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Original article

The Effect of Calisthenics Exercises on Body Composition in Soccer Players

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Abstract. *Study Objectives:* The purpose of the study was to examine the effect of calisthenics exercises on body composition in soccer players.*Methods:*18 male soccer players with ages of 18,16±1,04 years, height 174,94±7,68 m, body weight 69,99±8,68 kg participated in the study voluntarily. The soccer players participating in the study were randomly divided into 2 groups. 9 soccer players in the calisthenics exercises group (CEG) performed calisthenics exercise and soccer training, and 9 soccer players in the control group (CG) performed only soccer training. The study lasted a total of 8 weeks, with 3 workouts per week. Analysis of intergroup, intragroup, and the effect of training were carried out with repeated measures ANOVA. Significance was set at 0.05. *Results:* While there was no difference in the BMR and TBW of the subjects, there was a difference in pre and post-test measurements of body composition such as BW, BMI, FP, FM, and FFM. In comparison of pre and post-test changes of upper extremities between groups, there was a significant difference in the all variables of the subjects in pre and post-test measurements of RAFP, RAFM, RAFFM, LAFP, LAFM, and LAFFM in terms of inter-group, intra-group, and group*test interaction. In comparison of pre and post-test changes of lower extremities between groups, there was no difference in the RLFP of the subjects; there was a significant difference pre and post-test measurements of body composition such as RLFM, RLFFM, LLFP, LLFM, and LLFFM. *Conclusion:* It can be said that an 8-week calisthenics exercise can provide positive development of the whole body composition of soccer players.

Keywords: Soccer players, calisthenics exercise, body composition.

Introduction

Football was described as an intermittent sport (1) in which physically demanding, high-intensity actions like changing direction, jumping, and sprinting were important factors for competitive success in both young players (2) and adult (3). Performance in football is determined by physiological, psychological, biomechanical, and environmental factors. Physiological factors include five components of health-related fitness (body composition, cardio respiratory fitness, muscular strength, endurance, and flexibility) and sport-specific characteristics like speed and reaction time (4). In recent years, the health benefits of football have been extensively researched (5-6). Some studies showed that the physiological load during recreational football training (7) was similar to what observed in high-level male elite players (8), and football training 2–3 times per week during one hour for 12 weeks was shown to improve cardiovascular risk profile, VO_2max, muscle mass and reduce body fat percentage (BFP) in a group of untrained males (9). Body composition is considered as a key fitness element relevant to football player performance and in professional football, it is traditionally evaluated several times throughout the season to monitor the efficacy of training and nutrition. Besides,

non-optimal body composition may adversely influence football performance and the risk of injury (10). Excessive fat mass will load the football player with extra body weight, potentially affecting power output and demanding greater energy expenditure during the game (11). It is important to recognize that considerable individual differences in low and high levels of body fat occur between players and this might play a bigger role in optimal performance potential than generalizations about body fat itself. Although today's professional football players are not considered excessively fat, there is continuous pressure by coaches, physiotherapists, managers, and sports scientists to reduce players (ranging from professional to academy) body fat to minimum levels in the knowledge that low levels of body fat can enable them to perform more effectively (12). Since weight control is seen as very important in today's football, the training that provides this should be applied to the players. One of these types of training is considered as calisthenics exercises.

Calisthenic is a type of exercise that consists of a variety of movements that are practically performed without the need for equipment or apparatus that use your body weight. It is designed to increase body flexibility and strength through movements such as swinging, twisting, jumping, kicking, or bending; uses only body weight for resistance (13). There are many different variations such as different gymnastic movements, bounce exercises, push-ups, shuttle, pull-up, lunge, plank, squat, step up, crunch, dips, plyojack, burpee, and mountain climber. There are studies in the literature that convey the positive effects of calisthenics exercises on body composition (14), maxVO^2 (15-16), flexibility, anaerobic power, aerobic capacity, leg strength (17), power, flexibility, blood pressure, resting pulse (18), total cholesterol, triglycerides, systolic-diastolic blood pressure and decrease in obesity rates (19). Also studies are reporting that calisthenics exercises reduce the negative effects of fatigue, insomnia, difficulty concentrating, and depression (16). Regular exercise has an important role in obesity, hyperglycemia, LDL, blood pressure. Cardiovascular output and blood flow to working muscles are increasing throughout physical activity (19). In addition, simple motor skills have an impact on performance (20).

The aim of this study was to the investigate effect of the calisthenics exercises on body composition in soccer players.

Material and Method

Participants

After the pre-test period, 18 football players were divided into two groups; 9 calisthenics exercises group (CEG) and 9 control group (CG). For the sake of no difference between the groups in terms of both physical and physiological terms; the final state of the groups was determined in the form of 9 CEG (age=18,22±1,09 years, height=176,55±5,67 cm, weight=69,82±6,23 kg), 9 CG (age=18,11±1,05 years, height=173,88±9,51 cm, weight=70,16±8,90 kg). In addition, volunteer approval form was obtained from each player to participate in the study.

Procedures

During the training phase of the study, subjects were applied for an 8-week calisthenics exercises program, except for their training days. During the training period, subjects did not participate in any training programs except for technical and tactical training programs of their team. CEG participated in the calisthenics exercises program for approximately 60 minutes, including 15 minutes of warm-up and 15 minutes of cool-up exercises in 3 days (Monday, Wednesday, Friday).

Training Plan

The athletes belonging to the calisthenics exercises completed the exercises determined in the training plan, which lasted for 60 minutes in total 3 days a week and 1 minute rest between each set. 1 week before the first training day; the exercises they will do for 8 weeks were applied one by one, the errors were corrected and it was provided to perform the movement as desired. According to the increased loading principle as time progresses, the versions of the movements became harder and their number was increased. (21).

Table 1. 8-week calisthenics exercises program

Movements	1st Week	2nd Week	3rd Week	4th Week	5th Week	6th Week	7th Week	8th Week
Plank Climber	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Lower Ab Plank	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Plank Pushup Hold	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Pistol Squat Progression	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Plyo Jack	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
Superman	2X10	2X15	2X20	2X25	2X25	2X30	2X30	2X35
V-Up					2X25	2X30	2X30	2X35
Mountain Climber					2X25	2X30	2X30	2X35
The Pike Push-Up Tutorial					2X25	2X30	2X30	2X35
Dragon Flag							2X30	2X35
Dive Bomber Push-Up							2X30	2X35
Jack Sit Ups							2X30	2X35

Physical Measurements

Holtain brand stadiometer with a sensitivity of 0,01 cm was used to measure the height of the subjects. The height of the subjects was determined in anatomical position (barefoot) and the result was recorded as "cm". The body weight (BW) of the subjects was measured with a sensitivity of 0,01 kg in anatomical position (barefoot) and the result was recorded as "kg". Body mass index (BMI) values were determined by "BMI = weight (kg) / (height)^2" formula.

Bioelectrical impedance analysis was measured with the Tanita-BC 418 MA device (Tanita BC 418; Tokyo, Japan).Tanita device has 8 electrodes and uses high frequency constant current source (50 kHz, 500A). The individuals who participated in the measurement were asked not to eat anything until at least 4 hours before the measurement, not to drink anything including caffeine-containing drinks, not to use sauna or take a bath, not to drink alcohol until 24 hours before the measurement, and not to do sports on the day of the measurement. Individuals were asked to stand on bare feet on the metal surface of the device, to hold the parts of the device that should be handled with both hands and to release their arms parallel to the body. Measurements lasted for approximately 1-2 minutes for each subject, and the percentage of body fat detected by the bioelectrical impedance analyzer was printed out from the device (22).

Statistical Analysis

The data obtained from the pre and post-training measurements of soccer players were analyzed in the IBM SPSS 22 statistical program. Descriptive statistics are categorized according to all soccer players and groups. The pre- and post-test distributions of the variables were examined according to groups, the normality of the distributions and the homogeneity of the variance were determined by the Shapiro Wilk test and the Mauchly's Sphericity test. Analysis of intergroup, intragroup, and the effect of training were carried out with Repeated Measures ANOVA. Bonferroni test was used for post hoc comparisons; the significance level was accepted as 0,05.

Results

The results of the measurement of groups participating in the study were summarized in the tables below.

As seen in Table 2, the mean age, height, BW and BMI of two groups are respectively 18,16+1,04 years, 174,94+7,68 cm, 69,99+8,68 kg, 22,56+2,01 kg/m^2. Before the training period, there's not any statistically significant difference for all descriptive variables ($p>0,05$).

In Table 3, while there is no statistically difference in BMR and TBW of the subjects ($p>0,05$),there is a

Table 2. Descriptive statistics of participants and comparison of physical measurements between groups

Group	Variables	N	Mean± S. D.	Min.	Max.		
CEG	**Age** (year)	9	18,22**±1,09**	16	19		
CG		9	18,11±1,05	17	20		
CEG	**Height** (cm)	9	176,55**±5,67**	168,00	185,00		
CG		9	173,88±9,51	160,00	189,00		
CEG	**BW** (kg)	9	69,82**±6,23**	61,60	77,10		
CG		9	70,16±8,90	57,90	80,70		
CEG	**BMI** (kg/m^2)	9	22,87**±1,56**	21,20	25,20		
CG		9	22,25±2,45	19,00	26,60		
						Chi-Square (X^2)	**P**
Total	**Age** (year)	18	18,16**±1,04**	16	20	0,644	0,214
	Height (cm)		174,94±7,68	160,00	189,00	0,565	0,331
	BW (kg)		69,99±8,68	57,90	80,70	0,158	0,691
	BMI (kg/m^2)		22,56±2,01	19,00	26,60	0,236	0,627

* p< 0,05
BW: Body Weight, **BMI:** Body Mass Index

statistically significance in pre and post-test measurements of body composition such as BW, BMI, BFP, FM, and FFM. It is seen that there is a test*group interaction in five features(p<0,05).

It is seen in Table 4 that there is a statistically significant difference in all variables of the subjects in favor of CEG (p<0,05). These changes affect the test*group relationship.

In Table 5, while there is no statistically difference in RLFP of the subjects (p>0,05), there is a statistically significant difference in the other parameters (p<0,05). These differences affect the test*group interaction except for RLFP parameter.

Discussion and Conclusion

In the study, it was analyzed the effect of the calisthenics exercises on body composition in soccer players. Variables in which these changes have been observed are body weight (kg), BMI (kg/cm^2), body fat percentage (% fat), body fat mass (kg), body free fat mass (kg) and right leg fat percentage (% fat), right leg fat mass (kg), right leg free fat mass (kg), left leg fat percentage (% fat), left leg fat mass (kg), left leg free fat mass (kg). In Table 2, it was understood that before the training period, there's not any statistically significance for all descriptive variables between groups.

When table 3 is analyzed, it is seen that there is no difference in BMR and TBW of the subjects, there is a significant difference in the pre and post-test measurements of body composition such as BW, BMI, BFP, FM, and FFM. It was determined that the interaction in these five parameters was caused by a positive change in the results of the calisthenics exercises.According to the literature, studies are stating that aerobic exercises decrease body fat levels. In a high-intensity aerobic study, it was found a significant reduction in BW as a result of regular exercise (23). In another study conducted on 131 men and women, the subjects were divided into two groups as exercise and control groups and stated that there was a significant decrease in BW of the subjects after the 16-month exercise program (24). In the literature, it is possible to find studies related to reducing the amount of body fat where aerobic and resistance exercises are applied

Table 3. Comparison of pre and post-test changes of the whole body of groups

Variables	Group	N	Pre-Test $\bar{X}$±SS	Post Test $\bar{X}$±SS	In-group Change(%)	Test*Group F	p
BW (kg)	CEC	9	69,82+6,23	70,25+6,35	**0,43 (% 0,61)***	**5,499**	**0,032***
	CG	9	70,16+8,90	70,10+8,97	-0,06 (% -0,08)		
BMI (kg/m2)	CEC	9	22,87+1,56	23,04+1,58	**0,17 (% 0,74)***	**9,881**	**0,006***
	CG	9	22,25+2,45	22,17+2,45	-0,08 (% -0,35)		
BMR	CEC	9	1878,11+134,21	1880,72+136,05	2,61 (% 0,13)	2,821	0,112
	CG	9	1846,88+221,90	1847,66+221,78	0,78 (% 0,04)		
TBW (kg)	CEC	9	45,58+3,55	45,59+3,55	0,01 (% 0,02)	2,631	0,124
	CG	9	44,63+5,26	44,64+5,25	0,01 (% 0,02)		
FP (% fat)	CEC	9	10,44+3,86	10,08+3,68	**-0,36 (% -3,44)***	**18,932**	**0,000***
	CG	9	11,53+4,02	11,57+4,00	0,04 (% 0,34)		
FM (kg)	CEC	9	7,10+3,10	6,73+2,82	**-0,37 (% -5,21)***	**15,095**	**0,001***
	CG	9	8,22+3,62	8,34+3,62	0,12 (% 1,45)		
FFM (kg)	CEC	9	62,20+4,60	62,63+4,83	**0,43 (% 0,69)***	**8,077**	**0,012***
	CG	9	60,95+7,18	60,97+7,18	0,02 (% 0,03)		

* p< 0,05
BW: Body Weight, **BMI:** Body Mass Index, **BMR:** Basal Metabolic Rate, **TBW:** Total Body Water, **FP:** Fat Percentage, **FM:** Fat Mass, FFM: Free Fat Mass

Table 4. Comparison of pre and post-test changes of upper extremities betweengroups

Variables	Group	N	Pre-Test $\bar{X}$ ± SS	Post Test $\bar{X}$ ± SS	In-group Change(%)	Test*Group F	p
RAFP (% fat)	CEC	9	7,66+2,67	7,57+2,64	**-0,09 (% -1,17)***	**6,197**	**0,024***
	CG	9	8,41+3,07	8,42+3,09	0,01 (% 0,11)		
RAFM (kg)	CEC	9	1,35+0,13	1,27+0,10	**-0,08 (% -5,92)***	**7,804**	**0,013***
	CG	9	1,37+0,16	1,36+0,15	-0,01 (% -0,72)		
RAFFM (kg)	CEC	9	3,70+0,51	3,96+0,37	**0,26 (% 7,02)***	**6,733**	**0,020***
	CG	9	3,72+0,51	3,70+0,52	0,02 (% 0,53)		
LAFP (% fat)	CEC	9	7,74+2,63	7,34+2,64	**-0,40 (% -5,16)***	**11,011**	**0,004***
	CG	9	8,10+3,29	8,07+3,28	-0,03 (% -0,37)		
LAFM (kg)	CEC	9	1,35+0,13	1,32+0,12	**-0,03 (% -2,22)***	**7,699**	**0,014***
	CG	9	1,35+0,18	1,33+0,16	-0,02 (% -1,48)		
LAFFM (kg)	CEC	9	3,67+0,54	3,94+0,41	**0,27 (% 7,35)***	**6,865**	**0,019***
	CG	9	3,75+0,56	3,73+0,57	-0,02 (% -0,53)		

*** P< 0.05**
RAFP: Right Arm Fat Percentage, **RAFM:** Right Arm Fat Mass, **RAFFM:** Right Arm Free Fat Mass, **LAFP:** Left Arm Fat Percentage, **LAFM:** Left Arm Fat Mass, **LAFFM:** Left Arm Free Fat Mass

Table 5. Comparison of pre and post-test changes of lower extremities betweengroups

Variables	Group	N	Pre-Test $\bar{X}$ ±SS	Post Test $\bar{X}$ ±SS	In-group Change(%)	Test*Group F	p
RLFP (% fat)	CEC	9	10,05+2,83	9,51+2,46	**-0,54 (% -5,37)***	**3,002**	**0,102**
	CG	9	10,62+3,27	10,66+3,28	0,04 (% 0,37)		
RLFM (kg)	CEC	9	1,23+0,44	1,13+0,39	**-0,10 (% -8,13)***	**7,450**	**0,015***
	CG	9	1,29+0,52	1,31+0,54	0,02 (% 1,55)		
RLFFM (kg)	CEC	9	10,15+1,36	10,33+1,22	**0,18 (% 1,77)***	**9,003**	**0,008***
	CG	9	10,46+1,17	10,41+1,19	-0,05 (% -0,47)		
LLFP (% fat)	CEC	9	9,76+3,22	9,02+2,78	**-0,74 (% -7,58)***	**5,430**	**0,033***
	CG	9	10,30+3,52	10,34+3,52	0,04 (% 0,38)		
LLFM (kg)	CEC	9	1,21+0,49	1,12+0,44	**-0,09 (% -7,43)***	**6,654**	**0,020***
	CG	9	1,25+32,44	1,29+0,53	0,04 (% 3,20)		
LLFFM (kg)	CEC	9	10,50+1,17	10,17+1,37	**0,33 (% 3,14)***	**8,112**	**0,012***
	CG	9	10,51+1,19	10,45+1,17	-0,06 (% -0,57)		

***p< 0,05**
RLFP: Right Leg Fat Percentage, **RLFM:** Right Leg Fat Mass, **RLFFM:** Right Leg Free Fat Mass,
LLFP: Left Leg Fat Percentage, **LLFM:** Left Leg Fat Mass, **LLFFM:** Left Leg Free Fat Mass

together. A study performed an exercise program consisting of a combination of resistance and aerobics for 5 months, 5 days a week and it was reported that it was detected a 10% reduction in fat weight (25). In another study, it was reported that aerobic and resistance training significantly reduced BFP (26). Another study found that 12-week resistance training reduced participants' BW, waist circumference, abdominal fat, lean body mass, and lower body strength (27). In the performance evaluation of elite athletes, fat and lean body mass are important factors that confirm the training effect (28-29). Therefore, body composition is important for the elite athlete and is closely related to performance (30-31). Recent studies suggest that resistance training may also be effective, although more focus or aerobic training is needed to reduce or maintain BW (32). When the literature is searched, there are not many studies investigating the effects of calisthenics exercises on body composition. It was seen that different results were obtained in the studies. Some studies reported that calisthenics exercises improved body composition (33-40); on the other hand some studies reported that calisthenics exercises didn't effect on body composition (41-43). In a study on the swimmers, they practiced 8 weeks of calisthenics exercises on both stable and unstable ground. As a result, it was stated that calisthenics exercises applied to both grounds decreased BFP of athletes (44). In other studies on resistance training; it was observed that strength training had positive effects on body composition in a study in which 30 men performed strength training for 6 weeks (45). It was seen that standard weight lifting exercise was applied to sedentary men for 3 days a week for 10 weeks and pre and post-test BW averages of 85.5 ± 3.3 kg - 86.4 ± 2.9 kg were reported (46).It was performed a 9-month training program in a study on 62 men and was stated that BW decreased significantly (47). It was reported that the decrease in BW of the group performing strength training was statistically significant in a study on 16 male athletes (48). In another study, resistance training was applied to men for 3 days a week and 6 weeks and at the end of the study, it was reported that there was no significant change in BFP (49). It was found a significant decrease in body fat values of the experimental group after 12-week resistance training applied to obese patients (50). Besides, it is understood that if the exercises close to the maximal load intensity (80% and above) are applied

for around 6-8 weeks, there will be an increase in muscle strength between 25-30%, as well as an improvement in muscle hypertrophy is also provided. (51). In literature, it was seen that regular physical activities were effective in reducing the fat under the skin and increasing the lean mass of the body (52). Resistance exercises are an effective mechanism that stimulates muscle hypertrophy along with increases in muscle strength. (53-54). It is known that the first increases in muscle strength during the strength training process are due to the muscular-nervous system adaptations, and the muscle hypertrophy mechanism is effective in the subsequent strength increases (55). BW and BMI may vary depending on the duration, intensity, and frequency of the training. These parameters may also differ depending on the type of strength training performed. Body strength and BMI generally increase in strength studies that are performed to create muscle hypertrophy (25). According to these findings, it is thought that there is a statistically significant increase between the pre and post-test BW and lean body mass averages of the experimental group participating in the study as a result of the increase in BW due to muscle hypertrophy with the development of muscle strength in the direction of exercise. On the other hand, it is thought that there may be a decrease in body fat due to the acceleration of basal metabolism. The reasons for this are thought to be due to the training types applied to the subjects participating in the study, the severity of the load, the physical, physiological and nutritional characteristics of the subjects, and the different methods of measurement of BFP.

When table 4 is analyzed, there is a significant difference in all variables of the; pre and post-test measurements of body composition such as RAFP, RAFM, RAFFM, LAFP, LAFM, LAFFM. Accordingly, when the changes in all variables of the participant are examined, it is seen that there is a test*group interaction in all features. It was determined that the interaction in all parameters was caused by a positive decrease in the results of the experimental group. In Table 5, while there is no difference in the RAFP of the subjects, there is a significant difference in the pre and post-test measurements of body composition such as RLFM, RLFFM, LLFP, LLFM, and LLFFM. The difference between the groups appeared in the second measurements and it was seen that there was a statistically significant difference in the post-test measurements was due to the development of CEG. In the regional body analysis, it is understood that the calisthenics exercise program is very effective on both lower and upper extremities. It is a useful and beneficial form of exercise because of the brisk, low intensity, and modification that large muscle groups are used in the upper and lower extremities.

As a result; it can be said that calisthenics exercises, which are applied to soccer players 3 days a week for 8 weeks, can provide positive development of the whole body composition of footballers and the reduction of BFP of regional extremities and the increase of FFM.

Conflict of Interest: The authors declare that there is no conflict of interest about this manuscript.

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