



## Original Article

## Effects of Sensorimotor Stimulation Program with and Without Routine Physical Therapy on Balance and Cognitive Performance in Patients with Mild Traumatic Brain Injury: A randomized Controlled Trial

Huma Waqar<sup>1</sup>, Fahad Tanveer<sup>2</sup>, Syed Asadullah Arslan<sup>2</sup>, Ashfaq Ahmad<sup>2</sup>, Sana Sarfaraz<sup>2</sup> and Kaneez Fatima<sup>2</sup>

<sup>1</sup>Vivir health care, Western Australia

<sup>2</sup>The University of Lahore, Lahore, Pakistan

## ARTICLE INFO

**Key Words:**

Berg Balance Scale, Cognition, Numeric Pain Rating Scale, Sensorimotor, Traumatic Brain Injury

**How to Cite:**

Waqar, H. ., Tanveer, F. ., Asadullah Arslan, S. ., Ahmad, A. ., Sarfraz, S. ., & Fatima, K. .(2022). Effects of Sensorimotor Stimulation Program with and Without Routine Physical Therapy on Balance and Cognitive Performance in Patients with Mild Traumatic Brain Injury: A randomized Controlled Trial: Effects of Sensorimotor Stimulation Program on Balance and Cognitive Performance . Pakistan BioMedical Journal, 5(7).  
<https://doi.org/10.54393/pbmj.v5i7.684>

**\*Corresponding Author:**

Huma Waqar  
 Vivir health care, Western Australia  
[humawaqar72@gmail.com](mailto:humawaqar72@gmail.com)

Received Date: 13th July, 2022

Acceptance Date: 20th July, 2022

Published Date: 31st July, 2022

## ABSTRACT

The term "Traumatic brain injury (TBI)" has replaced the phrase "head injury." A disturbance in neuronal activity caused by the application of a quick, abrupt, and unbearable mechanical force is classified as traumatic brain injury. Every year, around 1.7 billion new cases of TBI are recorded worldwide. **Objectives:** To compare the effects of Routine physical therapy and Routine physical therapy along with Sensorimotor stimulation program on balance and cognitive performance in patients with mild traumatic brain injury. **Methods:** A total of 64 patients were divided into two groups, each including 32 people. Those in Group A got routine physiotherapy, whereas patients in Group B also received sensorimotor stimulation. Patients were randomized to groups at random using a lottery system. The study was intended as a single RCT with blinding. The duration of the intervention was sixteen weeks. Data was gathered on the first day prior to the implementation of treatments, then again after eight weeks, and finally after sixteen weeks. The obtained data was evaluated using the Berg balance scale and the Rancho loss amigos scale. **Results:** In group A, balance before treatment was  $21.90 \pm 5.43$  and after treatment of 8th and 16th weeks it was  $25.93 \pm 4.977$  and  $39.62 \pm 5.68$ . Mean of cognition before treatment was  $5.15 \pm 0.94$  and after treatment of 8th and 16th weeks it was  $5.468 \pm 0.802$  and  $5.90 \pm 0.85$  with  $p$ -value  $< 0.05$ . In group B balance before treatment was  $21.43 \pm 5.17$  and after treatment of 8th and 16th weeks it was  $27.12 \pm 6.59$  or  $52.78 \pm 2.70$ , mean of cognition before treatment was  $5.12 \pm 1.00$  and after treatment of 8th and 16th weeks it was  $6.250 \pm 0.87$  and  $7.70 \pm 0.4$  with  $p$ -value  $< 0.05$ . **Conclusions:** The study concluded that both treatment plans were effective for balance and cognitive performance but sensorimotor along with physical therapy significantly better outcomes as compared to conventional physical therapy treatment.

## INTRODUCTION

In major accidents, brain damage is the leading cause of death and disability. "Traumatic brain injury" has replaced "head injuries." Traumatic brain damage is defined as a disruption in neuronal activity induced by the sudden, unexpected, and intolerable application of mechanical stress [1]. A traumatic brain injury may be caused by a head hit, blow, or whiplash, an abrupt change in calvarium direction, or a penetrating head wound. It may also be caused by falls, sporting events, adolescent drinking, leisure activities, and car accidents [2, 3]. In Pakistan, a 220 million country, TBI is the primary cause of death and disability. A study of road traffic incidents in Pakistan

revealed that one in four individuals had a head injury, with 10 percent sustaining moderate to severe traumatic brain damage. Children aged 0-4 years, adolescents aged 15-19 years, and elderly individuals aged >75 years had the highest prevalence of TBI-related hospitalization and death. In all age categories, males outnumber women in terms of TBI-related visits. Asia has the greatest incidence of traumatic head injuries caused by falls (about 70%), unintentional injuries (57%), motor vehicle accidents (50%) and conflict (approximately 15%) [4-6]. Headaches, disorientation, vertigo, sight loss, hearing impairments, and exhaustion are other symptoms of mild TBI. Symptoms

of dizziness include disorientation, instability, vertigo, and lightheadedness. Mild traumatic brain injury is often accompanied with post-traumatic stress disorder, which manifests as irritability, memory loss, and sleep disturbance. Because of the long periods of bed rest and severe sedation that are often necessary, physiotherapy is a common and well-recognized component of TBI recovery. During the acute inpatient phase of treatment, the objective of improving mobility and upright posture is to restore neurological and physical function while preventing or resolving prospective difficulties. ICU stays are often accompanied by neuromuscular weakness, reduced aerobic capacity, and persistent participation limitations [7-9]. Routine emergency functional neuroimaging assessments, such as CT scans of the cranium, do not detect bleeding or other obvious aberrant development in individuals with mild traumatic brain injury. Even in the absence of abnormalities on highly specialized imaging modalities, mild TBI cannot be ruled out. This is because it is believed that mild TBI neurological symptoms are caused by a temporary disturbance of brain activity, such as reduced synaptic activity, changes in glucose absorption, changes in cerebral blood flow, and changed axonal function. The Glasgow Outcome Scale, Disability Rating Scale, Functional Independence Measure, Functional Status Examination, Evaluation Measure, Timeframe of Loss of Consciousness, and Post Traumatic Amnesia are used to evaluate the quality of life after a TBI [10-12]. Mild traumatic brain injury, the major cause of cognitive performance deficits and balance issues, has received little research attention. These obstacles complicate their everyday life and activities. Sensorimotor activation, which has been demonstrated to be the most effective option for those with moderate traumatic brain injury, is required to overcome these issues.

**RESULTS**

Descriptive results of group A and group B is represented in Table 1. In group A, balance before treatment was 21.90±5.43 and after treatment of 8th and 16th weeks it was 25.93±4.977 and 39.62±5.68. Mean of cognition before treatment was 5.15±0.94 and after treatment of 8th and 16th weeks it was 5.468±0.802 and 5.90±0.85 with p-value < 0.05. In group B balance before treatment was 21.43±5.17 and after treatment of 8th and 16th weeks it was 27.12±6.59 or 52.78±2.70, mean of cognition before treatment was 5.12±1.00 and after treatment of 8th and 16th weeks it was 6.250±0.87 and 7.70±0.4 with p-value < 0.05 (Table 2).

Descriptive Results	Control (Group A)	Experimental (Group B)	p-value
<b>Group</b>	<b>Mean ± SD</b>	<b>Mean ± SD</b>	<b>0.220</b>
Age	28.43±5.52	28.71±6.0	0.303
Height	5.51±0.33	85.40±0.367	0.285
Weight	70.62±13.57	73.25±11.19	0.404
Body Mass Index	25.23±4.72	26.47±3.91	
	<b>N (%)</b>	<b>N (%)</b>	
Modes of Injury	13 (40.6%)	16 (50%)	
	9 (28.1%)	9 (28.1%)	
	6 (18.8%)	5 (15.6%)	
	4 (12.5%)	2 (6.3%)	

**Table 1:** Descriptive statistics

Outcomes	Assessment	Control Group	Experimental Group	f	p-Value
Berg Balance Scale	Baseline	21.09± 5.44	21.44± 5.17	0.350	0.853
	After 8 weeks	25.94± 4.98	27.12± 6.59	3.684	0.050
	After 16 weeks	39.62± 5.68	52.78± 2.71	9.812	0.000
RLAS	Baseline	5.16 ± 0.95	5.125 1.01	0.470	0.829
	After 8 weeks	5.47± 0.80	6.25± 0.88	0.252	0.617
	After 16 weeks	5.91± 0.86	7.71± 0.44	5.911	0.010

**Table 2:** Comparison of Mean Scores of Balance RLAS Scores

**DISCUSSION**

Traumatic brain injury is one of the leading causes of mortality and disability globally, particularly among children and adolescents, and it may affect mobility, cognition, and balance. Early rehabilitation seems to be critical for an individual's functional recovery after catastrophic brain damage. It may even improve long-term survival chances. Physical therapy is essential for the recovery of impaired functions since it assesses the patient's cognitive level and tailors the proper method and techniques to each unique patient. The BBS and RLAS were employed in this research to assess people with moderate TBI who showed balance, coordination, and sensory impairments. Many of these illnesses impair mobility and quality of life. According to the study's findings, sensorimotor stimulation increased gait agility and balance the most of all motor functions. In 2022, Kreter et al., discovered that walking handicap is a common patient concern. As a result, several writers have called for physical therapy focusing on walking, balance, and stair climbing to enhance mobility in TBI patients [13, 14]. After a 7-year physical treatment programme with sensory stimulation, a patient with a traumatic brain injury recovered the ability to walk, talk, execute daily responsibilities, and participate in a range of leisure activities independently. This demonstrates that motor functions may be restored even after a long length of time, and that every interval is critical for recovery. Gagne et al., did research in 2021 in which they compared 40 TBI patients (20 athletes and 20 non-athletes). They were instructed to do four different motor

exercises, including binding onto a leg, walking on their toes, going backward up a step, and balancing on one leg. All four activities had an impact on running ability, although coma length had no effect on either athletes or non-athletes' running ability [15, 16]. Because we only included participants with mild TBI and a decent GCS in our research, we couldn't make any conclusions concerning the severity of TBI and physical function recovery based on the available data. Snir et al., examined physical awareness and rotation, visual attention and exploration, and limb movement and coordination in TBI patients in 2020 and found that those with a Glasgow Coma Scale (GCS) of 10-15 performed much better. The BBS balance test demonstrated that moderate TBI patients with a GCS of 13 to 15 exhibited the least improvement after the eighth week of physical treatment with sensorimotor stimulation. Individuals with mild TBI showed substantially superior balance recovery results after just 16 weeks of therapy, but individuals who did not get sensorimotor stimulation in addition to PT did not [17]. According to the current research, those with traumatic brain injuries improved the most in their balance and walking, while cognitive function improved the least. Trainee of hand movements is a useful physiotherapy treatment for TBI patients to recover impaired hand motions. According to the findings of this study, the mechanism of traumatic brain damage was connected with orientation to time and location, attention, identification of a pencil and a watch, and tactile contact during cognitive and balance recovery. However, Subramanian et al., do not recommend making prognosis judgments on balance and cognitive recovery in 2020 based purely on damage modalities. These findings point to the need for greater research into the latter phases of recovery. The findings show that when a person's balance improves, so does their gait. Walking and sitting to standing, as well as walking and balanced sitting, were shown to have a strong positive association in this research [18]. Individuals with a TBI should undergo gait training, according to our research, and different gait training strategies, such as treadmill walking with subconscious use of the upper limbs, improve the success of rehabilitation. Sharma et al., did a research in 2020 to investigate whether training in attention and cognitive function influenced balance training in those who had had head trauma. A 16-year-old boy with a brain injury received therapy to enhance his balance first in a calm, nonstimulating setting, and then in a nonlinear way. The frequency of loss of balance in distracting situations rose when a patient's attention was directed to a distraction. The physical treatment regimen included balance training and cognitive function enhancement. The patient was able to resume school activities with no loss of balance after 11

weeks of personalised therapy. According to the author, people with brain injuries need sensory and cognitive function training in addition to balance therapy [19]. Agitation and reduced cognitive functioning may impair the efficacy of practising certain talents, according to the findings of Joubran et al., in 2021. Furthermore, numerous writers observed that contractures, stiffness, and decreased balance, as well as challenges with attention and behaviour, a lack of excitement, and sadness, hampered the efficacy of physical treatment [20, 21]. Our research discovered that improving walking ability required considerably more than increasing leg strength, and that attention and spatial awareness were strongly connected to gait. Consistent with the previous study's findings, this investigation discovered a minor link between attention and walking in both persons with moderate TBI. Linnestad et al., study found that cognitive abilities recovered more slowly than motor functions in TBI patients getting physical treatment [22]. However, Morelli et al., observed that cognitive and motor recovery might be substantially separated [23]. Furthermore, the researchers did not examine the influence of these variables on recovery; hence, additional research is needed. Because of the large number of persons with moderate trauma receiving post-acute rehab, this constraint prevented the formation of cohesive groups and the execution of a full statistical analysis. Despite the difficulties in acquiring these treatments, experts in the area think that comprehensive multidisciplinary post-acute rehabilitation is the best strategy for addressing deficits from all stages of TBI [24]. In conclusion, individuals with traumatic brain injury had much improved motor and cognitive status restored during acute rehabilitation; however, this study did not disclose any relationships between kinds of damage and recovery during post-acute rehabilitation.

## CONCLUSION

The study concluded that both treatment plan was effective for balance and cognitive performance but sensorimotor along with physical therapy significantly better outcomes as compared to conventional physical therapy treatment.

## REFERENCES

- [1] Hicks SD, Onks C, Kim RY, Zhen KJ, Loeffert J, Loeffert AC, et al. Diagnosing mild traumatic brain injury using saliva RNA compared to cognitive and balance testing. *Clinical and translational medicine*. 2020 Oct; 10(6):e197. doi: 10.1002/ctm2.197
- [2] Maggio MG, De Luca R, Molonia F, Porcari B, Destro M, Casella C, et al. Cognitive rehabilitation in patients with traumatic brain injury: A narrative review on the

- emerging use of virtual reality. *Journal of Clinical Neuroscience*. 2019 Mar; 61:1-4. doi: 10.1016/j.jocn.2018.12.020
- [3] Donnelly J, Czosnyka M, Adams H, Cardim D, Koliass AG, Zeiler FA, et al. Twenty-Five Years of Intracranial Pressure Monitoring After Severe Traumatic Brain Injury: A Retrospective, Single-Center Analysis. *Neurosurgery*. 2019 Jul; 85(1):E75-E82. doi: 10.1093/neuros/nyy468
- [4] Marklund N, Bellander BM, Godbolt AK, Levin H, McCrory P, Thelin EP. Treatments and rehabilitation in the acute and chronic state of traumatic brain injury. *Journal of internal medicine*. 2019 Jun; 285(6):608-623. doi: 10.1111/joim.12900
- [5] Corrigan JD, Yang J, Singichetti B, Manchester K, Bogner J. Lifetime prevalence of traumatic brain injury with loss of consciousness. *Injury prevention*. 2018 Dec; 24(6):396-404. doi: 10.1136/injuryprev-2017-042371
- [6] Dewan MC, Rattani A, Gupta S, Baticulon RE, Hung YC, Punchak M, et al. Estimating the global incidence of traumatic brain injury. *Journal of neurosurgery*. 2018 Apr; 1-18. doi: 10.3171/2017.10.JNS17352
- [7] Pattinson CL, Shahim P, Taylor P, Dunbar K, Guedes VA, Motamedi V, et al. Elevated Tau in Military Personnel Relates to Chronic Symptoms Following Traumatic Brain Injury. *Journal of head trauma rehabilitation*. 2020 Feb; 35(1):66-73. doi: 10.1097/HTR.0000000000000485
- [8] Perry SA, Coetzer R, Saville CWN. The effectiveness of physical exercise as an intervention to reduce depressive symptoms following traumatic brain injury: A meta-analysis and systematic review. *Neuropsychological Rehabilitation*. 2020 Apr; 30(3):564-578. doi: 10.1080/09602011.2018.1469417
- [9] Vanderploeg RD, Belanger HG, Curtiss G, Bowles AO, Cooper DB. Reconceptualizing rehabilitation of individuals with chronic symptoms following mild traumatic brain injury. *Rehabilitation Psychology*. 2019 Feb; 64(1):1-12. doi: 10.1037/rep0000255
- [10] Kunker K, Peters DM, Mohapatra S. Long-term impact of mild traumatic brain injury on postural stability and executive function. *Neurological sciences*. 2020 Jul; 41(7):1899-1907. doi: 10.1007/s10072-020-04300-0
- [11] Tay MRJ, Soh YM, Plunkett TK, Ong PL, Huang W, Kong KH. The Validity of the Montreal Cognitive Assessment for Moderate to Severe Traumatic Brain Injury Patients: A Pilot Study. *American Journal of Physical Medicine and Rehabilitation*. 2019 Nov; 98(11):971-975. doi: 10.1097/PHM.0000000000001227
- [12] Voormolen DC, Polinder S, von Steinbuechel N, Vos PE, Cnossen MC, Haagsma JA. The association between post-concussion symptoms and health-related quality of life in patients with mild traumatic brain injury. *Injury*. 2019 May; 50(5):1068-1074. doi: 10.1016/j.injury.2018.12.002
- [13] Kreter N, Rogers CL, Fino PC. Anticipatory and reactive responses to underfoot perturbations during gait in healthy adults and individuals with a recent mild traumatic brain injury. *Clinical Biomechanics*. 2021 Dec; 90:105496. doi: 10.1016/j.clinbiomech.2021.105496.
- [14] Kleffelgaard I, Soberg HL, Tamber AL, Bruusgaard KA, Pripp AH, Sandhaug M, et al. The effects of vestibular rehabilitation on dizziness and balance problems in patients after traumatic brain injury: a randomized controlled trial. *Clinical Rehabilitation*. 2019 Jan; 33(1):74-84. doi: 10.1177/0269215518791274
- [15] Gagné MÉ, McFadyen BJ, Ouellet MC. Performance during dual-task walking in a corridor after mild traumatic brain injury: A potential functional marker to assist return-to-function decisions. *Brain Injury*. 2021 Jan; 35(2):173-179. doi: 10.1080/02699052.2020.1863467
- [16] Tefertiller C, Hays K, Natale A, O'Dell D, Ketchum J, Seigny M, et al. Results From a Randomized Controlled Trial to Address Balance Deficits After Traumatic Brain Injury. *Archives of physical medicine and rehabilitation*. 2019 Aug; 100(8):1409-1416. doi: 10.1016/j.apmr.2019.03.015
- [17] Snir Melamed M, Silberg T, Bar O, Brezner A, Landa J, Gliboa Y. Online Awareness among Adolescents with Acquired Brain Injury: Preliminary Findings following Performance of Motor, Cognitive and Functional Tasks. *Physical and Occupational Therapy in Pediatrics*. 2022; 42(4):451-464. doi: 10.1080/01942638.2022.2035038
- [18] Subramanian S, Chavez M, Gonzalez EA, Mezulic D, Villalpando L. Estimation of Task Practice Intensity in Individuals with Mild Traumatic Brain Injury. *Archives of Physical Medicine and Rehabilitation*. 2021 Oct; 102(10):e52-3. doi: 10.1016/j.apmr.2021.07.621
- [19] Sharma P and Halder S. Cognition, Quality Of Life and Mood State In Mild Traumatic Brain Injury: A Case Study. *Indian Journal of Mental Health*. 2021; 8(1):112.
- [20] Joubran K, Bar-Haim S, Shmuelof L. The functional and structural neural correlates of dynamic balance impairment and recovery in persons with acquired brain injury. *Scientific Reports*. 2022 May; 12(1):7990. doi: 10.1038/s41598-022-12123-6
- [21] Kakade P and Kanase SB. Effect of Multidimensional Exercise Program for Improving Balance in Traumatic Brain Injury Patients. *Medico-legal Update*. 2020 Jul; 20(3):155.

- [22] Linnestad AM, Løvstad M, Groven KS, Howe EI, Fure SCR, Spjelkavik Ø, et al. "Manoeuvring in uncharted waters - a balancing act": A qualitative exploration of treatment and improvement after mild traumatic brain injury. *Neuropsychological rehabilitation*. 2022 Feb; 1-21. doi: 10.1080/09602011.2022.2034651
- [23] Morelli N, Heebner NR, DeFeo CJ, Hoch MC. The Influence of Cognitive Dual Tasks on Concussion Balance Test Performance. *Motor Control*. 2021 Feb; 25(2):252-263. doi: 10.1123/mc.2020-0075
- [24] Gera G, Chesnutt J, Mancini M, Horak FB, King LA. Inertial Sensor-Based Assessment of Central Sensory Integration for Balance After Mild Traumatic Brain Injury. *Military Medicine*. 2018 Mar; 183:327-332. doi: 10.1093/milmed/usx162