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Relationship Between Trunk Endurance and Explosive Power Performances

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ABSTRACT

Aim: The aim of the research was to examine the relationships between trunk isometric endurance and explosive power performances.

Material and Method: Twenty-nine male students (age: 22.48±1.18 years) participated in the study. The endurance tests were determined as prone plank and Biering-Sorensen tests evaluating the anterior and posterior parts of the trunk. The explosive power performances were evaluated using 20 m sprint, T-Line agility and counter movement jump test. The relationships between trunk endurance tests and performance tests were analyzed using the Pearson correlation coefficient.

Results: The prone plank test score provided a moderate negatively correlation with the 20 m sprint and T-Line agility (r= -0.636; r= -0.578, respectively) and low positively correlation with the CMJ test (r= 0.458). Sorensen test score was a moderate negatively correlated with the 20 m sprint and T-Line agility (r= -0.564; r= -0.693, respectively) and low correlated with CMJ test (r= 0.376).

Conclusion: There is a moderate and low level significant correlation between trunk endurance scores and athletic performance tests. It can be said that especially explosive power scores may be affected by the endurance of the body; however it can be said that more research should be planned in order to have a detailed understanding.

Key Words: Core endurance, Explosive power, Plank, Sorensen.

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INTRODUCTION

Trunk strength and endurance are needed in terms of athletic performance, especially during explosive force elements such as sprinting and jumping (Nesser et al., 2008). The relationship between trunk endurance and explosive power components is thought to be important. The "core", also called the lumbopelvic-hip complex, is defined as a 3-dimensional anatomical box surrounded by muscles (Oliva-Lozano and Muyor, 2020).

When people practice locomotor movements such as walking, running, and swimming, they produce rhythmic motor patterns (Zehr, 2005). The central nervous system, which is the locomotor movement control mechanism, prepares the muscles by regulating the activation process required for the movement pattern and stabilizes the entire central muscular system (Kolář et al., 2012). The proximal segments in the core region play a key role in developing proper strength in the distal joints and maintaining bone positions that minimize internal loads on the joints (Kibler et al., 2006). In order for this system to work without interruption, the muscles must withstand the tension that occurs in a certain period of time and compensate for the external force. In this way, it can be ensured that the highest efficiency can be obtained in the shortest time.

Trunk endurance is essential for proper muscle activation and correct positioning during an activity. It is stated that adequate trunk muscle endurance contributes to spinal stability and therefore, it may be important for many of the complex movements performed by athletes (Evans et al., 2007). It can be said that one of the most important factors in ensuring spinal stability in explosive power performances where maximum efficiency is expected in the shortest time is the endurance of the trunk.

It is known in the literature that trunk endurance performance and various athletic performance elements have been examined (Okada et al., 2011; Imai and Kaneoka, 2016). It is seen that various isometric trunk endurance tests are used in these studies and are associated with many performance outputs. The aim of this study was to investigate the relationship between the endurance scores of the dorsal and ventral power lines of the trunk and various explosive force performances.

MATERIAL AND METHOD

Twenty-nine male members (age: 22.48±1.18 years) participated in the study. Ethic committee approved this study for research on human participants. All of the participants were previously informed about the testing procedures and any known risks and provided their own written informed consent.

Trunk Endurance Tests

Prone plank test was used to evaluate anterior and lateral central column muscle endurance. The test was terminated when the participant moved his torso 5 cm above or below the horizontal line and the time was recorded in seconds (Imai et al., 2016). Biering-Sorensen test was used to measure the endurance performance of the back extensor muscles (erector spinae and multifidus) (Biering-Sørensen, 1984).

Explosive Power Tests

In the study, 20 m sprint, counter movement jump and T-line agility tests were used to determine the explosive force scores. Participants were allowed 10-15 minutes for individual warm-up prior to the test, including 3-5 minutes of jogging and post-jogging and dynamic movements for the muscles associated with the sprint (Owen et al., 2014). These tests were completed on the same day and one of them was repeated twice. The test sequence was applied from short to long completed (CMJ, 20 m sprint and T-line agility, respectively).

Statistical Analysis

Descriptive statistics were calculated for all experimental data. In addition, all data were examined by the test of normal distribution (Shapiro Wilk) before any further analysis. The Pearson correlation coefficient (r) was used to determine the relationship between linear running and COD speed performances. SPSS version 23.0 was used for statistical analysis. Descriptive information was shown as mean, standard deviation (SD), and minimum-maximum. The level of significance was set at $p<0.05$.

RESULTS

Descriptive information was shown as mean, standard deviation (SD), and minimum-maximum (Table 1). Trunk endurance scores (plank and Sorensen) and athletic performance tests was shown in Table 2.

Table 1. Descriptive statistics of participants

Parameters	Mean	SD	Min	Max
Age (year)	22.48	1.18	21	26
BM (kg)	75.40	8.37	57.9	94.4
Height (cm)	178.44	5.06	169	187
BFR (%)	14.81	4.06	4.9	22.3
BMI (kg/m^2)	23.36	3.37	12.8	28.8

(BM: Body Mass; BFP: Body Fat Percentage; BMI: Body Mass Index)

Table 2. Descriptive statistics of trunk endurance and athletic performance scores

Parameters	Mean	SD	Min	Max
20m sprint (sec)	2.95	.09	2.76	3.2
T-Line agility (sec)	10.24	.85	8	11.9
CMJ (cm)	38.33	3.95	28	46
Prone plank (sec)	103	43.98	40	234
Sorensen (sec)	136.06	46.15	68	233

(CMJ: Counter Movement Jump)

A number of significant correlations were identified between trunk endurance and the explosive power performance measures (Table 3).

Table 3. Trunk endurance and explosive power performance correlations

	20 m sprint	T-Line agility	CMJ
Prone Plank	-0.636**	-0.578**	0.458*
Sorensen	-0.564**	-0.693**	0.376*

(CMJ: Counter Movement Jump; *p <0.05; **p<0.01)

The prone plank test score provided a moderate negatively correlation with the 20 m sprint and T-Line agility (r= -0.636; r= -0.578, respectively) and low positively correlation with the CMJ test (r= 0.458). Sorensen test score was a moderate negatively correlated with the 20 m sprint and T-Line agility (r= -0.564; r= -0.693, respectively) and low correlated with CMJ test (r= 0.376) (Figure 1).

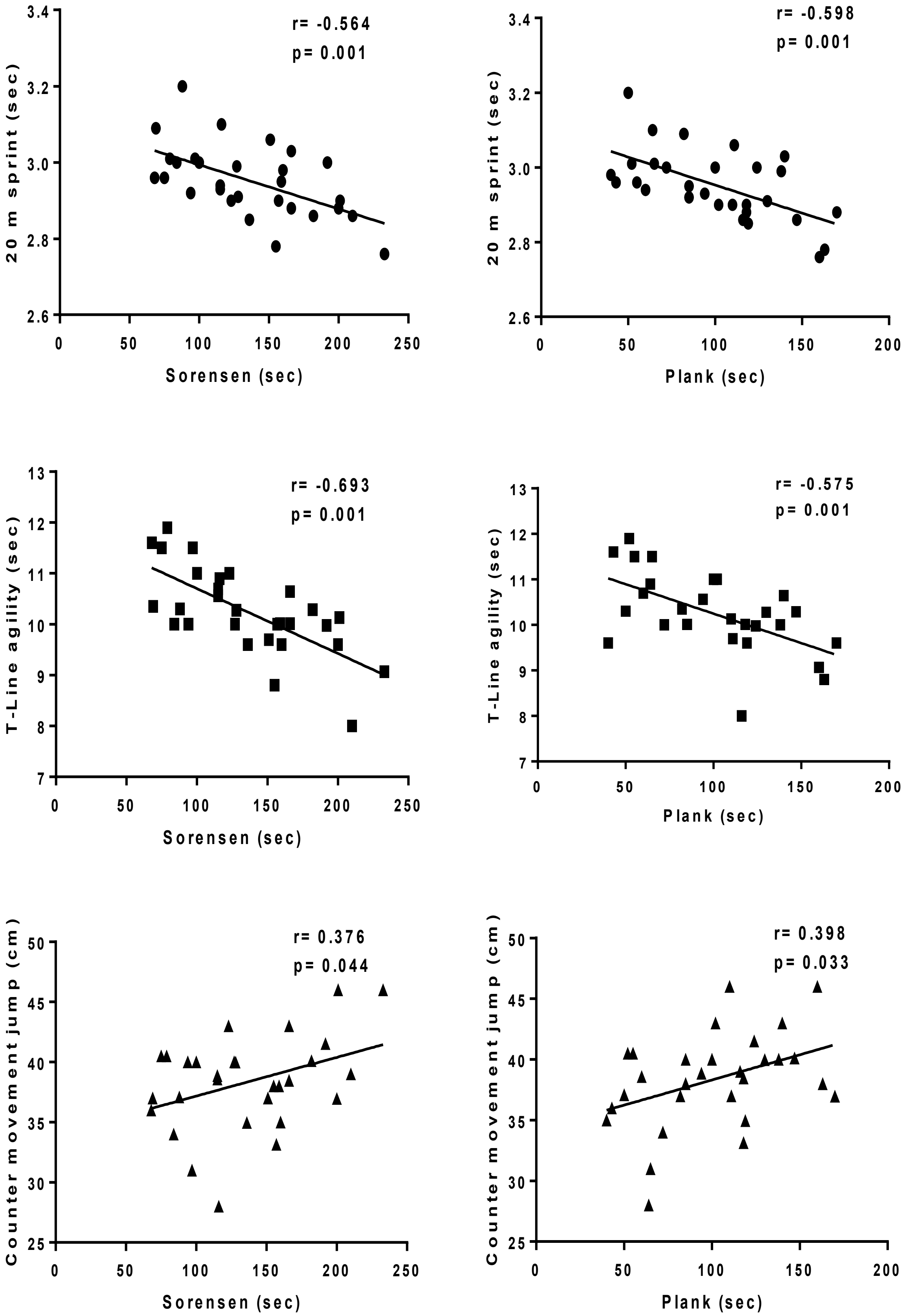

Figure 1. The relationship between trunk endurance and explosive power performances

DISCUSSION

The ventral and dorsal endurance performance of the trunk was evaluated in the study. The findings obtained in the study showed that there was a significant correlation between the trunk endurance scores and some selected explosive force performances. The trunk endurance scores were significantly moderate negative correlated to 20 m sprint, T-Line agility and low positive correlated to CMJ height ($p<0.05$).

The interaction between core strength - stabilization capacity and athletic performance is a controversial issue. At this point, it is stated that many more researches are needed in order to reach correct conclusions (Hibbs et al., 2008). However, considering that the core is the starting point and management center of movements, it can be thought that it may affect athletic performance. In addition, it is stated that the core zone-based training should be considered in terms of injury prevention potential rather than performance improvement (Huxel Bliven and Anderson, 2013).

It is known that the pelvic girdle and lumbar spine are reflexively stabilized before limb movements begin. Researchers have determined that deep layer muscle groups contract before any limb movement (Hodges and Richardson, 1997). It is stated that the transversus abdominis muscle is activated approximately 30 milliseconds before any shoulder movement and 110 milliseconds before the leg movement (Fredericson and Moore, 2005). Trunk strength plays an important role in the spinal stabilization process. Quick and sustainable stabilization will provide an advantage in activities where maximum movement speed is required. In this study, it was determined that endurance scores and athletic performance scores show a relationship in this direction.

It is mentioned that there is a moderate relationship between core stabilization ability and sportive performance scores. (Nesser et al., 2008). Imai et al. (2016) found that trunk endurance plank tests were positively correlated with the Yo-Yo intermittent recovery test, the Cooper test, and the step 50 agility test (Imai et al., 2016). In the literature, it is stated that there is a link between core stabilization and athletic performance, but more scientific research is needed (Sharrock et al., 2011). It is also stated that sports-specific tests should be applied to better understand the relationship between core ability and athletic performance tests (Nesser et al., 2008). When the findings of this study are evaluated in terms of the speed of movement, it can be stated that the trunk endurance has a significant effect on the explosive strength scores.

CONCLUSION

There is a moderate and low level significant correlation between trunk endurance scores and athletic performance tests. However, it is thought that no definite conclusion can be reached regarding direct interaction between core ability and athletic performan scores. It is thought that especially sport-specific movement patterns such as throwing, jumping, throwing should be associated with athletic performance. For this reason, it can be said that more research is needed to examine core exercise practices and athletic performance parameters.

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