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The Effect of Vertical and Horizontal Core Trainings on Core Strength, Agility and Speed

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Abstract

The aim of this study is to investigate the effect of core training in vertical and horizontal planes on core strength, speed and agility. Handball players aged 15-18 participated in the study (n=36); are divided into 3 groups as vertical core training group, horizontal core training group and control group. The vertical core training experimental group handball players participating in the study performed core training in the vertical plane in addition to the normal training, while the horizontal core training experimental group handball players performed core training in the horizontal plane in addition to the normal training for 8 weeks. The control group, on the other hand, do not participate in any extra training and continued their normal handball training. Experimental and control group handball players are given speed tests (5,10,20,30 meters), agility tests (505-T Test, Hexagon, Illinois), core strength endurance (core stability performance test) in order to determine their levels before and after this 8-week training. tests are applied. In the study, it is observed that vertical core training positively affected agility tests (505, Illinois, Hexagon and T test), while horizontal core training improved core strength, and both horizontal and vertical training improved 20 meters speed. As a result, it is concluded that core training in the horizontal plane affected core strength, while core training in the vertical plane affected speed and agility more than horizontal core training. In addition, in the tests involving running mechanics, it is concluded that vertical core training has a more significant effect than horizontal core training.

Keywords: Core Training, Handball, Agility, Speed

Dikey ve Yatay Core Antrenmanlarının Core Gücü, Çeviklik Ve Hız Üzerindeki Etkisi

Özet

Bu çalışmanın amacı dikey ve yatay düzlemde yapılan kor antrenmanların kor kuvveti, sürat ve çevikliğe etkisinin araştırılmasıdır. Araştırmaya katılan 15-18 yaş hentbolcular (n=36); dikey kor antrenman grubu, yatay kor antrenman grubu ve kontrol grubu olmak üzere 3 gruba ayrılmıştır. Çalışmaya katılan dikey kor antrenman deney grubu hentbolcuları normal antrenmanlara ek olarak dikey düzlemde, yatay kor antrenman deney grubu hentbolcuları ise normal antrenmanlara ek olarak yatay düzlemde 8 hafta boyunca kor antrenmanlar yapmıştır. Kontrol grubu ise ekstra bir antrenmana katılmamış normal hentbol antrenmanlarına devam etmiştir. Deney ve kontrol grubu hentbolculara bu 8 haftalık çalışmanın öncesi ve sonrasında seviyelerini belirlemek amacıyla sürat testleri (5,10,20,30 metre), çeviklik testleri (505-T Test, Hexagon, İllionis), kor kuvveti dayanıklılığı (kor stabilite performans testi) testleri uygulanmıştır. Çalışmada dikey kor antrenmanların çeviklik testlerini (505, İllionis, Hexagon ve T testi) olumlu yönde etkilediği, yatay kor antrenmanların ise kor kuvvetini geliştirdiği, hem yatay hem dikey antrenmanların özellikle 20 metre sürati geliştirdiği görülmüştür. Sonuç olarak yatay düzlemde yapılan kor antrenmanlarının kor kuvvetini etkilediği, dikey düzlemde yapılan kor antrenmanlarının ise sürat ve çevikliği yatay kor antrenmanlarına göre daha çok etkilediği sonucuna varılmıştır. Ayrıca koşu mekaniğinin bulunduğu testlerde dikey kor antrenmanların yatay kor antrenmanlarına göre daha önemli bir etki yarattığı sonucuna ulaşılmıştır.

Anahtar Kelimeler: Kor Antrenman, Hentbol, Çeviklik, Sürat

INTRODUCTION

In recent years, the core muscles, which are frequently applied in combined training and attract great attention, have started to become a basic part of training plans (1). The core area, which is also called the muscular box containing the core muscles of the body, the power area and the area where all movements begin, focuses on the strength and condition of regional and superficial muscles in training (2).

Core exercises have taken their place among the exercises commonly used in many sports branches and gyms. Core exercises are recommended for the development of the athletic structure of individuals and a more functional body (3).

Core training, which allows the development of arm and leg strength, is a dynamic concept that is constantly changing to adjust body composition or to provide resistance to external force. The stronger the core muscles, the more power production in the arms and legs (4). Core training may differ from weight training. However, core trainings are also studies aimed at increasing muscle strength. These studies focus on the strength and condition of regional and superficial muscles (2).

In the study examining the effect of core training on anaerobic power and balance in female handball players, significant changes are found in the anaerobic power and balance data of the experimental group at the end of 8 weeks, and it is stated that core training would positively affect sportive performance (5). An 8-week core training program is applied to examine the effect of core training on speed, balance and agility in male football players between the ages of 14-16 and agility, balance and strength parameters are improved (6). In the study examining the effects of static and dynamic core training on swimming performance and motoric properties in swimmers, it is found that dynamic core exercises provide more improvement on motoric properties than static core exercises (7). In a study examining the effects of static and dynamic core exercises on speed and agility performance on football players, it is found that no significant results are found in speed and agility, and it do not affect body composition, but increased core stability (8). In a study examining the effect of 8-week core training applied to female wrestlers on agility, quickness and acceleration, a significant improvement is found in the quickness, agility and acceleration first-post-test values of the group in which core training is applied in addition to the training, and it is seen that core training applied in addition to the training provided improvement in motor skills (9). In studies comparing different branches and different leagues, it has been seen that core strength is an important criterion and there is no significant difference when the core strength values of the athletes in the upper and lower leagues are compared (10, 11).

When the literature is examined, it is stated that the relationship between core stabilization and motoric characteristics in handball is an important factor in sportive success (4, 10, 12-15). However, it is seen that there are no studies in the literature on the effects of horizontal and vertical core training on core strength, speed and agility. The aim of this study is to investigate the effect of core training in vertical and horizontal planes on core strength, speed and agility.

METHOD

The research is designed as a pretest-posttest control group model, one of the real experimental models. In the research design, the dependent variable is the tests and measurements that determine core strength, speed and agility in young handball players between the ages of 15-18, and the independent variable is vertical and horizontal core training applied 3 days a week for 8 weeks. A total of 36 male handball players between the ages of 15-18 participated in the study.

Working Groups; Group 1 (n=11): Vertical Core Training Group, Group 2 (n=11): Horizontal Core Training Group, Group 3 (n=14): Control Group.

A total of 18 movements are determined to be applied in the vertical and horizontal planes, taking into account the ages and training levels of the participants. After the research and control groups have the necessary warm-up exercises, the pre-test is taken. The movements to be applied and the proper forms of the movements are shown to the athletes in the research group. It is applied as 24 units of training with the study groups for 8 weeks, 3 training sessions per week. It is applied for 20 minutes in the first two weeks, 30 minutes in the 3rd and 5th weeks, and 40 minutes in the 6,7th and 8th weeks. The rest period is given as 1x1. The control group trained for two hours, 3 days a week, on the other hand, do not do any extra core training and continued their routine handball training.

Training Program

VERTİCAL CORE TRAİNİNG	HORİZONTAL CORE TRAİNİNG
Oblique Twist	Plank
Planör	Side Plank(Right)
Pulling Theraband(Right Leg)	Side Plank(Left)
Pulling Theraband(Left Leg)	Hip Raises
Hanging Leg Raise	Cobra
Bosu Squat	Boat Pose
Throwing Ball in Bosu	Bicycle Crunch
Rotation Press	Spiderman Plank
Side Bend	Mountain Climber

Data Collection and Applied Tests

The prepared tests are applied in Konya Metropolitan Municipality and Ankara Spor Toto gyms. A total of 36 people from three groups participated in the study.

Publication Ethics of Research

For the research, the ethical compliance approval of the study is obtained with the decision number 2020/119 dated 18.12.2020 of the Social and Human Sciences Ethics Committee of Necmettin Erbakan University.

Anthropometric Measurements

Height Measurement And Body Weight

Desis B5 height measuring device was used for height measurement. Measurements were taken from the athletes with their feet bare, heels together, head in a frankfort plane, arms hanging freely from shoulders (16).

Body Weight Measurement

Desis B5 device was used for body weight measurement. Participants gave measurements in bare feet and anatomical posture with appropriate sportswear and the obtained values were recorded in 'kg' (17).

Body Mass İndex (BMI) Measurement

It was calculated by dividing the body weight by the square of the height in meters.

Performance Tests

In the study, speed and agility tests (excluding hexagon) were carried out with a WITTY Microgate brand (model: WIT001) photocell.

Speed Tests

5-10-20-30 meters speed tests are applied and the value obtained by the athlete from 2 attempts is recorded in seconds.

Agility Tests

T Drill Agility Test

In the test where A, B, C, D cones are placed and the athletes start with the whistle command, the athlete first runs from the A cone, touches the B point, goes to the C cone with sliding steps, and then touches the C cone with his left hand. The athlete then touches the D cone with his right hand, with sideways sliding steps. He then touches cone B with his left hand and goes back to cone A, where the stopwatch is stopped when he crosses the line. The athlete tries to do this as quickly as possible. The distance between funnel A and funnel B is 9.14 meters. The distance between funnel B and funnels C and D is 4.57 meters. Athletes are made 3 repetitions. Rest between repetitions is complete rest. The best grade made is considered (18).

505 Test

This test consists of running a distance of 10 meters and then traveling a distance of 5 meters without stopping. Photocell stopwatches fixed above the 5 meter line are placed at both the start and finish gates. In the direction of the approach run, the first door is the stop and the second door is the start. The round-trip time of the distance of 5 meters was recorded in seconds. Athletes are given 2 repetitions and their best scores are recorded (19).

Illinois Test

Four rectangular cones are placed at the corners of an area 5 meters wide and 10 meters long. These four cones are the starting, ending and two turning points. The area is divided lengthwise in two (2.5 meters). Medium error 4 cones are placed. The distance between these 4 cones is 3.3 meters. With the start command, the athlete starts the movement in the test and tries to complete the distance between the start and the finish at the highest speed (20).

Hexagon Test

A hexagon with sides of 66 centimeters (cm) is created on the ground. The participant faces the A line in the middle of the hexagon line. During the test, the participant will face the A line. With the start command, the stopwatch is started. The participant jumps with both feet outside the B line and back to the centre, then jumps to the C line and back to the centre, then D and so on. A lap is counted when the participant jumps over the A line and returns to the centre. After the participant completes 3 laps, the stopwatch is stopped and the time is recorded.

Core stability performance measurement

The 'Sport-specific core strength and stability plank test' protocol, consisting of 8 steps and a total duration of 3 minutes, is applied. The stages of the test are as follows;

1. Standard plank position forward (60 sec)
2. Raise right arm in plank position (15 sec)
3. Raise left arm in plank position (15 sec)
4. Right leg raise in plank position (15 sec)
5. Left leg raise in plank position (15 sec)
6. Raise left leg and right arm in plank position (15 sec)
7. Raise right leg and left arm in plank position (15 sec)
8. Taking the plank position again (30 sec)

It has been requested that in the starting position, only the tips of the toes, elbows and forearms are in contact with the ground, while the participants are lying on the ground in the starting position, taking a line parallel to the ground in such a way that the head, neck, shoulders, back, waist, hips and legs are straight like a rope and maintain this posture without disturbing. The time taken by the participant from this position to breaking his posture is written and recorded in seconds.

Analysis of Data

ANOVA test was used in mixed measurements in order to examine the existence of the difference between the posttest values of the control group, vertical core training group and vertical core training group (21). Before the analysis, the assumptions of the ANOVA test were checked. The first of the assumptions is the normal distribution. The normal distribution of the data was checked with kurtosis-skewness values and the values are expected to be between -1.5 and +1.5 according to (22). When the findings were examined, it was determined that the data set showed a normal distribution. Another assumption is that the participants show a homogeneous distribution, the homogeneity assumption is checked with Levene's test. Levene's test findings ($p>.05$) are expected. The Levene's test findings obtained showed that the groups showed a homogeneous distribution. Eta squared ($\eta 2$) value was used to determine to what extent the independent variable had an effect on the dependent variable. The eta squared formulation was used as (0.01) small effect, (0.06) medium effect, and (0.14) large effect (23, 24).

FINDINGS

Tablo 4.1. Average values of the study groups.

	N	Minimum	Maximum	Mean
Age	36	15	18	16,61±1,02
Height (cm)	36	164,5	189,0	177,68±7,04
Weight (kg)	36	45,4	97,2	73,89±13,20
BMİ (kg/cm²)	36	15,7	30,8	23,29±3,57

36 people took part in the research. The averages of the athletes in all groups participating in the research; age is 16.61±1.02, height is 177.68±7.04, weight is 73.89±13.20, and BMI is 23.29±3.57.

Table 4.2. Speed test in-group values table of study groups

		Group					
		Vertical Core Training	Horizontal Core Training	Control	F	p	η^2
5 Meters run	Pre-test	.97 ± .08	.99 ± .091	.95 ± .07	3.20	.08	.09
	Post-test	.96 ± .07	.96 ± .05	.93 ± .05			
10 Meters run	Pre-test	1.73 ± .17	1.75 ± .17	1.73 ± .11	.24	.63	.01
	Post-test	1.75 ± .17	1.76 ± .12	1.71 ± .13			
20 Meters run	Pre-test	3.06 ± .24	3.23 ± .28	3.09 ± .17	5.61	.02*	1.15
	Post-test	3.04 ± .23	3.18 ± .25	3.05 ± .13			
30 Meters run	Pre-test	4.40 ± .40	4.67 ± .42	4.40 ± .29	3.75	.06	.10
	Post-test	4.42 ± .39	4.56 ± .38	4.36 ± .23			

When Table 4.2 is examined, a significant difference is observed between the pre-test and post-test values of the groups in the 20-meter running (F(1, 33)=5.61, η2=1.15, p<.05) variable of the athletes.

5 meters run (F(1, 33)=3.20, η2=.09, p>.05), 10 meters run (F(1, 33)=.24, η2=.01, p>.05), and 30 In the meters running (F(1, 33)=, η2=.10, p>.05) variables, no statistically significant difference is found between the pre-test and post-test values.

Table 4.3. Table of speed test values between study groups.

	Group					
	Vertical Core Training	**Horizontal Core Training**	**Control**	**F**	**p**	**η²**
5 Meters run	.96 ± .07	.96 ± .05	.93 ± .05	1.17	.32	.07
10 Meters run	1.75 ± .17	1.76 ± .12	1.71 ± .13	.21	.81	.01
20 Meters run	3.04 ± .23	3.18 ± .25	3.05 ± .13	1.82	.18	.10
30 Meters run	4.42 ± .39	4.56 ± .38	4.36 ± .23	1.57	.22	.09

When Table 4.3 is examined, 5 meters running (F(2, 33)=1.17, η2=.07, p>.05), 10 meters running (F(2, 33)=.21, η2=.01, p>.05), 20 meters running (F(2, 33)=1.82, η2=.10, p>.05) and 30 meters running (F(2, 33)=1.57, η2=.09, p>.05) variables. No statistically significant difference is determined between the post-test values of the groups.

Table 4.4. Intragroup values table of the agility and core strength variables of the study groups.

		Group					
		Vertical Core Training	**Horizontal Core Training**	**Control**	**F**	**p**	**η²**
505	Pre-test	2.53 ± .19	2.70 ± .19	2.44 ± .19	9.45	.00**	.22
	Post-test	2.43 ± .18	2.65 ± .18	2.44 ± .16			
T-Test	Pre-test	10.18 ± .86	10.78 ± .86	10.25 ± .42	14.17	.00**	.30
	Post-test	9.79 ± .93	10.51 ± .60	10.04 ± .56			
Plank	Pre-test	83.18 ± 33.14	61.73 ± 28.48	106.64 ± 25.03	30.43	.00**	.48
	Post-test	100.45 ± 39.76	108.64 ± 47.78	106.07 ± 19.53			
Hexagon	Pre-test	13.77 ± 1.93	14.45 ± 1.78	13.40 ± 1.01	38.59	.00**	.54
	Post-test	13.14 ± 1.83	12.88 ± .84	12.83 ± 1.15			
İllionis	Pre-test	17.62 ± 1.69	18.45 ± 1.32	16.98 ± .78	58.87	.00**	.64
	Post-test	16.47 ± 1.34	17.38 ± 1.27	16.57 ± .82			

505 (F(1, 33)=9.45, η2=.22, p<.05), T-test (F(1, 33)=14.17, η2=.30, p<.05), plank (F(1, 33)=30.43, η2=.48, p<.05), hexagon (F(1, 33)=38.59, η2=.54, p<.05) and illionis (F(1, 33) =58.87, η2=.64, p<.05), the pretest values of the 3 groups are found to be significantly higher than the final values. When the effect size findings are examined; 505 (η2=.22), t-test (η2=.30), plank (η2=.48), hexagon (η2=.54) and illionis (η2=.64) are found to have great effect.

Table 4.5. Table of values between groups for agility and core strength variables of study groups

	Group					
	Vertical Core Training	**Horizontal Core Training**	**Control**	**F**	**p**	**η²**
505	2.43 ± .18	2.65 ± .18	2.44 ± .16	6.28	.01*	.28
T-Test	9.79 ± .93	10.51 ± .60	10.04 ± .56	2.88	.07	.15
Plank	100.45 ± 39.76	108.64 ± 47.78	106.07 ± 19.53	1.58	.22	.09
Hexagon	13.14 ± 1.83	12.88 ± .84	12.83 ± 1.15	.50	.61	.03
İllionis	16.47 ± 1.34	17.38 ± 1.27	16.57 ± .82	3.14	.06	.16

In Table 4.5, a statistically significant difference is determined between the 505 (F(2, 33)=6.28, η2=.28, p<.05) post-test values of the study groups. When the effect size findings are examined, it is determined

that it has a large effect with 505 (η2=.28). According to the Bonferroni follow-up test, in the 505 variable, the horizontal core training group is found to be significantly higher than the vertical core training group. It is observed that the group that received horizontal core training is also higher than the control group. There is no statistically significant difference between the vertical core training group and the control group.

T-test (F(2, 33)=2.88, η2=.15, p>.05), illionis (F(2, 33)=3.14, η2=.16, p>.05), plank (F(2, 33)=1.58, η2=.09, p>.05) and hexagon (F(2, 33)=.50, η2=.03, p>.05), no statistically significant difference is observed.

DISCUSSION and CONCLUSION

In this study, the effects of horizontal and vertical core training on core strength, speed and agility are investigated. In the study, core strength, agility and speed values are determined and evaluated by applying different tests.

The average of the participants in all groups participating in the research; age is 16.61±1.02, height is 177.68±7.04, weight is 73.89±13.20, and BMI is 23.29±3.57. In different studies, the mean age of male athletes belonging to similar age groups is 16.80±.42 years, and the average height is 175±9.16 cm (25). In another study, it is found that the mean height of the control group is 187.1±7.84 cm, and the mean body weight is 71±6.07, while the athletes in the experimental group are 189.3±4.52 cm and their weight is 71.26±6.66 kg is reported (26). It is seen that the physical characteristics of the general handball players in the age range of the athletes in the study are similar to the studies in the literature.

In the study, it is determined that horizontal and vertical core trainings have a significant positive effect on the 20-meter speed. In addition, it is seen that core trainings affected the speed development of 5,10 and 30 meters, but this improvement is not significant. In the literature, in studies investigating the effects of core training at different ages on speed development, it is seen that speed is affected by core training. It is determined that 8-week core training applied to 13-15 age group badminton players (27), 8-week core training applied to football players (28), and 12-week core strength training applied to the central region for 12-14 age group children (29), decreased the 20m sprint time and showed a positive development. However, it is stated that 10-week core training do not affect the 30-meter sprint performance in female volleyball players aged (30). Although this is not an expected result, it shows parallelism with the findings of our study. It has been determined both in our study and in the literature that core training does not affect the 30 m speed. It is thought that the most important reason why horizontal and vertical core trainings do not significantly affect the 5, 10 and 30 m speed is due to the fact that speed is a difficult motoric feature that needs to be developed at an early age. However, in the above studies (27-29) and in our study, it is seen that horizontal and vertical core training directly affects 20 meters speed significantly. When the speed findings are examined, the studies in the literature also support our study.

In the results of the study, it is determined that horizontal and vertical core trainings affect agility significantly. According to the agility tests in vertical core training, 505 test improved 4%, T test 3.8%, hexagonal 4%, Illinois 6.5%, while in horizontal core training the 505 test improved 1.8%, T test 2.5%, hexagonal 10%, Illinois 5.8%. development has been found. On the other hand, in the control group, who practiced Norman handball, it is observed that the agility development rates remained around 2% on average. It is seen that there are similar results in studies of core training conducted in the literature. It has shown that in the T test and pro agility tests of 8 weeks, it is found that 17-19 age group football players (31), young female volleyball players (32) and 10-12 age football players (33) caused a significant increase in speed and agility levels. In other studies, it has been reported that core strength training has a significant effect on quickness, agility and acceleration in female wrestlers (9) and tennis players (34), and all three parameters have improved significantly. However, although there are many studies in the literature showing that core training positively affects agility, there are also studies showing that it does not affect agility. It is determined that core training applied to 28 tennis players aged 11-15 for 10 weeks do not affect the speed and agility scores (35). In the agility tests applied in the study, it is seen that horizontal and vertical core exercises significantly improve this feature and when the effect size findings are evaluated, it has a great effect. When the literature is examined, it has been reported both in the literature and in the current study that the duration of experimental studies on agility varies between 6 and 12 weeks, and agility has improved significantly during this period. In the study, it is determined that 8-week horizontal and vertical core training increased agility significantly. It is seen that vertical core training is more important in sports

branches based on running such as handball, basketball and football, especially if the tests involving running mechanics are accepted as more important tests for handball.

In addition, the improvement in the control group in the Hexagon, Illinois and T test is the result of general handball training, and accordingly, it shows how important training is for handball. It is thought that better coordination of the working core muscles is effective on the results, so that the core muscles that are trained provide better body resistance and balance, and that the movement is carried out smoothly in the kinetic movements.

In the study, it is observed that core training has a great effect on the central region both in the vertical and horizontal planes. There are also studies on the cor plank relationship in the literature. In the study investigating the effect of 8-week core training on the development of some motoric features in 18-year-old football players, a significant difference is found in the plank value after the training (36). As a result of the 10-week core training program applied to tennis players aged 11-15, an increase of 13.8% in the shuttle test score and a 13.6% improvement in the plank test score is observed (35). It was found that combined trainings for the age group similar to our study group had a positive effect on core strength (37). Core strength is also an important element in combined training. It has been observed that not doing regular core strength training exercises significantly reduces core strength (38). Studies in the literature support our study. In the study, a significant improvement is observed in the plank test, which determines the core strength, and it is determined that this improvement has a great effect. Looking at the plank test data, it is determined that the vertical core training group improved by 20.7% and the horizontal core group by 76%. No improvement is observed in the control group. It is thought that the fact that the muscle groups trained in the training are also directly active in the plank movement is effective in this result.

In the findings of the study, it is determined that the trainings in the horizontal and vertical planes have effects on agility, speed and core strength. It has been observed that vertical core training has a positive effect on agility tests (505, Illinois, Hexagon and T test), horizontal core training improves core strength, and both horizontal and vertical training has a positive effect on 20 meters speed.

As a result, it has been determined that core training done in the horizontal plane improves core strength, while core training done in the vertical plane affects speed and agility more than horizontal core training. In addition, in the tests involving running mechanics, it is concluded that vertical core training has a more significant effect than horizontal core training.

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