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The Relationship between Body Composition and Speed, Agility, and Strength Parameters in Regional Amateur League Football Players

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Abstract

This study aimed to determine the relationship between body composition and speed, agility, and strength parameters in regional amateur league football players. Thirteen male football players who played in regional amateur league competitions of the Turkish Football Federation voluntarily participated in the study. The football players underwent body analysis measurements as well as tests of 20-m sprint, Illinois agility, countermovement jump (CMJ), leg strength, and back strength. The SPSS package program was used for the relational and descriptive analysis of the data. The Pearson correlation test was performed to determine the relationships between variables in normally distributed data. Moderate positive correlations were found between the Illinois agility test results and body weight (r = .594; *p* = .032), fat mass (r = .579; *p* = .038), and basal metabolic rate (r = .613; *p* = .026), while a moderate negative relationship existed between fluid percentage (r = -.578; *p* = .038) and agility. There were moderate positive correlations between leg strength and fat-free percentage (r = .556; *p* = .048) and muscle percentage (r = .555; *p* = .049), and a moderate negative relationship between leg strength and fat percentage (r = -.556; *p* = .048). Moderate positive correlations were observed between back strength and fat-free percentage (r = .629; *p* = .021) and muscle percentage (r = .628; *p* = .022), while moderate negative relationships were observed between back strength and fat mass (r = -.587; *p* = .035) and fat percentage (r = -.629; *p* = .021). There were no significant relationships between the 20-m sprint and CMJ tests and body composition parameters (*p* > .05). In order to optimize the physical performance of football players, we recommended balancing the fluid percentage, limiting body fat, and increasing the muscle percentage.
Keywords: Football, Body composition, Biomotor characteristics

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INTRODUCTION

Football is an intermittent team sport characterized by frequent transitions between high-intensity movements such as running, jumping, shooting, acceleration, and deceleration, as well as low to moderate-intensity activities like running, walking, and even standing (Dugdale et al., 2019). In the sport of football, movements of varying intensities are applied at irregular intervals over a long period, while technical and tactical skills in addition to basic motor skills specific to football have great weight (Aslan, 2007). Football is a performance-oriented contact sport that involves repeated moderate to high-intensity sports activities, often with periods of submaximal work in between (Milanović et al., 2017). Although mainly aerobic, football also consists of high-intensity, intermittent exercises, including a large number of sprints, negative and positive acceleration, jumps, and movements requiring agility, for different durations (Shephard, 1999). In team games such as football, changing direction, advanced perceptual skills, and correct decision-making abilities are required to exhibit high performance (Loturco et al., 2017). In football, players gain motor skills as well as physical, mental, tactical, and technical skills (Kayantaş & Söyler, 2020).

Knowing the somatotype and body composition characteristics can provide a significant advantage in determining the abilities of the athlete, creating training programs to improve aerobic performance and technical skills, and selecting athletes with high potential for success (Apti, 2010). Body composition constitutes an important factor in athletic performance (Kızılca & Okut, 2024). The term “body composition” is widely used to describe the body in terms of conceptual models incorporating components of the body such as total mass, fat-free (lean) mass, and total fat mass (Ward, 2018). It is well known that in order to have a successful athletic career, both the athlete’s physique and physical abilities must be suitable for sports (Yıldırım et al., 2024). Inappropriate body composition values can negatively affect joint and muscle health in athletes (Walsh et al., 2018). For this reason, studies have focused on the effects of athletes’ physiological characteristics, body composition, and physical characteristics on sports performance.

The relationship between body composition and biomotor characteristics in sports represents a major research topic. Several studies have examined the relationship between body composition and biomotor characteristics in football players (Aktaş & Aslan, 2018; Anwar & Noohu, 2016; Çelik et al., 2022; Figueiredo et al., 2021). However, there are no studies examining the relationship between body composition and speed, agility, and strength parameters in regional amateur league football players. Hence, there has emerged a need to eliminate this gap in the research, by evaluating football players’ performance on a scientific basis. Determining the relationship between body composition and speed, agility and strength in regional amateur league football players is important for improving the physical performance of players. Body composition includes factors such as fat ratio, muscle mass and bone structure, and these factors affect performance parameters such as speed, agility and strength. A good body composition allows football players to use these features more efficiently and reduces the risk of injury. Understanding this relationship allows football players to perform more efficiently and healthily by preparing special training programs for them. The present study was thus designed to determine the relationship between body composition and speed, agility, and strength parameters in regional amateur league football players.

METHODS

Research Model

The research method employed in this study is the relational survey model, two or more variables are examined in order to determine whether they vary in tandem and if so, to what degree (Karasar, 2011).

Research Group

The minimum sample size for this study was calculated using G*Power software (version 3.1.9.7) (Faul et al., 2009). The analysis took into account an α error probability of 0.05, a statistical power of 0.80 (1-β error probability), and an effect size of 0.50. The findings showed that at least 10 participants were necessary to achieve the required statistical power. The experimental group in this study consisted of 13 male football players from the regional amateur football league of the Turkish Football Federation. All 13 players participated in this study on a voluntary basis.

Ethical Approval

This research was conducted in accordance with the ethical principles stated in the Declaration of Helsinki. Prior to the start of the study, ethical approval was obtained from the Scientific Research and Publication Ethics Committee of Muş Alparslan University, decision number 10/18, dated 16.10.2024.

Data Collection Tools

Athletes who would participate in the study were asked to sign a voluntary consent form. Athletes who had not had a serious chronic disease in the last year, who did not have serious muscle or bone problems, and who did not have to use medication on a regular basis were included in the study. All participants were informed to comply with healthy eating conditions throughout the study. They were also told to avoid intense exercise and not to consume caffeine-containing liquids for 24 hours before starting the measurements. In the course of this research, the participants were tested for body composition, 20-m sprint, the Illinois agility test, CMJ, and back and leg strength.

Body Composition Measurements

The height measurements of the football players were determined using a stadiometer. Body mass, body mass index (BMI), fat-free mass, fat-free percentage, muscle mass, muscle percentage, fat mass, fat percentage, fluid mass, fluid percentage, bone mineral mass, bone mineral content, and basal metabolic rate were all measured with a Tanita MC 780 MA brand bioelectrical impedance analyzer. Care was taken to ensure that all of the football players were tested at least two hours after eating. Body composition measurements were taken with the participants dressed in only shorts and t-shirts, after having relieved themselves (Kahraman & Arslan, 2023).

Biomotor Tests

20-m Sprint Tests

Fusion brand Smart Speed electronic photocell devices were placed at the start and end points of the running track for distances of 20 meter. The athletes began each sprint from 50 cm behind the start line and were allowed two attempts for each distance, with the best times being recorded.

Illinois Agility Test

The Illinois Agility Test was conducted to determine the athletes' agility. The test track was created by placing four funnels at intervals of 3.3 m in the midline, at a distance of 2.5 m from the sideline, where training cones were placed at the four corners of an area measuring 10 m long by 5 m wide. Fusion brand Smart Speed electronic photocell devices were placed at the start and end points of the track. The athletes began the test lying face down on the floor 30 cm behind the start line, with their arms at their sides and their heads turned to the side or facing forward. The participants made a straight run from the corner cone opposite the start line, turning towards the central cone located on the diagonal, then returned to the first center cone by slaloming between the center cones to complete a round trip. Next, they ran towards the other corner cone on the diagonal, circled the cone, and completed the test by crossing the finish line as quickly as possible. Photocell gates at the start and finish points recorded the running values of the athletes in seconds and fractions of a second. Each participant was given two attempts with a three-minute passive rest interval in between; the best score was recorded. A disqualification decision was made if the participant failed to run the course, reach the finish line, complete the course, or skip any cone as instructed (Raya et al., 2013).

Countermovement Jump (CMJ) Test

The CMJ tests of the athletes were measured using an electronic Fusion brand Smart Jump jump mat. All athletes were instructed to climb onto the mat with their hands on their waists, and when ready, to jump as high as possible. After each jump, the athletes fell back onto the mat. The jump heights were measured in cm and the best result out of two attempts was recorded (Atan, 2019).

Back Strength

The back strength of the athletes was measured with a Takei brand (Japan) back dynamometer. The athletes were placed on the dynamometer stand, pressing on the section with the foot marks. They were instructed to grasp the dynamometer bar with their hands upside down (palms up), with their knees and arms tense, backs straight and torsos tilted slightly forward. While in this position, the length of the dynamometer chain was adjusted according to the physical characteristics of each athlete, who was then instructed to pull the dynamometer bar vertically, to the maximum level. The test was performed twice and the best value was recorded in kg.

Leg Strength

The leg strength of the athletes was measured with a Takei brand (Japan) leg dynamometer. The participants were placed on the dynamometer stand, pressing on the section with the foot marks. They were instructed to grasp the dynamometer bar with their hands straight (palms down) and with their knees bent, arms stretched, backs straight and torsos tilted slightly forward. While in this position, the length of the dynamometer chain was adjusted according to the physical characteristics of each athlete, who was then instructed to pull the dynamometer bar vertically, to the maximum level. The test was performed twice and the best value was recorded in kg.

Statistical Analysis

The SPSS (Statistical Package for the Social Sciences) program was used for relational and descriptive analysis of the data. The normality level of the data was determined by the Shapiro-Wilk test. The Pearson correlation test was performed to determine the relationships between variables in normally distributed data. In this study, the level of statistical significance was accepted as a value of $p < .05$.

RESULTS

Results of the descriptive statistics for the biomotor tests of the participating regional amateur league football players (mean age: 19.54±2.15 years) are presented in Tables 1.

Table 1. Biomotor tests descriptive statistics results

Biomotor Tests	Mean	Std. Dev.	Min.	Max.
20-m Sprint (sec)	3.09	0.17	2.73	3.33
Illinois Agility (sec)	16.65	1.22	15.06	18.59
CMJ (cm)	36.13	5.13	27.78	41.67
Leg Strength (kg)	129.38	25.81	89.50	177.50
Back Strength (kg)	123.88	20.59	91.50	157.50

n=13

Results of the descriptive statistics for the body composition measurements of the participating regional amateur league football players are presented in Tables 2.

Table 2. Body composition descriptive statistics results

Body Composition	Mean	Std. Dev.	Min.	Max.
Height (cm)	181.15	6.71	170.00	189.00
Body Weight (kg)	74.42	9.60	58.40	93.00
Body Mass Index (BMI) (kg/m2)	22.60	1.77	19.30	26.00
Fat-free Mass (kg)	63.59	6.03	54.10	74.90
Fat-free Percentage (%)	85.89	4.79	76.45	92.64
Fat Mass (kg)	10.82	4.90	4.30	21.90
Fat Percentage (%)	14.11	4.79	7.36	23.55
Muscle Mass (kg)	60.43	5.74	51.40	71.20
Muscle Percentage (%)	81.62	4.53	72.68	88.01
Fluid Mass (kg)	43.86	3.14	37.70	49.30
Fluid Percentage (%)	59.37	3.85	51.94	65.06
Bone Mineral Mass (kg)	3.83	0.83	2.81	5.47
Bone Mineral Content (%)	5.03	1.09	3.09	6.54
Basal Metabolic Rate (kcal)	1.93	0.19	1.61	2.25

n = 13

The results of the relationship between body composition and speed, agility and strength parameters in regional amateur league football players are presented in Table 3.

Table 3. Biomotor tests and body composition pearson correlation test results

Variables		20-m Sprint (sec)	Illinois Agility (sec)	CMJ (cm)	Leg Strength (kg)	Back Strength (kg)
Height (cm)	r	-.062	.309	-.389	-.019	-.018
	p	.841	.304	.188	.951	.953
Body Mass (kg)	r	.147	.594*	-.517	-.355	-.372
	p	.633	.032	.070	.234	.210
Fat-free Mass (kg)	r	-.120	.476	-.449	-.160	-.116
	p	.695	.100	.124	.600	.706
Fat-free Percentage (%)	r	-.502	-.524	.392	.556*	.629*
	p	.080	.066	.185	.048	.021
Fat Mass (kg)	r	.436	.579*	-.461	-.498	-.587*
	p	.137	.038	.113	.083	.035
Fat Percentage (%)	r	.502	.524	-.392	-.556*	-.629*
	p	.080	.066	.185	.048	.021
Muscle Mass (kg)	r	-.118	.478	-.451	-.162	-.118
	p	.700	.099	.122	.596	.701
Muscle Mass Percentage (%)	r	-.502	-.523	.390	.555*	.628*
	p	.080	.067	.188	.049	.022
Fluid Mass (kg)	r	-.052	.517	-.436	-.264	-.249
	p	.865	.070	.136	.384	.412
Fluid Percentage (%)	r	-.331	-.578*	.512	.429	.435
	p	.270	.038	.074	.144	.137
Bone Mineral Mass (kg)	r	.049	.122	-.185	-.391	-.245
	p	.874	.692	.546	.186	.419
Bone Mineral Content (%)	r	-.001	-.172	.083	-.231	-.126
	p	.997	.573	.788	.448	.682
Basal Metabolic Rate (kcal)	r	-.007	.613*	-.545	-.219	-.245
	p	.981	.026	.054	.472	.420

*$p < .05$; **$p < .01$; n = 13

For the participating football players, a moderate positive correlation was found between the Illinois agility test and body mass (r = .594; *p* = .032), fat mass (r = .579; *p* = .038), and basal metabolic rate (r = .613; *p* = .026), while a moderate negative correlation was observed between agility and fluid percentage (r = -.578; *p* = .038).

There was a moderate positive correlation between the participants' leg strength and fat-free percentage (r = .556; *p* = .048) and muscle percentage (r = .555; *p* = .049) and a moderate negative relationship between leg strength and fat percentage (r = -.556; *p* = .048).

A moderate positive correlation was observed between back strength and fat-free percentage (r = .629; *p* = .021) and muscle percentage (r = .628; *p* = .022) in the participating football players, whereas moderate negative relationships were detected between fat mass (r = -.587; *p* = .035) and fat percentage (r = -.629; *p* = .021).

There were no significant relationships between the body composition parameters and either the 20-m sprint or CMJ tests in the participating regional amateur league football players (*p* > .05 for all).

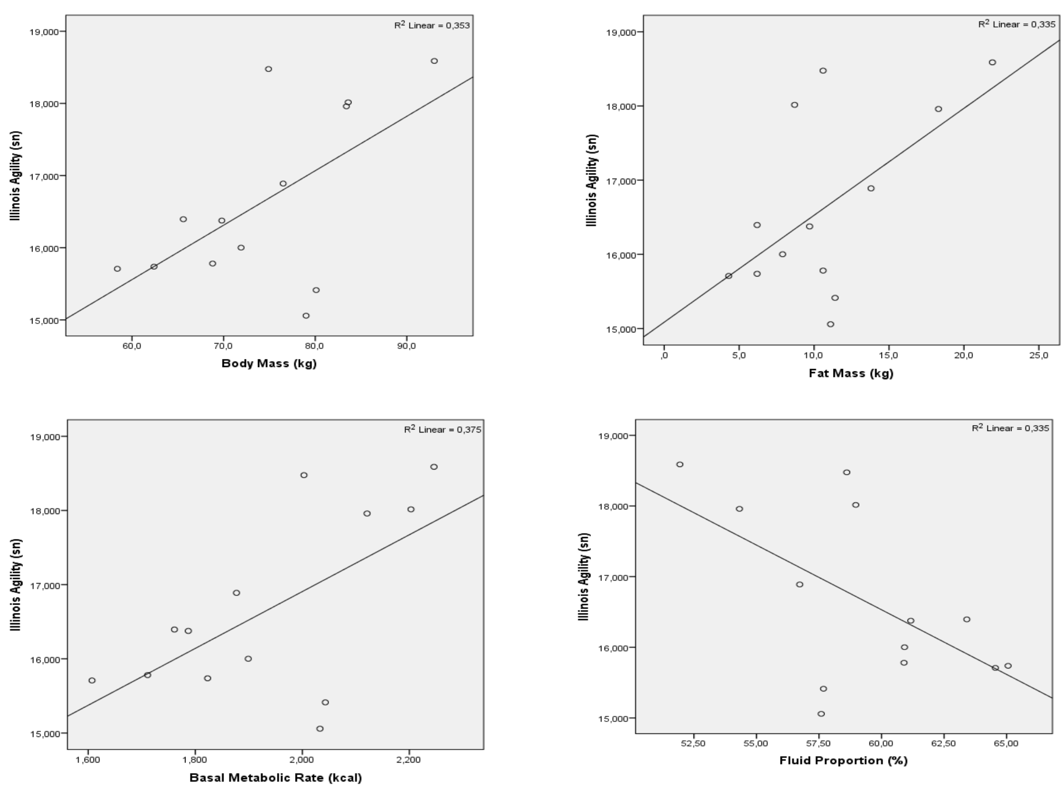

Figure 1. The relationship between the Illinois agility test and body mass, fat mass, basal metabolic rate, and fluid proportion

As the participants' body weight, fat mass, and basal metabolic rate increased, their Illinois agility test times were also observed to increase, indicating diminished agility. In contrast, as fluid percentages increased, their agility test times decreased, reflecting an improvement in agility performance.

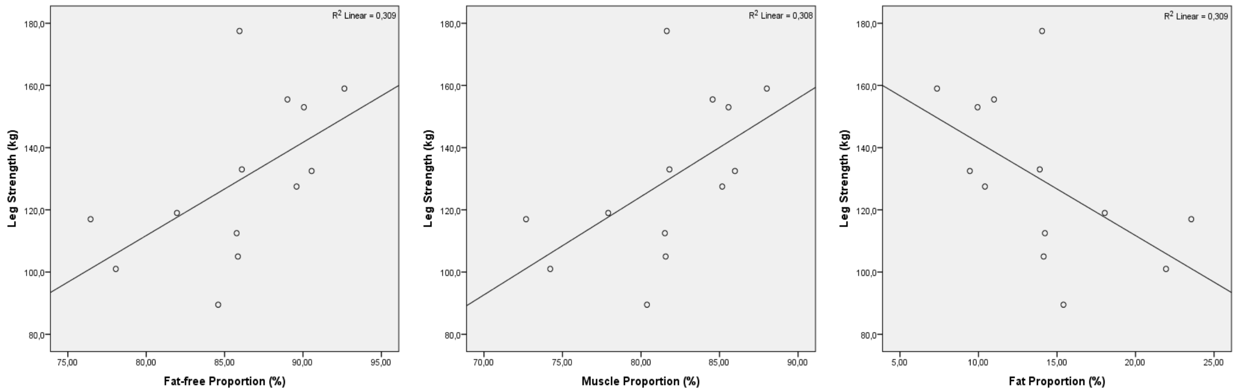

Figure 2. The relationship between leg strength and fat-free, muscle and fat proportions

In the participating football players, leg strength was found to increase with higher fat-free and muscle percentages, whereas leg strength decreased with increased fat percentage.

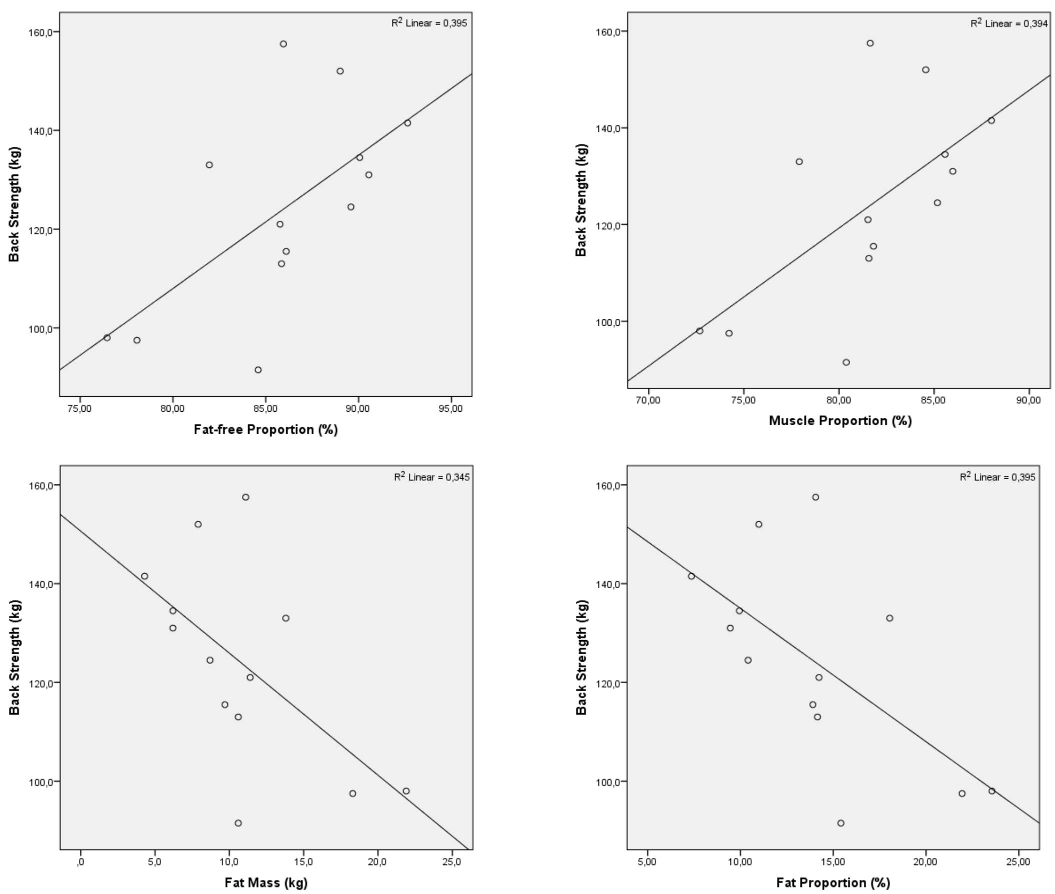

Figure 3. The relationship between back strength and fat-free proportion, muscle proportion, fat mass, and fat proportion

With increases in the participants’ fat-free and muscle proportions, back strength also increased, while back strength decreased with increased fat mass and fat percentage.

DISCUSSION

The present study aimed to determine the relationship between body composition and speed, agility, and strength parameters in regional amateur league male football players. Concerning the 20-m sprint, there were no significant relationships between this test and body composition parameters in the participating football players. Aktaş and Aslan (2018), on the other hand, observed a moderate positive relationship between the body fat percentages of football players and their 10-m and 30-m sprint performances. Anwar and Noohu (2016) similarly reported a moderately significant positive relationship between body fat percentage and 30-m sprint speeds in university football players. The discrepancy between the results of our research and those of studies reported in the literature may be due to category and age variables. In another study conducted with U18 male football players, there was a weak negative relationship between the 20-m speed test and fluid mass, while no significant difference was found between the 20-m speed test and other body composition parameters (Kahraman & Arslan, 2023). Time-motion analyses reveal that football players frequently perform short sprints, with the flat sprint being the most common movement performed prior to goals, both in terms of scoring goals and assisting teammates (Haugen et al., 2014). Additionally, players’ body composition may also affect their performance, helping to improve factors such as agility and speed. A study on young football players has revealed that sprint profiles are strongly correlated with both chronological age and maturity offset, independent of body size and training experience (Fernández-Galván et al., 2021).

In regard to the Illinois agility test, our study found moderate positive relationships between agility and body weight, fat mass, and basal metabolic rate, whereas a moderate negative relationship was observed between agility and fluid percentage in the participating regional amateur league football players. Agility is a very important component of overall health and fitness (Tabacchi et al., 2018). This feature allows individuals to change direction quickly and react quickly, significantly improving their physical performance. In addition, the development of agility improves body coordination and strengthens overall physical fitness. The knowledge of movements requiring agility, such as sudden stops and changing direction, among the basic features of football is evidence of the importance of agility for football players (Aktaş et al., 2020). The observed accelerations of football players are primarily performed in response to external stimuli (i.e., the movement of the ball, opponent, or teammates) and are typically prioritized with a change in direction of movement (Krolo et al., 2020). Cheuvront et al. (2008) emphasize that fluid intake has a direct effect on agility, endurance and explosive strength. Kahraman and Arslan (2023) failed to find a significant relationship between the T agility test and body composition parameters in their study of football players. A study conducted on adolescent male football players showed that body fat percentage was positively correlated with speed and agility at a moderate level across all age groups (França et al., 2022). This result does not align with the findings of the present study and may have resulted from the different agility tests applied.

No significant relationships were found between the CMJ test and various body composition parameters in the participating football players. Vertical jumping is a complex movement involving more than one joint and requires great muscle strength in the hips, knees, and ankles (Okut & Kızılca, 2024). Concerning the biomechanics of vertical jumping, the contraction levels of the hamstrings and quadriceps femoris muscles represent an important factor, and vertical pushing motion reflects the existence and significance of explosive power (Karadağ et al, 2024). In their study on U-18 male football players, Kahraman and Arslan (2023) found weak positive relationships between vertical jump and fat-free mass, muscle mass, and basal metabolic rate, and a moderate positive relationship between vertical jump and fluid mass. Figueiredo et al. (2021) observed negative relationships between body fat percentage and bounce performance in professional football players. In a study investigating the relationship between body fat percentage and performance parameters in football players, a moderately significant negative correlation was found between body fat percentage and vertical jump (Anwar & Noohu, 2016). Çelik et al. (2022) reported a weak negative relationship between the body fat percentage and vertical jump performance of football players. Another study conducted with football players found a strong negative correlation between vertical jump performance and body fat percentage (Esco et al., 2018). The results obtained in our research are not consistent with those of the abovementioned studies. This discrepancy is thought to derive from categorical and characteristic differences in the training levels and experimental groups.

In the present study, a moderate positive relationship was found between leg strength and fat-free muscle percentages, while a moderate negative relationship was observed between the leg strength and fat percentage of the participating athletes. For these regional amateur league football players, there were moderate positive relationships between back strength and fat-free and muscle percentages; in contrast, moderate negative relationships were observed between back strength and fat mass and fat percentage. Football players, who are constantly in motion during matches, require strength for every movement they make while playing (Yarayan & Müniroğlu, 2020). When body composition comes together with other performance elements such as the athlete's strength, flexibility, speed, endurance and agility, it emerges as only one of the high-level performance indicators and positively affects the athlete's performance (Asan, 2023). 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. 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.

CONCLUSIONS

In conclusion, our findings showed that with increases in body weight, fat mass, and basal metabolic rate the participating amateur football players, Illinois agility test times increased, indicating diminished agility. In contrast, with increased fluid percentage, agility test times decreased, evidence of improved agility performance. Both leg strength and back strength increased as the participants' fat-free and muscle percentages increased, while leg strength and back strength decreased with increased fat percentage. Increased fat mass was also associated with decreased back strength. In line with these results, it is important for regional amateur league football players to improve their body composition in order to increase their performance. In particular, reducing body fat and increasing muscle mass can improve agility performance and increase leg and back strength. In training programs, it is recommended that football players work to increase muscle mass and reduce fat. In addition, increasing fluid consumption can positively affect agility performance. Football players should be provided with nutritional and training guidance to manage body weight and fat mass, aiming to optimize both agility and strength parameters.

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Authors' Contribution: Research Design-MZK, SO, Data Collection- SO, IÇ, Statistical Analysis- MZK, Preparation of the Article, MZK, SO, IÇ.

Ethical Approval

Ethics Committee: Muş Alparslan University Scientific Research and Publication Ethics Committee Ethics Committee

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