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The Effect of Height on the Anareobic Power of Sub-Elite Athletes

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Abstract: The purpose of this study was to determine the effect of height on the anaerobic power of the sub-elite athletes attending to the department of physical education and sports. Participants of this study were composed of 94 male athletes. They were divided into two groups according to their heights taller than 180 cm (n=48) and shorter than 180 cm (n=46). Their age and anaerobic power characteristics were determined and their weight, height, leg strength and vertical jump characteristics were measured. Data obtained from measurements of each group were compared by Independent Sample T-Test. In addition, correlation analysis was applied to determine if there is a statistical relationship between height and anaerobic power. In conclusion; when there was a statistically significant difference between two groups in height, there were no significant differences between groups' age and weight parameters. In addition, there were no significant differences between two groups' leg power and vertical jump characteristics but there was a statistically significant difference between two groups' anaerobic power characteristics. Also, the correlation analysis results indicated that although there was a significant correlation between height and anaerobic power, there were no significant correlations between height and leg power, height and vertical jump.

Key words: Height · Anaerobic Power · Leg Strength · Vertical Jump

INTRODUCTION

Human skeletal muscle can perform work in the absence of an adequate supply of oxygen as a consequence of its ability to generate energy anaerobically [1]. In muscular activities that require near-maximal force production, such as sprint running, cycling and swimming, much of the energy needs are met by the ATP-phosphocreatine (PCr) system and anaerobic breakdown of muscle glycogen (glycolysis) [2]. Anaerobic power describes as a work performed at unit time [3] or a capability of reversibility of athlete's energy to strength at unit time [4].

Anaerobic power is one of the most important qualities for sports, because of "displaying the force depends on anaerobic process" [5]. Since the sufficient capacity of converting energy to power is closely related with fitness level of athletes, determination of anaerobic power capacity may be starting point of programming of anaerobic training periods [6]. For that reason, correctly determination of anaerobic power is very important. It was studied by lots of researcher [7,8] and several scientific methods like Wingate Test, Margaria-Kalamen Test, Lewis Test were founded for estimating of anaerobic power. Especially, jump tests are quite attractive considering that it provides a more specific measure of power in many athletes [9]. One of the most popular power prediction equations used with the vertical jump is the Lewis Formula [10]. The Lewis formula or nomogram was established by Fox and Mathews in 1974 is a commonly used formula. This formula only estimates average power and is based on a modified falling body equation. The original formula used the units of kg•m•sec.$^{-1}$(*http://www.topendsports.com/testing/vertical-jump-power.htm*). The Lewis Formula and Nomogram, widely adopted by researcher, are used to calculate power output from vertical jump-and-reach distance and body weight. The common point of vertical jump based formulas as the Harman Formula, Johnson and Bahamonde Formula, Sayers Formula and also Lewis Formula use body weight

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parameter. That is, when the anaerobic power is estimated with the help of one of these tests, body weight parameter has to be used. However, some studies assert that height also effects on anaerobic power [11-16] and it should be considered for anaerobic power. The purpose of this study was to determine if there is an effect of height by oneself on the anaerobic power or not.

MATERIALS AND METHODS

Participants of this study were composed of 94 male athletes whose body weights and ages are similar. They were divided into two groups according to their heights taller than 180 cm and shorter than 180 cm. The taller group was composed of 48 athletes and shorter group was composed of 46 athletes. Their ages and anaerobic power were determined and their weight, height, leg strength and vertical jump were measured.

Weight was measured by Tanita Body Fat Analyzer (Tanita, Japan) and height was measured by Holtaine Stadiometer (Holtaine, U.K.). Vertical jump was measured by Takei Digital Jumpmeter (Takei, Japan) with 0.1 cm sensitiveness and leg strength was measured by Takei Back and Lift Dynamometer (Takei, Japan).

The vertical jump test is used to measure leg power. The test consisted of bending at the knees in the standing position and taking off from both feet using a counterswing movement of the arms. The jump height was monitored with a digital jump meter.

For leg strength, participant was instructed to stand on a platform with knees fully extended and head and trunk erect. The participant grasped the hand bar using an alternating grip and the hand bar was positioned across the thighs. The participant was instructed to pull the hand bar straight upward using the leg muscles. So, the leg strength was monitored with a back and lift dynamometer.

Every test movement was explained to participants before application. For a 15 minutes warm-up duration was given to athletes. During warm up phase all athletes used same warm up protocol included low intensity running and some callisthenic movements. Whole measurements were repeated twice and the best one value of two attempts was recorded. Anaerobic power value was estimated with the help of Lewis Formula [17] shown below;

$$p = \sqrt{4,9}\ (weight)\ \sqrt{D^n}$$

In this formula, P signs power, D^n signs vertical jump distance as the meter and $\sqrt{4,9}$ is a constant figure.

Values were compared as statistical by SPSS (ver.11) and "á" level was set as 0.05 for statistical significance. Data obtained from measurements of each group were compared by Independent Sample T-Test. In addition, correlation analysis was applied to determine if there is a statistical relationship between height and anaerobic power.

RESULT

Totally 94 participants' mean values in age was 21.32±1.75 year, height was 178.04 ±5.82 cm, body weight was 72.56±3.68 kg, leg strength was 132.43±26.31 kg, vertical jump was 58.71±8.42 cm and anaerobic power was 122.84±11.67 kgm/sec.

Results of groups' values, differences between two groups and results of correlation analysis are shown as tables.

When there was a statistically significant difference ($p< 0.05$) between two groups in height, there were no significant differences ($p<0.05$) between groups' age and weight parameters. In addition, there were no significant differences ($p<0.05$) between two groups' leg power and vertical jump characteristics but there was a statistically significant difference ($p< 0.05$) between two groups' anaerobic power characteristics.

The correlation analysis results indicated that although there was a significant correlation ($p< 0.05$) between height and anaerobic power, there were no significant correlations ($p>0.05$) between height and leg power, also height and vertical jump.

DISCUSSION AND CONCLUSION

In this study, the obtained results were similar with other studies results at the point of age, height, weight, leg strength, vertical jump and anaerobic power. In their study, Bayar and Aktop [18] found the mean value of age of athletes as 21.29±2.25 year, Özkan *et al.* [7] found as 21.71±3.02 year, Selcuk and Aydos [19] found as 21.13±0.73 year. At the point of height; the mean value was found as 176.26±5.85 cm by Selçuk and Aydos, Aslan and İnan [20] found as 179.68±6.70 cm.

In the study of Karakollukçu and Aslan [21], the mean of weight of athletes was 71.06±8.41 kg and also Aslan and İnan [20] found as 74.24±10.99 kg.

Athletes' leg strength was found as 117.84±49.65 kg in the study of Biçer *et al.* [22]. Kutlu and Karadağ [23] found 125.00±12.90 kg and then Aslan and İnan [20] found as 132.51±23.51.

Table 1: Mean Values and Differences Between Two Groups

Variables	Taller Group (N=48) $\bar{x} \pm SD$	Shorter Group (N=46) $\bar{x} \pm SD$	t	p
Age (year)	21.02±1.80	21.63 ±1.66	-1.70	p>0.05
Height (cm)	182.33±4.15	173.57±3.45	11.11	p<0.05
Weight (kg)	73.10±4.06	72.00±3.19	1.462	p>0.05
Leg Strength (kg)	132. 35±26.32	132.50±26.60	-0.027	p>0.05
Vertical Jump (cm)	59.73±7.79	57.65±8.99	1.198	p>0.05
Anaerobic Power (kgm/sec.)	125.26±12.07	120.31±10.80	2.094	p<0.05

Table 2: Correlation Analysis Results

Variables	Correlation (r)	Result	
Height - Anaerobic Power	0.302	p= 0.003	p< 0.05
Height - Leg Strength	-0.040	p= 0.702	p>0.05
Height - Vertical Jump	0.144	p= 0.167	p>0.05

It was indicated that the means of three different groups' vertical jump values were respectively 51.00±7.00 cm, 56.00±10.00 cm and 52.00±11.00 cm by Savaş and Uğraş [24], Duyul *et al.* [25] found in three different groups respectively 65.72±9.85 cm, 54.37±6.72 cm and 53.80±9.07 cm.

At the point of anaerobic power of athletes; the mean value was found by Aslan ve İnan [20] as 128.53±19.55 kgm/sec. and Eler and Bereket [26] found as 131.26±13.26. Lots of studies indicated that there was a significant correlation between height and anaerobic power [11-16].

In this study, there was also a relationship between height and anaerobic power. In addition, although group's body weight, age, leg strength and vertical jump characteristics were similar, the taller group's anaerobic power values were higher than the shorter group's values. In this case; it can be claimed that only height also effects on anaerobic power by oneself.

For that reason; when the anaerobic power is estimated via Lewis Formula, besides body weight, height characteristics can be considered as one of the main effects and this formula which estimate anaerobic power can be revised in the light of this situation. Moreover, studies like this study can be designed for other tests and formulas which used body weight for estimating anaerobic power.

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