RESEARCH PAPER

Effects of Structured Six-Week Sensorimotor Training Program on Postural Control in Collegiate Cricketers: A Randomized Controlled Trial

Jibran Ahmed Khan[1], Nidhi Singh[2*]

[1]*Phd Research Scholar,* Department of Physiotherapy, School of Allied Health Sciences, Galgotias University, Greater Noida, Uttar Pradesh, India. ORCID ID: https://orcid.org/0009-0009-1849-8912 Email ID: Jibranpathan1990@gmail.com

[*2]Professor, Department of Physiotherapy, School of Allied Health Sciences, Galgotias University, Greater Noida, Uttar Pradesh, India. *ORCID ID: https://orcid.org/0009-0006-0811-9825 Email ID:* singh.nidhi@galgotiasuniversity.edu.in

Abstract

Cricket requires players to execute multiple movements because the game demands players to run and change directions while they also need to jump and throw and hit the ball. Athletes who experience balance problems will see their performance decrease while their chances of sustaining injuries to their lower body will increase. The randomized controlled trial was conducted to examine how the six-week sensorimotor training program affected dynamic and static postural control among collegiate cricketers. The researchers assigned thirty male collegiate cricketers who were 18 to 25 years old to either the experimental group which contained 15 participants or the control group which also contained 15 participants. The experimental group completed a three-time-per-week supervised sensorimotor training program which lasted six weeks while the control group followed their regular cricket training schedule. The Star Excursion Balance Test (SEBT) composite score assessed dynamic postural control while the Balance Error Scoring System (BESS) assessed static postural control. The researchers used paired t-tests to analyse within-group data while independent samples t-tests handled between-group data with a significance level at $p < 0.05$. The experimental group achieved significant progress in both dominant and non-dominant limb SEBT composite scores ($p < 0.001$). The experimental group achieved a significant decrease in BESS total error scores ($p < 0.001$) which showed that their static postural stability had improved. The control group maintained stable performance levels because their SEBT and BESS scores did not change significantly ($p > 0.05$). The experimental group showed superior results compared to the control group after the testing period ended ($p < 0.001$). The findings demonstrate that a structured sensorimotor training program leads to improved postural control for collegiate cricketers which results in better athletic performance and reduced risk of injuries.

Keywords: Sensorimotor training, postural control, cricket, proprioception, balance, rehabilitation

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Introduction

Cricket is an extensive sport where players have to constantly perform high-intensity movements like sprinting, cutting, jumping, and more different ways of running, bowling, and batting. The aforementioned actions are very often executed in the state of single-limb support, and thus, they are pretty taxing for the body areas that provide us with balance and stability (postural control and neuromuscular coordination respectively). It is control of balance that is why it is imperative for sports performance to be at its best and also for the prevention of lower-extremity injuries that are very prevalent among [1,2]. Besides, many researchers have shown a link between poor posture control and decreased movement efficacy as well as higher chances of ankle and knee injuries in athletes' groups [3].

Postural control is the capability to keep the centre of mass of the body within the base of support during static and dynamic movements. The function is a result of the intricate interplay of sensory inputs from the visual, vestibular, and somatosensory systems, followed by suitable motor actions to ensure stability [4]. In one-sided sports like cricket, repetitive task-specific loading frequently results in the dominance of one limb, which might mutually cause the dominant and non-dominant limbs to have different levels of postural control [5,6]. These differences among limbs have been recognized as possible contributors to lower-limb injury and decreased functional performance [7].

Sensorimotor training has become a common practice in sports rehabilitation and performance improvement due to its benefits on proprioception, joint stability, and neuromuscular control. Generally, this type of training consists of a combination of single-leg balance tasks, unstable surface exercises, and perturbation activities that are aimed at the sensorimotor system. A number of studies have shown that training of this sort is capable of boosting both static and dynamic balance in athletes [8,9,10,11] state that the process of gradual exposure to balance-challenging tasks improves sensory integration and motor planning, thus leading to better postural strategies and more efficient movement.

Accurate measurement of postural control is of utmost importance in the evaluation of training interventions. The Star Excursion Balance Test (SEBT) has been

*Author for Correspondence: singh.nidhi@galgotiasuniversity.edu.in

regarded as an effective measure of dynamic balance and has been confirmed to have excellent reliability and validity in the athletic population [9,10]. The Balance Error Scoring System (BESS) is often used for the evaluation of static postural stability and has been proven to be effective in recognizing balance difficulties among sportsmen and sportswomen [11], by assessing both predominant and non-predominant limbs with these instruments, one gains an understanding of the specific changes in the balance of the limbs.

Sensorimotor training has been supported by mounting evidence, but still, very few randomized controlled trials have investigated its short-term effects in collegiate cricketers considering limb dominance factors. Consequently, the main aim of the present research was to assess the impact of a sensorimotor training program over a period of 6 weeks on the postural control of both dominant and non-dominant limbs in collegiate cricketers as measured by SEBT and BESS. The researchers expected that the changes brought about by combining sensorimotor training would be considerably larger than those occurring with routine cricket training alone.

Methodology

Study Design and Setting

This study employed a prospective, parallel-group, single-blind Randomized Controlled Trial (RCT) design. The intervention and data collection took place at the Sports Training Centre of the institution. Ethical approval was obtained prior to the study's commencement (Approval No.: SEC/PhD/25/24). The trial was prospectively registered with the Clinical Trials Registry of India (CTRI) under registration number CTRI/2025/12/098714. Every procedure was performed in accordance with the ethical guidelines of the institutional ethics committee and the Declaration of Helsinki. The criteria for inclusion specified that male college-level cricketers aged between 18 and 25 years must have been actively engaged in organized cricket training and competitions for a minimum of six months, with a required training frequency of at least three sessions each week. Participants were expected to be in good overall health, free from any known vestibular, neurological, or visual impairments, and were obligated to provide voluntary written informed consent before taking part in the study. On the other hand, the exclusion criteria disqualified individuals who had a history of diagnosed vestibular disorders, such as vertigo, neurological conditions like epilepsy, multiple sclerosis, or peripheral neuropathy, as well as those with uncorrected visual deficits or ocular pathologies that could potentially affect balance assessment. Participants were also excluded if they had suffered a concussion or head injury in the last six months, experienced any musculoskeletal injuries impacting the lower limbs, spine, or balance-related structures in the preceding three months, or were currently taking medications that might affect balance or central nervous system function, including sedatives, anti-epileptics, or vestibular suppressants. Furthermore, individuals with systemic conditions such as uncontrolled diabetes or hypertension that could jeopardize safe participation in training were excluded from the study.

Sample Size

The G*Power software (version 3.1) was used for the sample size calculation of the randomized controlled trial. A t-test (two-tailed, independent) was chosen for outcome comparison between the two groups after the intervention. A moderate effect size (Cohen's $d = 0.80$) was selected based on previous studies with balance training in athletes and short-term sensorimotor interventions [10,11]. At a significance level of $\alpha = 0.05$ and a statistical power of 80% ($1-\beta = 0.80$), the estimated minimum sample size for the study was 30 participants (15 per group).

Procedure

All of the participants were provided with detailed information about the study's objectives, methods, possible advantages, and risks, and their written informed consent was taken before they participated. Baseline demographic data such as age, height, weight, playing experience, and limb dominance were collected. Limb dominance was assessed by asking the participants which leg they preferred for kicking the ball. After the selection process, the eligible participants were randomly assigned to the experimental group (sensorimotor training) or the control group (only routine cricket training) by a simple randomization method. The assessment of postural control was carried out at baseline and was followed by the intervention. The assessments of dynamic and static balance were conducted while the participants were in their regular sports shoes in order to replicate the sport-specific conditions. To reduce inter-rater variability, all evaluations were carried out by a single examiner. The Star Excursion Balance Test (SEBT) was used to evaluate dynamic postural control. The subjects were instructed to stand on the foot of the testing limb, while the other leg was used for reaching out as far as possible, in different directions. The subject was supposed to keep balance throughout the task. For every limb three practice efforts followed by three recorded attempts were done, and the average of the composite score was computed and divided by the leg length. The assessments were done for both the dominant and non-dominant limbs.

The Balance Error Scoring System (BESS) was the method used to measure static postural control. The subjects executed the standardized balance tasks according to the protocols, and the errors were recorded for each limb, i.e., for the dominant and non-dominant limbs separately. The testing conditions and scoring criteria remained the same for both the pre- and post-intervention evaluations. Once baseline testing was over, the participants in the experimental group took part in a sensorimotor training program for the next six weeks which was done in three sessions per week under strict supervision of a physiotherapist and each of the sessions lasted about 30 minutes. The training regimen consisted of single-leg standing exercises, balance board training, foam surface activities, and perturbation training with gradual increases in complexity and difficulty. A qualified physiotherapist supervised each session to ensure that the participants performed the exercises correctly and that they complied with the requirements. The control group was allowed to continue with their regular cricket training during the 6-week period of the study and were not given any supplementary balance or sensorimotor exercises. When the intervention period was over, the post-intervention assessments were carried out using the same SEBT and BESS methods, in the same environment, and by the same investigator as before.

Statistical Analysis

Data analysis was conducted utilizing IBM SPSS Statistics (Version 26.0). Data are shown with mean ± standard deviation. The data are displayed as mean values together with standard deviation values. The Shapiro–Wilk test assessed the normality of the data distribution because its result showed $p > 0.05$. The researchers used independent samples t-test to compare baseline demographic and anthropometric characteristics between experimental and control groups while using Fisher's exact test to analyse categorical data. The researchers used paired t-tests to analyse within-group data while they used independent samples t-tests to compare between different groups. The Star Excursion Balance Test (SEBT) composite scores for both dominant and non-dominant limbs assessed dynamic postural control while static postural control used limb-specific Balance Error Scoring System (BESS) total error scores for evaluation. The researchers calculated effect sizes by using Cohen's d. The researchers considered a p-value < 0.05 to determine statistical significance.

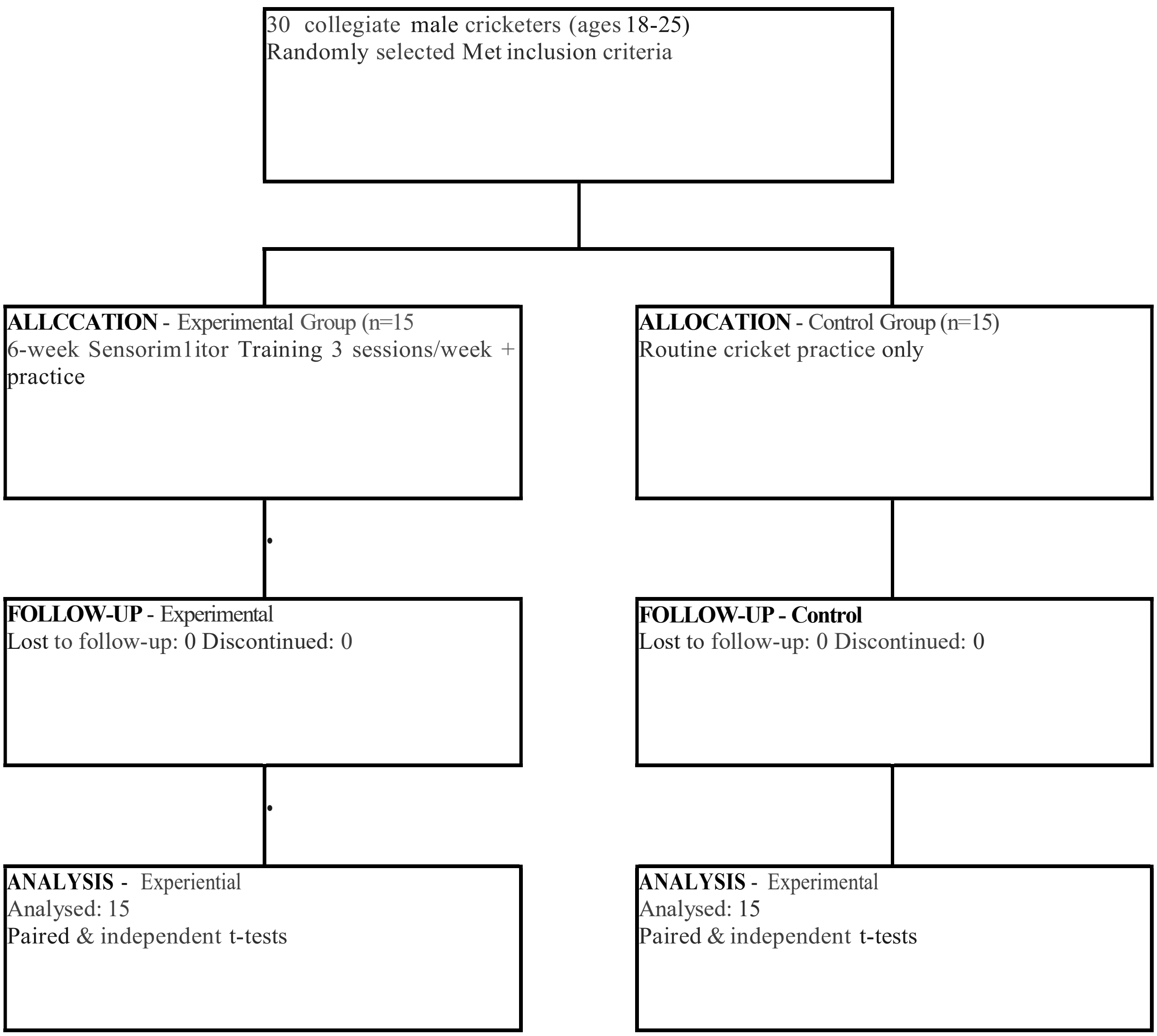

Fig 1: Progress through the phases of this study (CONSORT flow diagram)

Results

The baseline characteristics of participants in the experimental and control groups are shown in Table 1. on.

Table 1: Independent t-test and Fisher's Exact Test Revealing Differences in Demographic and Anthropometric Variables at Baseline Between Experimental and Control Groups

Variable	Experimental Group (n = 15)	Control Group (n = 15)	p-value
Age (years)	20.8 ± 1.9	20.6 ± 2.1	0.73
Height (cm)	173.4 ± 5.8	172.9 ± 6.1	0.81
Weight (kg)	67.2 ± 6.9	66.8 ± 7.2	0.84
BMI (kg/m²)	22.3 ± 1.8	22.4 ± 1.9	0.89
Cricket Experience (years)	4.1 ± 1.3	4.0 ± 1.4	0.78
Training Frequency (sessions/week)	4.8 ± 0.9	4.7 ± 1.0	0.66
Vision & Vestibular Status	Normal	Normal	—
Lower Limb Injury (past 3 months)	0	0	—
Overall Group Difference	—	—	p>0.05

There were no significant differences ($p > 0.05$) between groups for mean age, height, weight, BMI, years' experience in cricket, and frequency of training per week using independent samples t-test. There were also no significant differences ($p > 0.05$) between groups for vision and vestibular status and history of lower limb injury analysed using Fisher's exact test. Thus, both groups were comparable at baseline prior to the interventi

Table 2: Paired t-test Comparison of Star Excursion Balance Test (SEBT) Composite Scores (%) Within Group

Group	Limb	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	p-value
Experimental	Dominant	84.7 ± 5.3	93.5 ± 4.2	8.8	<0.001*
Experimental	Non-dominant	83.0 ± 5.7	91.3 ± 4.6	8.3	<0.001*
Control	Dominant	85.2 ± 5.0	86.1 ± 5.1	0.9	>0.05
Control	Non-dominant	83.9 ± 5.4	84.6 ± 5.5	0.7	>0.05

In Table 2, the experimental group showed significant improvement in SEBT composite scores after the intervention according to paired t-test analysis which showed difference between their dominant and non-dominant limb scores ($p < 0.001$). The control group showed no significant change between pre-test and post-test scores ($p > 0.05$).

Table 3: Paired t-test Comparison of Balance Error Scoring System (BESS) Total Error Scores Within Group

Group	Limb	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	p-value
Experimental	Dominant	18.0 ± 3.2	10.9 ± 2.5	7.1	<0.001*
Experimental	Non-dominant	18.8 ± 3.5	11.7 ± 2.7	7.1	<0.001*
Control	Dominant	17.6 ± 3.1	17.1 ± 3.1	0.5	>0.05
Control	Non-dominant	18.2 ± 3.4	17.7 ± 3.5	0.5	>0.05

In table 3, the paired t-test showed that BESS total error scores decreased significantly in the experimental group across both dominant and non-dominant limbs after the intervention ($p < 0.001$), which resulted in better static postural control. The control group exhibited no significant difference between their pre-test and post-test scores ($p > 0.05$).

Table 4: Independent t-test Showing Between-Group Comparison of Post-Intervention Outcomes

Outcome	Experimental (n=15) Mean ± SD	Control (n=15) Mean ± SD	Mean Difference	p-value
SEBT Dominant (%)	93.5 ± 4.2	86.1 ± 5.1	7.4	<0.001*
SEBT Non-dominant (%)	91.3 ± 4.6	84.6 ± 5.5	6.7	<0.001*
BESS Dominant (errors)	10.9 ± 2.5	17.1 ± 3.1	-6.2	<0.001*
BESS Non-dominant	11.7 ± 2.7	17.7 ± 3.5	-6.0	<0.001*

Outcome	Experimental (n=15) Mean ± SD	Control (n=15) Mean ± SD	Mean Difference	p-value
(errors)				

In table 4, the independent t-test analysis showed that all post-intervention outcomes between experimental and control groups demonstrated significant differences. The experimental group showed better SEBT composite scores for both their dominant and non-dominant limbs while they also performed better in BESS error scores which showed their enhanced ability to control both dynamic and static postures when compared to the control group ($p < 0.001$).

Discussion

The key aim of the randomized controlled trial was to assess the effect of the six-week sensorimotor training (SMT) program on the balance skills of the collegiate cricketers. The findings revealed that the carefully planned SMT protocol brought about a remarkable increase in both the performance measured by the Star Excursion Balance Test (SEBT) and the Balance Error Scoring System (BESS) in comparison with routine cricket training alone. The experimental group had an outstanding improvement in SEBT composite scores for both the dominant and non-dominant limbs. This indicates that SMT contributes to dynamic stability and neuromuscular reach which are essential for the rapid movements in different directions that take place in cricket such as the follow-throughs of bowling and lunges in fielding. Specific neuromuscular training is said to be a way of not only bridging the gap between static stability and functional sports performance but also enhancing the athlete's eccentric control of the stance limb [12]. The symmetry of limbs which was reduced in our study is reported to be in agreement with the findings of Brahmanand and Singh, who have documented that balance training focused on one side can lessen the unilateral deficits commonly met in overhead and asymmetric athletes and consequently equal the dispersion of mechanical load [13]. On the other hand, the significantly lower total error scores of BESS in the experimental group indicate better sensory reweighting in terms of static stability. The result is that athletes can more successfully integrate the proprioceptive and vestibular inputs when visual cues are disabled or surfaces are unstable. Mishra et al. point out that elite cricketers' repeated practice of balance-challenging activities develops "pre-programmed" motor responses which result in quicker postural adjustments in high-velocity sports [14]. The control group's stagnation in this area implies that regular cricket drills are not capable of providing the necessary high-level proprioceptive challenges to get the standard neural adaptations in postural control, as emphasized by Thomas et al. [15]. The positive changes in postural control from a clinical standpoint have far-reaching implications for injury prevention. Poor postural control is the main indicator of lower-extremity injuries. Rivera et al. showed that athletes with the poorest balance are the ones with the highest risk for not only ankle sprain (particularly lateral type) but also torn ACL [16]. Athletes in a particular sport, in this case, cricket, have to deal with regular stresses caused by their own movements, and the strengthening of their sensorimotor system will provide them with more effective means of protecting themselves against these stresses. Modern rehabilitation protocols, as pointed out by Brahmanand and Singh [13], are increasingly recommending that cognitive and sensorimotor challenges be incorporated in the training of athletes as a means of achieving better simulation of the "chaotic" nature of competitive sports environments. At last, Wulf and Lewthwaite mention that such improvements are very likely to be brought about by an external focus of attention which is encouraged during SMT, and which helps develop automaticity in motor control, hence, the link between a focus of attention and performance is believed to be through an individual's control of motor developing in terms of automaticity [17,18]. However, despite these positive outcomes, some limitations must be mentioned. The number of participants was rather small, and there were no long-term follow-ups conducted in this study to assess if the training effects remain. Moreover, only two measures were applied, which might not reflect all sides of postural control. Future research should cover larger populations, longer intervention durations, and injury surveillance to further explore the long-term benefits of sensorimotor training in cricket populations.

Limitations and Future Direction

While the results of the study were encouraging, it still came with limitations. The first issue was the sample used, which was rather small (n=30) so the findings could not easily be applied to the entire population of college cricketers. The second limitation was that only male participants took part in the study, hence, it remains unclear what the program's effects would have been on female cricketers. A short-term intervention was conducted over 6 weeks, with no long-term follow-up performed to find out if the improvements in postural control had been sustained at the end of the intervention; this formed the third limitation of the study. The outcome measures that were used only included SEBT and BESS; such parameters like reactive balance or proprioceptive acuity were neglected. Additionally, no injury tracking was performed in the study, hence, it is not known whether the improvements noted lead to a lower risk of musculoskeletal injuries. The future line of research should take these limitations into account by incorporating larger samples that are gender-diverse, longer interventions with follow-up assessments, injury surveillance, and various additional balance measures to gain a better understanding of the long-term impact of sensorimotor training among cricketers.

Conclusion

The outcome of this randomized controlled trial indicates that a well-structured 6-week sensorimotor training program can significantly improve the postural control of athletes in both static and dynamic situations. The program made such a difference that the SEBT (Star Excursion Balance Test) scores increased significantly, and the BESS (Balance Error Scoring System) error counts for the dominant and non-dominant limbs decreased a lot. Thus, it seems that the drills designed for the proprioceptive and neuromuscular training produced a more effective stimulus for the balance adaptation than the cricket training undertaken regularly. Moreover, the large differences found in the non-dominant limb hint that the sensorimotor training method can be used successfully for the purpose of lowering functional limb asymmetries, which are quite often found in sports like cricket that involve one-sided playing. The improvement of sensory integration and motor planning through this kind of training not only leads to better performance of the athlete in high-intensity movement but also helps to prevent secondary injuries and lowers the risk of reinjury in the case of a sports player with a history of musculoskeletal instability. The use of such sensorimotor exercises in the regular conditioning program of collegiate cricketers is highly recommended to increase the stability of joints and neuromuscular efficiency in the long term.

Conflict of Interest

The authors declare that there is no conflict of interest.

Acknowledgment

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Ethical Approval and Trial Registration

Ethical approval was obtained prior to the study's commencement (Approval No.: SEC/PhD/25/24). The trial was prospectively registered with the Clinical Trials Registry of India (CTRI) under registration number CTRI/2025/12/098714. Every procedure was performed in accordance with the ethical guidelines of the institutional ethics committee and the Declaration of Helsinki.

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