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A study on the effect of limb length and arm strength on the ball release velocity in cricket

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Abstract
Introduction: Cricket is a bat-and-ball game played between two teams of eleven players each on a field at the center of which is a rectangular 22-yard-long pitch. In the sport of cricket, bowling is the action of propelling the ball towards the wicket defended by a batsman. The aim of the study was to investigate the effect of limb length and arm strength on the ball release velocity in cricket.
Methodology: For the present the study, twelve slow medium pace bowlers were selected from various First Division Club of Kolkata league under C.A.B., age ranging from 20 to 30 years. The bowling actions of medium bowling technique of the selected cricketers (23.17 ± 3.95year, 172.04 ± 5.88cm, 62.79 ± 7.23kg) were recorded by two fixed cameras. The video was digitised and analysed by using the Kinovea-0.8.24 motion analysis software to measure the selected kinematic parameters. Mean, standard deviation and Pearson Product Moment Correlation test were employed to analyze the data statistically.
Results and Discussions: The results of the statistical analysis of the data revealed that arm length (77.79 ± 3.33 cm.), leg length (90.62 ± 3.71 cm.) and arm strength (44.09 ± 6.50 kg.) were positively related (r= 0.598, 0.587 & 0.722) with the ball release velocity (106.77 ± 7.61 km./h). As the bowlers with higher arm length and leg length have longer radius of rotation, greater force is applied to produce greater linear ball release velocity. Stronger arm also can exert more force on the ball to move faster.
Conclusions: From the study it may be concluded easily that there is a significantly positive relation of limb length and arm strength to ball release velocity.

Keywords: Cricket, bowling, slow medium, arm length, leg length, limb length, arm strength, ball release velocity

Introduction
The word 'Cricket' itself has become to mean in English language "Good Sportsmanship". We play to win of course and try out most to do but even more than that, we play cricket to maintain the high standards of sportsmanship. Cricket has become one of the most popular games in the world & of all major games in India. It is the only one that has jealously preserved by all those who play or support it.
Cricket is a bat-and-ball game played between two teams of 11 players each on a field at the center of which is a rectangular 22-yard-long pitch. The bowler delivers the ball to the batsman who attempts to hit the ball with his bat away from the fielders so he can run to the other end of the pitch and score a run. Each batsman continues batting until he is out. The batting team continues batting until ten batsmen are out, or a specified number of overs of six balls have been bowled, at which point the teams switch roles and the fielding team comes in to bat. In professional cricket, the length of a game ranges from 20 overs (T20) per side to Test cricket played over five days.
In earlier days, cricket was pre dominantly a game of royal people. The maharajas played during their leisure time. So people had no idea about the actual demands of the game. But today with advancement in technology in every sphere of life, cricket has gone down from sport less while dress to track suit and royal cricket grounds scientific gymnasiums and laboratory.
The increasing professionalism of preparing players for the physical demands of both test match and 1-day cricket, is influencing the coaching of player's *et al* levels of the game. A recent review of the literature on cricket concluded that much more research was required before a full understanding of the scientific aspects of the game could be made. Clearly, more

Cross-sectional, longitudinal, and intervention studies are required to address the physical preparation of players for the demands of contemporary international cricket.

Fast bowling, sometimes known as pace bowling, is one of the two main approaches to bowling in the sport of cricket. The other is spin bowling. Practitioners are usually known as fast bowlers, fastmen, pace bowlers, quicks, or pacemen, although sometimes the label refers to the specific fast bowling technique the bowler prefers, such as swing bowler or seam bowler.

The aim of fast bowling is to bowl the hard cricket ball at high speed and to induce it to bounce off the pitch in an erratic fashion or move sideways through the air, factors which make it difficult for the batsman to hit the ball cleanly. A typical fast delivery has a speed in the range of 137–153 km/h (85–95 mph).

Table 1: Various type of pace bowling and speed range

Type	km/h	mph
Fast	≥142	≥89
Fast-Medium	130-141	81-88
Medium-Fast	120-129	75-80
Medium	96-119	60-74
Slow Bowling	<96	<60

Most pace bowlers are medium-fast to fast in top level cricket. In general, bowlers of this type are described as right arm or left arm "fast", or right arm or left arm "fast-medium", and so on. The highest electronically measured speed for a ball bowled by any bowler is 161.3 km/h (100.23 mph) by Shoaib Akhtar (Pakistan) against England on 22 February 2003 in a World Cup match at Newlands, Cape Town, South Africa. Another technique of fast bowling is the sling action. This action generates extra speed but sacrifices control. Some bowlers who apply the sling action are Shaun Tait, Mitchell Johnson, Fidel Edwards and Lasith Malinga.

A key element of fast bowling is ball-release speed or ball release velocity (V-peak). Ball-release speed in fast bowlers is influenced by various anthropometric, morphological, and kinematic factors. Detailed anthropometric data on the proportions of different body compartments (muscle mass, fat mass, bone mass) is available for a number of sports, but this information is lacking in cricket. More studies of bowlers of different ages and levels are needed to develop specific guidelines for cricket authorities, coaches, and players.

Significance of the problem

The study will help

a) To categorize cricketers from very beginning stage.
b) To select pace bowler in Cricket.
c) To improve or to predict the higher performance for the basic level players.
d) To introduce the new training method to enhance the quality of pace bowling in cricket.
e) To do further research on this field with the help of better equipment and subject.

Methodology

Selection of Subjects: Twelve male pace bowlers have been randomly selected from various First division club of Kolkata league under C.A.B. ranging the age from 20 to 30 years.

Selection of the Variables

The following variables have been measured to conduct the research

1. Personal Data

i) Age
ii) Height
iii) Weight

2. Anthropometric variables

i) Arm Length
ii) Leg Length

3. Physical fitness variables

i) Arm Strength

4. Kinematic variables

I. Ball release velocity (Ball release speed)

Procedure for the Administering the Test

1. **Age:** Age has been calculated from the matriculation certificate of the subjects.
2. **Height:** Height of the subjects has been measured by Stadiometer.
3. **Weight:** Weighing machine has been used to measure weight of the subjects.
4. **Arm Length:** Equipment Required: Steel tape
   Procedure: Measurement has been taken from acromion process to the tip of the third finger.
5. **Leg Length:** Equipment Required: Steel tape
   Procedure: Measurement has been taken from the end of the spinal column to the floor.

Fig 1: Photograph of taking Anthropometric Measurement

6. Arm Strength

The Arm Strength has been measured by Handgrip Strength Test. The purpose of this test is to measure the maximum isometric strength of the hand and forearm muscles. (CLERKE A. 2005) [2].

Equipment Required: Handgrip dynamometer.

Procedure: The subject held the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The base has rest on first metacarpal (heel of palm), while the handle has rest on middle of four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The Subjects have been strongly encouraged to give a maximum effort.

Scoring: The best result from 3 trials is recorded, with at least 15 seconds recovery between each effort. The values will be taken in kg.

7. Ball release velocity (V-peak)

Equipment Required: Video camera and Computer

Procedure: The bowling actions have been captured by video camera. The camera has been placed at the sagittal right plane of the subject in distance of 10m from the middle stamp and on 120cm height. The video has been transferred to the computer and it has been digitized and analyzed with Kinovea 0.8.24 motion analysis software.

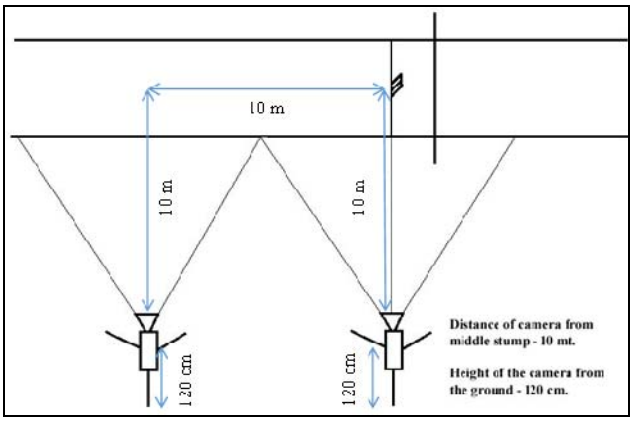

Fig 2: Diagram of Filming Environment for Recording the Bowling Action.

Fig 3: Photograph of Ball release velocity (V-peak) analysis

Design of the Study

First, the subjects have been brought on 05/02/2016 in the ground of Jadavpur University. On the day all arrangements have been done for administering the all test and measurements.

At the first half, researcher has taken personal data, anthropometric variables and fitness variables i.e. Age, Height, Weight, Arm Length, Leg Length, Standing Reach Height and Arm Strength.

The second half has been scheduled for taking video of bowling action to analyze ball release velocity. Every subject got three trials to bowl and the best one (valid) have been selected for the purpose of analysis.

The video have been transferred to the computer and it have been analyzed and digitized with the help of Kinovea 0.8.24 motion analysis software to get the actual ball release velocity and Ball Release Height of every subject.

Descriptive statistics and Product Moment Correlation test have been employed to analyze the data. The level of significance was set at 0.05 level for testing the null hypothesis in the study.

Result and discussion

The statistical analysis of the data on Anthropometric, Physical fitness and Kinematic variables collected on 12 male first division pace bowlers of Kolkata league is presented in this chapter.

Findings

The details of personal data and anthropometric, strength and kinematic measurement of the subjects are presented here.

Table 2: Details of personal data

Variables	Mean	SD
Age (Year)	23.17	4.13
Height (cm.)	172.04	6.14
Weight (kg.)	62.79	7.55

In the above table it is clearly cited that the mean and standard deviation of the age, height and weight of the subjects are 23.17 ± 4.13 year, 172.04 ±6.14 cm. and 62±7.55 kg respectively.

Table 3: Details of anthropometric variables

Variables	Mean	SD
Arm length (cm.)	77.79	3.33
Leg length (cm.)	90.62	3.71

From the above table, it is clear that the mean and standard deviation of the arm length, leg length, standing reach height and ball release height are respectively 77.79±3.33, 90.62±3.71, 222. 25±9.89 and 184.39±8.16 cm.

Table 4: Details of physical fitness and kinematic variables

Variables	Mean	SD
Arm strength (kg.)	44.09	6.50
Ball release velocity (km./h)	106.77	7.61

The above table shows that the mean and standard deviation of arm strength and ball release velocity are 44.09±6.50 kg. And 106.77±7.61km./h respectively.

The correlations of average ball release velocity with personal data, anthropometric variables, and Arm Strength are presented in the following tables and graphs.

Table 5: Correlation of selected Anthropometric variables with selected Kinematic variable

Sl. No.	Kinematic variable	Anthropometric variables	Coefficient of Correlation (r)
1.	V-Peak	Arm Length	0.598*
2.	V-Peak	Leg Length	0.587*

*Required value for being significant at 0.05 level and at 10 df is 0.576

From the above table it is observed that, there each relationships are found significant to ball release velocity i.e. the relationship of Peak bowling velocity with Arm length (r = 0.598) and Leg length (0.587)

The individual correlation table and graph are presented below:

Table 6: Correlation between Arm Length and Ball release velocity (V-peak).

Sl. No.	Arm Length (cm.)	V-peak (km./h)	Correlation
1.	82	107.04	
2.	82	115.13	
3.	78	115.85	
4.	83	105.35	
5.	76	109.87	
6.	76	97.38	
7.	76	94.95	**0.598**
8.	75	102.67	
9.	73	92.99	
10.	81	105.6	
11.	76	103.39	
12.	75.5	100.11	

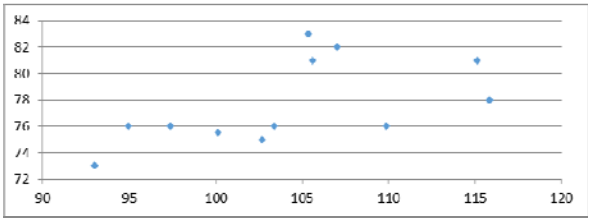

Fig 4: Graphical representation of Correlation between Arm Length and V-peak.

The above table and graph represent that Arm Lengths of the selected subjects stand from 73 to 83 cm. and it is strongly and positively correlated(r = 0.598) with Ball release velocity. This finding proves that a person with longer arm has a greater probability to bowl faster than a person with shorter arm. This finding may be helpful for the coaches to select or categorized the bowlers from very beginning stage. A bowler with longer arm should practice pace bowling rather than spin bowling.

Table 7: Correlation between Leg Length and Ball release velocity (V-peak).

Sl. No.	Leg Length (cm.)	V-peak (km./h)	Correlation
1.	92	107.04	
2.	93	115.13	
3.	92	115.85	
4.	96	105.35	
5.	92	109.87	
6.	87	97.38	
7.	88	94.95	**0.587**
8.	88	102.67	
9.	87	92.99	
10.	97.5	105.6	
11.	86	103.39	
12.	89	100.11	

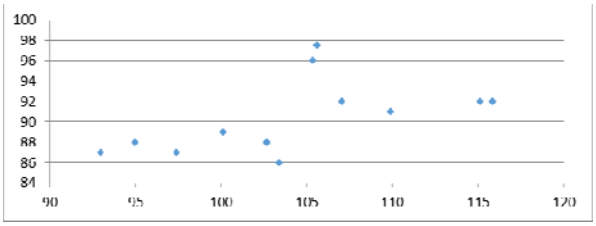

Fig 5: Graphical representation of Correlation between Leg Length and V-peak.

From the above table and graph it is clear that, Leg Length of the all selected subjects falls between 86 and 97.5 cm. The table and graph also represent the significant positive relation (r = 0.587) between Leg length and Ball release velocity. It means that to bowl faster, Leg Length is an important and unavoidable component. Because of that a good coach or selector should always consider Leg Length of the player as a criterion to select or categorize player.

Table 8: Correlation of selected Physical fitness variable with Kinematic variable.

Sl. No.	Kinematic variable	Physical fitness variable	Coefficient of Correlation (r)
1	V-peak	Arm Strength	0.722*

*Required value for being significant at 0.05 level and at 10 df is 0.576

From the above table and graph it is observed that, there is a significant relationship of peak bowling velocity with Arm Strength (r = 0.722) at 0.05level of significance of 10 degree of freedom.

The detail correlation table and graph are presented below:

Table 9: Correlation between Arm Strength and average Ball release velocity (V-peak).

Sl. No.	Arm Strength (kg.)	V-peak (km./h)	Correlation
1.	44.6	107.04	
2.	56.4	115.13	
3.	45.1	115.85	
4.	42.9	105.35	
5.	51.2	109.87	
6.	39.8	97.38	
7.	37.8	94.95	**0.722**
8.	42.6	102.67	
9.	33.1	92.99	
10.	38.3	105.6	
11.	50.1	103.39	
12.	47.2	100.11	

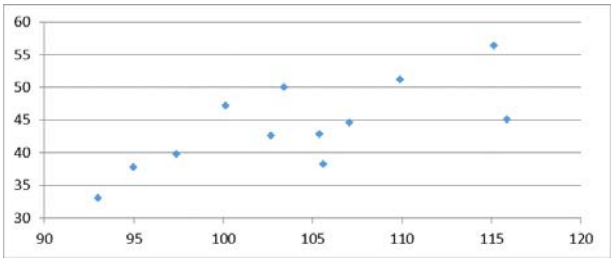

Fig 6: Graphical representation of Correlation between Arm Strength and V-peak.

From the above table and graph it is clear that, Arm strength of the all selected subjects ranges from 33.1 to 56.4 kg. The table and graph also represent the very strong and significant positive relation (r = 0.722) between Arm strength and Ball release velocity. It means that to bowl faster, Arm Strength is an important and unavoidable component, which should not be underestimated. That's why a good coach should always consider Arm Strength of the players as an important criterion to select or categorize the pace bowlers.

Discussion of Findings

During bowling, limb length of the bowler is an important factor to bowl faster. It is known, Arm of the bowler acts as a Lever and according to the laws of Biomechanics, greater resistance arm increases velocity. Not only Arm, but every movement of human body is guided by the principles of Lever. In case of Leg Length, human leg also acts as lever and same formula implies in this case. This may be the probable reason of strong positive relationship between Limb length [Arm Length (r = 0.598) and Leg Length (r = 0.587)] and Average Ball release velocity. On the other hand, longer limb contains more muscle mass to exert force. It also may be another reason. In a study, Ghosh and Chatterjee (2014) also have got significant positive relation of Arm length (r = 0.704) and Leg length (r = 0.774) with Pace bowling ability. In this study leg length has positive relation with Ball release velocity but statistically not significant. The probable reason of this may be the small sample or the large deviation of their age.

In case of Arm Strength, there is also a strong positive relation (r = 0.722) with average Ball release velocity. Stronger the arm can exert the more force to release the ball. This simple probable reason is behind this strong relationship.

Conclusion

From the above result and discussion, fowling conclusions can be drawn:

1. There is a significant positive effect of limb length on peak bowling speed in Cricket.
2. There is a significant positive effect of arm strength on peak bowling speed in Cricket.

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