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Exploring association between core muscle stability and performance parameters of sportspersons at inter college level

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Abstract
Core stability has been studied for more than 40 years and has become fundamental to training programmes for performance enhancement in diverse sporting codes. Since the early 1980s, core training, especially core stability training, has been the subject of many studies. However, the two fundamental concepts of core strength and core stability have generally not been distinguished. The proposed protection against injury and improved athletic performance from core stability training has been the subject of many research studies and review papers. Research on core stability exercise programmes and the associated improvement of athletic performance is limited. While studies demonstrated the positive effect of core training on the physical strength of athletes, they show different results regarding the effect on sport-specific performance. The purpose of the present investigation was to explore the association between core muscle stability and performance parameters of sportspersons at college level. The subjects for the present investigation were 41 male inter college level sportspersons from various colleges of Shivamogga District, Karnataka. The core muscle stability was assessed through 3 tests by McGill's torso muscular endurance test battery (McGill, 2015) [17]. Trunk Flexor Endurance Test, Trunk Lateral Endurance Test and Trunk Extensor Endurance Test. 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. Pearson product moment correlation coefficient was used to examine the relationship between core muscle strength and selected performance parameters. The core muscle ability of inter collegiate level sportspersons is not significantly related to selected performance parameters under investigation.

Keywords: Core muscle stability, inter-collegiate, sportspersons, sports skills, sports achievement, skill related physical fitness, tests

Introduction
A major topic of interest in sport events is the development of effective training methods to improve the performance of athletes (Dong, Yu & Chun, 2023) [23]. The most significant aspects impacting an athlete's competitive abilities are his or her physical fitness and skills. However, prior research has mostly focused on anthropometric (e.g., length, wingspan, etc.) as well as physiological performance (e.g., agility, endurance, speed, and strength) (Luo, *et al*., 2022) [9]. Physical fitness is an essential tool for excelling in sports. Muscles, mainly around the abdomen, play an important role in physical fitness. This is because the muscles of the abdominal area help connect the two parts of the body and provide better strength and stability. In order to have good strength and stability, systematic training for enhancement of physical strength or fitness needs to be given to those specific muscles. In order to perform well in any sport, physical strength, mental strength, and stress management are the most important aspects.
Scientific training is among the most critical factors that determine athletes' overall performance (D'Isanto *et al*., 2019) [2]. Athletes constantly improve their skills through strength and conditioning programs (Viru & Viru, 2000; Reed *et al*., 2012) [14, 12]. From among the components of physical fitness such as muscular strength, muscular endurance, cardiovascular fitness, flexibility, body composition, balance, coordination, power, speed,

and reaction time, the involvement of abdominal and back muscles plays a very important role in performing these components well. Core training, which has been receiving attention recently, has been reported to have positive effects on daily life and rehabilitation (Stevens, 2007) [13]. The core muscles including the abdominal and back muscles play an important role in sports participation. While walking, sitting, running, or jumping, every movement involves the core muscles. So for games that demand movement like football, handball, badminton, and volleyball, core muscles should be strong for these games and should be helpful for movement. During the sports process, the physical characteristics and regulators of each player undergo many types of changes, such as muscle strength, regulation of breathing rate, increased heart rate and temperature changes, which are closely related to this physical performance.

Strong core muscles are essential for runners, helping them train their upper and lower bodies efficiently. Muscles that are not strong cause the body to tire quickly. Muscles with less strength are more prone to injury, and because of this, they are unable to perform at their best. The core muscle is a key factor that stabilizes the spine and trunk during exercise, while maximizing leg balance and athletic performance. A strong core muscle not only makes the body more efficient, but also plays a key role in performing an integrated motor function that delivers the force generated in the trunk and pelvis to the limbs. It can also improve physical balance and develop neural control, the functions of muscles, coordination skills, proprioception, and other types of muscular strength (Kibler, Press & Sciascia, 2006; Willson, *et al*., 2005) [8, 15].

The core muscle consists of the muscles in the trunk and hip region. Along with the spine, abdominal viscera, and core muscles balance the upper and lower body and distribute the right amount of weight between the two parts. The core is a unit formed by the waist, pelvis, and hip. As the intermediate ring of the human body, the term specifically refers to the area below the shoulder joint, including the pelvis, and above the hip (Fredericson & Moore, 2005) [5]. The core muscles perform two main functions- 1) Avoids overloading the spine; and 2) The lower body and upper torso share the falling force. Strong and stable core muscle can aid in better sports performance and avoid injury.

Core strength is the strength of the abdominal and back muscles. The stronger the muscles, the better the performance, and therefore the ability to perform at a higher level in almost all sportspersons. Competitive sports demand higher requirements for the body. Athletes need more complex and higher load core exercises to promote performance (Faries & Greenwood, 2007) [4]. Core stability is the ability of the abdominal and back muscles to maintain balance. Core stability improves flexibility, enabling higher levels of performance. Akuthota and Nadler (2004) [1] defined core strength as the involvement of the anatomical structures around the lumbar spine in the maintenance of functional stability. Knowledge of functional core stability has led to the ability to classify and identify the components that affect core muscle function. The core muscles are important for dynamic stabilisation (Huxel Bliven & Anderson, 2013) [7].

Core stability, on the other hand, refers to the ability of passive and active stabilisers in the lumbopelvic region to maintain reliable trunk and hip posture, stability, and control during static or dynamic movements. It is more vital than strength to a certain extent (Zazulak *et al*., 2007) [16].

It is believed that a strong core allows an athlete the full transfer of forces generated with the lower extremities, through the torso, and to the upper extremities and sometimes an implement (McGill, 2004) [10]. A weak core is believed to interrupt the transfer of energy, resulting in reduced sport performance and risk of injury to a weak or underdeveloped muscle group. Training the core has become popular among strength coaches and personal trainers as a means to improve performance and reduce the chance for injury despite the lack of research to support such findings (Linderman, *et al*., 2009) [11].

Core stability has been studied for more than 40 years and has become fundamental to training programmes for performance enhancement in diverse sporting codes. Since the early 1980s, core training, especially core stability training, has been the subject of many studies. However, the two fundamental concepts of core strength and core stability have generally not been distinguished (Hibbs, *et al*., 2008) [6]. The proposed protection against injury and improved athletic performance from core stability training has been the subject of many research studies and review papers. Research on core stability exercise programmes and the associated improvement of athletic performance is limited. While studies demonstrated the positive effect of core training on the physical strength of athletes, they show different results regarding the effect on sport-specific performance (Dong, Yu & Chun, 2023) [3].

Objective of the study

The purpose of the present investigation was to explore the association between core muscle stability and performance parameters of sportspersons at college level.

Procedure

The subjects for the present investigation were 41 male inter college level sportspersons from various colleges of Shivamogga District, Karnataka. Their age ranged between 22 to 25 years. All the subjects participated at Kuvempu University inter collegiate competitions during last three years. The 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 core muscle stability was assessed through 3 tests by McGill's torso muscular endurance test battery (McGill, 2015) [17]. The three tests are briefly described as below.

- **Trunk Flexor Endurance Test:** The subject first assumed the beginning posture while seated, with the hips, knees, and second toe all in alignment. The subject was told to cross his arms across the chest, touching each hand to the opposing shoulder, rest on a board that was tilted 60 degrees, and maintain a neutral head posture. The subject were instructed to press their shoulders into the board and hold this "open" stance for

the duration of the test once the board has been taken out. To keep their spine flat to neutral, the subject was told to contract their abdominals. During the exam, the back was never permitted to arch. The feet was stabilized or the toes were secured beneath a strap in certain cases. The objective of the test was to maintain this 60-degree posture for the longest amount of time feasible without the assistance of back support. The subjects were encouraged to try this posture before the test. Administration and test protocol: The subject remains hung at a 60-degree angle as the investigator began the timer and pushes the board back roughly 4 inches. When the trunk posture noticeably changed, the test was called off. An eye was kept out for a change in the spine's neutral position or an increase in the low-back arch. The backrest was not allowed to be touched by any part of the back.

- **Trunk Lateral Endurance Test:** The correct body position was described after outlining the test's goal. The subjects were in the beginning position on their side with their legs extended and their feet stacked or in a tandem configuration. The subjects were asked to position their upper arm on their side and lower arm below them. When the subject was prepared, they were told to take a complete side-bridge posture, keeping their legs extended and their feet flat on the floor. With the forearm facing out, the elbow of the lower arm was placed squarely beneath the shoulder, and the upper arm was lying either across the chest or along the side of the body. The torso was aligned straightly with the hips lifted off the mat. The feet of subjects and the elbow or forearm of the lower arm were the sole things holding up the subject's body. To maintain this stance as long as possible was the objective of the test. When the subject violated the position, the test was over. The subject were encouraged to test out this posture before the test. As the client positioned themselves in the side-bridge position, the investigator started the timer. When the trunk posture noticeably changed, the test was called off. The neutral spine's deviation in an effort to keep balance and stability, the hips were not allowed to move forward or backward. Total time elapsed were taken as their score.
- **Trunk Extensor Endurance Test:** The correct body position was described once the test's purpose was explained. The client was lying on their back with their iliac crests positioned at the edge of the table and their upper extremities supported by their arms that are either on the ground or a riser. A strap was used to secure the client's lower legs to the table as they bear the weight of their upper bodies. The investigator used his own body weight. To remain horizontal and prone for the longest amount of time was the test's objective. The test was finished when the subject crossed the horizontal line. Before taking the test, the subjects were suggested to practice this stance. The tests were administered according to procedure when ready, the subject crossed his arms over his chest and elevated or stretched their torso till it was parallel to the floor. Once the subject was in this posture, the stopwatch was started. When the subject was unable to continue in the position, the test was terminated. Total time elapsed were taken as their score.

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
1.	Power	Vertical jump test	Marking powder	Centimeters
2.	Speed	30 meters dash	Stop watch, cones	Seconds
3.	Agility	Illinois Agility Test	Stop watch, cones	Seconds
4.	Coordination	Alternate hand ball toss test	Tennis ball, stop watch, flat wall	Repetitions
5.	Reaction time	Reaction time test	Reaction time tester	Milliseconds
6.	Balance	Y balance test	Y balance tester	centimeters
7.	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
8.	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) [18] was used for interpreting results on correlation in the present study.

Findings of the study

Descriptive results on core muscle stability and selected performance parameters of inter-collegiate level sportspersons are given in table 3 as below.

Table 3: Descriptive results of core muscle strength tests and selected performance parameters of inter-collegiate level sportspersons

	Mean	Std. Deviation	N
Trunk flexor endurance	34.56	5.80	41
Trunk lateral endurance	32.60	4.65	41
Trunk extensor endurance	30.59	3.47	41
Skill test	.86	.50	41
Sports achievement	.80	.59	41
Power	33.02	7.65	41
Speed	4.84	.37	41
Agility	17.89	1.06	41
Coordination	34.31	10.74	41
Reaction time	.38	.06	41
Balance	66.78	11.75	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 stability and selected performance parameters of inter-collegiate level sportspersons. The results are given in table 4.

Table 4: Summary of correlation between core muscle stability and selected performance parameters of inter-collegiate level sportspersons.

		Trunk flexor endurance	Trunk lateral endurance	Trunk extensor endurance
Skill test	Pearson Correlation	-.171	-.052	-.047
	Sig. (2-tailed)	.284	.746	.771
	N	41	41	41
Sports achievement	Pearson Correlation	-.057	.203	.202
	Sig. (2-tailed)	.725	.204	.206
	N	41	41	41
Power	Pearson Correlation	-.097	-.049	.122
	Sig. (2-tailed)	.546	.761	.446
	N	41	41	41
Speed	Pearson Correlation	.159	.080	-.060
	Sig. (2-tailed)	.321	.618	.708
	N	41	41	41
Agility	Pearson Correlation	-.083	-.027	.231
	Sig. (2-tailed)	.607	.867	.147
	N	41	41	41
Coordination	Pearson Correlation	-.114	-.029	-.008
	Sig. (2-tailed)	.480	.858	.960
	N	41	41	41
Reaction time	Pearson Correlation	.069	.004	.201
	Sig. (2-tailed)	.670	.978	.208
	N	41	41	41
Balance	Pearson Correlation	-.116	.082	.069
	Sig. (2-tailed)	.470	.612	.668
	N	41	41	41

There is no significant relationship between core muscle stability and various performance parameters of inter collegiate level sportspersons in the present investigation.

Discussion

A significant positive correlation between core muscle stability and selected performance parameters was expected in sportspersons at inter collegiate level. From the results of the study it is found that there exists no significant relationship between theses parameters. The results points out the fact that the development of core muscle ability was totally untouched by the athletes as well as physical educationists.

Conclusion

The core muscle ability of inter collegiate level sportspersons is not significantly related to selected performance parameters under investigation.

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