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Investigation of The Body Composition And Maximal Oxygen Consumption Capacity Of Elite Boxing And Wrestling Athletes

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Abstract

The aim of the study is to compare body composition and maximal oxygen consumption of elite boxing and wrestling athletes and to investigate the relationship between body composition and maximal oxygen consumption. A total of 26 elite athletes (13 boxing and 13 wrestling) were included in the study. On the same day, the and body composition assessment and maximal oxygen consumption measurement of the athletes were performed. Body composition evaluation of athletes was made with MF-BIA (Tanita MC-980, 1000 kHz, Tokyo, Japan) device. Maximal oxygen consumption measurement was made using a direct method breath-by-breath automatic portable gas analysis system (Cosmed K5, Italy). Mann Whitney U Test and Spearman Correlation Test were used for statistical analysis. The statistical significance level was determined as $p < 0.05$. There was not any difference in body weight, body fat percentage, and relative oxygen consumption values of boxing and wrestling athletes ($p > 0.05$); however, there were statistically significant differences in the Body Mass Index, muscle mass, absolute oxygen consumption, carbon dioxide production, respiratory coefficient, and heart rate values ($p < 0.05$). In boxing and wrestling athletes, there was a strong negative correlation between BMI and body fat percentage and relative oxygen consumption values ($p < 0.05$); Muscle mass and relative oxygen consumption values were found to be strong in boxing athletes and moderate in wrestling athletes ($p < 0.05$). As a result of our study, it has been observed that there is a relationship between body composition and maximal oxygen consumption of both boxing and wrestling athletes. In addition, with the knowledge that body composition is important in strength and anaerobic power-based sports branches, it raises the idea that athletes in these branches should do aerobic exercises to keep their body composition at the targeted levels.

Key words: boxing, wrestling, body fat, aerobic capacity

INTRODUCTION

Body composition is one of the important factors affecting sports performance, and It consists of components such as lean body mass, body fat mass, body muscle mass, body fat ratio. While optimal lean body mass and muscle mass affect sports performance positively, excess body fat mass negatively affects performance (29, 30). Body composition is affected by factors such as age, height, and gender; It has also been reported that body composition is affected by normal growth and development processes (4, 14, 28). It is known that the relationship between body composition and sports performance may vary according to the energy requirements of the sports branch (8, 12, 24, 28).

Another important factor affecting sports performance is aerobic capacity. Aerobic capacity is an indicator of a person's endurance in all physical activities, from daily activities to high-intensity exercise. Maximal oxygen consumption (Max VO2)

indicates the person's oxygen-carrying and using capacity, in other words, their aerobic capacity (26). Maximal oxygen consumption can be measured directly on the basis of the amount of oxygen and carbon dioxide in the expiratory air during maximal exercise or calculated indirectly during submaximal exercise using heart rate, exercise intensity, total work, etc. (19). Cinsiyet, yaş, vücut kompozisyonu ve spor branşı maksimal oksijen tüketimini etkileyen faktörlerdendir (19). In previous studies, the relationship between body composition and maximal oxygen consumption was investigated (3). On the other hand, the present study, to the authors' knowledge, is the first study that compares the body composition and maximal oxygen consumption of elite boxing and wrestling athletes in our country and investigates the relationship between body composition and maximal oxygen consumption of these athletes.

In the light of this information, with the hypothesis that boxing and wrestling have different body composition and maximal oxygen consumption, the aim of the study is to compare the body composition and maximal oxygen consumption of elite boxing and wrestling athletes in our country and to investigate the relationship between body composition and maximal oxygen consumption of each branch.

MATERIAL AND METHOD

Participants: A total of 26 national team athletes (13 boxing and 13 wrestling) were included in the study. The athletes were given detailed information about the study. The verbal and written consent of the athletes was obtained. The presence of chronic disease, past or ongoing sports injury history was questioned. Physical examinations were carried out by a sports medicine specialist.

The inclusion criteria in the study were at least 3 years of sports experience and to be at the national team level. The exclusion criteria from the study were to have an ongoing musculoskeletal injury or disease. All procedures of the study were in accordance with Helsinki Criteria and ethics committee approval was obtained from the University Ethics Committee (2020-41 / 04.03.2020).

Study Procedure: Body composition analysis was performed on the first day with the Bioelectrical Impedance Analysis (BIA) method. On the second day, the maximum oxygen consumption was measured with the breath-by-breath automatic portable gas analysis system.

Body Composition Evaluation: Body composition evaluation of the athletes was made with the MF-BIA (Tanita MC-980, 1000 kHz, Tokyo, Japan) device. Athletes were asked not to perform high-intensity exercise for at least 24 hours and not to drink diuretic beverages such as tea, coffee, etc.. At least 8 hours of fasting was achieved before the test. All metal items on the athletes were removed during testing. The test was conducted with athletes standing on the device with bare feet and holding the handpieces of the device with their hands. Bodyweight, body fat ratio, body fat mass, body muscle mass parameters were measured and recorded for statistical analysis.

Measurement of Maximal Oxygen Consumption: Measurement of the maximal oxygen consumption was made by running on the treadmill (H / p / cosmos para control, Germany). After 2 minutes of warm-up at a constant speed of 5 km/h, the speed of the treadmill was increased 0.016km/h per second, and the slope of the treadmill was increased 0.25% per minute. Measurements were made directly via breath-by-breath automatic portable gas analysis system (Cosmed K5, Italy). The basic unit of maximal oxygen consumption measurement is its absolute value expressed in liters per minute or milliliters. However, the absolute value is affected by body weight, therefore results are also expressed as a relative value (milliliter/kg/minute). The observation of three of the criteria listed below at the same time was accepted as an indication reaching the maximal oxygen use capacity, and the test was terminated:

- Despite the increase in workload, the increase in VO2 value between the two applied workloads is 150 ml.min-1. kg-1 or lower,
- Marking perceived fatigue level 17 and above in Borg's original scale
- Respiratory change rate (VCO2 / VO2) (RQ value) is 1.15 or above,
- The heartbeat rate is 85% or more of the maximal heartbeat,
- No increase in heart rate despite the increasing workload.

Statistical Analaysis: After the descriptive statistics of the data obtained, the data that do not show normal distribution according to the branch were compared with the Mann Whitney U Test. The relationship between body composition and maximum oxygen consumption was determined by Spearman Correlation Test. The statistical

significance level was determined as p <0.05. Statistical Analysis was performed using the SPSS 23.0 for Windows (Statistical Package for Social Sciences, Chicago, IL, USA) package program.

RESULTS

The results of body composition assessment of athletes in boxing and wrestling branches are given in Table 1. While there was no statistically significant difference in body weight and body fat percentage values of boxing and wrestling athletes (p> 0.05); however, when the Body Mass Index (BMI) and muscle mass values are examined, there were statistically significant differences (p <0.05). It was determined that BMI and muscle mass values were higher in wrestling athletes than in boxing athletes.

Table 1. Comparison of body composition of boxing and wrestling athletes

Body Composition		n	Mean	SD	Z	U	p
Age	Boxing	13	20,39	0,67	-4,334	0,000	0,198
	Wrestling	13	21,25	0,89			
Body Weight (kg)	Boxing	13	70,02	17,10	-1,257	60,000	0,209
	Wrestling	13	76,72	17,35			
BMI (kg/m²)	Boxing	13	22,47	3,90	-2,360	38,500	0,018*
	Wrestling	13	25,85	3,91			
Height (cm)	Boxing	13	174,58	7,67	-1,335	58,500	0,182
	Wrestling	13	170,81	7,17			
% Fat	Boxing	13	14,15	12,94	-1,744	50,500	0,081
	Wrestling	13	9,05	7,95			
Muscle Mass (kg)	Boxing	13	53,78	13,82	-2,026	45,000	0,043*
	Wrestling	13	64,33	9,72			

BMI: Body Mass Index, *: Mann Whitney U Test

The results of maximal oxygen consumption measurement of boxing and wrestling athletes are given in Table 2. While there was no statistically significant difference between the relative oxygen consumption (VO2 = ml / (kg * min)) values of boxing and wrestling athletes (p> 0.05); there were statistically significant differences in absolute oxygen consumption (VO2 = (ml / min)), carbon dioxide production (VCO2 = (ml / min)), respiratory coefficient (RQ) and heart rate (p <0.05). It is seen that wrestling athletes have lower heart rate and higher respiratory efficiency and oxygen consumption values compared to boxing athletes in the maxVO2 test.

Table 2. Comparison of the maximal oxygen consumption measurement of boxing and wrestling athletes

Oxygen Consumption		n	Mean	SD	Z	U	P
Absolute VO2 (ml/min)	Boxing	13	3522,80	363,62	-3,154	23,000	0,002*
	Wrestling	13	4258,13	609,01			
VCO_2 (ml/min)	Boxing	13	3569,71	471,25	-3,974	7,000	0,000*
	Wrestling	13	4994,33	618,09			
RQ	Boxing	13	1,01	0,11	-3,030	25,500	0,002*
	Wrestling	13	1,18	0,07			
Relative VO_2 ml/(kg*min)	Boxing	13	53,93	8,69	-0,462	75,500	0,644
	Wrestling	13	56,59	6,63			
Heart Rate (beat/min)	Boxing	13	193,92	8,83	-2,547	35,000	0,011*
	Wrestling	13	183,92	8,83			

VO_2: oxygen consumption, VCO_2: carbon dioxide production, RQ: Respiratory Quotient (VCO_2/VO_2), *: Mann Whitney U Test

The relationship between the body composition values of boxing and wrestling athletes and their maximal oxygen consumption capacity is given in Table 3. In boxing and wrestling branches, there was a high and statistically significant negative correlation between BMI and body fat percentage and relative oxygen consumption values (p <0.05). Muscle mass and relative oxygen consumption values were positively high in boxing athletes and a moderately significant correlation was found in wrestling athletes (p <0.05).

Table 3. The relationship between the maximal oxygen consumption measurements and body composition values of wrestling and boxing athletes

Body Composition	Relative Oxygen Consumption	
	Boxing	Wrestling
BMI	-,738**	-,632*
% Fat	-,849**	-,713**
Body Mass	,658*	,571*

BMI: Body Mass Index, *: Spearman Correlation Test

DISCUSSION

In the study conducted to compare the body composition and maximal oxygen consumption of boxing and wrestling athletes and to investigate the relationship between body composition and maximal oxygen consumption of each branch, the relative oxygen consumption values of the branches were found to be similar in terms of body weight, percentage of body fat and body weight; however, body mass index, muscle mass, absolute oxygen consumption, carbon dioxide production, respiratory coefficient, and heart rate values were found to be different. In addition, a relationship between body composition parameters and maximal oxygen consumption was found in both branches.

Body composition is one of the important indicators of physical fitness. It has an important role in following the nutrition program and training (1, 25). As there are technical and tactical differences between sports branches, it is thought that the body composition must be specific to the sports branch in order to adapt to these differences (11). The importance of muscle mass in sports branches that require strength and power is known (17, 27). In some branches, body mass determines the category that athlete competes. Athletes in these branches aim to keep their body mass under control in order to compete in the category they target. The weight control can be done with long-term regular diet programs, as well as quickly, close to the competition. Rapid weight loss often causes dehydration, and this can adversely affect the health and performance of the athlete (23). Boxing and wrestling are among these branches, and body composition has great importance in these branches (10). It is claimed that as the body mass and muscle mass increase within the weight category, the success increases (23). In a study examining the body composition of the Olympic-level boxing and wrestling athletes, it was found that the average body fat percentage of the athletes were statistically similar. Wrestling athletes have been shown to have higher average body mass and muscle mass than boxing athletes (22). These results are consistent with the results of the present study.

Another indicator of physical fitness is aerobic capacity. Aerobic capacity shows the endurance of the person (26). Maximal oxygen consumption is essential in combat sports as well as in other sport branches (31). In a study examining the aerobic capacity of wrestling athletes, the relative maximal oxygen consumption of the athletes was found to be 45.9 ± 6.6 mL/kg/min (21). In another study, the aerobic capacity of wrestling athletes was investigated, and the relative oxygen consumption capacity was found to be 45.1 ± 3.4 mL/kg/min (31). In the study performed by Rahmani-Nia et al., the maximal oxygen consumption level in young wrestlers was determined as 50 ± 4.75 mL/kg/min (20). In the study of Kravitz et al., The maximal oxygen consumption level of boxing athletes was found to be 41.0 ± 6.5 mL/kg/min (9). In another study conducted on boxing athletes, it was observed that the maximal oxygen consumption was 52.2 ± 7.2 mL/kg/min (6). It is thought that the reason for the different results in the literature may be related to factors such as training level, age, gender, etc.

Body composition can be at targeted levels with appropriate diet and training. Various studies have been conducted on the relationship between aerobic endurance and body composition (2, 5, 13, 15, 16). In the study of Minasian et al., it was shown that there is a strong negative correlation between body fat percentage and maximal oxygen consumption capacity in both boys and girls (15). In the study of Laxmi et al., it was shown that there is a moderate negative correlation between BMI and maximal oxygen consumption (5). In the study of Mondal et al., a weak-moderate negative correlation was found between BMI and maximal oxygen consumption, while a strong negative correlation was found between body fat percentage and maximal oxygen consumption (16). In our study, a strong negative correlation was found between body fat percentage

and maximal oxygen consumption, and the results are consistent with previous studies. The fact that the relationship between body fat percentage and aerobic endurance is stronger than the relationship between BMI indicates the importance of body fat percentage in body composition monitoring. There are also studies on the relationship between body fat percentage and lean body mass with anaerobic capacity and muscle strength (7, 18). These studies show the importance of body composition in boxing and wrestling sports where muscle strength and anaerobic power are essential for performance.

Due to the limited number of participants, it was not possible to evaluate the relationship between body composition parameters and maximal oxygen consumption via regression analysis. Besides, the fact that the study is a cross-sectional study does not show a cause-effect relationship. These situations can be considered as the limitations of the study. However, the present study, to the authors' knowledge, is the first study that compares the body composition and maximal oxygen consumption of elite boxing and wrestling athletes in our country and investigates the relationship between body composition and maximal oxygen consumption of these athletes.

CONCLUSION

Considering the results of the current study, the body composition values of wrestling and boxing athletes were similar. In addition, it has been observed that there is a relationship between body composition and maximal oxygen consumption of both boxing and wrestling athletes.

The fact that the level of this relationship with body fat percentage is higher than other parameters indicates that the fat percentage is an influential parameter in body composition monitoring.

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