AEROBIC AND ANAEROBIC POWER PROFILE OF ELITE TURKISH GRECO-ROMAN WRESTLERS

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ABSTRACT

The purpose of the present investigation is to describe the aerobic and anaerobic power parameters of the Greco-Roman wrestlers. Totally 20 voluntary greco-roman wrestlers participated in this study and elite wrestlers according to the weight classes system; 20 male wrestlers were assigned into 3 groups according to their body mass (Light Weight; body mass ranged between 52-68 kg, Middle Weight; body mass ranged between 72-78 kg, and Heavy Weight; body mass ranged between 82-132 kg).

Elite Greco-Roman wrestlers who were invited to the national and international competition into the first three degrees aged between 18–26 years old. Aerobic and Anaerobic power profile some physical characteristic included, height (cm), body weight (kg), maximal oxygen consumption, maximal anaerobic power, values were determined.

The results of this study (mean ± SD) are as follows: age (years) 21.6±2.5, training experience (years) 10.5±2.9, height (cm)172±6.6, body weight (kg) 80.4±17.5, body mass index (kg/m^2) 27±4.4, body fat percentage (%) 11.6±3.7, maximal oxygen uptake (Bruce protocol) 56.6±7.7 ml·$kg^{-1}$$dak^{-1}$, maximal heart rate (bpm) 189.7±10.1, maximum minute ventilation (lt/min.) 153.1±24.6, maximal respiratory rate (RER) 1.1 ±0.0, maximum anaerobic power (W) 592.4±111.2, Peak power (W·kg) 13.5±1.8, peak power (watt) 1072.7±249, mean power (W·kg^{-1}) 7.5±0.7 minimum power (W.s^{-1}) 233.9±65.2, minimum power (W·s^{-1}·kg^{-1}) 3±07. The present study provides a reference for the aerobic and anaerobic parameters that have been used in the prescription of individual training programs for the wrestlers. Experienced coaches can use this information in the process of designing a training program to maximize the fitness development of Wrestling, with one purpose only, to achieve success in wrestling

Key words: Elite Athlete, Greco-roman wrestling, peak VO2 - Wingate power test

ELİT TÜRK GREKOROMEN GÜREŞÇİLERİNİN AEROBİK VE ANAEROBİK KUVVET PROFİLLERİ

ÖZET

Bu araştırmanın amacı; Grekoromen güreşçilerin aerobik ve anaerobik kuvvet parametrelerinin araştırılmasıdır. Bu çalışmayı, sıklet sistemine göre elit güreşçiler olan toplamda 20 gönüllü grekoromen güreşçi katılmıştır; 20 erkek güreşçi, vücut kitlelerine göre 3 gruba ayrılmıştır (Hafif Sıklet: vücut kitlesi 52-68 kg arası, Orta Sıklet: vücut kitlesi 72-78 kg arası ve Ağır Sıklet: vücut kitlesi 82-132 kg arası).

İlk üç derecede ulusal ve uluslararası müsabakalara davet edilen elit Grekoromen güreşçiler 18-26 yaş aralığındadır. Aerobik ve anaerobik kuvvet profillerine bazı fiziksel özellikler dâhil edilmiştir; boy (cm), vücut ağırlığı (kg), maksimal oksijen tüketimi ve maksimal anaerobik kuvvet değerleri belirlenmiştir.

Bu çalışmanın sonuçları şu şekildedir (ortalama ± SD): yaş (yıl) 21.6±2.5, antrenman deneyimi (yıl) 10.5±2.9, boy (cm) 172±6.6, vücut ağırlığı (kg) 80.4±17.5, vücut kitle indeksi (kg/m2) 27±4.4, vücuttaki yağ oranı (%) 11.6±3.7, maksimal oksijen alımı (Bruce protokolü) 56.6±7.7 ml·kg-1dak-1, maksimal kalp atış hızı (bpm) 189.7±10.1, maksimum dakika ventilasyonu (lt/dak.) 153.1±24.6, maksimal solunum sayısı (RER) 1.1 ±0.0, maksimum anaerobik kuvvet (W) 592.4±111.2, Maksimum kuvvet (W·kg) 13.5±1.8, maksimum kuvvet (vat) 1072.7±249, ortalama kuvvet (W·kg-1) 7.5±0.7 minimum kuvvet (W.s-1) 233.9±65.2, minimum kuvvet (W·s-1·kg-1) 3±07. Bu araştırma, güreşçilerin bireysel antrenman programlarının hazırlanmasında kullanılan aerobik ve anaerobik parametrelere bir örnek teşkil etmektedir. Deneyimli antrenörler bu bilgileri, yalnızca güreşte başarıyı elde etmek adına formu en üst düzeye çıkarmak için antrenman programı hazırlama sürecinde kullanabilirler.

Anahtar Kelimeler: Elit Sporcu, Grekoromen güreş, maksimum VO2 - Wingate kuvvet testi

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INTRODUCTION

It is a struggle given by two wrestlers to be superior to each other by using their Intellect, technical skills, and strength on a wrestling mat within the limits of the rules laid down by FILA. Greco-Roman wrestling; on the other hand, is a type of wrestling involving performing some tricks on the upper part of the body of the rival.

Wrestling is defined as a sport in which two wrestlers or people attempt to subdue each other on a measured wrestling mat according to wrestling rules by using their technical knowledge, abilities, strengths and minds without any tools. Wrestling was an important part of the ancient Olympic Games and is still one of the more popular events of the modern Olympic Games.

Wrestling is not only a capability but also a sport which requires wrestlers to make the fastest move in short periods. Combining this capability with technique, intelligence and power is the first requirement of success. Besides obeying the rules, determination to win, struggle, endurance, strength-endurance, creativity, agility, immediate decision making, self reliance, proper nutrition, regular life, realizing the mistakes and correcting them, getting experience, flexibility and focusing on Roman, a classic style. (FILA) has made some changes not only in the duration of the game but also in the technical rules of it to make it more attractive. This situation leads to some changes in the methods of training and strategy of the sport, and accordingly, the profiles of the wrestlers are also changing. So, the importance of aerobic and anaerobic power profil characteristics of successful targets are the other factors influencing success.

In three two-minutes bouts, wrestling is described as a sport in which such factors as speed, power, quickness, flexibility, balance, muscular and cardiovascular strength, coordination affect the wrestler's performance, and lactic acid system is dominantly used in the scope of both aerobic and anaerobic energy system (Astrand 1977; Gökdemir 2000).

Moreover, wrestling is a sport in which making progress depends upon body strength substantially. In the evaluations based on body weight, wrestlers are shown among the strongest athletes. As a biomotor ability, strength is crucial not only in defense but also in the use of the techniques in attacks and resistance to attacks (counter attack) (Baykuş 1989). With the studies on wrestling during the season, it has been aimed that the characteristics of the wrestlers mentioned above are kept at the high levels, and the wrestlers make the best performance.

In recent years, after each Olympiad, The International Federation of Associated Wrestling Styles Greco-wrestlers is increasing for researchers. The aim of this research is to identify the profiles of elite wrestlers in Turkey. The importance of conducting a research study about the physical and physiological characteristics of elite wrestlers is progressively increasing among researchers and coaches in terms of controlling the performance and increasing it.

Greco-romen wrestlers need to have a high level of physical fitness to perform successfully in top-level competitions. Having good anaerobic and aerobic capacity are the most important factors needed to achieve good results in wrestling competitions (Bloomfield 1994).

MATERIAL and METHOD

Measurement groups of the participated in the study are weight class representation in the 3 group weight classes (1st group 52–62 kg; light weight, 2nd. group 72–78 kg; middleweight, 3rd group 82–132 kg; heavy weight).

Seventeen elite Greco-Romen wrestlers (who were between age the ages of 18–26 years old)represented Turkey in international competitions and won 7 gold, 10 silver, and bronze medals in European Championships voluntarily participated in the research. They were tested at performance measurement labs at Selçuk University, Department of Physical Education and Sports. All measurements were performed at the competition period, and the motivations of the athletes were gained. For this study, the Ethics Committee Approval of the Department of Physical Education and Sports at Selçuk University was received and athletes all signed the forms of voluntary participation.

Procedures

The physiological parameters included cardiovascular endurance, anaerobic power and body composition. Height (cm) and mass (kg) were also recorded Seca Medical Scale (SECA, Hamburg, Germany). BMI was calculated as body mass (kg) divided by height (m) squared.

Subcutaneous body fat was measured at seven sites (triceps, sub-scapula, biceps, abdominal, supra-iliac, thigh and calf) with a Skinfold caliper (Holtain). Body density, body fat percentage and lean body mass (LBM) were calculated from the formula developed by Durnin- Womersley (1974) and Siri (1961).

Maximal oxygen consumption of the subjects was identified by applying Bruce test protocol which is one of the frequently used clinical exercise tests and requires an athlete to increase the inclination and speed in each 3 minutes. According to this protocol, the competition starts with 2,7 km/hour speed and %10 inclination, and in each 3 minutes, both speed and inclination increase (Cooper and Storer 2001). Reaching the maximum heart rate (220-age), going beyond to 1,1 value of respiratory quotient or being fatigued as much as the sportsmen were not able to continue were accepted as the criteria to end the test. The value of oxygen uptake ($maxVO_2$) of the subjects is identified by following with the indirect calorimetry (Cosumed K4 b^2). Respiratory exchange ratio (RER) was figured out from the directly measured and recorded VO2 and carbon dioxide elimination values (VCO_2) in all phases

of the test. The calculations were worked out synchronously with the measurements which were obtained by using the programs in the portable indirect calorimetry software. Before the tests, per day the analyzer calibrated the certified gas mixture (O_2= % 15,6, CO_2= %4,1, N_2= Balans), of which the concentration was measured by 3L injector as proposed by the producer company. During the tests, the data recorded to the analyzer's memory was transferred to the computer.

Maximal anaerobic power of the legs was assessed by 5 seconds of leg cycling (Wingate test). The Wingate test consisted of a 30-second supramaximal cycling against a resistance load. Each test was performed on a Monark cycle ergometer (Model 894-E, Sweden) and for each participant the load was calculated as 0.075 $kg.kg^{-1}$ body mass. The participants warmed up by pedaling for 3 min against a 30 watt load. After a 5 min rest period, by the command "start" the participant began pedaling as fast as possible against a predetermined work load until the end of the test period. Strong verbal motivation was given to participants to maintain maximal pedaling rate during the test.

Statistical Analysis: The standard deviation (SD), the mean, standard deviation mean (X), minimum and maximum values of the measurement results of the study were calculated by using SPSS package.

RESULTS

Measurement parameters of the groups participated in the study are shown in the tables. Subject data and weight class representation in the 3 group weight classes are shown in Table 1. Results about the physical and physiological measurements of the groups are indicated both in-group and generally. (Mean±Standard Deviation and Maximum-Minimum) (1st group 52–62 kg; light weight, 2nd. group 72–78 kg; middleweight, 3rd group 82–132 kg; heavy weight).

The performance measures of the wrestlers are presented in Tables 1. and Table 2 contains testing results for maximum oxygen uptake, heart rate, maximum ventilation and respiratory exchange ratio. Table 3 contains testing results for anaerobic power parameters.

Table 1 Subject descriptive data (mean ± SD and range: min-max).

	Light Weight	Middle Weight	Heavy Weight	Total group
	n=6	n=7	n=7	n=20
Age (years)	21.7±1.5 20–23	21.9±2.7 18–26	21.4±2.9 18-26	21.6±2.5 18–26
Height (cm)	162.8±4.5 160–168	170.7±4.3 165–178	177.2±4.0 172–183	172±6.6 160–183
Weight (kg)	21.7±1.5 20–23	75.3±1.9 72–78	95.0±16.8 82–132	80.4±17.5 52–132
Training (years	58.4±5.3 52–62	11.0±3.1 6–16	10.1±3.5 7-16	10.5±2.9 6–16
Body Fat (%)	10±0,9 9–11	10.2±1.8 8–12	13.8±4.9 8–22	11.6±3.7 8–22
Body mass index (kg/m^2)	21.7±1.5 20–23	25.9±1.2 24–28	30.2±4.7 27–40	27±4.4 20–40

Table 2 Values of maximum oxygen uptake, heart rate, maximum ventilation and respiratory exchange ratio (mean ± SD and range: min-max).

	Light Weight	Middle Weight	Heavy Weight	Total group
	n=6	n=7	n=7	n=20
$MaxVO_2$ (ml/kg/min)	61.5±5.7 57–68	60.8±5.5 54–68	50.4±6.3 41–58	56.6±7.7 41–68
HR_{max} (pulse/min)	192.7±5.0 188-198	192.7±7.0 180-202	185.4±13.3 169–202	189.7±10.1 169–202
VE_{makx} (lt/dk)	135.8±7.3 129-177	152.5±16.3 134-177	161.2±33.1 103-200	153.1±24.6 103–200
RER	1.1±0.0 1–1	1.1±0.0 1–1	1.1±0.0 1–1	1.1±0.0 1–1

$MaxVO_2$ = maximal oxygen uptake; HRmax = maximum heart rate; VEmax =maximum minute ventilation; RER= respiratory exchange ratio

Table 3 Values of anaerobic power parameters (mean ± SD and range: min-max).

	Light Weight	Middle Weight	Heavy Weight	Total group
	n=6	n=7	n=7	n=20
Mean power (W)	443.2±76.3 375–525	567.7±41.6 499-627	681.1±90.9 583-837	592.4±111.2 375–837
Peak Power/kg (W/kg)	13.2±±2.4 11–16	13.3±1.7 11–16	13.7±1.9 11–16	13.5±1.8 11–16
Peak Power (W	772.8±170.4 651–968	1003.5±134.2 825–1191	1270.5±2003.5 926–1532	1072.7±249 651–1532
MeanPower (W/kg)	7.6±0.9 7-9	7.5±0.6 7-8	7.3±0.7 6–8	7.5±0.7 6–9
Minimum Power (W)	172.4±54 111-212	241.7±54.1 132-287	252.4±71.1 133-348	233.9±65.2 111–348
Minimum Power(W/kg)	2.9±0.7 2-3	3.2±0.7 2-4	2.7±0.7 1-3	3±0.7 1–4

DISCUSSION and CONCLUSION

The aim of this study is to aid coaches in finding the weakest spot of every athlete and to apply adequate training protocol for maximum development of their biological potentials. One of the most important factors determining the coach's success is to predict the general performance, capabilities of the wrestlers and how much progress will be in their technical capacities. The coach must test wrestlers in order to observe their performance. These tests can also form a basis for evaluation of the wrestler's present performance, figuring out the powerful and comparatively weaker sides and developing the optimum training program. The tests should be reliable, and performed and evaluated objectively.

Fat is a structural element of the human body. In addition to being criteria of health, body fat rate is also accepted to be a substantial element of sportive performance. In many sports, body fat rate is associated with performance criteria. The percentage of body fat is observed to be quite low in the athletes of the sports which put emphasis on endurance. However, in the research on the athletes, various results are obtained depending on sports type, gender, age, the level of performance and population. According to Carter and Yuhazs, the significance of fat arises from its majority rather than its minority in the bodies of athletes. In most of the sports, while fat rates at minimum level are enough for the best performance, any increase in these rates restrains the possibility to reach their maximum potential (Carter 1984). One of the most important issues for wrestlers is to have ideal body fat rate which does not affect their performance negatively.

In our study, body fat rate of the subjects is 11.6±3.7 %. France (1987) researched physiological profiles of his wrestlers in his study and found %9.45 fat rate in the wrestlers' body whose average age was 25. Mirzae and Akbar (2008) found 11.3±4.1 % fat rate in the bodies of his elite greco-roman Iranian wrestlers. Moreover, Boilau and Lohman (1977) stated that the body fat percentage of international male wrestlers changes from %4.5 to %16. On the other hand, Manore et al. (2000) claimed that body fat rate changes according to athlete's gender and division and sport type. All these researchers agreed that the percentage of the body fat rate ranges from %6 to %15 for male athletes. As a result, The body fat rate that we observed in our study is quite close to the literal rates.

Body mass index of the subjects is 27±4.4 (kg/m^2) in our study while Bahman and his colleagues obtained 25±4 kg/m^2 in elite freestyle Iranian wrestlers. The values we observed are close to those indicated by Bahman et al (2009).

Maximal oxygen uptake is described as the highest speed of lungs use and it is gained from tiring training. The higher max$VO_2$the athlete has, the longer time he can do exercise for (Horswill 1989).
Wrestlers need movement series in high intensity changing from 5 to 30 seconds, and for some activities, there are periods to relax in low intensity like

many other team sports. Despite the fact that most of the energy is provided from non-oxidative sources in such sports, the relaxation period is a oxidative activity. Thus, the rate of regeneration of urgent energy sources in the muscles and the elimination of anaerobic metabolism waste are quite related to anaerobic power of the athletes (Mach Dougall 1982).

The mean of maximum oxygen uptake values of 20 wrestlers is 56.6±7.7 $ml \cdot kg^{-1}.min^{-1}$ (Table 2). In similar studies, while Horsvill et al. (1989) found 52.6±4.7 ml/kg/min for $maxVO_2$, Bahman et al. (2009) found 50.5±4.7 ml/kg/min in his elite Iranian wrestlers. But, the value for $maxVO_2$ is higher than these results in our study. However, Sharrat and his colleagues found out 61,8 $ml \cdot kg^{-1}.min^{-1}$ (Sharratt 1986). Kelly and his colleagues (1978) found 61.0 $ml \cdot kg^{-1}. min^{1}.$ for $maxVO_2$ values. Our results are similar to these values. This difference may partially be explained by comparing the testing protocol employed in these studies. The studies noted that range of Max Vo_2 for international wrestlers was 50–62 $ml \cdot kg^{-1}.min^{-1}$. As a result, the $maxVO_2$ value advised for wrestlers' matches was equivalent to the value we found out.

Maximum pulse number of the subjects in our study is 189.7±10.1 pulse/min. On the other hand, Yoon (2002) found out 197.5±8.8 (pulse/min) in his elite Korean wrestlers. Utter et al. (2002) found 178 pulse/min for elite freestyle wrestlers by applying Bruce Test Protocol. The values we had are close to Yoon's results, but higher than Utter's et al.'s. This difference may be due to the fact that the average of wrestlers' age in Utter's study was 33.

Maximum minute ventilation of the subjects is established as 153.1±24.6 lt/min and maximal minute ventilation is established as 200 (lt/min) in our study. Utter et al. (2002) found out186 lt/min from his elite freestyle wrestlers. On the other side, Yoon (2002) found 141.56±21.99 lt/min from elite Korean wrestlers for the average of the maximal minute ventilation. The values we had in our study are higher than Yoon's study on elite korean wrestlers. This difference may come out because of the performance of the group and protocol of measurement.

The average of Maximum breathing coefficients of the subjects is 1.1±0.0 and maximum breathing coefficient is 1 in our study. Utter et al. (2002) established 1.24 from elite wrestlers. The values we gained from our study are lower than Utter's values established in his study. This difference may be because of his subjects were at the age of 33.

Anaerobic power is quite important for the reason that it has a dominant character in wrestling. Wrestling is a sport requiring rapid movements in short times. It is understood that anaerobic power is quite important in 6 minutes of wrestling. In our study, the Wingate test is used to measure the anaerobic capacity of the subjects.

The Wingate Anaerobic Test is the most popular test for assessing a person's anaerobic capacity. The WANT was developed during the 1970s at the

Wingate institute in Israel (Inbar et al. 1996). The anaerobic Wingate test performed on a cycle ergometer is a reliable and valid method of testing anaerobic performance. It has been used for assessment of anaerobic power in different sport disciplines and for all ages and genders. This test is performed on a cycle ergometer, and the most common parameters obtained are PP, MP and index of fatigue (IF). Peak power represents the highest value of mechanical power obtained during the test in all five–second intervals. Index of fatigue is the amount of power depletion during the test and is represented as a percentage of peak power (Beneke et al. 2002).

The mean power of the subjects is found 592.4±111.2 (Watt) in our study. Jelena et al (2009) found his wrestlers' mean power to be 516.11±89.98 (Watt). Bahman and his colleagues (2009) found 589.2±62.2 Watt on his elite freestyle Iranian wrestlers, Horswill and his colleagues (1989) found 540±25 Watt on his elite wrestlers. Our values are similar with Bahman et al.'s studies (2009), but they are higher than Jelena et al and Horswill et al's studies. This difference may be because of the variation of the weight used as a load during the test. For example, the load in our study was 0.075 kg/kg during the test, the load in Bahman et al's study was 0.090 kg/kg during the test.

Peak power/kg values of our subjects were 13.5±1.8 W/kg in our study. On the other hand, 9.76±1.80 W/kg was established by Jelena and his colleagues (2009) and 11.2±1.8 W/kg was found by Yoon (2002) for their wrestlers' peak power/kg values. While the values we got are close to values of Yoon's elite Korean wrestlers, they are higher than the values of Jelena et al's wrestlers. This difference may be again because of the performance of the athletes and measurement protocol.

The peak power of the subjects in our study is determined to be 1072.7±249 W. Jelena et al. (2009) determined on 765.53±174.57 W., and lastly, Yoon (2002) determined on 1350.0±311.2 W. for his elite Korean wrestlers. While our values are close to Yoon's values, they are higher than Jelena et al's values. This difference may be because of either the chosen athlete group at the average level or the young age of the athletes.

The mean power of the subjects we obtained in our study was 7.5±0.7 W/kg. Horswill obtained the general physiological profile of the successful wrestler is of one having high anaerobic power (mean range) of 6.1 to 7.5 W/kg (Horswill 1992). Yoon (2002) obtained 6.7±1.0 W/kg for the power of his elite Korean wrestlers while Jelena et al. (2009) obtained 6.63±1.14 W/kg for the mean power of their wrestlers. The values we obtained in our study are close to both Yoon's values and Jelena's values in their studies.

The minimum power of our subjects is 233.9±65.2 (W/s) in our study. While Jelena et al. (2009) found 125.32±33.90 W/s for their subjects' minimum power, Thomas et al. (2008) found 167.96±27.12 W/s. The values in our study are higher than both Jelena and Thomas and his collegues' values. This

difference may be due to both the facts that the values of the athlete group are at the average level, and that our athletes are at the elite level.

The minimum power/kg of the subjects is 3±0.7 W/kg in our study. As Thomas et al. (2008) established it 2.06±0.31 W/kg for his wrestlers, Jelena et al. (2009) established 1.59±0.33 W/kg for the minimum power/kg value of his wrestlers. The values we obtained are close to Thomas' values, but they are higher than the values of Jelena et al. This difference may be because of the fact that the athletes participated in the study are at the average level.

In our study, the fatigue index of the subjects is 77.8±5.6 %. Thomas et al. (2008) established it 63.79±10.82 (%) and lastly, Yoon (2002) established it 46.5±9.3 % in his elite Korean wrestlers. The values we had in our study are higher than all the literature above. The reasons of this difference may be that our wrestlers used in our study are at the elite level, the measurements occurred at the bout process, and peak power and average of our athletes' age are higher.

In conclusion, the present findings which are obtained from the tests on Turkish greco-roman wrestlers indicate that our wrestlers have similar physical and physiological profiles with the senior wrestlers of other countries. Moreover, harder and timely work is needed for the success in wrestling for the aim of choosing and analyzing the most distinguishing test considering the rules changed recently. This also provides reference data for the individual training programs for athletes.

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