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Research Article

CORRELATION BETWEEN CORE ENDURANCE AND ATHLETIC PERFORMANCE IN BASKETBALL PLAYERS

Zoya Nevrekar., Swati Nerkar and Ajay Kumar

DPO'S Nett college of Physiotherapy, Thane, India

A R T I C L E I N F O

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A B S T R A C T

Background: Basketball is a physically demanding sport requiring intense lateral, running, sprinting and jumping movements. Because much of their training incorporates the core, it is hypothesized that relationships exist between core endurance and performance in this population. This would also greatly impact the sports performance and rehabilitation literature as it would serve as the basis for sport specific exercise prescription and help with identifying appropriate training for higher level athletes.

Aims and Objectives- To assess core endurance of the athlete by McGill's core endurance test. To assess the athlete performance using t test,40-yard dash test and medicine ball throw test. To determine the correlation between core muscles endurance and athletic performance in basketball players.

Materials and Methods: A cross sectional study was conducted with a sample of 30basketball players between age of 18-25 years Also, players with a training period from 6 months to one year were included in the study. Individuals with Pre-existing MSK, neurological and cardiovascular disease, any abdominal injury in last 60 days, Acute injury or trauma, Untrained individuals were excluded. The study was started with performing MC Gill's core endurance test on all the subjects followed by which all the athletic performance test were performed (vertical jump, 40-yard dash, T-test. Then the core endurance and athletic performance were correlated to determine whether there is an existing relationship between the two.

Results: A weak to moderate relationship exists between core endurance and athletic performance in basketball players.

Conclusion: The study concluded that core endurance does contribute to athletic performance and should be taken into consideration in basketball players training.

INTRODUCTION

The core of our body consists of the spine, pelvis along with its musculature. The core can be considered to be the connection between the upper and lower body. Endurance of the core muscles can beexplained as how long the muscles of the core are able to maintain a contraction at a given task. Muscles that can sustain functions for a prolonged period of time are less likely to fatigue and can continue to provide support to the spinefor a long period of time, reducing the chance of injury and enhancing athletic performance. If core muscles do not have the endurance to maintain a neutral spine, then any movement through the spine will be hampered and there is an increase chance of injury.[1]

Theoretically it is mentioned that if the upper and lower body are strong and the core is weak the decrease in muscular force production through the core will result in inefficient movement patterns. Core training has become the norm in many athletic training programs throughout the United States during the past decade.[3]The core strength training in basketball sports is an important and key training task and relates to many technical action levels as to make basketball players have solid body posture, coordination of their upper and lower limbs, thus promoting the effective combination and coordinated development of each links of body and greatly improving the overall level in basketball sports.[4]

If a relationship does exist between core stability and sports performance, athletes possessing higher levels of core stability also may be less susceptible to injury.[1]Few studies have investigated the role of core endurance in performance among professional Basketball athletes, although numerous studies have investigated the importance of core stability. Also, it is possible that performance in specific sports is highly correlated to specific measures of athletic performance, while other sports demonstrate no relationship. Therefore, to achieve excellent performance in certain sports may require varied levels of core stability.

Therefore, the present study is to investigate the relationship between core endurance and various performances among athlete level basketball players.

Corresponding author:* **Zoya Nevrekar
DPO'S Nett college of Physiotherapy, Thane, India

In the past, several researches have been done on core muscles stability and athletic performance but very few researches have been done on basketball players correlating core endurance and athlete performance using Mc gill core endurance test, T-test, 40-yard dash test and medicine ball throw test as the outcome measures.

A number of isometric tests of trunk muscle endurance have been described for the trunk extensors, flexors and lateral musculature of the trunk. Following protocols established by McGill has been shown to have good reliability. For testing the trunk flexors, the trunk flexor endurance test which targets the anterior core muscles is used forassessment of trunk flexor endurance. For testing the lateral trunk muscles, the side bridge test has been used to optimally challenge quadratus lumborum and the othermuscles of the anterolateral trunk wall. For testing the trunk extensors, the extensor endurance test is used. Performance is evaluated by recording maximum time a person can maintain the test position. For testing speed, the 40-yd sprint test, which is the most widely, used method for evaluating sprint speed among athletes in various sports is being used. For testing agility, the T-test appears to be highly reliable and measures a combination of components, including leg speed, leg power, and agility. For testing strength, medicine ball throw test is used.

Procedure

30 basketball players from the metropolitan city with the age between 18 – 25 years, were recruited. Inclusion criteria: 1-Athletes willing to perform 2. Age group between-18 to 25 years 3. Basketball training period from 6 months to one year Exclusion criteria: Pre-existing MSK disease, neurological disease, cardiovascular disease 2. Any abdominal injury in last 60 days 3. Acute injury or trauma 4. Untrained individuals 5. Individuals trained for more than 1 year. Prior to the study a written consent form was taken from each subject.

Study Design: In this study the sample size was 30. Type of study was crosssectional and type of sampling was convenient. Procedure: Subjects were screened according to the inclusion and exclusion criteria. All participants performed 10–15 minutes of warm-up activities before participating in any of the athletic testing stations. A scoring sheet was made of each player before testing in order to record their performance in every test

During the current study the testing procedure and the proper technique to perform the test was explained. Each subject was given a minimum of a 4-minute break between each testing station in order to allow for adequate recovery. The study was started with performing MC Gill's core endurance test on all the subjects followed by which all the athletic performance test were performed (vertical jump, 40-yard dash, T-test).

Core Testing

The protocol consists of four tests that measure all aspects of the torso via isometric muscle endurance. A handheld stopwatch was used to measure the length of time participants were able to hold each isometric position.

Trunk Flexor Test: The flexor endurance test begins with the person in a sit-up position with the back resting against a wedge angled at 60 from the floor. Both knees and hips are flexed 90, the arms are folded across the chest with the hands placed on the opposite shoulder, and the feet are secured. To begin, the jig is pulled back 10 cm, and the person holds the isometric posture as long as possible. Failure is determined when any part of the person's back touches the jig. Normal value is 223 ± 134 s

Trunk Extensor Test: The back extensors are tested with the upper body cantilevered out over the end of the test bench and with the pelvis, knees, and hips secured. The upper limbs are held across the chest with the hands resting on the opposite shoulders. Failure occurs when the upper body drops below the horizontal position. Normal value is 164 ± 51 s

Lateral Musculature Test: The lateral musculature is tested with the person lying in the full side-bridge position (left and right side individually). Legs are extended, and the top foot is placed in front of the lower foot for support. Subjects support themselves on one elbow and on their feet while lifting their hips off the floor to create a straight line from head to toe. The uninvolved arm is held across the chest with the hand placed on the opposite shoulder. Failure occurs when the person loses the straight-back posture and/or the hip returns to the ground. Normal Values- Right side bridge-105 ± 44 s Left side bridge-103 ± 41 s

Athletic Performance Test

T-Test for agility

The client starts at cone A. On the trainer's command, the client sprints to cone B and touches the base of the cone with the right hand. He or she then shuffles left to cone C and touches the base of the cone with the left hand. He or she then shuffles right to cone D and touches the base of the cone with the right hand. He or she then shuffles back to cone B and touches the base with the right hand before running backward to the start (cone A). Stop the stopwatch as the client passes cone A

40 Yard Dash Test

The test involves running a single maximum sprint over 40 meters, with the time recorded. A thorough warm up should be given, including some practice starts and accelerations. Start from a stationary position, with one foot in front of the other. The front foot must be on the starting line. This runner should be stationary prior to starting. The person timing should stand at the finish line with one arm held high, and call 'ready' followed by a sweep down their arm quickly to start the subject (do not call out 'go' due to the time delay in the subject hearing the call). As the arm sweeps down, the tester should start the stopwatch which is held in the downward sweeping arm, and finish the stopwatch as their chest passes through the finish line. Normal value is

40-yard Sprint Scores (general guidelines)- 4.90 ± 0.34 seconds

Medicine Ball Throw Test

The subject stands at a line with the feet side by side and slightly apart, and facing the direction to which the ball is to be thrown. The ball is held with the hands on the side and slightly behind the center. The throwing action is similar to that used for a soccer/football sideline throw-in. The ball is brought back behind the head, then thrown vigorously forward as far as possible. The subject is permitted to step forward over the line after the ball is released, and is in fact encouraged to do so in

maximizing the distance of the throw. Three attempts are allowed.

scoring: The distance from the starting position to where the ball lands is recorded. The measurement is recorded to the nearest 0.5 foot or 10 cm. The best result of three throws is used.

Normal Values-Male- 10.7 m Female -7.2 m

Data Analysis and Interpretation

SPSS 28 software (United States) was used for analysis. Descriptive statistics were performed on all data.

The relevance of data to a normal distribution was evaluated using the Shapiro-Wilk test. The relationship between the study parameters was assessed using the Pearson's correlation analysis (r). A *p* value of <0.05 was considered statistically significant. The correlation coefficient values were defined as follows: very strong correlation (≥0.8); moderately strong correlation (0.6-0.8); fair correlation (0.3-0.5), and poor correlation (≤0.3).

RESULT

The study showed moderate correlation between all core endurance test and T-test whereas right bridge test moderately correlated with medicine ball throw test. The 40-yard test was weakly correlated with the core endurance test. The results of this study suggest that a significant, but weak or moderate relationship exists between core endurance and athletic performance in basketball players.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
FET	.151	30	.077	.957	30	.265
EET	.163	30	.042	.879	30	.003
Rt-SBT	.103	30	.200*	.974	30	.663
Lt-SBT	.113	30	.200*	.970	30	.540
FYT	.108	30	.200*	.976	30	.705
T-Test	.142	30	.123	.943	30	.111
MT	.149	30	.086	.934	30	.061

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 1 Shows the mean and standard deviation for the Demographic data (mean ± SD)

Variables	N	Minimum	Maximum	Mean	Std. Deviation
AGE	30	18	24	21.73	1.617
HEIGHT	30	167	198	180.50	7.842
WEIGHT	30	49	60	55.60	3.001
Valid N (listwise)	30				

Table 2 Shows the mean and standard deviation for the Core endurance and athletic performance variables (mean ± SD)

	N	Minimum	Maximum	Mean	Std. Deviation
FET	30	33.9	66.3	54.25	7.3391
EET	30	36.4	67.1	58.47	6.5074
Rt-SBT	30	30.2	45.2	38.03	4.0740
Lt-SBT	30	27.3	47.6	38.29	5.3614
FYT	30	5.1	6.7	5.920	.3755
T-test	30	7.1	9.3	8.033	.6656
MBTt	30	10.0	13.0	11.49	.8969
Valid N (listwise)	30				

Table 3 Shows the Core endurance correlations with each other

Core endurance	Flexion test	Extension test	Rt side bridge test	Lt side bridge test
FLEXION TEST	1			
EXTENSION TEST	0.75(0.001)	1		
RT SIDE BRIDGE	0.57(0.001)	0.535	1	
LT SIDE BRIDGE	0.271	0.305	0.24	1

Table 4 Shows the correlation between core endurance and athletic performance of 30 basketball player. The table presents Pearson's correlation coefficient and its significance value.

N=30		MC Gill Core Endurance Test			
		Flexor	Extensor	LT Side Bridge	RT Side Bridge
40 Yard Dash Test	R value	-0.404	-0.553	-0.087	-0.528
	P value	0.027	0.002	0.648	0.003
T-Test	R value	0.3	0.44	0.59	0.49
	P value	0.554	0.048	0.432	0.443
Medicine Ball Throw Test	R value	-0.401	-0.385	-0.181	0.548
	P value	0.028	0.036	0.338	0.02

Table 5 Shows the correlation between mean core endurance and athletic performance of 30 basketball player. The table presents Pearson's correlation coefficient and its significance value.

N=30		Mean MC Gill Core Endurance Test
Forty Yard Dash Test	R value-	0.49
	P value-	0.05
T-TEST	R value-	0.30
	P value-	0.17
Medicine Ball Throw Test	R value-	0.47
	P value-	0.08

DISCUSSION

Because much of the training in basketball incorporates the core, it is thought a relationship does exist between core endurance and performance in this population.No significant data exists about the relationship between performance and core endurance in this population. Sharrock et al. suggested a significant correlation between the core stability and performance in players.[1]

Whereas, Current study results are similar to Nesser et al who discovered at best only a moderate correlation between several sports-specific measures and core stability in football players. Andy Waldheim, Li Li* conducted a study "To determine the intra-tester reliability of clinical measurements that assess five components related to core stability: strength, endurance, flexibility, motor control, and function" states core endurance test to be the most reliable method of measuring core stability [2]

Chris Sharrock, Jarrod Cropper, Joel Mostad, Matt Johnson, and Terry Malone, conducted a study "To objectively evaluate the relationship between core stability and athletic performance measures in male and female collegiate athletes" stating that Power, speed and agility are three components in most sporting events.

Hence the present study focuses on correlation of core endurance and athletic performance in basketball players using McGill core endurance test for core endurance and 40-yard

dash t -test and medicine ball throw test for speed agility and power respectively. Players between 18-25 years with sample size of 30 in a metropolitan city were taken. Results were interpretated using Pearson's correlation coefficient in spss software

The study showed moderate correlation between core endurance test and T-test whereas right bridge test moderately correlated with medicine ball throw test. Atsushi Imai and Koji Kaneoka, showed significant correlations with the trunk endurance plank tests with running performance tests in badminton players, While the current study showed weak to no correlations.

Notably, the T-test demonstrated a higher correlation than other performance tests. The T-test requires sprinting and change of direction and can assess endurance ability as well as anaerobic capacity. These results indicate that core endurance tests may be related to running performance, and therefore may be useful tools for assessing abilities of athletes who require intermittent and continual endurance performance and change of direction, such as soccer and basketball players. Hence, we concluded that significant but not strong relationship between core endurance and athletic performance.

A variety of factors can affect the correlation values including the tests used to measure core endurance are not specific to speed agility and power or there is no correlation between the two in basketball players training. The term core endurance can be stated as muscles of the torso that can sustain prolonged contractions (i.e., muscle endurance reducing the chance of injury or to maintain sport performance. Therefore, greater (i.e., longer) core muscle endurance should show a better athletic performance. Considering the reliability and validity of McGill's core stability tests, another reason for the weak correlations between core endurance and athletic performance is that, all of the performance measures in this study were single repetition, quick, high intensity movements lasting 5-10 seconds. As, McGill's core endurance test is an isometric muscle contraction, a comparison of these two tests cannot be made because the high intensity quick movement usually involve primarily fast-twitch muscle fibers, whereas the core strength/stability tests requiring isometric hold focus more on slow-twitch muscle fibers. However, excessive movement/ instability of the trunk, particularly trunk rotation, interfere with the efficient transfer of work during sports activities. Thus, the control of trunk movement is important for better efficacy of movement during running as well as sprinting performance. Thus, a core stability is required for athletic performance.

Also, Trunk abilities required for the trunk endurance tests and performance test are different. Thus, trunk endurance tests, may not appropriately assess trunk function required for athletic performance. Also, results may have been different due to factors like athletes were fatigue, environmental conditions, sportswear and lack of encouragement.

Correlations did slightly improve when the four core strength tests were added together. Even then speed showed no correlation to core endurance. Because the core muscles work synergistically with one another during movement, it is difficult to single out one single aspect of core endurance and term it responsible for any given sporting performance. The core works together as a unit and, thus, should be analyzed as a unit which concludes a significant correlation between the two.

CONCLUSION

Although the significant correlations between core strength/stability were weak to moderate, they were still significant. This suggests that core endurance does contribute to athletic performance and should be taken into consideration in basketball players training.

Clinical Implication

This study helped us to identify the component of athletic performance which is more likely to cause injury to the spine if vigorous training of the same is done in the presence of a weak core. With this study injuries could be prevented in future by making sure that the athlete has good core stability while vigorous training of a component of athletic performance highly correlated with the core.

It is possible that performance in specific sports is highly correlated to specific measures of athletic performance, while other sports demonstrate no relationship. Therefore, to achieve excellent performance in certain sports may require varied levels of core stability.

Core endurance is necessary for optimal sport performance and should not be dismissed. Determination of the role of core strength/stability requires additional research and sport-specific means of determining its effectiveness.

Limitations

The study was performed over a small sample size
Only male athletes with a basketball training period of 6m-1 year aged 18-25 were taken in consideration.
Performance test were not specific to basketball players.

Suggestions

Further researches should focus on -
Using a large sample size
Including female basketball players

Athletic Performance should be judged on the basis of match performance including stamina, no of goals shot and other athletic attributes.

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