Effects of recreational football performed once a week on cardiovascular risk factors in middle-aged men.

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Objectives: It is well established that there is a strong relationship between physical activity, cardiovascular diseases and mortality. International guidelines recommend at least 150 minutes per week of moderate intensity aerobic training in order to achieve health benefits. Considering a lack of time is the major barrier to an active life style, the same benefits could possibly be achieved also with lower amount of the recommended training volume. 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 analysed the effect of one recreational football match per week on middle-aged men.

Design: randomised controlled trial.

Methods: 24 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 (5-a-side futsal match) on 36 x 18.5 meters 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% (p=0.002) and 5.9% (p=0.01). Systolic and mean blood pressure improved respectively of 2.5% (p=0.04) and 2.2% (p=0.04) in FG, while diastolic blood pressure did not change (p=0.09). CG did not show changes over the training period.

Conclusions: Recreational football activity produces health benefits by improving VO_{2max} and lowering blood pressure parameters in middle-aged men. This study may have important implications for designing physical activity-based health programs.

Keywords: soccer, futsal, cardiovascular diseases, health, prevention, sedentary.

Introduction

Based on the World Health Organization (WHO) 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 minutes 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, Blissmer, Deschenes, Franklin, & Lamonte, 2011). The lack of time is the major barrier to a regular active life style in general population (Reichert, Barros, Domingues, & Hallal, 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, Jeppesen, & Krustrup, 2010). At recreational level it is known that people usually practice football only once or twice per week for approximately one hour per session, which also corresponds to the time that the pitch is rented. 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, futsal (five-a-side football) 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).

Various studies have reported that football is an effective physical activity for inducing cardiovascular benefits (Krustrup et al., 2010; Krustrup et al., 2013). Previous researchers (Krustrup et al., 2009) found that regular football training (when performed 2 or 3 times a week) induces lowering blood pressure, as well as heart rate at rest, fat percentage, LDL cholesterol, and increases lean body mass as well as maximal aerobic power (VO_{2max}) (Milanović, Pantelić, Čović, Sporiš, & Krustrup, 2015; Oja et al., 2015). Total EE is one of the most important components of an exercise programme 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% (1268kcal) and 150% (1902 kcal) EE, respectively, as suggested in international guidelines (Beato, Impellizzeri, Coratella, & Schena, 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 practitioners). 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 a 1-hour 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 subjects were initially considered during enrolment process, but four were excluded during medical screening. 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 FG dropped out due to injuries to their hamstring and achilles tendon respectively, and two participants of CG dropped out for job-related reasons (e.g. lack of time). 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.

Enrolment

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 (Lee, Macfarlane, Lam, & Stewart, 2011; Shephard, 1988). No-active life style was defined as a lack of regular activity in the last year, up to 3 times per week at moderate intensity (< 20 min per session) (Krustrup et al., 2009). Subjects were categorised 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 a randomised controlled trial design. The randomization was performed according to a computer-generated sequence. The participants were randomised in a Football Group (FG = 10 participants) and a Control Group (CG = 14 participants) in order to obtain the correct number of subjects for recreational football matches. 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. In this study, VO_{2max} was considered the main outcome because it has been shown to be an independent and strong predictor of cardiovascular risk factors (Kodama et al., 2009; Lakka et al., 2003). ½ MET 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 x 18.5 meters). The training lasted 12 weeks (60 minutes 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 minutes of matches. Five players on the same team, in turn, acted as goalkeeper (changes from goalkeeper to players every 5 minutes). Researchers asked both FG and CG to maintain their normal life-style and nutrition behaviours throughout the duration of the protocol.

Testing procedures

The first day, after the medical screening, subjects completed a maximal oxygen uptake familiarization (submaximal) test on a treadmill. On the second day, anthropometrical measurements, blood pressure and heart rate (HR) at rest and blood sampling were completed. The third day consisted of participants completing the maximal incremental test on the treadmill. Subjects were asked to avoid any heavy physical activity on the day prior to testing and to refrain from caffeine 8 hours before testing. After 12 weeks of training, all subjects were re-tested with the same protocol.

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. An automated metabolic cart was used to measure respiratory parameters breath-by-breath (Quark b2, Cosmed, Italy). The running protocol consisted of three minutes at 9 $Km \cdot h^{-1}$ and speed increments of 0.5 $Km \cdot h^{-1}$ every minute until exhaustion. The criteria for achieving VO_{2max} were respiratory exchange ratio (RER) > 1.10, a HR within 10 beats min-1 of the maximal level predicted by age and an RPE score (CR 10 Borg scale) higher than 8 (Beato et al., 2016).

Blood pressure, heart rate at rest and blood analysis

Blood pressure, HRrest 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. HRrest was measured using a cardio polar (Polar S610i, Polar Electro Oy, Kempele, Finland). Blood pressure was measured using a sphygmomanometer (Heine, Germany). After 10 minutes at rest in supine position, the average HR was recorded during the last 3 minutes, while the assessment of systolic (SBP), diastolic (DBP) and mean blood pressure (MBP = 1/3 SBP + 2/3 DBP), was carried out 5 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 (TG), fasting glucose, cholesterol LDL (LDL-C), HDL-C, HDL/LDL-C ratio, total leucocyte count (WBC), total red cell count (RBC), haemoglobin concentration (HGB) and total platelet count (PLT) (Mann, Beedie, &

Jimenez, 2014). The analysis of blood specimens was concluded within 2 hours 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 BMI. The measures were obtained three times using the average value for the analysis.

Statistical analysis

The analysis was performed using an intentional to treat approach that is involving all the subjects as originally randomized and using the baseline values for the follow up. 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 analysed using a two-way analysis of variance (ANOVA) for repeated measures. When significant F-values were found, paired t-tests were applied. Data were presented as mean ± SD. We also reported the mean difference with corresponding confidence interval (CI95%). 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 above 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 were found for VO_{2max} and MAS after 12 training, F = 8.70, p = 0.007, ES = 0.80 and F = 5.84, p = 0.024, ES = 0.64. VO_{2max} and MAS improved in FG respectively of 4.4% (t = 4.31, p = 0.002, mean difference 1.89, CI95% (0.90 to 2.88)) and 5.95% (t = 3.28, p = 0.01, mean difference 0.7, CI95% (0.22 to 1.18)) at the contrary HR_{max}, RPE and R did not change over the period (p>0.05). CG did not record any meaningful variations (p>0.05).

Blood pressure: a time-group meaningful interaction were found after 12 training weeks in SBP and MBP, respectively F = 8.71, p =0.007, ES = 0.80 and F = 7.65, p = 0.011, ES = 0.75 with improved SBP and MBP of 2.5% (t = 2.392, p = 0.04, mean difference -3.18, CI95% (-0.17 to -6.19)) and 2.2% (t = -2.28, p = 0.044, mean difference -2.28, CI95% (-0.08 to -4.47)) respectively in FG, while DBP did not change during protocol period (p = 0.09, mean difference -1.84, CI95% (0.48 to -4.16)). CG did not show any meaningful variation over the protocol period.

Anthropometric analysis and blood analysis: in both FG and CG we did not observe any variation in anthropometric parameters, as well as in blood analyses (Table 2).

Discussion

To our knowledge this is the first study examining the effect of a 1-hour 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 VO_{2max}, 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 subjects (Beato et al., 2016; Lee, 2007). Therefore, people with limited free time for performing physical activity (the lack of time is one of the major barriers to a regular active life style in general population) can play recreational football once a week to improve their health status (Reichert et al., 2007).

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, that 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 mlO_2 Kg^{-1} min^{-1}. 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 mlO_2 Kg^{-1} 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 (Church, Earnest, Skinner, & Blair, 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 Milanovic (Milanović et al., 2015) that showed the meta-analysed effect (ES = 1.22) 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 an other 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) training effect on VO_{2max} after 12 weeks of training (Bangsbo, Hansen, Dvorak, & Krustrup, 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. Krustrup (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 subjects of the twenty-eight initially considered during the enrolment process. 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 (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 utilised a protocol of 1-hour per week that probably has a smaller effect than previous studies proposing 2 or 3-hours per week (Bangsbo, Junge, Dvorak, & Krustrup, 2014; Krustrup et al., 2010).

There were no substantial and significant changes in both blood and anthropometrical parameters (Table 1 and Table 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 2 or 3 training session per week as reported in previous studies (Bangsbo et al., 2014; Bangsbo et al., 2015; Beato 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 (Bangsbo et al., 2014; Fagard, 2001). 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 dL^{-1}) and LDL-C (from 111 ± 31 to 101 ± 18 mg dL^{-1}). It is important to underline that blood and anthropometric parameters are closely associated with nutrition strategies (Mann et al., 2014; Torger et al., 2012). There 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. Finally, future studies should also examine the risk/benefit ratio of recreational football especially considering we had two injuries during the 12 weeks intervention.

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, Dvorak, Junge, & Bangsbo, 2010). After the study, participants continued the football-training activity and this seems to emphasise 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 two to three times per week, the current investigation has shown that also low volume of football practice as low as 1-hour 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-hour 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 practise recreational football 1-hour per week and still have some health benefits.

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Table 1. Summary of physiological and anthropometrical data before and after 12 weeks of recreational football practice (FG, n = 10 and CG, n = 14). All data are presented in mean ± SDs.

	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} ($mLO_2\ min^{-1}\ Kg^{-1}$)	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 ($Km\ h^{-1}$)	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 (mm Hg)	132 ± 9	129 ± 9*	128 ± 14	130 ± 13
DBP (mm Hg)	90 ± 7	88 ± 5	88 ± 9	89 ± 9
MBP (mm Hg)	104 ± 7	101 ± 6*	101 ± 10	103 ± 10
HRrest (bpm)	59 ± 9	57 ± 3	62 ± 6	62 ± 7

* = $p < 0.05$ 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). All data are presented in mean ± SDs.

	FG pre	FG post	CG pre	CG post
Haematocrit (L L^{-1})	0.46 ± 0.03	0.46 ± 0.02	0.45 ± 0.02	0.45 ± 0.02
HGB (g L^{-1})	152.2 ± 11.2	151.9 ± 9.47	150.7 ± 9.1	150.3 ± 9.25
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 dL^{-1})	90.1 ± 13.8	86.9 ± 8.9	92.0 ± 11.3	86.9 ± 10.5
Total-C (mg dL^{-1})	195 ± 36	183 ± 33	216 ± 34	214 ± 33
HDL-C (mg dL^{-1})	56 ± 14	53 ± 12	50 ± 9	49 ± 8
LDL-C (mg dL^{-1})	111 ± 31	101 ± 18	143 ± 32	144 ± 31
TG (mg dL^{-1})	130.3 ± 76	128.2 ± 78	121.6 ± 40	115.6 ± 44

* = $p < 0.05$ 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 = haemoglobin concentration and PLT = total platelet count.