often linger, especially in more severe cases (21,22). These observations advocate for a shift in rehabilitation goals—from physical normalization alone to holistic recovery that includes psychological and social well-being. This study had several strengths, including the use of a validated, disease-specific instrument (QOLIBRI) and a focus on real-world outpatient populations in a low-resource setting. However, important limitations must be acknowledged. The cross-sectional design and lack of a control group restrict causal inference. The short follow-up period may not capture sustained or delayed effects of rehabilitation. Reliance on self-reported outcomes introduces potential response bias, particularly in populations with cognitive impairments. Additionally, the analysis was limited to age and gender as background variables, with no control for socioeconomic status, comorbidities, or injury mechanism—factors that could influence recovery trajectories. Absence of stratification by TBI severity further limits the generalizability and interpretability of domain-specific findings. In conclusion, the study adds valuable insight into the multidimensional recovery landscape of post-TBI patients in a resource-limited context. The findings highlight the efficacy of structured rehabilitation in improving QoL, particularly in cognitive, emotional, and social domains. Nonetheless, future research should incorporate longitudinal designs, control groups, and broader psychosocial variables—including injury severity, comorbid mental health conditions, and socioeconomic determinants—to better understand the long-term effectiveness and equity of rehabilitation strategies in TBI care.

CONCLUSION

This study concludes that a structured, multidisciplinary rehabilitation approach substantially enhances the quality of life in patients recovering from traumatic brain injury, particularly in cognitive, emotional, and functional domains. The consistent improvements observed across various age and gender groups reinforce the value of incorporating comprehensive rehabilitation strategies into routine outpatient care. In resource-limited settings like Pakistan, where long-term follow-up and support are often underemphasized, these findings underscore the critical need to prioritize holistic recovery frameworks. By focusing beyond physical recovery, this approach promotes more meaningful reintegration into daily life and supports a patient-centered model of care.

AUTHOR CONTRIBUTION

Author	**Contribution**
Amad Aziz	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Bibi Asma	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sajjad Ahmad	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ayesha	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Irfan Jan*	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published

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