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The Effects of Core Training on Swimming in Sedentary Women*

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ABSTRACT The study was done in Gaziantep OSKA swimming pool with the participation of 40 voluntary women. In this research, pre-test and post-test designed experimental method with the inclusion of control group has been applied. For the comparison of quantitative data and for the understanding of the difference, Mann Whitney-U test was used. For the analyses of the pre-test and post-test, non-parametric Wilcoxon test was used. In both control and experiment groups it was accepted that the difference be regarded as meaningful in situations where the P value is less than 0.05 in values of body weight, body fat percentage, vital capacity, right/left hand grip strength, leg and back strength, balance, flexibility, vertical leap, reaction time and shuttle run ($p<0.05$). In conclusion, the statistically meaningful effect of core training done 3 days a week during the 8 weeks period was proven to be effective on body fat percentage, left hand grip, leg and back strength, flexibility, vital capacity and vertical jump performances ($p<0.05$).

INTRODUCTION

Swimming is conceptually defined as a sports branch which includes several sub-disciplines that basically brings to mind the activities which are carried out in water. In Turkey, the swimming activities are carried out under the swimming federation as swimming and synchronized swimming activities (Soydan 2006).

Swimming is a popular sport in all age groups and it provides a very good cardiovascular condition in musculoskeletal system, without the need of stress weight activities. Therefore, it is a very good form of exercise for obese children. And it is a good option for people with asthma because of high heat and humidity. Whereas, as a negative feature, improving physical fitness and losing calories requires skillful swimming (Celebi 2008).

Strength is one of the basic biomotoric abilities which has a crucial value for every sport (Acar 2000). An important feature of sportive efficiency is the fact that it develops according to the increase of strength.

Based on this determination, many practitioners defend the need to include strength works to the practices of children and teenagers in order to increase their sporting success (Muratli 1997).

Also, in various studies, strength training is associated with a game which proves to give effective development stimulus, or in other words strength or quick strength has proven to have the ability to be "easily" increased within a unity (Cabri et al. 1988; Proft et al. 1988).

Strength and power has a variety of applications to the sports. Since swimming is a sport of strength, it is considered that giving as much power as possible in pulling the arm is an advantage. This increases the speed and therefore develops the performance. But it is not always easy to improve the strength and power. The development of strength and power is often hindered because it is not easy to access facilities or the various needed tools for training. An ideal working environment gives the athletes the opportunity to exercise certain activities and thus, improves their performance (Trappe and Pearson 1994). In the swimming sport, what is essential in terms of strength is the transfer of the obtained strength to the water (Tanaka and Swensen 1998).

There are some methods for improving the strength. These methods are provided with different equipment and machinery as per your own body weight (Page and Ellenbecker 2005). In swimming sport, it is known that strength is an important factor of performance (Selcuk 2013).

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"Core" means something central in the dictionary or central nucleus of living cells or is called the nucleus. As it can be understood from its name, it is a sensitive issue that should be considered seriously. The region called "Core" is the abdominal regions in front of the body, that is, the upper and lower abdominal muscles, the serratus located right near the upper abdominal muscles, the obliques located right near the lower abdominal muscles and the muscles in the back to the waist and to the neck and the muscle groups which give a correct posture to our skeleton. "Core practice" refers to the working of the abdominal and waist region mentioned above. The strengthening of the core region is not only essential for athletic durability but it also ensures the maintenance of our regular posture (Fahey et al. 2011).

As the core training has positive effects on strength development, it can be used in the land works of swimming trainings. This study therefore aims at the effects of physiological and motoric parameters of the core practice trainings on sedentary women between the ages of 18 to 24 who are doing swimming sport, with an added help or information gathered from literature on the sport.

METHODOLOGY

The experimental method which is designed for use in this research is the pre-test and post-test methods, with the inclusion of control group. The population of the research was formed by 40 (n=40) sedentary women between the ages of 18-24 who had registered for the summer swimming lessons at Gaziantep Oska Swimming Pool, and who were taken as a sample. Two groups were formed in the research; experiment group (n=20) and control group (n=20). The necessary permissions were taken before the research was carried out.

Preparation of Experiment Systems and Implementation

The effects of core training exercises on the performance were studied by examining the effects of some physical and motoric parameters on sedentary women who did core training in addition to their normal swimming trainings for 8 weeks. For the purpose of this research, the condition of not having attended swimming training previously was demanded and in order to be able to determine the health and exercise status, health and exercise status questionnaire was applied (Murphy 2010).

Experiment and Control Group

The experiment and control groups of this study were formed of 20 women each, totaling 40 voluntary women between the ages of 18 to 24 who participated in the study and who attended the Gaziantep Oska swimming lessons. Group core trainings were applied 3 days a week for 8 weeks before each swimming exercise. The training program started with warm up exercises, land trainings and running. Additional core training was applied and the training ended with stretching.

Physiological and Motoric Measurements

Body Weight and Body Fat Percentage Measurement

In the measurements Tanita (Innerscan BC532/ Japan) brand analyzer was used. The measurements were taken with minimum clothing. During these measurements, the individuals were asked to step on the metal surface of the device bare footed and to hold onto the device's holding parts with both hands and leave their arms free parallel to their bodies. The measurements lasted 1-2 minutes for each volunteer and by getting the output from the bioelectrical impedance analyzer; body weight, body mass index, basal metabolic rate, body fat mass, fatless body mass and total body water measurements were taken (Zorba 1999).

Length Measurement

The lengths of the women were measured by Seca brand electronic length measurer. During the measurement, the women were in anatomical position, with bare feet, heels united, breathless, head in the frontal plane, the top table of head touching the vertex point. The values obtained were recorded in cm (Zorba 1999).

Flexibility Performance Measurement

Sit-reach flexibility test was used. During the measurements, Lafayette Instrument Company brand sit-reach table was used. The individuals

were without shoes, their feet fully placed on sit-reach table and their palms down, their arms and knees not bent and reaching as much as possible to the front. In maximum reaching position, the individuals waited two seconds and after that the test measurement was recorded. The test was repeated three times and the highest value was taken for assessment (Tamer 2000).

Vertical Leap Performance Measurement

In order to determine leap performance, vertical leap test including the active jumping and squat jumping was used. Active jumping test was repeated three times and the highest value was taken (Tamer 2000).

Hand Grip Strength Measurement

The measurement was realized with Takkei brand hand dynamometer (Hand Grip). After five minutes of warming up, while the subject was standing and her measured arm not bending and not touching her body and her arm being 45° angle to the body, the measurement was taken. This was repeated three times for the right and left hand and the highest value was used (Tamer 2000).

Leg Strength Measurement

The measurement was taken by using Takkei brand back and leg (back and lift) dynamometer. After five minutes of warming up, the subjects placed their feet on the dynamometer table with their knees bent, their arms stretched, their backs straight, and their bodies tilted slightly forward, and while grasping the dynamometer bar, they pulled up the dynamometer bar vertically at a maximum rate by using their legs. This traction was repeated three times and the best value was recorded for each subject (Tamer 2000).

Back Strength Measurement

The test was realized by using the back dynamometer produced by Lafayette Instrument Company. The subjects, having their knees stretched, on the dynamometer with their backs straight, and their bodies tilted slightly forward and while grasping tightly the dynamometer bar, they will pull up the dynamometer bar vertically at a maximum rate. After a warming up of 3 to 5 minutes, this was repeated 3 times. The best results were noted down (Zorba 1999).

Flamingo Balance Test (FBT)

In order to determine the static balances of the research groups, Flamingo Balance Test was used. In this test, the person step on a wooden balance mechanism with her dominant foot and stands in a balance. The wooden balance mechanism is 50 cm. long, 4 cm. high and 3 cm. wide. By bending her other foot from the knee, by pulling it to her hips, she holds it with her hand on the same side. While the research group is in balance on one foot, the time starts and the group tries to stand in balance for 1 minute. When the balance is lost (if she leaves her foot, if she falls off the mechanism, if she touches the floor with any part of her body etc.) the time is stopped. When the research group gets on the balance mechanism and keeps her balance again, the time starts from the point it stopped. For about one minute the test goes on like this. When the time is completed, each attempt to provide balance (after the fall) is counted and this figure is recorded as the point of the person after the finishing of one minute at the end of the test (Zorba 1999).

20 Meter Shuttle Run Test

For the measurement of VO2 Max, 20 m shuttle run test was used. And in order to determine the running speed, 20 m shuttle run test cassette was used in accordance with the protocol. The subjects ran the 20 meter runway by touching the constricted line with their feet and the test continued till they made two mistakes and the result was recorded in matters of ml/kg/min (Tamer 2000; Mulazimoglu 2014).

Vital Capacity Measurement

The vital capacities of the sedentary women were measured by the process of "Maximal exhalation after maximal inhalation" (Ergen 2002).

Nelson Reaction Speed Test

The subject sits on the chair with her forearm and hand on the table in a comfortable way. Thumb and index finger tips are brought 8-10 cm outside the table. The upper parts of the thumb

and index finger are brought parallel to each other, the tip of the test ruler is positioned between the thumb and index finger of the subject, brought to the same position of the upper surface of the subject's thumb and the subject is looking directly on the concentration region. When the ruler was released, the subject was told to hold the ruler and with the command of 'get ready', 20 trials were made and by omitting the highest 5 trials, the mean value of the remaining 10 trials was recorded as the reaction rate of the person (Tamer 2000).

Training Program

The study was restricted to 8 weeks. The exercises were determined as 3 days a week and as 50-60 minutes and the trainings were completed in the company of Gaziantep University Graduate 1. Degree Swimming Instructor and two experts who are Mugla University Post Graduate students and pilates instructors. The experiment group did 10 minutes of land exercises, 20 minutes of core exercises, 20 minutes of water exercises and 10 minutes of cooling exercises. On the other hand the control group started with 10 minutes of warm up exercises and without doing any other training than the weekly training programs they only did water exercises. The trainings were applied as 45 minutes for the 1st and 2nd week, 55 minutes for the 3rd and 4th weeks, 60 minutes for the 5th and 6th weeks and 50 minutes for the 7th and 8th weeks respectively. The control group did land trainings and swimming exercises 3 times a week during the 8 weeks, but did not do any additional core training

Statistical Analysis

The data obtained in the research were transferred to a computer. The data were analyzed by using the statistical program. First, the pre-test measurements of the Control and Experiment groups were taken and the difference between the pre-tests was examined. After 8 weeks of training program, it was examined whether there is differentiation between the post-test values of experiment and control groups. While evaluating the data, defining statistical methods (Number, Percentage, Mean, Standard deviation) were used. For the comparison of the quantitative data, for defining the difference between the two groups Mann Whitney-U test was used. Non-parametric Wilcoxon test was used for the analysis of pre-tests and post-tests. The findings were evaluated in the confidence interval of 95 percent and on the level of 5 percent significance ($p<0.05$).

The 10 Core Exercise program selected in the above table was applied in a spectral method in each week for two (2) days (Table 1).

FINDINGS

The findings obtained from the analysis of the data collected from the women are presented in tables.

When the mean values of the age and height averages of the participants were examined as per the groups; when the experiment group sportswomen average value was examined, it was seen that the age average of experiment group's sportswomen is (20.40±1.64) and height average is (169.32±7.02); when the control group sportswomen average value was examined, it was seen

Table1: 8 week core training program applied in the research

Training program	*1-2 Week*	*3-4 Week*	*5-6 Week*	*7-8 Week*
Core movements	*Time/ Repeat time*	*Time/ Repeat time*	*Time/ Repeat time*	*Time/ Repeat time*
Side bend	20 sec	15 sec	12 sec	15 sec
Power shiver	20 sec	15 sec	12 sec	15 sec
Alternate legs jump	15	10	8	10
Squat	15	10	8	10
Crunch	15	10	8	10
Lying twist trunk	15	10	8	10
Twist with medicine ball	15	10	8	10
Side bridge	20 sec	15 sec	12 sec	15 sec
Alternate plank	20 sec	15 sec	12 ec	15 sec
Alternate superman	20	10	8	10

that the age average of control group's sportswomen is (20.70±1.72) and height average is (165.00±4.91) (Table 2).

Table 2: Age and height average of the groups

Variables	*n*	*Experiment group(X, ±sd)*	*Control group(X, ±sd)*
Age	20	20.40±1.64	20.70±1.72
Height	20	169.32±7.02	165.00±4.91
Weight	20	63.87±9.52	62.30±7.34

When the pre-test results of the experiment and control groups were compared; in the weight, fat percentage, right-left hand grip, leg strength, flexibility, vertical leap, shuttle, vital capacity, and nelson reaction measurements, there was no significant statistical difference found as per the result of Mann Whitney-U test. In the back strength and Flamingo balance tests, a significant difference was statistically found as per the result of Mann Whitney-U test ($p<0.05$) (Table 3).

When the post-test results of the experiment and control groups were compared, in the weight, fat percentage, right hand grip, flamingo balance, shuttle run, and Nelson reaction measurements, no significant difference was statistically found as per the result of Mann Whitney-U test ($p>0.05$). In the left hand grip, leg strength, back strength, flexibility, vertical leap and vital capacity tests, a significant difference was statistically found as per the result of Mann Whitney-U test ($p<0.05$) (Table 4).

In order to determine whether the mean of post-test of experiment group measurements showed a significant difference and by the result of the Wilcoxon test made for the paired groups, the difference between the arithmetic means of the measurements of fat percentage, left hand grip, leg strength, back strength, flamingo balance, flexibility, vertical leap, shuttle

Table 3: Comparison of pre-tests of experiment and control groups

Variables	*n*	*Experiment pre-test (X±sd)*	*Control pre-test (X ±sd)*	*t*	*p*
Weight	20	63.87 ± 9.52	62.30 ± 7.34	179.50	0.58
Fat percentage measurement	20	17.99 ± 5.30	17.95 ± 5.05	193.50	0.86
Right hand grip	20	27.07 ± 5.57	28.30 ± 3.66	184.00	0.66
Left hand grip	20	26.52 ± 4.89	24.90 ± 3.51	171.50	0.44
Leg strength	20	68.35 ± 15.06	60.60 ± 11.21	139.50	0.10
Back strength	20	78.00 ± 15.75	68.25 ± 8.77	100.00	**0.07**
Flamingo balance	20	1.90 ± 1.33	0.40 ± 0.60	69.50	**0.00**
Flexibility	20	32.12 ± 11.13	30.60 ± 9.72	188.00	0.745
Vertical leap	20	40.30 ± 11.39	37.00 ± 11.34	166.50	0.364
Shuttle run	20	57.67 ± 14.25	51.18 ± 15.71	109.00	0.146
Vital capacity	20	458.42 ± 97.71	416.11 ± 78.23	128.00	0.189
Reaction	20	8.25 ± 4.77	8.40 ± 2.66	178.00	0.550

Table 4: Comparison of post-tests of experiment and control groups

Variables	*n*	*Experiment pre-test (X±sd)*	*Control pre-test (X ±sd)*	*t*	*p*
Weight	20	63.24 ± 8.88	61.705 ± 7.22	179.50	0.579
Fat percentage Measurement	20	16.61 ± 4.94	17.600 ± 4.83	177.00	0.534
Right hand grip	20	30.65 ± 5.78	28.20 ± 3.78	137.50	0.090
Left hand grip	20	32.15 ± 4.57	25.30 ± 2.98	29.50	**0.000**
Leg strength	20	71.26 ± 13.12	60.45 ± 10.40	102.50	**0.008**
Back strength	20	80.85 ± 15.21	66.75 ± 8.73	73.00	**0.001**
Flamingo balance	20	0.55 ± 0.99	0.40 ± 0.60	195.50	0.880
Flexibility	20	37.00 ± 9.65	30.89 ± 9.85	126.00	**0.045**
Vertical leap	20	44.35 ± 11.36	36.75 ± 11.19	124.00	**0.039**
Shuttle run	20	50.56 ± 13.14	50.94 ± 16.62	151.50	0.740
Vital capacity	20	485.79 ± 94.71	412.78 ± 72.91	95.50	**0.022**
Reaction	20	6.25 ± 4.33	7.90 ± 2.47	140.00	0.103

and vital capacity was statistically found to be significant ($p<0.05$). The difference between the arithmetic means of the measurements of weight, right hand grip, and nelson reaction was not found to be statistically significant ($p>0.05$) (Table 5).

As a result of Wilcoxon test made for the paired groups in order to determine whether the means of control group's post-test showed a significant difference; the difference between the arithmetic means of measurements of weight, back strength, shuttle, and nelson reaction was statistically found to be significant ($p<0.05$). The difference between the arithmetic means of measurements of fat percentage, right hand grip, left hand grip, leg strength, flamingo balance, flexibility, vertical leap, vital capacity was not found to be statistically significant ($p>0.05$) (Table 6).

DISCUSSION

At the end of the research, after the 8 week long core training applied to sedentary women; the findings obtained in the values, such as physiological skills like vital capacity; motoric skills like vertical leap, left hand grip, leg and back strength, flexibility, were found to be significant at the level of ($p<0.05$).

When the sport literature was examined, no studies of core training were found which have been applied on sedentary women between the ages of 18 to 24 or on women swimmers. It was seen that similar studies had been made in other sport branches and in other age/sex groups.

It was found out that the core training which was the subject of the researchers had positively contributed a lot to the development of some motoric skills on sports people and sedentary

Table 5: The comparison of pre-tests and post-tests of experiment group

Variables	*n*	*Experiment pre-test (X±sd)*	*Control pre-test (X ±sd)*	*t*	*p*
Weight	20	63.87± 9.52	63.24± 8.88	-1.49	0.137
Fat percentage measurement	20	17.99± 5.31	16.61± 4.94	-2.87	**0.004**
Right hand grip	20	30.65± 5.78	28.20± 3.78	137.50	0.090
Left hand grip	20	26.52± 4.89	32.15± 4.57	-3.92	**0.000**
Leg strength	20	68.35±15.06	71.26±13.12	-2.42	**0.016**
Back strength	20	78.00±15.75	80.85±15.21	-3.25	**0.001**
Flamingo balance	20	1.90± 1.33	0.55± 0.99	-3.03	**0.002**
Flexibility	20	32.12±11.13	37.00± 9.65	-3.73	**0.000**
Vertical leap	20	40.30±11.40	44.35±11.38	-3.94	**0.000**
Shuttle run	20	50.56±13.14	57.67±14.25	-3.63	**0.000**
Vital capacity	20	458.42±97.71	485.79±94.71	-3.31	**0.001**
Nelson reaction	20	8.25± 4.78	6.25± 4.33	-1.67	0.094

Table 6: The comparison of pre-tests and post-tests of control group

Variables	*n*	*Experiment pre-test (X±sd)*	*Control pre-test (X ±sd)*	*t*	*p*
Weight	20	62.30± 3.66	61.71± 7.22	-2.938	**0.003**
Fat percentage measurement	20	17.95± 5.05	17.60± 4.83	-1.767	0.077
Right hand grip	20	28.30± 5.57	28.20± 3.78	-1.000	0.317
Left hand grip	20	24.90± 3.51	25.30± 2.98	-1.245	0.213
Leg strength	20	60.60±11.21	60.45±10.40	-0.528	0.597
Back strength	20	68.25± 8.77	66.75± 8.73	-3.449	**0.001**
Flamingo balance	20	0.40± 0.60	0.40± 0.60	0.000	1.000
Flexibility	20	30.60± 9.72	30.89± 9.85	-1.683	0.092
Vertical leap	20	37.00±11.35	36.75±11.19	-0.571	0.568
Shuttle run	20	50.94±16.63	51.18±15.71	-2.062	**0.039**
Vital capacity	20	416.11±78.23	412.78±72.91	-1.292	0.196
Nelson reaction	20	8.40± 2.66	7.90± 2.47	-2.233	**0.026**

individuals (Santana 2005; Samson et. al. 2007; Bassett and Llyod 2011; Hibbs et al. 2008; Thomas et al. 2009; Afyon and Boyaci 2013). In this study, the 8 week long core training, which had been applied to women between 18 to 24 years of age, turned out to contribute positively to the development of some motoric skills in these women, which makes it consistent with many studies in sport literature.

In the literature, it is seen that Core trainings have positive effects when used to decrease the disability risks and to rehabilitate. Considering that the experiment group in the research is sedentary individuals, it can be said that for the group whose strength had developed there is less risk of disability. Our findings seem to be consistent with some studies in the literature (Leetun et al. 2004; Hessari et al. 2011; Afyon 2014).

In a study which compared the resting exercise and resting respiration circulation parameters of various sport branch athletes and sedentary persons, Erdogan and his friends (1981) said they found out that there was a significant fall in the resting stated pulse of the athletes when compared with the control group. In this study also, positive changes were statistically determined in the vital capacities of the women.

In the experiment groups to whom various training programs were applied, it was seen that there were significant differences in the physical properties. When the literature is examined, the researchers meet studies which are parallel to theirs (Astrand 1968; Gokdemir et al. 2007; Juricskay et al. 2007). With the core training the researchers applied, they have found out significant statistical differences in the experiment group's pre-test and post-test body fat percentage measurements.

In conclusion, at the end of the 8 weeks of core training applied to women between 18 to 24 years of age who were doing swimming sport; a significant development of ($p<0.05$) level was found out in the values of motoric skills such as left hand grip, leg and back strength, flexibility and physiological skills such as vital capacity and vertical leap. Because of its positive effects on some physiological and motoric skills, core training program can be recommended to the trainers for them to apply to swimmers in women groups.

CONCLUSION

It is thought that when applied to swimming sport, core exercises may contribute positively to some physical and motoric skills, but many other researches are yet to be made.

RECOMMENDATIONS

It is recommended that the researchers do other comprehensive studies of core training with different age groups, with other exercise methods and determine the physical and motoric effects of core training.

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