DOI: 10.7860/JCDR/2022/51194.16073

Original Article

Physiotherapy Section

Relationship of Bowling Speed with Power and Dynamic Balance in Bowlers: A Cross-sectional Study

ABHISHEK ROHILLA[1], POOJA ANAND[2], SAJJAN PAL[3], ABHISTA SEHDAV[4]

ABSTRACT

Introduction: In the game of cricket, dynamic balance and the strength of lower limb muscles plays a major role while bowling or to control the bowling speed. Bowlers use different style of run ups to optimise their bowling speed. Therefore, for every athlete, physical fitness plays essential role.

Aim: To find the correlation between bowling speed and lower limb explosive power and dynamic balance in state and district level cricket bowlers.

Materials and Methods: This cross-sectional study was conducted at Cricket Gurukul, Faridabad, Mahadev Desai Cricket Academy, Faridabad, Haryana and Indraprastha Cricket Academy, Punjabi Bagh, New Delhi, India from January 2018 to January 2019. Total 98 male bowlers with age between 16-28 years, playing experience of atleast 6 months in University/District level and playing frequency atleast 5 days/weeks were included in the present study. Modified Star Excursion Balance Test (mSEBT) was used to measure the dynamic balance, broad jump test was used to measure lower limb explosive power and radar gun was used to measure the bowling speed. Data was analysed in the Statistical Package for the Social Sciences (SPSS) software 2.0 version. Descriptive statistics was calculated. Pearson's correlation coefficient was calculated. The p-value <0.05 was set as statistically significant.

Results: Mean age was 19±3.1 years and Body Mass Index (BMI) was 23.1±2.68 kg/m^2. Dynamic balance showed positive correlation with bowling speed (r=0.227, p<0.0001) and lower limb explosive power showed positive correlation (r=0.638, p<0.0001) with bowling speed in cricket bowlers.

Conclusion: It was found that, the bowling speed of the cricket bowlers can improve majorly, if the explosive power of the lower limb is improved, whereas, there is less impact of dynamic balance on the bowling speed.

Keywords: Ball release, Cricket, Fitness, Sports performance

INTRODUCTION

Cricket is an outdoor game and popularity of this game is grown immensely and at present time it is treated as the most popular game in India and all over the world. According to the game, physical fitness is very much essential for the players. In cricket the ball release speed plays a major role in bowling success. To attain a high speed, the bowlers require trunk strength because during bowling body must absorb ground reaction force as high as six times the body weight. Bowlers do overhead skill-bowling and throwing and both require the good shoulder strength. Quick bowling or quick release of ball is an explosive movement that involves coordination of whole body. This quick release of ball unharnessed the speed of bowlers with faster angular velocities of the bowling arm. This may indicate that bowlers with bigger power and rate of force development can be ready to rotate their bowling arm quicker and generate quicker ball unharness speeds. There is role of postactivation synergy which develops when heavy-ball bowling enhances bowling speed possibly at the value of bowling accuracy [1,2].

Previous studies reported strong correlation of run up speed and ball release speed [3,4]. Relationship between front knee motion and ball release speed during contact phase of bowling action was studied by previous literature. More extended front knee was associated with faster ball release speed and vice-versa, it has been noted that faster bowlers have large amount of knee extension during foot contact [5,6]. The efficient transfer of energy to the ball provided by front knee extension which fasters the ball release speed during bowling action [7-9]. So, muscular strength of lower limbs is required during bowling action to stabilise the pelvis/trunk and to transfer the energy efficiently to the bowling arm [10]. Ball release speed may compromise due to instability in this phase [2]. There is lack of research in terms of ball release speed, especially regarding the strength and dynamic balance of lower limbs. Dynamic balance is said to play important role in most of the athletic and sports performances. But it's not clear how much important role the dynamic balance plays in acquiring good bowling speed. Poor dynamic balance and weak core is a risk factor for injury and is associated with alterations in transfer of energy that leads to reduced performance in sports [11]. So, aim of the present study was to evaluate the correlation of dynamic balance and explosive power of lower limbs on bowling speed in bowlers.

MATERIALS AND METHODS

This cross-sectional was conducted at Cricket Gurukul, Faridabad, Mahadev Desai Cricket Academy, Faridabad, Haryana and Indraprastha Cricket Academy, Punjabi Bagh, New Delhi, India from January 2018 to January 2019. The ethical approval as obtained (No. MRIIRS/FAS/2017/164). Total 98 subjects were studied individually in performing Y balance and broad jump test.

Sample size calculation: Sampling method for the study was purposive sampling. G Power software (version 3.1) was used to calculate sample size and power of the study was found to be 95%.

Inclusion criteria: All male bowlers with age between 16 to 28 years with playing experience of atleast 6 months at University/District level and playing frequency atleast 5 days/weeks were included in the study.

Exclusion criteria: Players with spinal tumours, hypertension, impaired circulation and having extreme discomfort on contracting lower limb muscles and shoulder muscles, any metabolic, cardiac or neurological diseases or disorders were excluded from the study.

Instrumentation: Tape ruler, Stadiometer, Weighing Machine, Sticky Tape, Record book, Pen, Marker and Radar Speed Gun (BUSHNELL Velocity Speed Gun 101911) were used to measure the variables.

Independent variables: Dynamic balance and Lower limb explosive power.

Dependent variables: Bowling Speed.

Procedure

A written consent was taken from the players who volunteered for the study and fulfilled the inclusion and exclusion criteria of the study. The nature and importance of study was explained to the players (bowlers) and coaches. Subjects were informed regarding the various procedures to test their physical performance variables. An assessment form was designed to obtain the background information about each subject. Players were asked about their demographic details, connection with cricket that included their playing level, years of playing (>six months), their training sessions (atleast 5 days per week), diet planning, injury status. All participant's age, height, and BMI were recorded. All data collection and testing was done at outdoor court of the Cricket Academies. Subjects were asked to perform warm up session, after completing warm up they proceeded to perform testing stations. Two to three minutes were used between finishing the warm-up and beginning the performance testing. Then they were observed individually for lower limb explosive power and dynamic balance in which they were called for an orientation session, during orientation performance was measured (broad jump test and modified Star Excursion Balance Test (mSEBT)) until their scores no longer improved.

Warm-up: Subjects were asked to perform warm-up and sufficient recovery (3-5 minutes) was administered prior to the commencement of the test.

Y Balance test (mSEBT in cm): The test was performed in the following directions: Right Anterior, Left Anterior, Right Posteromedial, Left Posteromedial, Right Posterolateral and Left Posterolateral. With their hands firmly placed on their hips, the athlete should then be instructed to slide the leg forward as far as possible with their right foot and return back to the starting upright position. Reach distances were recorded. Then repeat this with the same foot for a total of three successful reaches. After they have completed three successful reaches with their right foot, they were permitted to repeat this procedure with left foot [12].

Broad jump test (cm): The player stood behind a line marked on the ground with feet slightly apart. A two foot take-off and landing was used, with swinging of the arms and bending of the knees to provide forward drive. The player attempted to jump as far as possible, landing on both feet without falling backwards. Total three attempts were allowed. The test administrator recorded the reach distance of each attempt in order to calculate the athlete broad jump test [13].

Bowling speed (km/hr): Radar Speed Gun (Bushnell velocity speed gun 101911) was used to measure subjects bowling speed with an accuracy of +/- 1 mph and +/- 2 kph using Doppler signal processing to measure speed. It is used to calculate speed of various balls like, baseball, softball or tennis ball of 16-177 kph speed (27 m away). Radar was used to pick up the speed of each ball in kph as it leaves the bowler's hand. When activated, an internal antenna sends out radiowaves at a specific frequency. When a moving object (thrown ball) enters this transmitted signal, the frequency of the reflected signal off the ball is changed and the change in frequency is proportional to the ball's speed. The speed of the radar was showed in either kph or mph. The signal transmitted is able to pass through materials such as Plexiglass, netting, white mesh fencing, backdrops, or tarpaulins without being impacted. Therefore, a protective barrier can be placed between the moving object and the radar without impacting the accuracy of the measurements in any way.

STATISTICAL ANALYSIS

The Statistical Package for the Social Sciences (SPSS) software 2.0 version was used to analyze all the data. Descriptive statistics was calculated. The p-value (<0.05) was considered as statistically significant. Pearson's correlation coefficients and p-value have been reported to find the relationship between variables.

RESULTS

[Table/Fig-1,2] showed demographic details and descriptive statistics of all variables.

Demographic details	Mean±SD
Age (years)	19±3.1
Height (cm)	169.5±7.71
Weight (Kg)	66.1±8.63
Body mass index (kg/m^2)	23.1±2.68

[Table/Fig-1]: The demographic details of the subject (n=98).

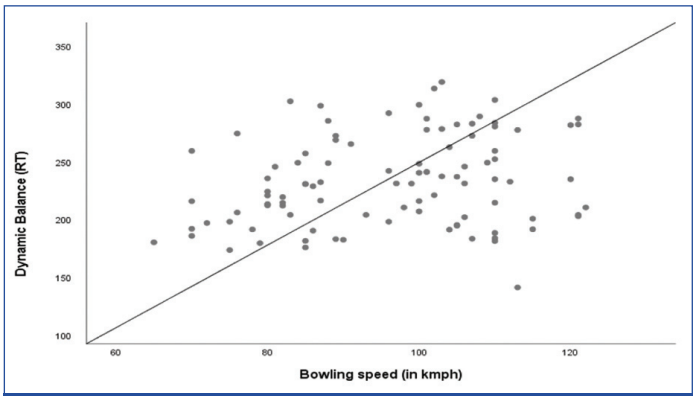
Variables	Mean	Standard Deviation (SD)
Bowling speed (km/hr)	96.17	14.43
Dynamic balance (cm)	226.54	38.91
Lower limb explosive power (cm)	209.61	15.99

[Table/Fig-2]: Descriptive statistics of all variables (n=98).

Association of bowling speed and dynamic balance: [Table/Fig-3] showed positive correlation between bowling speed and dynamic balance (r=0.227, p-value <0.0001) and [Table/Fig-4] represented scatter plot of relationship between bowling speed and dynamic balance.

Variables	Bowling speed	Dynamic balance
Pearson's correlation	1	0.227*
Sig. (2-tailed)		0.025

[Table/Fig-3]: Correlation of bowling speed with dynamic balance (n=98).
*Correlation is significant at the 0.05 level (2-tailed)

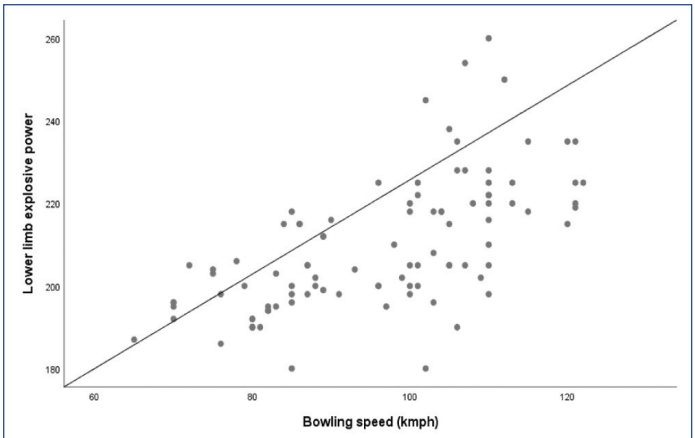


[Table/Fig-4]: Scatter plot representing the relationship between bowling speed and dynamic balance.

[Table/Fig-5] showed strong positive correlation between bowling speed and lower limb explosive power (r=0.638, p-value <0.0001) and [Table/Fig-6] showed scatter plot representing the relationship between bowling speed and lower limb explosive power.

Variables	Bowling speed	Lower limb explosive power
Bowling speed (n=98)		
Pearson's correlation	1	0.638**
Sig. (2-tailed)		0.001

[Table/Fig-5]: Correlation of bowling speed with lower limb explosive power.
**Correlation is significant at the 0.01 level (2-tailed)



[Table/Fig-6]: Scatter plot representing the relationship between bowling speed and lower limb explosive power.

DISCUSSION

Leg strength was a singular component, an orthogonal factor, which made a moderate contribution to the oblique and complex factor of leg power [14]. Khuman PR et al., found significant difference in three different sports athletes of cricket, soccer and volleyball in terms of static and dynamic balance. So, it was found that soccer players demonstrated higher balance compared with volleyball players and volleyball players demonstrated higher static and dynamic balance that of cricketers [15]. It was found that athletes with developed core have a better bowling speed. Bowling requires a complex coordination between upper and lower extremities. Stability of core played an important role in successful performance in sports and injury prevention but weak core increased the risk of injury [11,16].

The present study found a positive correlation of bowling speed with lower limb explosive power. Similarly Pyne DB et al., reported that lower body strength is an important contributor to ball release speed [17]. Measurement of joint kinematics of lower body played a significant role during delivery action of bowling [10]. During a ball release, there was a quick deceleration of the body's center of mass to transfer the energy to trunk and bowling arm using flexion extension knee action. Knee extension decelerated the body's center of mass speed to the bowling arm via trunk, whereas knee flexion reduced braking forces during front foot contact phase [7,9,18]. Cricket coaches should be aware of importance of leg power and dynamic balance while bowling. During training of athletes, focus should be placed on strengthening of lower limb and core for better performance in sports.

Limitation(s)

Although, subjects were almost matched in the current study, but, different mode of trainings and habits of athletes may be considered. Bowling technique, height of the bowlers and releasing point of time may impact the bowling speed which was not considered in the present study.

CONCLUSION(S)

The present study concluded that, the bowling speed of the cricket bowlers can improve majorly, if the explosive power of the lower limb is improved whereas, there is very less impact of dynamic balance on the bowling speed. There is a strong relationship found between lower limb power and dynamic balance with the bowling action of arm. More studies are required to get more accurate findings on this topic. Similar studies are required on females in order to determine possible gender differences in the effect of different combinational effect of lower limb explosive power and dynamic balance on performance. Studies can be done with more accurate procedures to get more improved results of lower limb explosive power and dynamic balance. Further studies can be done on larger sample size.

REFERENCES

[1] Feros SA, Young WB, O'Brien BJ. The acute effects of heavy-ball bowling on fast bowling performance in cricket. J Aust Strength Cond. 2013;21(suppl 2):41-44.
[2] Middleton KJ, Mills PM, Elliott BC, Alderson JA. The association between lower limb biomechanics and ball release speed in cricket fast bowlers: A comparison of high-performance and amateur competitors. Sports Biomechanics. 2016;15(3):357-69.
[3] Glazier SP, Paradisis GP, Cooper SM. Anthropometric and kinematic influences on release speed in men's fast-medium bowling. J Sports Sci. 2000;18(12):1013-21.
[4] Elliott BC, Foster DH. Fast bowling technique. In: Elliott B, Foster D, Blanksby B, eds. Send the Stumps Flying: The Science of Fast Bowling. Nedlands, WA: University of Western Australia Press; 1989:26-36.
[5] Burden AM, Bartlett RM. A kinematic investigation of elite fast and fast-medium cricket bowlers. InISBS-Conference Proceedings Archive 1990.
[6] Wormgoor S, Harden L, Mckinon W. Anthropometric, biomechanical, and isokinetic strength predictors of ball release speed in high-performance cricket fast bowlers. J Sports Sci. 2010;28(9):957-65.
[7] Portus MR, Mason BR, Elliott BC, Pfitzner MC, Done RP. Cricket: Technique factors related to ball release speed and trunk injuries in high performance cricket fast bowlers. Sports Biomech. 2004;3(2):263-84.
[8] Elliott BC, Foster DH, Gray S. Biomechanical and physical factors influencing fast bowling. Australian J Sci Med Sport. 1986;18(1):16-21.
[9] Ferdinands R, Marshall RN, Kersting U. Centre of mass kinematics of fast bowling in cricket. Sports Biomech. 2010;9(3):139-52.
[10] Ferdinands RE, Marshall RN, Round H, Broughan KA. Ball speed generation by fast bowlers in cricket. In Proceedings of the international society of biomechanics XIXth congress. 2003:0 6-11.
[11] Nesser TW, Lee WL. The relationship between core strength and performance in division I female soccer players. J Exerc Physiol Online. 2009;12(2):21-28.
[12] Shaffer SW, Teyhen DS, Lorenson CL, Warren RL, Koreerat CM, Straseske CA, Childs JD. Y-Balance Test: A reliability study involving multiple raters. Mil Med. 2013;178(11):1264-70.
[13] Ab Rahman Z, Kamal AA, Noor MA, Geok SK. Reliability, Validity, and Norm References of Standing Broad Jump. REVISTA GEINTEC-GESTAO INOVACAO E TECNOLOGIAS. 2021;11(3):1340-54.
[14] Considine WJ, Sullivan WJ. Relationship of selected tests of leg strength and leg power on college men. Research Quarterly. American Association for Health, Physical Education and Recreation. 1973;44(4):404-16.
[15] Khuman PR, Kamlesh T, Surbala L. Comparison of static and dynamic balance among collegiate cricket, soccer and volleyball male players. International Journal of Health & Allied Sciences. 2014;3(1):09.
[16] Hilligan BK. The relationship between core stability and bowling speed in asymptomatic male indoor action cricket bowlers. Durban, Durban University of Technology, Oct 2007.
[17] Pyne DB, Duthie GM, Saunders PU, Petersen CA, Portus MR. Anthropometric and strength correlates of fast bowling speed in junior and senior cricketers. J Strength Cond Res. 2006;20(3):620-26.
[18] Worthington P, King M, Ranson C. The influence of cricket fast bowlers' front leg technique on peak ground reaction forces. J Sports Sci. 2013;31(4):434-41.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Physiotherapy, Manav Rachna International University, Faridabad, Haryana, India.
2. Professor, Department of Physiotherapy, SGT University, Gurugram, Haryana, India.
3. Assistant Professor, Department of Physiotherapy, SGT University, Gurugram, Haryana, India.
4. Assistant Professor, Department of Physiotherapy, Manav Rachna International University, Faridabad, Haryana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Pooja Anand,
Professor, Department of Physiotherapy, SGT University, Gurugram, Haryana, India.
E-mail: pooojaanand@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jul 05, 2021
- Manual Googling: Dec 10, 2021
- iThenticate Software: Jan 31, 2022 (21%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jul 03, 2021**
Date of Peer Review: **Jul 29, 2021**
Date of Acceptance: **Dec 10, 2021**
Date of Publishing: **Mar 01, 2022**