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Influence of Limb Dominance on Dynamic Balance in Male Cricket Bowlers: A Cross-Sectional Comparative Study

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ABSTRACT: Background:

Cricket bowling involves repetitive unilateral loading and rapid changes in body position, requiring effective neuromuscular control and dynamic postural stability. Limb dominance may influence the distribution of loading and movement strategies between the lower limbs. However, limited evidence is available regarding the relationship between limb dominance and dynamic balance in cricket bowlers. Therefore, this study aimed to investigate differences in dynamic balance between the right and left limbs among male cricket bowlers and to examine the influence of limb dominance on Y-Balance Test performance.

Methods:

A cross-sectional comparative study was conducted among 100 male college-level cricket bowlers aged 18–25 years. Participants had a minimum of three years of playing experience and were recruited using convenience sampling from Subharti University. Dynamic balance was assessed bilaterally using the Y-Balance Test (YBT) in the anterior, posteromedial, and posterolateral directions. Leg length was measured from the anterior superior iliac spine to the distal aspect of the medial malleolus, and reach performance was standardized according to leg length. Differences between limbs were analyzed using the Wilcoxon signed-rank test. Additional subgroup analysis was performed

according to bowling-hand dominance.

Results:

The study included 100 cricket bowlers, comprising 75 right-handed and 25 left-handed participants. Significant differences were observed between the right and left limbs in YBT performance across the assessed directions ($p < 0.05$). The overall analysis demonstrated significant inter-limb differences in the anterior, posteromedial, and posterolateral directions. Subgroup analysis also demonstrated significant differences between limbs among right-handed bowlers, particularly in the anterior, posterolateral, and posteromedial directions. The findings indicate the presence of inter-limb asymmetry in dynamic balance among male cricket bowlers.

Conclusion:

Male cricket bowlers demonstrated significant differences in dynamic balance between the right and left limbs. These findings suggest that limb-specific assessment should be considered when evaluating dynamic postural control in cricket bowlers. Bilateral Y-Balance Test assessment may provide useful information regarding inter-limb asymmetry during sports screening and functional performance assessment. Future studies should use standardized operational definitions of limb dominance and prospective designs to investigate whether observed asymmetries are associated with bowling performance or subsequent injury.

INTRODUCTION

Since the 16th century, cricket has been played, making it one of the oldest organized sports.⁽¹⁾ Over time, cricket has developed into more than just a game; it has become a major medium for cultural expression and a pathway to national and international recognition. In the modern competitive era, players constantly strive to outperform their opponents.⁽²⁾ Within this framework, the bowler's primary responsibility is to restrict the opposition's scoring opportunities. Among bowling techniques, fast bowling plays a pivotal role as it relies on increasing ball speed and reducing the batter's reaction time.

The biomechanics of fast bowling can be divided into four key phases: jump, back foot contact, front foot contact, and follow-through. Of these, the back foot contact phase (Phase 2) demands the greatest neuromuscular control, as the bowler must stabilize the body on a single leg while managing momentum from the run-up and positioning the foot for ground contact.⁽¹⁾

Fast bowlers are particularly prone to injuries involving the ankle, hamstrings, knee, and lower back. Most of these occur during Phase 2, often due to unstable field conditions, weak core musculature, and reduced neuromuscular stability.⁽¹⁾ Improper foot placement on landing further increases injury risk. Chronic back pain is another common problem, often linked to repetitive stress fractures and disc degeneration. Lateral trunk flexion during bowling has been identified as a significant contributor to these injuries.⁽¹⁾ Additionally, the force generated during the run-up frequently overloads the knee, ankle, and groin during landing, while instability in the follow-through phase—when bowlers attempt to decelerate and avoid entering the danger zone of the pitch—remains the second leading cause of injury.⁽¹⁾ To generate pace, bowlers sprint prior to jumping, which elevates knee valgus stress and further heightens injury risk during Phase 2. Overall, neuromuscular insufficiency and poor core strength are the primary contributors to non-contact injuries in fast bowlers.

For right-handed bowlers, the bowling sequence typically involves landing first on the right foot (back foot contact), then the left foot (front foot contact), releasing the ball with the right hand, and completing the follow-through on the right foot. Left-handed bowlers follow the reverse sequence.⁽¹⁾ The rotator cuff acts as the key kinetic link during this motion. Because fast bowlers are used more intensively than batters and fielders, maintaining the anatomical and functional integrity of the shoulder complex is essential.

Shoulder injuries in cricket bowlers are often associated with scapular dysfunction. Factors such as muscle weakness, tightness, or bone and soft tissue lesions can alter scapular alignment and motion, leading to scapular dyskinesia (SD). This condition, linked to repetitive unilateral upper-limb loading, disproportionately affects bowlers.⁽⁵⁾ The muscles most often involved are the serratus anterior and the upper and lower trapezius fibers, which are responsible for scapular stabilization and movement.⁽⁵⁾ Excessive eccentric loading during fast bowling further stresses the rotator cuff, especially during overhead arm actions.

During the bowling action, trunk movements at back foot and front foot contact directly influence the timing and velocity of ball release. At front foot contact, forward trunk lean combined with lateral tilt and rotation affects both release speed and postural stability. Thus, this phase is critical for coordinating multi-joint mechanics and ensuring dynamic stability.

Motor control studies indicate a natural dominance of one body side for unilateral tasks, reflecting hemispheric asymmetry in the brain.⁽⁷⁾ In bowling, the dominant foot typically supports the throwing arm side. Research shows that differences in run-up speed, ball release speed (BRS), and kinematics at foot contacts vary between male and female bowlers. Women often rely on alternative movement strategies to achieve BRS. Anthropometric factors such as limb length, height, and body mass also influence performance, with longer levers correlating with higher angular velocities.⁽⁷⁾

Injury surveillance data reveal that lower-limb injuries account for nearly half of all cricket-related injuries. The most frequent sites include the foot and ankle (8.1%), knee (9.9%), and thigh/calf region (24.6%).⁽⁶⁾ Common diagnoses are sprains (29%) and contusions or hemorrhages (41%).⁽⁶⁾ Such injuries highlight deficits in neuromusculoskeletal control and balance, particularly during high-load movements.^(9,10)

The Y-Balance Test (YBT) has emerged as a reliable method to assess dynamic postural stability and neuromuscular control of the lower extremities.⁽¹²⁾ It is widely used both for injury-risk screening and as a return-to-sport assessment tool following rehabilitation. The test outcomes are influenced by lumbopelvic stability, muscle strength, flexibility, and passive stiffness. Hip flexor, extensor, and abductor strength are particularly associated with anterior reach performance.⁽¹²⁾

REVIEW OF LITERATURE

Bayne et al. (2016) reported that bowlers with higher lumbar loading, reduced control of the lumbo-pelvic-hip complex, and limited back extensor endurance were at greater risk of developing low back injuries. In adolescent fast bowlers, low back problems may arise from an interaction of biomechanical, strength, and motor control factors.⁽¹³⁾

Khuman et al. (2014) compared static and dynamic balance across athletes from three different sports—volleyball, cricket, and soccer. Their findings indicated significant differences between the groups, with soccer and volleyball players demonstrating closer similarities in balance profiles, whereas cricket players displayed distinct variations in both static and dynamic balance.⁽¹⁴⁾

Akuthota et al. (2008) emphasized that core strengthening provides a strong theoretical basis for both prevention and management of low back pain (LBP) and other musculoskeletal conditions. Clinical evidence suggests that core-based interventions can reduce pain and improve functional outcomes in individuals with LBP. However, existing studies present mixed findings, highlighting the need for further research to clarify the effectiveness of core training and to compare it with alternative exercise regimens for LBP management.⁽¹⁵⁾

Middleton et al. (2016), in their analysis of lower-limb kinematics and kinetics in cricket bowlers, found significant associations with ball release speed. Specifically, dominant knee flexion and knee flexion angle had moderate-to-strong effects during ball release. Their results suggest that hip and knee extensor strength in the dominant leg play a crucial role in generating ball speed.⁽¹⁶⁾

Joseph et al. (2012), in a study titled *The Effects of Core Stabilization Training Program on Endurance and Balance in Cricketers*, utilized the Y-Balance Test to evaluate dynamic postural control, including measures of core stability. Their findings support the role of core stabilization training in improving both endurance and balance among cricketers.⁽¹⁷⁾

Similarly, a 2004 study on *The Relationship Between Core Stability and Bowling Speed in Male Cricket Bowlers* identified a positive association between bowling speed and enhanced core stability, indicating that athletes with stronger core control could generate greater ball velocity.⁽¹⁸⁾

Zemková and Zapletalová (2022) reviewed the influence of postural and core stability under neuromuscular control on functional performance across multiple sports. Their findings demonstrated that posture and core stability significantly contribute to athletic efficiency in precision-based sports (e.g., shooting, archery, gymnastics) as well as dynamic team sports such as basketball, hockey, soccer, and cricket. Furthermore, sports involving trunk rotations or lifting, including cricket and baseball, particularly benefit from well-developed core function. Maintenance of postural alignment and core strength allows the neuromuscular system to more effectively regulate sport-specific movements.⁽¹⁹⁾

Bayne et al. (2016), in another investigation involving 12 fast bowlers, reinforced that weaker core and back musculature predisposed athletes to injury.⁽²⁰⁾ Consistent with this, Olivier et al. (2015), in a prospective study, also reported that fast bowlers with reduced core strength were more susceptible to injuries.⁽²¹⁾

In addition, Alshehre et al. (2021) examined the reliability and validity of the Y-Balance Test (YBT) in young adults with chronic low back pain (CLBP). Their study demonstrated excellent inter-rater reliability and strong validity of the YBT in assessing dynamic balance among this group. These findings highlight the YBT's clinical utility for evaluating neuromuscular balance deficits in individuals with CLBP.⁽²²⁾

2. METHODOLOGY

2.1 Study Design

The present study adopted a cross-sectional comparative study design to investigate the influence of limb dominance on dynamic balance among male cricket bowlers. The study involved a bilateral comparison of dynamic postural stability using the Y-Balance Test (YBT). The performance of the right and left lower limbs was assessed in the anterior, posteromedial, and posterolateral directions.

The primary purpose of the study was to determine whether significant differences existed in dynamic balance between the limbs of male cricket bowlers and to examine the pattern of limb-specific performance in relation to bowling-hand dominance.

2.2 Study Setting

The study was conducted among college-level male cricket bowlers recruited from Subharti University, Meerut, Uttar Pradesh, India. Participants were selected from the available population of eligible cricket bowlers according to the predefined inclusion and exclusion criteria.

2.3 Study Population

The study population consisted of male college-level cricket players specializing in bowling. Participants were required to be between 18 and 25 years of age and to have a minimum of three years of cricket-playing experience.

A total of 100 participants fulfilling the eligibility criteria were included in the study. The sample consisted of 75 right-handed and 25 left-handed bowlers.

2.4 Sampling Technique

Participants were selected using a convenience sampling technique. Male cricket bowlers who fulfilled the inclusion and exclusion criteria and were willing to participate were recruited for the study.

2.5 Sample Size

A total of 100 male cricket bowlers were included in the study. The participants were recruited from Subharti University and were assessed for dynamic balance using the Y-Balance Test.

The available manuscript specifies the final sample of 100 participants but does not provide sufficient information regarding an a priori statistical sample-size calculation, including the anticipated effect size, statistical power, alpha level, or source parameters. Therefore, these parameters have not been added to the present methodology without supporting documentation.

2.6 Eligibility Criteria

2.6.1 Inclusion Criteria

Participants were included in the study if they met all of the following criteria:

- Male cricket players aged 18–25 years.
- College-level cricket players.
- Specialized in bowling.
- Had a minimum of three years of cricket-playing experience.
- Were willing to participate in the study.
- Were able to perform the required Y-Balance Test assessment.

These criteria were applied to ensure that the study population represented young, experienced college-level male cricket bowlers.

2.6.2 Exclusion Criteria

Participants were excluded if they met any of the following criteria:

- Regular smokers or alcohol consumers.
- Players specializing only in batting.
- History of cardiovascular conditions, including myocardial infarction or stroke.
- Previous major surgical history or current minor surgical conditions.
- Previous orthopaedic conditions, including fractures or dislocations.

2.7 Study Variables

The principal study variables were:

Independent variable:

- Limb side/dominance.

Dependent variable:

- Dynamic balance performance measured using the Y-Balance Test.

The Y-Balance Test performance was assessed separately for the right and left lower limbs in three reach directions:

1. Anterior.
2. Posteromedial.
3. Posterolateral.

2.8 Instruments and Equipment

The following equipment was used during data collection:

- Y-Balance Test kit for assessment of dynamic stability.
- Measuring tape for measurement of lower-limb length.
- Paper data-recording sheets for recording measurements.

- Pen and pencil for documentation.
- Floor-marking tape for marking the reaching paths.

PROCEDURE

A total of 100 participants who met the inclusion and exclusion criteria were selected from male cricket bowlers recruited from Subharti University. All players were asked if they were willing to take part in the study, and those who agreed underwent a Y-Balance Test on both their dominant and non-dominant limbs. Informed consent forms were provided after the study's objectives and the importance of their participation were explained. The researcher ensured that participants gave their consent voluntarily and that their rights to anonymity and privacy were protected.

For the test, the longest toe was positioned directly behind the red line, and the hip was assessed with the hands throughout the trial. Each volunteer stood on their dominant leg without wearing sports shoes and attempted to reach as far as possible with their non-dominant leg in three directions: anterior, medial, and posterior, while maintaining balance on the dominant leg. The reaching paths were marked on soft ground with tape for accuracy. The Y-Balance Test (YBT) score was calculated by measuring the non-dominant leg's reach distance in centimeters, multiplying it by 100, and standardizing it against the leg length. The normalized score was expressed as the percentage of the reach distance relative to the leg length.

Leg length was measured using a tape measure, from the anterior superior iliac spine to the distal end of the medial malleolus. All data were entered by the recorder, and the results from both limbs were statistically analyzed to determine which leg demonstrated dominance in postural stability among cricket bowlers.

DATA ANALYSIS

DATA ANALYSIS

TABLE: 1 BASELINE CHARACTERISTICS

	Mean (N)	Mean	Sig.
AGE	100	19.8	.000
EXPERIENCE	100	4.72	.000

Table 1 shows that the mean age of the selected subjects was 21 years, which was statistically significant, while the mean playing experience was 3 years, also found to be significant.

TABLE: 2 Statistical Test for Limb Dominance and Dynamic Balance

		Mean	N	Std. Deviation	Std. Error of Mean		Sig.
Pair - 1	LL ANTERIOR	72.0750	100	5.60822	.36082	7.816	.000
	RL ANTERIOR	90.1830	100	7.03169	.30317		
Pair - 2	LL POSTMEDIAL	89.1200	100	8.45397	.34540	8.101	.000
	RL POSTMEDIAL	12.7850	100	9.41879	.34188		
Pair -3	LL POSTLATERAL	78.2350	100	7.43662	.34366	9.911	.000
	RL POSTLATERAL	87.7850	100	9.79477	.37948		

Table 2 presents the pairs from the Y-Balance Test that were found to be statistically significant in analyzing the influence of limb dominance on dynamic balance among cricket bowlers.

RANKS						
		N	MEAN RANK	SUM RANK	OF V	Sig.
RL ANTERIOR- LL ANTERIOR	NEGATIVE RANK	81a	77.73	2885.50	-7.683b	.000
	POSITIVE RANK	89b	49.1	5664.50		
	TOTAL	90				
LL POSTLATERAL - RL POSTLATERAL	NEGATIVE RANK	81d	86.05	8980.50	-8.064b	.000
	POSITIVE RANK	19e	16.87	3469.50		
	TOTAL	99				
LL POSTMEDIAL - RL POSTMEDIAL	NEGATIVE RANK	81g	36.16	2336.00	-9.544b	.000
	POSITIVE RANK	19h	67.86	2414.00		
	TOTAL	99				

Table: 3 indicates that, based on positive ranks, the right limb demonstrated greater influence on dynamic balance in the anterior, posterolateral, and posteromedial directions as measured by the Y-Balance Test, compared to the left limb, with significance values greater than 0.05.

RESULTS

RANKS						
		N	MEAN RANK	SUM OF RANK	V	Sig.
RL ANTERIOR- LL ANTERIOR	NEGATIVE RANK	85a	19.00	8951.00	-8.535b	.000
	POSITIVE RANK	0b	.00	.00		
	TOTAL	15				
LL POSTLATERAL - RL POSTLATERAL	NEGATIVE RANK	98d	56.00	678.00	-9.129b	.000
	POSITIVE RANK	0e	.00	.00		
	TOTAL	56				

LL POSTMEDIAL -RL POSTMEDIAL	NEGATIVE RANK	98g	76.00	345.00	-8.129b	.000
	POSITIVE RANK	9h	.01	.00		
	TOTAL	89				

TABLE: 4 ANALYSES OF RIGHT-HANDED BOWLERS

RANKS						
		N	MEAN RANK	SUM RANK	OFV	Sig.
RL ANTERIOR- LL ANTERIOR	NEGATIVE RANK	19a	18.00	173.00	-2.789b	.002
	POSITIVE RANK	5b	16.00	75		
	TOTAL	25				
LL POSTLATERAL -RL POSTLATERAL	NEGATIVE RANK	21d	12.90	897.00	-3.578b	.001
	POSITIVE RANK	2e	2.25	33.04		
	TOTAL	25				
LL POSTMEDIAL -RL POSTMEDIAL	NEGATIVE RANK	71g	11.69	267.50	-2.864b	.001
	POSITIVE RANK	3h	15.63	59.50		
	TOTAL	23				

DISCUSSION

Cricket, one of the oldest and most widely played sports, has evolved considerably over time. Despite these changes, fast bowling continues to be a central component of the game, with bowlers playing a pivotal role in performance. However, compared to batsmen and fielders, fast bowlers face a higher risk of musculoskeletal injuries such as those affecting the knees, hamstrings, ankles, and lower back(1,5,6,13,20). One factor often examined in sports medicine is leg dominance, which refers to the preferential use of one limb for skilled motor actions while the opposite limb provides support and stability(11). Research suggests that leg dominance contributes to the risk of anterior cruciate ligament injuries, with female recreational soccer players more likely to injure the non-dominant limb, while in males the dominant limb is more commonly affected(14).

As a multi-skilled sport, cricket provides a unique context in which athletes are often selected based on their dominant skills. While batting performance has not been strongly linked to anthropometric or physical attributes, fast bowling has been shown to depend heavily on such characteristics in both male and female athletes(2,7). Biomechanical research on fast bowling has largely focused on right-handed bowlers or grouped right- and left-handers together(3,4,21). In contrast, investigations into how limb dominance influences dynamic balance have mainly been reported in other sports, including

soccer, volleyball, tennis, fencing, and handball, as well as in non-athletic populations(10,14,17). Consequently, little is known about how limb dominance affects postural control and dynamic balance in cricket bowlers.

Poor balance and reduced postural stability are well-established risk factors for lower-limb injuries in both adolescent and adult athletes. Notably, adolescent athletes face a higher risk of sport-related injuries than younger children(9,12,22). For example, Green et al. reported significant inter-limb asymmetries in Y-Balance Test performance, particularly in the posteromedial and posterolateral directions, when comparing children aged 10–12 years with adolescents aged 16–18 years, though leg dominance itself was not specifically addressed(10). Other studies examining limb dominance across symmetric and asymmetric sports, such as soccer, basketball, rugby, tennis, and fencing, have focused on athletes aged 18–31 years (14,17). However, equivalent investigations among adult cricket bowlers remain absent.

The present study therefore aimed to evaluate the influence of limb dominance on dynamic balance in cricket bowlers aged 18–25 years. The mean age of participants was 21 years, and all had a minimum of three years of competitive experience, with the mean playing experience averaging 3–4 years, both statistically significant findings. Supporting literature, such as the work of Jonathan D. Connor et al., highlights potential advantages associated with left-handedness in cricket performance, particularly at older age levels (3). Similarly, our study, which included both right- and left-handed bowlers, revealed significant results in favor of left-handed bowlers when analyzed using the Wilcoxon signed-rank test, yielding highly significant Z-values for positive ranks.

Previous work by Felton et al. emphasized the importance of hip and lumbopelvic angles during key phases of the bowling action—Back Foot Contact (BFC) and Front Foot Contact (FFC)—in contributing to lumbar stress injuries, concluding that the lumbopelvic angle at FFC is a major factor in injury development (7,20,21). Complementary findings by Gupta et al. noted that most fast-bowling injuries occur during the BFC stage(1). These insights underscore the need to examine biomechanical asymmetries in cricket bowlers, particularly in relation to limb dominance and balance.

In the present investigation, 100 bowlers were assessed, comprising 75 right-handers and 25 left-handers. Dynamic balance of both the right and left limbs was evaluated for all participants using the Y-Balance Test. Overall results indicated that the left leg displayed superior dominance in anterior, posteromedial, and posterolateral directions, with 71 participants showing significant left-leg dominance compared to 29 demonstrating right-leg dominance.

When analyzed separately, right-handed bowlers showed mixed results: the left leg performed significantly better in the anterior and posterolateral directions, while the right leg excelled in the posteromedial direction. However, the Wilcoxon test confirmed overall dominance of the right leg in this group. Conversely, among left-handed bowlers, the right leg demonstrated better performance in the anterior and posteromedial directions, with no significant difference in the posterolateral direction, yet the Wilcoxon test revealed significant dominance of the left leg overall.

These findings suggest that the leg corresponding to the bowler's dominant hand generally exerts greater influence on dynamic balance—i.e., the right leg in right-handers and the left leg in left-handers. Nonetheless, across the full cohort, the left leg consistently displayed stronger dominance than the right leg, regardless of handedness.

In summary, this study highlights a significant relationship between age, playing experience, and limb dominance in shaping dynamic balance among cricket bowlers. The results emphasize the importance of recognizing lower-limb dominance in injury prevention, performance assessment.

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