Uluslararası Bozok Spor Bilimleri Dergisi, (2021) 2(2), 71-79
Bozok International Journal of Sport Science, (2021) 2(2), 71-79

Relationship Between Body Composition and Physical Performance Parameters In Soccer Players

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To cite this article/ Atıf icin:
Akdoğan. E., Heper, E., Cerrah, A.O., Kale, M. (2021). Relationship Between Body Composition and Physical Performance Parameters In Soccer Players. *Uluslararası Bozok Spor Bilimleri Dergisi*, *2*(2), 71-79.

Abstract

Objective: The purpose of this study was to investigate the relationship between body composition and physıcal performance parameters in amateur soccer players. **Material and Methods:** Sixteen healthy amateur male soccer players (Age: 25.78±2.7 years, height: 180.0±6.1cm, body weight: 76.80±3.4kg,) voluntarily participated in this study. Soccer team were assessed for total body and segmental estimates of body composition using dual-energy X-ray absorptiometry (DXA). Vertical jump performance tests, squat jump (SJ), active jump (AJ) and endurance performances were determined by the Yo-Yo intermittent recovery level 1 test (Yo-Yo IR1). Relationships between body composition and physıcal performance parameters were analyzed with pearson correlation coefficient. Probability level was ≤0.05. **Results & Discussion:** As a result of statistical analyses, there was a significant negative correlation between, SJ and CMJ percentage of leg fat (% LF) and leg fat kg (LF). There was also a significant negative correlation between Yo-Yo IR1 body fat (BF)**,** leg fat (LF), arm fat mass (AFM) and trunk fat mass (TFM). No significant correlation was seen among Yo-Yo IR1**,** SJ and CMJ with other total/segmental body composition. **Conclusion:** Results indicated that increased total/segmental body fat might be a detriment to the SJ, CMJ and Yo-Yo IR1 performance in soccer players. It is suggested that coaches should not allow soccer players to rise in body fat for the physical performance loss.

Keywords: Body Composition, Squat Jump, Counter Movement Jump, Yo-Yo Intermittent Recovery Test

Futbol Oyuncularında Vücut Kompozisyonları İle Fiziksel Performans Parametreleri Arasındaki İlişki

Özet

Amaç: Bu çalışmanın amacı amatör futbol oyuncularının vücut kompozisyonları ile fiziksel performans parametreleri arasındaki ilişkiyi araştırmaktır. **Gereç ve yöntemler:** Çalışmaya 16 sağlıklı erkek futbol oyuncusu (Yaş: 25.78±2.7yıl, Boy: 180.0±6.1cm, Kilo: 76.80±3.4kg,) gönüllü olarak katılmıştır. Futbolcuların segmental ve tüm vücut kompozisyonunu dual-enerji x-ray absorbsiyometri (DEXA) yöntemi ile incelenmiştir. Dikey sıçrama performans testleri squat sıçrama (SS), aktif sıçrama (AS) ve dayanıklılık performansları Yo-Yo aralıklı toparlanma seviye 1 testi (Yo-Yo AT1) test edilmiştir. Vücut kompozisyonları ile fiziksel performans parametreleri arasındaki ilişki Pearson Korelasyon katsayısıyla analiz edilmiştir. Anlamlılık düzeyi ≤0.05 alınmıştır. **Bulgular:** İstatistiksel analizler sonucunda, SS ve AS bacak yağ yüzdesi (% BY) ile bacak yağ kg (BY) arasında istatistiksel olarak anlamlı negatif ilişki bulunmuştur. Aynı zamanda Yo-Yo AT1 vücut yağı (VY), bacak yağı (BY), kol yağ kütlesi (KYK) ve gövde yağ kütlesi (GYK) arasında da anlamlı negatif ilişki bulunmuştur. Yo-Yo AT1, SS ve AS arasında diğer tüm / segmental vücut kompozisyonu ile istatistiksel olarak önemli bir ilişki bulunmamıştır. **Sonuç:** Sonuç olarak, artan tüm / segmental vücut yağının futbolcularda SJ,

CMJ ve Yo-Yo IR1 performansına zarar verebileceğini göstermistir. Antrenörlerin fiziksel performans kaybı için futbolcuların vücut yağlanma artışına izin vermemesi önerilir.

Anahtar kelimeler: Futbol, Vücut Kompozisyonu, Squat Sıçrama, Aktif Sıçrama, Yo-Yo Aralıklı Toparlanma Testi

INTRODUCTION

Measurement of body composition is now an essential component of sports science support in elite soccer (Milsom, Naughton, O'Boyle, Iqbal, Morgans and Drust, 2015). In fact, regular body composition assessments are often used to determine competitiveness and to monitor the effectiveness of dietary and training interventions (Sutton, Scott, Wallace, & Reilly, 2009). It has long been known that body composition is related to performance, with special attention to total and segmental fat and muscle. In the last few years, dual-energy X-ray absorptiometry (DXA) has become the gold standard for body composition analysis, allowing reproducible fat, lean and mineral mass estimates; As far as we know (Reilly and Williams 2009; Milanese, Pıscıtellı, Lampis and Zancanaro 2011; Sutton and Stewart 2012).

Soccer involves high intensity exercise periods interspersed with lower intensity exercise periods. The physiological and physical demands of soccer require players to be in a variety of subjects such as aerobic and anaerobic strength, muscle strength, flexibility and agility (Svensson and Drust, 2005).

The importance of body composition in soccer performance remains unclear; But, it is a primary concern in conditioning programs for a season at all competitive levels. Physical stress inherent in training sessions and competition throughout a season can alter body composition. Strength and conditioning programs for soccer require the development of aerobic-anaerobic capacity, strength and power (Silvestre, West, Maresh and Kraemer, 2006).

In today's professional soccer leagues, players stay active for about 10 to 11 months. The pre-season period is relatively short and lasts about two months, but the competition season lasts 8 to 9 months. After the competitive season is completed, players usually go through a rest phase of about four to six weeks (an off-season period) before a new season begins (Meckel, Doron, Eliakim and Eliakim, 2018). Previous research has determined that short periods of detraining (8 weeks) can result in increased body fat percentage in professional soccer players with reduced aerobic performance, anaerobic power and sprinting ability (Ostojic, 2001; Ross and Leveritt, 2001; Reilly and Williams, 2003; Hoshikawa, et al. 2004). The relationship between body composition and changes in physical performance is also of great interest to power and fitness trainers (Silvestre et al. 2006). It can be assumed that there may be changes in body composition and physical performance from beginning to end of a football training and competitive season.

Although seasonal changes have been investigated in professional soccer players pre and postseason (Silvestre et al. 2006; Carling and Orhant, 2010; Owen, et al. 2018) and in relation to body composition and physiological fitness over the season in semiprofessional soccer players, (Caldwell and Peters, 2009) as far as we know, few studies has analyzed the relationships between jump ability and aerobic performance with body composition in amateur soccer players. Therefore, the aim of this study was to investigate the relationship between body composition and physıcal performance parameters in amateur soccer players.

METHODS

Research Model

In this study, which aims to evaluate the relationship between body compositions and physical performance parameters of amateur soccer players, the relational screening model, one of the general screening models, was used. Based on this scanning model, it was desired to question whether there is a positive or negative correlational value between body compositions and physical performance parameters (Karasar, 2012).

Subjects

Sixteen healthy amateur male soccer players (Age: 25.78±2.7years, height: 180.0±6.1cm, body weight: 76.80±3.4kg,) voluntarily participated in this study. All the participants were playing for the same Turkish club competing in the regional amateur league. They trained for 90 to 120 minutes five days a week in soccer sessions with their team in their normal training cycle. Completion of the body composition measure and 100% of performance assessment during the investigation period, and not present injures during the investigation period were adopted to gather data about the participants in the final analysis. The study was conducted in accordance with the Helsinki Declaration for experiments involving humans. As for the ethical issues. The local Research Ethics Committee approved the research (Board approval numbers: **15525**). The participants were informed verbally first, and then were given a consent form for participation.

Procedure

All measurements and tests were carried out during the pre-season period. The test sessions were completed in two days between 9:00 and 12:00 a.m. On the first day, anthropometry, body composition measurement and jumping performance were carried out at the Laboratory of Kinanthropometry at the Faculty of Sport Sciences, ……..University. On the second day, the yo-yo intermittent recovery level 1 (Yo-yo IR1) test was carried out on a natural grass soccer field. Subjects were warned not to take any drugs; drink coffee; and get involved in physical activities at least 24 hours before the test day.

Measurements

Anthropometric Characteristics

Body mass (kg) of the players was measured barefoot by using a scale (Seca, Vogel & Halke, Hamburg) with a precision of 0.1 kg. While the players' head was maintained in the Frankfurt plane, height was measured with an stadiometer (Holtain Ltd, UK) with an accuracy of 0.1 cm.

Total body and segmental body composition (fat percentage, bone mass, muscle mass, and fat mass) was evaluated by means of DXA using a total body scanner the Dual-energy X-ray absorptiometry (Lunar Prodigy Pro; GE, Healthcare, Madison, WI, USA) according to the manufacturer's procedures. The scanner calibration was completed using phantoms as per manufacturer's standard directions in the morning before the measurements. The same operator to ensure consistency performed all scanning and analyses. Prior to assessment, all subjects were advised not to wear any jewelery or have **any metal in their bodies while** screening. In order to ensure a standard supine position was adopted during the scans, the

subjects' knees and ankles were tied with a Velcro strap while their arms were extended by their sides. Typical duration of the examinations was from 6 to 8 min, depending on the height of the subject.

Vertical Jump Measurements

To measure the explosive power of the lower extremities, players performed jump tests (squat jump (SJ) and countermovement jump (CMJ) using a Smartspeed, (Fusion Sport Pty Queensland, Australia). Participants to avoid any effect of arm swing, the hands are held on the hips during the jumps. Before squat jump, participants were told to start jumping when their knee angle is approximately at 90°. During jumping participants were asked to jump as high as they can. During Countermovement jump from the standing position, the subjects were required to bend their knees to a 90° angle and perform a maximal vertical thrust (stretch–shortening cycle). Subjects were instructed to keep their body vertical throughout the jump and to land with knees fully extended. Any jump that was perceived to deviate from the required instructions was repeated. The participants performed two jumps the best trial was recorded and was expressed as cm.

Yo-Yo Intermittent Recovery Test Level 1.

The Yo-Yo İntermittent Recovery Test Level – 1 (Yo-Yo IR1) test was performed on a soccer field with a natural grass surface after 15-min of the standardized warm up as described by Krustrup et al. (2006). The test consisted of repeated 20 m shuttle runs at progressively increasing speeds dictated by an audio bleep emitted from a CD player. Between each shuttle, participants were instructed to jog for 10 seconds within a 10 m area (5 m going + 5 m return) marked behind the finishing line. The test was terminated after failure to achieve a shuttle run in the given time on two occasions. The number of successfully completed shuttles was recorded, running distance (YO-YO IR1 distance (m)) was calculated. The tape (Yo-Yo tests, HO + Strom, Denmark) was calibrated before every trial, and the procedures were identical to those previously described and suggested by Bangsbo et al. (2008).

Statistical Analyses:

SPSS 18 software (SPSS Inc., Chicago, IL, USA) was used to analyse statistically the data. Data are reported as means and standard deviations, and a 0.05 level of confidence was selected throughout the study. A normality test (Shapiro-Wilk) was applied to ascertain the normal distribution of data. Relationships between body composition and physıcal performance parameters were analyzed with pearson correlation coefficient. Probability level was ≤ 0.05.

RESULTS

Table 1 below displays the descriptive statistics related to physical and total/segmental body composition while Table 2 presents the results of physical performance test results. Additionally, the relationship between total/segmental body composition, and physical performance parameters are shown in Table 3. According to result of the study, there was no statistically relationship between SJ and CMJ percentage of body fat, body fat weight, fat free mass and lean leg fat ($p<0,05$). There was also no statistically relationship between Yo-Yo IR1 performance percentage of body fat, fat free mass, lean leg fat and percentage of leg fat

(p<0,05). However there was a significant negative correlation between, SJ and CMJ percentage of leg fat and leg fat weight (p<0,05). There was also a significant negative correlation between Yo-Yo IR1 performance body fat weight, leg fat weight, arm fat mass and trunk fat mass (p<0,05).

Tablo 1. The descriptive statistics of physical and total/segmental body composition (N16)

Variable	Mean	SD
Age (years)	25.78	2.7
Height (cm)	180.0	6.1
Weight (kg)	76.30	3.4
Body Fat percentages (%)	16.25	3.89
Body Fat Mass (kg)	11.93	3.73
Lean Body Mass (kg)	60.59	7.65
Arm Fat percentages (%)	15.38	3.47
Arm Fat Mass (kg)	1.30	0.35
Lean Arm Mass (kg)	7.19	1.15
Leg Fat percentages (%)	15.78	4.25
Leg Fat Mass (kg)	4.05	1.42
Lean Leg Mass (kg)	21.35	2.76
Trunk Fat percentages (%)	16.40	4.82
Trunk Fat Mass (kg)	5.85	2.06
Trunk Lean Mass (kg)	29.29	3.13

Tablo 2. The results of physical performance test (N16)

Variable	Mean	SD
Squat Jump (cm)	35,62	3.93
Countermovement Jump (cm)	37.24	3.83
Yo-Yo Intermittent recovery (m)	1505	405,0

Tablo 3. The relationship between total/segmental body composition and physical performance parameters on male soccer players

	SJ _cm		CMJ _cm		Yo-Yo IR1	
	r	**p**	**r**	**P**	**r**	**p**
Body fat (%)	-426	.100	-.432	.095	-.458	.074
Body fat (kg)	-293	.271	-.319	.229	-.576*	.020
Lean body Mass (kg)	-363	0.14	-.313	.238	-.416	.109
Arm Fat percentages (%)	-489	.055	-460	.073	-194	.471
Arm Fat Mass (kg)	-430	.096	-449	.081	-503*	.047
Lean Arm Mass (kg)	173	.521	.100	.713	.466	.049
Leg fat percentages (%)	-602*	.014	-.643**	.007	-.435	.092
Leg fat (kg)	.441*	.098	-.503*	.047	-.590*	.016
Lean leg mass (kg)	.303	.254	-.364	.166	-.465	.070
Trunk Fat percentages (%)	-258	.335	-245	.360	-431	.095
Trunk Fat Mass (kg)	-216	.421	-215	.423	-507*	.045
Trunk Lean Mass (kg)	.284	.286	-246	.358	-326	.218

SJ=Squat Jump, CMJ=Countermovement Jump, Yo-Yo IR1=Yo-Yo İntermittent Recovery Test Level–1
*Difference statistically significant *p<0.05. Difference statistically significant **p<0.01*

DISCUSSION

The aim of this study was to investigate the relationship between body composition and physıcal performance parameters in amateur soccer players. The results of this research study showed that there was no statistically relationship between SJ and CMJ with total/segmental body composition. However, there was a only negative correlation between SJ and CMJ of % LF and LF. There was also a significant negative correlation between Yo-Yo IR1 performance with total/segmental body fat (BF, LF, AFM, and TFM).

The height and body mass of the soccer players in this study were similar to those reported in the previous studies (Casajus, 2001; Kalapotharakos, Ziogas and Tokmakidis, 2011; Devlin, Kingsley, Leveritt and Belski, 2017). In addition, the percentage body fat 16.2% was similar to that reported in other studies, (Caldwell and Peters, 2009; Anwar and Noohu, 2016; Atakan el al. 2017) but higher when compared with other studies (Kutlu, Sofi and Bozkuş, 2007; Dupont et al., 2008; Milanese et al., 2011; Anwar and Noohu, 2016; Devlin et al., 2017; Meckel et al., 2018). This disparity could be due to different methods to access percent body fat, different times (pre-in season) of data collection, and differences in training programs (Silvestre et al. 2006).

The study of body composition is important in those sports where body weight must be moved repeatedly against gravity (Casajus 2001). Among the various methods of assesssing body composition, the bicompartmental anthropometric method is most frequently used in soccer players. Although there is no specific formula to estimate body fat percentage in soccer players, In the last few years, dual-energy X-ray absorptiometry (DXA) has become the gold standard for body composition analysis (Reilly et al. 2009; Milanese et al.,2011; Sutton and Stewart 2012). Therefore, total and segmental body composition measurements were made using DXA, which provides a reliable estimate.

In this study, there was no statistically relationship between SJ and CMJ with total/segmental body composition parameters. Nevertheless, there was a only negative relationship between % LF and LF with SJ and CMJ. That is an increase in LF percentage and kg may be negatively affect jump performance. Previous studies have reported a weak negative correlation of body fat percentage with vertical jump height (Anwar and Noohu, 2016). Similarly Silvestre et al. (2006) found that percent body fat had a negative correlation with vertical jump (r = -0.55) in soccer players. Sporis, Jukic, Ostojic, and Milanovic (2009) found that, a strong negative correlation was found between BF and SJ (r = -20.78), and CMJ (r = -20.92) in soccer players. Similarly to our study, Atakan el al. (2017) no significant correlation was found among CMJ, SJ and BF, fat mass index and %BF in soccer players.

The researchers explained that the increasing % BF had significant negative effects on certain performance variables used to compare football players (Anwar and Noohu, 2016). Increased %BF was reported to have a direct negative relationship on both anaerobic and aerobic performance. Most notably, increased total/segmental BF composition was associated with decreased Yo-Yo IR1 performance score.

In this study significant negative correlation between Yo-Yo IR1 performance with BF, LF, AFM, and TFM. These results show that, is an increase in total/segmental body fat kg (BF,

LF, AFM, and TFM) will negatively affect Yo-Yo IR performance. However, to our knowledge, there are very few studies to correlate body composition variables and, Yo-Yo IR performance. Similarly to our study, Silvestre et al. (2006) found that total body fat had negative correlation with cardiorespiratory capacity (Yo-Yo Endurance Test) (r = -0.67). This study also reports that, percent body fat had a negative correlation with cardiorespiratory capacity (r =-0.65). Similiar to this study Anwar and Noohu, (2016) found that there was a significant moderate negative correlation of body fat percentage with (r = –0.4) aerobic performance (Cooper 12 minute run/walk test) in soccer players.

The results of the present study show that the excess total/segmental body fat and kg has a more negative effect on physical performances variables in soccer players in the pre-season period. It is suggested that coaches should not allow soccer players to rise in ectomorph for the physical performance loss in the off-season period.

CONCLUSION

As a result there was no statistically relationship between SJ and CMJ with total/segmental body composition. However, there was a only negative correlation between SJ and CMJ of (%) LF and LF. There was also a significant negative correlation between Yo-Yo IR1 performance body fat weight, leg fat weight, arm fat mass and trunk fat mass. Results indicated that increased body fat might be a detriment to the SJ, CMJ and Yo-Yo IR performance. There are much more correlation studies are necessary with body composition, explosıve power and aerobic performance.

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