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Determining relationship between core muscle strength and performance parameters of sportspersons at secondary school level

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Abstract

Core muscle ability is detrimental in skill-based fitness for athletes. Core stability and balance are critically important almost for all kinds of sports and activities. Having a strong and stable core muscle can help perform better and avoid injury. Nowadays, physical and technical experts, coaches and athletes at home and abroad have incorporated core strength into strength training, which has a certain effect on the special achievements of each project. Although the media portrays these ideas as truth, the scientific community remains uncertain as to the relationship between core stability and athletic performance. The purpose of the present study was to determine the relationship between core muscle strength and performance parameters of sportspersons at secondary school level of Shivamogga District. The subjects for the present investigation were 41 male inter school level sportspersons from various schools of Shivamogga District, Karnataka. The muscle strength was assessed through 3 tests- The forward medicine ball toss test, the backward medicine ball throw test and the rotational medicine ball throw test. Performance parameters include the following- Power, Speed, Agility, Coordination, Reaction time, Balance, Skill levels and Sports achievement. Pearson product moment correlation coefficient was used to examine the relationship between core muscle strength and selected performance parameters. Core muscle strength is negatively correlated with skill levels of high school sportspersons. Core muscle strength is negatively correlated with sports achievement of high school sportspersons. Core muscle strength is positively correlated with power of high school sportspersons.

Keywords: Core strength, performance parameters, skill levels, sports achievement, correlation, high school, core muscles

Introduction

Different analysts define their own meaning for the term high performance in the field of sports. But top performance in sports can be said to involve a high or outstanding level of ability to perform to reach a goal. Physical fitness is the ability of the physical components to develop functional capacity and participate in activities with their cooperation. As physical fitness is one of the most important aspects, it is necessary to place more emphasis on it. Variety of exercises are accomplished to increase physical fitness.

Performance of a player in sports mainly depends of four aspects. These four elements, namely – technical training, physical fitness development, mental training and recovery play a very important role in sports. In addition to this, there are also some other specific aspects that we have to perform according to the sport. The above factors are of great importance for achieving high performance in sports. These work together to enable athletes to perform well. For example, endurance plays a major role in running a marathon, while weight lifting plays an important role in throwing, striking and jumping events. Different parts of the body are covered for each activity.

Core muscle ability is detrimental in skill-based fitness for athletes. Career of sportspersons can be successful through involvement in a variety of activities to develop skill-based fitness. But collaborating is just as important as having a solid set of skills. For example, cardiovascular fitness is needed to increase endurance, upper back and lower back coordination, and body balance. Core muscles give proper shape to the body, gives strength to the body, and helps to make different types of movements of the body with the strength of the abdominal muscles.

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Core stability and balance are critically important almost for all kinds of sports and activities (Nurten & Esin, 2019) [7]. The core is the trunk and hip group, along with the spine, abdominal viscera, and core muscles that balance the upper and lower body and distribute the right amount of weight between the two parts. Mainly, the core muscles perform two functions- Avoids overloading the spine and the lower body and upper torso share the falling force.

Many different models of the core anatomy have been proposed in the literature that attempt to explain the complex interaction between the muscular and neural elements. These models often differ depending on the context in which they were developed. Some researchers have described the core as a double walled cylinder with the diaphragm as the roof, abdominals as the front, paraspinals and gluteals as the back, and the pelvic floor and hip musculature as the bottom (Richardson, *et al.*, 1999) [4]. Researchers with a specific interest in sports suggest that the core includes all the musculature between the sternum and knees, with a specific focus on the low back, hips, and abdominals (Fig, 2005) [5]. It has also been suggested that the core should include the muscles of the shoulder and pelvis because they are critical in the transfer of forces across the body (Gracovetsky, Farfan & Lamy, 1981) [6].

Having a strong and stable core muscle can help perform better and avoid injury. If we look at the relationship between core muscle ability and physical fitness in athletes, it can be said that these two factors are interdependent, because if core muscles are strong enough to be able to perform effectively in sports, it is also helpful to stay away from injury to perform well most of the time. It is believed among the experts that the core strength training is one of the most important components in the field of power and conditioning in order to improve athletic performance and to prevent the risk of injury (Sato & Mokha, 2009) [8]. Core training focuses on strength and power development of local and global muscles which work together to stabilize the spine (Nurten & Esin, 2019) [7].

Muscle strength and stability together can be said to be abilities of core. Due to the strength of the abdominal and back muscles, the body is able to maintain stability without falling, and the dependence of the abdominal and back muscles is important to engage effectively in daily activities and sports activities.

Nowadays, physical and technical experts, coaches and athletes at home and abroad have incorporated core strength into strength training, which has a certain effect on the special achievements of each project. The main role of core strength in sports is to generate strength, transmit power and control power, especially for systemic sports projects (Yonghua, 2017) [1]. Core training is increasingly recognized by industry experts and coaches as an important part of athlete strength training. At present, core strength training has become a hot topic in physical training (Li, Wand & Di, 2019) [2].

The mantra of “core training” makes athletes believe that enhanced core stability will improve their performance on the field or court. Although the media portrays these ideas as truth, the scientific community remains uncertain as to the relationship between core stability and athletic performance. This relationship may prove challenging to define because functional and core demands are typically sport or position specific and many questions, such as which element of core stability is most essential to performance, remain unanswered (Sharrock, *et al.*, 2011) [3].

Objective of the study

The purpose of the present study was to determine the relationship between core muscle strength and performance parameters of sportspersons at secondary school level of Shivamogga District.

Procedure

The subjects for the present investigation were 41 male inter school level sportspersons from various schools of Shivamogga District, Karnataka. Their age ranged between 14 to 16 years. All the subjects participated at taluk level and above competitions during 2021-22. The adolescent sportspersons belonged to four sporting events- volleyball, handball, football and badminton. Details about subjects are provided in table 1.

Table 1: Details about subjects selected for the study

Sl. No.	Event	No. of. subjects
1	Handball	12
2	Volleyball	12
3	Football	12
4	Badminton	5
Total subjects		41

The muscle strength was assessed through 3 tests- The forward medicine ball toss test, the backward medicine ball throw test and the rotational medicine ball throw test. Standard testing protocol was observed for the present investigation. The medicine ball used in the present study was of 4 kilograms weight. Brief description of each test is given as below:

- **The forward medicine ball toss test (Sharrock, *et al.*, 2011) [3]:** The individual will be given instructions to sit upright on a pad that is put on the floor in a standard posture, which is defined as 90 degrees of knee flexion and a neutral trunk position. At the level of the nipples, a medicine ball with a preset mass is held at the chest. The intended assignment required the participants to toss the medicine ball with two hands in a motion equivalent to a chest pass. Prior to the toss, the person is told not to pump their arms or rock back; this is done to limit muscular contractions and momentum throughout the activity. After the initial toss, the individual is told not to throw again, yet they do not weaken their muscles. The throw's distance is expressed in inches.
- **The backward overhead medicine ball throw test (Stockbrugger and Haennel, 2003):** The participant is told to stand in a predetermined, designated posture with their weight evenly distributed between their feet. The medicine ball is held at a height that is around knee-height. The individual is then told to bend their knees while simultaneously lowering the medicine ball towards their ankles. At this moment, the subject extends the legs and subsequently the back, lifts the shoulders, and flexes the shoulder to start the throw and allow the medicine ball to be thrown over the head as far as possible. The throw's distance is expressed in inches.
- **The rotational medicine ball throw test (Shinkle, *et al.*, 2012):** When describing this throw, the subject was positioned at the end of a regular adjustable weight lifting bench. The individual was told to keep his feet level on the ground the whole time he was throwing. The throwing motion began with the torso rotated to the right side and the hips and abdomen flexed forward. A

maximum contraction was started in the direction of the contralateral side in order to toss the medicine ball.

The performance parameters were assessed through following tests given in table 2. The skill related physical

fitness parameters selected in the study was assessed through standardized tests. The skill levels of sportspersons was assessed through skill tests given below for different games. The sports achievement was assessed through points awarding system developed for this purpose.

Table 2: Details on testing protocols selected for performance parameters in the study.

Sl. No.	Components	Names of tests	Equipment	Units of measurement
	Power	Vertical jump test	Marking powder	Centimeters
	Speed	30 meters dash	Stop watch, cones	Seconds
	Agility	Illinois Agility Test	Stop watch, cones	Seconds
	Coordination	Alternate hand ball toss test	Tennis ball, stop watch, flat wall	Repetitions
	Reaction time	Reaction time test	Reaction time tester	Milliseconds
	Balance	Y balance test	Y balance tester	centimeters
	Skill levels	Russel Lounge Volleyball test	Volleyballs, court, plain wall, stop watch	Volley counts, service points
		Lockhart and Mc. Pherson Badminton test	Racket, shuttle, plain wall, stop watch	Counts
		Cornish Handball test	Plain wall, Handballs, markings	Scores
		Mc Donald Soccer test	Football, Plain wall, stop watch	Kick counts
	Sports achievement	Points awarding system	--	Points

Descriptive statistics Mean and Standard Deviation was used to establish the normalcy of data. Pearson product moment correlation coefficient was used to examine the relationship between core muscle strength and selected performance parameters. Rule of Thumb for Interpreting the Size of a Correlation Coefficient given by Hinkle, Wiersma

& Jurs, (2003) [9] was used for interpreting results on correlation in the present study.

Results of the study

Descriptive results on core muscle strength and selected performance parameters are given in table 3 as below.

Table 3: Descriptive results of core muscle strength tests and selected performance parameters

	Mean	Std. Deviation	N
Forward medicine ball toss	4.10	1.15	41
Backward medicine ball throw	5.31	1.34	41
Rotational medicine ball throw	4.28	.68	41
Power	38.05	7.29	41
Speed	5.20	.33	41
Agility	18.95	.97	41
Coordination	32.80	5.02	41
Reaction time	.37	.03	41
Balance	67.83	5.41	41

Table 3 makes it clear that the data obtained are normally distributed with acceptable homogeneity of sample. The raw data was further treated with Pearson product moment

correlation coefficient to assess the relationship between the core muscle strength and selected performance parameters. The results are given in table 4.

Table 4: Summary of correlation between core muscle strength and selected performance parameters of high school level sportspersons.

		Forward	Backward	Rotational
Power	Pearson Correlation	.336*	-.094	.184
	Sig. (2-tailed)	.032	.557	.248
	N	41	41	41
Speed	Pearson Correlation	-.281	-.026	-.235
	Sig. (2-tailed)	.075	.870	.139
	N	41	41	41
Agility	Pearson Correlation	.109	.119	.286
	Sig. (2-tailed)	.497	.458	.070
	N	41	41	41
Coordination	Pearson Correlation	.161	.064	.206
	Sig. (2-tailed)	.316	.690	.197
	N	41	41	41
Reaction time	Pearson Correlation	.049	.225	.035
	Sig. (2-tailed)	.762	.158	.828
	N	41	41	41
Balance	Pearson Correlation	-.292	.202	.020
	Sig. (2-tailed)	.064	.206	.904
	N	41	41	41
Skill test	Pearson Correlation	-.470**	-.020	-.039
	Sig. (2-tailed)	.002	.901	.809
	N	41	41	41
Sports achievement	Pearson Correlation	-.336*	-.336*	-.355*
	Sig. (2-tailed)	.032	.032	.023
	N	41	41	41

From table 4 it is apparent that there is low negative correlation between forward medicine ball throw ability and skill performance at 0.01 level of significance; there is low negative correlation between forward medicine ball throw ability and sports achievement at 0.05 level of significance; there is low positive correlation between forward medicine ball throw ability and power at 0.05 level of significance; there is low negative correlation between backward medicine ball throw ability and sports achievement at 0.05 level of significance; and there is low negative correlation between rotational medicine ball throw ability and sports achievement at 0.05 level of significance.

Discussion

The findings of the study obtained here is observed to be influenced by growth and development stages of adolescents. Since the physical growth is still in progress, the results cannot be generalized.

Conclusion

On the basis of the results of the study the following conclusions are drawn:

- Core muscle strength is negatively correlated with skill levels of high school sportspersons.
- Core muscle strength is negatively correlated with sports achievement of high school sportspersons.
- Core muscle strength is positively correlated with power of high school sportspersons.

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