

THE EFFECT OF BODY AWARENESS THERAPY ON BALANCE AND COORDINATION IN STROKE

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ABSTRACT

Stroke represents a significant global health burden with approximately 13.7 million annual cases, often resulting in neurological damage that compromises sensorimotor control, balance, and cognition. To address these deficits, this Randomized Controlled Trial evaluated the impact of Body Awareness Therapy (BAT), a mind-body physiotherapeutic intervention, on stroke survivors. Twenty-six participants were recruited via convenience sampling and randomly allocated into experimental (n=13) and control (n=13) groups using the sealed envelope method; both groups underwent conventional physical therapy for two weeks (five days per week), with the experimental group receiving additional BAT. Outcome measures included the Berg Balance Scale, Mini-Mental State Examination, and coordination tests. While both groups demonstrated improvements from baseline, between-group analysis revealed no statistically significant difference in balance or coordination; however, the experimental group showed a statistically significant improvement in cognitive function compared to the control. Consequently, while the addition of BAT to conventional rehabilitation did not significantly enhance balance or coordination over the two-week period, the findings suggest it demonstrates a positive and significant effect on cognitive function in stroke patients.

Keywords: Body Awareness Therapy; Stroke; Cerebrovascular Accident; Balance; Coordination; Cognition; Randomized Controlled Trial; Rehabilitation

INTRODUCTION

Stroke constitutes a profound perturbation of central nervous system function, precipitated by a disruption in cerebral blood circulation. This cerebrovascular accident (CVA) manifests primarily through contralateral deficits in response to stimuli, indicative of the lesion's

location within the brain (Kutlay et al., 2018). The clinical presentation is characterized by acute neurological deficits attributable solely to vascular aetiology, often involving widespread cerebral injury. Symptomatology includes sudden onset numbness, speech disturbances, visual

impairments, and significant loss of balance or coordination, rendering the condition life-threatening, particularly within the critical first 24 hours (Maqbool et al., 2022). For survivors, the sequelae are often immediate and pervasive, altering cognitive processing, language, proprioception, and overall quality of life (Barclay et al., 2020).

Pathologically, stroke is categorised into two primary distinct types based on underlying mechanisms. Ischemic stroke, accounting for approximately 80% of cases, arises from thrombotic occlusion, infarction, or severe shock leading to tissue death (O'Sullivan et al., 2019). Conversely, hemorrhagic stroke comprises the remaining 20% of incidents, resulting from the rupture of arterial vessels and subsequent extravasation of blood or fluids into the brain parenchyma. Understanding this dichotomy is essential for appropriate clinical management, as the physiological implications and therapeutic interventions differ significantly between ischemic and hemorrhagic presentations. The epidemiological burden of cerebrovascular accident is substantial, ranking as a leading cause of global mortality with a mortality ratio of 12.2% following coronary heart diseases (Sherin et al., 2020). Globally, stroke is the second leading cause of death, contributing to 5.5 million fatalities and 13.7 million incident cases annually (Kass et al., 2021). In developing contexts such as Pakistan, data remains limited; however, Karachi has reported prevalence rates as high as 19.1% (Sherin et al., 2020). Furthermore, demographic disparities exist, with ischemic stroke exhibiting a higher prevalence and recurrence rate in males compared to females, affecting 76 to 119 individuals per 100,000 globally (Skajaa et al., 2022; Maqbool et al., 2022).

Neurologically, the condition induces irreversible impairments within the nervous system, severely degrading sensorimotor functions. These deficits compromise selective muscle control, postural stability, and the coordination requisite for complex movements (Kong et al., 2015). Activity restrictions are notably more prevalent in the upper extremities than the lower, affecting between 33% and 95% of patients, which subsequently diminishes motor, psychological,

and somatosensory capacities (Barclay et al., 2020). Consequently, balance disturbances are ubiquitous among stroke survivors, elevating the risk of falls, anxiety, and mortality, thereby necessitating physical functional therapies after the initial acute phase to mitigate these risks (Maqbool et al., 2022). Biomechanically, balance is paramount for independent living, maintained by the precise adjustment of the Center of Gravity (COG) over the Base of Support (BOS). This equilibrium relies on multisensory integration involving vestibular, visual, and somatosensory inputs regulated by the nervous system (Kong et al., 2015). Coordination, defined as the synergistic interaction of multiple joints and muscles to achieve purposeful movement, is equally critical. Asymmetrical movements of the limbs demand excessive energy expenditure to maintain stability, highlighting the importance of restoring symmetrical motor patterns to reduce physiological load and improve functional efficiency (Kim and Lim, 2018). Beyond physical disabilities, stroke is inextricably linked to intellectual and cognitive dysfunction, the severity of which correlates with the intensity of the cerebrovascular event (Kass et al., 2021). The impact extends beyond the patient to caregivers and family members, creating a broader psychosocial burden. Consequently, management requires a continuum of care, encompassing both short-term inpatient stabilization and long-term outpatient support to address the holistic needs of the patient and their support network (Kass et al., 2021). This comprehensive approach is vital for managing the complex interplay between physical disability and cognitive decline.

Neurorehabilitation serves as the medicinal branch dedicated to recovering impaired neural functions through motor learning and functional restoration (Maier et al., 2019). This process is arduous and time-intensive, requiring collaboration between patients and specialized rehabilitation teams (Kutlay et al., 2018). Various physiotherapeutic modalities are employed, including Neurodynamic techniques, Bobath, Proprioceptive Neuromuscular Facilitation (PNF), and dual-task training (Her et al., 2011; Seid and Moloro, 2022; Pathak et al., 2021; Nguyen et al., 2022; Brustio et al., 2018). Among these, Body

Awareness Therapy (BAT) emerges as a restorative approach focusing on relearning self-awareness movements to strengthen functional capacity in activities of daily living (Alamer et al., 2020). BAT utilizes fundamental movements, such as center-line stimulation and weight shifting across supine, sitting, and standing positions, to foster mind-body integration (Lindvall et al., 2016).

Objective:

1. **Primary Objective:** To evaluate the therapeutic efficacy of Body Awareness Therapy in enhancing postural balance and motor coordination amongst individuals post-stroke.
2. **Secondary Objective:** To investigate the impact of Body Awareness Therapy on cognitive function within this clinical cohort.

Literature Review:

Cerebrovascular accident (CVA), clinically termed stroke, constitutes a profound perturbation of central nervous system function, precipitated by compromised cerebral circulation. This pathology is broadly categorised into ischemic events, stemming from thrombotic or embolic occlusions, and hemorrhagic incidents arising from arterial rupture (Muniyar and Darade, 2018). Epidemiologically, stroke represents a critical global health burden, ranked by the World Health Organization as the second leading cause of mortality in individuals over sixty and the fifth among those aged fifteen to fifty-nine. The incidence is projected to rise significantly by 2030, affecting both developed and developing nations alike (Avan et al., 2019). The clinical sequelae of CVA are pervasive, often manifesting as hemiparesis or hemiplegia contingent upon the lesion's laterality. Primary risk factors encompass hypertension, diabetes, cardiovascular diseases, and sedentary lifestyles, which collectively exacerbate neurological vulnerability. According to the International Classification of Functioning, Disability and Health (ICF), stroke induces activity limitations and participation restrictions, thereby diminishing societal engagement (Langhorne et al., 2011). Survivors frequently contend with sensory deficits, aphasia, and psychological challenges, necessitating comprehensive

management beyond acute care (Muniyar and Darade, 2018).

Balance impairment remains a predominant complication, characterized by asymmetric postural stability and compromised stability limits. Such deficits severely hinder functional independence, increasing the propensity for falls and secondary neuro musculoskeletal complications such as contractures and pressure sores. Loss of trunk stability and anticipatory postural adjustments further exacerbate difficulties in sitting, standing, and ambulation, often rendering patients dependent on assistive devices or caregivers for mobility (Bang et al., 2015). Coordination deficits similarly impede recovery, marked by reduced range of motion and disrupted sensorimotor integration. These impairments affect both intralimb coordination, involving multiple joints within a single limb, and interlimb coordination, which is required for bilateral tasks (Doost et al., 2019). Approximately sixty percent of survivors experience upper limb dysfunction, significantly obstructing activities of daily living (ADLs). As the aging population expands, the prevalence of such functional disabilities is anticipated to rise, underscoring the need for targeted interventions (Deutschbein et al., 2020).

Neurorehabilitation serves as the cornerstone of recovery, employing a multidisciplinary team to restore physiological and functional capacity. Early intervention during the acute or sub-acute phases is critical to mitigating permanent disability and facilitating neural plasticity (An and Shaughnessy, 2011). While conventional therapies address motor relearning, approximately 15 to 20 percent of survivors remain permanently disabled, highlighting the necessity for innovative therapeutic approaches that address both somatic and functional impairments (Her et al., 2011). Body Awareness Therapy (BAT) has emerged as a distinct physiotherapeutic modality that integrates cognitive and physical functions. This approach necessitates concentrated attention on bodily sensations and movement quality, fostering a synergistic relationship between mind and body (Alamer et al., 2020). BAT exercises, performed in supine, sitting, or standing positions, aim to enhance sensory-motor integration and self-

awareness, particularly beneficial for patients experiencing dissociation from affected body regions (Lindvall et al., 2016).

Empirical evidence supports the efficacy of BAT in stroke rehabilitation. Lindvall and Forsberg (2014) demonstrated significant improvements in stability and movement quality within a randomized controlled trial. Similarly, Sarıçan et al. (2023) reported enhanced trunk control, upper extremity function, and reduced fear of falling following BAT intervention. Furthermore, Serrada et al. (2022) found that class-based BAT programs yielded superior outcomes compared to home-based training, suggesting that structured group dynamics may augment therapeutic benefits. Broader research indicates BAT's potential across various conditions, including psychiatric disorders, though results remain varied (Hedlund and Gyllensten, 2010). In the context of stroke, studies by Pelton et al. (2012) and Serrada et al. (2021) highlight the links among body awareness, sensation, and quality of life. While existing literature confirms BAT's utility in improving functional movements and self-acceptance, further investigation is warranted to fully elucidate its mechanisms regarding coordination and long-term cognitive recovery.

METHODOLOGY

Study Design and Setting A randomized controlled trial (RCT) was conducted to evaluate the effects of body awareness therapy on balance and coordination in stroke survivors. The study was registered under Clinical Trial ID NCT05958732. Data collection took place over six months, from January 2023 to June 2023, within the Neurological Department (Stroke Unit) of Shifa International Hospital, Islamabad.

Ethical Considerations Ethical approval was obtained from the Department Research Advisory Committee (DRAC) and the Institutional Review Board (IRB) of Shifa International Hospital (Approval Letter # IRB 0352-22). Informed consent was secured from all participants prior to enrollment.

Participants: The study population consisted of adults with sub-acute hemiplegic stroke. Using OpenEpi software, based on parameters from Bang and Cho (2016), the calculated sample size

was 26 participants. Participants were selected by random sampling using the sealed-envelope method and allocated to two groups.

Inclusion Criteria:

- Diagnosis of ischemic sub-acute hemiplegic stroke.
- Age range: 30–85 years.
- Both genders included.

Exclusion Criteria:

- Presence of comorbid neurological conditions other than stroke.
- Severe cognitive impairment.
- Other significant medical comorbidities contraindicate therapy.

Intervention Protocol Participants were randomly assigned to either the Experimental Group (Body Awareness Therapy + Conventional PT) or the Control Group (Conventional PT only). Both groups underwent assessment before and after a two-week intervention period.

• **Conventional Physical Therapy (Control):** Participants received 25 minutes of standard therapy, five days a week. This included warm-up general range of motion (ROM) exercises, static balance training (e.g., single- and dual-leg stance), dynamic balance activities (e.g., zigzag walking, weight shifting), and coordination drills (e.g., finger-to-nose, tandem stepping).

• **Body Awareness Therapy (Experimental):** In addition to the 25-minute conventional protocol, this group received an extra 20–30 minutes of specific body awareness training. Exercises focused on proprioception, cross-lateral integration, and somatosensory perception (e.g., contralateral limb touching, weight shifting, coordinated limb movements).

Outcome Measures Data were collected using a self-structured demographic questionnaire and the following standardized clinical tools:

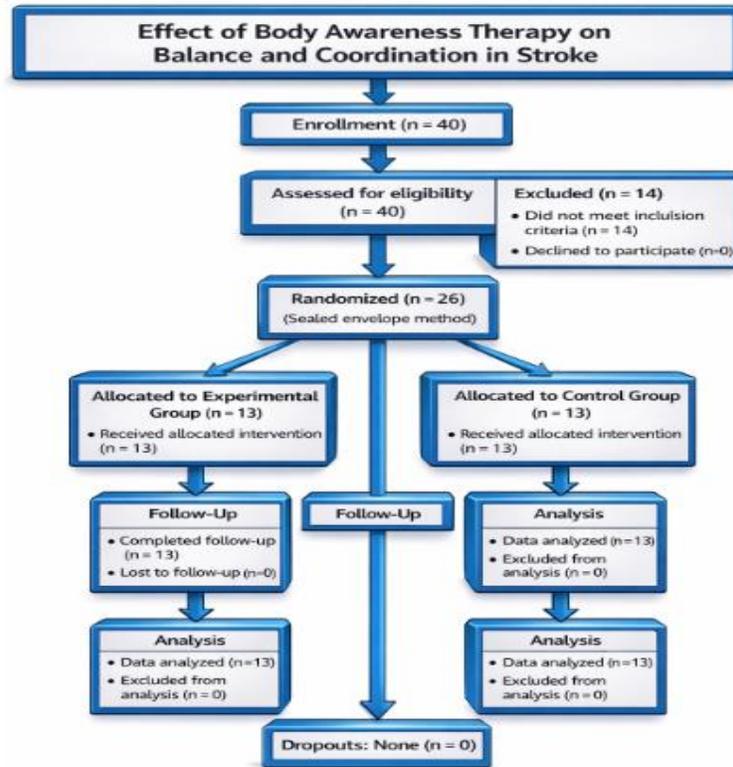
1. **Berg Balance Scale (BBS):** A 14-item scale used to assess static and dynamic balance. Scores range from 0 to 56, with higher scores indicating better balance and lower fall risk. The tool demonstrates high validity and reliability (CI 0.96–0.98) in post-stroke populations.
2. **Coordination Tests:** Both Equilibrium (e.g., standing on one foot, walking variations) and Non-Equilibrium tests (e.g., finger-to-nose, heel-to-

shin, rebound phenomenon) were administered. Performance was graded on a 0–4 scale, ranging from inability to perform (0) to normal performance (4).

3. **Mini-Mental State Examination (MMSE):** Used to screen for cognitive

impairment. Scores range from 0 to 30 and assess orientation, registration, attention, recall, and language. Scores ≥ 24 indicate no cognitive impairment.

Consort Diagram



Results

General Demographics

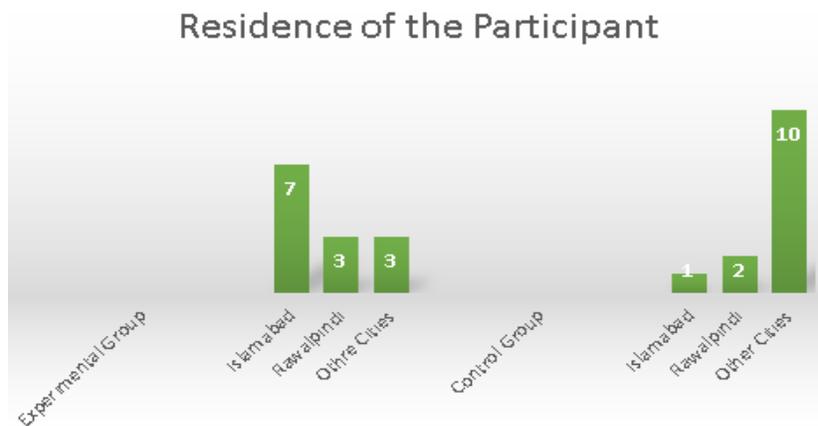
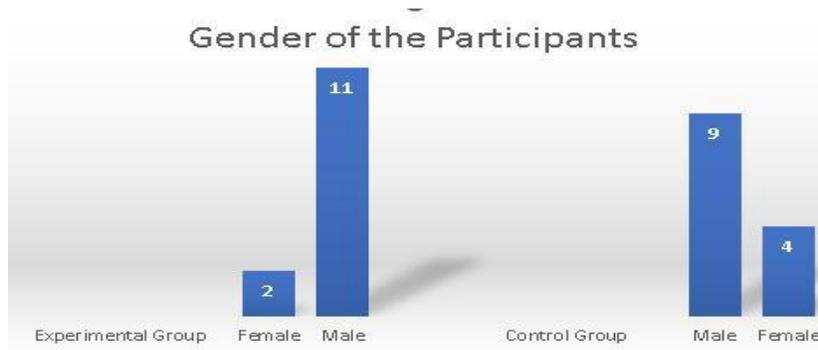
The mean age and standard deviation of the experimental group was 61.92 ± 10.859 and the

mean age and standard deviation of the control group was 62.69 ± 9.455 .

Table1 General Demographics

Demographics	Mean ± S.D		
	Over All	Experimental Group	Control Group
Age(years)	62.31 ± 9.983	61.92 ± 10.859	62.69 ± 9.455

Below are the graphs that show the participants gender, affected side and the residence of the participants.



Between Group Analysis

Comparison between the group at Baseline

Table 2 Comparison between the group at Baseline (Mann Whitney Test)

S. No	Variables	Groups	Median (IQR)	Mean Rank	p-Value
1	Berg Balance Scale	Experimental	43(25)	15.5	0.181
		Control	40(50)	11.5	
2	Mini-Mental State Examination	Experimental	25(0.5)	15.5	0.141
		Control	25(0.5)	11.42	
3	Non-Equilibrium Coordination	Experimental	3(0.5)	15.88	0.073
		Control	2(0)	11.12	
4	Equilibrium Coordination	Experimental	2(0.5)	14.00	0.697
		Control	2(0.5)	13.00	

Table 2 presents the baseline comparison between the experimental and control groups using the Mann-Whitney U test, a non-parametric analysis appropriate for non-normally distributed data (reported as median and interquartile range). Across all four outcome measures, Berg Balance Scale ($p = 0.181$), Mini-Mental State Examination ($p = 0.141$), Non-Equilibrium Coordination ($p = 0.073$), and Equilibrium Coordination ($p = 0.697$), no statistically significant differences were observed between groups at baseline (all $p > 0.05$). Although the experimental group showed slightly higher median scores on the Berg Balance Scale (43 vs. 40) and Non-Equilibrium Coordination (3 vs. 2), these numerical differences did not reach statistical significance, indicating that any

observed variation is likely attributable to random chance rather than systematic group disparity. This baseline equivalence is methodologically important, as it supports the validity of the randomization process (sealed envelope method) and strengthens confidence that any post-intervention differences can be more reliably attributed to the Body Awareness Therapy intervention rather than pre-existing group imbalances. The Non-Equilibrium Coordination measure approached marginal significance ($p = 0.073$), suggesting a trend that warrants cautious interpretation but does not compromise the overall comparability of the two groups at study entry.

Comparison between the groups after 2 weeks:

Table 3 Comparison between the groups After 2 weeks (Mann Whitney U Test)

S. No	Variables	Groups	Median (IQR)	MeanRank	p-Value
1	BergBalanceScale	Experimental	51(4)	15.65	0.149
		Control	49(9)	11.35	
2	Mini-Mental State Examination	Experimental	27(0.5)	16.38	0.030
		Control	27(0.5)	10.62	
3	Non-Equilibrium Coordination	Experimental	4(0.5)	14.73	0.344
		Control	3(0.5)	12.27	
4	Equilibrium Coordination	Experimental	4(0.5)	13.50	1.000
		Control	4(0.5)	13.50	

Table 3 presents the between-group comparison after two weeks of intervention using the Mann-Whitney U test, revealing that only one of the four outcome measures demonstrated a statistically significant difference. Specifically, the Mini-Mental State Examination (MMSE) showed a significant between-group difference ($p = 0.030$), with the experimental group achieving a higher mean rank (16.38 vs. 10.62) despite identical median scores of 27 (IQR = 0.5) in both groups, indicating a favorable shift in the distribution of cognitive scores toward the upper range for participants receiving Body Awareness Therapy. For the Berg Balance Scale, the experimental group exhibited a numerically higher median score (51 vs. 49) with less variability (IQR = 4 vs. 9), yet this difference did not reach statistical significance ($p = 0.149$), suggesting a potential trend toward improved balance that may require a longer intervention period or larger sample to

detect reliably. Both coordination measures, Non-Equilibrium ($p = 0.344$) and Equilibrium Coordination ($p = 1.000$)—showed no significant between-group differences, with the latter demonstrating complete equivalence in median scores (4), interquartile ranges (0.5), and mean ranks (13.50), indicating that two weeks of intervention was insufficient to elicit detectable changes in motor coordination outcomes. Overall, these early post-intervention findings suggest that Body Awareness Therapy may exert a more immediate influence on cognitive aspects of function (as captured by MMSE ranking) than on physical balance or coordination metrics, though the limited statistical significance across most outcomes underscores the preliminary nature of these results and the importance of evaluating longer-term follow-up data to determine the intervention's sustained efficacy

Within Group Analysis Control Group

Table 4 Within Group Analysis Control Group (Wilcoxon signed rank test)

S. No	Variable	Base Value (IQR)	Line Median	After 2 weeks Value Median (IQR)	Mean Rank	P value
1	BBS	40(18)		49(9)	7.00	0.001
2	MMSE	25(0.5)		27(0.5)	7.00	0.001
3	Non-Equilibrium Coordination	2(0)		3(0.5)	6.50	0.002
4	Equilibrium Coordination	2(0.5)		4(0.5)	7.00	0.001

Table 4 presents the within-group analysis for the Control Group using the Wilcoxon signed-rank test, a non-parametric statistical method appropriate for comparing paired, non-normally distributed data at baseline versus after two weeks of conventional physiotherapy. The results demonstrate statistically significant improvements across all four outcome measures: the Berg Balance Scale median score increased from 40 (IQR = 18) to 49 (IQR = 9; $p = 0.001$), indicating enhanced static and dynamic balance; the Mini-Mental State Examination improved from 25 (IQR = 0.5) to 27 (IQR = 0.5; $p = 0.001$), suggesting a modest but significant gain in cognitive function; Non-Equilibrium Coordination scores rose from 2 (IQR = 0) to 3 (IQR = 0.5; $p = 0.002$), reflecting improved limb

coordination during movement; and Equilibrium Coordination showed the largest relative improvement, increasing from 2 (IQR = 0.5) to 4 (IQR = 0.5; $p = 0.001$), denoting better postural control during coordinated tasks. The consistent mean rank of 7.00 (or near it) across three of the four variables further supports a uniform directional improvement within the group. These findings confirm that conventional physiotherapy alone yields clinically meaningful short-term benefits in balance, cognition, and motor coordination among stroke survivors, which serves as an important reference point for evaluating whether the addition of Body Awareness Therapy in the experimental group produces superior or additive effects beyond standard care.

Within Group Analysis Experimental Group:

Table 5 Within Group Analysis Experimental Group (Wilcoxon signed rank test)

S. No	Variable	Base Line Value (IQR)	Line Median	After 2 weeks Median (IQR)	2 Value	Mean Rank	P value
1	BBS	43(5.5)		51(2)		7.00	0.001
2	MMSE	25(0.5)		27(0.5)		7.00	0.001
3	Non- Equilibrium Coordination	3(0.5)		4(0.5)		6.00	0.001
4	Equilibrium Coordination	2(0.5)		4(0.5)		7.00	0.001

Table 5 presents the within-group analysis for the Experimental Group using the Wilcoxon signed-rank test, demonstrating statistically significant improvements ($p = 0.001$ for all variables) across all four outcome measures following two weeks of Body Awareness Therapy combined with conventional physiotherapy. The Berg Balance Scale median score increased from 43 (IQR = 5.5) to 51 (IQR = 2), indicating not only enhanced balance performance but also reduced variability in responses, suggesting more consistent therapeutic benefits among participants. Cognitive function, as measured by the Mini-Mental State Examination, improved from 25 (IQR = 0.5) to 27 (IQR = 0.5; $p = 0.001$), mirroring the control group's gain yet achieved alongside greater balance improvements. Both coordination domains showed meaningful progress: Non-Equilibrium Coordination increased from 3 (IQR = 0.5) to 4 (IQR = 0.5; mean rank = 6.00, $p = 0.001$), and Equilibrium Coordination demonstrated the largest relative gain, doubling from 2 (IQR = 0.5) to 4 (IQR = 0.5; $p = 0.001$). The uniformly high mean ranks (6.00–7.00) confirm a consistent directional improvement across all participants. Collectively, these findings indicate that the integration of Body Awareness Therapy with standard rehabilitation yields robust, statistically significant short-term enhancements in balance, cognition, and motor coordination among stroke survivors, providing a foundation for comparing the magnitude of

change against the control group to determine the additive therapeutic value of this mind-body intervention.

Conclusion and Recommendation:

This study investigated the effect of Body Awareness Therapy (BAT) on balance, coordination, and cognition in stroke patients, revealing a distinct therapeutic advantage in cognitive function. While both experimental and control groups demonstrated significant within-group improvements across all variables, the between-group analysis indicated that BAT yielded a statistically significant superior improvement only in cognition (MMSE), with no significant difference observed for balance or coordination measures. This finding aligns with Lindvall et al. (2016), who reported that BAT positively impacts body perception and cognition despite the challenging nature of the exercises. Similarly, Ahn et al. (2018) and Fregonesi et al. (2014) supported the notion that movements focused on body awareness enhance concentration and mental functioning, thereby improving cognitive outcomes in patients with cerebrovascular accidents. The current results reinforce the hypothesis that BAT's mind-body integration specifically targets cognitive domains more effectively than physical metrics in the short term. Conversely, the lack of significant between-group differences in balance (BBS) and coordination contrasts with some existing literature, though

within-group improvements remain clinically relevant. While Bang and Cho (2016) found that BAT positively affected stability and mobility over 4 weeks, the current study's 2-week duration may have been insufficient to detect detectable between-group physical changes beyond conventional therapy. Additionally, Serrada et al. (2021) noted improvements in functional activities and self-acceptance rather than direct motor metrics, which partially resonate with the current study's observation that physical gains were comparable across groups. However, the significant within-group improvements observed in both arms corroborate Maqbool et al. (2022) and confirm that structured balance and coordination exercises inherently benefit stroke survivors regardless of the specific adjunctive therapy. This suggests that while BAT is potent for cognition, its additive value for motor recovery may require longer intervention periods to surpass standard care.

Several limitations must be considered when interpreting these findings, including the inpatient hospital setting, communication barriers with participants, and an unequal gender distribution, which may affect the generalizability of the results. The inpatient environment may limit the ecological validity of functional tasks, while communication difficulties may affect the accuracy of cognitive and coordination assessments. Despite these constraints, the study concludes that BAT is particularly effective for enhancing cognition in sub-acute hemiplegic individuals, even if it does not currently demonstrate superior efficacy over conventional therapy for balance and coordination alone. Future research should address these limitations to validate the long-term sustainability of these cognitive benefits and determine if extended treatment durations can unlock significant motor advantages comparable to those seen in cognitive domains.

Future Recommendations

- **Expand Setting and Sample:** Future studies should utilize outpatient settings with larger sample sizes to enhance the generalizability of findings beyond the acute inpatient environment.

- **Diverse Stroke Populations:** Research should be extended to include various stroke classifications and severities to determine whether BAT efficacy varies across patient profiles.
- **Long-Term Follow-Up:** Investigations into the long-term effects of Body Awareness Therapy are recommended to assess the sustainability of cognitive improvements and the potential delayed emergence of motor benefits

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