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The relationship between body composition and biomotor performance parameters in U18 football players

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Abstract

Background and Study Aim This study aimed to determine the relationship between body composition and biomotor performance parameters in male football players under 18 years of age (U18).

Material and Methods Eighteen male football players who play in the U18 category in the local football league in Muş province, Turkey voluntarily participated in this research. The players underwent body analysis measurements and performed the following tests: 10-m and 20-m sprints, T agility, vertical jump, and the Yo-Yo intermittent recovery test (level 1). The SPSS package program was used for relational and descriptive analysis of the data. The Pearson correlation test was performed to determine relationships between variables in normally distributed data, while the Spearman correlation test was used for non-normally distributed data.

Results A weak negative correlation was observed between the 20-m sprint test and fluid (liquid) mass (r=-.448; p=.047). There was a weak positive correlation between vertical jump heights and lean mass (r=.475; p=.034), muscle mass (r=.475; p=.034), and basal metabolic rate (r=.461; p=.041), while vertical jump and fluid mass (r=.574; p=.008) exhibited a moderate positive correlation. A weak positive correlation was found between the 10-m sprint test and visceral fat (r=.489; p=.029). No significant association existed between the T agility and Yo-Yo tests and body composition parameters (p>.05).

Conclusions Higher levels of lean mass, muscle mass, fluid mass, and basal metabolic rates correlated with improved vertical jump performances. As the fluid mass of the participants increased, their 20-m sprint times also increased; a similar relationship was observed between visceral fat proportions and 10-m sprint times. In order to improve the physical performances of football players, we propose inhibiting the accumulation of body fat while increasing fluid and muscle levels.

Keywords: football, body composition, sprint, agility, jumping

Introduction

The definition of performance in sports is expressed as the ability of the organism to resist an increasing workload [1]. The proportion and intensity of an athlete's physiological ability to resist a workload are associated with that person's physical and body structure. The term biomotor performance (or physical fitness) is related to the health of the whole body [2]. In terms of sports, biomotor performance represents the evaluation of various biomotor characteristics. The purpose of assessing performance is to quantify the burst of energy that occurs together with the aerobic and anaerobic capacities of the skeletal muscles during exercise [3]. In addition to biomotor characteristics, body composition also constitutes an important factor in evaluating athletic performance. Body composition generally consists of fat, bone, muscle cells, other organic matter, and extracellular fluids. Factors affecting body composition, many of which are closely related to lifestyle, include age, gender, muscle, physical activity levels, diseases, and nutrition. Body composition can be divided into fat and lean mass. The latter encompasses muscle, bone, water, nerves, veins, and other organic substances, while fat mass is classified as subcutaneous fat, stored fat, and essential fats [4].

The human body is comprised of certain proportions of water, protein, fat, and minerals. After genetic disposition, the most important factor that determines these rates is lifestyle, of which physical activity constitutes a critical component. Thus, sports play a crucial role in the vital activities that determine body composition. In healthy individuals, these proportions are balanced; when imbalances in body composition are promptly detected, we can evaluate and counteract problems related to the individual's body development. Analyzing actual body composition values and their relationships to each other is of paramount importance for diagnosing health problems linked to these components [5]. In addition, understanding the relationship between body composition parameters and different types of sports and biomotor characteristics is necessary for optimal

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athletic performance. The sport of football, which is of great interest to large numbers of spectators, is seeing developments in terms of performance and tempo with each passing day. The fast pace of play in football requires ever more running, and at greater speeds, during matches. In order to achieve goals and attain high performance levels, the physical and physiological fitness of the athletes must be adequate to the specific requirement of the sport in question [6].

In order for football players to perform at a high level during competition, they must be in peak physical, mental, and psychological condition, as well as possess advanced techniques and tactics [7]. Following advances in technology, major developments have also occurred in the science of sports training, and as a result, the fitness levels of football players on different teams have grown ever closer. As the aerobic capacity and endurance of football players have increased, the pace of the game has likewise increased, and with it, the level of play [8], since in football, both aerobic and anaerobic capacity affect the athlete's performance. Based on an analysis of football matches, professional football players were determined to run a total distance of about 14 km and perform approximately 1400 short-distance actions during the course of a match [9]. The ability of football players to adapt to such physical demands is related to the development of biomotor characteristics such as speed, endurance, and strength.

The quality and structure of training undergone by football players affects their body composition and biomotor performance parameters. Along with increases in the rigor, intensity, and volume of training sessions, the total time allocated to training is also greater. As a result, professional football players have approached the limits of football players' biomotor abilities. Meanwhile, amateur teams, with the goal of promotion to professional leagues, have attempted to rid themselves of their amateur identities, following the results of research utilizing high-level training methods and content [10]. As an intensely competitive sport, football requires optimal biomotor performance levels and body compositions on the part of its players in order for them to achieve success.

Purpose of the Study. The study purpose was to determine the relationship between body composition and speed, agility, jump and endurance in U18 male football players. In addition, the results of the research are expected to contribute to the literature.

Materials and Methods

Participants

The study participants consisted of 20 male football players in the U18 category playing in local football leagues in Muş, Turkey. The athletes participated in this research voluntarily. This study was conducted in accordance with the principles specified in the Declaproportionn of Helsinki and ethical approval was obtained from the Scientific Research and Publication Ethics Committee of Muş Alparslan University in Turkey (date: 02.01.2023, decision no. 56).

Research Design

The model used for this research was the relational screening model, in which two or more variables are analyzed to determine whether they change in tandem and, if so, to what degree [11]. The players underwent body analysis measurements and performed the following tests: 10-m and 20-m sprints, T agility, vertical jump, and the Yo-Yo intermittent recovery test (level 1). The physical characteristics of the U18 football players are shown in Table 1.

Body Composition Measurements

The heights of the participating football players were determined using a stadiometer. The remaining parameters, which included body mass, BMI (body mass index), lean mass, lean proportion, muscle mass, muscle proportion, fat mass, fat proportion, fluid mass, fluid proportion, basal metabolic rate, and visceral fat proportion, were measured with the Tanita MC 780 device. Care was taken to ensure that all tests were performed at least two hours following the participants' last meal. Body composition measurements were taken after the players had relieved themselves, wearing only shorts and T-shirts.

Biomotor Tests

10-m and 20-m Sprint Tests: A Fusion brand Smart Speed electronic photocell device was placed at the starting and ending points of a 10-m and 20-m running track. The athletes started each sprint at a distance of 50 cm behind the start line. Each athlete was allowed two attempts at each distance, and the faster scores were recorded [12].

T Agility Test: This test, which assesses agility, measured the speed of the athletes as they covered pre-determined distances while changing direction. It includes forward sprinting, sliding to the right and left, and back-and-forth running movements [13].

Vertical Jump Test: The vertical jump heights of the athletes were measured using the electronic Fusion brand SmartJump jump mat. The athletes were instructed to stand on the mat with their hands on their waists and to jump as high as possible when ready. After jumping, the athletes landed back on the mat. The heights reached by the participants were measured in cm and the athletes were allowed two jumps, with the better of the two scores being recorded [14].

Yo-Yo 1 Intermittent Recovery Test: In order to determine the endurance levels of the participating

U18 athletes, the Yo-Yo 1 intermittent recovery test (the "1" refers to level 1), which consists of a 20-m running area and a 5-m active recovery section on a simulated football field, was employed. The athlete must follow a 20-m run with 10 seconds of active recovery. The test was started at 10 km/h and over the course of the testing period the acceleration rates were increased. During the test, audio signals, produced from the licensed CD via computer and sound systems, indicated that the participants should regularly increase their running speeds. The athletes adapted their pace in accordance with the signal sounds that they heard. The test was terminated in cases where the player missed the signal sound on three occasions at different times or if the athlete voluntarily discontinued the test [15, 16].

Statistical Analysis

The SPSS package program was used for relational and descriptive analysis of the data. Data with skewness and kurtosis values between -1.5 and +1.5 were considered to exhibit normal distribution [17]. The Pearson correlation test was conducted to determine the relationships between variables in normally distributed data, while the Spearman correlation test was used for non-normally distributed data. A value of p<.05 was accepted as statistically significant for this study.

Results

While examining the statistical relationship between the body composition and biomotor performance parameters of U18 male football players, the normality level of the data was determined first. Parametric and non-parametric correlation tests were applied according to the skewness and kurtosis values of the data. The descriptive statistics results of the footballers' body composition and biomotor performance parameters are shown in Table 1 and Table 2.

It was determined that fluid proportion and visceral fat proportion parameters did not show normal distribution according to skewness and kurtosis values in the body composition data of U18 male football players. Other body composition parameters were found to have a normal distribution (Table 1). In the biomotor test data, it was determined that all parameters showed normal distribution according to the skewness and kurtosis values (Table 2).

The results of correlation tests applied to statistically determine the relationship between body composition and biomotor performance parameters of U18 male football players are given in Table 3 and Table 4.

A weak negative correlation was observed between the 20-m sprint test and fluid mass (r=-

Table 1. Descriptive Statistics Results for Body Composition (n=20)

Body Composition	X̄±Std. Dev.	Min.	Max.	Skewness	Kurtosis
Height (cm)	175.0±4.8	167.0	185.0	.440	-.403
Body Mass (kg)	61.0±6.3	47.0	71.8	-.266	.091
BMI (kg/m^2)	19.9±2.1	16.1	25.1	.686	1.308
Fat-free Mass (kg)	54.2±5.3	43.3	65.8	-.113	.351
Fat-free Proportion (%)	89.0±3.7	80.3	94.5	-1.123	.759
Muscle Mass (kg)	51.5±5.0	41.1	62.5	-.116	.339
Muscle Proportion (%)	84.6±3.5	76.2	89.8	-1.130	.803
Fat Mass (kg)	6.8±2.7	3.2	13.1	1.111	.713
Fat Proportion (%)	10.9±3.8	4.5	19.7	.980	.754
Fluid Mass (kg)	38.5±2.8	32.6	43.9	-.282	.141
Fluid Proportion (%)	64.3±5.9	57.8	86.6	2.934	11.005
Basal Metabolic Rate (kcal)	1.6±0.1	1.3	1.9	-.067	.304
Visceral Fat Proportion (%)	1.2±0.5	1.0	3.0	2.745	7.401

Table 2. Descriptive Statistics Results for Biomotor Tests (n=20)

Biomotor Tests	X̄±Std. Dev.	Min.	Max.	Skewness	Kurtosis
10-m Sprint (sec)	1.8±0.1	1.6	2.0	.424	.190
20-m Sprint (sec)	3.0±0.2	2.7	3.4	.979	.755
T Agility Test (sec)	10.7±0.6	9.4	11.7	-.240	-.205
Vertical Jump (cm)	34.9±5.7	23.6	44.3	.135	-.683
Yo-Yo Test (m)	1691.0±472.6	1040.0	2480.0	.301	-1.220

Table 3. Pearson Correlation Test Results for Body Composition and Biomotor Tests (n=20)

Variables		10-m Sprint	20-m Sprint	T Agility Test	Vertical Jump	Yo-Yo Test
Height (cm)	r	.054	-.140	-.118	.188	.063
	p	.820	.555	.621	.428	.792
Body Mass (kg)	r	-.235	-.181	-.253	.353	-.050
	p	.318	.444	.282	.127	.835
BMI (%)	r	-.265	-.098	-.190	.258	-.094
	p	.258	.680	.422	.272	.695
Fat-free Mass (kg)	r	-.356	-.374	-.237	.475*	-.056
	p	.123	.104	.315	.034	.816
Fat-free Proportion (%)	r	-.190	-.375	.091	.191	-.036
	p	.422	.103	.703	.420	.880
Muscle Mass (kg)	r	-.357	-.375	-.238	.475*	-.055
	p	.122	.104	.313	.034	.817
Muscle Proportion (%)	r	-.198	-.382	.087	.196	-.035
	p	.402	.096	.716	.407	.883
Fat Mass (kg)	r	.140	.307	-.132	-.097	-.007
	p	.557	.189	.580	.685	.978
Fat Proportion (%)	r	.175	.371	-.085	-.179	.041
	p	.460	.107	.722	.449	.864
Fluid Mass (kg)	r	-.441	-.448*	-.335	.574**	-.008
	p	.052	.047	.148	.008	.973
Basal Metabolic Rate (kcal)	r	-.341	-.345	-.237	.461*	-.062
	p	.141	.136	.314	.041	.796

*p<.05; **p<.01

Table 4. Spearman Correlation Test Results for Body Composition and Biomotor Tests (n=20)

Variables		10-m Sprint	20-m Sprint	T Agility Test	Vertical Jump	Yo-Yo Test
Visceral Fat Proportion (%)	r	.489*	.396	.047	-.380	-.211
	p	.029	.084	.843	.098	.371
Fluid Proportion (%)	r	-.205	-.108	.146	-.005	.140
	p	.386	.652	.539	.985	.556

*p<.05; **p<.01

.448; p=.047) in the U18 football players. Weak positive correlations were detected between the vertical jump test and lean mass (r=.475; p=.034), muscle mass (r=.475; p=.034), and basal metabolic rate (r=.461; p=.041). The vertical jump test was also found to have a moderate positive correlation with fluid mass (r=.574; p=.008) (Table 3).

A weak positive correlation was detected between the 10-m sprint test and visceral fat proportion (r=.489; p=.029) (Table 4).

The graphs of the relationship between the body composition and biomotor performance parameters of U18 male football players are shown in Figure 1 and Figure 2.

Figure 1 shows the positive correlations observed between the vertical jump heights and lean mass, muscle mass, fluid mass, and basal metabolic rates of the U18 football players. According to the graphs, as lean mass, muscle mass, fluid mass, and basal metabolic rates increased, the vertical jump performances of the participants also improved.

The graph showing the negative relationship between the 20-m sprint test and fluid mass of the participating U18 football players is presented in Figure 2. Based on the graph, an increase in liquid mass is associated with a decrease in the 20-m sprint times of the football players. In other words, the sprint performances improved with increased liquid mass. The other graph depicts the positive relationship between 10-m sprint times and visceral

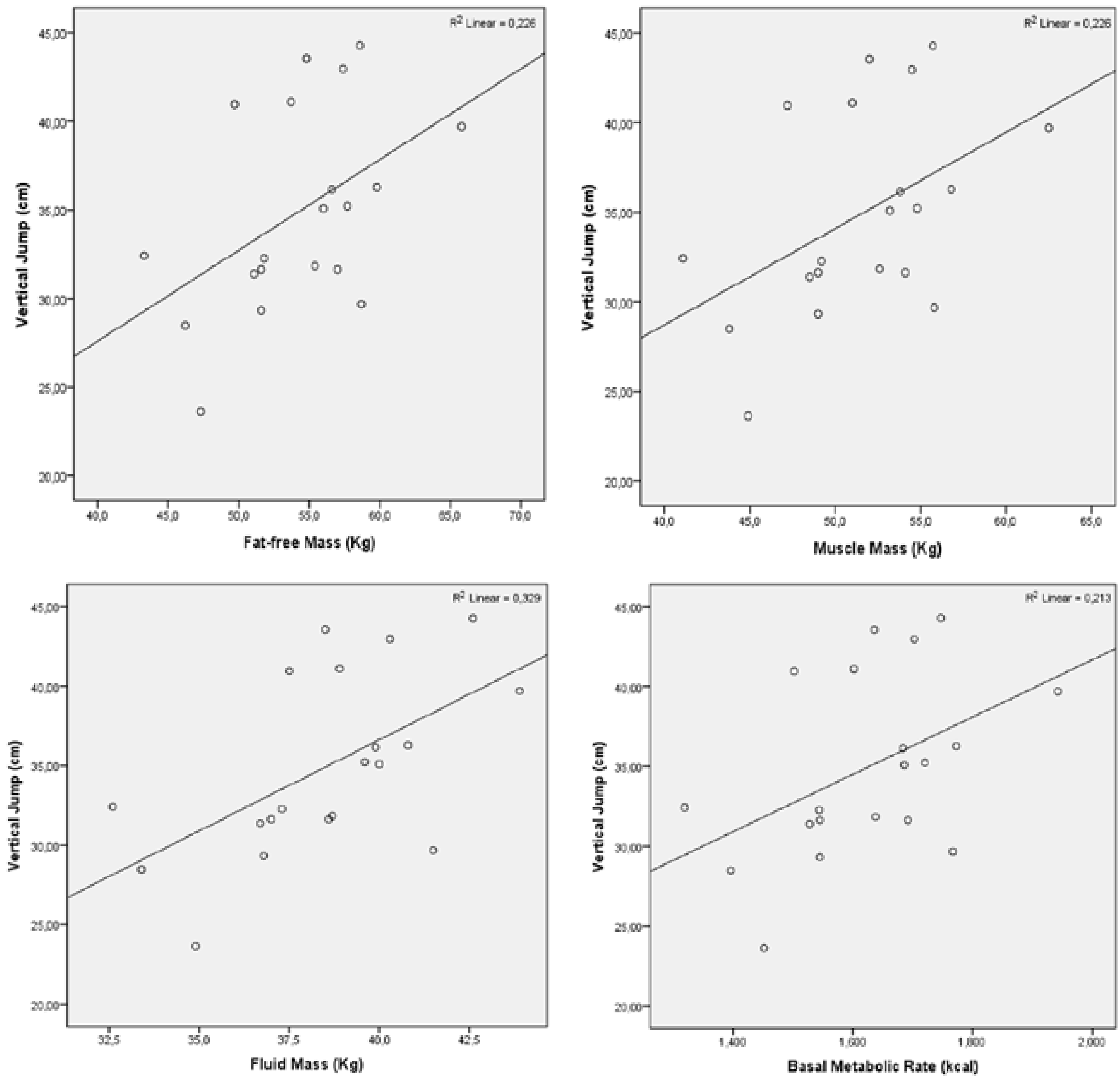

Figure 1. The relationships between vertical jump and lean (fat-free) mass, muscle mass, fluid (liquid) mass, and basal metabolic rate

fat. As visceral fat increased, sprint times also rose, corresponding to poorer sprinting performance.

Discussion

Since football is a sport involving intense conflict and skirmishes between players, their biomotor performance levels and body compositions are critical for success in competition. The present study aimed to determine the relationship between body composition and biomotor performance parameters in male football players in the U18 category.

In the present study, a statistically significant relationship was observed between the 10-m and 20-m sprint tests and body fat percentages in the participating U18 male football players. A review of the literature revealed a positive but weak association between body fat percentage and 10-m sprint tests and a moderate positive relationship between body fat percentage and 30-m sprint tests in a study on football players [18]. Damayanti and Adriani reported a strong positive correlation between body fat percentage and 20-m sprint performance in futsal players [19]. In their study on football players, Cerrah et al. determined that a moderate positive correlation existed between body fat percentage and 10-m and 30-m sprint performances while finding a strong positive relationship between body fat mass and 10-m and 30-m sprint tests [20]. Anwar and Noohu detected a moderate positive moderate correlation between body fat percentage and 30-m sprints in football players attending university [21]. Hyka Bicoku and Mysliu noted a weak positive association between the body fat percentage of football players and 50-m sprints, while Aktaş and

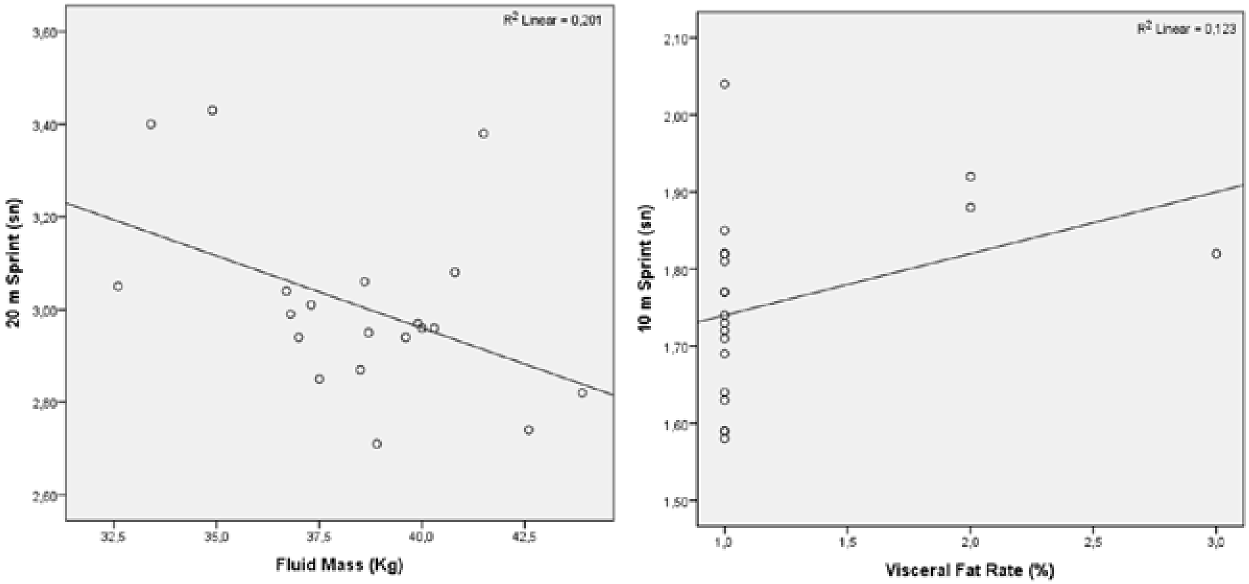

Figure 2. The relationships between lean mass and 20-m sprint (left) and visceral fat and 10-m sprint (right).

Aslan reported a moderately positive relationship between football players' body fat percentage and 10-m and 30-m sprint performances [22, 23]. The author of one study concluded that in order to achieve a high level of performance in football, incorporating both aerobic and anaerobic processes, serious attention must be paid to the lean body mass and body fat proportion of the players [24]. Another study examining the relationship between the body composition and performance parameters of football players determined that low body fat percentage resulted in better sprint performance [25]. The results obtained from our study, however, are not consistent with the findings of these studies. This discrepancy may be due to differences in the training levels and physical characteristics of the participants involved in the various studies.

Concerning visceral fat, among the findings of the present study, a weak positive correlation was detected between visceral fat and 10-m sprint times in the U18 male football players, although no significant relationship existed between visceral fat and the 20-m sprint, T agility, vertical jump, and Yo-Yo tests. A literature search found no study investigating the relationship between visceral fat levels and biomotor characteristics. According to our results, high visceral fat levels in the participating football players negatively affected their 10-m sprint performances.

In our study, there was a weak positive correlation between vertical jump and lean mass, muscle mass, and basal metabolic rate (kcal) in the participating U18 male football players. Additionally, a moderate positive correlation was detected between vertical jump and fluid mass. Thus, increases in lean mass, muscle mass, fluid mass, and the basal metabolic rates of the football players were associated with improved vertical jump performances. The reverse of this situation can be expressed thusly: as the proportion of body fat increased, vertical jump performance declined. However, our study found no significant relationship between vertical jump and body fat percentage. In a study by Çelik et al. a weak negative correlation was observed between the body fat percentage of football players and their vertical jump performance [18]. Silvestre et al. detected a statistically significant relationship between body composition and vertical jump, while Anwar and Noohu reported a moderately significant negative correlation between body fat percentage and vertical jump in university-educated football players [26, 21]. Esco et al. found a strong negative correlation between the body fat percentage of football players and vertical jump, and Figueiredo et al. observed a negative relationship between body fat percentage and jumping performance in professional football players [27, 28]. A study by Atakan et al. concluded that jumping performance was negatively affected by an increase in body fat percentage in football players [29]. In a study on young football players, those with low body fat percentages demonstrated superior vertical jump performances [25]. In the aforementioned studies, a negative relationship was determined to exist between vertical jump and body fat percentage. These results indicate that an increase in body fat percentage in football players negatively affects vertical jump performance. Having a higher percentage of body fat impairs the performance of football players in activities involving the movement of the body [21]. Body fat limits mobility and leads to a decline in performance; therefore, a high level of body fat would be expected to negatively affect speed and jumping ability. As a result, athletes with low body fat percentages can perform better than athletes with higher body fat levels [19].

With regard to fluid mass, we observed a weak negative correlation between the 20-m sprint test and fluid mass in the U18 male football players in this study. Increased liquid mass corresponded with decreased (thus, improved) 20-m sprint times on the part of the participants. Therefore, maintaining fluid balance in football players represents an important factor in optimizing performance; body fluids and electrolytes need to be replenished during and after training. Implementing practices to maintain the balance of fluids in the body before engaging in high-intensity and sprint exercises will prevent a decline in the performance of football players [30]. In addition, athletes should consume more fluids in order to avoid hyperthermia in hot and humid weather conditions [31].

Conclusions

In conclusion, as lean mass, muscle mass, fluid mass, and basal metabolic rate increased in U18 male soccer players, their vertical jump performances also improved. Increased fluid mass was also associated with improved (decreased) 20-m sprint times. Meanwhile, as visceral fat levels increased, the 10-m sprint times of the participating football players also increased, indicating a decline in performance. In order to improve the physical performance of football players, we suggest preventing the accumulation of body fat while increasing fluid and muscle mass levels.

Conflict of interest

There is no conflict of interest between the authors

References

1. Parlak E. *Evaluation of nutritional status, anthropometric measurements and performance of female star basketball team athletes.* [Master thesis]. Cukurova University Graduate School of Natural and Applied Sciences, Adana; 2009.
2. Klein M, Fröhlich M, Emrich E. Motor performance and bodyweight of children and adolescents in Saarland–Status quo. *European Journal of Sport Science,* 2013; 13(3): 280–289. https://doi.org/10.1080/17461391.2011.635702
3. Yıldız SA. What is the meaning of aerobic and anaerobic capacity?. *Respiratory Journal,* 2012; 14: 1–8.
4. Zorba E. *Physical fitness.* Mugla: Gazi Bookstore; 2001.
5. Aysan HA. *The effects of sporting activity levels on body composition and bone mineral density in sports high school and science high school students.* [PhD. thesis]. Fırat University Institute of Health Sciences, Elazıg; 2010.
6. Kalyon TA. *Sports medicine, athlete health and sports injuries.* Ankara: GATA Printing House; 1990.
7. Hoff J, Gran A, Helgerud J. Maximal strength training improves aerobic enduraace performance. *Scandinavian Journal of Medicine and Science in Sports,* 2002; 12(5): 288–295. https://doi.org/10.1034/j.1600-0838.2002.01140.x
8. Barnes C, Archer DT, Hogg B, Bush M, Bradley PS. The Evolution of Physical and Technical Performance Parameters in the English Premier League. *Journal o f Sports Medicine,* 2014; 35(13): 1095–1100. https://doi.org/10.1055/s-0034-1375695
9. Akgün N. *Exercise and sports physiology.* Izmir: Ege University Press; 1994.
10. Aslan CS, Koç H. Comparison of selected physical, physiological and motoric characteristics of amateur football players according to their positions. *CBU Journal of Physical Education and Sport Sciences*, 2015; 10(1): 56–65.
11. Karasar N. *Scientific research methods.* Ankara: Nobel Publications; 2011.
12. Özdemir FM. *Investigation of the relationship between agility, speed, power and strength in young football players according to age.* [Master thesis]. Baskent University Institute of Health Sciences, Ankara; 2013.
13. Okudur A, Sanioğlu A. Examination of the relationship between balance and agility in 12 year old tennis players. *Selcuk University Journal of Physical Education and Sport Sciences,* 2012; 14(2): 165–170.
14. Atan T. The effect of different warm-up protocols on joint range of motion, jump and sprint performance. *OPUS International Journal of Society Researches*, 2019; 13(19): 621–635. https://doi.org/10.26466/opus.574260
15. Bangsbo J. Energy demands in competitive soccer. *Journal of Sports Sciences,* 1994; 12(1): 5–12. https://doi.org/10.1080/02640414.1994.12059272
16. Mohr M, Krustrup P, Bangsbo J. Match performance of high-standard soccer players with special reference to development of fatigue. *Journal of Sports Sciences,* 2003; 21(7): 519–528. https://doi.org/10.1080/0264041031000071182
17. Tabachnick B, Fidell LS. *Using multivariate statistics*. Boston: Pearson; 2013.
18. Çelik S, Örer GE, Diler K, Yelken ME. Investigation of the relationship between the body fat percentage of football players and their speed and vertical jump performances. *Gazi Journal of Physical Education and Sports Sciences,* 2022; 27(4): 313–332. https://doi.org/10.53434/gbesbd.1134779
19. Damayanti C, Adriani M. Correlation between percentage of body fat with speed and cardiorespiratory endurance among futsal athletes

in surabaya. *Media Gizi Indonesia,* 2021; 16(1): 53–61. https://doi.org/10.20473/mgi.v16i1.53-61
20. Cerrah AO, Polat C, Ertan E. Investigation of some physical and technical parameters of super amateur league football players according to their positions. *Nigde University Journal of Physical Education and Sport Sciences,* 2011; 5(1): 1–6.
21. Anwar S, Noohu MM. Correlation of percentage body fat and muscle mass with anaerobic an aerobic performance in collegiate soccer players. *Indian J Physiol Pharmacol,* 2016; 60(2): 137–144.
22. Hyka A, Bicoku E, Mysliu A. The association of sprint performance with anthropometric parameters in youth soccer players. *Sport Mont Journal,* 2017; 15(1): 31–35.
23. Aktaş H, Aslan C. Investigation of the relationship between body composition and speed in amateur football players. *Canakkale Onsekiz Mart University Journal of Sport Sciences,* 2018; 1(1): 17–25.
24. Aslan CS. *Comparison of narrow field games and running training in football: Physical, physiological and technical characteristics.* Germany: Lap Lambert Academic Publishing; 2016.
25. Gameiro P, Familia C, Granja D, Caetano C, Ferreira D, Godinho C. Relationship between body composition, sprint performance and vertical jump tests in young elite soccer players. *Annals of Medicine,* 2018: 50: 168–169.
26. Silvestre R, West C, Maresh CM, Kraemer WJ. Body composition and physical performance in men's soccer: a study of a national collegiate athletic association division iteam. *Journal of Strength Conditioning Research,* 2006; 20(1): 177–183. https://doi.org/10.1519/R-17715.1
27. Esco MR, Fedewa MV, Cicone ZS, Sinelnikov OA, Sekulic D, Holmes CJ. Field-based performance tests are related to body fat percentage and fat-free mass, but not body mass index, in youth soccer players. *Sports,* 2018; 6(4): 105. https://doi.org/10.3390/sports6040105
28. Figueiredo DH, Dourado AC, Stanganelli LCR, Gonçalves HR. Evaluation of body composition and its relationship with physical fitness in professional soccer players at the beginning of pre-season. *Retos: Nuevas Tendencias En Educación Física, Deporte Y Recreación,* 2021; (40): 117–125. https://doi.org/10.47197/retos.v1i40.82863
29. Atakan MM, Unver E, Demirci N, Bulut S, Turnagol HH. Effect of body composition on fitness performance in young male football players. *Turkish Journal of Sport and Exercise,* 2017; 19(1): 54–59.
30. Esen S. *The effect of rehydration on some electrolyte levels in professional football players.* [Master thesis]. Selcuk University Institute of Health Sciences, Konya; 2017.
31. Bilici MF. Physical activity during adolescence. The effect of sports and nutrition on sports performance and physical development. In C. Yaman (Ed.). *Nutrition and Obesity*. İstanbul: Güven Plus Group Consulting; 2019.

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