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ARTICLE

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Effects of recreational football performed once a week (1 h per 12 weeks) on cardiovascular risk factors in middle-aged sedentary men

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ABSTRACT

Objectives: It is well established that there is a strong relationship between physical activity, cardiovascular diseases and mortality. Regular recreational football training can lower blood pressure, heart rate at rest, fat percentage, LDL cholesterol and increase maximal aerobic power (VO_{2max}). This study analyzed the effect of one recreational football training per week on middle-aged men.

Design: Randomized controlled trial.

Methods: Twenty-four participants (mean ± SDs; age 44.5 ± 4.7 years, weight 81.9 ± 10.4 kg, height 175.0 ± 7.3 cm) were randomized in a football group (FG = 10) and control group (CG = 14). FG performed supervised recreational football training (five-a-side futsal match) on 36 × 18.5 m synthetic indoor and outdoor field, 60 min per week over 12 weeks.

Results: After training, VO_{2max} and maximal aerobic speed improved in FG respectively of 4.4% (+1.89 mL O_2· kg^{-1}·min^{-1}, P = 0.002) and 5.9% (P = 0.01). Systolic and mean blood pressure decreased respectively of 2.5% (−3.18 mmHg, P = 0.04) and 2.2% (−2.28 mmHg, P = 0.04) in FG, while diastolic blood pressure did not change (−1.84 mmHg, P = 0.09).

Conclusions: Recreational football activity produces health benefits by improving VO_2 max and lowering blood pressure parameters in middle-aged men.

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KEYWORDS
Soccer; futsal; cardiovascular diseases; health; prevention; sedentary

Introduction

Based on the World Health Organization, sedentary lifestyle causes about 1.9 million deaths per year worldwide (Hamer & Chida 2008). It is well established that there is a strong relationship among physical activity, cardiovascular diseases and mortality (Barlow et al. 2012). For this reason, the American College of Sport Medicine (ACSM) has recommended that adults aged 18–65 years should engage at least 150 min of moderate-intensity (between 55% and 65% of an individual maximal heart rate HR_{max}) physical activity per week to improve their health status (Garber et al. 2011). The lack of time is the major barrier to a regular active lifestyle in general population (Reichert et al. 2007). Nevertheless, sedentary people could also get some health benefits with a lower amount of training volume than recommended by the international guidelines (Lee 2007). It is widely accepted that a dose–response relationship exists between training volume and positive health adaptations (Lee 2007), but scarce literature is available about the necessary minimal amount of it, especially for activities like football or game sport in general (Garber et al. 2011).

Football is a very popular sport in Western nations (Krustrup et al. 2009), and its popularity may be used for increasing the intrinsic motivation and hence the adherence to physical activity (Ottesen et al. 2010). At recreational level, it is known that people usually practice football only once or twice per week for approximately 1 h per session, which also corresponds to the time that the pitch is rented but this weekly volume has not been previously investigated (Beato, Impellizzeri et al. 2016). Furthermore, recreational players commonly reduce the size of the pitch and the number of players since it is easier to arrange smaller groups for friendly matches. Therefore, five-a-side football (futsal) is the most common form of recreational football and may be a valid alternative to continuous running exercise in order to improve cardiovascular fitness (Castagna et al. 2007). In detail, futsal is played on smaller pitch than football (e.g., 40 × 20 m), a smaller ball is used (size 4) and matches are played between team of five players each (Beato, Coratella et al. 2016).

Various studies have reported that football is an effective physical activity for inducing cardiovascular benefits (Krustrup, Aagaard, et al. 2010; Krustrup et al. 2013). Previous researchers (Krustrup et al. 2009) found that regular football training (when performed two or three times a week) induces lowering blood pressure, as well as heart rate (HR) at rest, fat percentage, low-density lipoprotein (LDL) cholesterol, and increases lean body mass as well as maximal aerobic power (VO_{2max}) (Milanović et al. 2015; Oja et al. 2015). Other evidences reported that 6 months of football training for 1 h twice a week induced significant improvements in cardiac structure and function in formerly inactive men with mild-to-moderate arterial hypertension (Andersen et al. 2014). Another study reported that football training after 12–16 weeks is able to increase VO_{2max} and muscle mass equivalently or greater

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than running-based training (Krustrup, Dvorak, et al. 2010; Milanović et al. 2015).

Total energy expenditure (EE) is one of the most important components of an exercise program for health promotion (Ainsworth et al. 2011). Recent evidence has reported that one, two and three sessions per week are almost equivalent to 50% (634 kcal), 100% (1268 kcal) and 150% (1902 kcal) EE, respectively, as suggested in international guidelines (Beato, Impellizzeri, et al. 2016). Despite the popularity and wide appeal of this sport, no one has investigated the effect of one session per week on middle-aged male players (the most common practice). This study gives practical information to the development of preventive health programs using a small dose of football training.

The aim of this study is therefore to assess the effect of an 1 h recreational football session per week, hypothesizing that this volume, after 12 weeks, will give meaningful positive changes on cardiovascular risk factors in healthy individuals.

Methods

Twenty-eight sedentary participants were initially considered during enrollment process, but four were excluded during medical screening (ECG test). Twenty-four healthy male participants without specific pathologies (assessed by medical screening) were enrolled in this study (mean ± SDs; age 44.5 ± 4.7 years, weight 81.9 ± 10.4 kg, height 175.0 ± 7.3 cm). All participants were informed about the potential risks of the study and signed an informed consent. Twenty participants completed the study, while two participants of the football group (FG) dropped out due to injuries to their hamstring and Achilles tendon, respectively, and two participants of the control group (CG) dropped out for job-related reasons (e.g., lack of time). CONSORT (Consolidated Standards of Reporting Trials) participant flow is reported in Figure 1 (Moher et al. 2001). Adherence recorded in this randomized controlled trial (RCT) was 83% (Zhang et al. 2014). All procedures were approved by the Ethics Committee of the Department of Neurological and Movement Sciences, University of Verona (Italy), and conducted according to the Declaration of Helsinki for human studies of the World Medical Association.

Enrollment

Potential participants were recruited through the main communication channels available at the university such as newspapers, television, web ads and flyers. Participants completed the Physical Activity Readiness Questionnaires and the International Physical Activity Questionnaire to assess their level of compatibility with the training program and to ensure the absence of regular physical exercise in the last period (Shephard 1988; Lee et al. 2011). No-active lifestyle was defined as a lack of regular activity in the last year, up to three times per week at moderate intensity (<20 min per session) (Krustrup et al. 2009). Participants were categorized into risk categories based on ACSM guidelines (Thompson & ACSM 2009) and we included only those belonging to the low- and medium-risk categories. No economic incentives were provided.

Study design

In this study, we used an RCT design. The randomization was performed according to a computer-generated sequence. The participants were randomized in an FG (= 10 participants) and a CG (= 14 participants) in order to obtain the correct number of participants for recreational football matches. After the randomization, baseline differences were tested by *t*-tests without finding any statistical difference. The FG performed recreational football training once per week over 12 weeks. The CG did not perform any training during the experimental period (Krustrup et al. 2013). Outcome measures were assessed before and after the experimental period. VO_{2max} is an independent and strong predictor of cardiovascular risk factors (Lakka et al. 2003; Kodama et al. 2009). ½ MET (metabolic equivalent) of improvement corresponds to a decrement of 7.9% of mortality risk reduction (Blair et al. 1995; Kodama et al. 2009).

Interventions

Participants completed recreational futsal matches on a synthetic indoor or outdoor field (36 × 18.5 m). The training lasted 12 weeks (60 min per session) with all the matches played in the evening (at 8.00 p.m.). Before recreational matches, participants completed a standardized 5-min warm-up followed by 55 min of matches. Five players on the same team, in turn, acted as goalkeeper (changes from goalkeeper to players every 5 min). Researchers asked both FG and CG to maintain their normal lifestyle and nutrition behaviors throughout the duration of the protocol.

Testing procedures

The first day, after the medical screening, participants completed a VO_2 familiarization (submaximal) test on a treadmill. On the second day, anthropometrical measurements, blood pressure and HR at rest and blood sampling were completed. The third day consisted of participants completing the maximal incremental test on the treadmill. Participants were asked to avoid any heavy physical activity on the day prior to testing and to refrain from caffeine 8 h before testing. After 12 weeks of training, all participants were retested with the same protocol. Medical doctors and assessor that administered the interventions and assessed the outcomes were blinded.

Maximal aerobic power

A maximal running incremental test was used to determine VO_{2max} (primary outcome), maximal aerobic speed (MAS), HR_{max} and HR-VO_2 relation. In this study, VO_{2max} was considered the primary outcome because it was demonstrated that low levels of cardiovascular fitness are associated with an increase in cardiovascular risk factor (Blair et al. 1995; Kodama et al. 2009). Moreover, it can be considered an important and independent factor for the prevention of cardiovascular diseases (Kodama et al. 2009; Eriksen et al. 2016). An automated metabolic cart was used to measure respiratory parameters breath-by-breath (Quark b2, Cosmed, Italy). The running

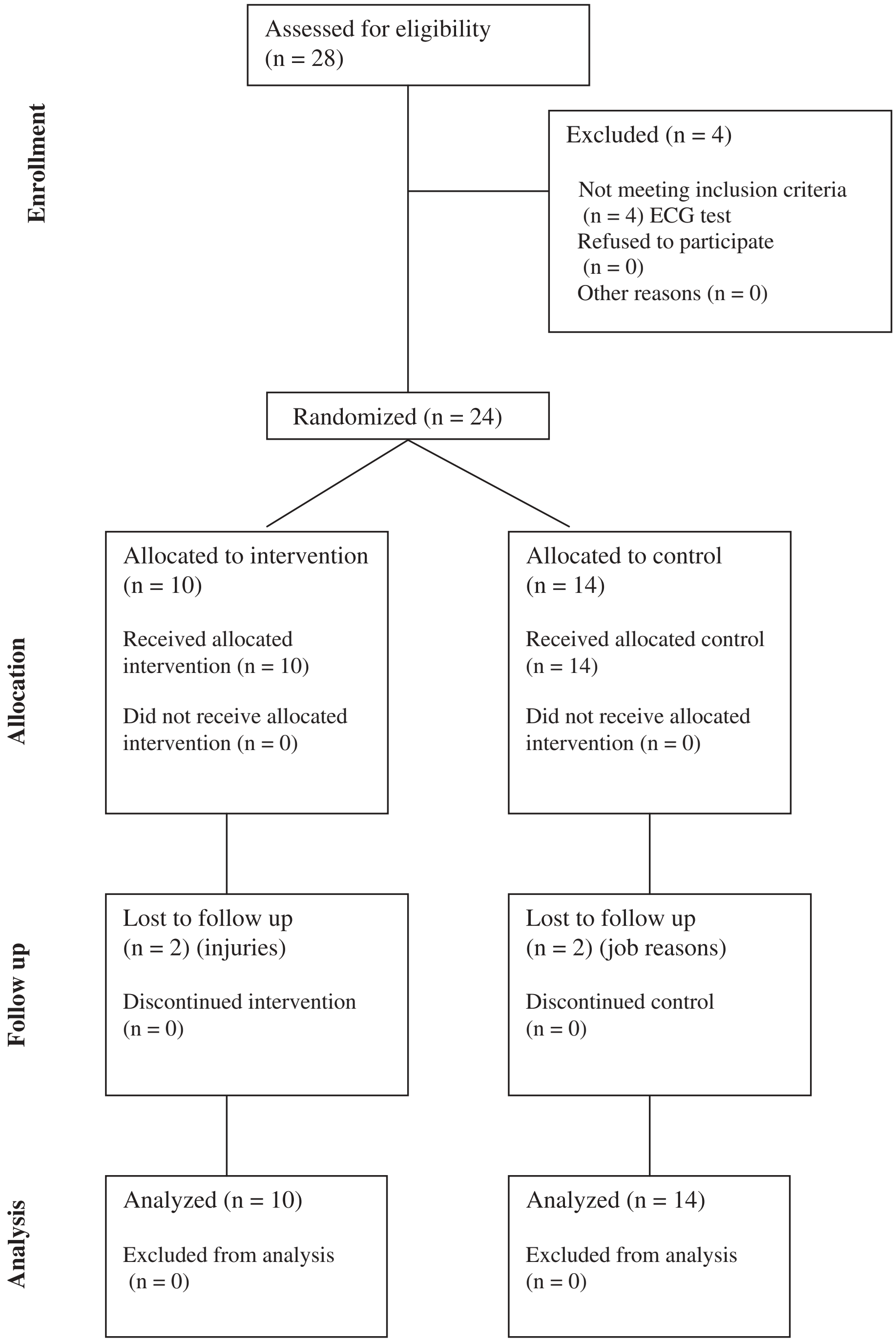

Figure 1. CONSORT diagram showing the flow of participants through each stage of a randomized trial.

protocol consisted of 3 min at 9 km· h^{-1} and speed increments of 0.5 km·h^{-1} every minute until exhaustion. The criteria for achieving VO_{2max} were respiratory exchange ratio (RER) > 1.10, an HR within 10 beats min^{-1} of the maximal level predicted by age and an rate of perceived exertion (RPE) score (CR 10 Borg scale) higher than 8 (Beato, Impellizzeri, et al. 2016).

Blood pressure, HR at rest and blood analysis

Blood pressure, HR_{rest} and blood analysis were assessed on the morning of day 1 and participants were asked to fast from midnight onwards the night before these measurements were recorded. HR_{rest} was measured using a cardio polar (Polar S610i, Polar Electro Oy, Kempele, Finland). Blood pressure was measured using a sphygmomanometer (Heine, Germany). After 10 min at rest in supine position, the average HR was recorded during the last 3 min, while the assessment of systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP = 1/3 SBP + 2/3 DBP) was carried out five times and the mean value was used for the analyses (Krustrup et al. 2013). Blood samples were obtained by veins in the participants' arms in the morning and stored in blood tubes containing K2EDTA (Terumo Europe N.V., Leuven, Belgium). The blood samples were immediately transported to the local laboratory where they were stored in controlled conditions of temperature and humidity. The analysis was performed on Advia 2120 (Siemens Healthcare Diagnostics, Tarrytown, NY, USA), which included measurement of triglycerides (TGs), fasting glucose, cholesterol LDL (LDL-C), HDL (high-density lipoprotein)-C, HDL/LDL-C ratio, total leucocyte count (WBC), total red cell count (RBC), hemoglobin concentration (HGB) and total platelet count (PLT) (Mann et al. 2014). The analysis of blood specimens was concluded within 2 h after sample collection.

Anthropometric parameters

Body fat estimation was determined using a skinfold-based method (skinfold calibre, Gima S.p.A., MI, Italy). Skinfolds were measured in seven different sites: triceps, subscapular, midaxillary, chest, suprailiac, abdomen and anterior thigh; body density was calculated using the Jackson and Pollock equation (Jackson & Pollock 1978). We also recorded body weight (BW), height by Stadiometer (Seca, Italy) and body mass index (BMI). The measures were obtained three times using the average value for the analysis.

Statistical analysis

The analysis was performed using an intention-to-treat analysis that involved all the participants as originally randomized and used the baseline values for the follow up (Ellenberg 1996). Shapiro–Wilk test was used for checking the normality (assumption). The effect of the training protocols (FG and CG) and the time of testing (Pre–Post) on the outcome measure parameters were analyzed using a two-way analysis of variance (ANOVA) for repeated measures. We evaluate the effect of training by analysis of covariance (ANCOVA) considering VO_{2max} and blood pressure baseline values as covariates. Before ANCOVA analysis, baseline values (FG and CG) were tested without finding any statistical difference (temporal additivity assumption). When significant *F*-values were found, post hoc analysis was performed (Tukey). Data were presented as mean ± SD. We also reported the mean difference with corresponding confidence interval (95% CI). The *P* values were reported to indicate the strength of the evidence. Effect size (ES) was also calculated to evaluate time and training effect, and values of 0.01, 0.06 and >0.15 were considered small, medium and large, respectively (Levine & Hullett 2002). Statistical analyses were performed by SPSS software version 20 for Windows 7, Chicago, USA.

Results

Aerobic power

A meaningful interaction time-group (ANOVA) was found for VO_{2max} and MAS after 12 training weeks, $F = 8.70$, $P = 0.007$, ES = 0.80 (large) and $F = 5.84$, $P = 0.024$, ES = 0.64 (large). VO_{2max} and MAS improved in FG respectively of 4.4% ($t = 4.31$, $P = 0.002$, mean difference 1.89, 95% CI (0.90 to 2.88) mL $O_2 \cdot kg^{-1}.min^{-1}\cdot$) and 5.95% ($t = 3.28$, $P = 0.01$, mean difference 0.7, 95% CI (0.22 to 1.18) $km \cdot h^{-1}$) at the contrary HR_{max}, RPE and *R* did not change over the period ($P > 0.05$). A meaningful interaction time-group (ANCOVA) was found for VO_{2max} and MAS taking baseline values as covariates, $F = 10.4$, $P = 0.004$ and $F = 5.8$, $P = 0.02$, respectively. CG did not record any meaningful variations ($P > 0.05$) (Table 1). No between-group interaction was found between FG and CG at baseline level for any variables, but meaningful differences were found after the treatment in VO_{2max} ($P = 0.014$) in FG (45.06 mL $O_2 \cdot kg^{-1}.min^{-1}$) compared to CG (41.05 mL $O_2 \cdot kg^{-1}.min^{-1}$).

Blood pressure

A time-group meaningful interaction (ANOVA) was found after 12 training weeks in SBP and MBP, respectively, $F = 8.71$, $P = 0.007$, ES = 0.80 (large) and $F = 7.65$, $P = 0.011$, ES = 0.75 (large) with decreased SBP and MBP of 2.5% ($t = 2.392$, $P = 0.04$, mean difference −3.18 mmHg, 95% CI (−0.17 to −6.19)) and 2.2% ($t = -2.28$, $P = 0.044$, mean difference −2.28 mmHg, 95% CI (−0.08 to −4.47)) respectively in FG, while DBP did not change during protocol period ($P = 0.09$, mean difference −1.84, 95% CI (0.48 to −4.16) mmHg). A meaningful interaction time-group (ANCOVA) was found for SBP and MBP taking baseline values as covariates, $F = 6.79$, $P = 0.017$ and $F = 7.12$, $P = 0.02$, respectively. CG did not show any meaningful variation over the protocol period (Table 1). No between-group interactions were found between FG and CG at baseline level for any variables as well as after the treatment.

Anthropometric analysis and blood analysis

In both FG and CG, we did not observe any variation in anthropometric parameters, as well as in blood variables (Table 2).

Table 1. Summary of physiological and anthropometrical data before and after 12 weeks of recreational football practice (FG, $n = 10$ and CG, $n = 14$).

	FG pre	FG post	CG pre	CG post
Age (years)	42.9 ± 4.2		45.6 ± 4.8	
Height (m)	175.1 ± 6.7		174.9 ± 7.9	
BW (kg)	82.1 ± 10.7	82.2 ± 11.2	81.8 ± 10.6	82.0 ± 10.5
Fat mass (%)	18.5 ± 3.8	18.3 ± 3.6	20.2 ± 3.4	20.7 ± 3.6
BMI	26.7 ± 2.8	26.8 ± 2.9	26.7 ± 2.6	26.8 ± 2.7
VO_{2max} (mL $O_2 \cdot kg^{-1} \cdot min^{-1}$)	43.2 ± 4.4	45.1 ± 4.6*	41.5 ± 3.1	41.1 ± 2.8
RER	1.12 ± 0.03	1.11 ± 0.02	1.12 ± 0.03	1.11 ± 0.03
MAS ($km \cdot h^{-1}$)	11.8 ± 1.3	12.5 ± 1.3*	11.5 ± 1.1	11.6 ± 1.3
HR_{max} (bpm)	178 ± 11	173 ± 12	176 ± 10	173 ± 13
RPE	8.0 ± 1.2	8.0 ± 0.8	8.1 ± 0.9	7.9 ± 0.7
SBP (mmHg)	132 ± 9	129 ± 9*	128 ± 14	130 ± 13
DBP (mmHg)	90 ± 7	88 ± 5	88 ± 9	89 ± 9
MBP (mmHg)	104 ± 7	101 ± 6*	101 ± 10	103 ± 10
HR_{rest} (bpm)	59 ± 9	57 ± 3	62 ± 6	62 ± 7

All data are presented in mean ± SDs.
* $P < 0.05$ pre compared to post.
BW: body weight; BMI: body mass index; RER: respiratory exchange ratio; HR_{max}: maximum heart rate; VO_{2max}: maximal aerobic power; MAS: maximal aerobic speed; RPE: rate of perceived exertion; SBP: systolic blood pressure; DBP: diastolic blood pressure; MBP: mean blood pressure.

Table 2. Summary of blood analysis before and after 12 weeks of recreational football practice (FG, $n = 10$ and CG, $n = 14$).

	FG pre	FG post	CG pre	CG post
Hematocrit ($L \cdot L^{-1}$)	0.46 ± 0.03	0.46 ± 0.02	0.45 ± 0.02	0.45 ± 0.02
HGB ($g \cdot L^{-1}$)	152.2 ± 11.2	151.9 ± 9.4	150.7 ± 9.1	150.3 ± 9.2
RBC (10^{12} L^{-1})	5.01 ± 0.49	5.02 ± 0.41	5.23 ± 0.43	5.12 ± 0.32
PLT (10^{9} L^{-1})	227.4 ± 56.6	220.8 ± 44.0	222.8 ± 48.4	213.3 ± 33.8
WBC (10^{9} L^{-1})	6.29 ± 1.45	6.65 ± 1.43	6.29 ± 2.8	6.27 ± 1.57
FA ($mg \cdot dL^{-1}$)	90.1 ± 13.8	86.9 ± 8.9	92.0 ± 11.3	86.9 ± 10.5
Total-C ($mg \cdot^{-1}$)	195 ± 36	183 ± 33	216 ± 34	214 ± 33
HDL-C ($mg \cdot dL^{-1}$)	56 ± 14	53 ± 12	50 ± 9	49 ± 8
LDL-C ($mg \cdot dL^{-1}$)	111 ± 31	101 ± 18	143 ± 32	144 ± 31
TG ($mg \cdot dL^{-1}$)	130.3 ± 76.1	128.2 ± 78.2	121.6 ± 40.1	115.6 ± 44.4

All data are presented in mean ± SDs.
*$P < 0.05$ pre compared to post.
TG: triglycerides; FA: fasting glucose; LDL-C: cholesterol LDL; HDL-C: cholesterol HDL; Total-C: total cholesterol; WBC: total leucocyte count; RBC: total red cell count; HGB: hemoglobin concentration; PLT: total platelet count.

Discussion

To our knowledge, this is the first study examining the effect of an 1 h recreational football session per week on cardiovascular risk factors in middle-aged men. As hypothesized, we found that 12 weeks of recreational football decreased some cardiovascular risk factors and specifically increased VO_{2max}, as well as decreased SBP and MBP. This study also supports previous findings that even a low training volume is important and enough to give some meaningful improvements on health parameters in middle-aged male participants (Lee 2007; Beato, Impellizzeri, et al. 2016). Therefore, people with limited free time for performing physical activity (the lack of time is one of the major barriers to a regular active lifestyle in general population) can play recreational football once a week to improve their health status (Reichert et al. 2007). However, these observed changes are possible with such training volume, but they are less pronounced than in previous football studies with more frequent training and a higher training volume (Bangsbo et al. 2015; Milanović et al. 2015).

In this study, we used the VO_{2max} as the main outcome given it has been demonstrated that low levels of cardiovascular fitness are associated with an increase in cardiovascular risk factor (Kodama et al. 2009). We considered ½ MET the value corresponding to the minimum meaningful improvement, which is an improvement producing a decrement of cardiovascular risk factors. Indeed, ½ MET and 1 MET of increment corresponds to 7.9% and 13% reduction in risk mortality, respectively (Blair et al. 1995; Kodama et al. 2009). According to our hypothesis, after 12 weeks of recreational football, participants improved their VO_{2max} by 4.4%, corresponding to 1.9 mL $O_2 \cdot kg^{-1} \cdot min^{-1}$; moreover, meaningful differences were found at the end of the treatment about VO_{2max} in FG compared to CG (45.06 and 41.05 mL $O_2 \cdot kg^{-1}.min^{-1}$, respectively). This result is half the improvement shown in a recent study (Krustrup et al. 2013), in which the authors found an increase of 2.8 mL $O_2 \cdot kg^{-1} \cdot min^{-1}$ (9%) after 6 months of football training performed twice per week. Assuming a dose–response relation as suggested by the study of Church et al. (2007), the difference between the current and the previous study may be justified by the different doses of physical activity (lower in the current study). Moreover, recent literature supports the general validity of recreational football as reported by Milanović et al. (2015) that showed the meta-analyzed effect (ES = 1.22, large) on VO_{2max} of recreational football in men compared to controls. Based on this meta-analysis, football is effective for improving maximal aerobic capacity and general fitness parameters after short to medium training periods, as reported in another recent revision (Milanović et al. 2015; Oja et al. 2015). These findings are aligned with the results recorded in this study that show a medium (ES = 0.80, large) training effect on VO_{2max} after 12 weeks of training (Bangsbo et al. 2015; Milanović et al. 2015; Oja et al. 2015).

SBP and MBP decreased after the training period which confirms the positive effects a low volume of recreational football can have on blood pressure (ES = 0.8 and 0.75, large respectively). Krustrup et al. (2013) suggested that football can be used as a nonpharmacological treatment of hypertension in middle-aged men and that this activity may be even better than the pharmacological approach. This study reported an improvement of 13 and 8 mmHg in SBP and DBP, respectively (Krustrup et al. 2013). These values are much higher for hypertensive men. Nevertheless, the improvements found in the current study are comparable to the 3 and 2 mmHg reported in normotensive male population after 12 weeks of endurance training (Fagard 2001). The population enrolled in this study is healthy, thus generally normotensive. It needs to be considered that our sample was influenced by the exclusion, during medical screening, of four participants of the 28 initially considered during the enrollment process (Figure 1). The small reduction of blood pressure reported in our study can be explained by the inclusion of normotensive participants, and this is supported by Bangsbo et al. (2015), who reported that blood pressure was not reduced in some previous studies due to the inclusion on healthy participants. Moreover, a dose–response effect may be associated with blood pressure reduction. This study utilized a protocol of 1 h per week that probably has a smaller effect than previous studies proposing 2 or 3 h per week (Krustrup, Aagaard, et al. 2010; Bangsbo et al. 2014).

There were no substantial and significant changes in both blood and anthropometrical parameters (Tables 1 and 2). A dose–response relationship does exist between the amount of exercise and fitness (Lee 2007). Thus, to find greater improvements, it may be necessary to administrate a heavier recreational football dose such as two or three training sessions per week as reported in previous studies (Bangsbo et al. 2014, 2015; Beato, Impellizzeri, et al. 2016). The reason that we did not find any improvement in blood analysis could be explained by the low training volume proposed and by the blood clinically normal baseline levels (Fagard 2001; Bangsbo et al. 2014). Furthermore, other previous studies, involving 2–3 training sessions per week, did not found meaningful variations after the protocol period in untrained male (age range 31–54 years) (Andersen et al. 2010; Krustrup et al. 2013). Generally, it is reported an improvement on LDL-C and total-C after a period of recreational football training, while many other studies have not found meaningful effects (Bangsbo et al. 2015). In this study, we found no statistical trend in both total-C (from 195 ± 36 to 183 ± 33 $mg \cdot dL^{-1}$) and LDL-C (from 111 ± 31 to 101 ± 18 $mg \cdot dL^{-1}$). It is important to underline that blood and anthropometric parameters are closely associated with nutrition strategies (Torger et al. 2012; Mann et al. 2014). It is well documented that exercise without dietary intervention has a small capacity to reduce weight and fat percentage, as well as a small effectiveness on blood parameters (Church et al. 2007).

This study has some limitations. The first limitation is associated to the lack of nutritional and physical activity control in both FG and CG. Participants were asked to continue their usual diet and to avoid starting any other physical activity programs, but we did not monitor their nutritional intake and we could not monitor the activity completed outside the training sessions. This might have affected the training effect on blood and anthropometric parameters. The findings of this study cannot necessarily be extended to other specific populations. Therefore, future studies should examine the effects of low volume recreational football on middle-aged women and younger or older individuals. Moreover, real dose–response concurrently comparing the effects of different doses of exercise (e.g., none, one and two sessions per week) is necessary. This study is the first that compares football training volume (1 h a week) versus control. Future studies could compare the effect of such training versus running-based methods on cardiovascular risk factors. Previous studies reported that football training was able to improve VO_{2max} better than running training (13% and 8%, respectively) as well as for other physiological parameters associated with health (e.g., SBP, DBP, etc.) (Krustrup et al. 2009; Krustrup, Aagaard, et al. 2010). Finally, future studies should also examine the risk/benefit ratio of recreational football especially considering we had two injuries during the 12-week intervention. Currently, little knowledge is available regarding the relationship between recreational sports and injuries. Taking into account the high intensity of football and its characteristics (invasion sport), it is possible to suppose a higher injury risk compared to jogging and running-based activities (Krustrup, Dvorak, et al. 2010).

Recreational football, other than being an effective exercise strategy to enhance aerobic fitness and reduce cardiovascular risk factors, can improve interpersonal relationships and social skills in people. Furthermore, it can promote empathy through smaller groups allowing face-to-face communication (Krustrup et al. 2009; Ottesen et al. 2010). This is a crucial factor to improve adherence of health programs (Krustrup, Aagaard, et al. 2010). Treatment adherence may influence the therapeutic effect that is observed in an RCT. In this study, adherence was recording a value of 83%, in agreement to what was previously reported in the literature (88.4%; range: 48–100%) (Zhang et al. 2014). After the study, participants continued the football training activity and this seems to emphasize the capacity of recreational football in improving interpersonal relationships and adherence to health programs (Bangsbo et al. 2014). While previous studies have shown that substantial benefits can be obtained by performing recreational football 2–3 times per week, the current investigation has shown that also low volume of football practice as low as 1 h per week can produce health benefits such as improved VO_{2max} and blood pressure in middle-aged men. This is in agreement with previous studies revealing the positive effects of physical activity performed at half the recommend ACSM quantity (Lee 2007). This study may have important implications for designing physical activity-based health programs.

Practical implications

Recreational football is an effective training modality to stimulate and improve cardiovascular fitness in healthy middle-aged men. This study shows the effect of 1 h recreational football session per week and suggests that a lower training volume than recommended by ACSM guidelines can give meaningful benefits. This study suggests that people with limited free time available for participating in training programs (common barrier to physical activity) can practice recreational football 1 h per week and still have some health benefits. However, these observed changes are less pronounced than in previous football studies with more frequent training and a higher training volume.

Disclosure statement

No potential conflict of interest was reported by the authors.

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