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Relationship between body composition and speed, strength and jumping performance in young male soccer players

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Abstract

Body composition is very important for athletic performance. The aim of this study was to determine the relationship between body composition and speed, strength and jumping performance in young male football players. This research was designed in the relational screening model. 18 male football players (age: 14.17±0.38 years) who actively play football in local amateur football leagues participated in the study voluntarily. Body composition measurement, counter movement jump, 30m sprint and back strength, test were used as data collection tools. Pearson Correlation Test was used in the relational analysis of normally distributed data. A moderately significant positive relationship was found between fat free mass and back strength (r=.545, p=.019), muscle mass and back strength (r=.545, p=.019) and fluid mass and back strength (r=.548, p=.019). A moderately significant positive relationship was found between bone mineral mass and back strength (r=.584, p=.011). A moderately significant positive relationship was found between basal metabolism and back strength (r=.574, p=.013). A moderately significant positive relationship was found between bone mineral mass and CMJ (r=.584, p=.011). In amateur football players, muscle strength increases as lean body mass, muscle mass and fluid mass increase. In this case, it can be said that having more muscle mass and fluid mass positively affects strength. It can be suggested that performance increase can be achieved by keeping lean body mass under control and adjusting body fluid balance well in young male football players.

Introduction

Football, although a significant part of it is aerobic, is a sport branch that includes many maximum level sprints, jumping, high tempo and continuous fast runs, light tempo runs, important physical contacts, movements requiring agility and walking during the competition (Tumilty, 1993; Little & Williams, 2005). Considering the functioning of football in this way, bio motor characteristics such as strength, speed and endurance are quite important in football (Little, 2005). Intense activities such as sprinting, jumping, dual combat, dribbling and small-sided games are intensively applied in football (Kahraman et al., 2023). Though endurance and high intensity runs performed at certain intervals are important in football, football is a branch that requires the development of very different skills as a character. In order to be successful in football, the physical, technical and tactical levels of the athletes are quite important. In the success parameters of football, a body composition suitable for the game characteristics of this branch and physical parameters are quite important (Açıkada et al., 1999).

One of the important factors affecting the performance of football players is body composition (Köse et al., 2021). Although the organs and systems of the organism are similar, each individual has a different body composition. Body composition covers the values of bones, muscles, fat, water and minerals in the body and indicates the total body mass. However, in body composition tests of athletes, the body's fat level and lean level are mostly taken as basis. While lean mass covers muscles, bones, body water level, nerves, veins and some organic substances, fat mass covers the amount of stored fat, subcutaneous fat and essential fats (Aktaş & Aslan, 2011). Factors affecting body composition, which is an important parameter for athletes and sedentary individuals, are age, gender, physical activity level, current muscle type, past diseases

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and nutrition (Zorba, 2004). Physical fitness parameters have an important role in the athlete's physical ability, strength and capacity in football. In recent years, how physical development occurs with age and how it develops, especially from the perspective of children, has emerged as a detail that has been wondered about (Fox et al., 1999). In order to be successful in football, it is important to have advanced physical fitness parameters, but ideal body composition values also affect performance. Having an ideal or low body fat ratio is considered a positive situation for athlete performance. High levels of body fat create a negative situation for bio motor characteristics and can cause negative results on performance in sports that require endurance by causing additional energy consumption (Engels, 2002).

The main purpose of studies investigating body composition is to determine the level of effect of body composition on athletes' performance (Canlı, 2020). By evaluating the body composition of athletes, different body types are determined and evaluations are made in this way. Individual training loads and nutrition diets of athletes are determined with body composition analyses to be performed on athletes before the season. Because while excessive fat levels have negative effects on football player performance, good muscle mass and ideal body fat ratio will have negative effects on the athlete's speed, strength and endurance (Sutton, 2009). This study aimed to examine the impact of body composition on speed, strength, and jumping performance in young male soccer players, providing a scientific perspective on optimizing athletic performance.

Methods

This research was designed in the relational screening model. Before the study, the ethics committee approval of the study was obtained with the decision numbered 14 and dated 02.01.2025 of the Bitlis Eren University Non-Interventional Clinical Research Ethics Committee.

Participants

The population of the study consisted of young football players, while the sample included 18 male football players aged 14-15 who voluntarily participated in the study and played for an amateur football team that trained regularly. Detailed information about the study was given to the athletes and their parents. Voluntary consent forms were obtained from the athletes who would participate in the study, and parental consent forms were obtained from the parents of the athletes participating in the study. Participants who had any chronic disease, had a musculoskeletal injury in the last year, and who needed to use medication on a regular basis were not included in the study. All participants were instructed to follow regular eating habits and to avoid taking any ergogenic aids or stimulants during the experiment. They were also advised not to engage in vigorous physical activity and not to consume caffeine for 24 hours before the measurements.

Data Collection Tools

Body Composition Measurement: Body weight, body mass index, body fat ratio, body water ratio, body muscle ratio and body internal fat ratio of athletes who met the inclusion and exclusion criteria were first determined by bioelectrical impedance analysis method by entering the height, age and gender of the participants, which were previously determined with a tape measure, into the data screen of the device (Tanita BC-418 MA, Japan). The values read from the output obtained after the device completed the measurements were recorded. Participants were asked not to enter the bath or sauna at least 24 hours before the measurements and also not to consume any food at least 4 hours before the measurements. The measurements were applied between 08:00 and 10:00 in the morning and the participants did not exercise on the day the measurements were made. By making sure that the feet were not wet during the measurement, the hands and heels were placed on the electrodes and the athletes held the handles connected to the electrodes on the device throughout the measurement period.

Counter Movement Jump (CMJ) Test: It is a test used to determine the level of leg strength, jumping power and alactacid anaerobic power. The vertical jump measurements of the athletes were measured with an electronic Fusion brand Smart Jump jumping mat. All athletes were asked to stand on the mat with their hands on their hips and when the athletes were ready, they were asked to jump to the highest point they could and after jumping, they fell back onto the mat. The athletes had two trials and their jump heights were measured in cm and their best scores were recorded (Atan, 2019).

30m Speed Test: Photocells were placed at the beginning and end of the 30-meter track. The participants waited in a standing position 50 cm behind the starting line and when they were ready, they started sprinting with the command and when they passed the second photocell, the times were recorded. Each athlete

was given two trials and their best time at the end of the trials was recorded (Balcıoğlu, 2018).

Back Strength Test: After the athletes warmed up for 5 minutes, the subjects placed their feet on the dynamometer stand with their knees bent, and with their arms stretched, their backs straight and their bodies slightly bent forward, they pulled the dynamometer bar they held with their hands vertically up to the maximum extent using their backs and the values were recorded. Each athlete was given two trials and their best score was recorded at the end of the trials.

Analysis of Data

SPSS 27 program was used in the statistical data analysis of the data. Descriptive statistics of the variables were given as mean and standard deviation. Before data analysis, the normality of the data was evaluated using the Shapiro-Wilk test. It was determined that the data had a normal distribution. Pearson correlation analyses were used in the correlation analysis between the variables. $P < 0.05$ was accepted as the statistical significance level in the study.

Results

Information on the demographic characteristics of amateur football players participating in the study is given in Table 1.

Descriptive statistics and normality test results of the bio motor characteristics and body composition variables of the football players are presented in Table 2.

Body composition values and 30 m sprint, back strength and jumping performance values of young male football players are given in Table 3.

Table 1
Demographic information of football players (n=18).

Variables	Mean	Std. Dev.
Age (years)	14.17	0.38
Height (cm)	169.56	7.06
Body Weight (kg)	57.22	9.39
BMI (kg/m^2)	19.81	2.35

No significant relationship was found between body composition values and 30 m sprint test in young male soccer players ($p>0.05$). A moderately significant positive relationship was found between fat free mass and back strength ($r = .545$, $p=.019$), muscle mass and back strength ($r = .545$, $p=.019$), and fluid mass and back strength ($r = .548$, $p=.019$). A moderately significant positive relationship was found between bone mineral mass and back strength ($r = .584$, $p=.011$). A moderately significant positive relationship was found between basal metabolism and back strength ($r = .574$, $p=.013$). A moderately significant positive relationship was found between bone mineral mass and CMJ ($r = .584$, $p=.011$).

Table 2
Descriptive statistics and normality test results of the variables.

Variables	Mean	Std. Dev.	Shapiro-Wilk	
			Statistic	p
30 m Speed (sec)	5.05	0.47	.936	.201
Back Strength (kg)	100.22	23.57	.982	.957
CMJ (cm)	30.42	4.21	.971	.774
Fat Free Mass (Kg)	48.07	6.92	.969	.724
Fat Free Ratio (%)	84.36	3.36	.977	.892
Fat Mass (kg)	9.14	3.05	.955	.454
Fat Ratio (%)	15.65	3.36	.977	.893
Muscle Mass (kg)	45.62	6.60	.969	.728
Muscle Ratio (%)	80.04	3.17	.979	.915
Liquid Mass (kg)	35.27	4.74	.968	.715
Liquid Ratio (%)	61.98	2.80	.973	.813
Bone Mineral Mass (kg)	2.49	0.36	.967	.692
Bone Mineral Ratio (%)	4.39	0.17	.976	.875
Basal Metabolism Rate (kcal)	1.72	0.19	.970	.763

Table 3
Body composition values and 30 m sprint, back strength and jump performance values

Variables		30 m Speed (sec)	Back Strength (kg)	CMJ (cm)
Fat Free Mass (Kg)	r	-.404	.545 *	.441
	p	.096	.019	.067
Fat Free Ratio (%)	r	-.104	-.246	.025
	p	.680	.326	.923
Fat Mass (kg)	r	-.097	.392	.099
	p	.700	.107	.695
Fat Ratio (%)	r	.104	.246	-.024
	p	.680	.326	.923
Muscle Mass (kg)	r	-.404	.545 *	.443
	p	.097	.019	.066
Muscle Ratio (%)	r	-.107	-.243	.040
	p	.672	.331	.876
Liquid Mass (kg)	r	-.409	.548 *	.451
	p	.092	.019	.060
Liquid Ratio (%)	r	-.024	-.322	-.051
	p	.924	.192	.841
Bone Mineral Mass (kg)	r	-.449	.584 *	.496 *
	p	.062	.011	.036
Bone Mineral Ratio (%)	r	-.102	-.249	.026
	p	.687	.320	.920
Basal Metabolism Rate (kcal)	r	-.405	.574 *	.354
	p	.096	.013	.150

** Correlation is significant at the 0.05 level*

Discussion

According to our research results examining the relationship between body composition and speed, strength and jumping performance, significant relationships were found in the lean body mass and back strength variables. Accordingly, it was found that back strength increased as lean body mass increased. When the muscle mass and back strength variables were examined, a significant relationship was found and it was found that back strength increased as muscle mass increased. Significant relationships were also found between the fluid mass and back strength variables. Accordingly, it was found that back strength increased as fluid mass increased. Separate significant relationships were found in the bone mineral mass and back strength and jumping strength variables, and it was found that back strength and jumping performance increased as bone mineral mass increased ($p<0.05$). Significant relationships were also found between the basal metabolism and back strength variables. Accordingly, it was found that back strength increased as basal metabolic rate increased. No significant relationship was found between speed tests and body composition parameters ($p>0.05$). According to our study results, statistically significant relationships were found between body composition values and bio motor characteristics.

Accordingly, it was determined that back strength increased as lean body mass increased. When the muscle mass and back strength variables were examined, a significant relationship was found, and it was found that back strength increased as muscle mass increased. When the literature was examined; Legg et al. (2021) found that strength level increased as lean body size increased in the study they investigated the relationship between body composition and vertical jump performance in female university volleyball athletes. Çelik et al. (2022) found that jumping strength decreased as body fat level of athletes increased in the study they conducted to examine the relationship between body fat percentage and vertical jump and speed performances of football players. According to this result, low fat level has a positive effect on performance. The study results support our study results. Kahraman & Arslan (2023) found a low positive relationship between vertical jump and lean mass,

muscle mass and basal metabolic rate in football players, while a positive moderate relationship was found between vertical jump and fluid mass. Bridge et al. (2014) It has been determined that body mass and fat percentage are the determining factors in Taekwondo performance. Özkan & Sarol (2008) conducted a study investigating the relationship between body composition, leg volume, leg mass, anaerobic performance, and leg strength in mountain climbers, and determined that athletes with low body weight and a lower body fat ratio had higher leg strength values. Özkan et al. (2010) investigated the relationship between body composition, somatotype characteristics, anaerobic performance, and leg and back strength in female volleyball players, and determined that body composition and somatotype characteristics played a determining role in leg-back strength and anaerobic performance. Güder et al. (2022) conducted a study that examined the relationship between body composition, strength, and flexibility in 12- to 14-year-old taekwondo athletes. The study concluded that there was a positive and significant relationship between body composition variables and certain strength parameters in taekwondo athletes. Developing leg and back strength helps athletes to be more successful in movements requiring anaerobic power. Accordingly, excess body weight, body fat percentage and low muscle mass also cause an increase in the load on the legs and back and cause failure in these movements that are important for athletes and require anaerobic power (Almuzaini, 2001). As a result of our study, it was found that there is a statistical relationship between leg-back strength and body composition. Ben Mansour et al. (2021) examined the effect of body composition on strength and power in male and female students and determined that excess body fat ratio reduces strength levels. In the study, where body fat ratio was 17% in males and 25% in females, it was found that excess body fat caused a strength limitation of 30% to 70% in females. When body composition is combined with other performance elements such as strength, flexibility, speed, endurance and agility of the athlete, it emerges as only one of the high-level performance indicators and positively affects the athlete's performance (Aslan, 2023). Larsson & Henriksson (2008) conducted a study examining the relationship between body composition and performance values in skiers. The study found significant correlations between total body weight and absolute lean body mass with performance values. Massidda et al. (2013), in a study, conducted on 64 athletes from the elite Italian gymnastics team, it was determined that body type has direct effects on performance. Silvestre et al. (2006) investigated the relationship between body composition parameters and physical performance of football players and found significant correlations between total body fat ratio and physical performance parameters. Almuzaini (2007) conducted a study to determine isokinetic power, endurance, isometric power, and anaerobic power in untrained healthy children and adolescents, and found that lean body mass was the main determinant of power and strength performances. Miyatake et al. (2012) conducted a study investigating the relationship between muscle strength and anthropometric and body composition parameters in adolescents, and found that grip strength in adolescents was positively correlated with height and lean body mass. The study also found significant correlations between leg strength, height, body weight, hip circumference, and lean body mass. In a different study, Bevier et al. (1989) conducted a study evaluating the relationship between body composition, maximal aerobic capacity, muscle strength, and bone mineral density in 91 healthy men and women aged between 61 and 84, and found significant relationships between lean mass per kilogram and back strength and spine mineral density. Lafortuna et al. (2005) conducted a study examining the relationships between body composition and muscle strength in obese women and men, and determined that high muscle strength in both male and female subjects was possible with a low body fat mass. Davies & Young (1984) examined the effects of excess weight on power output in children and adolescents and concluded that excess body weight or fat mass negatively affected power output.

When the literature is examined, it is seen that there are results that do not coincide with our study results (Apti, 2010). Canlı (2020) examined the relationships between body composition and physical fitness parameters in pre- adolescent football players and could not detect a significant relationship between body fat level and performance indicators. It is thought that the reason why the study results are not similar to our study results is due to the closeness of the body fat levels of the athletes in the current study. Hazır et al. (2010) did not detect a relationship between anthropometric values and performance values in the study in which they investigated the relationship between agility and body composition and anaerobic power in young football players. According to our study results, no significant relationship was found between body composition values and the 30 m sprint test. During sprinting, both force production and body weight support are

important. Higher muscle mass allows for greater force production, while excessive body fat percentage may negatively affect performance (Chelly et al., 2010). Due to the short duration of the sprint, the effect of body composition may be overshadowed by other physical and neuromuscular factors (Cronin & Hansen, 2005). A higher lean body mass positively influences quick direction changes and reaction time, while a high body fat percentage can restrict mobility (Reilly et al., 2010). A study indicated that reducing body fat mass has a greater impact on sprint performance than increasing muscle mass (Abe et al., 2020).

Conclusion

When the study results were examined, significant relationships were found in the lean body mass and back strength variables. Accordingly, it was determined that back strength increased as lean body mass increased. When the muscle mass and back strength variables were examined, a significant relationship was found and it was determined that back strength increased as muscle mass increased. According to the results of this study, in which we tried to determine the effects of body composition values on strength, speed and jumping performance of young football players, it was determined that there were relationships between body composition values and performance values. In the light of this study, which proved the effects of body composition on performance, it can be recommended that more comprehensive studies can be conducted on this subject with different subject groups.

Author's Contribution

Study Design: SK; Data Collection: SK; Statistical Analysis: SK; Manuscript Preparation: SK; Funds Collection: SK.

Ethical Approval

The study was approved by the Bitlis Eren University of Non-Interventional Clinical Research Ethical Committee (2025/14) and it was carried out in accordance with the Code of Ethics of the World Medical Association also known as a declaration of Helsinki.

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Conflict of Interest

The author hereby declare that there was no conflict of interest in conducting this research.

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