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

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3 26 *Objectives:* It is well established that there is a strong relationship between physical activity,  
4  
5 27 cardiovascular diseases and mortality. International guidelines recommend at least 150  
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7 28 minutes per week of moderate intensity aerobic training in order to achieve health benefits.  
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10 29 Considering a lack of time is the major barrier to an active life style, the same benefits could  
11  
12 30 possibly be achieved also with lower amount of the recommended training volume. Regular  
13  
14 31 recreational football training can lower blood pressure, heart rate at rest, fat percentage, LDL  
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16 32 cholesterol and increase maximal aerobic power ( $VO_{2max}$ ). This study analysed the effect of  
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18 33 one recreational football match per week on middle-aged men.

20 34 *Design:* randomised controlled trial.

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23 35 *Methods:* 24 participants (mean  $\pm$  SDs; age  $44.5 \pm 4.7$  years, weight  $81.9 \pm 10.4$  kg, height  
24  
25 36  $175.0 \pm 7.3$  cm) were randomized in a Football Group (FG=10) and Control Group (CG=14).  
26  
27 37 FG performed supervised recreational football training (5-a-side futsal match) on 36 x 18.5  
28  
29 38 meters synthetic indoor and outdoor field, 60 min per week over 12 weeks.

31  
32 39 *Results:* After training,  $VO_{2max}$  and maximal aerobic speed improved in FG respectively of  
33  
34 40 4.4% ( $p=0.002$ ) and 5.9% ( $p=0.01$ ). Systolic and mean blood pressure improved respectively  
35  
36 41 of 2.5% ( $p=0.04$ ) and 2.2% ( $p=0.04$ ) in FG, while diastolic blood pressure did not change  
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38 42 ( $p=0.09$ ). CG did not show changes over the training period.

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41 43 *Conclusions:* Recreational football activity produces health benefits by improving  $VO_{2max}$  and  
42  
43 44 lowering blood pressure parameters in middle-aged men. This study may have important  
44  
45 45 implications for designing physical activity-based health programs.

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49 47 **Keywords:** soccer, futsal, cardiovascular diseases, health, prevention, sedentary.

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## 49 Introduction

50 Based on the World Health Organization (WHO) sedentary lifestyle causes about 1.9  
51 million deaths per year worldwide (Hamer & Chida, 2008). It is well established that there is  
52 a strong relationship among physical activity, cardiovascular diseases and mortality (Barlow  
53 et al., 2012). For this reason the American College of Sport Medicine (ACSM) has  
54 recommended that adults aged 18-65 years should engage at least 150 minutes of moderate  
55 intensity (between 55 and 65% of an individual maximal heart rate  $HR_{max}$ ), physical activity  
56 per week to improve their health status (Garber, Blissmer, Deschenes, Franklin, & Lamonte,  
57 2011). The lack of time is the major barrier to a regular active life style in general population  
58 (Reichert, Barros, Domingues, & Hallal, 2007). Nevertheless, sedentary people could also get  
59 some health benefits with a lower amount of training volume than recommended by the  
60 international guidelines (Lee, 2007). It is widely accepted that a dose response relationship  
61 exists between training volume and positive health adaptations (Lee, 2007), but scarce  
62 literature is available about the necessary minimal amount of it, especially for activities like  
63 football or game sport in general (Garber et al., 2011).

64 Football is a very popular sport in western nations (Krustrup et al., 2009), and its  
65 popularity may be used for increasing the intrinsic motivation and hence the adherence to  
66 physical activity (Ottesen, Jeppesen, & Krustrup, 2010). At recreational level it is known that  
67 people usually practice football only once or twice per week for approximately one hour per  
68 session, which also corresponds to the time that the pitch is rented. Furthermore, recreational  
69 players commonly reduce the size of the pitch and the number of players since it is easier to  
70 arrange smaller groups for friendly matches. Therefore, futsal (five-a-side football) is the  
71 most common form of recreational football and may be a valid alternative to continuous  
72 running exercise in order to improve cardiovascular fitness (Castagna et al., 2007).

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3 73 Various studies have reported that football is an effective physical activity for  
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5 74 inducing cardiovascular benefits (Krustrup et al., 2010; Krustrup et al., 2013). Previous  
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7 75 researchers (Krustrup et al., 2009) found that regular football training (when performed 2 or 3  
8  
9 76 times a week) induces lowering blood pressure, as well as heart rate at rest, fat percentage,  
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11 77 LDL cholesterol, and increases lean body mass as well as maximal aerobic power ( $VO_{2max}$ )  
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13 78 (Milanović, Pantelić, Čović, Sporiš, & Krustrup, 2015; Oja et al., 2015). Total EE is one of  
14  
15 79 the most important components of an exercise programme for health promotion (Ainsworth et  
16  
17 80 al., 2011). Recent evidence has reported that one, two and three sessions per week are almost  
18  
19 81 equivalent to 50% (634 kcal), 100% (1268kcal) and 150% (1902 kcal) EE, respectively, as  
20  
21 82 suggested in international guidelines (Beato, Impellizzeri, Coratella, & Schena, 2016).  
22  
23 83 Despite the popularity and wide appeal of this sport, no one has investigated the effect of one  
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25 84 session per week on middle-aged male players (the most common practitioners). This study  
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27 85 gives practical information to the development of preventive health programs using a small  
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29 86 dose of football training.  
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34 87 The aim of this study is therefore to assess the effect of a 1-hour recreational football  
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36 88 session per week, hypothesizing that this volume, after 12 weeks, will give meaningful  
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38 89 positive changes on cardiovascular risk factors in healthy individuals.  
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## 43 91 **Methods**

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45 92 Twenty-eight sedentary subjects were initially considered during enrolment process,  
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47 93 but four were excluded during medical screening. Twenty-four healthy male participants  
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49 94 without specific pathologies (assessed by medical screening) were enrolled in this study  
50  
51 95 (mean  $\pm$  SDs; age  $44.5 \pm 4.7$  years, weight  $81.9 \pm 10.4$  kg, height  $175.0 \pm 7.3$  cm). All  
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53 96 participants were informed about the potential risks of the study and signed an informed  
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55 97 consent. Twenty participants completed the study, while two participants of FG dropped out  
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3 98 due to injuries to their hamstring and achilles tendon respectively, and two participants of CG  
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5 99 dropped out for job-related reasons (e.g. lack of time). All procedures were approved by the  
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7 100 Ethics Committee of the Department of Neurological and Movement Sciences, University of  
8  
9 101 Verona (Italy) and conducted according to the declaration of Helsinki for human studies of  
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11 102 the World Medical Association.  
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103

104 *Enrolment*

105 Potential participants were recruited through the main communication channels  
106 available at the university such as newspapers, television, web ads and flyers. Participants  
107 completed the Physical Activity Readiness Questionnaires and the International Physical  
108 Activity Questionnaire to assess their level of compatibility with the training program and to  
109 ensure the absence of regular physical exercise in the last period (Lee, Macfarlane, Lam, &  
110 Stewart, 2011; Shephard, 1988). No-active life style was defined as a lack of regular activity  
111 in the last year, up to 3 times per week at moderate intensity (< 20 min per session) (Krustrup  
112 et al., 2009). Subjects were categorised into risk categories based on ACSM guidelines  
113 (Thompson & ACSM, 2009) and we included only those belonging to the low and medium  
114 risk categories. No economic incentives were provided.  
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115

116 *Study design*

117 In this study we used a randomised controlled trial design. The randomization was  
118 performed according to a computer-generated sequence. The participants were randomised in  
119 a Football Group (FG = 10 participants) and a Control Group (CG = 14 participants) in order  
120 to obtain the correct number of subjects for recreational football matches. The FG performed  
121 recreational football training once per week over 12 weeks. The CG did not perform any  
122 training during the experimental period (Krustrup et al., 2013). Outcome measures were

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3 123 assessed before and after the experimental period. In this study,  $VO_{2max}$  was considered the  
4  
5 124 main outcome because it has been shown to be an independent and strong predictor of  
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7 125 cardiovascular risk factors (Kodama et al., 2009; Lakka et al., 2003).  $\frac{1}{2}$  MET of improvement  
8  
9 126 corresponds to a decrement of 7.9% of mortality risk reduction (Blair et al., 1995; Kodama et  
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11 127 al., 2009).

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### 15 16 129 *Interventions*

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18 130 Participants completed recreational futsal matches on a synthetic indoor or outdoor  
19  
20 131 field (36 x 18.5 meters). The training lasted 12 weeks (60 minutes per session) with all the  
21  
22 132 matches played in the evening (at 8.00 p.m.). Before recreational matches, participants  
23  
24 133 completed a standardized 5-min warm-up followed by 55 minutes of matches. Five players on  
25  
26 134 the same team, in turn, acted as goalkeeper (changes from goalkeeper to players every 5  
27  
28 135 minutes). Researchers asked both FG and CG to maintain their normal life-style and nutrition  
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30 136 behaviours throughout the duration of the protocol.

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### 35 36 138 *Testing procedures*

37  
38 139 The first day, after the medical screening, subjects completed a maximal oxygen  
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40 140 uptake familiarization (submaximal) test on a treadmill. On the second day, anthropometrical  
41  
42 141 measurements, blood pressure and heart rate (HR) at rest and blood sampling were completed.  
43  
44 142 The third day consisted of participants completing the maximal incremental test on the  
45  
46 143 treadmill. Subjects were asked to avoid any heavy physical activity on the day prior to testing  
47  
48 144 and to refrain from caffeine 8 hours before testing. After 12 weeks of training, all subjects  
49  
50 145 were re-tested with the same protocol.

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### 55 56 147 *Maximal aerobic power*

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3 148 A maximal running incremental test was used to determine  $VO_{2max}$  (primary outcome),  
4  
5 149 maximal aerobic speed (MAS),  $HR_{max}$  and HR- $VO_2$  relation. An automated metabolic cart  
6  
7 150 was used to measure respiratory parameters breath-by-breath (Quark b2, Cosmed, Italy). The  
8  
9 151 running protocol consisted of three minutes at  $9 \text{ Km}\cdot\text{h}^{-1}$  and speed increments of  $0.5 \text{ Km}\cdot\text{h}^{-1}$   
10  
11 152 every minute until exhaustion. The criteria for achieving  $VO_{2max}$  were respiratory exchange  
12  
13 153 ratio (RER)  $> 1.10$ , a HR within 10 beats  $\text{min}^{-1}$  of the maximal level predicted by age and an  
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15 154 RPE score (CR 10 Borg scale) higher than 8 (Beato et al., 2016).  
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21 156 *Blood pressure, heart rate at rest and blood analysis*  
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23 157 Blood pressure,  $HR_{rest}$  and blood analysis were assessed on the morning of day 1 and  
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25 158 participants were asked to fast from midnight onwards the night before these measurements  
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27 159 were recorded.  $HR_{rest}$  was measured using a cardio polar (Polar S610i, Polar Electro Oy,  
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29 160 Kempele, Finland). Blood pressure was measured using a sphygmomanometer (Heine,  
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31 161 Germany). After 10 minutes at rest in supine position, the average HR was recorded during  
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33 162 the last 3 minutes, while the assessment of systolic (SBP), diastolic (DBP) and mean blood  
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35 163 pressure ( $MBP = 1/3 \text{ SBP} + 2/3 \text{ DBP}$ ), was carried out 5 times and the mean value was used  
36  
37 164 for the analyses (Krustrup et al., 2013). Blood samples were obtained by veins in the  
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39 165 participants' arms in the morning, and stored in blood tubes containing K2EDTA (Terumo  
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41 166 Europe N.V., Leuven, Belgium). The blood samples were immediately transported to the  
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43 167 local laboratory where they were stored in controlled conditions of temperature and humidity.  
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45 168 The analysis was performed on Advia 2120 (Siemens Healthcare Diagnostics, Tarrytown NY,  
46  
47 169 USA), which included measurement of triglycerides (TG), fasting glucose, cholesterol LDL  
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49 170 (LDL-C), HDL-C, HDL/LDL-C ratio, total leucocyte count (WBC), total red cell count  
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51 171 (RBC), haemoglobin concentration (HGB) and total platelet count (PLT) (Mann, Beedie, &  
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3 172 Jimenez, 2014). The analysis of blood specimens was concluded within 2 hours after sample  
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5 173 collection.

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9 175 *Anthropometric parameters*

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11 176 Body fat estimation was determined using a skinfold-based method (skinfold calibre,  
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13 177 Gima S.p.A., MI, Italy). Skinfolds were measured in seven different sites: triceps,  
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15 178 subscapular, midaxillary, chest, suprailiac, abdomen, and anterior thigh; body density was  
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17 179 calculated using the Jackson and Pollock equation (Jackson & Pollock, 1978). We also  
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19 180 recorded body weight (BW), height by Stadiometer (Seca, Italy) and BMI. The measures were  
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21 181 obtained three times using the average value for the analysis.  
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25 183 *Statistical analysis*

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27 184 The analysis was performed using an intentional to treat approach that is involving all  
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29 185 the subjects as originally randomized and using the baseline values for the follow up. Shapiro-  
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31 186 Wilk test was used for checking the normality (assumption). The effect of the training  
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33 187 protocols (FG and CG) and the time of testing (Pre - Post) on the outcome measure  
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35 188 parameters were analysed using a two-way analysis of variance (ANOVA) for repeated  
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37 189 measures. When significant F-values were found, paired t-tests were applied. Data were  
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39 190 presented as mean  $\pm$  SD. We also reported the mean difference with corresponding  
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41 191 confidence interval (CI95%). The p values were reported to indicate the strength of the  
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43 192 evidence. Effect size (ES) was also calculated to evaluate time and training effect, and values  
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45 193 of 0.01, 0.06, and above 0.15 were considered small, medium, and large, respectively (Levine  
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47 194 & Hullett, 2002). Statistical analyses were performed by SPSS software version 20 for  
48  
49 195 Windows 7, Chicago, USA.  
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51 196



## 197 Results

198 Aerobic power: a meaningful interaction time-group were found for  $VO_{2max}$  and MAS  
199 after 12 training,  $F = 8.70$ ,  $p = 0.007$ ,  $ES = 0.80$  and  $F = 5.84$ ,  $p = 0.024$ ,  $ES = 0.64$ .  $VO_{2max}$   
200 and MAS improved in FG respectively of 4.4% ( $t = 4.31$ ,  $p = 0.002$ , mean difference 1.89,  
201 CI95% (0.90 to 2.88)) and 5.95% ( $t = 3.28$ ,  $p = 0.01$ , mean difference 0.7, CI95% (0.22 to  
202 1.18)) at the contrary  $HR_{max}$ , RPE and R did not change over the period ( $p > 0.05$ ). CG did not  
203 record any meaningful variations ( $p > 0.05$ ).

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

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

## 214 Discussion

215 To our knowledge this is the first study examining the effect of a 1-hour recreational  
216 football session per week on cardiovascular risk factors in middle-aged men. As hypothesized  
217 we found that 12 weeks of recreational football decreased some cardiovascular risk factors  
218 and specifically  $VO_{2max}$ , SBP and MBP. This study also supports previous findings that even  
219 a low training volume is important and enough to give some meaningful improvements on  
220 health parameters in middle-aged male subjects (Beato et al., 2016; Lee, 2007). Therefore,  
221 people with limited free time for performing physical activity (the lack of time is one of the

222 major barriers to a regular active life style in general population) can play recreational  
223 football once a week to improve their health status (Reichert et al., 2007).

224 In this study we used the  $VO_{2max}$  as the main outcome given it has been demonstrated  
225 that low levels of cardiovascular fitness are associated with an increase in cardiovascular risk  
226 factor (Kodama et al., 2009). We considered  $\frac{1}{2}$  MET the value corresponding to the minimum  
227 meaningful improvement, that is an improvement producing a decrement of cardiovascular  
228 risk factors. Indeed,  $\frac{1}{2}$  MET and 1 MET of increment corresponds to 7.9% and 13%  
229 reduction in risk mortality, respectively (Blair et al., 1995; Kodama et al., 2009). According  
230 to our hypothesis, after 12 weeks of recreational football, participants improved their  $VO_{2max}$   
231 by 4.4%, corresponding to  $1.9 \text{ mlO}_2 \text{ Kg}^{-1} \text{ min}^{-1}$ . This result is half the improvement shown in  
232 a recent study (Krustrup et al., 2013), in which the authors found an increase of  $2.8 \text{ mlO}_2 \text{ Kg}^{-1}$   
233  $\text{min}^{-1}$  (9%) after 6 months of football training performed twice per week. Assuming a dose-  
234 response relation as suggested by the study of Church (Church, Earnest, Skinner, & Blair,  
235 2007), the difference between the current and the previous study may be justified by the  
236 different doses of physical activity (lower in the current study). Moreover, recent literature  
237 supports the general validity of recreational football as reported by Milanovic (Milanović et  
238 al., 2015) that showed the meta-analysed effect ( $ES = 1.22$ ) on  $VO_{2max}$  of recreational football  
239 in men compared to controls. Based on this meta-analysis, football is effective for improving  
240 maximal aerobic capacity and general fitness parameters after short to medium training  
241 periods, as reported in an other recent revision (Milanović et al., 2015; Oja et al., 2015).  
242 These findings are aligned with the results recorded in this study that show a medium ( $ES =$   
243  $0.80$ ) training effect on  $VO_{2max}$  after 12 weeks of training (Bangsbo, Hansen, Dvorak, &  
244 Krustrup, 2015; Milanović et al., 2015; Oja et al., 2015).

245 SBP and MBP decreased after the training period which confirms the positive effects  
246 a low volume of recreational football can have on blood pressure. Krustrup (Krustrup et al.,

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2  
3 247 2013) suggested that football can be used as a nonpharmacological treatment of hypertension  
4  
5 248 in middle-aged men and that this activity may be even better than the pharmacological  
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7 249 approach. This study reported an improvement of 13 and 8 mmHg in SBP and DBP,  
8  
9 250 respectively (Krustrup et al., 2013). These values are much higher for hypertensive men.  
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11 251 Nevertheless, the improvements found in the current study are comparable to the 3 and 2  
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13 252 mmHg reported in normotensive male population after 12 weeks of endurance training  
14  
15 253 (Fagard, 2001). The population enrolled in this study is healthy, thus generally normotensive.  
16  
17 254 It needs to be considered that our sample was influenced by the exclusion, during medical  
18  
19 255 screening, of four subjects of the twenty-eight initially considered during the enrolment  
20  
21 256 process. The small reduction of blood pressure reported in our study can be explained by the  
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23 257 inclusion of normotensive participants, and this is supported by Bangsbo (Bangsbo et al.,  
24  
25 258 2015) who reported that blood pressure was not reduced in some previous studies due to the  
26  
27 259 inclusion on healthy participants. Moreover, a dose-response effect may be associated with  
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29 260 blood pressure reduction. This study utilised a protocol of 1-hour per week that probably has  
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31 261 a smaller effect than previous studies proposing 2 or 3-hours per week (Bangsbo, Junge,  
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33 262 Dvorak, & Krustrup, 2014; Krustrup et al., 2010).

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38 263 There were no substantial and significant changes in both blood and anthropometrical  
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40 264 parameters (Table 1 and Table 2). A dose-response relationship does exist between the  
41  
42 265 amount of exercise and fitness (Lee, 2007). Thus, to find greater improvements, it may be  
43  
44 266 necessary to administrate a heavier recreational football dose such as 2 or 3 training session  
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46 267 per week as reported in previous studies (Bangsbo et al., 2014; Bangsbo et al., 2015; Beato et  
47  
48 268 al., 2016). The reason that we did not find any improvement in blood analysis could be  
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50 269 explained by the low training volume proposed and by the blood clinically normal baseline  
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52 270 levels (Bangsbo et al., 2014; Fagard, 2001). Furthermore, other previous studies, involving 2-  
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54 271 3 training sessions per week, did not found meaningful variations after the protocol period in  
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3 272 untrained male (age range 31-54 years) (Andersen et al., 2010; Krstrup et al., 2013).  
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5 273 Generally, it is reported an improvement on LDL-C and Total-C after a period of recreational  
6  
7 274 football training, while many other studies have not found meaningful effects (Bangsbo et al.,  
8  
9 275 2015). In this study we found no statistical trend in both Total-C (from  $195 \pm 36$  to  $183 \pm 33$   
10  
11 276  $\text{mg dL}^{-1}$ ) and LDL-C (from  $111 \pm 31$  to  $101 \pm 18 \text{ mg dL}^{-1}$ ). It is important to underline that  
12  
13 277 blood and anthropometric parameters are closely associated with nutrition strategies (Mann et  
14  
15 278 al., 2014; Torger et al., 2012). There is well-documented that exercise without dietary  
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17 279 intervention has a small capacity to reduce weight and fat percentage, as well as a small  
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19 280 effectiveness on blood parameters (Church et al., 2007).

22  
23 281 This study has some limitations. The first limitation is associated to the lack of  
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25 282 nutritional and physical activity control in both FG and CG. Participants were asked to  
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27 283 continue their usual diet and to avoid starting any other physical activity programs, but we did  
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29 284 not monitor their nutritional intake and we could not monitor the activity completed outside  
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31 285 the training sessions. This might have affected the training effect on blood and anthropometric  
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33 286 parameters. The findings of this study cannot necessarily be extended to other specific  
34  
35 287 populations. Therefore, future studies should examine the effects of low volume recreational  
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37 288 football on middle-aged women and younger or older individuals. Moreover, real dose-  
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39 289 response concurrently comparing the effects of different doses of exercise (e.g. none, one and  
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41 290 two sessions per week) is necessary. Finally, future studies should also examine the  
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43 291 risk/benefit ratio of recreational football especially considering we had two injuries during the  
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45 292 12 weeks intervention.

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49 293 Recreational football, other than being an effective exercise strategy to enhance  
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51 294 aerobic fitness and reduce cardiovascular risk factors, can improve interpersonal relationships  
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53 295 and social skills in people. Furthermore, it can promote empathy through smaller groups  
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55 296 allowing face-to-face communication (Krstrup et al., 2009; Ottesen et al., 2010). This is a  
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3 297 crucial factor to improve adherence of health programs (Krustrup, Dvorak, Junge, & Bangsbo,  
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5 298 2010). After the study, participants continued the football-training activity and this seems to  
6  
7 299 emphasise the capacity of recreational football in improving interpersonal relationships and  
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9 300 adherence to health programs (Bangsbo et al., 2014). While previous studies have shown that  
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11 301 substantial benefits can be obtained by performing recreational football two to three times per  
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13 302 week, the current investigation has shown that also low volume of football practice as low as  
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15 303 1-hour per week can produce health benefits such as improved  $VO_{2max}$  and blood pressure in  
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17 304 middle-aged men. This is in agreement with previous studies revealing the positive effects of  
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19 305 physical activity performed at half the recommend ACSM quantity (Lee, 2007). This study  
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21 306 may have important implications for designing physical activity-based health programs.  
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### 27 308 **Practical implications**

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31 310 Recreational football is an effective training modality to stimulate and improve cardiovascular  
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33 311 fitness in healthy middle-aged men. This study shows the effect of 1-hour recreational  
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35 312 football session per week and suggests that a lower training volume than recommended by  
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37 313 ACSM guidelines can give meaningful benefits. This study suggests that people with limited  
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39 314 free time available for participating in training programs (common barrier to physical activity)  
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41 315 can practise recreational football 1-hour per week and still have some health benefits.  
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422 Table 1. Summary of physiological and anthropometrical data before and after 12 weeks of  
 423 recreational football practice (FG, n = 10 and CG, n = 14). All data are presented in mean  $\pm$   
 424 SDs.

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

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426 \* = p < 0.05 pre compared to post.

427 BW = body weight; BMI = body mass index; RER = respiratory exchange ratio; HR<sub>max</sub> =  
 428 maximum heart rate; VO<sub>2max</sub> = maximal aerobic power; MAS = maximal aerobic speed; RPE  
 429 = Rate of Perceived Exertion; SBP = systolic blood pressure; DBP = diastolic blood pressure;  
 430 MBP = mean blood pressure.

431 Table 2. Summary of Blood analysis before and after 12 weeks of recreational football  
 432 practice (FG, n = 10 and CG, n = 14). All data are presented in mean  $\pm$  SDs.  
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	FG pre	FG post	CG pre	CG post
Haematocrit (L L <sup>-1</sup> )	0.46 $\pm$ 0.03	0.46 $\pm$ 0.02	0.45 $\pm$ 0.02	0.45 $\pm$ 0.02
HGB (g L <sup>-1</sup> )	152.2 $\pm$ 11.2	151.9 $\pm$ 9.47	150.7 $\pm$ 9.1	150.3 $\pm$ 9.25
RBC (10 <sup>12</sup> L <sup>-1</sup> )	5.01 $\pm$ 0.49	5.02 $\pm$ 0.41	5.23 $\pm$ 0.43	5.12 $\pm$ 0.32
PLT (10 <sup>9</sup> L <sup>-1</sup> )	227.4 $\pm$ 56.6	220.8 $\pm$ 44.0	222.8 $\pm$ 48.4	213.3 $\pm$ 33.8
WBC (10 <sup>9</sup> L <sup>-1</sup> )	6.29 $\pm$ 1.45	6.65 $\pm$ 1.43	6.29 $\pm$ 2.8	6.27 $\pm$ 1.57
FA (mg dL <sup>-1</sup> )	90.1 $\pm$ 13.8	86.9 $\pm$ 8.9	92.0 $\pm$ 11.3	86.9 $\pm$ 10.5
Total-C (mg dL <sup>-1</sup> )	195 $\pm$ 36	183 $\pm$ 33	216 $\pm$ 34	214 $\pm$ 33
HDL-C (mg dL <sup>-1</sup> )	56 $\pm$ 14	53 $\pm$ 12	50 $\pm$ 9	49 $\pm$ 8
LDL-C (mg dL <sup>-1</sup> )	111 $\pm$ 31	101 $\pm$ 18	143 $\pm$ 32	144 $\pm$ 31
TG (mg dL <sup>-1</sup> )	130.3 $\pm$ 76	128.2 $\pm$ 78	121.6 $\pm$ 40	115.6 $\pm$ 44

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435 \* = p < 0.05 pre compared to post.

436 TG = triglycerides, FA = fasting glucose, LDL-C = cholesterol LDL, HDL-C = cholesterol

437 HDL, Total-C = Total cholesterol, WBC =total leucocyte count, RBC = total red cell count,

438 HGB = haemoglobin concentration and PLT = total platelet count.

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