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Correlation Between Core Stability and Hamstring Flexibility with Run-Up Speed in Fast Bowlers

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Abstract

In fast bowlers, core stability and hamstring flexibility play a key role in maintaining correct body mechanics and preventing injuries, since fast bowling actions are repeated in many ways where the spine and pelvis are under a lot of stress. Good hamstring flexibility and core strength are important for good posture and movement, and to reduce the risk of injury. To evaluate the relationship between core stability and hamstring flexibility with run-up speed in fast bowlers. A cross-sectional study of 83 male cricket bowlers aged 18 to 25 will assess core stability using a functional test (plank test), hamstring flexibility with the active knee extension test, and run-up speed via a speed test. The data will be collected using convenience sampling from males in Faisalabad. Data will be collected after meeting the inclusion (only males, actively training for the last 6 months, free from any acute injury) and exclusion criteria (trauma, under rehabilitation, recent history of lower back, hamstring, or core muscle injury). Core stability showed a significant positive correlation with run-up speed ($r_s = 0.568$, $p < 0.01$). In contrast, hamstring flexibility was significantly negatively correlated with run-up speed on both the right ($r_s = -0.540$, $p < 0.01$) and left sides ($r_s = -0.501$, $p < 0.01$). The study concluded that core stability and hamstring flexibility are significantly associated with run-up speed in fast bowlers. Better core stability and improved hamstring flexibility contribute to enhanced run-up performance.

Keywords: *stability, hamstring flexibility, tightness, run-up speed, fast bowlers, core endurance,*

Introduction

Fast bowling in cricket is a demanding sport that needs good run-up speed and power from the bowler's body. This study examines how core stability (the strength and balance of your trunk muscles) and hamstring flexibility (the stretchiness of your back thigh muscles) relate to how fast a bowler can bowl. As a physical therapy student, I want to determine whether, through player testing, faster bowlers can increase their speed and reduce injury risk by strengthening their hamstrings and improving their core stability. The core is a box of muscles comprising the anterior abdominal wall, the posterior paraspinal and gluteal muscles, the diaphragm, and the pelvic floor and hip girdle as the base. Within this box, 29 muscles majorly stabilize the spine and pelvis during active movement. Without these muscles, the spine would be unstable under compressive forces, much less than the upper body weight. This system, when working correctly, will allow efficient distribution of the forces applied and the maximum power generation with minimum compressive and/or shearing forces placed on the joints of the kinematic chain. It is very important in basic sports as it offers proximal stability for distal movement (Akuthota et al. 2008).

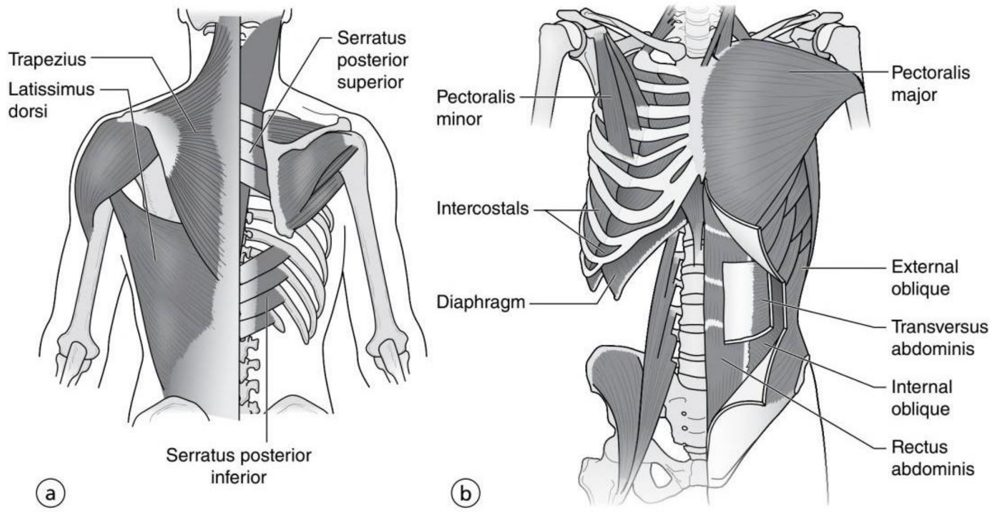

Figure 1.1: The Anatomical Core (a) Posterior view and (b) Anterior view (Willardson 2024).

The multifidus and erector spinae muscles are significant muscles that contribute to maintaining the stability of the spine and supporting the body's control during fast bowling. Repeatedly flexing, twisting and rotating the lower back when bowling places a significant amount of stress on the lower back or lumbar spine of a fast bowler. These muscles are important for posture and support the passage of forces from the legs to the upper limbs during the bowling action. A significant muscle imbalance or asymmetry in the multifidus and erector spinae muscles can develop with fast bowling which is repetitive and largely one sided. This imbalance will reduce spinal stability and can cause low back pain and other injuries. Therefore, maintaining good strength and endurance of these muscles is important for both bowling performance and injury prevention in fast bowlers (Gray et al. 2016). The mechanism of force transmission in the kinematic chain of a bowling athlete is the arm, while the shoulder acts as a funnel that regulates the force. The ground, legs, and the throwing force are the generators of force. The shoulder capacity is insignificant; the shoulder part must work correctly with these players. Other body parts generate the forces required for the game. In addition to propulsion, transferring troops to more distant areas of the body is crucial for stability (Anand et al. 2017).

Core stability is a crucial factor in sports performance, particularly when executing repeated movements at high speeds, such as in cricket fast bowling. The muscles around the body and the pelvis help to stabilize the body during the bowling action so that a force can be transferred through the body and into the arm of the bowler. Good core control is essential for maintaining balance and smooth movement for fast bowlers as they continually bend, twist and extend their bodies quickly. Research has demonstrated that weak muscle control and poor core stability can have a negative impact on performance and a higher risk for overuse injuries in the lower back and lower limbs. Due to this, core stability exercise has been viewed as a significant component of the fitness and rehabilitation regime of fast bowlers (Butt et al. 2024).

Cricket injuries to lower back are quite common and affect the fast bowlers for a period of time. It is not uncommon to see structural and stress related changes in the lower back in both youth and adult players, resulting in longer recovery times and time off the field. These injuries are repetitive and are the focus of research to determine primary physical and biomechanical factors. The majority of studies have focused upon technique of bowling, and the way the spine moves, however, there is a lack of understanding of the relationship between these and the development of injury or pain. This indicates a need for a deeper understanding of the performance and physical factors that influence the bowling technique and injury risk in fast bowlers (Senington et al. 2020). The repeated and high-impact nature of bowler's action increases the risk of injury in the lumbar spine for fast bowlers in cricket. These injuries, such as intervertebral disc stress reaction and pars interarticularis, typically have long recovery times and can exclude players from football for a prolonged period. It's found that a combination of intrinsic factors such as muscle strength, endurance, range of motion, trunk control and previous injuries, as well as extrinsic factors such as workload and technique of bowling, all contribute to injury risk for fast bowlers. The lumbopelvic and trunk control is particularly crucial in order to manage the mechanical loading of the spine and maintain stability during bowling (Farhart et al. 2023). Fast bowling is a style of bowling and the action involves using the lower half of the body and transferring the power from there up the legs, hips and into the spine. All of the ankle, knee and hip joints are involved in the movement of energy to the lower back, causing stress in this area. The lower back is constantly loaded when bowlers do this repeatedly in high intensity over a prolonged period of time, particularly when bowling the delivery. Over time these repeated forces can impact movement and can potentially aggravate spine strain. Hence, the significance of understanding of the mechanics of bowling in the context of performance and injury risk in fast bowlers (Crewe et al. 2013).

Fast bowling is an exercise of good coordination and smooth movement. The lower body and upper body are connected by the trunk in a way that enables the lower body to move efficiently to the ball and allows the upper body to control and direct the ball, during the run up and delivery. Therefore, core stability is a good thing to have as poor stability can have an impact on the movement pattern and therefore the performance of the bowling action and its run up speed. Many recreational and club bowlers do not have adequate strength and conditioning programs that could lead to less efficient movement and less core control. There have also been previous studies that have reported improvement in core strength correlates to better dynamic performance, improvement in movement efficiency and faster bowling speed (Latha et al. 2026).

Run-up speed is important in bowling on the other hand, it helps to build momentum before the ball is released. When the run-up is fast but still under control, bowlers can generate more speed and maintain a smooth rhythm throughout their action. Fast bowling is essentially a series of movements that start with the legs, progress through the trunk, and end with the arm when the ball is released. Studies have also shown that faster bowlers often land with better front knee position and have more control over their trunk during the delivery stride, which helps make their action more efficient. Core stability is also important because it helps maintain balance and allows force to move efficiently through the body during bowling. Because of this, studying the relationship between run-up speed, trunk stability, and hamstring flexibility may help provide a better understanding of bowling performance in recreational fast bowlers (Bailey et al. 2023).

Rationale of Study

Run-up speed is important for a fast bowler as it helps generate speed and puts pressure on the batsman. With the popularity of Pakistani cricket, the demand for skilled fast bowlers is also increasing. Therefore, improving physical attributes like core strength and flexibility will not only lead to better performance but also reduce injury. Core stability supports efficient transfer of energy from the lower body to the upper body, while good posture allows for smooth movement and helps prevent strain during bowling. The aim of this study is to help athletes and coaches understand how developing their core can improve performance and prevent injuries.

Aims and Objectives

Our study aimed to determine the relationship between core stability, hamstring flexibility, and run-up speed in fast bowlers.

Research Question
What is the relationship between core stability and hamstring flexibility with the run-up speed in fast bowlers?

Hypothesis

Null Hypothesis
There is no significant relationship between core stability and hamstring flexibility with the run-up speed in fast bowlers.

Alternate Hypothesis
There is a significant relationship between core stability and hamstring flexibility with the run-up speed in fast bowlers.

Significance
This study helps coaches, physiotherapists, and players to understand the relationship between core stability, hamstring flexibility, and run-up speed in fast bowlers.

Review of Literature
The present study aimed to determine core endurance and side-to-side difference in 42 fast bowlers of the university level between age of 18-26 years. Core endurance was assessed by the McGill Torso Endurance Test (flexor, extensor, right-side and left-side plank tests). Results indicated that overall core endurance was below the recommended core values, and that the extensor muscles were the weakest. Besides, there was a significant difference between the endurance of the bowlers on their dominant and non-dominant sides as a large majority (90.5%) showed that they were more powerful on the dominant side. The outcomes of this study indicate that core endurance is frequently low for university fast bowlers and that there are difference scores between the dominant and non-dominant sides. This implies that there is a need for more balance core training to enhance stability, minimize injury risk, and enable better performance in the delivery of the ball (Krishnan et al. 2025).

This study was conducted to find the relationship between core stability and lower extremity injury risk in fast bowlers. Fifty elite fast bowlers (aged 18–30 years) were included in an observational study. Core stability was assessed using the McGill torso endurance test battery, while lower-limb function and injury history were evaluated via the Lower Extremity Functional Scale (LEFS). The analysis found only a weak correlation between lower-extremity injury (as measured by LEFS) and core stability: for example, correlation coefficients for flexor endurance, extensor endurance, and side-plank measures were $r = 0.027$ ($p = 0.530$), $r = 0.1896$ ($p = 0.291$), and $r \approx 0.19–0.21$ ($p > 0.29$), respectively. According to these results, the study concluded that there is a weak association between core endurance (as tested) and lower-limb injury among fast bowlers. Although the individual core endurance measures correlated with one another, their association with lower-extremity injury or dysfunction was not significant (ADHAV 2021).

This study was done to check the effect of core stability exercises on balance in beginner male cricket players. A total of 44 players took part in the study and were divided into two groups. One group followed a 6-week core stability exercise program, while the other group continued their normal daily activities without any special core training. Another 10 healthy subjects were also included for comparison. Dynamic balance was checked before and after training through the Johnson Modification Bass of Dynamic Balance test. The results showed that the players who performed core stability exercises improved their balance much more than the control group. The study suggested that regular core training can help cricket players improve balance, body control, and movement stability during sports activities (Gill et al. 2024).

Olivier, Olivier, and Mnguni provide the clearest evidence that relates core stability to bowling performance in cricket. The Sahrmann scale was used to measure trunk stability, the Bourbon test was used to measure endurance, and ultrasound was used to measure muscle thickness in a cross-sectional study of 46 male teenage pace bowlers with a mean age of 15.9 years. The results showed that better trunk stability was linked with higher bowling speed. However, core endurance and muscle thickness only showed weak to moderate relationships and didn't have any clear connection with bowling accuracy. Release speed was found to be unrelated to any measure of trunk endurance, with non-significant correlation coefficients of 0.209 and 0.153 for dorsal and ventral endurance, respectively. The authors came to the conclusion that while static endurance seems to have no bearing on performance, improved trunk muscle stability is linked to faster bowling regardless of anthropometry (Olivier et al. 2022).

Another study looked at the relationship between core endurance and hamstring flexibility. It included 33 participants (both males and females) aged 18–25 years, with and without hamstring tightness. Core endurance was assessed using the McGill core endurance test battery, while hamstring flexibility was measured using the active knee extension (AKE) test on both legs. The correlation between core endurance and hamstring flexibility was analyzed statistically using Pearson's correlation. The results showed a moderate, positive, and significant correlation between the flexor endurance test and hamstring flexibility on both sides, and a weak, positive, but significant correlation between the extensor endurance test and hamstring flexibility. Correlations between the right and left lateral bridge tests and the respective side hamstring flexibility were negative and not significant for right lateral torso endurance. The study concluded that the core should be considered as a whole unit when designing strengthening programs to maintain and improve hamstring flexibility (Kapre et al. 2024).

A study examined the relationship between core endurance, bowling performance, and injury risk in university-level fast bowlers. A cross-sectional study of 50 male bowlers (18–25 years) assessed core endurance using the plank, side plank, and sit-up tests, and also evaluated performance and injury history. Results showed that improved core endurance was associated with better bowling performance and a reduced risk of injury. The study emphasizes the need for core endurance training for better bowling performance and reducing the risk of musculoskeletal injuries in university-level fast bowlers (Hossain[1] et al).

This study was conducted to check the effect of selected exercises on explosive strength, speed, endurance, and agility in medium fast bowlers. In the beginning, 60 bowlers were selected and their fitness levels were tested using standard performance tests for these components. After arranging the scores, 10 top performers and 10 low performers were removed to keep a more average group. Finally, 40 players were selected and divided into two equal groups, experimental and control, with 20 participants in each group. A pre-test was taken before starting the training program in both groups. After that, the experimental group was given a planned exercise training program. The results showed clear improvement in the experimental group, where post-test scores were better than pre-test scores. Overall, the findings show that selected exercises helped improve key fitness components in medium fast bowlers (Sarkar et al. 2022).

This study was conducted to examine the relationship between run-up mechanics and ball speed generation in fast bowlers. A total of 34 premier-grade fast bowlers with a mean age of 22.3 ± 3.7 years participated in the study. A three-dimensional motion analysis system was used to assess the center of mass velocity during the bowling approach and delivery stride. The bowlers were divided into four groups based on bowling speed: slow-medium, medium, medium-fast, and fast. The results showed that bowlers in the faster groups had significantly greater run-up velocities compared to the slow-medium bowlers. The study also found that centre of mass deceleration during the delivery stride was one of the strongest predictors of higher ball speed. Overall, the findings suggest that effective run-up mechanics and proper coordination during the delivery stride play an important role in generating greater bowling speed in fast bowlers (Ferdinands et al. 2010).

Methodology

Study Design

The study was a cross-sectional study.

Study Setting

Cricket Academies of Faisalabad, including Madina Cricket Club, Ittehad Cricket Club and Combined Cricket Club.

Duration of Study

This study was completed 4 months after the synopsis was approved.

Sample Size

The sample size is 83 Cricket fast bowlers (male)

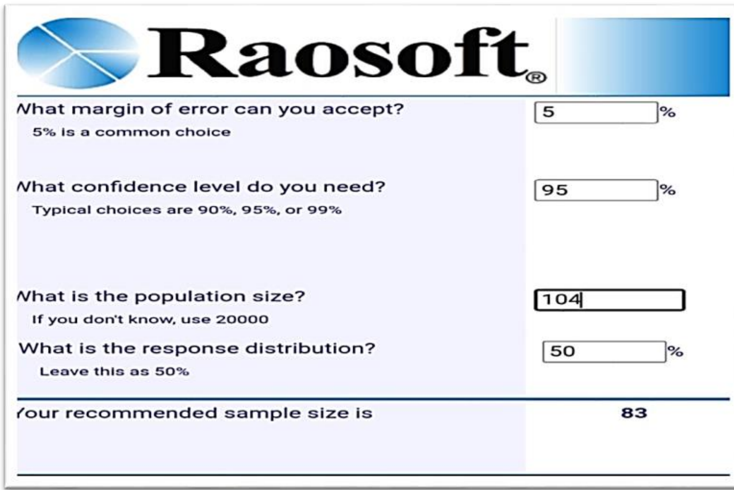

Figure 3.1: Raosoft

Study Population

The study population consisted of Cricket bowlers in Faisalabad.

Sampling Technique

The study was Purposive Sampling technique.

Selection Criteria

Inclusion Criteria

The participants were selected based on the following:

- Only males.
- Playing at club or district level cricket.
- 18 to 25 years old (Vk et al. 2024)
- Actively training for at least 6 months.
- Free from any musculoskeletal injury.

Exclusion Criteria

- Recent history of lower back, hamstring, or core muscle injury.
- Shoulder Pathology
- History of spinal surgery(Vk et al. 2024)
- Trauma or neurological disorders
- Lower limb radiating pain
- Failure to complete all testing procedures.

Outcome Measures

We measure:

- Run-up speed

- Core stability
- Hamstring flexibility

Data Collection Tools

Data collection tools used in this study:

- Speed Test
- Plank Test
- Active Knee Extension Test

Data Collection Procedure

The data for this study were collected from fast bowlers aged 18 to 30 years at different cricket clubs and academies. Participants will be selected after it is confirmed that they meet the inclusion and exclusion criteria. After getting their consent, each participant will be assessed for core stability using the plank test, hamstring flexibility using the Active Knee Extension (AKE) test, and run-up speed using a speed test. The tests were performed under the supervision of coaches or physiotherapists in a safe environment. Careful documentation of the results will be done to explore the correlation between core stability, hamstring flexibility and fast bowling speed.

Speed Test

Measure of the run up speed of the fast bowlers was done with 20 m sprint test. Each was asked to run 20 metres at their 'normal' running speed. A stopwatch was used to measure the time for the total distance. The total distance (20 meters) was then divided by the time taken (in seconds) in order to determine the run-up speed and the formula used was:

Speed = Distance ÷ Time

The result was displayed in m/s (m per second). It was devised to evaluate the velocity of the bowlers when they take up the approach.

Plank Test

Core stability of the participants was evaluated using plank test. Straight plank position was asked of each fast bowler for as long as they can. The body was supported on the forearms and toes during the test and the head, back and legs were maintained in a straight line. The participants were instructed to maintain the correct position without dropping the hips or bending the knees. The total time for which the position was held was recorded in seconds and used to measure core stability.

Figure 3.2: Plank test

Active Knee Extension Test

Hamstring flexibility was assessed using the Active Knee Extension (AKE) test on both the right and left legs. During the test, the participant lay in a supine position while the hip was maintained at 90 degrees flexion. The participant was then instructed to actively extend the knee as far as possible without moving the hip position. A goniometer was used to measure the knee extension angle for both legs.

Figure 3.3: Active Knee Extension Test

Ethical Consideration:

Before starting our research work, a data collection letter will be obtained from the college. Before taking any data, the participants will sign consent forms.

Results

The results of the study are given below, along with tables and figures.

Demographic Data

The interpretation of demographic data, i.e., age and BMI are given below.

Table 4.1: Descriptive Statistics of age

Statistics		
Mean		2.6627
Std. Deviation		1.17159

The mean age of participants was 2.66 ± 1.17 years with 83 valid responses.

Table 4.2: Age of the Participants

Age of the participants					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**18-19**	20	24.1	24.1	24.1
	20-21	15	18.1	18.1	42.2
	22-23	21	25.3	25.3	67.5
	24-25	27	32.5	32.5	100.0
	Total	83	100.0	100.0	

The table shows the data of 83 participants that most participants were in the 24–25 years group (32.5%), followed by 22–23 years (25.3%). The 18–19 years group made up 24.1%, while the smallest group was 20–21 years (18.1%). Overall, the sample had more participants from the older age groups.

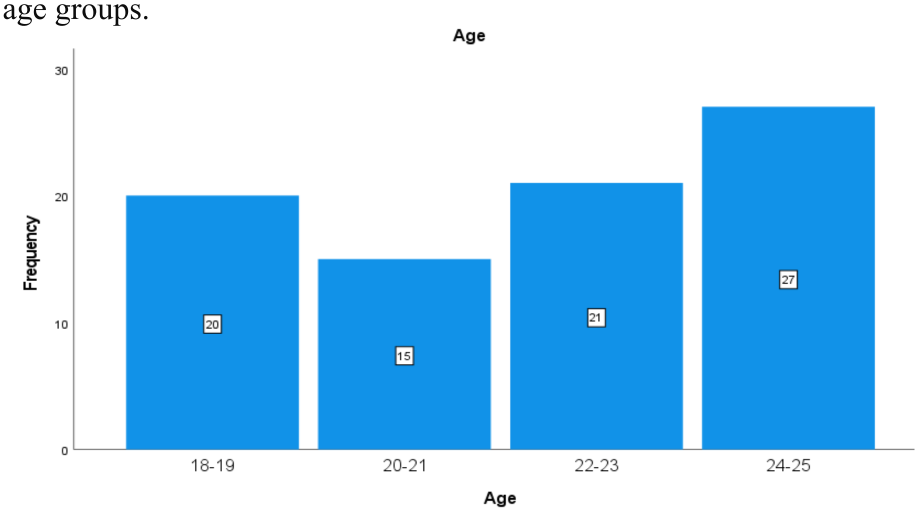

Figure 4.1: Age of the Participants

The figure shows the distribution of the ages of the 83 participants (N = 83). The data is divided into four groups from 18 to 25 years old. The largest group is the 24–25 age bracket, which includes 27 participants (32.5%). The next largest is the 22–23 group with 21 participants (25.3%), followed closely by the 18–19 group with 20 participants (24.1%). The smallest group is the 20–21 age category, which has only 15 participants (18.1%).

Descriptive Statistics of BMI

This section represents the descriptive statistics of the study variables obtained from the participants.

Table 4.3: Descriptive Statistics of BMI

Statistics	
Mean	1.892
Std. Deviation	0.5634

The table shows the participants' BMI categories (N = 83). The results show a mean score of 1.89 with a standard deviation of 0.56.

Table 4.4: BMI of the Participants

BMI					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Under Weight**	18	21.7	21.7	21.7
	Normal Weight	56	67.5	67.5	89.2
	Over Weight	9	10.8	10.8	100.0
	Total	83	100.0	100.0	

The table shows the BMI status of the 83 participants. Most fast bowlers (56 individuals, 67.5%) are in the normal weight category. Another 18 participants (21.7%) are underweight, while 9 participants (10.8%) fall into the overweight group. Overall, most of the athletes in the sample have a normal weight status.

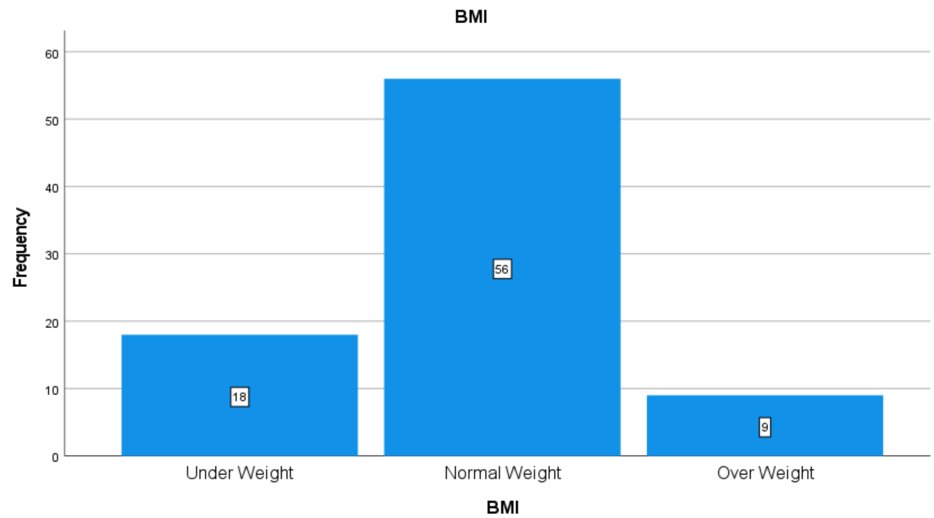

Figure 4.2: BMI of the Participants

The figure shows the BMI distribution of the 83 fast bowlers. It is clear from the bar chart that 56 participants fall in the Normal Weight category. The Under Weight group includes 18 participants, while the Over Weight group is the least common with 9 participants. Overall, the chart shows that most of the athletes are in the normal weight range.

Descriptive Statistics of Plank Test

This section represents the descriptive statistics of the plank test variables obtained from the participants.

Table 4.5: Descriptive Statistics of Plank Test

Statistics	
Mean	3.8193
Std. Deviation	0.58736

The table shows the descriptive statistics for the participants' core performance on the Plank Test (N = 83). The results show a mean category score of 3.82 with a standard deviation of 0.59.

Table 4.6: Plank Test

Plank Test					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Average 60-119 Sec**	23	27.7	27.7	27.7
	Excellent 120-239 Sec	52	62.7	62.7	90.4
	Elite 240 Above	8	9.6	9.6	100.0
	Total	83	100.0	100.0	

This table shows the classification of the 83 participants (N = 83) based on their Plank Test results.52 fast bowlers are in the "Excellent" category (120–239 seconds), with (62.7%). Then 23 participants (27.7%) fall into the "Average" group (60–119 seconds), while only 8 players (9.6%) reached the "Elite" level (240 seconds and above).

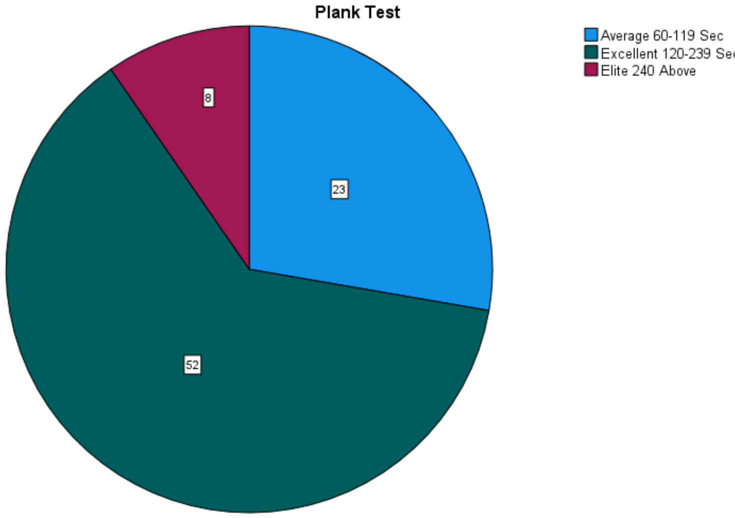

Figure 4.3: Plank Test

This figure shows the Plank Test performance of the 83 fast bowlers. The largest section of the chart belongs to the “Excellent” category, which includes 52 participants. The “Average” category is the next largest with 23 participants, while the “Elite” group is the smallest, with only 8 players. Overall, the figure shows that most of the bowlers performed well and achieved good core endurance levels in the plank test.

Descriptive Statistics for Right Active Knee Extension Test

This section represents the descriptive statistics of the right active knee extension test variables obtained from the participants.

Table 4.7: Descriptive Statistics for Right Active Knee Extension Test

Statistics	
Mean	2.1807
Std. Deviation	0.73492

This table shows the descriptive statistics for the participants' performance on the Right Active Knee Extension Test (N = 83). The analysis indicates a mean category score of 2.18 with a standard deviation of 0.73.

Table 4.8: Right Active Knee Extension Test

Right Active Knee Test					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Normal 19 degree**	14	16.9	16.9	16.9
	Mild Tightness 20-30 degree	42	50.6	50.6	67.5
	Moderate Tightness 31-45 degree	25	30.1	30.1	97.6
	Severe Tightness 46 degree	2	2.4	2.4	100.0
	Total	83	100.0	100.0	

The table shows the Right Active Knee Extension Test results for 83 participants. 42 of 83 (50.6%) of the fast bowlers experienced mild hamstring tightness between 20 and 30 degrees. Twenty-five participants (30.1%) had moderate tightness (31 to 45 degrees). Only 14 (16.9%) players were in a normal range (19 degrees or less) and only 2 (2.4%) showed severe tightness (46 degrees or more). It can be concluded from these results that the mild hamstring tightness was the most frequently occurring problem for the bowlers.

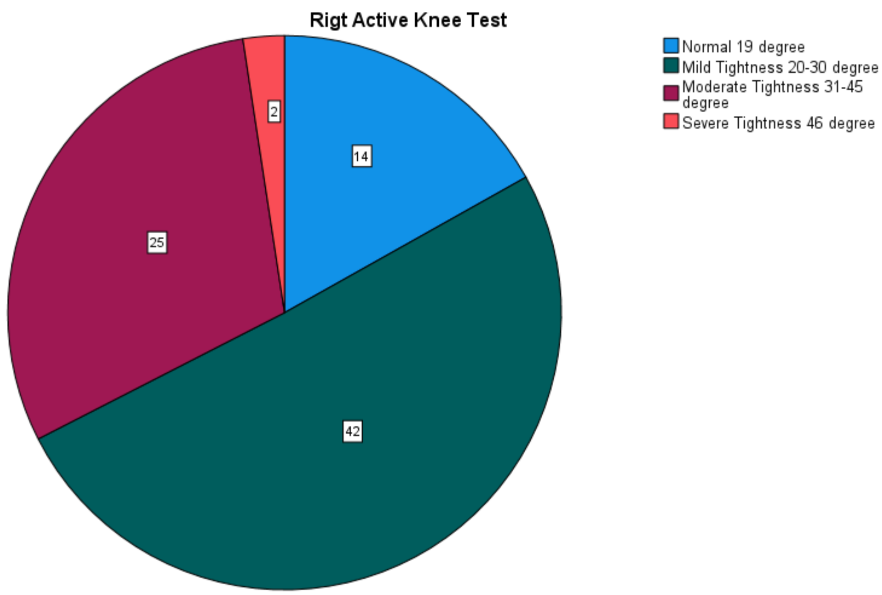

Figure 4.4: Right Active Knee Extension Test

The pie chart shows the distribution of the Right Active Knee Extension Test results using a pie chart. The majority of the chart is devoted to "mild tightness," with 42 participants. There were 14 participants in the normal group, the moderate group having 25 participants. There are only 2 participants with severe tightness. The overall picture of the chart is that the majority of bowlers suffered from hamstring tightness on the right side of their body.

Descriptive Statistics for Left Active Knee Extension Test

This section represents the descriptive statistics of the left active knee extension test variables obtained from the participants.

Table 4.9: Descriptive Statistics for Left Active Knee Extension Test

Statistics	
Mean	2.0723
Std. Deviation	0.77747

This table presents descriptive statistics for participants' performance on the Left Active Knee Extension Test (N = 83). The analysis indicates a mean category score of 2.07 with a standard deviation of 0.78.

Table 4.10: Left Active Knee Extension Test

Left Active Knee Test					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Normal 19 degree**	19	22.9	22.9	22.9
	Mild Tightness 20-30 degree	42	50.6	50.6	73.5
	Moderate Tightness 31-45 degree	19	22.9	22.9	96.4
	Severe Tightness 46 degree	3	3.6	3.6	100.0
	Total	83	100.0	100.0	

This table shows the Left Active Knee Extension Test results of the 83 participants (N = 83). The majority of fast bowlers (42, 50.6%) had mild left hamstring restrictions (20-30 degrees). Another 19 players (22.9%) had moderate tightness (31–45 degrees) and 19 (22.9%) had normal tightness. Only 3 participants (3.6%) experienced severe (tightness of 46 degrees or more). Overall, the findings indicate a high prevalence of hamstring tightness on the left side in most of the bowlers in the study.

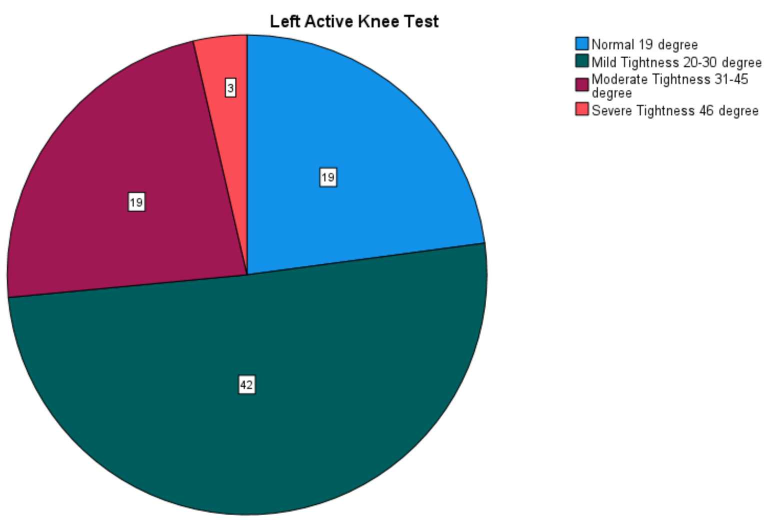

Figure 4.5: Left Active Knee Extension Test

The pie chart represents the distribution of results of the Left Active Knee Extension Test. The largest category on the chart is the "mild tightness" category (42 participants). The number of persons in the normal range and moderate tightness group are the same (19). The smallest category is severe tightness, 3 participants is identified with severe tightness. As a whole, the chart indicates that the majority of bowlers experienced a certain amount of tightness in their left hamstring.

Descriptive Statistics for Run-up Speed

This section represents the descriptive statistics of the run-up speed variables obtained from the participants.

Table 4.11: Descriptive Statistics for Run-up Speed

Statistics	
Mean	2.1566
Std. Deviation	.59432

The table presents descriptive statistics for participants' run-up speed (N = 83). The analysis indicates a mean category score of 2.16 with a standard deviation of 0.59.

Table 4.12: Run-up Speed

Run-up Speed					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Slow Speed 2.8-3.9**	9	10.8	10.8	10.8
	Moderate Speed 4-5.6	52	62.7	62.7	73.5
	Explosive Speed 5.7-6.7	22	26.5	26.5	100.0
	Total	83	100.0	100.0	

Table displays the results of the run-up speed of the 83 participants. The majority of fast bowlers (52) or 62.7% of the total are in the “Moderate Speed” category (4-5.6). Another 22 participants (26.5%) are in the “Explosive Speed” range (5.7–6.7), while only 9 players (10.8%) are in the “Slow Speed” category (2.8–3.9). Overall, the run up speed of most of the bowlers is moderate to high.

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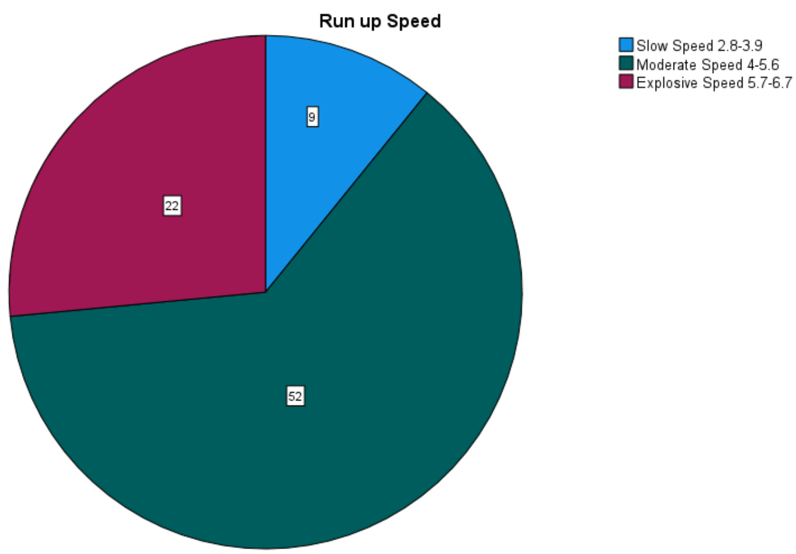

Figure 4.6: Run-up Speed Distribution of the Participants

The pie chart gives us a quick visual overview of the run-up speeds of the 83 fast bowlers. The largest slice by far shows the moderate speed category, which covers 52 of the players. The next biggest slice represents the 22 bowlers who hit explosive speeds, while the smallest slice represents the remaining 9 players in the slow-speed group. This way, it’s easy to see that the vast majority of the bowlers naturally lean toward a quicker, more aggressive run-up pace

Test of Normality for Study Variables

This section represents the test of normality of the study variables obtained from the participants.

Table 4.13: Test of Normality

Tests of Normality						
	Kolmogorov-Smirnov[a]			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Plank Test	.344	83	<.001	.751	83	<.001
Right Active Knee Test	.272	83	<.001	.839	83	<.001
Left Active Knee Test	.272	83	<.001	.845	83	<.001
Run up Speed	.339	83	<.001	.756	83	<.001

The table shows the results of the Kolmogorov-Smirnov and Shapiro-Wilk tests used to assess the distribution of the data for the Plank Test, Right Active Knee Test, Left Active Knee Test, and Run-up Speed (N = 83). The results show that the significance values (Sig.) for all variables in both tests are less than 0.001 ($p < 0.001$). Since these values are below 0.05, the assumption of normality is rejected. This means the data is not normally distributed, so non-parametric tests need to be used for further correlation analysis.

Nonparametric Correlation

Correlation between Core Stability and Run-up Speed

This section presents the correlation between core stability and participants' run-up speed.

Table 4.14: Correlation between Core Stability and Run-up Speed

Correlation				
			Run up Speed	**Plank Test**
Spearman's rho	**Run up Speed**	**Correlation Coefficient**	1.000	.568**
		Sig. (2-tailed)	.	<.001
		N	83	83
	Plank Test	**Correlation Coefficient**	.568**	1.000
		Sig. (2-tailed)	<.001	.
		N	83	83
Correlation is significant at the 0.01 level (2-tailed).				

This study also found a significant positive link between core stability and run-up speed ($r_s = 0.568$, $p < .001$). Bowlers with stronger core endurance usually have faster run-up performance. This is because they have better trunk control, improved balance, and transfer force more efficiently from their lower limbs to their upper body during the bowling approach.

Correlation between Run-up Speed and Right Active Knee Extension Test

This section presents the correlation between run-up speed and the right active knee extension test.

Table 4.15: Correlation between Run-up Speed and Right Active Knee Extension Test

Correlations				
			Run up Speed	**Right Active Knee Test**
Spearman's rho	**Run up Speed**	**Correlation Coefficient**	1.000	-.537**
		Sig. (2-tailed)	.	< .001
		N	83	83
	Rigt Active Knee Test	**Correlation Coefficient**	-.537**	1.000
		Sig. (2-tailed)	<.001	.
		N	83	83
Correlation is significant at the 0.01 level (2-tailed).				

This study found a strong negative link between run-up speed and right hamstring tightness (r_s = −0.537, p < .001). Bowlers with tighter hamstrings usually run up more slowly. This is because their stride is less efficient, their lower limbs move less freely, and their running mechanics are affected during the bowling approach.

Correlation between Run-up Speed and Left Active Knee Extension Test

This section presents the correlation between run-up speed and the left active knee extension test.

Table 4.16: Correlation between Run-up Speed and Left Active Knee Extension Test

Correlations				
			Run up Speed	**Left Active Knee Test**
Spearman's rho	**Run up Speed**	**Correlation Coefficient**	1.000	-.501**
		Sig. (2-tailed)	.	<.001
		N	83	83
	Left Active Knee Test	**Correlation Coefficient**	-.501**	1.000
		Sig. (2-tailed)	<.001	.
		N	83	83
Correlation is significant at the 0.01 level (2-tailed).				

This study found a strong negative link between run-up speed and left hamstring tightness (r_s = −0.501, p < .001). Bowlers with tighter hamstrings usually run up more slowly. This is because their stride is less efficient, their lower limbs move less freely, and their running mechanics are affected during the bowling approach. This study found that core stability, hamstring tightness, and run-up speed are actually connected among our 83 fast bowlers. The results were highly significant across the board and tell a really clear story. First, there is a strong positive link between the Plank Test and Run up Speed (r_S = .568, p < .001). This simply means that bowlers with better core endurance tend to have faster, more explosive run-ups. On the flip side, run-up speed has a clear negative relationship with both the Right Knee Test (r_S = -.540, p < .001) and the Left Knee Test (r_S = -.501, p < .001). Since higher scores on these knee tests indicate tighter hamstrings, these negative numbers show that greater hamstring tightness is directly tied to slower run-up speed. We also see that better core stability goes hand-in-hand with better flexibility, as the Plank Test negatively correlates with right tightness (r_S= -.513) and left tightness (r_S = -.527). Lastly, there is a strong link between both legs (r_S = .648), meaning if a bowler has tight hamstrings on their right side, they usually have them on the left side too.

Discussion

Cricket is one of the most popular sports in the world, and fast bowling is considered one of the most physically demanding skills in the game. Fast bowlers require a combination of speed, stability, flexibility, coordination, and muscular control to generate effective bowling performance. Among the important components involved in bowling performance are core stability, hamstring flexibility, and run-up speed, as these factors contribute to force generation and transfer throughout the kinetic chain. Therefore, the present study was conducted to determine the relationship between core stability, hamstring flexibility, and run-up speed in fast bowlers aged 18–25 years (Olivier et al. 2022). The present study found a strong positive correlation between core stability and running speed ($r_s = .568$, $p < .001$). This means that bowlers with greater core endurance show greater run up speed. Core stability is important for trunk control, balance and efficient transfer from lower to upper body in the bowling action. This conclusion is consistent with other studies that found that enhanced core stability leads to improved performance in bowling, and more bowling velocity. They also found speed bowlers' bowling speed to be positively correlated with trunk stability in Olivier and Olivier, and Mnguni. They have also found that their stability in the trunk positively correlated with their bowling speed (correlation coefficients of 0.209 and 0.153 for dorsal and ventral stability respectively) but the correlation was weak and non-significant with the endurances of the trunk. The present study revealed that there was a significant negative correlation between hamstring tightness and running speed. The right active knee test showed a correlation of $r_s = -0.540$ ($p < .001$), while the left active knee test showed $r_s = -0.501$ ($p < .001$). It also implies that bowlers with tighter hamstrings tended to have slower run-up. The flexibility of the hamstrings is crucial prior to the start of the race, as it facilitates smooth running, efficient stride, pelvic motion and efficient force production from the lower body. A tight hamstring can restrict motion and decrease the efficiency of running while approaching the ball.

The other important discovery from the study was the correlation between core stability with hamstring tightness. There was a negative correlation between core stability and the right ($r_s = -0.513$) and left ($r_s = -0.527$) hamstring tightness. In other words, bowlers with more core stability generally exhibited less stiffness in the hamstring and greater flexibility. This is in line with previous studies that also indicate that the core and lower body do not function independently during sports movement, but rather they operate together (Kaushik et al. 2025). The findings of the current study is corroborated by another previous study done by Kaushik et al. (2025) on hamstring flexibility and sprint performance. Kaushik et al, assessed 168 young players (19-25 years) with the Active Knee Extension Test and a 30m sprint test, and observed a weak negative correlation between hamstring flexibility and sprint time in the males, but no significant relationship in females. This is consistent with the present study as it demonstrated that there was a significant negative correlation between hamstring tightness and run-up speed for both right ($r_s = -0.540$) and left arm ($r_s = -0.501$) fast bowlers, indicating that the higher the hamstring tightness, the slower the run-up performance for fast bowlers. Another study on hamstring stiffness by Khanal, Kanakapura Channanke Gowda, and Rout also showed that hamstring flexibility was increased with soft tissue mobilization and cupping therapy which improved range of Active Knee Extension and sprint times, suggesting an improvement in running ability after hamstring loosening. The findings of the present study are corroborated by the findings of these studies, which indicate that hamstring flexibility is important to sprinting ability and the approach speed of a bowler. Another previous study also supports the findings of the present research by showing how common hamstring problems and injuries are in fast bowlers. A study on elite Australian male cricketers (2006–2016) reported a high injury rate overall, with fast bowlers being the most affected group. Among these injuries, hamstring strains were one of the most common, and the study also reported that the increasing demands of T20 cricket may place extra stress on players, leading to more hamstring-related problems because of repeated high-intensity bowling and heavy workload. These findings are similar to the present study, which showed that hamstring tightness has a significant negative relationship with run-up speed (Right AKE: $r_s = -0.540$; Left AKE: $r_s = -0.501$). In simple words, both studies show that tight or overworked hamstrings can reduce performance and may also increase the chances of injury in fast bowlers during high-intensity bowling. The findings of the present study can further be explained through the kinetic chain concept. Fast bowling performance depends on the coordinated transfer of force from the lower limbs through the trunk and upper extremities to the ball. Previous biomechanical studies have shown that faster bowlers generally exhibit greater run-up velocity, improved trunk control, and better lower-limb mechanics during the delivery stride. Therefore, limitations in either core stability or hamstring flexibility may reduce the efficiency of force transfer and negatively affect bowling performance.

Conclusion

There was a definite correlation between core stability, hamstring flexibility and the bowlers' speed during the runs-up in the present study. Those who did not have tight hamstrings had a faster run up speed whereas those who had the tighter hamstrings had slower run up speed. Overall, the results showed that flexibility of the hamstrings and strength of the core muscle is important for good bowling performance. It also emphasizes the importance of incorporating core and flexibility exercises into normal training to enhance performance and minimize the risk of injury.

Recommendations

Future studies need to involve a greater number of and a broader range of players, specifically professional fast bowlers (male and female), to enable more generalization. The use of long-term or training-based studies to gain insight into cause and effect would also be beneficial. Further studies are also required on other meaningful variables such as bowling technique, strength and workload for an all-rounder analysis of performance.

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