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Original Research Article

Relationship between Linear Speed and Lower-body Power with Change-of-Direction Speed in Young Basketball Players- A Cross-Sectional Study

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ABSTRACT

Background and Objectives: A basketball player needs good fitness, flexibility, power, agility, endurance, strength & vertical jump ability to achieve sporting targets. The aim of this study was to see the relationship between linear speed and lower body power with change of direction speed in young basketball players.

Methods: 40 players (only males), playing basketball since 2 year, age between 18-25 years from different colleges in Surat and Bardoli were included for the study. All players had filled up the informed consent form and the self-administered questionnaire. Outcome measures used were Modified Illinois Change of direction test, 20- meter Sprint and Vertical Jump Height to assess Agility, Linear Speed and Lower-body Power, respectively.

Results: Pearson rank correlation was used to see the correlation between Linear Speed and Lower-body Power with Change of Direction Speed. Results were considered to be significant at $p<0.05$. All statistical analysis was performed using SPSS version 22. For agility test and 20 meter sprint $r= 0.573$ with $p= 0.000$. For agility test and VJH $r= -0.319$ with $p= 0.045$.

Conclusion: There is positive correlation found between Linear speed with change of direction speed in young basketball players which concluded that as time duration for agility decreased, time duration for linear speed also decreased. There is negative correlation found between Lower-body power with change of direction speed in young basketball players which concluded that as time duration for agility decreased, power for vertical jump height increased.

Keywords: Basketball, Agility, Speed, Vertical Jump Height, Power.

INTRODUCTION

Basketball is considered as one of the most popular team sport played & viewed on the large scale all over world. It is one of the sports characterized by many of basic & variable skills. [1] It is an extremely dynamic team sport with global popularity, especially among youth. It involves a pattern of intermittent, dynamic, skilled movement activities and has complex demands that require a combination of individual skills, team plays, tactics, and motivational aspects. It is an aerobic-based anaerobic sport which requires activities with maximum strength and power which includes jumping, turns, dribbles, sprints, screens and low intensity activity such as walking, jogging, stopping. [2]

In basketball, the ability to generate maximal strength levels in shortest duration (muscular power) has been considered as

vital component to obtain high sport performance level. [3-4] One of the practical functions of training is physical adaptation of the player to perform the sport activities which improve the training of the player to reach to higher levels in the sport activities. [5] Moreover, basketball preseason programs includes strength training [6-7] with a background of related benefits that improve sports performance, reduced injury rate, and provide higher motivation levels for the athletes. [8]

It is one of the most desired goals of basketball players, regardless if their playing position is guard, forward or centre, to improve their jumping ability, in addition to achieving a high level of expertise in the other defensive and offensive acts they have to perform during the game. [9]

During basketball game, professional's players cover about 3500-5000m. Each players carry out about 1000, mainly short, activity lasting about 2 seconds; time motion analysis has shown that these short activities are performed with a different frequency according to player's position. Explosive strength, take-off power, speed and agility are abilities that make an important contribution to efficient movement with and without the ball, thus play an important role in basketball technique and tactis. [2] Mc/nnes et al. have reported that basketball players engage in approximately 105 high-intensity runs per match, with sprintstride bouts (2-6 sec) occurring on average every 21 sec during live time. As a result, the ability to repeatedly sprint over the duration of match (63.5 & 36.5 min of total & live time, respectively) may be considered a performance component in basketball conditioning. [10]

Many authors have suggested that strength, power, agility and speed are important characteristics for elite basketball players. [11] A basketball player needs good fitness, flexibility, power, agility, endurance, strength & vertical jump ability to achieve sporting targets. [12] The significance of developing good conditioning programs based on the specific physiological demands of each sport is considered a key factor to success. [13]

Thus, the aim of this study is to see the relationship between linear speed and lower body power with change of direction speed in young basketball players. Physical fitness is important for top class performance in sports and also for injury prevention. College level and University level players are the future talents, who can become top level players. Basketball players require good agility, power and speed. The finding of this study will help Sports Physiotherapist, Coaches, Fitness Trainers and Players themselves to appropriately train and improve performance by introducing modifications in practice sessions.

METHODS

A cross sectional study conducted by collecting data from Uka Tarsadia University- Bardoli, Sardar Vallabhbhai National Institute of Technology (SVNIT) - Surat and K.P Commerce College- Surat. This sample of convenience comprised 40 male basketball players. The players were required to be: participated at competitive level for minimum 2 years, physical activity practice volume was approximately 16 hours per week and age between 18-25 years playing basketball at college level. Individual with any, musculoskeletal and neurological impairment, pathological condition of spine, hip, knee, and pelvis, any traumatic condition in past 6 months, cardiovascular disease, uncontrolled metabolic disorder such as Diabetes Mellitus, Undergone any surgical procedure and individuals with poor balance, functional strength and flexibility, impaired ROM and Muscle power were excluded from study. The subjects were informed about the possible risks and benefits of the study and gave their informed consent to participate in this study.

Preliminary measurements and demographic data were taken prior to the beginning of the study, in which subject's age, sex, height and weight were taken. The procedure allowed the players to do 5 minutes warm up. After that, Linear Speed, Lower body Power and Agility were checked by the 20-meter sprint test, Vertical jump height (VJH) and Modified Illinois Change of Direction test (MICOD), respectively which was preceded by cool down period of 5-minutes involving slow jogging was performed by players.

1) 20-METER SPRINT TEST: [14]

This test was used to determine the player's maximum sprint speed & the ability to accelerate from stationary position. Equipment used were Cones, Stopwatch, Whistle and Measuring tape. 20-meter track was measured and marked using cones. Researcher had stayed at finish line with stopwatch. For this test, players had to position himself at starting line and were instructed to give signal to researcher by raising his right hand when he was ready. At the sound of the whistle, players sprinted with all-out effort. As player crossed the finish line the time had been recorded by stopwatch on second.

2) VERTICAL JUMP HEIGHT (VJH): [15]

Vertical jump height was measured by the Stand and Reach test. VJH was used to measure Power of the players. Materials used were measuring tape and chalk for marking on wall. Players were positioned so that they were standing with equal weight on bilateral lower extremities, which was approximately shoulder-width apart. The players stand, side on with the dominant shoulder, with a piece of chalk in the hand closest to wall, and was instructed to reach as high as possible and make a mark on wall; this was called the Standing reach height and was recorded as a zero starting position. The players then ask to bend (flex) the knees approximately 120 degrees and swing the arms prior to the jump. The players were not allowed to run up or a shuffle step prior to the jump. The player was asked to jump and place a second chalk mark as high as possible on the wall, this was called the Jumping height. This test is selected because it has high validity (0.80) and reliability (0.93) and because it allows arm movement and a squat motion before the jump, such as those performed in sports like basketball. The player's vertical jump score was measured as the distance between the two chalk marks; means the standing reach height and the jumping height. The difference between two chalk marks was measured in centimetres.

3) MODIFIED ILLINOIS CHANGE OF DIRECTION TEST (MICOD): [16]

This test was used to determine the ability to accelerate, decelerate, and turn in different directions, and run at different angles. This test was selected based upon established criteria and its reported validity and reproducibility of the test. Materials used were Cones, Stopwatch and Measuring tape. The MICOD test was set up with four cones forming the agility area. On command, from a standing position player sprinted 5m, turned and returned back to starting line, then, he swerved in and out of four markers (cones), completed two 5m sprints to finish the agility course. Players were instructed to complete the test as quickly as possible. They were instructed not to cover the markers but to run around them. When player failed to do this, the trial was stopped and re-attempt after the requisite recovery period. Time shown in the stopwatch was recorded in seconds.

Statistical Analysis

Descriptive statistics including mean and standard deviation were analysed. Descriptive statistics of age, height and weight distribution among 40 players were done. Results were considered to be significant at $p<0.05$. All statistical analysis was performed using Statistics Package for Social Sciences (SPSS) version 22. Normality of distribution tested by the Shapiro-Wilk test. The relationships

between the linear speed (20-m sprint) and jump tests (VJH) with the MICOD speed tests was also investigated via Pearson's two-tailed correlation analysis.

RESULTS

4.1 Demographic Data:

Table: 4.1.1 Demographic Data of the Basketball Players (Mean ± SD)

Variables	Mean ±SD
Age(year)	20.25±1.44
Height(cm)	172.8±7.02
Weight(kg)	63.71±10.77

Table 4.1.1 represented demographic data of Basketball players which included age(year), height(cm) and weight(kg) among 40 Basketball Players, which shown in table.

4.2 Descriptive Data:

Table: 4.2.1 Group Statistics

	N	Mean	Std. Deviation
MICOD Test	40	13.54	1.00
20-meter sprint test	40	3.83	0.4
VJH	40	44.52	8.71

(MICOD- Modified Illinois Change of Direction, VJH- Vertical Jump Height)

Table 4.2.1 represented mean and standard Deviation of Basketball players for MICOD test, 20-Meter Sprint test and VJH, which shown in table.

Table 4.2.2 Correlation of MICOD test and 20-meter Sprint Test

	MICOD	20m Sprint test
MICOD Pearson Correlation	1	0.573
Sig. (2-tailed)		0.000
N	40	40
Sprint Pearson Correlation	0.573	1
Sig. (2-tailed)	0.000	
N	40	40

Correlation is significant at the 0.05 level (2-tailed)

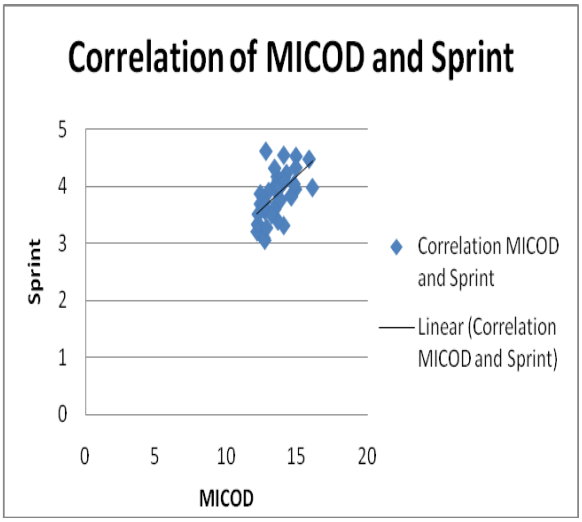
Table 4.2.2 represented the correlation of MICOD and Sprint test. There was linear positive correlation between MICOD and 20-meter Sprint test in basketball players. The correlation coefficient was 0.573 and is statistically significant as the p-value was less than 0.05.

Table 4.2.3 Correlation of MICOD Test and Vertical Jump Height

	MICOD	VJH
MICOD Pearson Correlation	1	-0.319
Sig. (2-tailed)		.045
N	40	40
VJH Pearson Correlation	-0.319	1
Sig. (2-tailed)	.045	
N	40	40

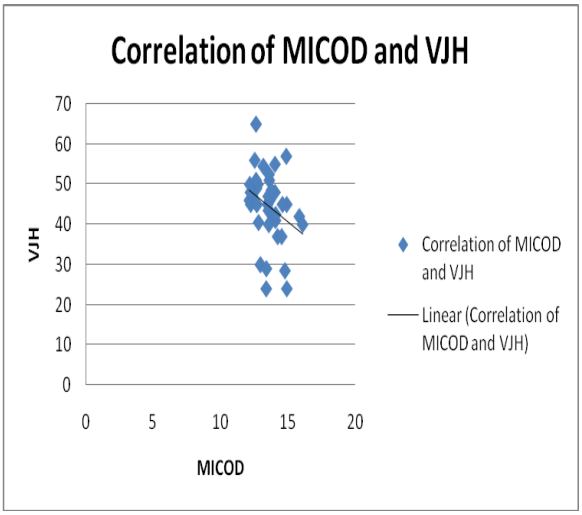
Correlation is significant at the 0.05 level (2-tailed)

Table 4.2.3 represented the correlation of MICOD test and VJH. There was a linear negative correlation between MICOD and VJH in basketball players. The correlation coefficient was
-0.319 and is statistically significant as the p value was less than 0.05.



Graph 1: Correlation of MICOD test and 20-meter Sprint Test

Graph-1 represented the correlation of MICOD test and 20- meter Sprint test. There was Positive correlation between MICOD test and 20-meter Sprint test which showed that as time duration for agility decreased, time duration for linear speed also decreased.



Graph: 2 Correlation of MICOD test and Vertical Jump Height

Graph-2 represented the correlation of MICOD test and VJH. There was negative

correlation between MICOD test and VJH which showed that as time duration of Agility decreased, power for VJH increased.

DISCUSSION

The present study was conducted to see the relationship between linear speed and lower body power with change of direction speed in young basketball players age between 18-25 years. The Sample size was 40. The outcome measures used were Vertical Jump Height, 20-m Sprint Test and Modified Illinois Change of Direction Test to measure power, speed and agility respectively. The study aimed to help sports physiotherapist, coaches, fitness trainers and players themselves to appropriately train and improve performance by introducing modification in practice session. Result of this study shows that there is positive correlation between MICOD and 20-m sprint and there is negative correlation between MICOD and VJH.

Abbas Asadi, et al., [17] conducted the study on relationship between jumping ability, agility and sprint performance in young basketball players and showed moderate to strong correlation between jumping ability and agility and moderate to strong correlation between agility and sprint performance of young basketball players.

Most of the studies conducted in the past by Alemdaroglu, [2] Chaouachi, et al. [11] focused on studying the relationship between the Strength and agility. Many studies conducted in the past by Alemdaroglu, [2] Little and Williams [18] focused on studying the relationship between the agility and speed. Whereas the present study focused on studying the relationship between the linear speed and lower body power with change of direction speed.

Robert G. Lockie 1, et al., [19] conducted the study on the Relationships between Linear Speed and Lower-Body Power with Change-of-Direction Speed in Women Soccer Athletes. Pearson's correlations determined relationships between COD speed, linear speed, and power, with regression equations calculated. Division I players demonstrated superior 505, COD deficit, VJ height, PAPw, and P:BM (d = 1.09–2.21). Division II players were faster in the MTT (d = 1.51). For all players, the 505 correlated with the 10-m sprint and VJ height, while the COD deficit players, the 505 correlated with the 10-m sprint. This study was done on soccer player but present study done on basketball players and there was strong relation found between Agility, Power and Speed. For relationship between MICOD and Sprint r=0.573 with p=0.000 and for MICOD and VJH r= - 0.319 with p=0.045.

UtkuAlemdaroglu, [2] conducted the study on The Relationship Between Muscle Strength, Anaerobic Performance, Agility, Sprint Ability and Vertical Jump Performance in Professional Basketball Players. Moreover, strong relations were found between the performance of athletes in different field tests ($p< 0.05$). In present study, there was strong relation found between Change of Direction speed, Power and Speed.

Many studies done on tennis players, in which most of the authors used a T-test and dot drill test to determine speed and agility. They found that the players became quicker and more agile enabling them to get more balls and be more effective tennis players. Present study done on basketball players. In this study MICOD used for Agility to see the relationship with Power and Speed. Result showed strong correlation with $p<0.05$.

Sporiš, G. et al. [20] conducted the study to determine the correlation between the speed, agility and quickness, and to determine the correlation between tests with and without the ball in young soccer players. The participants were tested on a 10-m Sprint (B10S), 30-m Sprint (B30S), Flying 20-m Sprint (B20S), Zigzag test (CC) and Zigzag with the Ball (CCL). Significant relationships were found

between test CC and B30S (r=0.560), as well as between test CC and B20S (r=0.603). There were no significant relationships between CC and B10S (r=0.323). The agility test with the ball (CCL) has not shown significant correlation with speed and quickness (r=0.093-0.247). This was contrast to our result which showed that there were positive correlation found between agility and speed.

Dr. Sanjit Sardar, et al., [21] conducted study on estimation of kabaddi performance on the basis of selected physical fitness components and find out correlation between Independent variables (cardiovascular endurance, flexibility, agility, speed and explosive strength) and Dependent variables (kabaddi performance). Similarly, Archna Sharma, et al., [22] conducted study on correlations of anthropometric characteristics with physical fitness tests in Indian professional hockey players to investigate the correlations of anthropometrics characteristics with isokinetic strength (handgrip strength), lower limb power, aerobic strength, and skill tests.

In first study, they found there was a significant relationship between kabaddi performance and cardiovascular endurance, flexibility, agility, speed and explosive strength and insignificant relationship between kabaddi performance and flexibility and speed. In second study, results indicated statistically significant ($p<0.05$) differences only in lower limb power between Indian national and state level male hockey players. Agility, Speed and Power are very important for the basketball players' good performance. Hence, present study conducted on agility, speed and power- the components of physical fitness.

CONCLUSION

Physical fitness is important for top class performance in sports and also for injury prevention. A basketball player needs good fitness, flexibility, power, agility, endurance, strength & vertical jump ability to achieve sporting targets. The significance of developing good conditioning programs based on the specific physiological demands of each sport is considered a key factor to success. Results of this study showed that there was positive correlation found between Linear speed with change of direction speed in young basketball players which concluded that as time duration for agility decreased, time duration for linear speed also decreased. There was negative correlation found between Lower-body power with change of direction speed in young basketball players which concluded that as time duration for agility decreased, power for vertical jump height increased.

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