

Soccer vs. running training effects in young adult men: which programme is more effective in improvement of body composition? Randomized controlled trial

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ABSTRACT: The aims of this study were: 1) To determine the effects of a 12-week recreational soccer training programme and continuous endurance running on body composition of young adult men and 2) to determine which of these two programmes was more effective concerning body composition. Sixty-four participants completed the randomized controlled trial and were randomly assigned to one of three groups: a soccer training group (SOC; n=20), a running group (RUN; n=21) or a control group performing no physical training (CON; n=23). Training programmes for SOC and RUN lasted 12-week with 3 training sessions per week. Soccer sessions consisted of 60 min ordinary five-a-side, six-a-side or seven-a-side matches on a 30-45 m wide and 45-60 m long plastic grass pitch. Running sessions consisted of 60 min of continuous moderate intensity running at the same average heart rate as in SOC (~80% HRmax). All participants, regardless of group assignment, were tested for each of the following dependent variables: body weight, body height, body mass index, percent body fat, body fat mass, fat-free mass and total body water. In the SOC and RUN groups there was a significant decrease ($p < 0.05$) in body composition parameters from pre- to post-training values for all measures with the exception of fat-free mass and total body water. Body mass index, percent body fat and body fat mass did not differ between groups at baseline, but by week 12 were significantly lower ($p < 0.05$) in the SOC and RUN groups compared to CON. To conclude, recreational soccer training provides at least the same changes in body composition parameters as continuous running in young adult men when the training intensity is well matched.

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INTRODUCTION

The prevalence of obesity has risen greatly during the last two decades [1]. Obesity is considered one of the most important public health problems and according to evaluation the second most common cause of mortality that can be successfully prevented [2]. Regular physical activity has been established as one of the most effective means of obesity prevention [3-5]. Most studies [2, 6-8] evaluating the effects of physical activities on body composition have focused on the effects of aerobic exercise training such as walking, jogging, running and cycling. Recently, however, a few studies [9, 10] have confirmed positive effects of recreational soccer on body composition in untrained men, including subjects with limited soccer experience and skills. According to the Compendium of Physical Activities, team sports such as soccer, basketball and handball are estimated to represent vigorous intensity exercises (8.0-10.0 Metabolic Equivalent Task) [11].

Soccer is a popular team sport with >400 million active players worldwide, and due to motivational and social factors it may have great potential as a health-promotion activity for inactive individuals

with a passion for soccer [10]. Ottesenet et al. [12] suggested that team sports, such as soccer, may have an advantage over individual sports in the development of social capital. Also, recreational soccer training is as effective as running training in healthy untrained men because training time and mean training intensity are similar [13].

After 12 weeks of recreational soccer training, the number of capillaries and maximal oxygen uptake were increased while systolic and diastolic blood pressure and resting heart rate were reduced [9]. Moreover, the recreational soccer group even showed reduced LDL cholesterol [9, 13] and increased lean body mass [13], while these beneficial adaptations were not present in the running group. In the study by Krstrup et al. [14], solid evidence was provided that recreational soccer has a marked impact on metabolic fitness for untrained men. One of the characteristics of recreational soccer is high energy expenditure; thus this kind of activity may serve as an appropriate alternative for exercise intervention for body composition improvement. The large number of different train-

ing components in soccer (e.g. continuous running, acceleration, rapid decelerations, jumps, sprints, duels) appears to evoke significant adaptive changes in a number of physiological systems as well as body composition [10]. On the other hand, Mahdiabadi et al. [15] confirmed that continuous and interval training produce similar effects on cardiovascular function in male non-athletes after an eight-week training programme.

Recreational soccer in the form of small-sided games has been shown to be an effective performance-enhancing and health-promoting activity for untrained and inexperienced men aged 20-55 [9, 10]. Recent studies have confirmed that recreational soccer is very effective in reducing cardiovascular risk factors [16], blood pressure [9], agility [17], maximal oxygen uptake [10], some health-related fitness parameters, self-esteem as well as several motor skills [17]. However, to our knowledge, there is no study of the effects of recreational soccer on body composition in young adult men. Therefore, the aims of this study were: 1) To determine the effects of a 12-week recreational soccer training programme or continuous endurance running on body composition of young adult men and 2) to determine which of these two programmes was more effective concerning the body composition. We hypothesized that recreational soccer is at least as efficacious as a running exercise programme is in improvement of body composition parameters in young adult males.

MATERIALS AND METHODS

Participants. Sixty-nine healthy untrained males enrolled in this randomised controlled trial. The participants had not been involved in any type of regular physical training for at least two years. In addition, none of the participants were involved in professional or amateur soccer within two years before the training programme. Sixty-four participants completed the study and were randomly assigned to one of three groups: a soccer training group (SOC; n=20), a running group (RUN; n=21), or a control group performing no physical training (CON; n=23). Two participants from the SOC group withdrew from the study (one left the study for personal reasons, one due to lack of time), while two participants withdrew from the RUN group (one due to minor injuries occurring during training, one due to lack of time). One soccer player was filtered out due to low compliance (training frequency < 1.2 times per week). For the participants who completed the study no group differences were present in pre-intervention. General descriptive parameters are presented in Table 1. The experimental protocol and associated risks were explained both orally and in writing to all subjects before they provided written consent. The study was approved by the Ethics Committee of the Faculty of Kinesiology, University of Zagreb, according to the Helsinki Declaration.

Procedure

All participants, regardless of group assignment, were tested for each of the following dependent variables: body weight, body height, body

mass index, percentage of body fat (absolute and relative values) and fat-free mass. All pre- and post-training testing procedures were completed for all participants, spaced 12 weeks apart. During testing, the air temperature ranged from 24°C to 27°C.

Anthropometric measures

Anthropometric variables were measured according to the instructions of the International Biological Program (IBP). Body height was measured to the nearest 0.1 cm at maximal inhalation.

Body composition

Anthropometric variables were measured according to the instructions of the IBP at the beginning of the study. Body height was measured to the nearest 0.1 cm. Body composition parameters were assessed by a Tanita Body Composition Analyser (BC-418; Tanita, Tokyo, Japan). The Tanita BC-418 body fat analyser measures impedance across both arms, legs and trunk via multiple frequencies of 50 kHz. The system's eight electrodes are in the form of footpads and each footpad is divided in half so that the anterior and posterior portions form two separate electrodes. Impedance and body mass are automatically measured, and the subject's height and age are manually entered into the system. Percent body fat measured using the Tanita BC-418 has been shown to correlate highly with the reference measure of dual-energy X-ray absorptiometry [18]. The participants were asked to avoid the following procedures before body composition measurement as described by Rechet et al. [19]: not to perform any physical exercises during 12 hours before testing, not to eat or drink anything during the four hours before the evaluation, to urinate at least 30 minutes before the evaluation, not to take any diuretics during the seven days prior to the test, and not to consume alcohol during the 48 hours preceding the test.

Training programme

Outdoor training was performed three times per week for 12 weeks. The participants in the intervention groups performed a 12-week training programme, whereas the participants in CON continued

TABLE I. Description of training programme

	Recreational soccer	Running exercises
Frequency	3 times / week	3 times / week
Duration	60 min (10 min warm-up 4x10 min exercise, rest 2 min)	60 min (10 min warm-up; 40 min running; 10 min cool down)
Intensity	~ 80 (65-100) % HRmax	~ 80 (65-85) % HRmax
Type of activity	Five-a-side, six-a-side or seven-a-side matches on a 30-45 m wide and 45-60 m long pitch	Continuous moderate intensity running

normal daily life activities during the study period. All training sessions were supervised by trained exercise instructors and careful records were kept of each participant's workout performance.

Soccer sessions consisted of 60 min ordinary five-a-side, six-a-side or seven-a-side matches on a 30-45 m wide and 45-60 m long plastic grass pitch. All small side games under recreational soccer training programme were conducted without respect of players' playing position. Each training session was initiated by a 10 min low-intensity warm-up period and thereafter the participants carried out four playing periods each lasting 10 min separated by 2 min recovery periods. Heart rate of participants was measured continuously during all training sessions using heart rate belts (Polar Team System, Polar Electro Oy, Kempele, Finland). The average heart rate during recreational soccer training was $81 \pm 4\%$ of individual maximal heart rate, which is equivalent to 151 ± 6 bpm. Around 20% of total training activity during recreational soccer was with intensity above $90\% HR_{max}$.

Running sessions consisted of 60 min of continuous moderate intensity running at the same average heart rate as in SOC ($\sim 80\% HR_{max}$) (measured with Polar; Polar Electro, Kempele, Finland) performed in the park. Each training session was initiated by a 10-min low-intensity ($\sim 65\% HR_{max}$) warm-up period consisted of walking and jogging. The total number of training sessions did not differ between groups and was 31.3 ± 2.2 and 29.8 ± 3.1 per week for participants in SOC and RUN group, respectively. The training programme was designed to conform in principle to that recommended by the American College of Sports Medicine [20]. A more detailed description of the training programme is presented in Table 1. There was no difference in the training volume, intensity and frequency, which is an important factor when comparing the effects of these two groups.

Statistical analysis

Data analysis was performed using the Statistical Package for the Social Sciences (v13.0, SPSS Inc., Chicago, IL, USA). Descriptive statistics, Kolmogorov-Smirnov (normality of the distribution) and

Levene's (homogeneity of variance) tests were calculated for all experimental data before inferential testing. Changes in body composition parameters were compared over the training period for players in the two experimental and control groups using two-factor (group x time) univariate analysis of variance (ANOVA). Effect size (ES) were classified as follows: <0.2 was defined as trivial, $0.2-0.6$ was defined as small, $0.6-1.2$ was defined as moderate, $1.2-2.0$ was defined as large, >2.0 was defined as very large and >4.0 was defined as extremely large [21]. Statistical significance was set at $p < 0.05$.

RESULTS

The Kolmogorov-Smirnov tests showed that data were normally distributed and no violation of homogeneity of variance was found using Levene's test. The experimental and control groups were well matched on the pre-training tests with no significant differences found for any variable between the three groups. The SOC group showed a significant decrease ($p < 0.05$) in body composition parameters from pre- to post-training values for all measures with the exception of fat-free mass ($p = 0.308$; $ES = 0.019$) and total body water ($p = 0.918$; $ES = 0.001$) (Table 2). Percent of body fat, body weight, body fat mass and body mass index were statistically significantly different between baseline and after 12 weeks of continuous training in the RUN group. A large effect size was observed for body fat mass ($ES = 0.729$) and medium for percent body fat ($ES = 0.433$) in the running group. There were no statistically significant changes ($p > 0.05$) in any variables of body composition from pre- to post-training in the CON group.

Body mass index, percent body fat and body fat mass did not differ between groups at baseline, but by week 12 they were significantly lower ($p < 0.05$) in the SOC and RUN groups compared to CON. No significant differences ($p > 0.05$) in fat-free mass and total body water were found for either SOC, RUN or CON groups between baseline and after the 12-week training programme. There were no statistically significant differences ($p > 0.05$) between SOC and RUN groups in any parameters of body composition after the training programme.

TABLE 2. Body composition parameters for soccer, running and control group before and 12-week training intervention (Mean \pm SD).

	Soccer group (n=20)		Running group (n=21)		Control group (n=23)	
	Initial	Final	Initial	Final	Initial	Final
Body height (cm)	178.59 \pm 4.21	178.59 \pm 4.21	179.44 \pm 7.05	179.44 \pm 7.05	177.83 \pm 8.03	177.83 \pm 8.03
Body mass (kg)	78.06 \pm 8.34	72.18 \pm 8.34*	78.06 \pm 5.49	72.28 \pm 5.48#	76.55 \pm 12.02	79.22 \pm 12.58
Body mass index	24.45 \pm 2.20	22.60 \pm 2.21*	24.29 \pm 1.93	22.49 \pm 1.85#	24.12 \pm 2.89	24.96 \pm 3.07
Fat free mass (kg)	59.42 \pm 5.66	58.42 \pm 7.37	58.96 \pm 4.23	57.82 \pm 5.40	58.67 \pm 9.73	61.82 \pm 9.72
Percent body fat (%)	23.77 \pm 1.35	19.10 \pm 3.44*	24.46 \pm 1.72	20.07 \pm 3.34#	23.44 \pm 3.66	21.89 \pm 4.20
Body fat mass (kg)	18.63 \pm 2.83	13.77 \pm 2.94*	19.10 \pm 2.00	14.46 \pm 2.34#	17.88 \pm 3.91	17.40 \pm 4.82
Total body water (l)	33.06 \pm 8.34	34.22 \pm 5.58	33.52 \pm 11.98	36.11 \pm 8.61	34.78 \pm 5.63	35.92 \pm 12.58

Note: * – statistically significant difference between SOC and CON groups, $p < 0.05$; # – statistically significant difference between RUN and CON groups, $p < 0.05$.

DISCUSSION

The present study examined the effects of 12-week recreational soccer and continuous running training programmes on body composition in young adult men. Both training programmes led to significant changes in body mass, body mass index, body fat percentage and body fat mass without differences between groups. Our hypothesis that recreational soccer is as effective as continuous running was confirmed in this study.

Both training groups showed a reduction in body mass, body fat percentage and body fat mass. As recreational soccer combines aerobic high-intensity training, aerobic moderate-intensity training and resistance training [22], in this study it led to changes in body composition parameters. Our results are in accordance with recent reports [23-25] indicating positive effects with similar training time and mean training intensity. In comparison with our results where body fat mass was reduced by ~5 kg in both SOC and RUN groups, Krustrupet *et al.* [9] obtained a reduction of ~ 2.1-3.0 kg. Nyboet *et al.* [24] found in both recreational soccer and a comparable running group a significant decline in body fat percentage, which was not the case with intensive interval training and a short-term strength training group. This may be related to the fact that the total energy expenditure is limited during interval and strength training compared to continuous running and recreational soccer, where high energy consumption has a direct impact on body fat reduction [26]. In addition, recreational soccer leads to changes in parameters of metabolic fitness, such as fat oxidation during exercise, lipid profile, capillarization and enzyme activation [25], especially in men who are not involved in any kind of recreation. Moreover, recreational soccer affects the fat mass oxidation during activities with low and moderate intensity along with the reduction of lactate level [14]. These changes occur as a result of peripheral muscle adaptation with an increase in the number of muscle capillaries by 23% and the training-induced conversion of IIX fibres into IIA fibres [14].

Unlike body fat percentage, fat-free mass was not significantly increased following the 12-week training programme of recreational soccer, continuous running or in the control group. Krustrupet *et al.* [9] found a significant increase in lean body mass for recreational soccer and strength training groups compared to interval and continuous training groups, which contrasts with our results. These results suggest that recreational soccer as a kind of aerobic interval training is an activity that affects body system functions leading to significant changes that have an impact on health status and body composition. Furthermore, even short-term soccer studies have shown significant changes in fitness components as well as favourable effects on cardiovascular risk factors such as maximal oxygen uptake, heart function, body fat mass and low density lipoprotein (LDL) cholesterol levels in healthy untrained young men and women [27]. This study showed that recreational soccer is an equally effective training method as moderate continuous running in improving fitness parameters, especially body composition. Both training programmes lead to great energy expenditure which reduces body

composition parameters, especially those associated with body fat, but soccer training seems to be more time-efficient. This is in agreement with a previous study, suggesting that high-intensity interval training is a time-efficient strategy for gaining health effects from exercise [28] and could provide greater improvements in somatic features and health-related physical fitness than continuous moderate exercise training [29]. All the groups showed increases in total body water, but these changes were not statistically significant. This finding suggests that type of training (SOC or RUN) does not influence the body water responses to various types of exercises.

One reason for the improvements in the soccer group is the marked and frequent change in exercise intensity when playing soccer, despite the fact that average heart rate was the same in the soccer and running groups. During this experimental programme recreational soccer players spend ~20% of the total training time in activities with intensity above 90% HR_{max}, compared to only 1% for the continuous running group. Similar results were obtained by Krustrupet *et al.* [30], who concluded that higher intensity produces superior changes in the soccer group than other comparable groups. Thus, it is likely that high-intensity periods make recreational soccer training superior in terms of producing improvements in performance [30]. Unfortunately, no studies to date have directly compared recreational soccer and high-intensity interval training with the same training volume, so future investigations are warranted to compare the magnitude of improvements with these training methods for better understanding of the mechanism.

To our knowledge, this was the first study specifically designed to examine the parallel effects of recreational soccer and continuous running on all body composition parameters. Apart from many advantages of this study, there were several study limitations. First and foremost, the sample of participants consisted only of male subjects, as women were not included in the study. Also, this study determines only body composition of the subject without any additional information regarding maximal oxygen uptake, strength, motor ability or flexibility. Further studies should provide an insight into the effects of recreational soccer in different groups of participants, such as children, adults or elderly people, as well as obese people or people with different social backgrounds. A similar study should be conducted to determine the effects of recreational soccer on health-related fitness components. Also, the effects of recreational soccer should be compared with different types of training such as strength, high-intensity intermittent or concurrent training.

CONCLUSIONS

To conclude, recreational soccer training provides at least the same changes in body composition parameters as continuous running of the same training volume and relative intensity in young adult men. Furthermore, recreational soccer has established superior changes in fat mass compared to continuous running but these changes were not significant. This may be related to the findings of many intense actions and significant stimulation of the anaerobic system during

recreational soccer. Also greater improvement observed in the soccer group is related to training intensity, whereas 20% of total training activity during recreational soccer was with intensity above 90% HR_{max} .

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