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Broad-spectrum physical fitness benefits of recreational football: systematic review and meta-analysis

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ABSTRACT

Background: A previous meta-analysis showed that maximal oxygen uptake increased by 3.51 mL/kg/min (95% CI 3.07–4.15) during a 3-6 month recreational football programme in comparison with continuous moderate intensity running, strength training or a passive control group. In addition, narrative reviews have demonstrated beneficial effects of recreational football on physical fitness and health status.

Objective: The purpose of this systematic review and meta-analysis was to evaluate the magnitude of effects of recreational football on blood pressure, body composition, lipid profile and muscular fitness with reference to age, gender and health status.

Design: Systematic review and meta-analysis

Data sources: MEDLINE, PubMed, SPORTDiscus, Web of Science, CINAHL and Google Scholar were searched prior to February 1, 2017. In addition, Google Scholar alerts were set up in January 2012 to identify potential papers with the following key terms: recreational football, recreational soccer, street football and street soccer.

Eligibility criteria for selecting studies: Randomised and matched controlled trials with participants allocated to a recreational football group or any other type of exercises or passive control group were included. Training programmes had to last at least 2 weeks to meet inclusion criteria. The primary outcome measures were blood pressure, resting heart rate, body composition, muscular fitness, and blood lipids and glucose tolerance. A total of 31 papers met the inclusion criteria and were included.

Results: The effect of recreational football on systolic blood pressure (SBP) vs. no-exercise controls was *most likely extremely large beneficial* (ES=4.20 mmHg; 95% CI: 1.87, 6.53). In addition, *a most likely very large beneficial* (ES=3.98 mmHg; 95% CI: 2.32, 5.64) effect was observed for diastolic blood pressure (DBP). Furthermore, a *most likely extremely large beneficial* effect was shown for SBP and DBP in mildly hypertensive participants (11 and 7 mmHg decrease, respectively) and pre-hypertensive participants (10 and 7 mmHg decrease, respectively). Meta–analysis of recreational football determined the impact on resting heart rate as *most likely extremely large beneficial* (ES=6.03 beats/min; 95% CI: 4.43, 7.64) when compared to non-active groups. The observed recreational football effect on fat body mass was *most likely large beneficial* (ES=1.72 kg; 95% CI: 0.86, 2.58) and the effect on countermovement jump (CMJ) performance was *most likely very large beneficial* (ES=2.27 cm; 95% CI: 1.29, 3.25) when compared to non-active groups. *Possibly beneficial* decreases were found in low density lipoprotein levels (ES=0.21 mmol/l; 95% CI: 0.06, 0.36). *Possibly largely beneficial* effect was observed for diastolic blood pressure in comparison to continuous running training. *Small harmful* and *unclear* results were noted for systolic blood pressure, fat and lean body mass, BMI as well as muscular fitness when compared to running and Zumba training.

Conclusion: The present meta-analysis demonstrated multiple broad-spectrum benefits of recreational football on health-related physical fitness compared to no-exercise controls, including improvements in blood pressure, resting heart rate, fat mass, LDL cholesterol and counter-movement jump performance. Additionally, recreational football is efficient and effective as Zumba and continuous running exercise regimes with highlighted social, motivational and competitive component.

What is already known

- Recreational football is an intense versatile activity with marked positive effects on aerobic fitness
- This exercise modality is suitable for both genders regardless of age, fitness level and skills
- Recreational football is a highly motivating activity compared to conventional exercise programmes

What are the new findings

- Recreational football displays positive effects on health-related physical fitness in comparison with no-exercise controls, including beneficial effects on cardiovascular, metabolic and muscle-skeletal health
- Recreational football induces a broad-spectrum positive impact on health-related physical fitness in healthy people regardless of gender and fitness level
- Recreational football can be applied as an effective broad spectrum non-pharmacological treatment of lifestyle diseases, such as hypertension and metabolic syndrome

1 Introduction

It is now well established that physical fitness is a strong mortality predictor and that physical training is a cornerstone in the prevention and treatment of lifestyle diseases including hypertension, type 2 diabetes and osteoporosis[1-4]. Conventional training approaches, such as high-intensity interval training (HIIT), endurance running and strength training are well known to be effective at improving cardiovascular, metabolic and musculoskeletal fitness, respectively[5-8]. However, participation in multi-faceted exercise training may be effective at simultaneously stimulating all three main fitness areas, thereby providing broad-spectrum fitness and health benefits[2-5]. Over the last decade, there has been growing evidence that recreational football is precisely this type of multi-faceted exercise training. Small-sided football training for untrained health adults across the lifespan as well as several patient groups have been shown to elicit average heart rates of 80-85% of maximal heart rate (HRmax) during 60-minute sessions, with 15-50% of total training time in the highest aerobic training zone above 90% HRmax[6]. In addition, small-sided football training comprises multiple strength training elements, with more than 100 high-intensity runs and hundreds of specific intense actions such as dribbles, shots, tackles, turns and jumps in 60-min training sessions[7]. Many individual studies have reported recreational football to be an effective type of physical activity with positive effects on hypertension in middle aged men [8] and women [9], for cardiovascular and metabolic responses in patients with type 2 diabetes [10], on heart function [11], on physical capacity [12], on muscle mass in prostate cancer patients [11] and on bone mineral density and mass [13], with positive effects in various age categories and populations for cardio-respiratory fitness, muscular fitness, health profile and physical capacity [5] and three narrative reviews have confirmed the effects of recreational football training on cardiovascular, metabolic and musculo-skeletal fitness regardless of age and health status[9 10 14]. To date, only two systematic reviews and meta-analyses have evaluated the effects of recreational football, and these had a predominant focus on aerobic fitness. Milanović and colleagues [6] meta-analysed 17 studies and reported that recreational football produces large improvements in VO_2max compared to strength training and no-exercise controls, while a moderate effect size was observed in comparison to continuous endurance running. Likewise, Oja, et al. [15]showed significant positive effects on VO_2max and resting heart rate compared to a no-exercise control, with borderline significance for fat percentage. The effects of recreational football on broad-spectrum fitness and health benefits, however, have yet to be meta-analysed.

The purpose of this systematic review and meta-analysis was therefore to carry an up-to-date evaluation of the broad-spectrum health-related fitness effects of recreational football training in relation to age and health status, with a specific focus on the magnitude of effects on (1) blood pressure, (2) resting heart rate (RHR), (3) body composition, (4) muscular fitness evaluated as jump performance, and (5) blood lipids and glucose tolerance.

2 Methods

2.1 Search strategy and study selection

The search and study selection strategy applied in this systematic review and meta-analysis was similar to that of a previous published paper by Milanović, et al. [6]. All procedures relevant for papers identification were carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [16]. Computerised literature searches were conducted on the following databases: MEDLINE, PubMed, SPORTDiscus, Web of Science, CINAHL and Google Scholar. A structured search included papers published prior to

February 1, 2017. In addition, Google Scholar alerts were set up in January 2012 to identify potential papers with the following key terms: recreational football, recreational soccer, street football and street soccer. A manual search was performed covering the areas of recreational football/soccer, recreational physical activity, recreational small-sided games and physical fitness using the following key terms and strings, either singly or in combination: ("recreational small-sided games" [All Fields] OR "recreational football" [All Fields] OR "recreational soccer" [All Fields] OR "street football" [All Fields] or "street soccer" [All Fields]) AND ("effect" [All Fields] OR "impact" [All Fields] OR "influence" [All Fields]) AND ("physical fitness" [Mesh] OR "health status" [Mesh] OR "blood pressure" [Mesh] OR "countermovement jump" [Mesh] OR "CMJ" [Mesh] OR "body composition" [Mesh] OR "body mass index" [Mesh] OR "lean body mass" [Mesh] OR "body mass" [Mesh] OR "resting heart rate" [Mesh] OR "blood lipid" [Mesh] OR "glucose tolerance" [Mesh]) AND ("randomised controlled trial" [All fields] OR "randomized controlled trial" [Publication Type]).

The study selection process is shown in Figure 1. Two independent reviewers (ZM and NČ) performed the literature search, identification, screening, quality assessment and data extraction. Firstly, the titles were initially screened by the reviewers during the electronic searches to assess suitability of papers and all papers beyond the scope of this meta-analysis were excluded. Secondly, abstracts were assessed using predetermined inclusion and exclusion criteria. Thirdly, the full texts of the remaining papers that met the inclusion criteria were retrieved for inclusion in the ongoing procedure and reviewed by the two reviewers to reach a final decision on inclusion in the meta-analysis. Finally, reference lists from retrieved manuscripts were also examined for any other potentially eligible papers. Any disagreements between the reviewers were resolved by consensus or arbitration by a third reviewer (GS). If full text of any paper was not available, the corresponding author was contacted by mail or ResearchGate. Inclusion and exclusion criteria were considered study characteristics and report characteristics (Table 1). Type of study and participants: randomised and matched controlled trials were included in meta-analysis without any restriction regarding age and health status of participants. Type of interventions: training programmes had to last at least 2 weeks, with participants allocated to a recreational football group or any other type of exercises or passive control group. Studies with unbalanced diet in groups were excluded from analysis. Type of outcome measure: the primary outcome measures for the meta-analysis were blood pressure, RHR, body composition, muscular fitness evaluated as jump performance, and blood lipids and glucose tolerance.

Table 1 about here

2.2 Data extraction

The Cochrane Consumers and Communication Review Group's standardised protocol for data extraction was used to extract: (i) study characteristics including author(s), title and year of publication; (ii) participant information such as sample size, age, health status and gender; (iii) description of the training intervention, including types of exercise, intensity, duration and frequency; and (iv) study outcomes, including the following physical fitness components: systolic and diastolic blood pressure, resting heart rate, body mass, body mass index (BMI), lean body mass, fat mass, metabolic responses including: Low and High Density Lipoproteins (LDL and HDL), total cholesterol, triglycerides, glucose and glucose tolerance and muscular fitness. When needed, pre- and post BMI values were manually calculated. In most of the studies, mean and SD (also computed when dispersion was expressed as SEM) pre- and post-values were reported, while correlation was not reported. Accordingly, in these instances the correlation value was set at 0.5, as used previously by Bacon et al. [17]. Graph digitiser software (DigitizeIt, Germany) was used to obtain data values in studies where only plots were published. Data extraction was undertaken by ZM, while NČ checked the extracted data for accuracy and completeness. Disagreements were resolved by consensus or by GS. The reviewers were not blinded to authors, institutions or manuscript journals. The summery of findings with appropriate quality of evidence table was created using GRADE approach [18]. The methodological criteria were dependent on five primary domains (risk of bias, inconsistency, indirectness, precision and publication bias), as well as the overall quality of the evidence (high, moderate, low, or very low).

2.3 Assessment of risk of bias

Risk of bias was evaluated according to the PRISMA recommendation [19]. PEDro scale was used to determine the quality of the studies and potential risk of bias. Two independent reviewers assessed quality and risk of bias using checklists. Agreement between the two reviewers was assessed using k statistics for full-text screening and rating of relevance and risk of bias. In the event of disagreement about the risk of bias, the third reviewer checked the data and took the final decision on it. The k agreement rate between reviewers was k=0.94.

2.4 Statistical analysis

Difference in means and 95% confidence intervals (CIs) were calculated for the included studies. The I^2 measure of inconsistency was used to examine between-study variability, with values greater than 50% considered indicative of high heterogeneity [20]. This statistic, expressed as a percentage between 0 and 100, can be interpreted as the percentage of heterogeneity in the system or, basically, the amount of total variation accounted for by the between-studies variance [21]. Publication bias was assessed by examining asymmetry of funnel plots using Egger's test, and

P<0.10 was considered a significant publication bias. Pooled estimates of the effect of recreational football on blood pressure, RHR, body composition, metabolic responses and muscular fitness using effect size (ES), were obtained using random effects models. ES values were classified as follows: <0.2 trivial, 0.2–0.6 small, 0.6–1.2 moderate, 1.2–2.0 large, and >2.0 very large and >4.0 extremely large [22]. The precision of the pooled effect was reported as a 95% confidence interval (CI) and as probabilities that the true value of the effect was trivial, beneficial or harmful in relation to threshold values for benefit and harm. The chance of the true effect being trivial, beneficial or harmful was then interpreted using the following scale: 25-75%, possibly; 75-95%, likely; 95-99.5%, very likely; >99.5%, most likely [17]. These probabilities were then used to make a qualitative probabilistic inference about the overall effect[21]. Five moderator variables with appropriate levels were selected for additional analysis of all outcomes: 1) type of control group (no-exercise, continuous running, strength training and Zumba groups); 2) gender (male and female); 3) age (18-45, 45-65 or >65 years); 4) length of training intervention (≤12 weeks and >12 weeks); and 5) training frequency (≤2 weeks and >2 weeks). In addition, the type of hypertension was used as a moderator for systolic blood pressure (SBP) and diastolic blood pressure (DBP) outcome where levels were: normotensive, mid-hypertensive and hypertensive. All statistical analyses were conducted using Comprehensive Meta-analysis software, version 2 (Biostat Inc, Englewood, NJ). P<0.05 was considered statistically significant.

3 Results

3.1 Study selection and characteristics

A total of 712 papers were identified across the databases in the initial search and an additional 64 papers were selected on the basis of their references. After duplications were removed, 342 papers remained. Based on a screening of the title and abstract, 278 articles were discarded (195 excluded after title analysis, 83 excluded after abstract analysis). The full text of the 64 remaining papers was assessed in more detail for eligibility. Each paper was carefully read and coded for study characteristics, participant information, description of the training intervention and study outcomes. 33 papers did not meet the inclusion criteria, while 31 papers that met the inclusion criteria were included in the systematic review and meta-analysis. 17, 15, 19 and 10 papers were included in the meta-analysis of blood pressure, RHR, body composition and muscular fitness, respectively. Additionally, 10 papers were included for metabolic response comparisons.

Figure 1 about here

All eligible studies were controlled trials, published in English from the beginning of 2009 until February 2017. In order to perform meta-analysis from 31 papers which met inclusion criteria, 17 studies [5 8 9 23-36] featured data changes in blood pressure, 15 covered RHR [5 8 9 23-25 29-35 37], 19 papers [2 5 9-11 24-32 34-39] related to body composition while 10 studies [2 11 12 24 38-43] provided sufficient data for muscular fitness. Metabolic responses data extraction featured 10 studies for LDL and HDL[5 9 24-26 30 31 35 44 45], eight studies for triglycerides [9 24-26 30 35 44 45], nine for total cholesterol[5 9 24-26 30 35 44 45] and glucose[24-26 30 31 35 37 44 45] and five for glucose tolerance[24 30 31 35 44 46] (Fig. 1).

3.2 Football training intervention

Recreational football training interventions were composed of a 10-15 minute warm-up period followed by competitive game formats of 4 vs 4, 5 vs 5, 6 vs 6, 7 vs 7, and 9 vs 9 without specific tasks. Pitch dimensions ranged from 20x30 m to 45x65 m covered with grass and artificial grass surfaces or asphalt as well as indoor surfaces. Authors did not report the playing role of the goal keeper or the specific rules used during matches. All subjects trained for between 10 and 72 weeks. The most common intervention periods were 12 weeks [2 5 11 23 24 27 29 41] and 16 weeks [12 28 37]. Total time in the high aerobic intensity zone (> 90%HRmax) ranged from one-tenth to one-third of overall exercise time.

Table 2 about here

Table 3 about here

3.3 Study outcomes for blood pressure

The meta-analysed effects of recreational football on SBP and DBP were similar (Table 5). The recreational football effect on SBP when compared to no-exercises controls was *most likely extremely large beneficial.* A *most likely extremely large beneficial* (ES=3.89 mmHg; 95% CI: 2.33, 5.44) effect on DBP was observed for recreational football compared to no-exercise groups. A *most likely extremely large beneficial* ES was observed in the group of mildly hypertensive participants (decrease of 10.8 and 6.8 mmHg for SBP and DBP in football group and 4 and 0 mmHg in controls). In the pre-hypertensive group, the observed effects were *most likely extremely large beneficial* (ES=5.52 mmHg; 95% CI: 3.51, 7.54; decrease of 7.3 and 2.0

mmHg for FG and controls) and *likely extremely large beneficial* (ES=4.36 mmHg; 95% CI: 0.02, 8.70; decrease of 9.5 and 4.7 mmHg for FG and controls) for DBP and SBP. In the normotensive group, the observed effects were *possibly large beneficial* for both SBP and DBP (ES=1.80 mmHg, 95% CI: -0.04, 3.65, and ES=1.21 mmHg, 95% CI: -0.11, 2.32).

When the results were analysed separately for men and women, the meta-analysed effect of recreational football on SBP was *possibly very large beneficial* and *very likely extremely large beneficial* for men and women (ES=2.25 mmHg; 95% CI: 0.21, 4.30 and ES=4.17 mmHg; 95% CI: 1.15, 7.19). For the DBP results the evidence was stronger for an effect in men than in women with *most likely very large beneficial* effects for men (ES=3.98 mmHg; 95% CI: 2.32, 5.64) and *likely very large beneficial* effects for women (ES=2.28 mmHg; 95% CI: 0.82, 3.75). When a comparison of recreational football effects was performed for the age groups *most likely extremely large beneficial* and *most likely very large beneficial* effects were noted in the 45-65 age group for both SDP and DBP as well as for the *likely very large beneficial* effects for DBP in 18-45 age group. In the 18-45 and +65 group, the effects were *unclear* for SBP and in +65 group, the effects for DBP were *unclear*. *Unclear* (ES=0.67 mmHg; 95% CI: -1.90, 3.24) and a *likely very largely beneficial* (ES=2.15 mmHg; 95% CI: 0.46, 3.83) effect sizes were seen for SBP and DBP for the duration time of up to 12 weeks of training. *Most likely extremely large beneficial* effects (ES=4.59 mmHg; 95% CI: 2.46, 6.72) and *most likely very large beneficial* effects (ES=3.63 mmHg; 95% CI: 2.14, 5.12) were observed for training periods lasting more than 12 weeks for SBP and DBP respectively. When the results were moderated using training frequency, a *likely large beneficial* and *most likely extremely large beneficial* ES was retrieved for moderators (≤ 2 and > 2 sessions per week) for DPB. *Likely very large beneficial* effects were observed for SBP for both moderators. A mean decrease of 5.3 mmHg and 4.0 mmHg for SBP and DBP was observed for football group and 3.5 and 0.7 mmHg for controls, respectively.

The effects on SBP of football when compared to running and Zumba groups was *possibly moderately harmful*, while the effect on DBP was *unclear* when compared to a Zumba group. The effect of recreational football on DBP when compared to continuous running was *possibly large beneficial* (ES=2.21 mmHg; 95% CI: -0.81, 5.23).

Table 5 about here

3.4 Study outcomes for resting heart rate

Meta–analysis of the effect of recreational football on RHR was determined as *most likely extremely large beneficial* (ES=6.03 beats/min; 95% CI: 4.43, 7.64) when compared to a non-active control group (Table 6). A *small unclear* effect was found in comparison with running (ES=0.57 beats/min; 95% CI: -1.48, 2.62). *Most likely extremely large beneficial* and *very likely very large beneficial* effects were observed for male and female gender moderators (ES=5.06 beats/min; 95% CI: 2.48, 7.64, and ES=2.95 beats/min; 95% CI: 0.76, 5.14). The effect on RHR in 18-45-year-olds was beneficial (ES=3.19 beats/min; 95% CI: 0.95, 5.43, *very likely very large beneficial*). When compared to the 45-65 and 65+ age groups, the observed effects were *most likely extremely large beneficial* (ES=5.66 beats/min; 95% CI: 2.14, 9.18 and ES=6.0 beats/min; 95% CI: 4.34, 7.66). In cases where the results were compared by the training intervention duration moderators, the results were unclear and beneficial for up to 12 weeks (ES=1.99 beats/min; 95% CI: -2.09, 6.08), and longer than 12 weeks (ES=4.70 beats/min; 95% CI: 2.76, 6.65, *most likely extremely large beneficial*). *Most likely extremely large beneficial* effects were observed when training frequency was ≤ 2 while *very likely very large beneficial* effects were reported in the case of 2 or more sessions per week. *Most likely very large beneficial* (ES=3.83 beats/min; 95% CI: 2.16, 5.51) effect of recreational football intervention was computed for overall sample.

Table 6 about here

3.5 Study outcomes for body composition

Trivial and small effects were observed for BMI compared to all other investigated training regimes (Table 7). Similar results were observed for body mass where the meta-analysed effects were trivial to small regardless of the type of control moderators with *unlikely small beneficial* and *very unlikely small harmful* effects for or the no-exercise and running groups (Table 7). ES values for LBM were trivial and small regardless of moderator variables (Table 8). In addition, the meta-analysed effect of recreational football compared to Zumba and for 46-65-year-old participants was unclear. With respect to overall gender sample, effect of football training was rated as *very likely moderately beneficial* (ES=1.10 kg/m^2; 95% CI: 0.54, 1.66). Observed recreational football effect values in respect of fat mass was most likely large beneficial (ES=1.72 kg; 95% CI: 0.86, 2.58) when compared to no-exercise controls (Table 8). The effects were possibly small harmful when compared to running (ES=-0.41 kg; 95% CI: -1.24, 0.42) and unclear when compared to Zumba (ES=0.35 kg; 95% CI: -1.54, 2.24). In respect of gender, ES was very likely large beneficial and possibly moderately beneficial for male and female moderators. Beneficial effects were observed in the 18-45-year-old and 45-65-year-old groups (possibly moderately beneficial and most likely large beneficial). When sub-group analysis was performed very likely large beneficial and likely moderately beneficial effects were observed for intervention duration of up to 12 weeks and over 12 weeks while unlikely small harmful and most likely large beneficial ES was seen for up to two sessions per week and over two sessions per week.

Tables 7 and 8 about here

3.6 Study outcomes for muscular fitness

Overall change induced by recreational football training on CMJ was classified as *moderately likely beneficial* (ES=1.08 cm; 95% CI: 0.15, 2.0). The meta-analysed effect on CMJ of recreational football compared to no-exercise controls was *most likely very large beneficial* (ES=2.27 cm; 95% CI: 1.29, 3.25; Table 6). The effect was *unclear* when compared to running (ES=0.28 cm; 95% CI: -1.05, 1.61) and *possibly trivially harmful* when compared to strength training (ES=-1.06 cm; 95% CI: -3.40, 1.28). In cases where the results were analysed separately for men and women, ES values were *very likely large beneficial* and *unclear*. When compared between age group for 18-45-year-olds ES was *unclear*, for 46-65-year-olds it was *unlikely trivially harmful* (ES=-0.01 cm; 95% CI: -1.03, 1.01) and for 65+ group the result was *very likely large beneficial* (ES=1.63 cm; 95% CI: 0.48, 2.78). For training intervention duration, the effects were classified as *unclear* (ES=0.09 cm; 95% CI: -1.86, 2.03) for the up to 12 week intervention period and *most likely large beneficial* (ES=1.72 cm; 95% CI: 0.77, 2.66) for the over 12 week intervention period. In respect of the training frequency, the effects were *likely large beneficial* (ES=1.56 cm; 95% CI: 0.0, 3.12) and *likely moderately beneficial* (ES=1.05 cm; 95% CI: -0.15, 2.25) for up to two sessions per week and over two sessions per week.

3.7 Study outcomes for metabolic responses

Effects of recreational football on metabolic responses was compared with no-exercise controls, but not compared by type of training intervention, sex, age, training frequency and duration moderators (Figure 2). Overall effect was classified as *possibly small beneficial* (ES=0.21 mmol/l; 95% CI: 0.06, 0.36) for LDL cholesterol (Figure 2). M*ost likely trivial* (ES=0.05 mmol/l; 95% CI: -0.02, 0.13) were observed for HDL cholesterol. *Likely trivial* effects were observed for total cholesterol (ES=0.13 mmol/l; 95% CI: -0.03, 0.29), triglycerides (ES=0.15 mmol/l; 95% CI: 0.03, 0.26) and glucose (ES=0.00 mmol/l; 95% CI: -0.22, 0.22), while p*ossibly trivial* effects were seen for glucose tolerance (ES=-0.13; 95% CI: -0.49, 0.22) (Fig. 2).

Figure 2 about here

3.8 Publication bias

The Egger's test was performed to provide statistical evidence of funnel plot asymmetry. The results indicated publication bias for blood pressure and CMJ analysis ($P<0.10$). Publication bias was not observed for the remaining variables ($P>0.10$).

3.9 GRADE recommendations for strength of evidence

Observed results strongly recommend to use recreational football to reduce BMI, body mass and lean body mass because overall quality of evidence is high without any publication bias or inconsistency among included studies (Table 4). Moderate quality of evidences were determined for SBP and DBP without inconsistency. Results recommended recreational football because of its desirable effects on SBP and DBP. Additionally, certainty of metabolic parameters (total cholesterol, LDL, triglycerides, fasting glucose and glucose tolerance) were high without risk of bias and inconsistency. In contrast, certainty of fat mass variable is low with serious inconsistency as well as strongly suspected publication bias.

4 Discussion

The principal findings from the 31 papers that met the inclusion criteria were that recreational football has multiple positive effects on health-related physical fitness in comparison to no-exercise controls, including beneficial effects on systolic and diastolic blood pressure, resting heart rate, fat mass, LDL cholesterol and counter-movement jump performance.

Previous meta-analyses have revealed that recreational football interventions lasting 3-4 months have a positive impact on maximal oxygen uptake compared to no-exercise controls in both men and women, with calculated average effects of 4.11 mL/kg/min [47] and 3.51 mL/kg/min [6], respectively. One of the main findings of the present study is that, when compared to no-exercise controls, recreational football interventions demonstrate additional positive effects on cardiovascular fitness and health profile, including improvements in blood pressure. Indeed, the impact of 3-4 months of recreational football organised as 45-60 min 2-3 times per week was *most likely beneficial* for SBP and *most likely beneficial* for DBP compared to no-exercise controls. As expected, a greater blood pressure reduction was observed with 3-4 months of recreational football interventions for hypertensive participants than for normotensive individuals [48]. The observed reduction in SBP and DBP was 11 and 7 mmHg in mild-hypertensive subjects and 10 and 7 mmHg in pre-hypertensive individuals. These improvements are comparable to the acute effect of taking one standard dose of a BP lowering drug [49], and have important clinical importance as a blood pressure reduction of such a magnitude corresponds to a lowered risk of sudden cardiac stroke by 20 – 30% in hypertensive individuals [49].

The positive effects were observed in both men and women, and for 18-45-year-old and 45-60-year-old age groups. Specifically, the meta-analysis showed the effect of recreational football on SBP to be *possibly very large* and *very likely extremely large beneficial* in men and women, and indicated that the effect on DBP was greater for men than for women. When recreational football effects were related to age *likely very large beneficial* effects were observed for DBP in the 18-45 age group and *most likely very large beneficial* for the 45-65 age group, whereas only the 45-65 age group had positive effects on SBP. It was interesting to note that a harmful effect was found for SBP and a large beneficial effect for DBP compared to continuous running. Aerobic training that lasts between 16-52 weeks can lower resting blood pressure (both SBP and DBP) by 1-2% [35 50]. Football training proved to be superior in lowering DBP directly induced through improved muscle capillarisation, decreased arterial stiffness and increased cardiac relaxation time [35]. Recreational football effectively lowered SBP but in comparison to Zumba exercise it had moderately negative effects. Physiological effects, including cardiovascular response to Zumba activity are not fully elucidated and further research is needed[26 27].

With regard to the impact of recreational football training on RHR our findings provide further support for the previous scientific studies which found that heart rate decreases with 3-4 months of recreational football performed for 45-60 min 2-3 times per week (6 bpm; [47]). Hence, the present meta-analysis showed the effect of recreational football on RHR to be *most likely extremely large beneficial* when compared to a non-active group, with positive very large effects in men, as well as women. Positive effects were detected across all adult age ranges, including 18-45 year-olds, 45-65 year-olds and over 65 years. No clear evidence were obtained when comparing the effects of recreational football on RHR with those of other sporting activities.

The present meta-analysis rates the effect of recreational football in respect of fat mass to be *most likely large beneficial* compared to inactive controls, which is in accordance with the recent analysis by Oja, et al. [15]. Thus, football training interventions lasting 12-16 weeks (2x60-min sessions/week) are likely to cause a decrease in total fat mass of 1-3 kg, which is clinically significant for overweight and obese adults [47]. The present, as well as other meta-analyses [47] provide evidence that recreational football training is very likely beneficial for decreasing fat mass in both genders. Moreover, the 18-45 and 45-65 age groups were observed to respond to this type of physical training. The effects of football training are not as clear when compared to other exercise training protocols. For example, there are no clear effects when compared with Zumba dancing. Considering the limited number of studies reporting the effects of other sport disciplines, conclusions about the health benefits cannot yet be conclusively drawn. When evaluating the impact of recreational football on LBM the effects were rated as trivial to small, when performed 2x60 min per week for 12-16 weeks, while the effect of football vs Zumba was unclear. In relation to gender, women display a greater effect than their male counterparts. In addition, participants in the 18-45 age group tend to respond better than older age groups (45-65 and 65+).

The effect of recreational football training on CMJ when compared to in-active controls was *most likely very large beneficial*. The outcome of football training was unclear when compared to running and potentially lower when compared to strength training. Considering the limited existing data, no clear gender effect in females was detected with respect to the effects of recreational football training, while in men the effect was *very likely large beneficial*. In individuals older than 65 years, somewhat greater effect sizes were observed compared to the 18-

45 age group. Finally, recreational football training interventions lasting longer than 12 weeks induced better responses in CMJ performance than interventions lasting less than 12 weeks.

Metabolic responses and their relationship to recreational football were displayed through changes in blood lipids, glucose concentration and glucose tolerance. It is strongly substantiated that exercise training lowers these metabolic risk factors for pathological conditions such as cardiac dysfunctions, sudden mortality and morbidity, arteriosclerosis and type II diabetics [3 24 35]. In a narrative review by Bangsbo, et al. [3] it was reported that changes provoked by recreational football were mainly non-significant including reduced LDL cholesterol level (4-15%)[5 29 33] and total cholesterol (0.6-8%) [7 25 33] along with elevated HDL level (0-9%)[7 31]. The present meta-analysis indicates similar outcomes with *possibly small beneficial* decrease in LDL along with *most likely and likely trivial* in HDL upregulation and triglycerides and total cholesterol decrement. The LDL decrease was related mainly to increased weekly training frequency for the first 12 weeks which could not be maintained for an additional 52 weeks when training frequency was reduced [24 35]. The changes were generally caused by the responsive nature of LDL and HDL to aerobically induced energy expenditure[24 32 44]. Additionally, the metabolic responses for fasting glucose and glucose tolerance (after two hours) were *trivial.* Although, the precise effects of recreational football compared to other types of exercise were not meta-analysed due to insufficient data, it is evident that recreational football display a greater effect on blood lipids compared to other aerobic exercise regimes [5 24 29], and that the magnitude of change is associated to sex, baseline obesity level and maximal oxidative capacity [32]. Further scientific work should examine effectiveness of recreational football of different formats and in comparison to strength training on various health-related physical fitness components.

Despite the multitude benefits elucidated in the present systematic review and meta-analysis there are some limitations. For example, it is plausible to suggest that studies reporting statistically significant or positive results are more likely to be published in scientific journals compared to results showing no treatment effects. In line with this statement, one of the limitations in this meta-analysis is the phenomenon of negative results publication bias. Additionally, the small number of included studies measuring to metabolic parameters may be a limitation, since as effect sizes could not be calculated for moderator variables. Finally, the lack of duplicate data extraction could be considered as a limitation of this meta-analysis.

5 Conclusion

In conclusion, the present meta-analysis demonstrated multiple broad-spectrum positive physical health effects of recreational football training in comparison to no-exercise controls, including beneficial effects on blood pressure, resting heart rate, fat mass, LDL cholesterol and counter-movement jump performance. In addition, it was evident that the majority of these effects occurred independently of age and gender, and most of the effects, except improvements in CMJ, occurred after only 12 weeks of training. Recreational football proved to be similarly effective and beneficial when compared to other exercise regimes on health-related physical fitness components. Thus, recreational football is a worthwhile alternative to Zumba dancing and continuous running providing similar decreases in body weight and fat mass.

Compliance with Ethical Standards

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Conflict of interest

The authors have no conflicts of interest that are directly relevant to the content of the present review.

Author Contributions

ZM, SP and NČ selected studies and extracted data. ZM and GS analyzed the data. ZM, NČ and PK were responsible for conception and design, drafting and revising the manuscript. ZM, PK, MM wrote the paper, and all authors commented the paper and approved the final version.

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TABLE CAPTION

Table 1 Inclusion and exclusion criteria

Table 2 Systematic review and characteristics of included studies selected for meta-analysis and relevant outcomes

Table 3 Systematic review and overall observed effects for metabolic parameters

Table 4 GRADE quality of evidence of included studies and relevant outcomes

Table 5 Effect of recreational football on systolic and diastolic blood pressure with modifying effects for type of control group, gender, age, length of training intervention and training frequency

Table 6 Effect of recreational football on resting heart rate and muscular fitness with modifying effects for type of control group, gender, age, length of training intervention and training frequency

Table 7 Effect of recreational football on body mass index and body mass with modifying effects for type of control group, gender, age, length of training intervention and training frequency

Table 8 Effect of recreational football on lean body mass and fat mass with modifying effects for type of control group, gender, age, length of training intervention and training frequency

FIGURE CAPTION

Figure 1 Flow chart diagram of the study selection; BP – blood pressure; RHR – resting heart rate; body composition and CMJ – countermovement jump.

Figure 2 Forest plot of the effect sizes and 95% confidence intervals (CIs) of the changes in overall metabolic parameters; MBI – magnitude based inferences; LDL - low density lipoproteins; HDL - high density lipoproteins

Table 1 Inclusion and exclusion criteria

	Inclusion criteria	**Exclusion criteria**
Type of study	English language Longitudinal design evaluating interventions, Randomized controlled trials Matched controlled trials	Non-randomized Uncontrolled Cross-section studies Case study
Type of participants	Sedentary Untrained Recreational Non-athlete Patients Both genders Any health status	Mixed gender
Type of intervention	Training programmes > 2 weeks Recreational football/soccer Continuous endurance running Strength training Zumba training No-Exercise (control) group	Studies incorporating diet Number of training sessions < 1 per week
Type of outcome measure	Systolic and diastolic blood pressure Resting heart rate Body mass index Body mass Lean body mass Fat body mass Countermovement jump LDL, HDL and total cholesterol Glucose and glucose tolerance	Any other physical fitness parameters

Table 2 Systematic review and characteristics of included studies selected for meta-analysis and relevant outcomes

Study	Population					Training programme					Outcomes								
	Status	Gender	Age (yr)	Sample size	Drop out (*n*)	Duration (weeks)	Comparison group (*n*)	Average intensity (%HRmax)	Days/wk	Session (min)	SBP (mmHg)	DBP (mmHg)	RHR (bpm)	BW (kg)	LBM (kg)	FM (kg)	BMI (kg/m^2)	CMJ (cm)
Andersen et al. [44]	Type II diabetics	M	49±2	21	3	24	CG (n=9)	83±2	1.5±0.9	60				FG: 1.1 ↓* CG: 0.6 ↑	FG: 0.7 ↑ CG: 0.8 ↑	FG: 1.7 ↓* CG: 0.1 ↓↑	FG: 0.3 ↓ CG: 0.3 ↑	
Andersen et al. [51]	Mild to moderate hypertension	M	31-54	22	3	12	CG (n=9)	83	1.7±0.2	60	FG: 12 ↓* CG: nc	FG: 7↓* CG: nc	FG: 12 ↓* CG: 1 ↑					
Andersen et al. [52]	Healthy untrained	F	36.5±8.2	47	0	16	RG (n=18) CG (n=10)	82	1.8	60	FG: 6 ↓* RG: 5 ↓* CG: nc	FG: 4 ↓* RG: 3 ↓* CG: nc						
Andersen et al. [8]	Untrained hypertensive	M	31-54	31	10	26	CG (n=11)	Not reported	1.7±0.1	60	FG: 12 ↓* CG: 6 ↓	FG: 8 ↓* CG: 4 ↓	FG: 8↓* CG: 3 ↑					
Andersen et al. [46]	Untrained elderly	M	63-74	26	1	16	STG (n=9) CG (n=8)	84.1±1	1.6±0.1	60								FG: 1.8 ↑ RG: 1.7 ↑ CG: 1.2 ↓
Barene et al. [27]	Healthy hospital employees	F	25-65	118	23	12	ZG (n=30) CG (n=34)	78.3±4.4	2.4±0.5	60	FG: 2 ↓ ZG: nc CG: nc	FG: nc ZG: nc CG: nc		FG: 0.8 ↓ ZG: 0.8 ↓ CG: nc	FG: 0.2 ↑ ZG: nc CG: nc	FG: 1 ↓* ZG: 0.6 ↓ CG: 0.3 ↓	FG: 0.3 ↓ ZG: 0.7 ↓* CG: nc	
Barene et al. [26]	Healthy hospital employees	F	25-65	118	41	40	ZG (n=30) CG (n=34)	78.6±3.2	12 weeks - 2.4±0.5 28 weeks - 1.2±0.2	60	FG: nc ZG: 3 ↓ CG: nc	FG: nc ZG: nc CG: nc		FG: 1.1 ↓* ZG: 2.1 ↓* CG: nc	FG: 0.1 ↑ ZG: 0.2 ↑ CG: nc	FG: 1.2 ↓* ZG: 1.3 ↓* CG: 0.3 ↓	FG: 0.3 ↓ ZG: 0.7 ↓* CG: nc	
Connolly et al. [28]	Healthy inactive	F	20-45	66	22	16	VFG (n=21) CG (n=24)	85±5	2.0	15	FG: 2 ↑ VFG: 3 ↓ CG: 1 ↑	FG: 1 ↑ VFG: 1 ↓ CG: nc	FG: 4 ↓ VFG: 2 ↓ CG: 4 ↓	FG: 0.7 ↓ VFG: 0.2 ↑ CG: nc	FG: 0.7 ↑ VFG: 0.1 ↑ CG: nc	FG: 1.4 ↓* VFG: 0.3 ↑ CG: 0.2 ↓	FG: 0.2 ↓ VFG: 0.1 ↑ CG: nc	
Helge et al. [40]	Healthy untrained	F	36.5±7.7	37	50	14	RG (n=16) CG (n=9)	83	1.8±0.3	60	FG: 6 ↓* RG: 5 ↓* CG: nc							FG: 6% ↑* RG: 7% %↑* CG: nc

Study	Population					Training programme					Outcomes								
	Status	Gender	Age (yr)	Sample size	Drop out (*n*)	Duration (weeks)	Comparison group (*n*)	Average intensity (%HRmax)	Days/wk	Session (min)	SBP (mmHg)	DBP (mmHg)	RHR (bpm)	BW (kg)	LBM (kg)	FM (kg)	BMI (kg/m^2)	CMJ (cm)
Helge et al. [13]	Homeless	M	26-50	55	22	12	CG (n=10)	Not reported	2.2±0.7	Not reported					FG: 2.5% ↑* CG: nc			
Jakobsen et al. [41]	Healthy untrained	M	21-45	49	0	12	STG (n=8) HIRG (n=7) RG (n=9) CG (n=10)	80	2.3	55				STG: 2.7% ↑* FG: nc HIRG: nc RG: nc CG: nc				STG: 20 ↑* FG: nc HIRG: nc RG: nc CG: nc
Knoepfli - Lenzin et al. [29]	Untrained mild hypertension	M	20-45	104	57	12	RG (n=15) CG (n=17)	79.9±4.5	2.4±0.2	59±2	FG: 11 ↓* RG: 7 ↓* CG: 7 ↓*	FG: 9 ↓* RG: 6 ↓* CG: 4 ↓*	FG: 7 ↓* RG: 9 ↓* CG: 6 ↓*	FG: 1.6 ↓ RG: 1.6 ↓ CG: 0.2 ↓	FG: 0.5 ↑ RG: nc CG: 0.3 ↓	FG: 2 ↓* RG: 1.7 ↓* CG:0.1 ↑		
Krustrup et al. [53]	Healthy untrained	F	19-47	28	6	68	RG (n=8) CG (n=7)	81±1	1.78	60	FG: 7 ↓ RG: 7 ↓ CG: 2 ↓	FG: 4 ↓ RG: 3 ↓ CG: 2 ↓	FG: 5 ↓* RG: 6 ↓* CG: nc	FG: 0.3 ↑ RG: 0.2 ↑ CG: 0.7 ↓	FG: 1.4 ↑* RG: 1.3 ↑* CG: 0.1 ↓	FG: 1.4 ↓* RG: 0.3 ↓ CG: 0.5↓		
Krustrup et al. [37]	Healthy untrained	F	19-47	53	12	16	RG (n=18) CG (n=14)	83	1.8	60	FG: 7 ↓ RG: 6 ↓ CG: nc	FG: 4 ↓ RG: 3 ↓ CG: nc	FG: 7 ↓* RG: 7 ↓* CG: 1 ↓	FG: 0.3 ↓ RG: 0.7 ↓ CG: 0.2 ↓	FG: 1.4 ↑* RG: 1.3 ↑* CG: 0.2 ↓	FG: 1.2 ↓* RG: 2.2 ↓* CG: 0.9 ↓*	FG: 0.3 ↓ RG: 0.7 ↓ CG: 0.2 ↓	
Krustrup et al. [5]	Healthy untrained	M	20-43	36	4	12	RG (n=12) CG (n=11)	82	2.3	60	FG: 8 ↓* RG: 8 ↓* CG: nc	FG: 5 ↓* RG: 5 ↓* CG: nc	FG: 6 ↓* RG: 6 ↓* CG: 1 ↑	FG: 1.1 ↓* RG: 1 ↓* CG: 0.1 ↓	FG: 1.7 ↑* RG: 0.6 ↑ CG: 0.1 ↑	FG: 2.7 ↓* RG: 1.7 ↓* CG: 0.3 ↓	FG: 0.3 ↓ RG: 0.3 ↓ CG: nc	
Krustrup et al. [31]	Untrained with mild hypertension	M	30-55	43	10	26	CG (n=11)	85±7	1.7±0.5	60	FG: 13 ↓* CG: 8 ↓*	FG: 8 ↓* CG: 3 ↓*	FG: 8 ↓* CG: 3 ↓		FG: 0.2 ↑ CG: 0.2 ↑	FG: 1.9 ↓* CG: 0.9 ↓		
Milanovic et al. [54]	Non athletic men	M	20-40	69	5	12	RG (n=21) CG (n=23)	80	3.0	60				FG: 5.9 ↓* RG: 5.7 ↓* CG: 2.6 ↑*	FG: 6.1% ↑* RG: 5.8% ↑* CG: 2% ↑*	FG: 4.8 ↓* RG: 4.6 ↓* CG: 0.5 ↓	FG: 1.8 ↓* RG: 1.8 ↓* CG: 0.8 ↑	FG: 5.4 ↑* RG: 1.3 ↑* CG: 0.2 ↑

Study	Population					Training programme					Outcomes							
	Status	Gender	Age (yr)	Sample size	Drop out (*n*)	Duration (weeks)	Comparison group (*n*)	Average intensity (%HRmax)	Days/wk	Session (min)	SBP (mmHg)	DBP (mmHg)	RHR (bpm)	BW (kg)	LBM (kg)	FM (kg)	BMI (kg/m^2)	CMJ (cm)
Mohr et al. [9]	Sedentary with mild hypertension	F	40-50	42	1	15	CG (n=20)	80.5±1.1	3.0±0.1	60	FG: 12 ↓* CG: nc	FG: 6 ↓* CG: nc	FG: 7 ↓* CG: 3 ↓	FG: 1.4 ↓* CG: 1 ↑*	FG: 1.2 ↑* CG: nc	FG: 2.3↓* CG: 0.4 ↑	FG: 0.6 ↓* CG: 0.3 ↑	
Mohr et al. [32]	Premenopausal with mild hypertension	F	40-52	83	0	15	HITS (n=21) MODS (n=21) CG (n=21)	~80	3.0±0.5	60	FG: 12 ↓* HITS: 6 ↓* MODS: 4 ↓* CG: 1 ↓	FG: 6 ↓* HITS: 2 ↓ MODS: nc CG: 1 ↓	FG: 7 ↓* HITS: 5 ↓* MODS: 5 ↓* CG: 0.9 ↑	FG: 1.4 ↓* HITS: 0.6 ↓ MODS: 1.4 ↓* CG: 0.9 ↑	FG: 1.2 ↑* HITS: 1.7 ↑* MODS: 1 ↑* CG: 0.4 ↑	HITS: 1 ↓* MODS: 1.7 ↓* CG: 0.4 ↑		
Randers et al. [24]	Healthy untrained	M	20-43	22	5	12+52	CG (n=7)	12 weeks: 81 52 weeks: 82	12 weeks - 1.8-2.9 52 weeks - 0.9-1.6	60	FG: 8 ↓* CG: nc	FG: 3 ↓ CG: nc	FG: 6 ↓* CG: 3 ↑	FG: 1.4 ↓* CG: 1 ↑*		FG: 2.4 ↓* CG: 0.1↓		
Randers et al. [25]	Homeless	M	27-47	55	23	12	CG (n=10)	82±4	2.8±0.8	60			FG: 4 ↓* CG: 3 ↑	FG: 0.9 ↓ CG: 0.6 ↑	FG: 1.1 ↑* CG: 0.4 ↑	FG: 1.7 ↓* CG: 0.6 ↑	FG: 0.3 ↓ CG: 0.2 ↑	
Schmidt et al. [55]	Untrained	M	65-75	27	1	52	STG (n=9) CG (n=8)	Not reported	1.7±0.3	60	FG: 0.2 ↓ STG: 2 ↑ CG: nc	FG: nc STG: 1 ↑ CG: nc	FG: 8 ↓* STG: 2 ↓ CG: 2 ↓					
Uth et al. [11]	Prostate cancer	M	43-74	57	8	12	CG (n=28)	84.6±3.9	1.7±0.1	45-60				FG: 0.2↓ CG: 0.1↓	FG: 0.9 ↑* CG: 0.1↑	FG: 0.2 ↓ CG: 0.1↓	FG: 0.1↓ CG: 0.1↓	FG: 1.1 ↑* CG: 0.8 ↓*
Andersen et al. [45]	Healthy elderly	M	63-74	27	1	16+46	STG (n=9) CG (n=8)	~80	1.7±0.3	60				FG: 2.3↓* STG: 0.3↓ CG: 1↑	FG: 0.6↓ STG: 0.9↑* CG: 0.4↑	FG: 1.8↓ STG: 1↓ CG: 0.1↓	FG: 0.8 ↓* STG: 0.1 ↓ CG: 0.3↑	
Barane et al. [42]	Healthy hospital employees	F	25-63	107		41	ZG (n=37) CG (n=35)	78%	2-3	60								FG: nc ZG: 0.3 ↓ CG: nc
Hammami et at. [34]	Post pubertal adolescent	M	15.9±0.6	22	0	8	CG (n=11)	84.6	2	30-45	FG: 2↑ CG: 3↑	FG: 3↓ CG: nc	FG: 5↓ CG: 7↓					
Krustrup et al. [35]	Mildly hypertensive middle aged	F	45±5	41	10	52	CG (n=12)	~80	2.5±0.4	45-60	FG: 7↓* CG: 3↑	FG:4↓ CG: 4↑	FG: 7↓ CG: 3↓	FG: 2.5↓* CG: 0.6↑	FG: 2.6 ↑* CG: 1.1↑	FG: 3.2↓* CG: 0.2↑		
Seabra et al. [38]	Overweight children	M	8-12	17	0	26	CG (n=8)	78%	4	60-90								FG: 7.7↑* CG: 0.1↓
Seabra et al. [36]	Overweight children	M	8-12	90	2	26	TG (n=29) CG (n=30)	78%	3	60-90	FG: 0.4↑ TG: 4.9↑ CG: 1.4↑	FG: 3.9↓ TG: 4.8↓ CG: 1.8↑		FG: 0.4↓ TG: 1.5↑ CG: 1.9↑	FG: 1.5↑* TG: 1.7↑* CG: 1↑*	FG: 1.3 ↓* TG: 1.7 ↓* CG: 2.4↑*	FG: 0.2↓ TG: 0.1↓ CG: 0.2↑	

Study	Population					Training programme					Outcomes								
	Status	Gender	Age (yr)	Sample size	Drop out (*n*)	Duration (weeks)	Comparison group (*n*)	Average intensity (%HRmax)	Days/wk	Session (min)	SBP (mmHg)	DBP (mmHg)	RHR (bpm)	BW (kg)	LBM (kg)	FM (kg)	BMI (kg/m^2)	CMJ (cm)
Sundstrup et al. [43]	Healthy elderly	M	68.2±3.2	27	2	16+36	STG (n=9) CG (n=8)	~80	2-3	45-60								FG: 5.8↑* STG: 5.5↑ CG: 2.5 ↑
Uth et al. [39]	Prostate cancer	M	67±7	57	16	32	CG (n=28)		2-3	45-60					FG: 0.1↓ CG: 0.1↓	FG: 0.2↓ CG: 0.1↓		FG: 0.9↑ CG: 0.7↓

↑* - significant increase; ↑ - increase; ↓* - significant decrease; ↓ - decrease; **nc** – no changes; **HRmax** - maximal heart rate; **RM** - repetition maximum; **M** – male; **F** – female; **CMJ** – countermovement jump; **SBP** – systolic blood pressure; **DBP** – diastolic blood pressure; **BW** – body weight; **LBM** – lean body mass; **FM** – fat mass **BMI** – body mass index; **RHR** - resting heart rate; **ST** – strength training; **FG** – football group; **CG** – control group; **STG** – strength training group; **VFG** – vibration strength group; **RG** – running group; **ZG** – Zumba group; **TG** – traditional activity group; **HIRG** – high intensity running group; **DCG** – doctoral advice control group; **HITS** – high intensity swimming group; **MODS** – moderate intensity swimming group; **WK** – week

Table 3 Systematic review and overall observed effects for metabolic parameters

Study	Population: Status	Gender	Age (yr)	Sample size	Drop out (*n*)	Training programme: Duration (weeks)	Comparison group (*n*)	Average intensity (%HRmax)	Days/wk	Session (min)	Outcomes: LDL chol (mmol/L)	HDLchol (mmol/L)	Triglycerides (mmol/L)	Total cholesterol (mmol/L)	Glucose (mmol/L)	Glucose tolerance (mmol/L)
Andersen et al. [44]	Type II diabetics	M	49±2	21	3	24	CG (n=9)	83±2	1.5±0.9	60					FG: 1.0 ↓* CG: 0.9 ↑	
Andersen et al. [51]	Mild to moderate hypertension	M	31-54	22	3	12	CG (n=9)	83	1.7±0.2	60	FG: nc CG: nc	FG: nc CG: 0.1↓	FG: 0.2 ↑ CG: nc	FG: nc* CG: 0.5 ↓		
Barene et al. [26]	Healthy hospital employees	F	25-65	118	41	40	ZG (n=30) CG (n=34)	78.6±3.2	12 weeks - 2.4±0.5 28 weeks - 1.2±0.2	60	FG: 0.1↓ ZG: 0.2↓ CG: nc	FG: nc ZG: nc CG: nc	FG: nc ZG: 0.1↑ CG: nc	FG: nc ZG: 0.2↓ CG: nc	FG: 0.1 ↑ ZG: 0.2 ↓ CG: nc	
Krustrup et al. [53]	Healthy untrained	F	19-47	28	6	68	RG (n=8) CG (n=7)	81±1	1.78	60	FG: 0.2 ↓ RG: nc CG: 0.1 ↑	FG: 0.1 ↑ RG: 0.1 ↑ CG: 0.1 ↑	FG: 0.06 ↓ RG: 0.06 ↑ CG: 0.05 ↑	FG: 0.1 ↓ RG: 0.1 ↓ CG: 0.2 ↑	FG: nc RG: 0.4 ↓ CG: 0.1 ↑	FG: 0.1 ↓ RG: 0.3 ↓ CG: 0.3 ↑
Krustrup et al. [37]	Healthy untrained	F	19-47	53	12	16	RG (n=18) CG (n=14)	83	1.8	60					FG: 0.07 ↓ RG: nc CG: 0.3 ↓	
Krustrup et al. [5]	Healthy untrained	M	20-43	36	4	12	RG (n=12) CG (n=11)	82	2.3	60	FG: 0.4 ↓ RG: 0.1 ↓ CG: nc	FG: 0.1↑ RG: 0.1↑ CG: 0.1↑		FG: 0.2 ↓ RG: 0.3 ↓ CG: nc		
Krustrup et al. [31]	Untrained with mild hypertension	M	30-55	43	10	26	CG (n=11)	85±7	1.7±0.5	60	FG: 0.3 ↓ CG: 0.3 ↑	FG: 0.1 ↓ CG: 0.1 ↑			FG: nc CG: 0.3 ↓	
Mohr et al. [9]	Sedentary with mild hypertension	F	35-50	42	1	15	CG (n=20)	80.5±1.1	3.0±0.1	60	FG: nc CG: nc	FG: nc CG: nc	FG: 0.2 ↓ CG: 0.3 ↑	FG: 0.4 ↓ CG: 0.1 ↑		
Randers et al. [24]	Healthy untrained	M	20-43	22	5	12+52	CG (n=7)	12 weeks: 81 52 weeks: 82	12 weeks - 1.8-2.9 52 weeks - 0.9-1.6	60	FG: 0.2 ↓ CG: 0.2 ↑	FG: 0.1 ↑ CG: nc	FG: 0.2 ↓ CG: 0.2 ↓	FG: nc CG: 0.1 ↑	FG: 0.2 ↓ CG: nc	FG: 0.2 ↓ CG: 0.2 ↓
Randers et al. [25]	Homeless	M	27-47	55	23	12	CG (n=10)	82±4	2.8±0.8	60	FG: 0.4 ↓* CG: 0.1 ↑	FG: nc CG: 0.1 ↓	FG: 0.08 ↑ CG: 0.1 ↑	FG: 0.1 ↓ CG: 0.1 ↑	FG: 0.1 ↑ CG: 0.2 ↓	
Andersen et al. [45]	Healthy elderly	M	63-74	27	1	16+46	STG (n=9) CG (n=8)	~80	1.7±0.3	60	FG: nc STG: 0.2 ↑ CG: 0.1↑	FG: 0.2 ↑ STG: 0.3↑ CG: nc	FG: nc STG: 0.1 ↑ CG: 0.2 ↑	FG: 0.5 ↓ STG: 0.5↓ CG: 0.1↓	FG: nc STG: 0.1↑ CG: 0.2↑	FG: 0.1↓ STG: 0.4 ↑ CG: nc
Krustrup et al. [35]	Mildly hypertensive middle aged	F	45±5	41	10	52	CG (n=12)	~80	2.5±0.4	45-60	FG: 0.1 ↓* CG: 0.3 ↑	FG: 0.2 ↑* CG: 0.2 ↓	FG: 0.1 ↓* CG: 0.2 ↑	FG: nc CG: 0.5 ↑	FG: 0.3 ↑ CG: 0.2 ↑	

↑* - significant increase; ↑ - increase; ↓* - significant decrease; ↓ - decrease; **nc** – no changes; **HRmax** - maximal heart rate; **RM** - repetition maximum; **M** – male; **F** – female; **LDL** – Low density lipoproteins; **HDL** – High density lipoprotein; **ST** – strength training; **FG** – football group; **CG** – control group; **STG** – strength training group; **RG** – running group; **ZG** – Zumba group; **WK** – week

Table 4. GRADE quality of evidence of included studies and relevant outcomes

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	**Study design**	**Risk of bias**	**Inconsistency**	**Indirectness**	**Imprecision**	**Other considerations**	**Recreational football**	**other exercise and control**	**Relative (95% CI)**	**Absolute (95% CI)**		
Systolic blood pressure OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 110 to 151)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	457	453	-	MD **4.4 mmHg lower** (7.6 lower to 1.1 lower)	⊕⊕⊕◯ MODERATE	
Diastolic blood pressure OVERALL (follow up: range 15 weeks to 54 weeks; Scale from: 58 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	294	484	-	MD **3 mmHg lower** (4.1 lower to 1.1 lower)	⊕⊕⊕◯ MODERATE	
Resting heart rate OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 51 to 80)												
15	randomised trials	not serious	serious [b]	not serious	not serious	publication bias strongly suspected [a]	245	330	-	MD **5.7 bpm lower** (8.3 lower to 3.1 lower)	⊕⊕◯◯ LOW	CRITICAL
Body mass index OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	463	421	-	MD **0.3 kg/m2 lower** (0.6 lower to 0.1 lower)	⊕⊕⊕⊕ HIGH	
Body mass OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 65 to 100)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
19	randomised trials	not serious	not serious	not serious	not serious	none	557	502	-	MD **2.1 kg lower** (5.4 lower to 0.8 lower)	⨁⨁⨁⨁ HIGH	
Lean body mass OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 38 to 67)												
19	randomised trials	not serious	not serious	not serious	not serious	none	573	521	-	**0.4 kg higher** (0.1 higher to 0.8 higher)	⨁⨁⨁⨁ HIGH	
Fat mass OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 38)												
19	randomised trials	not serious	serious [b]	not serious	not serious	publication bias strongly suspected [a]	576	522	-	MD **1 kg lower** (1.7 lower to 0.6 lower)	⨁⨁◯◯ LOW	CRITICAL
Muscular fitness OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 11.5 to 49.4)												
10	randomised trials	not serious	very serious [b]	not serious	not serious	publication bias strongly suspected [a]	170	227	-	MD **2.5 cm higher** (0.9 higher to 4.1 higher)	⨁◯◯◯ VERY LOW	
Low density lipoproteins OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 2.3 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	273	214	-	MD **0.2 m/mol lower** (0.4 lower to 0.1 lower)	⨁⨁⨁⨁ HIGH	
Total cholesterol OVERAll (follow up: range 12 weeks to 54 weeks; Scale from: 3.2 to 5.9)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
9	randomised trials	not serious	not serious	not serious	not serious	none	521	203	-	MD **0.1 m/mol lower** (0.3 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	
Triglycerides OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	227	183	-	MD **0.1 m/mol lower** (0.2 lower to 0)	⊕⊕⊕⊕ HIGH	
Fasting glucose OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 8.8)												
9	randomised trials	not serious	not serious	not serious	not serious	none	245	193	-	MD **0.1 m/mol lower** (0.4 lower to 0.3 higher)	⊕⊕⊕⊕ HIGH	
Glucose tolerance OVERALL (follow up: range 12 weeks to 54 weeks; Scale from: 24 to 69)												
5	randomised trials	not serious	not serious	not serious	not serious	none	116	78	-	MD **41.3 m/mol higher** (28.4 higher to 54.3 higher)	⊕⊕⊕⊕ HIGH	

CI: Confidence interval; **MD:** Mean difference; a. Significant result (P<0.10) of Egger's test for funnel plot asymmetry; b. Assumption of large heterogenit

Table 5 Effect of recreational football on systolic and diastolic blood pressure with modifying effects for type of control group, gender, age, length of training intervention and training frequency

	Systolic blood pressure			Diastolic blood pressure		
	Effect size (95% CI)	±95%CL	Magnitude Based Inference	Effect size (95% CI)	±95%CL	Magnitude Based Inference
Type of control						
No-exercises	4.20 (1.87, 6.53)	1.7	Most likely extremely large beneficial	3.89 (2.33, 5.44)	1.3	Most likely very largely beneficial
Running group	-0.75 (-4.24, 2.74)	3.7	Possibly moderately harmful	2.21 (-0.81, 5.23)	3.1	Possibly largely beneficial
Zumba group	-0.71 (-6.32, 4.91)	6.0	Possibly moderately harmful	0.54 (-2.69, 3.77)	3.4	Unclear
Gender						
Male	2.25 (0.21, 4.30)	2.0	Possibly very large beneficial	3.98 (2.32, 5.64)	1.1	Most likely very largely beneficial
Female	4.17 (1.15, 7.19)	2.8	Very likely extremely large beneficial	2.28 (0.82, 3.75)	1.9	Likely very largely beneficial
Age (years)						
18-45	1.23 (-1.32, 3.77)	2.7	Unclear	2.49 (0.70, 4.28)	1.7	Likely very largely beneficial
45-65	5.69 (2.97, 8.41)	2.3	Most likely extremely large beneficial	3.99 (2.16, 5.83)	1.3	Most likely very largely beneficial
>65	1.02 (-8.32, 10.35)	10.0	Unclear	0.31 (-4.67, 5.29)	5.3	Unclear
Length of training intervention						
≤12 weeks	0.67 (-1.90, 3.24)	13.0	Unclear	2.15 (0.46, 3.83)	1.6	Likely very largely beneficial
>12 weeks	4.59 (2.46, 6.72)	1.5	Most likely extremely large beneficial	3.63 (2.14, 5.12)	1.2	Most likely very largely beneficial
Training frequency						
≤2 weeks	2.77 (0.78, 4.77)	1.8	Likely very large beneficial	1.96 (0.47, 3.45)	1.4	Likely largely beneficial
>2 weeks	3.71 (0.69, 6.73)	2.9	Likely very large beneficial	4.0 (2.48, 5.54)	1.6	Most likely extremely large beneficial
Type of hypertension						
Normotensive	1.80 (-0.04, 3.65)	1.8	Possibly largely beneficial	1.21 (0.11, 2.32)	1.1	Possibly largely beneficial
Pre-Hypertensive	4.36 (0.02, 8.70)	4.3	Likely extremely large beneficial	5.52 (3.51, 7.54)	2.2	Most likely extremely large beneficial
Mild-Hypertensive	7.97 (5.03, 10.91)	2.6	Most likely extremely large beneficial	6.53 (3.81, 9.25)	1.6	Most likely extremely large beneficial

CL – confidence limit

Table 6 Effect of recreational football on resting heart rate and muscular fitness with modifying effects for type of control group, gender, age, length of training intervention and training frequency

	Resting heart rate			Muscular fitness		
	Effect size (95% CI)	±95%CL	Magnitude Based Inference	Effect size (95% CI)	±95%CL	Magnitude Based Inference
Type of control						
No-exercises	6.03 (4.43, 7.46)	2.0	Most likely extremely large beneficial	2.27 (1.29, 3.25)	0.74	Most likely very largely beneficial
Running group	0.57 (-1.48, 2.62)	2.2	Unclear	0.28 (-1.05, 1.61)	1.4	Unclear
Zumba group				-1.06 (-3.40, 1.28)	2.5	Possibly moderately harmful
Gender						
Male	5.06 (2.48, 7.64)	1.7	Most likely extremely large beneficial	1.48 (0.20, 2.75)	1.2	Very likely largely beneficial
Female	2.95 (0.76, 5.14)	2.1	Very likely very largely beneficial	0.63 (-0.72, 1.97)	1.4	Unclear
Age (years)						
18-45	3.19 (0.95, 5.43)	2.1	Very likely very largely beneficial	0.92 (-1.07, 2.1)	0.72	Unclear
45-65	5.66 (2.14, 9.18)	3.2	Most likely extremely large beneficial	-0.005 (-1.03, 1.01)	1.0	Unlikely trivially harmful
>65	6.0 (4.34, 7.66)	2.4	Most likely extremely large beneficial	1.63 (0.48, 2.78)	2.7	Very likely largely beneficial
Length of training intervention						
≤12 weeks	1.99 (-2.09, 6.08)	4.3	Unclear	0.09 (-1.86, 2.03)	2.1	Unclear
>12 weeks	4.70 (2.76, 6.65)	1.5	Most likely extremely large beneficial	1.72 (0.77, 2.66)	0.56	Most likely largely beneficial
Training frequency						
≤2 weeks	4.58 (2.1, 7.07)	1.5	Most likely extremely large beneficial	1.56 (0.00, 3.12)	1.6	Likely largely beneficial
>2 weeks	3.36 (1.13, 5.59)	2.0	Very likely very largely beneficial	1.05 (-0.15, 2.25)	1.2	Likely moderately beneficial

CL – confidence limit

Table 7 Effect of recreational football on body mass index and body mass with modifying effects for type of control group, gender, age, length of training intervention and training frequency

	Body mass index			Body mass		
	Effect size (95% CI)	±95%CL	Magnitude Based Inference	Effect size (95% CI)	±95%CL	Magnitude Based Inference
Type of control						
No-exercises	0.28 (-0.12, 0.67)	0.41	Possibly small beneficial	0.7 (-0.29, 1.68)	1.0	Unlikely small beneficial
Running group	-0.12 (-0.54, 0.30)	0.45	Unlikely trivially harmful	-0.21 (-1.34, 0.92)	1.2	Very unlikely small harmful
Zumba group	-0.4 (-1.34, 0.54)	0.99	Possibly small harmful	0.09 (-2.58, 2.75)	2.9	Unlikely trivially harmful
Gender						
Male	0.54 (0.15, 0.93)	0.37	Likely small beneficial	1.64 (0.42, 2.87)	1.2	Likely largely beneficial
Female	-0.19 (-0.50, 0.13)	0.33	Unlikely trivially harmful	-0.14 (-0.94, 0.67)	0.86	Very unlikely trivially harmful
Age (years)						
18-45	0.02 (-0.36, 0.41)	0.42	Very unlikely trivially harmful	-0.17 (-1.03, 0.68)	0.91	Very unlikely trivially harmful
45-65	0.02 (-0.63, 0.67)	0.69	Unlikely trivially harmful	1.08 (-0.47, 2.63)	1.6	Possibly moderately beneficial
>65	0.50 (-0.03, 1.03)	0.53	Possibly small beneficial	1.52 (-0.13, 3.17)	1.7	Possibly largely beneficial
Length of training intervention						
≤12 weeks	0.46 (-0.24, 1.13)	0.71	Possibly small beneficial	1.04 (-0.98, 3.06)	2.1	Unclear
>12 weeks	0.03 (-0.24, 0.30)	0.29	Most unlikely trivially beneficial	0.32 (-0.39, 1.04)	0.76	Most unlikely small harmful
Training frequency						
≤2 weeks	0.01 (-0.27, 0.29)	0.31	Very unlikely trivially harmful	0.15 (-0.60, 0.90)	0.80	Most likely trivially beneficial
>2 weeks	0.39 (-0.13, 0.92)	0.54	Possibly small beneficial	1.48 (-0.07, 3.03)	1.6	Possibly largely beneficial

CL – confidence limit

Table 8 Effect of recreational football on lean body mass and fat mass with modifying effects for type of control group, gender, age, length of training intervention and training frequency

	Lean body mass			Fat mass		
	Effect size (95% CI)	±95%CL	Magnitude Based Inference	Effect size (95% CI)	±95%CL	Magnitude Based Inference
Type of control						
No-exercises	0.51 (0.03, 0.99)	0.48	Possibly moderately beneficial	1.72 (0.86, 2.58)	0.56	Most likely largely beneficial
Running group	0.20 (-0.40, 0.79)	0.33	Very unlikely small harmful	-0.41 (-1.24, 0.42)	0.87	Possibly small harmful
Zumba group	0.05 (-2.30, 2.39)	2.5	Unclear	0.35 (-1.54, 2.24)	2.0	Unclear
Gender						
Male	0.12 (-0.48, 0.71)	0.63	Very unlikely trivially harmful	1.33 (0.61, 0.04)	1.9	Very likely largely beneficial
Female	0.59 (0.16, 1.02)	0.40	Possibly small beneficial	0.74 (-0.17, 1.65)	0.93	Possibly moderately beneficial
Age (years)						
18-45	0.56 (0.11, 1.0)	0.43	Possibly small beneficial	0.68 (-0.31, 1.67)	1.0	Possibly moderately beneficial
45-65	0.28 (-0.73, 1.29)	1.1	Unclear	1.63 (1.0, 2.27)	0.66	Most likely largely beneficial
>65	0.20 (-0.73, 1.13)	0.99	Unlikely small beneficial	0.58 (-0.56, 1.72)		Unclear
Length of training intervention						
≤12 weeks	-0.02 (-1.31, 1.28)	1.3	Unlikely trivially harmful	1.45 (0.41, 2.49)	0.97	Very likely largely beneficial
>12 weeks	0.46 (0.10, 0.82)	0.35	Unlikely small beneficial	0.88 (0.16, 1.59)	0.69	Likely moderately beneficial
Training frequency						
≤2 weeks	0.46 (0.08, 0.84)	0.37	Unlikely small beneficial	-0.32 (-0.86, 0.21)	0.19	Unlikely small harmful
>2 weeks	0.43 (0.08, 0.77)	0.17	Unlikely small beneficial	1.66 (1.66, 0.99)	0.67	Most likely largely beneficial

CL – confidence limit

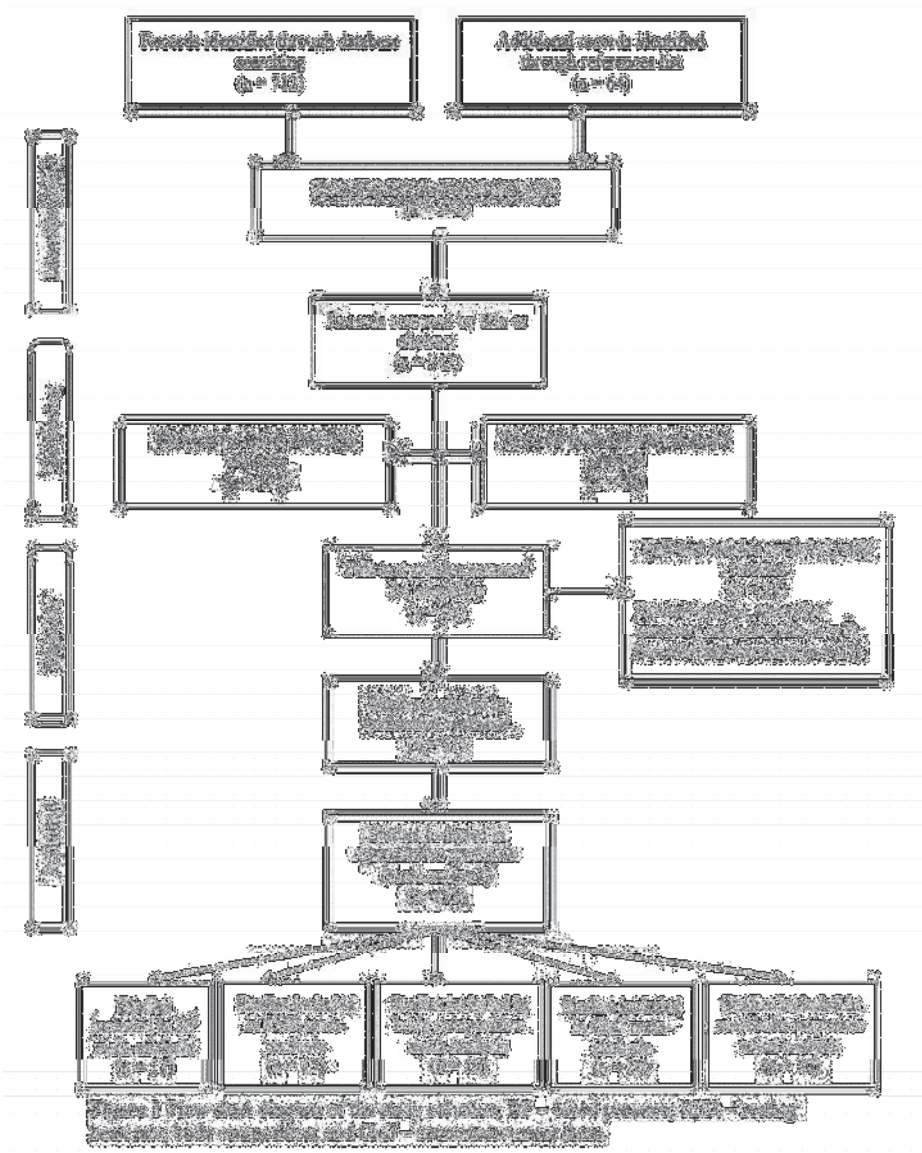

Figure 1 Flow chart diagram of the study selection; BP – blood pressure; RHR – resting heart rate; body composition; and CMJ – countermovement jump.

50x63mm (300 x 300 DPI)

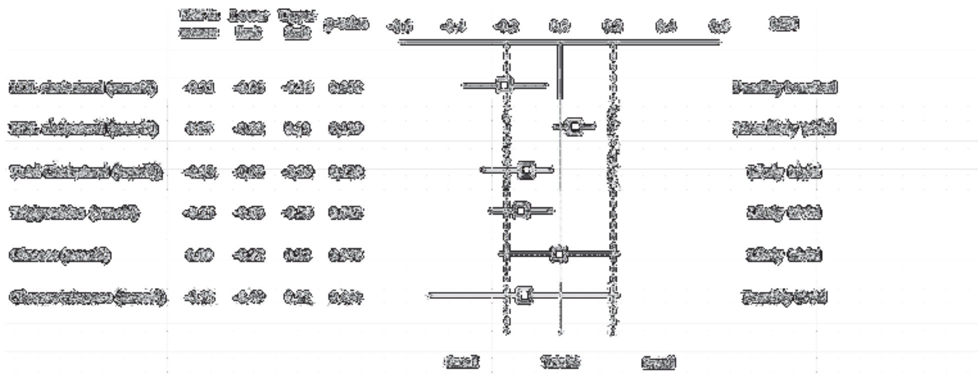

Figure 2 Forest plot of the effect sizes and 95% confidence intervals (CIs) of the changes in overall metabolic parameters; MBI – magnitude based inferences; LDL - low density lipoproteins; HDL - high density lipoproteins

Study characteristics

Cardiovascular fitness assessed by SBP and DBP covered a sample size of 770 subjects comprising 294 participants (151 male and 143 female) in recreational football intervention groups, and 484 participants (186 males and 290 females) in comparison groups of Zumba training [26 27], vibration training [28], running training [18 30] strength training [11], typical physical activity [35] high and moderate intensity swimming training and no-exercises controls (CG). The health benefits of recreational football health benefits was assessed in hypertensive untrained men [8 25 31], homeless men [17], healthy males [11 16 18], post pubertal [33] and overweight [35] children, sedentary women with hypertension [9 32 34] and healthy females [26-28 30]. The majority of participants were aged between 20 and 45 years with a range of 8 to 75 years old. The average intensity of the observed training programmes varied from 71% to 83% of maximal heart rate (HRmax). Organized sessions of recreational football were mostly conducted 2-3 times per week with a frequency of 1.2–3.0 sessions per week. Mean systolic and diastolic blood pressure values oscillated from 111/58 mmHg to 153/97 mmHg.

The RHR meta-analysis featured a sample of 565 adults. The recreational football effects were assessed in 143 males and 102 females and compared to variety of controls comprising of 148 male and 172 and female participants. In brief, the effects of recreational football on RHR were examined in untrained hypertensive [8 29], untrained [16 18] homeless [17] and elderly [11] men and in inactive hypertensive females [9 28 30 32 34 36] and post pubertal children [33]. The subject's age ranged from 15 to 75 years with measured RHR values between 61 and 77 beats per minute (bpm). Training interventions featured bouts of small-sided games lasting no longer than 60 min interrupted with resting periods of 2-3 min. Subjects trained 2-3 times per week, with the exception of the follow-up period in one study [16] where the training frequency was lowered to 1.2 sessions per week. RHR was measured in a lying position after the rest period.

The effects of recreational football on body composition were determined by assessing meta-analysis data on body mass, lean body mass (LBM) and BMI. In total, the sample comprised 911 participants. 424 males (171 representing recreational football groups (SG) and 252 representing random controls) and 488 females (176 in SGs and 312 in random control groups or other training intervention groups). The health effects of playing recreational football were investigated in untrained healthy men [4 18 43] and children [35] and women [26-28 30 36], and in patients with hypertension [9 29 31 34], type 2 diabetes [10 44] and prostate cancer [13 38]. The participant's age varied from 8 to 75 years. The recreational football training interventions featured average intensities of 78-85% HRmax with a training frequency of 1.5-3 times per week.

For the muscular fitness test, the overall sample size was 397 participants, 170 were included in recreational football training interventions, while 227 were coded as variety of CG, strength training and running controls. Two studies [39 41], investigated the effects of recreational football in premenopausal women, sampling 128 females. Overall, 269 adult male participants were included, measuring training effects on muscular fitness from three studies [4 16 40] in healthy untrained men, two studies [12 42] in elderly men and two studies [13 38] in men with prostate cancer. The participants' age ranged from 20 to 74 years. The training interventions had average duration of 55-60 min per training session with a training frequency ranging from 1.6 to 3 sessions per week. Randers, et al. [16] and a 52-weeks follow-up period with training frequency reduced to 0.9 – 1.6 times per week which was used for the meta-analysis as an individual study. The average training intensity expressed as a heart rate value was ~82% HRmax (range: 80-84% HRmax). Jump height performance ranged from 9.6 to 45.2 cm.

Metabolic responses included changes in LDL, HDL, total cholesterol, triglycerides, fasting glucose and glucose tolerance. Age range of the participants was 18-74 years. Data was obtained from 10 studies [11 15 16 21 22 31 35 36 40 50] for low and high-density lipoproteins. Total number from included studies was 202 (83 males and 119 females) of recreational footballers and 214 controls (64 males and 150 females). Nine studies [11 15 16 21 22 31 35 40 50] were suitable to extract data for total cholesterol. Sample size was 168 (66 males and 102 females) and 132 (44 males and 88 females) of recreational football players and variety of controls. Eight studies [15 16 21 22 31 35 40 50] were used to compute data for triglycerides. Overall, 156 football intervention participants and 183 controls were included in study. Obtained data for fasting glucose level were extracted from 9 studies [16 21 22 31 35 36 40 42 50]. Overall sample featured 84 males and 81 female that played recreational football and 56 males and 67 females randomized in variety of controls. Glucose tolerance included sample of 86 football players (of whom 65 were males) and 78 controls (47 male participants) extracted from five studies [16 21 35 36 40 51].

Study outcomes

Body mass index. When recreational football was compared to male and female group ES *were likely small beneficial* and *very unlikely trivially harmful* (ES= 0.54; 95% CI: 0.15, 0.93 and ES= -0.18; 95% CI: -0.50, 0.12). When the results were moderated using age groups, an *very unlikely trivially harmful* ES was obsereved in the 18-45-year-old population (ES= 0.02; 95% CI: -0.36, 0.41). The effect size for the 45-65 and 65+ participants was *unlikely trivally harmfull* and *possibly moderately beneficial* (ES= 0.02; 95% CI: -0.63, 0.67 and ES= 0.5; 95% CI: -0.02, 1.03). *Possibly small benefical* and *most unlikely trivial harmful* effects were observed for duration of intervention of up to 12 and longer than 12 weeks. *Very unlikely trivially harmfull* and *possibly small beneficial* effects were observed for up to 2 and over 2 sessions per week (ES= 0.01; 95% CI -0.27, 0.29 and ES= 0.39; 95% CI: -0.13, 0.92).

Lean body mass. Greater ES was observed for women (ES= 0.59; 95% CI: 0.16, 1.02, *possibly small beneficial*) than men (ES= 0.12; 95% CI: -0.48, 0.71, *very unlikely trivially harmful*). The effect of age was small (*possibly beneficial, unclear* and *unlikely trivially harmful* for 18-45, 45-65 and 65+ groups). When comapred to intervention duration period, ES outcome for the up to 12 weeks and over 12 weeks moderators was *unlikely trivially harmful* and *unlikely small benificial*, respectively. When training frequency was compared for two or less sessions per week, the effect was benifical (ES= 0.46; 0.08, 0.84, *unlikely small beneficial*) as well as for more than two sessions per week (ES= 0.43; 0.08, 0.77, *most unlikely trivially harmful*).

Table X. GRADE quality of evidence of included studies and relevant outcomes

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Systolic blood pressure in MEN (follow up: range 12 weeks to 12 weeks; Scale from: 110 to 151)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	238	194	-	MD **6.5 mmHg lower** (10.6 lower to 2.4 lower)	⨁⨁⨁◯ MODERATE	
Systolic blood pressure in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 113 to 142)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	307	291	-	MD **0.5 mmHg lower** (4.2 lower to 3.3 higher)	⨁⨁⨁◯ MODERATE	
Systolic blood pressure with MILD HYPERTENSION (follow up: range 12 weeks to 54 weeks; Scale from: 138 to 151)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	74	43	-	MD **7.8 mmHg lower** (1.7 lower to 1.1 higher)	⨁⨁⨁◯ MODERATE	
Systolic blood pressure with NORMOTENSIVE (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 125)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	333	308	-	MD **2.9 mmHg lower** (7.6 lower to 1.7 higher)	⨁⨁⨁◯ MODERATE	
Systolic blood pressure with PREHYPERTENSIVE (follow up: range 12 weeks to 54 weeks; Scale from: 130 to 139)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	138	134	-	MD **3.2 mmHg lower** (7.2 lower to 0.7 higher)	⨁⨁⨁◯ MODERATE	
Systolic blood pressure in > 65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 125 to 136)												
17	randomised trials	serious [b]	serious [c]	not serious	not serious	publication bias strongly suspected [a]	18	17	-	MD **7.1 mmHg lower** (7.8 lower to 4.8 higher)	⨁◯◯◯ VERY LOW	
Systolic blood pressure in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 136)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	164	139	-	MD **1.6 mmHg lower** (7.4 lower to 4.1 higher)	⊕⊕⊕◯ MODERATE	
Systolic blood pressure in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 113 to 151)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	294	259	-	MD **4.7 mmHg lower** (8.1 lower to 1.2 lower)	⊕⊕⊕◯ MODERATE	
Systolic blood pressure <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 134)												
17	randomised trials	not serious	not serious	not serious	not serious	none	134	159	-	MD **3 mmHg lower** (7 lower to 1.1 higher)	⊕⊕⊕⊕ HIGH	
Systolic blood pressure >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 151)												
17	randomised trials	not serious	not serious	not serious	not serious	none	386	341	-	MD **3.1 mmHg lower** (8 lower to 0.3 lower)	⊕⊕⊕⊕ HIGH	
Systolic blood pressure <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 153)												
17	randomised trials	not serious	not serious	not serious	not serious	none	246	206	-	MD **5.3 mmHg lower** (10.7 lower to 0.3 higher)	⊕⊕⊕⊕ HIGH	
Systolic blood pressure >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 111 to 142)												
17	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	299	279	-	MD **2.2 mmHg lower** (4.5 lower to 0.2 higher)	⊕⊕⊕◯ MODERATE	
Diastolic blood pressure in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 58 to 96)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
17	randomised trials	not serious	not serious	not serious	not serious	none	209	174	-	MD **4.4 mmHg lower** (7.2 lower to 1.5 lower)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 60 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	none	369	348	-	MD **0.3 mmHg lower** (3.5 lower to 2.8 higher)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure with MILD HYPERTENSION (follow up: range 12 weeks to 54 weeks; Scale from: 87 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	none	74	43	-	MD **6.7 mmHg lower** (17.4 lower to 3.9 higher)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure with NORMOTENSION (follow up: range 12 weeks to 54 weeks; Scale from: 58 to 78)												
17	randomised trials	not serious	not serious	not serious	not serious	none	390	365	-	MD **1.4 mmHg lower** (4.1 lower to 1.4 higher)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure with PREHYPERTENSION (follow up: range 12 weeks to 54 weeks; Scale from: 86 to 88)												
17	randomised trials	not serious	not serious	not serious	not serious	none	114	114	-	MD **1.7 mmHg lower** (5.8 lower to 2.5 higher)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure in > 65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 74 to 74)												
17	randomised trials	not serious	not serious	not serious	not serious	none	18	17	-	MD **3.5 mmHg lower** (4 lower to 2.3 higher)	⊕⊕⊕⊕ HIGH	
Diastolic blood pressure in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 68 to 88)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
17	randomised trials	not serious	not serious	not serious	not serious	none	197	176	-	MD **1.1 mmHg lower** (5.2 lower to 3.2 higher)	⨁⨁⨁⨁ HIGH	
Diastolic blood pressure in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 73 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	none	294	259	-	MD **2.8 mmHg lower** (6.3 lower to 0.58 higher)	⨁⨁⨁⨁ HIGH	
Diastolic blood pressure <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 60 to 88)												
17	randomised trials	not serious	not serious	not serious	not serious	none	205	195	-	MD **2.1 mmHg lower** (4.3 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Diastolic blood pressure >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 58 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	none	373	327	-	MD **2.3 mmHG lower** (5.6 lower to 1.02 higher)	⨁⨁⨁⨁ HIGH	
Diastolic blood pressure <2h per week (follow up: range 12 weeks to 54 weeks; Scale from: 60 to 97)												
17	randomised trials	not serious	not serious	not serious	not serious	none	279	243	-	MD **2.8 mmHg lower** (6.8 lower to 1.3 higher)	⨁⨁⨁⨁ HIGH	
Diastolic blood presure >2h per week (follow up: range 12 weeks to 54 weeks; Scale from: 58 to 88)												
17	randomised trials	not serious	not serious	not serious	not serious	none	299	279	-	MD **1.7 mmHg lower** (3.8 lower to 0.5 higher)	⨁⨁⨁⨁ HIGH	
Resting heart rate in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 61 to 79)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	169	124	-	MD **3.8 bpm lower** (7.8 lower to 0.8 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 61 to 77)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	185	172	-	MD **7.2 mmHg lower** (11.6 lower to 2.9 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 64 to 64)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	18	17	-	MD **2 bpm lower** (2.7 lower to 2.3 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 61 to 77)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	178	154	-	MD **4.9 bpm lower** (8.4 lower to 1.4 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 73 to 79)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	158	125	-	MD **7.6 bpm lower** (13.6 lower to 2.3 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 59 to 74)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	76	63	-	MD **5.8 bpm lower** (10.8 lower to 3.3 higher)	⨁⨁⨁◯ MODERATE	
Resting heart rate >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 54 to 80)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	278	234	-	MD **5.7 bpm lower** (8.6 lower to 2.8 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 61 to 79)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	175	140	-	MD **3.1 bpm lower** (5.7 lower to 0.4 lower)	⨁⨁⨁◯ MODERATE	
Resting heart rate >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 61 to 80)												
15	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	179	156	-	MD **6.2 bpm lower** (13 lower to 4.6 lower)	⨁⨁⨁◯ MODERATE	
Body mass index in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 22.6 to 30.7)												
19	randomised trials	not serious	not serious	not serious	not serious	none	212	183	-	MD **0.6 kg/m2 lower** (1 lower to 0.2 lower)	⨁⨁⨁⨁ HIGH	
Body mass index in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	251	238	-	MD **0.1 kg/m2 lower** (0.3 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Body mass index in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 26 to 28.3)												
19	randomised trials	not serious	not serious	not serious	not serious	none	62	57	-	MD **0.5 kg/m2 lower** (1 lower to 0.1 higher)	⨁⨁⨁⨁ HIGH	
Body mass index in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 27)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
19	randomised trials	not serious	not serious	not serious	not serious	none	198	184	-	MD **0.3 kg/m2 lower** (0.8 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Body mass index in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 24.4 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	203	180	-	MD **0.3 kg/m2 lower** (0.7 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Body mass index <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	190	176	-	MD **0.5 kg/m2 lower** (1.2 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Body mass index >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	273	245	-	MD **0.25 kg/m2 lower** (0.49 lower to 0.01 lower)	⨁⨁⨁⨁ HIGH	
Body mass index <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	252	225	-	MD **0.2 kg/m2 lower** (0.5 lower to 0)	⨁⨁⨁⨁ HIGH	
Body mass index >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 22.5 to 35)												
19	randomised trials	not serious	not serious	not serious	not serious	none	211	196	-	MD **0.5 kg/m2 lower** (1.1 lower to 0.1 higher)	⨁⨁⨁⨁ HIGH	
Body mass in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 72 to 100)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
19	randomised trials	not serious	not serious	not serious	not serious	none	222	190	-	MD **1.7 kg lower** (1.8 lower to 0.5 lower)	⨁⨁⨁⨁ HIGH	
Body mass in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 64 to 82)												
19	randomised trials	not serious	not serious	not serious	not serious	none	333	312	-	MD **0.6 kg lower** (1.3 lower to 0)	⨁⨁⨁⨁ HIGH	
Body mass in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 75 to 84)												
19	randomised trials	not serious	not serious	not serious	not serious	none	62	57	-	MD **1.3 kg lower** (3 lower to 0.3 higher)	⨁⨁⨁⨁ HIGH	
Body mass in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 64 to 88)												
19	randomised trials	not serious	not serious	not serious	not serious	none	208	191	-	MD **1 kg lower** (2.3 lower to 0.3 higher)	⨁⨁⨁⨁ HIGH	
Body mass in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 69 to 100)												
19	randomised trials	not serious	not serious	not serious	not serious	none	285	254	-	MD **1.3 kg lower** (2 lower to 0.6 lower)	⨁⨁⨁⨁ HIGH	
Body mass <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 68 to 88)												
19	randomised trials	not serious	not serious	not serious	not serious	none	190	176	-	MD **1.5 kg lower** (3.5 lower to 0.6 lower)	⨁⨁⨁⨁ HIGH	
Body mass >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 66 to 100)												
19	randomised trials	not serious	not serious	not serious	not serious	none	365	326	-	MD **1 kg lower** (1.6 lower to 0.6 lower)	⨁⨁⨁⨁ HIGH	

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Body mass <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 64 to 100)												
19	randomised trials	not serious	not serious	not serious	not serious	none	262	232	-	MD **0.8 kg lower** (1.5 lower to 0.2 lower)	⨁⨁⨁⨁ HIGH	
Body mass >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 68 to 88)												
19	randomised trials	not serious	not serious	not serious	not serious	none	293	270	-	MD **1.6 kg lower** (2.9 lower to 0.3 lower)	⨁⨁⨁⨁ HIGH	
Lean body mass in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 52 to 67)												
19	randomised trials	not serious	not serious	not serious	not serious	none	240	209	-	MD **0.8 kg higher** (0.4 higher to 1.7 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 38 to 47)												
19	randomised trials	not serious	not serious	not serious	not serious	none	333	312	-	MD **0.5 kg higher** (0.2 higher to 0.8 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 52 to 59)												
19	randomised trials	not serious	not serious	not serious	not serious	none	83	77	-	MD **0.4 kg lower** (1.4 lower to 0.4 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass in 19-45 year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 38 to 67)												
19	randomised trials	not serious	not serious	not serious	not serious	none	208	191	-	MD **0.3 kg higher** (0.5 lower to 1.1 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 41 to 63)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
19	randomised trials	not serious	not serious	not serious	not serious	none	282	253	-	MD **0.3 kg higher** (0.1 lower to 0.7 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 46 to 65)												
19	randomised trials	not serious	not serious	not serious	not serious	none	200	183	-	MD **0.2 kg higher** (1.2 lower to 1.2 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 38 to 67)												
19	randomised trials	not serious	not serious	not serious	not serious	none	373	338	-	MD **0.2 kg higher** (0.2 lower to 0.6 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 38 to 67)												
19	randomised trials	not serious	not serious	not serious	not serious	none	259	231	-	MD **0.04 kg higher** (0.4 lower to 0.5 higher)	⨁⨁⨁⨁ HIGH	
Lean body mass > 2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 41 to 63)												
19	randomised trials	not serious	not serious	not serious	not serious	none	314	290	-	MD **0.3 kg higher** (0.5 lower to 1.1 higher)	⨁⨁⨁⨁ HIGH	
Fat mass in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 21 to 31)												
19	randomised trials	not serious	not serious	not serious	not serious	none	243	210	-	MD **1 kg lower** (1.5 lower to 0.6 lower)	⨁⨁⨁⨁ HIGH	
Fat mass in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 22 to 38)												
19	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	333	312	-	MD **1 kg lower** (1.6 lower to 0.5 lower)	⨁⨁⨁◯ MODERATE	

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Fat mass in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 21 to 30)												
19	randomised trials	not serious	not serious	not serious	not serious	none	83	77	-	MD **0.5 kg lower** (1.2 lower to 0.2 higher)	⊕⊕⊕⊕ HIGH	
Fat mass in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 29)												
19	randomised trials	not serious	not serious	not serious	not serious	none	208	191	-	MD **1.1 kg lower** (1.6 lower to 0.5 lower)	⊕⊕⊕⊕ HIGH	
Fat mass in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 22 to 38)												
19	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	285	254	-	MD **1.2 kg lower** (1.9 lower to 0.6 lower)	⊕⊕⊕◯ MODERATE	
Fat mass <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 37)												
19	randomised trials	not serious	not serious	not serious	not serious	none	190	176	-	MD **1.1 kg lower** (1.8 lower to 0.4 lower)	⊕⊕⊕⊕ HIGH	
Fat mass >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 38)												
19	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	386	346	-	MD **1 kg lower** (1.5 lower to 0.6 lower)	⊕⊕⊕◯ MODERATE	
Fat mass <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 37)												
19	randomised trials	not serious	not serious	not serious	not serious	none	262	232	-	MD **0.8 kg lower** (1.3 lower to 0.3 lower)	⊕⊕⊕⊕ HIGH	
Fat mass >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 19 to 38)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
19	randomised trials	not serious	not serious	not serious	not serious	none	314	290	-	MD **1.3 kg lower** (1.9 lower to 0.8 lower)	⊕⊕⊕⊕ HIGH	
Muscular fitness in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 11.5 to 49.4)												
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	217	190	-	MD **3.3 cm higher** (1.2 higher to 5.3 higher)	⊕⊕⊕◯ MODERATE	
Muscular fitness in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 21.4 to 28.3)												
10	randomised trials	not serious	serious [b]	not serious	not serious	publication bias strongly suspected [a]	172	165	-	MD **0.3 cm higher** (1.3 lower to 2 higher)	⊕⊕◯◯ LOW	
Muscular fitness in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 11.5 to 17.3)												
10	randomised trials	not serious	not serious	not serious	not serious	none	103	97	-	MD **3.6 cm higher** (0.1 higher to 7 higher)	⊕⊕⊕⊕ HIGH	
Muscular fitness in 19-45 - year-olds (follow up: range 12 weeks to 54; Scale from: 26.1 to 49.4)												
10	randomised trials	not serious	not serious	not serious	not serious	none	129	110	-	MD **2.2 cm higher** (0.2 lower to 4.6 higher)	⊕⊕⊕⊕ HIGH	
Muscular fitness in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 21.4 to 29.2)												
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	148	140	-	MD **0.4 cm lower** (1 lower to 1.2 higher)	⊕⊕⊕◯ MODERATE	
Muscular fitness <12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 21.4 to 49.4)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	169	148	-	MD **1.3 cm higher** (1.5 lower to 4.2 higher)	⨁⨁⨁◯ MODERATE	
Muscular fitness >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 11.5 to 44.2)												
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	220	207	-	MD **3.1 cm higher** (1 higher to 5.2 higher)	⨁⨁⨁◯ MODERATE	
Muscular fitness <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 11.6 to 44.2)												
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	91	84	-	MD **1.4 cm higher** (0.7 lower to 3.5 higher)	⨁⨁⨁◯ MODERATE	
Muscular fitness >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 11.5 to 49.4)												
10	randomised trials	not serious	not serious	not serious	not serious	publication bias strongly suspected [a]	298	271	-	MD **3 cm higher** (0.7 higher to 5.2 higher)	⨁⨁⨁◯ MODERATE	
Low density lipoproteins in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 2.7 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	109	74	-	MD **0.3 m/mol lower** (0.5 lower to 0.5 higher)	⨁⨁⨁⨁ HIGH	
Low density lipiproteins in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 2.5 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	82	63	-	MD **0.2 m/mol lower** (0.5 lower to 0.1 higher)	⨁⨁⨁⨁ HIGH	
Low density lipoproteins in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 2.5 to 3.7)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
10	randomised trials	not serious	not serious	not serious	not serious	none	120	79	-	MD **0.4 m/mol lower** (0.5 lower to 0.3 lower)	⊕⊕⊕⊕ HIGH	
Low density lipoproteins in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 3.2 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	135	118	-	MD **0.08 m/mol lower** (0.3 lower to 0.2 higher)	⊕⊕⊕⊕ HIGH	
Low density lipoproteins >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 2.5 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	263	207	-	MD **0.2 m/mol lower** (0.4 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	
Low density lipoproteins <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 2.5 to 3.5)												
10	randomised trials	not serious	not serious	not serious	not serious	none	182		-	MD **0.3 m/mol lower** (0.4 lower to 0.1 lower)	⊕⊕⊕⊕ HIGH	
Low density lipoproteins >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 3.1 to 3.7)												
10	randomised trials	not serious	not serious	not serious	not serious	none	40	32	-	MD **0.2 m/mol lower** (0.3 lower to 0)	⊕⊕⊕⊕ HIGH	
Total cholesterol in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 3.7 to 5.9)												
9	randomised trials	not serious	not serious	not serious	not serious	none	87	63	-	MD **0 m/mol** (0.31 lower to 0.23 higher)	⊕⊕⊕⊕ HIGH	
Total cholesterol in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 4.3 to 5.8)												
9	randomised trials	not serious	not serious	not serious	not serious	none	164	140	-	MD **0.2 m/mol lower** (0.5 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Total cholesterol in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 3.2 to 3.7)												
9	randomised trials	not serious	not serious	not serious	not serious	none	18	17	-	MD **0.2 m/mol lower** (2.7 lower to 2.3 higher)	⊕⊕⊕⊕ HIGH	
Total cholesterol in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 4.0 to 5.2)												
9	randomised trials	not serious	not serious	not serious	not serious	none	98	68	-	MD **0.1 m/mol lower** (0.3 lower to 4 higher)	⊕⊕⊕⊕ HIGH	
Total cholesterol in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks)												
9	randomised trials	not serious	not serious	not serious	not serious	none	135	118	-	MD **0.1 m/mol lower** (0.6 lower to 0)	⊕⊕⊕⊕ HIGH	
Total cholesterol >12 weeks (follow up: range 12 weeks to 54 weeks)												
9	randomised trials	not serious	not serious	not serious	not serious	none	241	196	-	MD **0.1 m/mol lower** (0.3 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	
Total cholesterol <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 3.2 to 5.9)												
9	randomised trials	not serious	not serious	not serious	not serious	none	211	171	-	MD **0.1 m/mol higher** (0.3 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	
Total cholesterol >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 4.9 to 5.7)												
9	randomised trials	not serious	not serious	not serious	not serious	none	40	32	-	MD **0 m/mol** (0.2 lower to 0.1 higher)	⊕⊕⊕⊕ HIGH	
Triglycerides in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 0.9 to 2.1)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
8	randomised trials	not serious	not serious	not serious	not serious	none	63	43	-	MD **0.006 m/mol higher** (0.2 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Triglycerides in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	164	140	-	MD **0.2 m/mol higher** (0.4 lower to 0)	⨁⨁⨁⨁ HIGH	
Triglycerides in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 0.9 to 1.2)												
8	randomised trials	not serious	not serious	not serious	not serious	none	9	9	-	MD **0.2 m/mol lower** (0.8 lower to 0.5 higher)	⨁⨁⨁⨁ HIGH	
Triglycerides in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 1.6)												
8	randomised trials	not serious	not serious	not serious	not serious	none	74	48	-	MD **0.04 m/mol lower** (0.2 lower to 0.1 higher)	⨁⨁⨁⨁ HIGH	
Triglycerides in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 0.9 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	118	135	-	MD **0.1 m/mol lower** (0.5 lower to 0.2 higher)	⨁⨁⨁⨁ HIGH	
Triglycerides >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	217	176	-	MD **0.1 m/mol lower** (0.3 lower to 0)	⨁⨁⨁⨁ HIGH	
Triglycerides <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	187	151	-	MD **0 m/mol** (0.1 lower to 0.1 higher)	⨁⨁⨁⨁ HIGH	

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Triglycerides >2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 0.7 to 3.7)												
8	randomised trials	not serious	not serious	not serious	not serious	none	40	32	-	MD **0.4 m/mol lower** (1.2 lower to 0.9 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 8.8)												
9	randomised trials	not serious	not serious	not serious	not serious	none	93	63	-	MD **0.2 m/mol lower** (0.9 lower to 0.5 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 5.7)												
9	randomised trials	not serious	not serious	not serious	not serious	none	152	130	-	MD **0.1 m/mol higher** (0.1 lower to 0.3 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 5.0 to 5.7)												
9	randomised trials	not serious	not serious	not serious	not serious	none	18	17	-	MD **0.1 m/mol lower** (0.7 higher to 0.6 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose in 18-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 5.7)												
9	randomised trials	not serious	not serious	not serious	not serious	none	83	58	-	MD **0.1 m/mol higher** (0.3 lower to 0.4 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose in 46-65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 8.8)												
9	randomised trials	not serious	not serious	not serious	not serious	none	144	118	-	MD **0.2 m/mol lower** (1.1 lower to 0.8 higher)	⊕⊕⊕⊕ HIGH	
Fasting glucose >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 8.8)												

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
9	randomised trials	not serious	not serious	not serious	not serious	none	235	186	-	MD **0 m/mol** (0.4 lower to 0.4 higher)	⨁⨁⨁⨁ HIGH	
Fasting glucose <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 4.8 to 8.8)												
9	randomised trials	not serious	not serious	not serious	not serious	none	226	181	-	MD **0.1 m/mol lower** (0.5 lower to 0.3 higher)	⨁⨁⨁⨁ HIGH	
Glucose tolerance in MEN (follow up: range 12 weeks to 54 weeks; Scale from: 24 to 64)												
5	randomised trials	not serious	not serious	not serious	not serious	none	52	36	-	MD **32.9 m/mol higher** (15.7 higher to 50 higher)	⨁⨁⨁⨁ HIGH	
Glucose tolerance in WOMEN (follow up: range 12 weeks to 54 weeks; Scale from: 50 to 69)												
5	randomised trials	not serious	not serious	not serious	not serious	none	64	42	-	MD **52.7 m/mol higher** (30.9 higher to 74.4 higher)	⨁⨁⨁⨁ HIGH	
Glucose tolerance in >65 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 24 to 48)												
5	randomised trials	not serious	not serious	not serious	not serious	none	17	17	-	MD **26.5 m/mol higher** (5.3 lower to 58.3 higher)	⨁⨁⨁⨁ HIGH	
Glucose tolerance in 19-45 - year-olds (follow up: range 12 weeks to 54 weeks; Scale from: 33 to 69)												
5	randomised trials	not serious	not serious	not serious	not serious	none	86	52	-	MD **47 m/mol higher** (25.7 higher to 68.3 higher)	⨁⨁⨁⨁ HIGH	
Glucose tolerance >12 weeks (follow up: range 12 weeks to 54 weeks; Scale from: 33 to 69)												
5	randomised trials	not serious	not serious	not serious	not serious	none	116	78	-	MD **41.4 m/mol higher** (28.4 higher to 54.3 higher)	⨁⨁⨁⨁ HIGH	

Certainty assessment							№ of patients		Effect		Certainty	Importance
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Recreational football	other exercise and control	Relative (95% CI)	Absolute (95% CI)		
Glucose tolerance <2 times per week (follow up: range 12 weeks to 54 weeks; Scale from: 33 to 69)												
5	randomised trials	not serious	not serious	not serious	not serious	none	116	78	-	MD **41.4 m/mol higher** (28.4 higher to 54.3 higher)	⨁⨁⨁⨁ HIGH	

CI: Confidence interval; **MD:** Mean difference

Explanations

a. Significant result (P<0.10) of Egger's test for funnel plot asymmetry

b. Publication with follow up

c. Assumption of large heterogenity