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Comparison of Environmental Measurement Values in Extremities with Some Strength Parameters after Weight Training

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Abstract

It was aimed to investigate whether the increase in arm and leg circumference measurement values of weight training applied in a training has an effect on strength. Twenty-two boxers with a mean age of 20.09 ± 1.41 years were included in the study. Measurements were taken twice, after the warm-up, before starting and after training. Right and left upper arm and forearm circumference, right and left femur and calf circumference values were determined. In addition, right and left-hand grip strength, leg strength and back strength values were determined. As a result of the analysis, it was seen that there was no significant difference ($p < 0.05$) between right and left-hand grip strength pre-test and post-test values. It was determined that there was a difference between the leg strength pre-test and post-test values and between the pre-test and post-test values of all other parameters in favour of the post-test. However, the right arm and forearm circumference measurement values were calculated with the right-hand grip strength, respectively. Left-arm and forearm circumference measurement values were calculated with the left-hand drag force, respectively. Shoulder circumference measurement values with both right hand and left-hand drag force, respectively and correlation was detected.

Introduction:

Maintaining high muscle strength and hypertrophy is important for a variety of populations. For the general public, these features make it easier to perform daily life activities (Ranten *et al.*, 2002). Again, the evidence of the negative relationship between muscle fitness and mortality is not only clear but also has wide-ranging effects on health (Fitzgerald *et al.*, 2004). The relationship between body structure and functions of sports has been the subject of research until today in sports research. In addition to physiological, psychological, and tactical factors, the position of the body, structure, and performance has an important place in evaluating (Viviani & Baldin, 1993). The need to maximize muscle strength is also very important to many athletes. Because in sports, a production capacity close to the maximum power is required. Given the direct correlation between muscle cross-sectional area (CSA) and force generation (Maughan *et al.*, 1983) hypertrophy is necessary.

Performance in sports has been reported to be directly

related to the athlete's body structure, gender, and age (Kayserilioglu *et al.*, 1996). Force generation depends on the laws of physics. Muscle strength; The mass of the muscles involved in the movement is significantly affected by the total cross-sectional area (physiological cross-sectional area) and the structure of the muscles' leverage systems (Nicolay & Walker, 2005).

Force, according to Zatziorski; is when the organism meets or defeats an external resistance through muscles. All sports disciplines use force to increase the performance of athletes (Karatosun, 2010). Force can be defined in a narrow sense as the ability to apply force. The effect of strength on success in all sports branches is accepted by everyone. Especially in heavyweight sports, the quality and quantity of force are even more important. Today, strength and strong athletes are evaluated in proportion to athletes' body structures and the strength they produce per body weight (Winter & Maughan, 1991).

Resistance training is the primary form of exercise to increase muscle adaptation. Studies (Sayin *et al.*, 1995; Kayserilioglu *et al.*, 1996) show that increased resistance

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exercise can cause significant increases in muscle strength and hypertrophy, regardless of age and gender. Studies (Kraemer & Ratamess, 2004; Mcdonag *et al.*, 1984) reported that 65% of the maximum load should be worked to achieve an increase in muscle hypertrophy, and even higher loads were required to maximize strength. It has been shown that resistance training increases muscle mass and muscle strength after 2-3 months (Peterson *et al.*, 2001).

The aim of this study is to; Whether or not weight training applied to athletes has an effect on environmental measurement values, and how this increase affects some strength parameters..

Methodology & Findings:

The study group was composed of 22 boxers, aged between 18-22 years who were engaged in sports at the Van Youth Provincial Sports Directorate, and whose bodyweight mean was 71.27 ± 9.50 kg. In the formation of the working group, criteria such as the participants' absence of any health problems and volunteering were taken as a basis. 15 minutes of warm-up was done before the measurements were taken. After that, pre-test measurements were taken. The last test measurements were taken after the strength training. It was aimed to determine whether there was a change in environmental measurements and some force parameters after the strength training.

Measurements were taken; age, height, and weight are determined as environmental measurements; Shoulder circumference measurements were taken in cm with the right and left arm, right and left forearm, right and left upper leg, right and left lower leg. Among the force measurements, right-hand grip strength, left-hand grip strength, and back strength were measured. Athletes' height; In anatomical posture, barefoot, with the heels of the feet united, holding the breath, the head was positioned in the frontal plane with the overhead plate touching the vertex point, and the measurement was taken in 'cm' with a stadiometer (Holtain Ltd., UK) measuring ± 1 mm. Bodyweight; The subjects were taken in kg 'with a scales (Tanita 401 A, Japan) measuring with an accuracy of ± 100 gr while only in shorts, bare feet, and anatomy posture in 25 positions.

Aptamil brand inflexible 7 mm. A thick tape measure was used. Measurements were made while the candidates were standing and the tape measure was made parallel to the floor, fitting the measurement area exactly.

Shoulder Perimeter was measured in cm, passing through the widest point of the deltoid muscles. Arm Environment; Two measurements (cm) were taken from the widest point of the arm, from the elbow joint before and after the training while the elbow was contracted (at 90 degrees).

For forearm environment two measurements (cm) were taken from the widest point of the forearm, the arm in flexion position from the elbow joint, and before and after

the training when the elbow was at 90 degrees.

Thigh Environment Measurement of the thigh muscle, were taken while the participant was standing, was asked to contract the thigh muscle (m. Quadriceps muscle), close to the groin and from the widest area (cm).

While calf measurements were made, the candidate was asked to rise at two feet. Measurements were made from the widest part of the calf (m. Triceps Surae in contraction) (cm) Force Measurements: Leg and back strength (Prosport-TMR HBD 1000) was measured with a dynamometer and claw force (Takei brand digital) was measured with a dynamometer. Handgrip strength was measured with a takei brand handgrip.

Looking at the pre-test post-test values of the variables in Table-1, it was found that there was no significant difference between the right and left-hand grip strength pre-test post-test values. It was observed that there was a significant increase at $p < 0.05$ level between leg pre-test post-test strengths. It was determined that there was a significant ($p < 0.01$) difference between the pretest and posttest values of other variables in favour of the posttest.

Table-1: Pre-test and Post-test mean values and significance levels of some variables

Variables	Pre-test Mean $\pm$ Std.	Post-Test Mean $\pm$ Std.	Mean Diff.	t	p
RAC (cm)	30.09 $\pm$ 3.56	32.00 $\pm$ 3.85	1.9091	-11.039	.000
RFC (cm)	26.46 $\pm$ 2.77	28.55 $\pm$ 2.40	2.0909	-12.090	.000
RH-gF(kg)	43.56 $\pm$ 13.64	43.53 $\pm$ 14.45	-.0364	.030	.977
LAC(cm)	30.36 $\pm$ 3.86	31.73 $\pm$ 3.55	1.3636	-7.090	.000
LFC (cm)	26.18 $\pm$ 2.92	28.18 $\pm$ 2.61	2.0000	-21.494	.000
LH-gF (kg)	39.31 $\pm$ 7.56	39.56 $\pm$ 7.91	.2545	-.460	.651
RFeC	51.09 $\pm$ 5.06	52.55 $\pm$ 5.02	1.4545	-5.405	.000
RCC (cm)	36.09 $\pm$ 2.71	36.64 $\pm$ 2.70	.5455	-3.813	.001
LFeC	50.74 $\pm$ 4.96	52.18 $\pm$ 4.95	1.4545	-6.197	.000
LCC (cm)	35.91 $\pm$ 3.07	36.55 $\pm$ 3.00	.6364	-3.780	.001
LegS (kg)	130.09 $\pm$ 27.89	133.73 $\pm$ 30.67	3.6364	-2.389	.026

RAC-Right arm circumference; RFC-Right forearm circumference; RH-gF-Right hand grip force; LAC-Left arm circumference; LFC- Left forearm circumference; LH-gF-Left hand-grip force; RFeC-Right femoral circumference; RCC-Right calf circumference; LFeC-Left Femoral Circumference; LCC- Left Calf Circumference; LegS-Leg Strength.

Table 2. Correlation coefficients of right and left hand grip strength values with some variables

Variables	RH-gS (kg)	LH-gS (kg)
Right arm circumference (cm)	.533*	-
Right forearm circumference (cm)	.510*	-
Left arm circumference (cm)	-	.427*
Left forearm circumference (cm)	-	.384
Shoulder circumference (cm)	.574**	.656**

* $p < 0.05$; ** $p < 0.01$

When the correlation coefficients of the variables in Table 2 with the right and left hand grip strengths were examined, it was determined that the right upper arm and forearm circumference measurement values showed significance at the level of $p < 0.05$ with the right hand grip

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strength values. Again, it was found that the left upper arm circumference measurement values showed significance at the $p < 0.05$ level with the values of left hand grip strength. There was a significant relationship between shoulder circumference measurement values and both right and left hand grip strength values at $p < 0.01$ level.

Table 3. Correlation Coefficients of Leg and Back Strength Values with Some Variables

Variables	LegS (kg)	BackF (kg)
Right femoral circumference (cm)	.329	.384
Right calf circumference (cm)	.531*	.640**
Left femoral circumference (cm)	.476*	.435*
Left calf circumference (cm)	.485*	.579**
Back force (kg)	.936**	1

* $p < 0.05$; ** $p < 0.01$

When Table 3 was examined, it was seen that the leg strength had a correlation coefficient of $p < 0.05$ with the right calf, left femur and left calf circumference measurement values, and a $p < 0.01$ level with the back strength. In addition, the back strength was found to have a correlation coefficient of $p < 0.05$ with the left femur circumference measurement and $p < 0.01$ with the right and left calf circumference measurement.

Discussion & Conclusion:

In the study, it was found that there was an increase of $p < 0.01$ in favor of the second measurement between the pre-test and post-test mean values of right arm circumference and right forearm circumference measurements. On the other hand, it was observed that there was no significant difference ($p < 0.05$) between the mean values of right-hand grip strength pre-test and post-test measurements. In addition, the correlation coefficient between right arm and right forearm circumference measurements and right-hand grip strength was found to be $r = .533$ and $r = .510$, respectively. It was determined that these coefficients were significant at the $p < 0.05$ level. It was revealed that the right-hand grip strength ($r = .574$) increased parallel to the increase in shoulder circumference measurement values. In a study conducted on athletes engaged in active sports (Temur, 2017), it was observed that the right-hand grip strength increased in parallel with the right arm circumference measurements. Anakwe *et al.*, (2007), it was revealed that hand grip strength increased parallel to the forearm circumference measurement value. Bompá & Calcina (1994) stated that muscle fibers grow with the increase in myofibril and other cell elements in muscle fibers with strength training. However, he reported that 30-60% of hypertrophy can occur with muscle training. He also suggested that hypertrophy is largely caused by the increase in the diameter of the fibers. The high circumferential measurement values of a limb can be caused by the excess muscle mass in that area, the excess subcutaneous fat layer, and the bone structure.

It was also determined that there was an increase of $p < 0.01$ in favor of the post-test between the left arm and

forearm circumference pre-test and post-test measurement values. Despite the increase in left arm and forearm circumference, there was no significant difference ($p < 0.05$) in left-hand grip strength between pre-test and post-test. The correlation coefficient between left arm circumference measurement and left-hand grip strength was found to be .427, which was significant at the $p < 0.05$ level. The correlation coefficient ($r = .384$) between left forearm circumference measurement and left-hand grip strength was not found to be significant ($p < 0.05$). Jansen *et al.* (2003), in their study comparing hand grip strength and finger grip strength with anthropometric measurements, reported that these forces were positively correlated with arm and forearm circumference measurements. In this study, although the circumference values of the right and left arm circumferences increase with the exercise, the fact that there is no significant increase in the grip strength of both hands shows us that the increase in strength is not possible with an acute increase in the diameter of the muscle fibers, but with a chronic increase. When the relationship between shoulder circumference measurement values and right and left-hand grip strength is examined, the correlation coefficient ($r = .656$; ($p < 0.01$)). It is thought that M. Deltoideus muscle, which extends to the upper end of the humerus by wrapping the shoulder joint from the front, outside, and back, and the developed bone structure may also be effective in this. Because, in another study (Temur, 2012), it was found that Bone Mineral Density positively affected hand grip strength. It was determined that there was a significant increase ($p < 0.01$) between the measurement values of the right femur and calf circumference before and after weight training in favor of the last measurement. Again, it was found that there was an increase of $p < 0.01$ in favor of the last measurement between the values of the left femur and left calf circumference before and after weight training. In parallel with these increasing circumference measurements, an increase in leg strength was found. In a previous study (Temur, 2017), it was found that there was no significant difference ($p < 0.05$) between thigh and calf circumference and vertical and horizontal jump. On the contrary, Yidirim & Özdemir (1986) reported in their study that as the calf circumference increased, the vertical jump distance also increased, and again, as the calf circumference increased, the horizontal jump distance increased in parallel. Brown *et al.*, (1986) in his study, revealed that there is a significant relationship between leg strength and vertical jump. The high circumference values of the thigh and calf area are thought to be due to the muscle mass and bone structure in that area. This can give us information about leg strength. Besides, as a result of the statistical comparison of the leg strength and back strength values of the participants, the correlation coefficient (r) between back strength and leg strength is .936; ($p < 0.01$). It is thought that the connection of the back

muscles with the leg muscles may be effective in this. As a result, the excessive arm and leg circumference measurements increase the strength of these limbs. It was also observed that shoulder-width affected hand grip strength and back strength affected leg strength. Although the upper arm and forearm circumferences increased after weight training, the hand grip strength did not change. However, it was determined that with the increase in the results of the training applied in the measurements of right and left leg, thigh, and calf circumference, an increase in leg strength also occurred.

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