IS BODY FAT RATIO OF LOWER EXTREMITIES A PREDICTOR OF RACE TIME IN UNIVERSITY TRIATHLETES?

Ülviye BİLGİN[1]
Ebru ÇETİN[1]
Mergül ÇOLAK[2]
İmdat YARIM[1]
Halil TAŞKIN[3]

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ABSTRACT

This study was conducted to investigate the effects of lower extremity fat ratios on race time in university triathletes.
The study was carried out with a total of 43 (17 women and 26 men) volunteer athletes who participating and completed the competition in the 9th World Universities Triathlon Championships (age 22,30±2,42 year, height 172,76±16,08 cm, body weight 64,79±9,93 kg). Bioelectrical impedance analysis method (BIA) was used in the evaluation of body composition and lower limb segmental analysis (Tanita BC 418). Measurements were performed before the competition in a fasting condition with shorts and t-shirts. The athletes were competed in Olympic triathlon distance (1.5 km swimming, 40 km cycling, and 10 km running) at a temperature of 40° C. The SPSS 16.0 statistical program was used in the calculation and evaluation of the data. According to the test of normality results, the Pearson correlation analysis was used to explain the relationship between the measurements. The linear regression analysis was employed to determine the effects of lower extremity fat rate on race time.
This study investigating the effect of lower extremity fat ratio on race time revealed that lower extremity fat ratio has a significant effect on running, cycling and total race time; except for swimming, at p<0.001 level. The regression results have shown that running, cycling and total race time have a statistically significant relationship respectively with fat mass $_{(r = 0.699,\ r = 0.781,\ r = 0.807)}$, fat percentage $_{(r = 0.711,\ r = 0.868,\ r = 0.866)}$, fat-free mass $_{(r = -0.492,\ r = -0.741,\ r = -0.681)}$ and muscle mass $_{(r = -0.497,\ r = -0.748,\ r = -0.687)}$ at p<0.001 level.
As a result, it was concluded in this study that lower extremity fat percentage, fat mass, fat-free and muscle mass are important variables to predict the running, cycling and total race time for college triathletes. The lower extremity fat-free mass and muscle mass showed a negative correlation with running, cycling and total racing time, and the fat mass and fat percentage showed a positive correlation. It was also shown that these variables had no effect on swimming time. Accordingly, it can be said that the contribution of running and cycling time to total racing time is more than that of the swimming time. However, as the lower extremity fat mass and fat percentage decrease, total race time of athletes shortens and accordingly their performance is likely to be affected positively.
Keywords: Skinfold, Thigh, Calf, Body Composition, Triathlon, Performance.

ÜNİVERSİTELİ TRİATLETLERDE ALT EKSTREMİTE YAĞ ORANLARI YARIŞ ZAMANININ BELİRLEYİCİSİ MİDİR?

ÖZ

Bu çalışma, alt ekstremite yağ oranlarının üniversiteli triatletlerin yarış zamanına etkisini incelenmek amacıyla yapılmıştır.
Çalışma, 9. Dünya Üniversitelerarası Triatlon Şampiyonasına katılan ve yarışmayı tamamlayan 17 kadın ve 26 erkek olmak üzere toplam 43 gönüllü sporcu ile gerçekleştirilmiştir (yaş 22,30±2,42 yıl, boy 172,76±16,08 cm, vücut ağırlığı 64,79±9,93 kg). Vücut kompozisyonu ve alt ekstremite segmental analiz değerlendirilmesinde bioelektrik impedans analiz yöntemi (BIA) kullanılmıştır (Tanita BC 418). Ölçümler, müsabaka öncesi aç karnına şort ve tişörtle yapılmıştır. Sporcular 40°C lik hava sıcaklığında Olimpik triatlon (1.5 km yüzme, 40 km bisiklet ve 10 km koşu) mesafelerinde yarıştılar.
Verilerin hesaplanması ve değerlendirilmesinde SPSS 16.0 istatistik programı kullanılmıştır. Normallik testi sonuçlarına göre ölçümler arasındaki ilişkiyi açıklamak için Pearson korelasyon analizi, yağ oranlarının yarış zamanına etkisini tespit etmek için de linear regresyon analizi kullanılmıştır.
Alt ekstremite yağ oranlarının yarış zamanına etkisinin incelendiği bu çalışmada; alt ekstremite yağ oranlarının yüzme zamanı hariç koşu, bisiklet ve total yarış zamanına p<0,001 düzeyinde anlamlı etkisinin olduğu görülmüştür. Elde edilen regresyon sonuçlarına göre koşu, bisiklet ve total yarış zamanlarının sırasıyla; yağ kitlesi $_{(r=0,699,\ r=0,781,\ r=0,807)}$, yağ yüzdesi $_{(r=0,711,\ r=0,868,\ r=0,866),}$ yağsız kitle $_{(r= -0,492,\ r= -0,741,\ r= -0,681)}$ ve kas kitlesi $_{(r= -0,497,\ r= -0,748,\ r= -0,687)}$ arasındaki ilişkilerinin istatistiksel açıdan p<0,001 düzeyinde anlamlı olduğu tespit edilmiştir.
Sonuç olarak bu çalışma, üniversiteli triatletlerde alt ekstremite yağ yüzdesi, yağ, yağsız ve kas kitlelerinin koşu, bisiklet ve total yarış zamanını tahmin etmek için önemli değişkenler olduğunu ortaya koymuştur. Alt ekstremite yağsız kitle ve kas kitlesinin koşu, bisiklet ve total yarış zamanlarıyla negatif ilişki gösterdiği, yağ kitlesi ve yağ yüzdesinin ise pozitif ilişki gösterdiği belirlenmiştir. Ayrıca bu değişkenlerin yüzme zamanına etki etmediği ortaya konulmuştur. Buna bağlı olarak, total yarış zamanına koşu ve bisiklet zamanlarının katkısının yüzme zamanına göre daha yüksek olduğu söylenebilir. Bununla birlikte alt ekstremite yağ kitlesi ve yağ yüzdesi değerleri azaldıkça yarışmacıların total yarış zamanının azalacağı, buna bağlı olarak performanslarının da olumlu yönde etkileneceği söylenebilir.
Anahtar Kelimeler: Skinfold, Uyluk, Baldır, Vücut Kompozisyonu, Triatlon, Performans.

1 Gazi University Spors Sciences Faculty, Ankara, Turkey
2 Erzincan University Physical Education and Sports Collage, Erzincan, Turkey
3 Selçuk University Sports Sciences Faculty, Konya, Turkey

INTRODUCTION

Triathlon is an endurance sport composed of three individual disciplines (swimming, cycling and running)[29]. There are many factors affecting performance in endurance sports. Alongside physiological parameters, various anthropometric parameters such as body mass[5,21,23,31,35,36], body mass index (BMI)[5,10,21], body fat[3,10,13,21,25,39], total skinfold thicknesses[5,24], lower extremity skinfold thicknesses[1,5,27,28], height[5,9,12,30], upper leg length[38], leg length[9,25], and thigh and upper arm circumferences[23,38] have been shown in many studies to be associated with endurance and race performance.

Low fat level is important for total performance time in elite triathletes[25] because body fat is a dead weight in essence to be carried throughout the race, which negatively affects performance when the body mass has to move both vertically and horizontally[4,8]. A review of the studies in the literature revealed that mostly the effects of anthropometric characteristics and body composition as well as physiological characteristics on endurance performance and race time were investigated, but studies examining the effect of fatty and fat-free ratios of body segments on race time and performance were found to be rather limited. For this reason, this study was carried out to investigate the effect of lower extremity fat ratios on race time in triathletes.

MATERIALS AND METHODS

The study group consisted of a total of 43 volunteering triathletes, 17 female and 26 male, who participated in the 9th World University Triathlon Championship that took place in Erdek, Balıkesir and who completed the competition. The mean age, height and weight of the triathletes were 22,30±2,42 years, 172,76±16,08 cm and 64,79±9,93 kg, respectively. The participants were informed about all the measurements to be used during data collection prior to the contest and their signed Subject Consent Forms were obtained.

Bioelectrical impedance analysis method (BIA) was used in the evaluation of body composition and lower limb segmental analysis (Tanita BC 418). Measurements were performed before the competition in a fasting condition with shorts and t-shirts. The athletes were competed in Olympic triathlon distance (1.5 km swimming, 40 km cycling, and 10 km running) at a temperature of 40 ° C.

The SPSS 16.0 statistics program was used to analyze the data. According to the test of normality results, the Pearson correlation analysis was used to explain the relationship between the measurements. The linear regression analysis was employed to determine the effects of lower extremity fat mass, fat-free mass, fat percentage and muscle mass on swimming, cycling, running and total race time. The level of significance was taken as 0.05.

RESULTS

Table 1. Results of regression between lower extremity segmental analysis and running time

Variables		B	Standard error	Beta	t	p
Running Time	Fat Mass	4,285	0,685	0,699	6,256	<0,000
	R = 0,699 R^2 = 0,488	F = 39,142	p = 0,000			
	Fat-Free Mass	-1,317	0,364	-0,492	-3,618	<0,001
	R = 0,492 R^2 = 0,242	F = 13,092	p = 0,001			
	Fat Percentage	0,447	0,069	0,711	6,475	<0,000
	R = 0,711 R^2 = 0,506	F = 41,931	p = 0,000			
	Muscle Mass	-1,391	0,380	-0,497	-3,665	<0,001
	R = 0,497 R^2 = 0,247	F = 13,429	p = 0,001			

As a result of the assessments in terms of running time, it is seen in Table 1 that there is a significant positive correlation ($p<0,001$) between running time and fat percentage ($r= 0,711$), fat mass ($r= 0,699$) and a significant negative correlation ($p<0,001$) between running time and fat-free mass ($r= -0,492$), muscle mass ($r= -0,497$). This can be interpreted as the time it takes for triathletes to complete the race will increase as their lower extremity fat percentage and fat mass values increase or, just the opposite, the time it takes for contestants to complete the race will decrease as these values of them decrease. An increase in race time means diminished performance. Evaluating from this point of view, increases in fat percentage and fat mass will negatively affect running performance.

Table 2. Results of regression between lower extremity segmental analysis and swimming time

Variables		B	Standard error	Beta	t	p
Swimming Time	Fat Mass	- 50,795	75,740	-0,104	-0,671	0,506
	R = 0,104 R^2 = 0,011	F =0,450	p = 0,506			
	Fat-Free Mass	18,839	33,110	0,089	0,569	0,572
	R = 0,089 R^2 = 0,008	F = 0,324	p = 0,572			
	Fat Percentage	-5,544	7,751	-0,111	-0,715	0,478
	R = 0,111 R^2 = 0,012	F = 0,512	p = 0,478			
	Muscle Mass	19,897	34,649	0,089	0,574	0,569
	R = 0,089 R^2 = 0,008	F = 0,330	p= 0,569			

The results of the regression between lower extremity segmental analysis and swimming time were not found statistically significant ($p>0.05$) (Table 2). According to these results, lower extremity fat mass, fat-free mass, muscle mass and fat percentage do not affect swimming time; thus, swimming time is not a predictor of total race time with respect to the above variables.

Table 3. Results of regression between lower extremity segmental analysis and cycling time

	Variables	B	Standard error	Beta	t	p
Cycling Time	Fat Mass	6,283	0,783	0,781	8,019	<0,000
	R = 0,781 R^2 = 0,611	F = 64,307	p = 0,000			
	Fat-Free Mass	-2,606	0,367	-0,743	-7,101	<0,000
	R = 0,743 R^2 = 0,552	F = 50,428	p = 0,000			
	Fat Percentage	0,715	0,064	0,868	11,194	<0,000
	R = 0,868 R^2 = 0,753	F = 125,305	p = 0,000			
	Muscle Mass	-2,748	0,380	-0,748	-7,224	<0,000
	R = 0,748 R^2 = 0,560	F = 52,182	p = 0,000			

A review of Table 3 reveals that there is a highly significant positive correlation (p<0.001) between cycling time and fat percentage (r=0.868), fat mass (r=0.781) and a highly significant negative correlation (p<0.001) between cycling time and fat-free mass (r=-0.743), muscle mass (r=-0.748). The results obtained for cycling time are similar to those of running time, having the same effect on race time/performance.

Table 4. Results of regression between lower extremity segmental analysis and total race time

	Variables	B	Standard error	Beta	t	p
Total Race Time	Fat Mass	11,936	1,366	0,807	8,735	<0,000
	R = 0,807 R^2 = 0,650	F = 76,300	p = 0,000			
	Fat-Free Mass	-4,401	0,738	-0,681	-5,960	<0,000
	R = 0,681 R^2 = 0,464	F = 35,518	p = 0,000			
	Fat Percentage	1,313	0,118	0,866	11,105	<0,000
	R = 0,866 R^2 = 0,751	F = 123,331	p = 0,000			
	Muscle Mass	-4,647	0,767	-0,687	-6,060	<0,000
	R = 0,687 R^2 = 0,472	F = 36,724	p = 0,000			

As a result of the assessments in terms of total race time, it is seen in Table 4 that there is a highly significant positive correlation (p<0,001) between total race time and fat percentage (r= 0,866), fat mass (r= 0,807) and a moderately significant negative correlation (p<0,001) between total race time and fat-free mass (r= -0,681), muscle mass (r= -0,687). We can say that the total race time of the contestants will decrease as their lower extremity fat percentage and fat mass decline, meaning that their race performance will be affected positively.

DISCUSSION

Conducted to determine the effect of lower extremity fat ratios of university triathletes on race time, this study revealed that the lower extremity fat ratios or fat-free and muscle masses did not affect swimming time as shown by the segmental analysis results (p>0.05, Table 2). However, fat percentage and fat mass had a statistically significant positive correlation (p<0.001), and fat-free mass and muscle mass a significant negative correlation with running, cycling and total race times (p<0.001) (Tables 1, 3 and 4). The studies made on endurance athletes have shown that the physical characteristics of sportspeople may play an important role in their performance[6,11,21,22,5,34]. Therefore, regardless of the type of a given sport, sportspeople should have favourable anthropometric and physiological characteristics to improve their performance[31].

A study made on ultra-marathon runners has demonstrated that lower levels of body mass and skinfold thickness are associated with a better running performance[11]. It has been stated that in endurance sports the decrease in the body fat is specific to the selected muscle groups used during workouts and race performance improves as a result of the decrease in lower extremity skinfold thicknesses[28]. In another study, Bale et al. (1986) have similarly reported that there is a significant association between decreased skinfold thickness in the thigh region and improvement in performance[5]. The length of race distance seems to be important in the correlation between skinfold thickness and race performance[16]. The anthropometric characteristics of triathletes are stated to be associated also with the content of the training[21]. In another study, Knechtle et al. (2010a) have argued that the anthropometric characteristics of triathletes are associated more with the total race time than with the training content[22]. Due to the nature of triathlon trainings, the magnitude of running exercises and general training causes reduction in lower extremity skinfold thicknesses[2]. Reduced lower extremity skinfold thickness means reduced fat ratio in the lower extremities. Therefore, we can say that as the lower extremity fat ratio decreases, the race performance is affected positively in triathlon, which is an endurance sport.

It was stated in the studies investigating the effect of anthropometric characteristics on race performance that the comparisons between triathletes and runners revealed that different morphological factors were important in triathletes. In one of these studies, Landers et al. (2000), have underlined that strength, fat deposition, segmental length of the extremities and musculoskeletal mass are important for performance[25]. They also found that the anthropometric characteristics of contestants accounted for 47% of the variance in triathlon performance. It was also reported that the body fat of triathletes was another factor influencing race performance[35,37].

Studies have reported that lower fat ratios affect the running performance positively during triathlon races[21,34]. It has been stated that lower body fat percentage, larger body segment length and higher fat-free body mass are associated with better performance in cycling and triathlon races[20]. Belli et al. (2016) have stated that high level of body fat accumulations particularly in the lower extremities and abdominal region may negatively affect the performance of ultra marathon runners[6]. Similarly, Hagan et al. (1987) have found that there is a positive correlation between body fat and marathon race time in female marathon runners[10]. The results obtained in the present study with respect to lower extremity fat mass and fat percentage are similar to those in the literature.

It has been observed in many studies that physical performance has a positive correlation with musculoskeletal mass and fat-free body mass[7,19,26,33]. In other words, higher fat-free body mass and muscle mass lead to increased physical performance. We found in this study that the fat-free mass and muscle mass parameters had a significant negative correlation with running, cycling and total race times. In other words, increased fat-free and muscle masses result in shortened race time, hence better physical performance. We see that the results obtained in this study are supported by those in the literature.

When the results of swimming performance were evaluated in this study, it was seen that the fatty and fat-free masses of the body did not affect swimming time significantly. In the literature, a study made on swimmers reported that body fat did not affect race time[14] and some other studies also reported that body fat was not associated with race time[15,17]. Similarly, Knechtle and Duff (2007) found in another study that with the exception of swimming performance, cycling and running performances were significantly correlated with total race time. According to their results, running had the highest effect and swimming had the lowest effect on race performance. They stressed that contrary to running and cycling performances, there was a need for well-trained legs and well trained upper body for excellent swimming performance. They also stated however that a well-trained upper body did not produce a beneficial effect during cycling and running performance[18]. The results obtained in this study regarding swimming time are similar to those in the literature.

CONCLUSION

In conclusion, this study revealed that lower extremity fat percentage and fat, fat-free and muscle masses are major variables to estimate the running, cycling and total race times in university triathletes. According to the results obtained from this study, we can say that a low body fat ratio of lower extremities is a predictor of running, cycling and total race time in Olympic Triathlon contests.

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