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The effects of Core Training on speed, anaerobic power and agility in 11–14 age wrestlers

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Abstract

Background. Core exercises improve the central muscles of the human body such as the spine, abdomen, hip and pelvic muscle groups. It is also known that a strong core will provide a transfer of force from the lower extremity to the upper extremity.

Objective. The aim of this study is to examine the effect of including 8-week core training program in wrestling training on speed, anaerobic power and agility performance in wrestlers aged 11-14.

Methods. 24 wrestlers between the ages of 11-14 participated in this study. Participants were divided into two homogeneous groups of 12, considering their age and body weight. One group formed the experimental group (EG; n = 12) and the other formed the control group (CG; n = 12). In addition to wrestling training, core training program was applied to the experimental group 2 days a week (Tuesday-Friday) for 8 weeks. During this time the control group undertook a technical warm-up session specific to wrestling with a partner. Two-way repeated measures of ANOVA was used to analyze the mean differences between groups. One-way repeated measures of ANOVA was used to examine the score differences in the pre-post tests of the same group. The effect size was analyzed. For statistical significance level $p < 0.05$ was accepted.

Results. There was no significant improvement in speed ($p = .943$), anaerobic power ($p = .680$), and agility performance ($p = .343$) from the pre-test to the post-test in the control group. In the experimental group, a statistically significant improvement was observed in all of the measured properties (speed, $p = .001$; anaerobic power, $p = .000$; agility, $p = .028$). In addition, group x time interaction between experimental group and control group pre-test and post-test scores was found to be statistically significant (speed, $p = .000$; anaerobic power, $p = .006$; agility, $p = .023$).

Conclusion. With the addition of the 8-week core training program to wrestling training, it has been observed that speed, anaerobic power and agility performances have been positively affected.

Introduction

The core is defined as a consisting of the abdominals in front, paraspinal and gluteals in the back, diaphragm on the top, oblique on the sides and pelvic muscles below [Akuthota, Nadler, 2004; Hibbs *et al.* 2008]. Core exercises are known to improve the central muscles of the human body such as the spine, abdominal, hip and pelvic muscle groups [Brill, Cozen 2002]. It has been reported that a strong core will provide a transfer of force from the lower limb to the upper limb and the transfer of force is as important as its creation. [Bompa 1999; McGill 2009]. Many studies have claimed that having a strong core is essential for muscular endurance, injury prevention and improved performance [Arab *et al.* 2007; Durall *et al.* 2009; Kibler *et al.* 2006; McGill 2001; McGill *et al.* 1999].

Core training is becoming increasingly popular among fitness professionals for reasons such as increasing strength, lowering the risk of injury and helping physical rehabilitation [Durall *et al.* 2009; Myer *et al.* 2004]. However, studies investigating the effects of core training on athletic performance in sports are limited [Denhou *et al.* 2020].

Wrestling requires significant upper and lower body strength and muscular endurance, muscular

power and adequate recovery for an effective performance [Schmidt *et al.* 2005]. In addition, core strength and endurance has been accepted as one of the most fundamental physiological characteristics for wrestlers, because the core muscles must be in good condition to resist the forces acting on the spine during carrying, pushing and pulling movements [Basar *et al.* 2014]. In addition to these dynamic movements, isometric core strength in challenging positions helps wrestlers maintain body control and increase their defensive performance [Basar *et al.* 2014].

Core muscles located in the center of the body, such as the spinal, pelvic and abdominal muscles, produce all the strength and mobility of the human body [Yoon *et al.* 2015]. It is thought that strengthening these core muscles in wrestling will significantly support the improvement of performance.

The importance of agility and speed in many sports can not be ignored. In wrestling, agility and speed are important components for success, like other motor skills [Mirzaei *et al.* 2009]. During the match, a wrestler attacks, defends, counterattacks and strategically has to apply these attacks quickly in order to avoid the opponent's defense [Gokdemir 2000]. Moreover, wrestlers with high agility and speed can perform their techniques faster than others [Mirzaei *et al.* 2011]. Although speed and agility seem like running activities, it can be said that they cannot replace each other in training applications [Bayraktar 2013]. In the literature, it is seen that the studies on speed and agility in wrestlers are limited.

Since wrestling is a sport that requires very fast movements in short periods, anaerobic power is very important for wrestlers [Cicioglu *et al.* 2007]. Many factors go into the development of an elite wrestler. A successful wrestler should have a high level of anaerobic power, speed and agility performance as well as motoric features such as strength, endurance and flexibility [Deane *et al.* 2005]. Many studies in the literature have reported that successful wrestlers have high levels of anaerobic power [Horswill 1992; Yoon 2002; Jelena *et al.* 2009]. Studies reveal that the most important feature that distinguishes successful wrestlers from less successful wrestlers is the anaerobic power value [Abellan *et al.* 2010; Franchini *et al.* 2011; Horswill *et al.* 1989].

The aim of the present study is to investigate the effects of inclusion of an 8-week core training program in wrestling training on speed, anaerobic power and agility performance among wrestlers aged 11-14. It was hypothesized that the core training program would significantly improve speed, anaerobic power and agility which are important components of performance in wrestlers.

Methods

Participants

Twenty-four wrestlers attending a sports club in Bursa province participated in this study. In order to participate in the study, the conditions of not having any injury in the last 6 months were sought. Participants were divided into two homogeneous groups of 12, considering their age and body weight. One group formed the experimental group (EG) and the other formed the control group (CG). The descriptive characteristics of the participants of all groups were given in Table 1.

Table 1. Descriptive statistics (mean ± SD)

Group	Age (y)	Body height (m)	Body weight (kg)	BMI (kg/m^2)
EG (n=12)	12.67 ± 1.073	1.51 ± 0.110	42.33 ± 13.931	18.10 ± 4.013
CG (n=12)	12.75 ± 0.965	1.50 ± 0.106	42.83 ± 13.100	18.73 ± 3.920
Total (n=24)	12.71 ± 0.999	1.51 ± 0.107	42.58 ± 13.227	18.41 ± 3.893

The families of the participants were informed about the study process and their written consents were obtained. In addition, the participants were made to fill the voluntary consent form prepared in accordance with the Declaration of Helsinki. All the procedures were approved by the Health Sciences University Bursa Yuksek İhtisas Education and Research Hospital Clinical Research Ethics Committee (Date: 06.01.2021; Number: 2011-KAEK-25 2021/01-14).

Procedures

Both groups routinely practiced wrestling training together, 5 days a week (90 minutes). In addition to wrestling training, core exercise program was applied to the experimental group 2 days a week (Tuesday-Friday) for 8 weeks. Core exercises were applied in the first part of the wrestling training after 15 min warming up [Afyon 2014]. While the experimental group completed the core training for 22 minutes, the control group undertook a technical warm-up session specific to wrestling with a partner. Details of the core training program were shown in Figure 1.

The movements that develop the core region were organized by taking some studies in the literature as an example [Thomas, William 2009; Basset, Leach 2011]. Exercises numbered from 1 to 6 on the first day and from 7 to 12 on the second day were used in core training sessions performed 2 days a week. This cycle continued for 8 weeks. 6 different movements were applied in 3 sets in each training. 30 seconds between movements and 2 minutes rest time between the sets were given. Thus, each training session lasted approximately 22 minutes [Afyon 2014; Thomas, William 2009; Basset, Leach 2011]. The

training of both groups was done by the same trainer who has a 2nd level wrestling coaching certificate. Tests were conducted at the beginning and end of the 8-week study.

No	Core Exercises (Duration / Repetition)	No	Core Exercises (Duration / Repetition)
1	Plank 30 second	7	Superman 30 second
2	Plank to push-up 30 repetitions	8	Push-up side plank 30 repetitions (15 right – 15 left side)
3	Banana 30 second	9	Reverse plank 30 second
4	Bicycle crunches 30 repetitions	10	Long arm knee crunches 30 repetitions
5	Bridge 30 second	11	Leg raises 30 second
6	Leg raised circles 30 repetitions (15 right – 15 left side)	12	Plank with Opposite Arm and Leg Raise 30 repetitions (15 right – 15 left)

Figure 1. Core training program (photos were taken at training)

Measures

Height and weight measurements

The heights of participants were measured using 0.5 cm-sensitive stadiometer SECA 217 (USA), whereas the body weight was measured with lightweight clothes and bare feet by using 0.05 kg-sensitive electronic scale Tanita BWB-800S (Japan) [Niu *et al.* 2018].

Agility test

Agility was measured with the T-Test created by Semenick [1990]. Four cones were placed in the T shape and the participants touched the cones A-B-C-D-B-A respectively. During the test, the participant constantly looks in the same direction and changes direction by sliding to the right or left or running back. Time was measured with a an electronic timing system (Brower Timing System, Salt Lake City, UT) to 0.01 seconds. Participants repeated the test 2 times with an interval of 2 minutes and the best score was used in the analysis.

Speed Test

Fitlight TrainerTM (FitLight Sports Corp, Ontario, Canada) device was used for 10 m speed measurement. 2 lights were placed at the starting point and 10th m. Subjects started 50 cm behind the starting point and ran 10 m at maximum speed. Participants repeated the test 2 times with an interval of 2 minutes and the best score was used in the analysis.

Anaerobic power test

Anaerobic power was calculated with the Lewis formula. Anaerobic Power (kg/m/sec) = √4.9 x body weight (kg) x √vertical jump distance (m)

Vertical jump was measured using the 0.1 cm precision Sport Expert TM, MPS-501 (Tumer Elektronik LTD) power platform. The squat jump test protocol was used to evaluate the jumping performance. Participants' knees were bent about 90 degrees, with their hands fixed on the hips, and initially made a maximal jump without spring movement. Participants repeated the test 2 times with an interval of 2 minutes and the best score was used to calculate anaerobic power.

Statistical analysis

SPSS for Windows 23.0 (SPSS Inc, Chicago, USA) was used in the analysis of the data. Descriptive statistics were given as mean and standard deviation. The two-way repeated measures of ANOVA was used to analyze the mean differences between groups. The one-way repeated measures of ANOVA was used to examine the score differences in the pre-post tests of the same group. The effect size was analyzed and $p < 0.05$ was accepted for statistical significance.

Results

One-way repeated measures of ANOVA results of speed, anaerobic power and agility scores of each of the experimental group (EG) and control group (CG) were given in Table 2. In EG, speed improved by 0.142 ± 0.32 seconds from pre-test to post-test, and this change was statistically significant ($F = 19.091$, $p = 0.001 < 0.05$, $\eta 2 = 0.634$). It was observed that there was an improvement of 0.001 ± 0.011 seconds between pre-post test in CG speed scores and this change was not significant ($F = 0.005$, $p = 0.943 > 0.05$, $\eta 2 = 0.000$).

Anaerobic power scores showed improvements of -5.078 ± 0.499 kg/m/sec and -0.100 ± 0.237 kg/m/sec in EG and CG, respectively. The change in EG was found to be statistically significant ($F = 103.584$, $p = 0.000 < 0.05$, $\eta 2 = 0.904$), but the change in CG was not significant ($F = 0.179$, $p = 0.680 > 0.05$, $\eta 2 = 0.016$).

When the agility scores were analyzed, it was seen that they were similar to the results of speed and anaerobic power analysis. EG agility scores improved by 0.110 ± 0.044 seconds from pre-test to post-test, and this change was statistically significant ($F = 6.348$, $p = 0.028 < 0.05$, $\eta 2 = 0.366$). There was a statistically insignificant decrease of -0.047 ± 0.047 sec between pre-post-test in the agility scores of CG ($F = 0.984$, $p = 0.343 > 0.05$, $\eta 2 = 0.082$).

Two-way repeated measures of ANOVA results of pre-test and post-test of EG and CG were given in Table 3. Group x time interaction between EG and CG speed pre-test and post-test scores was found to be statistically significant ($F = 16.776$, $p = 0.000 < 0.05$, $\eta 2$

Table 2. One-way repeated measures of ANOVA results of speed, anaerobic power and agility scores in EG and CG

		Pre-test	Post-test	Difference	F	p	η^2
EG (n12)	Speed (sec)	2.184 ± 0.185	2.043 ± 0.122	0.142 ± 0.32	19.091*	0.001	0.634
	Anaerobic power (kg/m/sec)	53.644 ± 19.964	58.722 ± 20.665	-5.078 ± 0.499	103.584*	0.000	0.904
	Agility (sec)	10.499 ± 0.778	10.389 ± 0.688	0.110 ± 0.044	6.348*	0.028	0.366
CG (n12)	Speed (sec)	2.208 ± 0.157	2.201 ± 0.172	0.001 ± 0.011	0.005	0.943	0.000
	Anaerobic power (kg/m/sec)	54.929 ± 19.324	55.029 ± 19.352	-0.100 ± 0.237	0.179	0.680	0.016
	Agility (sec)	10.435 ± 0.730	10.488 ± 0.666	-0.047 ± 0.047	0.984	0.343	0.082

EG = Experimental Group; CG = Control Group; * = Significant difference ($p < 0.05$); η^2 = Effect size.

Table 3. Two-way repeated measures of ANOVA results of pre-test and post-test of EG and CG

		Pre-test	Post-test	Group X Time		
				F	p	η^2
Speed (sec)	EG (n12)	2.184 ± 0.185	2.043 ± 0.122			
	CG (n12)	2.202 ± 0.157	2.201 ± 0.172	16.776*	0.000	0.433
	Total (n=24)	2.193 ± 0.168	2.122 ± 0.167			
Anaerobic power (kg/m/sec)	EG (n12)	53.644 ± 19.964	58.722 ± 20.665			
	CG (n12)	54.929 ± 19.324	55.029 ± 19.352	9.136*	0.006	0.293
	Total (n=24)	54.286 ± 19.226	55.700 ± 20.535			
Agility (sec)	EG (n12)	10.499 ± 0.778	10.389 ± 0.688			
	CG (n12)	10.435 ± 0.730	10.482 ± 0.666	5.957*	0.023	0.213
	Total (n=24)	10.467 ± 0.739	10.435 ± 0.664			

EG = Experimental Group; CG = Control Group; * = Significant difference ($p < 0.05$); η 2 = Effect size.

= 0.433). The situation is similar in anaerobic power and agility scores. Group x time interaction was statistically significant between EG and CG anaerobic power scores ($F = 9.136$, $p = 0.006 < 0.05$, η 2 = 0.293), group x time interaction was statistically significant between EG and CG agility scores ($F = 5.957$, $p = 0.023 < 0.05$, η 2 = 0.213).

Discussion

Pelvic and abdominal muscles, called core muscles, act as bridges between the upper and lower body. The harmony and power transmission between the upper and lower body is very important for performance. In addition, core muscle weakness can cause injury and imbalance [Bashir *et al.* 2019]. Wrestling is a sport that requires excellent strength in both the upper and lower body areas [Horswill 1992]. For this reason, developing core muscles is considered important for success in wrestling. On the other hand, in wrestling, muscle strength, speed, agility, vertical jump, reaction time, balance, a high anaerobic and aerobic capacity are key factors for success [Imamoglu *et al.* 2018; Otag, Otag 2011]. In our study, we aimed to investigate the effects of core exercises applied for 8 weeks in addition to wrestling training on speed, anaerobic power and agility performances, which are important factors for success in wrestling. We hypothesized that core training will positively affect the listed physical abilities.

In the presented study, according to the tests performed at the beginning and end of the 8-week training period, there was no significant improvement in speed, anaerobic power and agility performance from the pre-test to the post-test in the control group. In the experimental group, a statistically significant improvement was observed in all of the measured properties (speed, anaerobic power and agility). These results support our hypothesis.

There were many studies in the literature that report that core training has positive effects on athletic performance. However, studies investigating the effects of core training on wrestlers' performance were limited.

In the present study, it was observed that the speed, anaerobic power and agility scores of EG athletes who were applied core exercises improved significantly more than CG athletes. In addition, the group x time interaction between speed, anaerobic power and agility pre-post tests was found to be statistically significant. In this case, it can be said that core exercises positively affect the development of speed, anaerobic power and agility in wrestlers aged 11-14.

In a study investigating the effects of core exercises on physical fitness in 9-12 year old children, it was reported that core exercises positively affect jumping performance [Ahmadi *et al.* 2014]. In a study conducted with basketball, soccer and volleyball athletes with an average age of 15.3, it was stated that 6-week core exercises significantly improved the 9.1 m speed performance [Myer *et al.* 2005]. In another study, it was reported that core

exercises can be safely added to tennis training and core exercises positively affect agility [Bashir *et al.* 2019]. In a study conducted with football players, it was reported that there is a positive relationship between core muscles and agility [Nesser *et al.* 2008]. In another study, it was concluded that 8-week core exercise improved the vertical jump and 20 m speed performance of football players more in the experimental group compared to the control group [Dogan *et al.* 2016]. In a study conducted with handball players, it was reported that speed, agility and leg explosive strength increased significantly after 8 weeks of core strength training [Balaji, Murugavel 2013]. It is seen that these studies in the literature give parallel results with our study and support our study.

In the presented study, it was observed that 8-week wrestling training did not significantly affect speed, anaerobic power and agility in CG without core exercises.. However, it is known that wrestling training positively affects these characteristics [Gul *et al.* 2013; Cicioglu *et al.* 2007; Gokdemir 2000]. This situation is thought to be caused by the short training period (8 weeks). In addition, the content of the wrestling training program is unknown, because no intervention was made to the routine wrestling training in both groups.

Conclusion

With the addition of the 8-week core training program to wrestling training, it has been observed that speed, anaerobic power and agility performances, which are important features for athlete success, have been positively affected. In order to achieve better development and performance, it is recommended to include core exercises in wrestling training.

Conflict of interests

There were no conflicts of interest.

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Wpływ *Treningu Core* na szybkość, moc anaerobową i zwinność u zapaśników w wieku 11–14 lat

Słowa kluczowe: ćwiczenia *core*, trening, zapasy, wydolność

Streszczenie

Tło. Ćwiczenia *core* poprawiają centralne mięśnie ludzkiego ciała, takie jak kręgosłup, brzuch, grupy mięśniowe bioder i miednicy. Wiadomo również, że silny rdzeń zapewni przeniesienie siły z kończyny dolnej na górną.

Cel. Celem pracy było zbadanie wpływu włączenia 8-tygodniowego programu *treningu core* do treningu zapaśniczego na szybkość, moc anaerobową i sprawność zwinnościową u zapaśników w wieku 11-14 lat.

Metody. W badaniu wzięło udział 24 zapaśników w wieku 11-14 lat. Uczestnicy zostali podzieleni na dwie jednorodne grupy po 12 osób, biorąc pod uwagę ich wiek i masę ciała. Jedna grupa stanowiła grupę eksperymentalną (EG; n = 12), a druga grupę kontrolną (CG; n = 12). Oprócz treningu zapaśniczego, w grupie eksperymentalnej zastosowano program *core training* 2 dni w tygodniu (wtorek-piątek) przez 8 tygodni. W tym czasie grupa kontrolna podejmowała sesję rozgrzewki technicznej właściwej dla zapasów z partnerem. Do analizy średnich różnic między grupami zastosowano dwukierunkowe powtarzane środki ANOVA. Jednokierunkowe powtarzane pomiary ANOVA zostały użyte do zbadania różnic punktowych w pre-post testach tej samej

grupy. Analizie poddano wielkość efektu. Dla poziomu istotności statystycznej przyjęto p < 0,05.
Wyniki. Nie stwierdzono istotnej poprawy w szybkości (p = .943), mocy anaerobowej (p = .680) i sprawności zwinnościowej (p = .343) od pre-testu do post-testu w grupie kontrolnej. W grupie eksperymentalnej zaobserwowano istotną statystycznie poprawę wszystkich mierzonych właściwości (szybkość, p = .001; moc anaerobowa, p = .000; zwinność, p = .028). Ponadto stwierdzono, że interakcja czasowa grupy x między grupą eksperymentalną a grupą kontrolną przed i po teście była istotna statystycznie (szybkość, p = 0,000; siła beztlenowa, p = 0,006; zwinność, p = 0,023) .
Wniosek. Wraz z dodaniem 8-tygodniowego podstawowego programu treningowego do treningu zapaśniczego zaobserwowano pozytywny wpływ na szybkość, moc beztlenową i zwinność.