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Research article

The relationship between body composition and anaerobic performance of elite young wrestlers

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Abstract
The purpose of the present study was to investigate the relationship between body composition and anaerobic performance in young elite wrestlers. Method: Eight female (age = 16.2 ± 1.1 yrs) and 8 male (age = 17.3 ± 0.9 yrs) wrestlers from the Turkish cadet and junior national team participated in this study. Fat free mass (FFM) and percent fat mass (%FM) were carried out through electric bioimpedance. Anaerobic performance was assessed by the Wingate test (load was calculated as 0.090 kg x.kg^{-1} body mass). FFM was greater in male wrestlers [65.4 ± 12.3 (kg)] than female wrestlers (45.1 ± 4.6 (kg) $p < 0.01$). %FM was lower in male wrestlers (9.7 ± 6.3) than female wrestlers (18.5 ± 2.8; $p < 0.01$). Peak power was significantly higher in male wrestlers than female wrestlers (8.5 ± 1.0 W·kg^{-1} vs. 6.8 ± 0.6 W·kg^{-1}; $p < 0.01$). Mean power was significantly correlated with FFM in both genders ($r = 0.73$ $p < 0.05$ in female; $r = 0.90$ $p < 0.05$ in male). No relationship was obtained between anaerobic parameters and %FM. In conclusion, our result demonstrated no association between anaerobic parameters and %FM. Wrestlers and their coaches should take into account FFM rather than %FM for higher anaerobic performance.

Key words: Fat free mass, performance, female wrestling, Wingate test, power .

Introduction

Freestyle wrestling is one of the main styles of amateur competitive wrestling. Other forms include female wrestling, Greco-Roman wrestling, sambo, beach wrestling, grappling and traditional wrestling. Freestyle wrestling is practiced in three two-minute periods with a 30-second rest between rounds in current international competition. A wrestler wins the match when he has won two out of three periods. Female wrestling is classified as a different category because of the gender difference although its rules are the same with free style wrestling of men. A wrestling match requires tremendous physical activity, power and strength of body musculature as well as isometric force for various wrestling techniques (Horswill, 1992). Power in wrestlers is related with quick and explosive effort that leads to wrestling success (Lansky, 1999). Anaerobic power and capacity are important in wrestling because of the need of short-duration and high intensity performance. Wingate test can be used to reflect the maximum ability of wrestlers to generate power (Yoon, 2002).

Common wrestling types are freestyle, female and Greco-Roman wrestling that can be defined as Olympic wrestling types and the collegiate wrestling, which is common in the United States. Both Olympic and collegiate wrestling tournaments are especially run at young ages. The majority of wrestlers are concerned about the amount of body weight because competitors are matched based on body-weight. They generally want to minimize the body fat level and the total body weight without losing their body strength and power (Yoon, 2002). However, no relation was shown between the percentage of fat mass (%FM) and the level of wrestling success (Horswill, 1992; Yoon, 2002). Since the information on anaerobic power and fatness in elite young female and male wrestlers is limited, we investigated possible relationships between the anaerobic performance and FFM and %FM of elite young female and male wrestlers.

Methods

Participants

Eighteen wrestlers (M/F, 8/8) aged between 15 and 19 yrs (mean ± SD, 16.6 ± 1.1), volunteered to participate in the study. The participants were considered elite athletes since all wrestlers had national and international degrees. All female wrestlers and seven male wrestlers were the members of Turkish women's and men's cadet national team. One male wrestler was the member of Turkish junior national team. They qualified for national competitions in Turkey, 36% of participants (n = 6) achieved Turkish cadet level champion status, 81% of participants (n = 13) achieved national degree in Turkey and 44% of participants (n = 8) achieved international degree. The study was approved by the local ethics committee of Trakya University. All wrestlers were assessed through the competitive season. Details of the study were explained to each participant and signed informed consent was obtained from the participants or their parents whose children were below 18.. All participants underwent a structured interview and all physical examinations were performed by the same physician (AV). No participants were declared any physical illnesses. A self-administered questionnaire was used to assess age, participation age to sports, and the amount of training in a week.

Measurements of body fat

Body fat measurements were performed before Wingate anaerobic test on the same day by bioelectrical body impedance analysis (BIA) using a body fat analyzer (model Tanita TBF300 Japan. Athletic programmed mode was selected prior to assessment. Analyzer uses a 50-Hz current source with electrodes on each foot to measure

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Table 1. Demographic, antropometric variables and hemodynamic parameters of the wrestlers. Values are expressed as mean (±SD).

	Female (n = 8)	**Male** (n = 8)
Demographic variable		
Age (yrs)	16.2 (1.1)	17.3 (.9)
Antropometric variables		
Height (m)	1.62 (.04)	1.74 (.06) **
Weight (kg)	55.0 (6.5)	73.2 (17.7) **
BMI ($kg \cdot m^{-2}$)	21.4 (2.3)	24.1 (4.5)
Hemodynamic		
Heart Rate ($beats \cdot min^{-1}$)	68 (12)	61 (8)
Systolic BP (mmHg)	105.6 (10.5)	100.6 (6.7)
Diastolic BP (mmHg)	75.0 (12.8)	60.6 (8.6) *
Sport history		
Participation age to sports (yr)	11.6 (2.6)	8.4 (1.2) *
Duration of training (yr)	4.1 (2.2)	8.6 (1.4) **
Amount of training (h/week)	12.6 (2.7)	11.0 (1.7)

BMI: Body Mass Index. * and ** denote $p < 0.05$ and 0.01 respectively.

impedance to electrical conductivity as it passes through body fluids and calculates FFM, %FM and fat mass (FM). Measurements were performed without accessories that contain metal (earrings, belts, coins), and female wrestlers should not have a menstrual period. To ensure normal hydration status for BIA testing, participants were asked to adhere to the following pretest requirements: (a) no vigorous exercise within 12 hours of the test (b) no caffeine or alcohol consumption within 12 hours of the test. Participants verified adherence to these instructions before testing. The reliability and validity of BIA has been established in previous studies (Jackson et al., 1988). The results obtained by BIA are found comparable with the results of other standard anthropometric methods such as skinfold fat and hydrostatically measured percent fat.

Anaerobic test

The Wingate test consisted of a 30-s supramaximal cycling against a resistance load. Each test was performed on a Monark cycle ergometer (Model 894-E) and the load was calculated as 0.090 kg $x.kg^{-1}$ body mass for each participant. The participants warmed up by pedalling for 3 min against a 30 watt load. After 5 min rest period, by the command "start" the participants began pedalling against a predetermined work load. The participants were requested to pedal as fast as possible to preserve maximal pedalling speed until the end of the test period. Strong motivation was given verbally to participants during the test. The data were used to calculate peak power and mean power that can be seen elsewhere (Bar-Or O. 1987).

Statistical analysis

General characteristics of the participants were presented as means and standard deviations. Statistical comparison of the female and male groups was carried out using Mann Whitney-U test. Spearman's correlation coefficients were used to express the relationships between anaerobic test parameters and body composition parameters (%FM and FFM). Interpretation of correlation coefficients was as follows: $r \leq 0.49$ weak relationship; $0.50 \leq r \leq 0.74$ moderate relationship; and $r \geq 0.75$ strong relationship (Portney and Watkins 2000). A p value less than 0.05 was considered statistically significant.

RESULTS

Demographic, hemodynamic characteristics and sport history of the participants were shown in Table 1. BMI scores were not significantly different between female and male groups. Mean diastolic blood pressure of female wrestlers was lower than males (Table 1).

Anaerobic performance parameters obtained from Wingate test and body fat measurements including FFM, %FM, FM were shown in Table 2. Peak power (W) was positively correlated with FFM ($r = 0.81$ $p < 0.01$) in male wrestlers. No significant correlation was found between peak power (W) and FFM in female wrestlers. Mean power (W) was significantly correlated with FFM in both females and males ($r = 0.73$ $p < 0.05$; $r = 0.90$ $p < 0.05$ respectively). Minimum (W) power was also positively

Table 2. Anaerobic and body composition measurements of the wrestlers. Values are expressed as mean (±SD).

	Female (n = 8)	**Male** (n = 8)
Wingate test measurements		
Peak Power (w/kg)	6.8 (.6)	8.5 (1.0) **
Peak Power (w)	376.6 (57.9)	615.4 (114.3) **
Mean Power (w/kg)	5.0 (.5)	6.3 (.8) *
Mean Power (w)	279.9 (47.8)	458.2 (91.6) **
Minimum Power (w/kg)	3.0 (.8)	3.6 (.3)
Minimum Power (w)	170.3 (57.9)	263.0 (60.0) **
Body composition		
FFM (kg)	45.1 (4.6)	65.4 (12.3) **
%FM (%)	18.5 (2.8)	9.7 (6.3) **
FM (kg)	10.4 (2.7)	7.9 (7.3)

FFM: Fat Free Mass; %FM: percent fat mass; FM: fat mass.

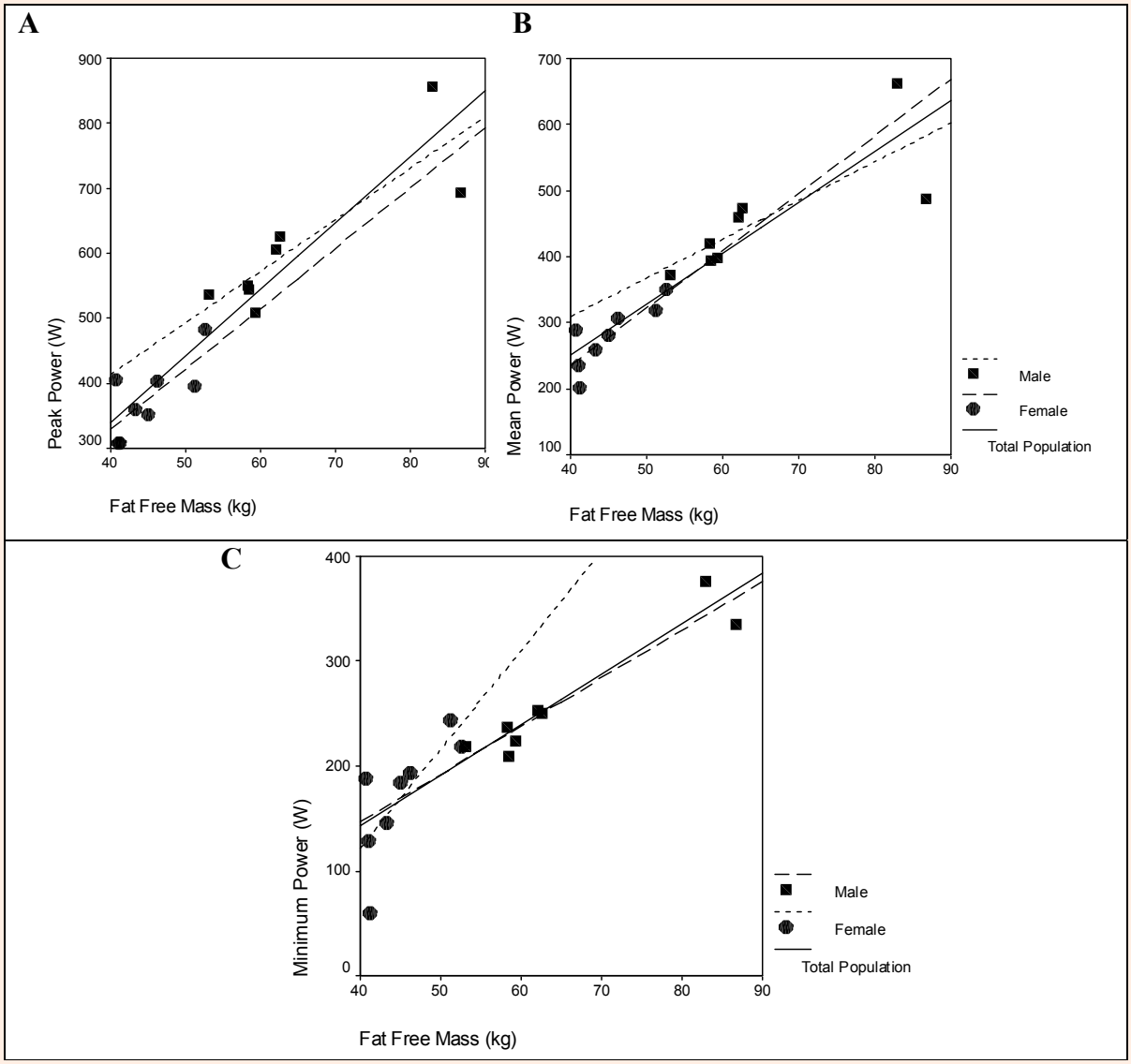

Figure 1. The relationship between peak power and fat free mass (A; r = 0.90 p < 0.01), mean power and fat free mass (B; r = 0.95 p < 0.01), minimum power and fat free mass (C; r = 0.89 p < 0.01).

associated with FFM in female and male wrestlers (r = 0.71 p < 0.05, r= 0.83 p < 0.01 respectively). When participants of both genders were examined as a whole, a strong relationship was obtained in peak power (W) and FFM; mean power (W) and FFM; and minimum (W) power and FFM values (Figure 1). We also looked for the same relationship between relative (to body weight) anaerobic power and body composition parameters. Peak power ($W \cdot kg^{-1}$) and FFM (r = 0.49 p < 0.05); mean power ($W \cdot kg^{-1}$) and FFM values (r = 0.55 p < 0.05) were moderately correlated in whole group. In female wrestlers, %FM was not associated with peak power (W) (r = 0.52 p=0.18), mean power (W) (r = 0.47 p = 0.23), and minimum power (W) (r = 0.45 p = 0.26). In male wrestlers, no relationship was found between peak power (W) and %FM (r = 0.40 p = 0.31); mean power (W) and %FM (r = 0.33 p = 0.41), and minimum power (W) and %FM (r = 0.30 p = 0.41).

Discussion

In the present study, the relationship between anaerobic performance and body composition in elite female and male wrestlers were investigated. Our study demonstrated that changes in peak power are primarily related with FFM in young male wrestlers. Mean power and minimum power were significantly associated with FFM in both female and male wrestlers. However, no significant correlation was found between anaerobic parameters and %FM in both genders.

Body fat includes lipids from adipose and other body tissues. In general, most wrestlers attempt to have a very small percentage of body fat, as they are matched by body-weight prior to each meet. Eventually, optimal body composition is one of the major concerns of the wrestlers. Wrestlers and coaches consider %FM as a factor that must be taken under control. It is believed that lower %FM values are advantageous. Our study suggested that FFM rather than %FM may be a predictor of anaerobic performance in wrestlers. In accordance with our study, previous studies demonstrated that changes in power are

primarily related with FFM in young male wrestlers (Kelly et al., 1978; Roemmich and Sinning, 1996; 1997). It was shown that insufficient dietary intake reduces protein nutrition, impairs muscular performance and decreases FFM levels (Roemmich and Sinning, 1997). FFM changes were associated with the changes in strength and power during the sport season (Roemmich and Sinning, 1997).

The mean peak power of male wrestlers was 8.5 $W \cdot kg^{-1}$ in our study group. In a previous study, similar peak power values were reported (Horswill et al., 1989). The mean peak power value of elite male wrestlers (age = 17.0 ± 0.2 yrs) was reported as 8.6 W/kg in this study (Horswill et al., 1989). However, peak power values in our study seem somewhat lower than those of several reports (Horswill, 1992; Horswill et al., 1992). For example a study of elite senior wrestlers above 20 years old, peak anaerobic power for legs was reported as 10.8 $W \cdot kg^{-1}$ (Horswill et al., 1992). Horswill (1992) reported the mean range of peak power as 11.5 to 19.9 $W \cdot kg^{-1}$ in successful wrestlers. All above studies, 0.075 kg $x.kg^{-1}$ of the wrestlers' mass is used as a load during the Wingate Test (Horswill et al., 1989; Horswill et al., 1992). However, the load was set at 0.090 kg $x.kg^{-1}$ body weight for participants in our study. The lower peak power values of male wrestlers may result from loading methodology (higher resistance load) in Wingate Test. Age difference also can be considered as another factor. Additionally, we could not find any related study that is performed similar resistance load and similar age group in female wrestlers to compare our peak power values.

Yoon (2002) stated that the percentage of body fat ranges from 3 to 13 in well-trained wrestlers. The range of % FM extends from about 4 to 9% with the exception of super heavy-weights (Yoon, 2002). In a previous study, it was demonstrated that %FM value of adolescent male wrestlers was 8.03 (Roemmich and Sinning, 1997). In another study, %FM of young male wrestlers was found as 8.4 (Silva et al., 1981). Mean %FM value of our male wrestlers was 9.7%. This value was similar to the mean %FM values of the wrestlers of previous studies.

The present study included both male and female wrestlers. %FM in female wrestlers is significantly higher than the males as expected. In our study, mean value of %FM was 18.5 in female wrestlers. No related study was found in female wrestlers to compare %FM with our female wrestlers in the same age group. However, various levels of %FM values were reported in elite female athletes in the same age group and different sport types. For example, the %FM of adolescent female distance runners, Greek rhythmic gymnastics and Canadian rhythmic gymnastics was reported as 23.9%, 14.3 % and 16.2%, respectively (Klentrou and Plyley, 2003; Mitsuzono and Ube, 2006).

A recent study by Hubner-Wozniak et al. (2004) demonstrated that males had higher peak power and mean power than females after normalization for body mass and FFM of elite female and male wrestlers. Our study population was comprised of age-matched elite female and male wrestlers. The mean BMI values were also similar in female and male wrestlers in our study. Considering their FFM male wrestlers were greater than the females. Therefore we could not obtain the normalization of FFM levels in our limited study population.

Further studies that provide FFM normalization in both genders would better explain the relationship between anaerobic performance and body composition.

Conclusion

Our study demonstrated that peak power was significantly associated with FFM in young male wrestlers. Additionally, mean power and minimum power were significantly associated with FFM in both female and male wrestlers. We described % FM values as 9.7 in male and 18.5 in young female wrestlers. No relationship was found between anaerobic parameters and %FM in the present study. Our study suggested that both female and male wrestlers and their coaches should take into account FFM levels rather than %FM for higher anaerobic performance.

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Key points

- Mean power and fat free mass association was obtained from both genders.
- Anaerobic performance parameters obtained from Wingate Test were positively associated with fat free mass but not % fat mass in elite young wrestlers.
- % FM values were 18.5 in young female wrestlers, and it was 9.7 in male wrestlers.

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