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INVESTIGATION OF THE RELATION OF THE LEG VOLUME TO THE ANAEROBIC POWER VALUES IN THE ELITE SWIMMERS

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Abstract:
The purpose of this study is to investigate the relationship of leg volume to the anaerobic power values in elite swimmers. The average age of the participants was 16.50 ± 52 years, the average age of the sport was 7.83 ± 1.69 years, the average height was 176.36 ± 6.71 cm, body weight average of 66.16 ± 8.56 kg who participated in the swimming competitions and participated in the swimming competitions regularly in Antalya Kulaç Swimming Specialized Sports Club. Right leg volume, left leg volume, total leg volume and anaerobic strength tests of the players were taken. There was a significant positive correlation between the right leg volume and the anaerobic power relationship, the left leg volume with the anaerobic relationship, and the total leg volume with the anaerobic power association values ($p < 0,05$). As a result, the leg volume in the elite swimmers has positive anaerobic results. For this reason, it is suggested that the training programs to be applied should include mainly leg exercises.

Keywords: swimming, leg volume, anaerobic power

1. Introduction

Sports are considered to be very important for public health, recently. It is known by anyone that sports have positive effects on living quality and health. Sportive exercises that are completed through proper programs and techniques might be beneficial for our

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bodies, while sportive exercises completed in an improper way might lead to muscle injuries and muscle damage (Smith and Miles, 2000).

The most serious factors to have an impact on anaerobic performance can be listed as individuals' gender, age, muscle structure, fibril composition, enzyme activity and training. As an addition, it would not be possible to reach desired performance level, unless structure of physical qualities and sports branch that is performed are compliant. Besides, power combines with other performance indicators such as strength, speed, flexibility, agility and durability and impacts sportspeople's performances in a positive manner. (Özkan, Köklü and Ersöz, 2010)

Considering another view, it is reported in some studies conducted by many researchers, it is reported that anaerobic power and anaerobic performance values are increased as a result of an increment in leg muscle volume and muscle mass, calf, thigh and leg volume and leg mass (Dr. Ste Croix et. al., 2000). Reason for the condition is considered that, having a number of muscle groups, muscle fibres and muscle mass as parts of leg formation leads for more power and strength formed by the leg (Özkan and Sarol, 2008).

Anaerobic strength is very important for any sportive activities; however, it is more important for some sport branches in which it is utilized in a greater level. As is known, sudden and severe strength power formation is needed in many sports branches such as American football (Kin-İşler et al., 2008), ice hockey, handball, basketball (Potteiger et al., 2010) for their stressful and sudden attack defences; sort distance races (100m, 200m) (Vescovi et al., 2008), near-finish-line attacks of middle distance races (Kalinski et al., 2002), jumping and throwing related branches (Tsaklis, 2002), tables tennis, wrestling (Vardar et al., 2002), gymnastic, tennis and short distance swimming styles (50m, 100m, 200m) (Arpınar et al., 2003; Bencke et al., 2002), skiing (Mikkola et al., 2010) and many more. This system in need is provided by the aerobic energy system (Al-Hazza et al., 2002, Bencke et al., 2002). Considering all these conditions, anaerobic capacity and having the conscious of anaerobic powers have a great importance in terms of sportspeople's performance.

2. Materials and Methods

12 volunteer, male sportsmen who are licenced at Antalya Kulaç Yüzme İhtisas Spor Kulübü (Swimming specialty sports club) having 16.50±,52 years age mean, 7.83±1.69 sports career mean, 176.33±6.71 cm height mean and 66.16±8.56 kg weight mean have attended to study group.

2.1 Laboratory Measurements

Participants' height values are measured with 0.1 precision SECA (Germany) height scale, their body weight are measured with 0.5 precision SECA (Germany) electronic scale. Anaerobic power is measured with a Monark 834 E (Sweden) bicycle ergometer which is modified for WAnT, connected to a computer and working with a compatible software. Leg volume values are measured with a tape measure, a ruler featuring a water gauge and a Harpenden calliper.

2.2 Statistical Analysis

Data analysis is conducted in a computer environment, using SPSS 20.0 statistics program.

For normal quantile of the data, "Shapiro-Wilk Test" is conducted. Minimum and maximum value, arithmetic mean and standard deviation values are calculated in statistical analysis. "Pearson" correlation analysis is used for normal quantile data and "Spearman" correlation analysis for abnormal quantile data is used for the relationship between leg volume and anaerobic power. Data is assessed according to "0.05" relativity level.

3. Findings

Table 1: Normality Test of Anaerobic Power Data

	Mean	SD	p
Peak Power (W)	923.69	7.37	.998
Mean Power (W)	726.65	6.53	1.000

Table 1 shows Peak Power and Mean Power data in normal quantile.

Table 2: Normality Test of Leg Volume Data

Leg Volume (lt)	Mean	SD	p
Right Leg	7992.83	1029.82	.379
Left Leg	7974.74	1016.88	.395
Total Leg	15967.57	2046.67	.387

Table 2 shows leg volume data in normal quantile

Table 3: Relationship between Right Leg Volume and Anaerobic Power

	Mean	SD	r	p
Peak Power (W)	923.69	7.37	.222	.047
Mean Power (W)	726.65	6.53	.253	.038

Table 3 shows that, there is a positive relative relationship between right leg volume values and peak and mean power values ($p<0,05$).

Table 4: Relationship between Left Leg Volume and Anaerobic Power

	Mean	SD	r	p
Peak Power (W)	923.69	7.37	.222	.047
Mean Power (W)	726.65	6.53	.253	.038

Table 4 shows that, there is a positive relative relationship between left leg volume values and peak and mean power values ($p<0,05$).

Table 5: Relationship between Total Leg Volume and Anaerobic Power

	Mean	SS	r	p
Peak Power (W)	923.69	7.37	.222	.047
Mean Power (W)	726.65	6.53	.253	.038

Table 5 shows that, there is a positive relative relationship between total leg volume values and peak and mean power values (p<0,05).

4. Discussion

Having excessive fatty tissues or body mass without fat impact on performance for all sports branches which involve anaerobic workout. A high level body fat ratio causes a decrease in strength, agility, flexibility and leads to energy loss. The reason is that, fatty tissues have no contribution into body's anaerobic energy system and cause to excessive energy consumption as they limit muscles' movements. Additionally, excessive fat ratio might also have a negative impact on performance in sport branches requiring durability and agility (Dore et al., 2000). Considering sports in which anaerobic energy is superior, it is undeniable that a high level of body fat percentage impacts anaerobic performance negatively.

It is reported in a study that there is a relationship between not fatty body mass and anaerobic performance while no relationships are found between not fatty body mass and body fat percentage (Vardar et al., 2007). Additionally, it is found in the Wingate test that maximum power is affected by muscular contraction Murphy et al., 1986). Power depends on muscles' length and speed of contraction before contraction. In muscular contraction, there is an inverse proportion between speed of contraction and load. It is also known that, participant's reacted total speed to load decreases and this decrease is proportionated with strength and as a result maximum power outputs are affected. Additionally, thigh wideness, large amount of muscle mass and muscle fibres causes a higher level strength-power output and this affects maximum power (Bouchard et al., 1991; De Ste Croix et al., 2000; Armstrong et al., 2001).

In a study conducted by Günay and Onay (1999), a positive relation was found between leg strength, body length and leg length, considering relation levels between anthropometric parameters and strength parameters. These results have shown that sportspeople who are having longer leg lengths have a higher leg strength. Additionally, this appointed relation between anaerobic power, wider thighs, thigh length and height leads to the idea that, sportspeople who have longer thigh lengths and wider thighs might have a higher level anaerobic power. Besides, muscles' fibril length, muscles' cross sectional area, leg volume and muscle mass play a determining role on the power that muscle will product in anaerobic conditions (Armstrong et al., 2001).

It is frequently reported in many studies that, sportspeople who have a greater amount of leg volume, muscle mass and muscle's cross sectional area have a better anaerobic performance (Van Praagh, 1990; Welsman, 1997; De Ste Croix, 2000; Grant et al., 2001; Dore et al., 2001).

Welsman et al. (1997) have found a relative relationship between leg mass volume and anaerobic performance. In a similar study, a relationship between anaerobic power and not fatty body mass, not fatty leg volume and body weight. It is reported in literature reviews that, an increase in thigh, calf, leg volume, leg muscle volume and not fatty leg volume causes an increment in anaerobic performance values. Findings of our study about the relationship between leg volume and anaerobic power bear resemblance to many studies in the literature.

5. Conclusion

Consequently, it is revealed that swimmers who have a greater leg volume might have a higher level anaerobic power. It is recommended to concentrate on lower extremity in any subsequent training programs. Our research will make a contribution into literature.

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