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Review article

Intervention Effects of Recreational Football on Obesity-Related Health Outcomes: A Systematic Review and Meta-Analysis

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Abstract

Obesity is a major public health concern, and effective yet engaging exercise strategies are needed to improve obesity-related health outcomes. This systematic review and meta-analysis aimed to evaluate the effects of recreational football on body composition and cardiometabolic outcomes in individuals with overweight or obesity. Five electronic databases were searched from inception to December 2025 for English-language randomized controlled trials (RCTs) comparing recreational football with non-football control conditions. Meta-analyses were performed using RevMan 5.4. Publication bias was assessed using funnel plots and Egger's regression test where applicable, and certainty of evidence was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach. Sixteen RCTs involving 387 participants were included, with the available evidence derived predominantly from children/adolescents and male participants. In the primary between-group meta-analyses, recreational football significantly improved body mass index (BMI), body fat percentage (BFP), waist circumference (WC), triglycerides (TG), systolic blood pressure (SBP), and diastolic blood pressure (DBP). Findings for lean body mass (LBM) were inconsistent, and no significant between-group effects were observed for total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), or high-density lipoprotein cholesterol (HDL-C). Overall, recreational football may be a promising exercise modality for improving several obesity-related health outcomes in individuals with overweight or obesity, particularly body composition, TG, and blood pressure. These findings should nevertheless be interpreted in light of the predominantly male and pediatric/adolescent samples, the inconsistent LBM results, and the overall moderate-to-low certainty of evidence. Large, well-designed RCTs with standardized protocols and longer follow-up are warranted.

Key words: Recreational football, obesity, meta-analysis, body composition, metabolic health.

Introduction

Overweight and obesity are major global public health challenges and are strongly associated with hypertension, dyslipidemia, type 2 diabetes, premature mortality, and increased healthcare costs (Chooi et al., 2019; Lobstein et al., 2022; Wong et al., 2020). Although genetic susceptibility contributes to obesity risk, lifestyle-related factors, particularly chronic positive energy balance, are regarded as the principal drivers of its development (Berenson and group, 2012). Effective long-term management therefore requires sustainable strategies, especially regular physical activity (Hall et al., 2022; Khera et al., 2016; Petridou et al., 2019; Verboven and Hansen, 2021).

Among exercise-based interventions, recreational football has attracted increasing attention as a potentially effective and engaging modality. In this review, recreational football refers broadly to football-based activities performed in structured or semi-structured formats for health-related purposes rather than competitive performance, including small-sided games and organized sessions in school or community settings. Unlike conventional exercise programs, recreational football combines intermittent high-intensity activity, multidirectional movement, and social interaction, features that may support sustained participation while also providing meaningful physiological stimuli (Andersen et al., 2014a; Bangsbo et al., 2014; 2015; Krustrup et al., 2016; 2018; Milanović et al., 2019). Previous studies have shown that football participation can improve physical fitness, body composition, and selected cardiovascular and metabolic outcomes across different age groups (Andersen et al., 2014a; Bangsbo et al., 2014; 2015; Hernandez-Martin et al., 2021; Krustrup et al., 2016; 2018; Milanović et al., 2019; Seabra et al., 2014). In children and adolescents, football programs have been associated with increased physical activity, improved bone-related outcomes, reduced adiposity, and enhanced cardiorespiratory fitness (Hernandez-Martin et al., 2021; Krustrup et al., 2016; Seabra et al., 2014). In adults, participation has been linked to favorable changes in fat mass, cardiovascular function, and metabolic health indicators (Andersen et al., 2014a; Bangsbo et al., 2014; 2015; Krustrup et al., 2018; Milanović et al., 2019).

However, the effects of recreational football specifically in individuals with overweight or obesity remain unclear. Existing studies vary considerably in participant characteristics, intervention duration, training frequency, comparator conditions, and reported outcomes, complicating interpretation of the overall evidence and limiting its clinical applicability (Clemente et al., 2022; Hernandez-Martin et al., 2021; Milanović et al., 2019). In particular, age, sex, training dose, and comparator type may influence both the magnitude and consistency of the observed effects. Although children, adolescents, and adults differ in growth, maturation, and baseline metabolic characteristics, they share clinically relevant obesity-related outcome domains, particularly body composition and cardiometabolic health. A pooled evaluation may therefore help estimate the overall direction of effect across overweight/obese populations while identifying important sources of heterogeneity. Moreover, although football has been recognized as a health-promoting activity in previous research, evidence addressing both body composition and cardiometabolic

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outcomes in overweight or obese populations remains limited and fragmented. A focused quantitative synthesis is therefore needed to clarify the potential health effects of recreational football in this population.

Accordingly, this systematic review and meta-analysis aimed to evaluate whether recreational football, compared with non-football control conditions, improves body composition and cardiometabolic outcomes in individuals with overweight or obesity. BMI, BFP, WC, and LBM were defined as primary outcomes, whereas TG, TC, LDL-C, HDL-C, SBP, and DBP were examined as secondary outcomes.

Methods

This systematic review and meta-analysis was conducted in accordance with the PRISMA 2020 guidelines and was prospectively registered in PROSPERO on 17 May 2025 (registration ID: CRD420251054341).

Literature search

We systematically searched Web of Science, PubMed, Embase, Scopus, and SPORTDiscus on 23 December 2025 for studies published up to December 2025. The search strategy combined keywords and controlled vocabulary related to recreational football, obesity, body composition, metabolic health, and randomized controlled trials. Detailed database-specific search strategies, including Boolean operators and search fields, are provided in Supplementary Table S1.

Inclusion and exclusion criteria

Studies were included if they met the following criteria: (1) randomized controlled trials (RCTs); (2) participants were classified as overweight or obese according to BMI-based criteria reported in the included studies (e.g., WHO definitions or age-specific BMI percentiles); (3) reported at least one outcome related to body composition (e.g., BMI, BFP, WC, and LBM) or metabolic indicators (e.g., blood lipids and blood pressure); (4) used recreational football as the sole intervention for at least 3 months; (5) were published in English; (6) included a control group receiving no exercise intervention, placebo intervention, or usual physical activity; and (7) were available in full text.

Studies were excluded if they met any of the following criteria: (1) nonrandomized studies (e.g., retrospective studies, case reports, or observational studies); (2) combined interventions involving other forms of exercise or dietary regulation, making it difficult to isolate the effects of recreational football; (3) intervention duration of less than 3 months; (4) participants who were not overweight or obese; (5) incomplete outcome data or absence of necessary statistical information; and (6) non-English publications or studies published as conference abstracts, reviews, or other non-original articles.

Screening and data extraction

Relevant data were extracted into a predesigned electronic data extraction sheet. The following specific data items were collected: (1) general study information (first author, publication year, journal, country, and study design); (2) participant characteristics (sample size per group, age, sex distribution, and baseline BMI classification); (3) intervention details (modality, duration, frequency, session length, and exercise intensity); (4) outcome measures, including body composition outcomes (BMI, body fat percentage [BFP], waist circumference [WC], and lean body mass [LBM]) and cardiometabolic outcomes (triglycerides [TG], total cholesterol [TC], low-density lipoprotein cholesterol [LDL-C], high-density lipoprotein cholesterol [HDL-C], systolic blood pressure [SBP], and diastolic blood pressure [DBP]), along with the assessment tools used for each outcome; and (5) additional contextual and clinical variables where available (training adherence/exposure, medication use, dietary control, pubertal status, and baseline physical activity).

When relevant data were missing, we attempted to contact the corresponding authors. If no response was received, numerical data were extracted from graphs using GetData Graph Digitizer and checked for accuracy by a second reviewer. When duplicate reports or overlapping cohorts were suspected, study characteristics and sample information were compared, and only the most complete dataset was retained for analysis. All retrieved records were imported into EndNote 20 for deduplication. Two reviewers independently screened titles and abstracts for initial eligibility. The full texts of potentially eligible studies were then assessed in detail. Any disagreements were resolved through discussion or, when necessary, by consultation with a third reviewer.

Risk of bias assessment

Risk of bias was independently assessed by two reviewers using the Cochrane Risk of Bias 2 (RoB 2) tool. Because RoB 2 is a result-level tool, judgments were assessed with reference to the outcomes included in the meta-analysis. This tool evaluates five domains: (1) bias arising from the randomization process, (2) bias due to deviations from intended interventions, (3) bias due to missing outcome data, (4) bias in measurement of the outcome, and (5) bias in selection of the reported result.

Each domain was judged as “low risk,” “some concerns,” or “high risk” according to RoB 2 guidance. An overall risk-of-bias judgment was assigned for each study–outcome result. Any disagreements were resolved through discussion, with consultation from a third reviewer when required.

Statistical analysis

All statistical analyses were performed using Review Manager (RevMan, version 5.4). When outcomes were reported using comparable units and measurement conventions across studies, pooled effects were expressed as mean differences (MDs) with 95% confidence intervals (CIs). When outcome measures differed in scale or measurement convention, standardized mean differences (SMDs) were used. In the present review, MDs were applied to anthropometric and blood pressure outcomes, whereas SMDs were used for lipid-related outcomes, including TG, TC, LDL-C, and HDL-C.

Pooled effect estimates were calculated using post-intervention values to compare outcomes between the intervention and control groups. When required, standard deviations were derived from reported data according to standard meta-analytic procedures.

Statistical heterogeneity was assessed using the I^2 statistic, with values of 25%, 50%, and 75% representing low, moderate, and high heterogeneity, respectively. A fixed-effect model was used when heterogeneity was low ($I^2 \leq 50\%$), whereas a random-effects model was applied when substantial heterogeneity was present ($I^2 > 50\%$).

Subgroup analyses were conducted to explore potential sources of heterogeneity according to participant age and training frequency. The comparator type was also considered a potential source of heterogeneity. However, because the number of studies within individual comparator categories was limited and unevenly distributed across outcomes, a separate subgroup analysis by comparator type was not performed. Age was categorized as <20 years and ≥20 years, and training frequency as <3 sessions/week and ≥3 sessions/week. These subgroup categories were selected on the basis of the distribution of the available studies and their potential clinical relevance. Random-effects models were used for subgroup analyses, and formal tests for subgroup differences were performed in RevMan. Sensitivity analyses were conducted by sequentially removing individual studies to assess the robustness of the pooled results.

Publication bias was assessed visually using funnel plots. When at least 10 studies were available for a given outcome, Egger's regression test was additionally performed using R (version 4.5.0).

Certainty of evidence assessment

The certainty of evidence for each outcome was assessed using the GRADE approach across five domains: risk of bias, inconsistency, indirectness, imprecision, and publication bias. Because all included studies were randomized controlled trials, certainty was initially rated as high and then downgraded according to predefined criteria. Risk of bias was judged based on the RoB 2 judgments of the studies contributing data to each outcome; one level was downgraded when a substantial proportion of evidence came from studies with some concerns or high risk of bias, and two levels were downgraded when most evidence came from high-risk studies. Inconsistency was downgraded by one level when I^2 was ≥50% and by two levels when I^2 was ≥75% without a plausible explanation. Indirectness was downgraded when important population, intervention, comparator, or outcome mismatches were present. Imprecision was downgraded when the total sample size was <400 participants or when the 95% CI crossed or approached the line of no effect. Publication bias was downgraded when funnel plot asymmetry was observed or when Egger's regression test indicated potential small-study effects ($P < 0.10$), when applicable. Certainty was rated as high, moderate, low, or very low accordingly. A summary table of the certainty of evidence for each outcome is presented in the main text.

Results

Literature search results

A total of 909 records were initially identified through database searches (Web of Science, PubMed, Embase, Scopus, and SPORTDiscus). After title screening, 492 records were excluded because of irrelevance or duplication, leaving 417 records for abstract screening. Subsequently, 366 records were excluded after abstract review for reasons such as non-randomized designs, interventions not involving football, professional football interventions, or insufficient data. The remaining 51 full-text articles were assessed for eligibility. After full-text evaluation, 35 articles were excluded because of intervention duration of less than 3 months, non-randomized designs, multiple uncontrolled intervention components, or irrelevant outcomes. Finally, 16 studies (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Faude et al., 2010; Hansen et al., 2013; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Lousa et al., 2017; Randers et al., 2010; Seabra et al., 2014; 2016; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023; Weintraub et al., 2008) were included in this systematic review and meta-analysis (Figure 1).

Characteristics of the included studies

A total of 16 randomized controlled trials (RCTs) (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Faude et al., 2010; Hansen et al., 2013; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Lousa et al., 2017; Randers et al., 2010; Seabra et al., 2014; 2016; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023; Weintraub et al., 2008) published between 2008 and 2023 were included, comprising 387 participants (200 in football intervention groups and 187 in control groups). Participants ranged in age from 8 to 68.1 years. Most studies (n = 11) focused on children and adolescents aged 8 - 17 years, whereas the remaining studies included adults with mean ages ranging from 20 to 68.1 years.

All studies targeted overweight or obese populations, with inclusion criteria generally based on BMI at or above the 85th or 97th percentile for age and sex, BMI > 2 standard deviations above WHO reference values, or BMI ≥ 20.5 kg/m² for prepubertal children. Intervention duration ranged from 3 to 6 months. In addition to study and intervention characteristics, several studies reported contextual factors relevant to interpretation of the findings, including training adherence/exposure, medication-related eligibility or restrictions, dietary control, pubertal status, and baseline physical activity. The most commonly reported outcomes were BMI (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Faude et al., 2010; Hansen et al., 2013; Krustrup et al., 2009; Lousa et al., 2017; Seabra et al., 2014; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023; Weintraub et al., 2008) (n = 13), BFP (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Lousa et al., 2017; Randers et al., 2010; Seabra et al., 2014; 2016; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023) (n = 13), and LBM (Andersen et al., 21014b; 2016; Cvetković et al., 2018; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Seabra et al., 2014; 2016; Soares et al., 2023; Vasconcellos et al., 2016; Wang et al., 2023) (n = 10). WC (Knoepfli-Lenzin et al., 2010; Lousa et al., 2017; Seabra et al., 2016; Soares et al., 2023; Vasconcellos et al., 2021) (n = 5), TG (Andersen et al., 2016; Randers et

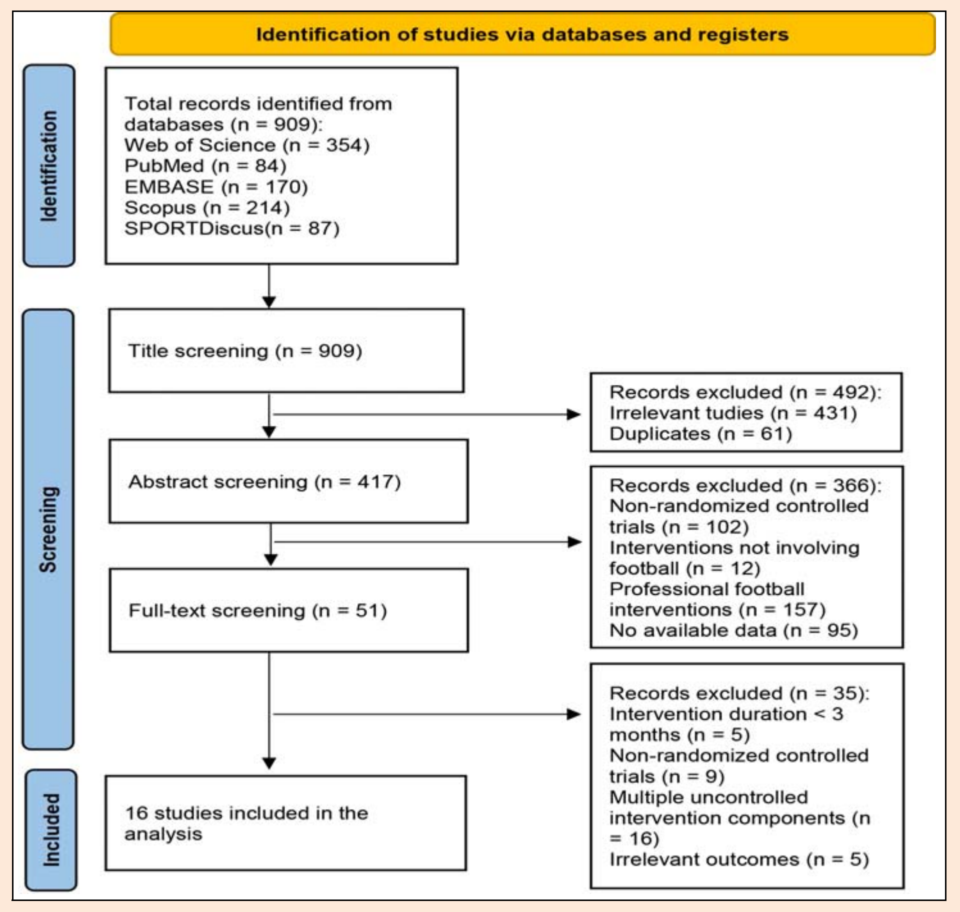


Figure 1. **Flow diagram of study selection.**

al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021) (n = 5), TC (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016) (n = 6), LDL-C (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016) (n = 6), HDL-C (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021) (n = 7), SBP (Andersen et al., 2016; Cvetković et al., 2018; Hansen et al., 2013; Krustrup et al., 2009; Seabra et al., 2016; Vasconcellos et al., 2016) (n = 6), and DBP (Cvetković et al., 2018; Hansen et al., 2013; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021) (n = 7) were also reported across multiple studies.

Anthropometric measurements were obtained primarily using stadiometers and dual-energy X-ray absorptiometry (DXA), including models such as the Hologic QDR 4500A and Lunar GE systems. Metabolic parameters were generally assessed using enzymatic assay kits and automated analyzers. Blood pressure was measured using standard clinical devices. Several studies did not specify the instruments used (Table 1).

Intervention characteristics

All 16 included studies used an RCT design, with the intervention group receiving recreational football training. Most control groups involved no-exercise or usual-activity comparators, whereas others involved sedentary behavior, health education, or other non-football comparison conditions.

Intervention duration ranged from 3 to 6 months. Three-month interventions were the most common (n = 8), followed by six-month interventions (n = 6), and one study used a four-month protocol. Training frequency varied from 2 to 4 sessions/week, with 3 sessions/week (n = 9) and 4 sessions/week (n = 4) being the most common. Several studies allowed flexible training frequencies (e.g., 2 - 3 sessions/week). Session duration was generally about 60 min (n = 12), with a few extending to 60 - 90 min (n = 2). Exercise intensity was quantified mainly by average heart rate or percentage of maximal heart rate (HRmax), ranging from 50% to 83% of HRmax. Most studies (n = 8) reported intensities between 70% and 83% HRmax. However, some studies did not report a specific intensity level.

There was also heterogeneity in control-group conditions. "Daily activity" was not consistently defined across studies, and comparators such as health education or sedentary lifestyle may have represented different counterfactual conditions. In addition, several studies did not provide detailed descriptions of session duration or training intensity (Table 2).

Risk of bias assessment

Risk of bias was assessed using the Cochrane RoB 2 tool. Overall, most study–outcome judgments were rated as low risk or some concerns, whereas high-risk judgments were uncommon.

Some concerns were primarily related to the randomization process and selection of the reported result, mainly because of insufficient reporting of allocation procedures or the absence of clearly pre-specified analysis plans. In contrast, most study–outcome judgments were rated as low risk in domains related to missing outcome data and outcome measurement, particularly when objective outcome measures were used. Detailed results of the risk-of-bias assessment are shown in Figure 2 and Figure 3. The detailed RoB 2 assessment by study, outcome, and domain is provided in Supplementary Table S2.

Table 1. Study characteristics, reported outcomes, assessment tools, and selected contextual/clinical variables of the included studies.

Author (Year)	Age, yrs	BMI, kg/m^2	Intervention (M/F)	Control (M/F)	Reported Outcomes	Assessment Tools/Instruments	Training adherence / exposure	Medication use	Dietary control	Pubertal stage	Baseline physical activity
Seabra et al. (2014)	8-12	≥ 85th percentile	12/0	8/0	BMI, BFP, LBM	Stadiometer, DXA[1]	Attendance ≈85%	Participants taking medication excluded	Dietary intake recorded	Maturity offset reported	Baseline PA assessed (accelerometer)
Seabra et al. (2016)	8-12	> 2 SD (WHO)	29/0	30/0	BFP, LBM, WC, TG, TC, LDL-C, HDL-C, SBP,DBP	Stadiometer, DXA[1], enzymatic kits[2]	Attendance >85%	Medication affecting outcomes excluded	Dietary intake recorded + nutrition session	Tanner stage reported	Baseline PA assessed (accelerometer)
Knoepfli-Lenzin et al. (2010)	25-45	37.0 ± 4.0	15/0	17/0	BFP, LBM, WC, TC, LDL-C, HDL-C	DXA[3]	Training frequency ≈2.4 sessions/week	Participants with relevant medication excluded	-	NA (adults)	Habitually active participants reported
Weintraub et al. (2008)	9-10	≥ 85th percentile	9/-	12/-	BMI	Stadiometer	Attendance ≈42%	Participants with relevant medication excluded	No dietary intervention	-	Baseline PA assessed (accelerometer)
Vasconcellos et al. (2016)	12-17	> 2 SD (WHO)	8/2	6/4	BMI, BFP, LBM, TG, TC, HDL-C, LDL-C, SBP, DBP	Stadiometer, DXA[5], analyzer[4], kits[2]	-	Medication excluded	No dietary intervention	Tanner stage 4-5	-
Vasconcellos et al. (2021)	13-17	≥ 97th percentile	4/2	5/2	BMI, BFP, WC, TG, HDL-C, SBP, DBP	Stadiometer, DXA[5], analyzer[4], kits[2]	Attendance ≈100%	Health conditions/medications excluded	-	Tanner stage 3-5	-
Soares et al. (2023)	12-17	≥ 95th percentile	8/2	6/2	BMI, BFP, WC, LBM	Stadiometer, DXA[5]	Attendance ≈100%	Medical conditions excluded	No dietary monitoring	Tanner stage 4-5	-
Lousa et al. (2017)	8-12	> 2 SD (WHO)	13/0	13/0	BMI, BFP, WC	Stadiometer, DXA[1]	Attendance >85%	Participants taking medication excluded	-	-	-
Randers et al. (2010)	20-43	25.6 ± 0.6	10/-	7/-	BFP, TG, TC, LDL-C, HDL-C	DXA[3], analyzer[4], kits[2]	Training frequency 2.4 → 1.3 sessions/week	None reported	Additional organized training not allowed	NA	Participants untrained ≥2 years

BMI, body mass index; BFP, body fat percentage; WC, waist circumference; LBM, lean body mass; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; DXA, dual-energy X-ray absorptiometry; WHO, World Health Organization; SD, standard deviation; M/F, male/female; PA, physical activity; NA, not applicable. M/F indicates the number of male and female participants in each group. Training adherence/exposure refers to participant compliance with the intervention, including attendance rate, number of sessions completed, or training frequency, as reported by the original studies. "–" indicates data not reported. Superscript numbers denote the measurement tools or assay methods reported in the included studies: [1]DXA (e.g., Hologic QDR 4500A); [2]enzymatic assay kits/reagents; [3]DXA (e.g., Lunar GE systems); [4]automated biochemical analyzer; [5]standard clinical blood pressure device; [6]bioelectrical impedance analysis (BIA).

Table 1. **Continue…**

Author (Year)	Age, yrs	BMI, kg/m^2	Intervention (M/F)	Control (M/F)	Reported Outcomes	Assessment Tools/Instruments	Training adherence / exposure	Medication use	Dietary control	Pubertal stage	Baseline physical activity
Cvetković et al. (2018)	11-13	> 20.5	10/-	14/-	BMI, BFP, LBM, SBP, DBP	Stadiometer, BIA[6]	≥50% session participation	Health contraindications excluded	Participants asked to maintain usual diet	-	No regular exercise prior to study
Faude et al. (2010)	8-12	-	5/6	3/8	BMI	Stadiometer	Attendance ≈65-72%	None reported	Nutrition component removed	Tanner ≤2	No regular sports participation
Krustrup et al. (2009)	20-43	25.6 ± 0.6	12/0	10/0	BMI, BFP, LBM, TC, LDL-C, HDL-C, SBP, DBP	DXA[3], analyzer[4], kits[2]	27.6 sessions completed	None reported	-	NA	Participants previously untrained
Hansen et al. (2013)	8-12	≥ 85th percentile	17/3	7/4	BMI, SBP, DBP	-	No dropouts reported	None reported	Participants maintained usual diet	Preadolescent participants	Baseline PA described
Wang et al. (2023)	12-14	Simple obesity	12/0	12/0	BMI, BFP, LBM	-	Training frequency 4 sessions/week	Participants using weight-loss drugs excluded	-	Adolescents (12-14 yrs)	Regular exercisers excluded
Andersen et al. (2014)	49.8 ± 1.7	30.4 ± 5.1	12/0	9/0	BMI, BFP, LBM	DXA[3]	37.6 sessions completed	Participants continued routine glucose-lowering medication	Participants instructed not to change lifestyle	NA	Habitual PA maintained
Andersen et al. (2016)	68.1 ± 2.1	27.0 ± 4.3	9/0	8/0	BMI, BFP, LBM, TG, TC, LDL-C, HDL-C, SBP, DBP	DXA[3], analyzer[4], reagents[2]	Attendance 66-73%; training frequency 1.7-1.8 sessions/week	No subjects took medication	3-day dietary intake recorded	NA	Baseline PA measured (pedometer + questionnaire)

BMI, body mass index; BFP, body fat percentage; WC, waist circumference; LBM, lean body mass; TG, triglycerides; TC, total cholesterol; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; DBP, diastolic blood pressure; DXA, dual-energy X-ray absorptiometry; WHO, World Health Organization; SD, standard deviation; M/F, male/female; PA, physical activity; NA, not applicable. M/F indicates the number of male and female participants in each group. Training adherence/exposure refers to participant compliance with the intervention, including attendance rate, number of sessions completed, or training frequency, as reported by the original studies. "–" indicates data not reported. Superscript numbers denote the measurement tools or assay methods reported in the included studies: [1]DXA (e.g., Hologic QDR 4500A); [2]enzymatic assay kits/reagents; [3]DXA (e.g., Lunar GE systems); [4]automated biochemical analyzer; [5]standard clinical blood pressure device; [6]bioelectrical impedance analysis (BIA).

Meta-Analysis Results

Effects on body composition

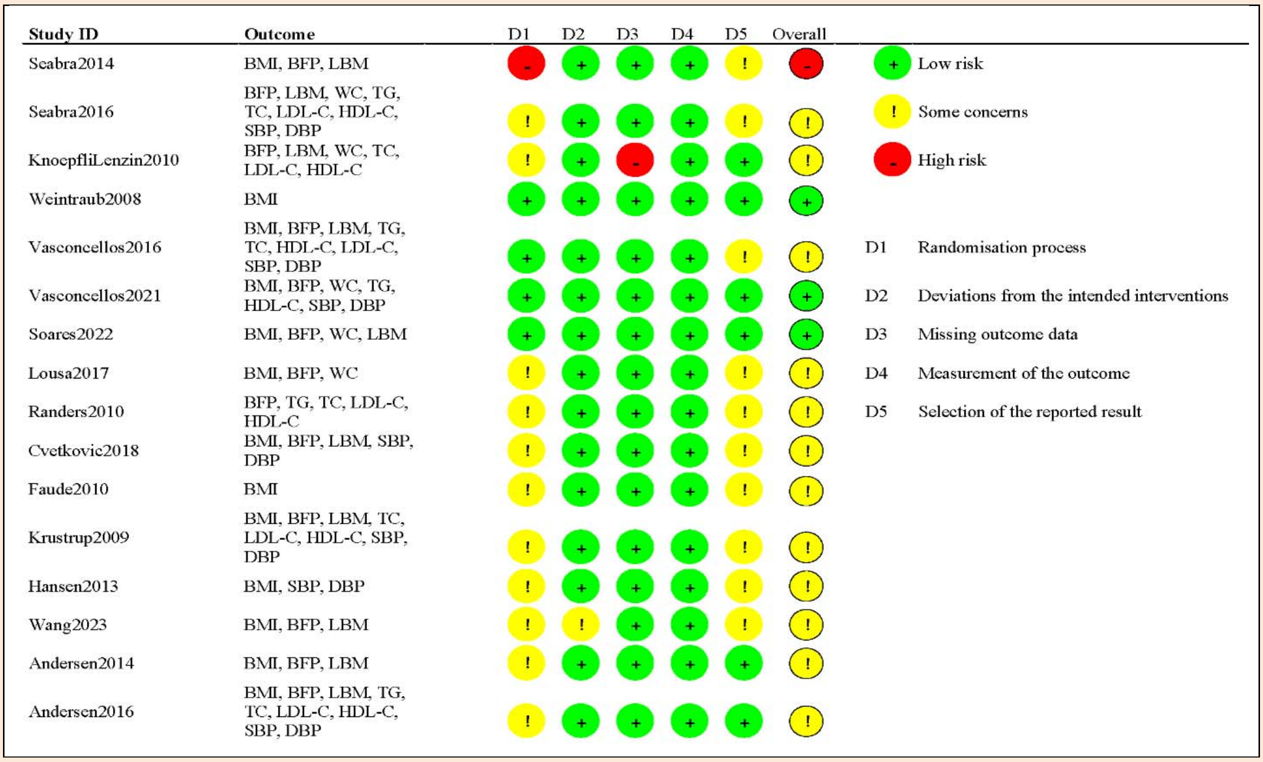
Compared with control conditions, recreational football was associated with significant improvements in several body-composition indicators.

Pooled analyses showed significant reductions in BMI (MD = -2.58 kg/m^2, 95% CI: -3.35 to -1.81, P < 0.00001; I^2 = 10%, 13 studies (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Faude et al., 2010; Hansen et al., 2013; Krustrup et al., 2009; Lousa et al., 2017; Seabra et al., 2014; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023; Weintraub et al., 2008), BFP (MD = -2.95%, 95% CI: -4.45 to -1.46, P = 0.0001; I^2 = 10%, 13 studies (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Lousa et al., 2017; Randers et al., 2010; Seabra et al., 2014, 2016; Soares et al., 2023; Vasconcellos et al., 2016; 2021; Wang et al., 2023), and WC (MD = -8.15 cm, 95% CI: -11.60 to -4.71, P < 0.00001; I^2 = 17%, 5 studies (Knoepfli-Lenzin et al., 2010; Lousa et al., 2017; Seabra et al., 2016; Soares et al., 2023; Vasconcellos et al., 2021). Heterogeneity for these outcomes was low (Figure 4).

Table 2. Characteristics of the intervention measures.

Author (Year)	Intervention Type		Duration, month	Frequency, sessions/wk	Session Duration, min	Exercise Intensity (%HRmax)
	Intervention Group	Control Group				
Seabra et al. (2014)	Recreational Football	Daily Activities	5	4	60–90	>80%
Seabra et al. (2016)	Recreational Football	Daily Activities	6	3	-	70–80%
Knoepfli–Lenzin et al. (2010)	Recreational Football	Daily Activities	3	3	60	–
Weintraub et al. (2008)	Recreational Football	Health Education	6	3–4	90	–
Vasconcellos et al. (2016)	Recreational Football	–	3	3	60	–
Vasconcellos et al. (2021)	Recreational Football	Daily Activities	3	3	60	≈84.5± 4.1%
Soares et al. (2023)	Recreational Football	Daily Activities	3	3	–	–
Lousa et al. (2017)	Recreational Football	Sedentary Behavior	6	3	60	70–80%
Randers et al. (2010)	Recreational Football	Daily Activities	3	2.4	60	81–83%
Cvetković et al. (2018)	Recreational Football	Daily Activities	3	2	–	–
Faude et al. (2010)	Recreational Football	Daily Activities	6	4	60	–
Krustrup et al. (2009)	Recreational Football	Daily Activities	3	2–3	60	≈82%
Hansen et al. (2013)	Recreational Football	Daily Activities	3	4	60	≈80%
Wang et al. (2023)	Recreational Football	Daily Activities	3	4	60–90	50–70%
Andersen et al. (2014)	Recreational Football	Sedentary Behavior	6	2	60	83 ± 2%
Andersen et al. (2016)	Recreational Football	DailyActivities	4	2	60	–

mo – months; wk – week; min – minutes; HRmax – maximum heart rate. "–" indicates data not reported. Exercise intensity was based on average heart rate during sessions when available; some studies estimated intensity by %HRmax without direct monitoring.



Study ID	Outcome	D1	D2	D3	D4	D5	Overall
Seabra2014	BMI, BFP, LBM	-	+	+	+	!	-
Seabra2016	BFP, LBM, WC, TG, TC, LDL-C, HDL-C, SBP, DBP	!	+	+	+	!	!
KnoepfliLenzin2010	BFP, LBM, WC, TC, LDL-C, HDL-C	!	+	-	+	+	!
Weintraub2008	BMI	+	+	+	+	+	+
Vasconcellos2016	BMI, BFP, LBM, TG, TC, HDL-C, LDL-C, SBP, DBP	+	+	+	+	!	!
Vasconcellos2021	BMI, BFP, WC, TG, HDL-C, SBP, DBP	+	+	+	+	+	+
Soares2022	BMI, BFP, WC, LBM	+	+	+	+	+	+
Lousa2017	BMI, BFP, WC	!	+	+	+	!	!
Randers2010	BFP, TG, TC, LDL-C, HDL-C	!	+	+	+	!	!
Cvetkovic2018	BMI, BFP, LBM, SBP, DBP	!	+	+	+	!	!
Faude2010	BMI	!	+	+	+	!	!
Krustrup2009	BMI, BFP, LBM, TC, LDL-C, HDL-C, SBP, DBP	!	+	+	+	!	!
Hansen2013	BMI, SBP, DBP	!	+	+	+	!	!
Wang2023	BMI, BFP, LBM	!	!	+	+	!	!
Andersen2014	BMI, BFP, LBM	!	+	+	+	+	!
Andersen2016	BMI, BFP, LBM, TG, TC, LDL-C, HDL-C, SBP, DBP	!	+	+	+	+	!

+ Low risk
! Some concerns
- High risk

D1 Randomisation process
D2 Deviations from the intended interventions
D3 Missing outcome data
D4 Measurement of the outcome
D5 Selection of the reported result

Figure 2. Overall risk-of-bias judgments across the included studies.

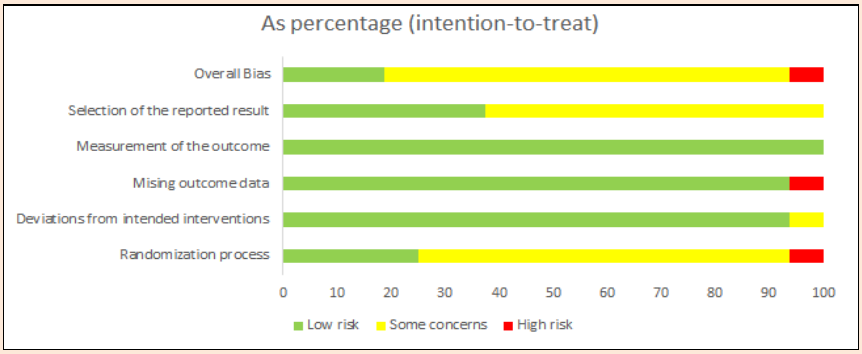
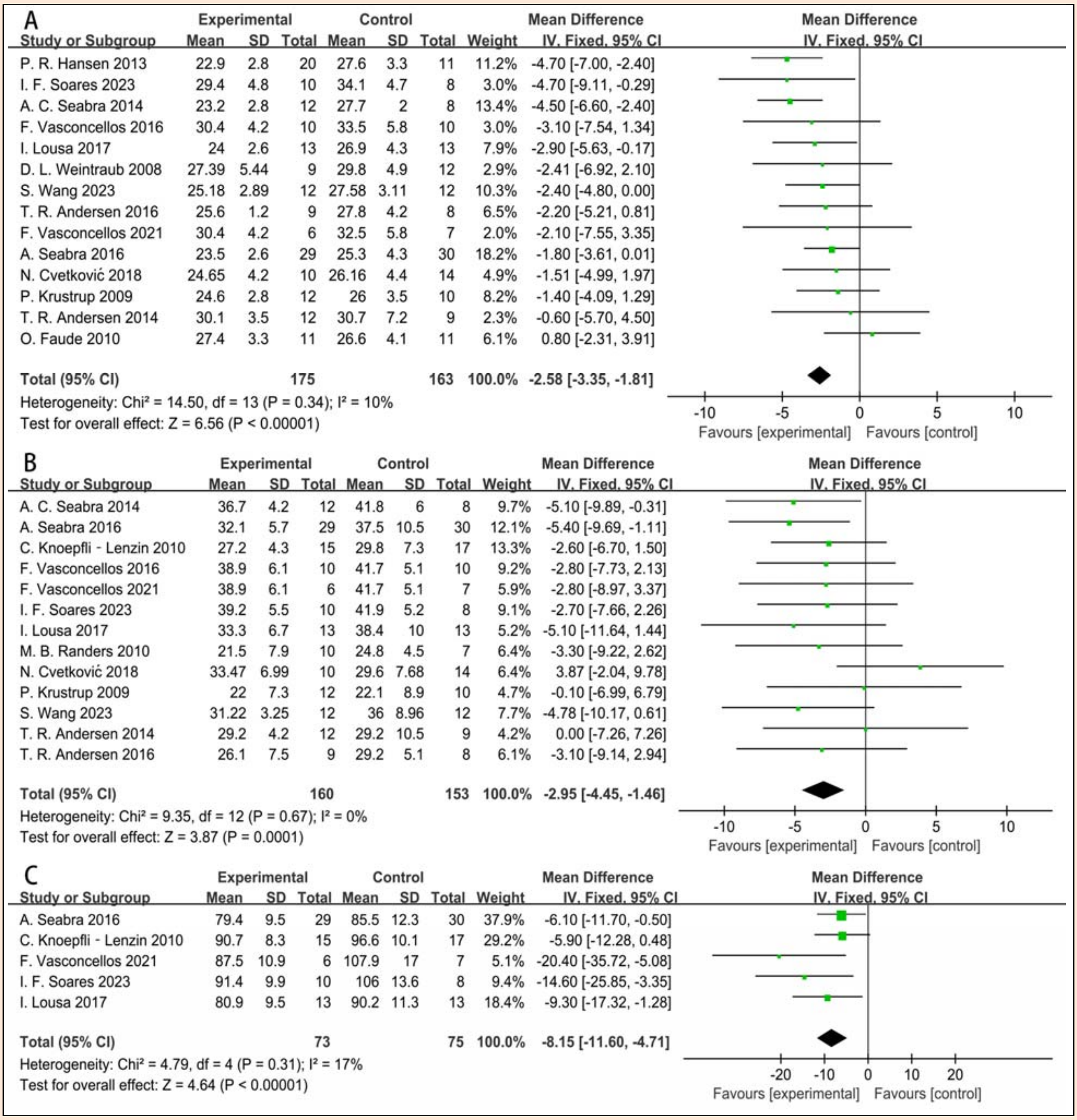


Figure 3. Risk-of-bias summary for the included studies.



A

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
P. R. Hansen 2013	22.9	2.8	20	27.6	3.3	11	11.2%	-4.70 [-7.00, -2.40]
I. F. Soares 2023	29.4	4.8	10	34.1	4.7	8	3.0%	-4.70 [-9.11, -0.29]
A. C. Seabra 2014	23.2	2.8	12	27.7	2	8	13.4%	-4.50 [-6.60, -2.40]
F. Vasconcellos 2016	30.4	4.2	10	33.5	5.8	10	3.0%	-3.10 [-7.54, 1.34]
I. Lousa 2017	24	2.6	13	26.9	4.3	13	7.9%	-2.90 [-5.63, -0.17]
D. L. Weintraub 2008	27.39	5.44	9	29.8	4.9	12	2.9%	-2.41 [-6.92, 2.10]
S. Wang 2023	25.18	2.89	12	27.58	3.11	12	10.3%	-2.40 [-4.80, 0.00]
T. R. Andersen 2016	25.6	1.2	9	27.8	4.2	8	6.5%	-2.20 [-5.21, 0.81]
F. Vasconcellos 2021	30.4	4.2	6	32.5	5.8	7	2.0%	-2.10 [-7.55, 3.35]
A. Seabra 2016	23.5	2.6	29	25.3	4.3	30	18.2%	-1.80 [-3.61, 0.01]
N. Cvetković 2018	24.65	4.2	10	26.16	4.4	14	4.9%	-1.51 [-4.99, 1.97]
P. Krustrup 2009	24.6	2.8	12	26	3.5	10	8.2%	-1.40 [-4.09, 1.29]
T. R. Andersen 2014	30.1	3.5	12	30.7	7.2	9	2.3%	-0.60 [-5.70, 4.50]
O. Faude 2010	27.4	3.3	11	26.6	4.1	11	6.1%	0.80 [-2.31, 3.91]
Total (95% CI)			**175**			**163**	**100.0%**	**-2.58 [-3.35, -1.81]**

Heterogeneity: Chi² = 14.50, df = 13 (P = 0.34); I² = 10%
Test for overall effect: Z = 6.56 (P < 0.00001)

B

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
A. C. Seabra 2014	36.7	4.2	12	41.8	6	8	9.7%	-5.10 [-9.89, -0.31]
A. Seabra 2016	32.1	5.7	29	37.5	10.5	30	12.1%	-5.40 [-9.69, -1.11]
C. Knoepfli - Lenzin 2010	27.2	4.3	15	29.8	7.3	17	13.3%	-2.60 [-6.70, 1.50]
F. Vasconcellos 2016	38.9	6.1	10	41.7	5.1	10	9.2%	-2.80 [-7.73, 2.13]
F. Vasconcellos 2021	38.9	6.1	6	41.7	5.1	7	5.9%	-2.80 [-8.97, 3.37]
I. F. Soares 2023	39.2	5.5	10	41.9	5.2	8	9.1%	-2.70 [-7.66, 2.26]
I. Lousa 2017	33.3	6.7	13	38.4	10	13	5.2%	-5.10 [-11.64, 1.44]
M. B. Randers 2010	21.5	7.9	10	24.8	4.5	7	6.4%	-3.30 [-9.22, 2.62]
N. Cvetković 2018	33.47	6.99	10	29.6	7.68	14	6.4%	3.87 [-2.04, 9.78]
P. Krustrup 2009	22	7.3	12	22.1	8.9	10	4.7%	-0.10 [-6.99, 6.79]
S. Wang 2023	31.22	3.25	12	36	8.96	12	7.7%	-4.78 [-10.17, 0.61]
T. R. Andersen 2014	29.2	4.2	12	29.2	10.5	9	4.2%	0.00 [-7.26, 7.26]
T. R. Andersen 2016	26.1	7.5	9	29.2	5.1	8	6.1%	-3.10 [-9.14, 2.94]
Total (95% CI)			**160**			**153**	**100.0%**	**-2.95 [-4.45, -1.46]**

Heterogeneity: Chi² = 9.35, df = 12 (P = 0.67); I² = 0%
Test for overall effect: Z = 3.87 (P = 0.0001)

C

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	79.4	9.5	29	85.5	12.3	30	37.9%	-6.10 [-11.70, -0.50]
C. Knoepfli - Lenzin 2010	90.7	8.3	15	96.6	10.1	17	29.2%	-5.90 [-12.28, 0.48]
F. Vasconcellos 2021	87.5	10.9	6	107.9	17	7	5.1%	-20.40 [-35.72, -5.08]
I. F. Soares 2023	91.4	9.9	10	106	13.6	8	9.4%	-14.60 [-25.85, -3.35]
I. Lousa 2017	80.9	9.5	13	90.2	11.3	13	18.4%	-9.30 [-17.32, -1.28]
Total (95% CI)			**73**			**75**	**100.0%**	**-8.15 [-11.60, -4.71]**

Heterogeneity: Chi² = 4.79, df = 4 (P = 0.31); I² = 17%
Test for overall effect: Z = 4.64 (P < 0.00001)

Figure 4. Forest plot showing the comparison of (A) BMI; (B) BFP; and (C) WC between the intervention and control groups.

For LBM, the primary between-group analysis favored the control group (MD = -3.00 kg, 95% CI: -5.87 to -0.14, P = 0.04), with substantial heterogeneity (I² = 74%, 10 studies (Andersen et al., 2014b; 2016; Cvetković et al., 2018; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Seabra et al., 2014; 2016; Soares et al., 2023; Vasconcellos et al., 2016; Wang et al., 2023). In addition to the primary comparison, a supplementary within-group pre-post meta-analysis indicated a significant increase in LBM following football intervention (MD = +1.83 kg, 95% CI: 0.71 to 2.96, P = 0.001) (Figure 5). This supplementary finding should be interpreted cautiously because the primary between-group comparison favored the control group and showed considerable heterogeneity.

Effects on cardiometabolic markers

Recreational football was associated with significant reductions in both SBP and DBP. For SBP, a random-effects model showed a significant reduction (MD = -6.62 mmHg, 95% CI: -10.16 to -3.09, P = 0.0002; I² = 55%, 6 studies (Andersen et al., 2016; Cvetković et al., 2018; Hansen et al., 2013; Krustrup et al., 2009; Seabra et al., 2016; Vasconcellos et al., 2016). For DBP, a fixed-effect model also showed a significant reduction (MD = -2.60 mmHg, 95% CI: -4.56 to -0.65, P = 0.009; I² = 0%, 7 studies (Cvetković et al., 2018; Hansen et al., 2013; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021) (Figure 6).

TG levels were also significantly reduced in the football group (SMD = -0.57, 95% CI: -0.93 to -0.20, P = 0.002; I² = 30%, 5 studies (Andersen et al., 2016; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021).

By contrast, recreational football did not significantly affect other lipid parameters, including TC (SMD = -0.31, 95% CI: -0.62 to 0.00, P = 0.05; I^2 = 29%, 6 studies (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016), LDL-C (SMD = -0.28, 95% CI: -0.59 to 0.03, P = 0.07; I^2 = 20%, 6 studies (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016), or HDL-C (SMD = 0.30, 95% CI: 0.00 to 0.60, P = 0.05; I^2 = 44%, 7 studies (Andersen et al., 2016; Knoepfli-Lenzin et al., 2010; Krustrup et al., 2009; Randers et al., 2010; Seabra et al., 2016; Vasconcellos et al., 2016; 2021) compared with control conditions. Heterogeneity across these outcomes was low to moderate.

Subgroup and sensitivity analyses

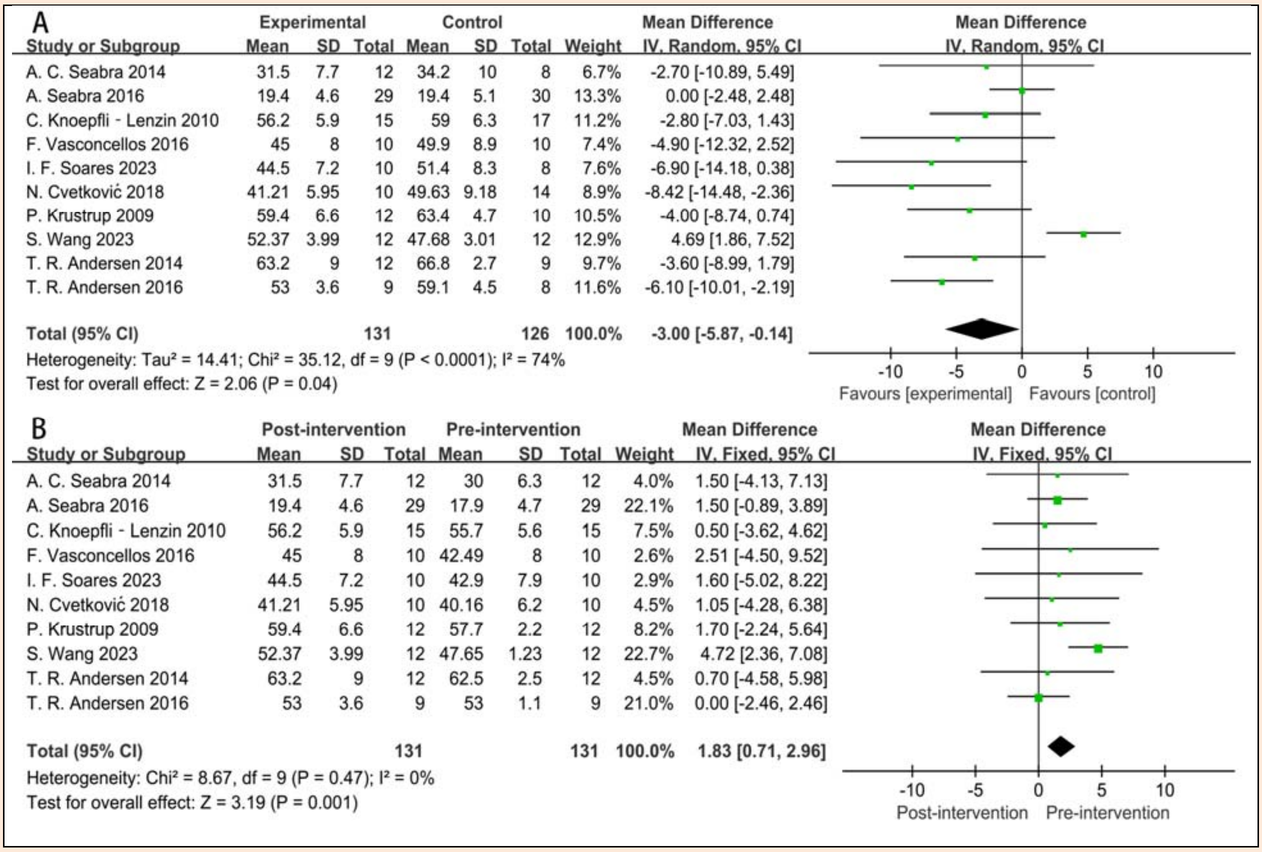
Subgroup analyses of LBM showed that the pooled effect was not significant in participants aged <20 years (MD = -2.31 kg, 95% CI: -6.53 to 1.90; P = 0.28; I^2 = 79%), but was significant in those aged ≥20 years (MD = -4.28 kg, 95% CI: -6.52 to -2.05; P = 0.0002; I^2 = 0%). However, the test for subgroup differences was not significant (Chi^2 = 0.66, df = 1, P = 0.42), indicating no statistically significant difference between age subgroups. In the training-frequency subgroup analysis, a significant pooled effect was observed in studies with <3 sessions/week (MD = -5.42 kg, 95% CI: -7.83 to -3.01; P < 0.0001; I^2 = 0%), whereas no significant effect was found in studies with ≥3 sessions/week (MD = -1.19 kg, 95% CI: -4.65 to 2.27; P = 0.50; I^2 = 71%). The test for subgroup differences approached statistical significance (Chi^2 = 3.87, df = 1, P = 0.05), suggesting that training frequency may have contributed to the observed variability (Figure 7).

Sensitivity analyses supported the robustness of the primary findings. For LBM, exclusion of Wang et al. (2023) reduced heterogeneity to I^2 = 37% without changing the direction of the pooled effect. For SBP, exclusion of Seabra et al. (2016) reduced heterogeneity to I^2 = 0% while the result remained statistically significant. For all other outcomes, sequential exclusion of individual studies did not materially alter the pooled estimates.

Publication bias

Publication bias was assessed visually using funnel plots for all outcomes (Figure 8). Overall, most funnel plots appeared broadly symmetrical, suggesting no clear evidence of substantial publication bias for BMI, BFP, WC, SBP, DBP, TG, TC, LDL-C, and HDL-C. However, the funnel plot for LBM showed some asymmetry.

For outcomes with at least 10 studies, Egger's regression test was additionally performed. The results indicated no significant small-study effects for BMI (t = 0.65, df = 12, P = 0.5253) or BFP (t = 1.66, df = 11, P = 0.1260). In contrast, Egger's test for LBM was statistically significant (t = -2.61, df = 8, P = 0.0314), suggesting potential small-study effects or publication bias for this outcome. This finding should nevertheless be interpreted cautiously because the number of included studies remained limited (Figure 8).



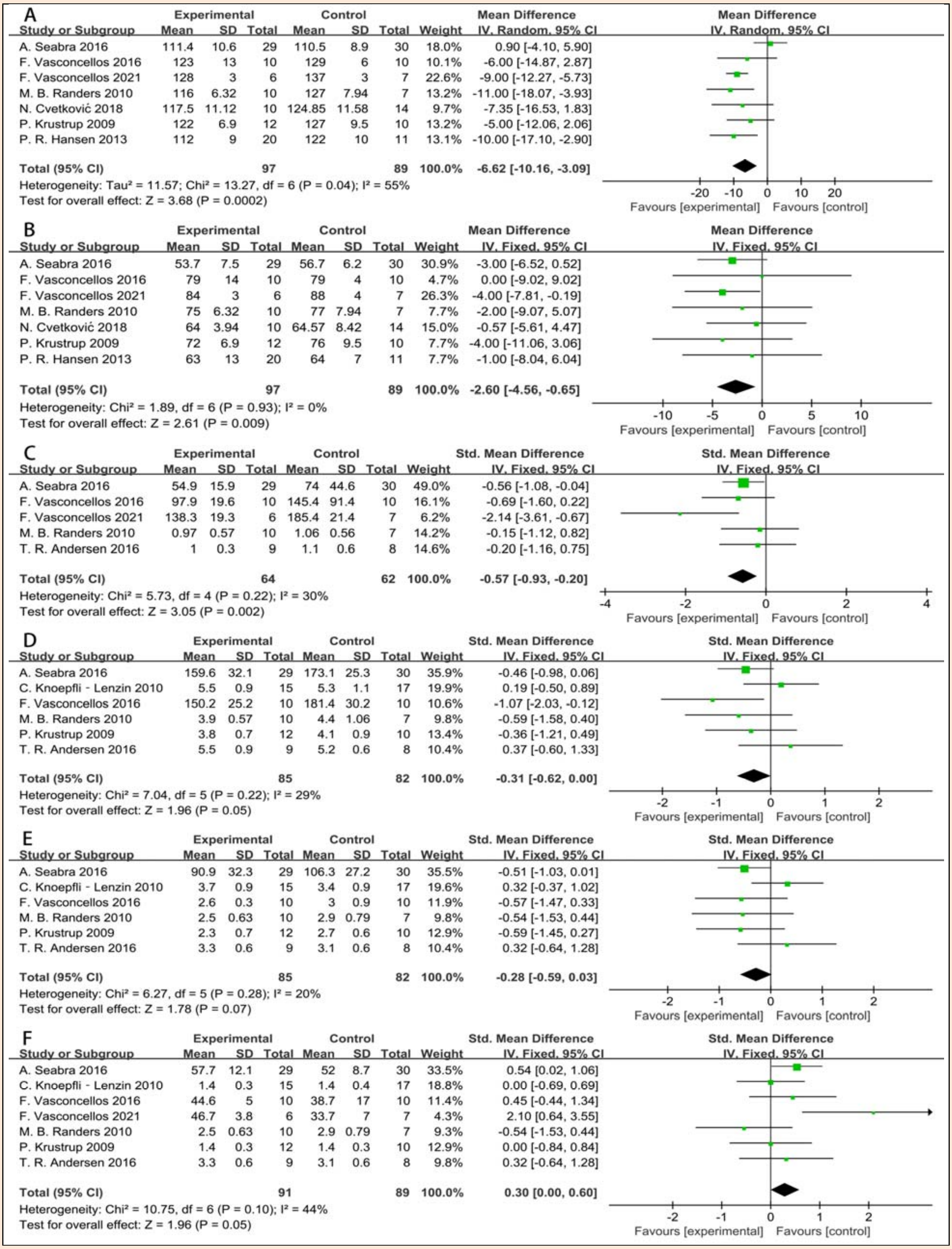
Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
A. C. Seabra 2014	31.5	7.7	12	34.2	10	8	6.7%	-2.70 [-10.89, 5.49]
A. Seabra 2016	19.4	4.6	29	19.4	5.1	30	13.3%	0.00 [-2.48, 2.48]
C. Knoepfli - Lenzin 2010	56.2	5.9	15	59	6.3	17	11.2%	-2.80 [-7.03, 1.43]
F. Vasconcellos 2016	45	8	10	49.9	8.9	10	7.4%	-4.90 [-12.32, 2.52]
I. F. Soares 2023	44.5	7.2	10	51.4	8.3	8	7.6%	-6.90 [-14.18, 0.38]
N. Cvetković 2018	41.21	5.95	10	49.63	9.18	14	8.9%	-8.42 [-14.48, -2.36]
P. Krustrup 2009	59.4	6.6	12	63.4	4.7	10	10.5%	-4.00 [-8.74, 0.74]
S. Wang 2023	52.37	3.99	12	47.68	3.01	12	12.9%	4.69 [1.86, 7.52]
T. R. Andersen 2014	63.2	9	12	66.8	2.7	9	9.7%	-3.60 [-8.99, 1.79]
T. R. Andersen 2016	53	3.6	9	59.1	4.5	8	11.6%	-6.10 [-10.01, -2.19]
Total (95% CI)			**131**			**126**	**100.0%**	**-3.00 [-5.87, -0.14]**

Heterogeneity: Tau^2 = 14.41; Chi^2 = 35.12, df = 9 (P < 0.0001); I^2 = 74%
Test for overall effect: Z = 2.06 (P = 0.04)

Study or Subgroup	Post-intervention Mean	SD	Total	Pre-intervention Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
A. C. Seabra 2014	31.5	7.7	12	30	6.3	12	4.0%	1.50 [-4.13, 7.13]
A. Seabra 2016	19.4	4.6	29	17.9	4.7	29	22.1%	1.50 [-0.89, 3.89]
C. Knoepfli - Lenzin 2010	56.2	5.9	15	55.7	5.6	15	7.5%	0.50 [-3.62, 4.62]
F. Vasconcellos 2016	45	8	10	42.49	8	10	2.6%	2.51 [-4.50, 9.52]
I. F. Soares 2023	44.5	7.2	10	42.9	7.9	10	2.9%	1.60 [-5.02, 8.22]
N. Cvetković 2018	41.21	5.95	10	40.16	6.2	10	4.5%	1.05 [-4.28, 6.38]
P. Krustrup 2009	59.4	6.6	12	57.7	2.2	12	8.2%	1.70 [-2.24, 5.64]
S. Wang 2023	52.37	3.99	12	47.65	1.23	12	22.7%	4.72 [2.36, 7.08]
T. R. Andersen 2014	63.2	9	12	62.5	2.5	12	4.5%	0.70 [-4.58, 5.98]
T. R. Andersen 2016	53	3.6	9	53	1.1	9	21.0%	0.00 [-2.46, 2.46]
Total (95% CI)			**131**			**131**	**100.0%**	**1.83 [0.71, 2.96]**

Heterogeneity: Chi^2 = 8.67, df = 9 (P = 0.47); I^2 = 0%
Test for overall effect: Z = 3.19 (P = 0.001)

Figure 5. Forest plots of (A) the between-group comparison for LBM and (B) the within-group pre–post analysis of LBM following football intervention.



A

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
A. Seabra 2016	111.4	10.6	29	110.5	8.9	30	18.0%	0.90 [-4.10, 5.90]
F. Vasconcellos 2016	123	13	10	129	6	10	10.1%	-6.00 [-14.87, 2.87]
F. Vasconcellos 2021	128	3	6	137	3	7	22.6%	-9.00 [-12.27, -5.73]
M. B. Randers 2010	116	6.32	10	127	7.94	7	13.2%	-11.00 [-18.07, -3.93]
N. Cvetković 2018	117.5	11.12	10	124.85	11.58	14	9.7%	-7.35 [-16.53, 1.83]
P. Krustrup 2009	122	6.9	12	127	9.5	10	13.2%	-5.00 [-12.06, 2.06]
P. R. Hansen 2013	112	9	20	122	10	11	13.1%	-10.00 [-17.10, -2.90]
Total (95% CI)			**97**			**89**	**100.0%**	**-6.62 [-10.16, -3.09]**

Heterogeneity: Tau² = 11.57; Chi² = 13.27, df = 6 (P = 0.04); I² = 55%
Test for overall effect: Z = 3.68 (P = 0.0002)

B

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	53.7	7.5	29	56.7	6.2	30	30.9%	-3.00 [-6.52, 0.52]
F. Vasconcellos 2016	79	14	10	79	4	10	4.7%	0.00 [-9.02, 9.02]
F. Vasconcellos 2021	84	3	6	88	4	7	26.3%	-4.00 [-7.81, -0.19]
M. B. Randers 2010	75	6.32	10	77	7.94	7	7.7%	-2.00 [-9.07, 5.07]
N. Cvetković 2018	64	3.94	10	64.57	8.42	14	15.0%	-0.57 [-5.61, 4.47]
P. Krustrup 2009	72	6.9	12	76	9.5	10	7.7%	-4.00 [-11.06, 3.06]
P. R. Hansen 2013	63	13	20	64	7	11	7.7%	-1.00 [-8.04, 6.04]
Total (95% CI)			**97**			**89**	**100.0%**	**-2.60 [-4.56, -0.65]**

Heterogeneity: Chi² = 1.89, df = 6 (P = 0.93); I² = 0%
Test for overall effect: Z = 2.61 (P = 0.009)

C

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	54.9	15.9	29	74	44.6	30	49.0%	-0.56 [-1.08, -0.04]
F. Vasconcellos 2016	97.9	19.6	10	145.4	91.4	10	16.1%	-0.69 [-1.60, 0.22]
F. Vasconcellos 2021	138.3	19.3	6	185.4	21.4	7	6.2%	-2.14 [-3.61, -0.67]
M. B. Randers 2010	0.97	0.57	10	1.06	0.56	7	14.2%	-0.15 [-1.12, 0.82]
T. R. Andersen 2016	1	0.3	9	1.1	0.6	8	14.6%	-0.20 [-1.16, 0.75]
Total (95% CI)			**64**			**62**	**100.0%**	**-0.57 [-0.93, -0.20]**

Heterogeneity: Chi² = 5.73, df = 4 (P = 0.22); I² = 30%
Test for overall effect: Z = 3.05 (P = 0.002)

D

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	159.6	32.1	29	173.1	25.3	30	35.9%	-0.46 [-0.98, 0.06]
C. Knoepfli - Lenzin 2010	5.5	0.9	15	5.3	1.1	17	19.9%	0.19 [-0.50, 0.89]
F. Vasconcellos 2016	150.2	25.2	10	181.4	30.2	10	10.6%	-1.07 [-2.03, -0.12]
M. B. Randers 2010	3.9	0.57	10	4.4	1.06	7	9.8%	-0.59 [-1.58, 0.40]
P. Krustrup 2009	3.8	0.7	12	4.1	0.9	10	13.4%	-0.36 [-1.21, 0.49]
T. R. Andersen 2016	5.5	0.9	9	5.2	0.6	8	10.4%	0.37 [-0.60, 1.33]
Total (95% CI)			**85**			**82**	**100.0%**	**-0.31 [-0.62, 0.00]**

Heterogeneity: Chi² = 7.04, df = 5 (P = 0.22); I² = 29%
Test for overall effect: Z = 1.96 (P = 0.05)

E

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	90.9	32.3	29	106.3	27.2	30	35.5%	-0.51 [-1.03, 0.01]
C. Knoepfli - Lenzin 2010	3.7	0.9	15	3.4	0.9	17	19.6%	0.32 [-0.37, 1.02]
F. Vasconcellos 2016	2.6	0.3	10	3	0.9	10	11.9%	-0.57 [-1.47, 0.33]
M. B. Randers 2010	2.5	0.63	10	2.9	0.79	7	9.8%	-0.54 [-1.53, 0.44]
P. Krustrup 2009	2.3	0.7	12	2.7	0.6	10	12.9%	-0.59 [-1.45, 0.27]
T. R. Andersen 2016	3.3	0.6	9	3.1	0.6	8	10.4%	0.32 [-0.64, 1.28]
Total (95% CI)			**85**			**82**	**100.0%**	**-0.28 [-0.59, 0.03]**

Heterogeneity: Chi² = 6.27, df = 5 (P = 0.28); I² = 20%
Test for overall effect: Z = 1.78 (P = 0.07)

F

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Fixed, 95% CI
A. Seabra 2016	57.7	12.1	29	52	8.7	30	33.5%	0.54 [0.02, 1.06]
C. Knoepfli - Lenzin 2010	1.4	0.3	15	1.4	0.4	17	18.8%	0.00 [-0.69, 0.69]
F. Vasconcellos 2016	44.6	5	10	38.7	17	10	11.4%	0.45 [-0.44, 1.34]
F. Vasconcellos 2021	46.7	3.8	6	33.7	7	7	4.3%	2.10 [0.64, 3.55]
M. B. Randers 2010	2.5	0.63	10	2.9	0.79	7	9.3%	-0.54 [-1.53, 0.44]
P. Krustrup 2009	1.4	0.3	12	1.4	0.3	10	12.9%	0.00 [-0.84, 0.84]
T. R. Andersen 2016	3.3	0.6	9	3.1	0.6	8	9.8%	0.32 [-0.64, 1.28]
Total (95% CI)			**91**			**89**	**100.0%**	**0.30 [0.00, 0.60]**

Heterogeneity: Chi² = 10.75, df = 6 (P = 0.10); I² = 44%
Test for overall effect: Z = 1.96 (P = 0.05)

Figure 6. **Forest plots of the effects of recreational football on (A) SBP, (B) DBP, (C) TG, (D) TC, (E) LDL-C, and (F) HDL-C.**

Certainty of evidence

The certainty of evidence for the main outcomes was assessed using the GRADE approach. Overall, the certainty of evidence ranged from moderate to low across outcomes (Table 3). For body-composition outcomes, certainty was rated as moderate for BMI, BFP, and WC, mainly because of concerns regarding risk of bias in several included trials. Certainty for LBM was rated as low because of risk-of-bias concerns, substantial heterogeneity ($I^2 = 74\%$), and potential publication bias.

For cardiometabolic outcomes, certainty was moderate for DBP but low for TG and SBP. Certainty for TG was downgraded mainly because of risk-of-bias concerns and imprecision, whereas certainty for SBP was downgraded because of risk-of-bias concerns and inconsistency. Similarly, certainty for lipid outcomes (TC, LDL-C, and HDL-C) was considered low because of risk-of-bias concerns and imprecision.

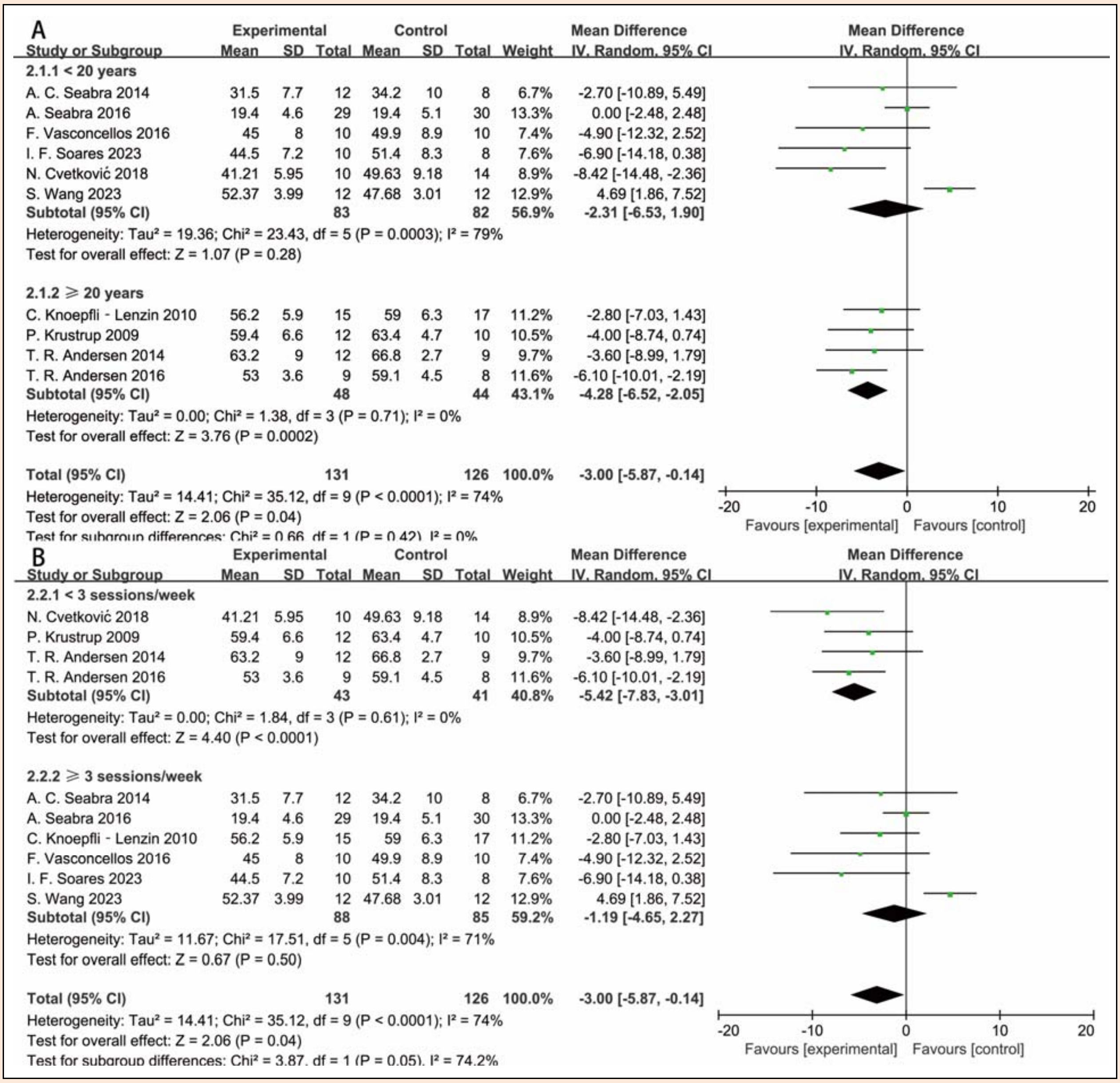


Figure 7. Subgroup analyses of the effects of recreational football on LBM by (A) age (<20 vs ≥20 years) and (B) training frequency (<3 vs ≥3 sessions/week).

Discussion

Effects on body composition

This systematic review and meta-analysis indicates that recreational football can improve several body-composition outcomes in individuals with overweight or obesity, particularly BMI, body fat percentage, and waist circumference. These findings suggest that football-based exercise may be an effective strategy for reducing overall and central adiposity in this population. Given the close association between excess adiposity, especially abdominal fat accumulation, and cardiometabolic risk, the observed reductions in BMI, BFP, and WC may be clinically relevant.

Several features of recreational football may help explain these favorable changes. Football training typically involves repeated bouts of running, acceleration, deceleration, changes of direction, and intermittent high-intensity activity performed over a sustained session (Krustrup et al., 2010). These activity patterns may increase total energy expenditure and provide a stimulus conducive to reductions in adiposity. In addition, the game-based and socially interactive nature of football may promote continued participation and enhance the cumulative effect of training over time (Krustrup et al., 2016; Krustrup et al., 2018; Milanović et al., 2019).

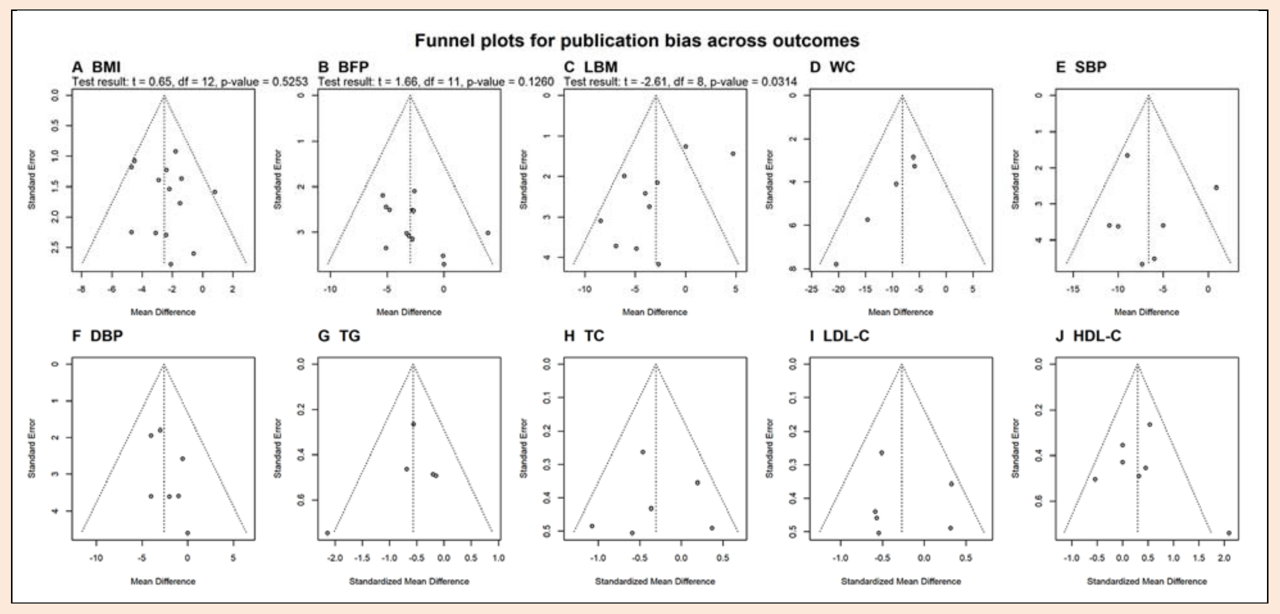


Figure 8. Funnel plots for publication bias assessment: (A) BMI; (B) BFP; (C) WC; (D) LBM; (E) TG; (F) SBP; (G) DBP; (H) TC; (I) LDL-C; (J) HDL-C.

Table 3. Summary of certainty of evidence for each outcome.

Outcome	No. of studies	Participants (n)	Effect estimate	Heterogeneity (I^2)	Certainty of evidence	Reasons for downgrading
BMI	13	310	MD = −2.58 kg/m², 95% CI: −3.35 to −1.81	10%	Moderate	Risk of bias
BFP	13	305	MD = −2.95%, 95% CI: −4.45 to −1.46	10%	Moderate	Risk of bias
WC	5	132	MD = −8.15 cm, 95% CI: −11.60 to −4.71	17%	Moderate	Risk of bias
LBM	10	210	MD = −3.00 kg, 95% CI: −5.87 to −0.14	74%	Low	Risk of bias; inconsistency; potential publication bias
TG	5	146	SMD = −0.57, 95% CI: −0.93 to −0.20	30%	Low	Risk of bias; imprecision
SBP	6	162	MD = −6.62 mmHg, 95% CI: −10.16 to −3.09	55%	Low	Risk of bias; inconsistency
DBP	7	178	MD = −2.60 mmHg, 95% CI: −4.56 to −0.65	0%	Moderate	Risk of bias
TC	6	172	SMD = −0.31, 95% CI: −0.62 to 0.00	29%	Low	Risk of bias; imprecision
LDL-C	6	168	SMD = −0.28, 95% CI: −0.59 to 0.03	20%	Low	Risk of bias; imprecision
HDL-C	7	181	SMD = 0.30, 95% CI: 0.00 to 0.60	44%	Low	Risk of bias; imprecision

High = very confident that the true effect lies close to that of the estimate; Moderate = moderate confidence in the effect estimate; Low = limited confidence in the effect estimate; Very low = very little confidence in the effect estimate.

By contrast, the effect on LBM remains uncertain. In the primary between-group meta-analysis, recreational football did not show a clear benefit for LBM, and the pooled estimate was accompanied by substantial heterogeneity. Subgroup analyses suggested that the effect may have differed by age and training frequency, with somewhat more favorable patterns in studies involving adults and in those using lower training frequencies; however, these subgroup findings were not robust and did not fully explain the observed heterogeneity. Additional variation in intervention design, measurement methods, baseline characteristics, developmental stage, and comparator conditions may also have contributed to the inconsistent results. Previous reviews have likewise suggested that football-based interventions may produce more consistent effects on adiposity-related outcomes than on lean mass (Wang et al., 2024). Because intensity data were incompletely reported and definitions of overweight and obesity varied across studies, further subgroup exploration was limited. Overall, the current evidence does not support a firm conclusion regarding the effect of recreational football on LBM.

Effects on cardiometabolic health

The present findings suggest that recreational football may improve selected cardiometabolic outcomes in individuals with overweight or obesity, with the clearest effects observed for triglycerides and blood pressure. The reductions in SBP and DBP are particularly relevant because elevated blood pressure is among the most important cardiovascular risk factors associated with excess adiposity. The reduction in triglycerides likewise indicates that the benefits of recreational football may extend beyond body-composition changes alone.

These favorable findings may be related to physiological adaptations commonly associated with intermittent exercise training. Recreational football typically combines repeated high-intensity efforts with periods of lower-intensity recovery, a pattern that may be relevant to both vascular regulation and triglyceride metabolism (Hambrecht et al., 2000; Wang and Eckel, 2009; Wang, 2004). From a clinical perspective, this pattern is important because improvements in blood pressure and triglycerides may contribute meaningfully to cardiometabolic risk reduction in populations with overweight or obesity.

Interpretation of these lipid-related findings is also complicated by variation in intervention duration and training frequency. Previous evidence suggests that relatively large exercise volumes may be required to reduce LDL-C and increase HDL-C (Kraus et al., 2002; LEON and SANCHEZ, 2001). In addition, dietary control and medication-related procedures were not reported consistently across the included trials. Some studies excluded participants using relevant medications or recorded dietary intake, whereas others provided limited or no monitoring of these factors, which may have contributed to uncertainty in the lipid-related findings. Finally, the relatively small number of studies and modest sample sizes for individual lipid outcomes may have limited statistical power.

Taken together, the available evidence indicates a more consistent pattern of benefit for triglycerides and blood pressure than for TC, LDL-C, and HDL-C. Recreational football therefore appears to offer cardiometabolic benefits in individuals with overweight or obesity, although the strength of evidence differs across specific outcomes.

Limitations and Future Directions

Several limitations of this review should be acknowledged. First, the total sample size was relatively small, and methodological concerns remained in several trials, including incomplete reporting and heterogeneity in intervention protocols and comparator conditions. Although subgroup analyses were conducted where feasible, they did not fully explain the observed variability across outcomes.

Second, the external validity of the review is constrained by the composition of the available evidence base. Most included data were derived from male participants and from children or adolescents, whereas substantially fewer data were available for adult women and broader clinical populations. This is important because developmental stage, baseline metabolic status, and intervention setting may influence both the magnitude and pattern of response. Accordingly, the present findings are most directly applicable to populations resembling those most frequently represented in the included studies.

Third, the long-term sustainability of the observed benefits could not be evaluated because follow-up data were rarely reported. The present review therefore reflects intervention effects over the study periods included rather than the durability of those effects after the intervention ended. Finally, the restriction to English-language publications may have introduced language bias.

Future research should address these limitations through large, well-designed multicenter randomized controlled trials with longer follow-up and more consistent reporting of participant characteristics, intervention dose, comparator conditions, adherence, baseline metabolic status, and relevant co-interventions. Subgroup analyses based on sex, age, developmental stage, baseline BMI category, and training exposure may help identify the populations most likely to benefit from football-based interventions. Further studies are also needed to determine whether the effects of recreational football differ according to baseline risk profile and clinical context.

Conclusion

Recreational football appears to improve several obesity-related health outcomes in individuals with overweight or obesity, with the most consistent benefits observed for adiposity-related measures, triglycerides, and blood pressure. In contrast, the evidence for lean body mass and for conventional lipid markers, including TC, LDL-C, and HDL-C, remains less consistent. Because the current evidence base is derived predominantly from male participants and children/adolescents, these findings should be generalized with caution to women, adults, and broader clinical populations. Overall, recreational football represents a promising exercise modality for obesity-related health improvement, but larger and better-designed trials are needed to clarify the magnitude, consistency, and applicability of its effects.

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Key points

- Recreational football significantly improved body composition indicators, including BMI, body fat percentage, and waist circumference, in individuals with overweight or obesity.
- Recreational football produced favorable cardiometabolic effects, particularly reductions in triglycerides and blood pressure.
- No significant between-group effects were observed for total cholesterol, LDL-C, or HDL-C.
- Most included trials involved children/adolescents and male participants, highlighting the need for more evidence in adults, females, and diverse clinical populations.
- Recreational football may be an engaging and practical exercise strategy for obesity-related health promotion, although the certainty of evidence ranged from moderate to low across outcomes.

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Supplementary Table S1. **Complete search strategies**

Databases	Search Strategy	
Web of Science	#1	TS=(soccer OR football OR "small-sided soccer" OR "small-sided football" OR "recreational soccer" OR "recreational football")
	#2	TS=(overweight OR obesity OR obese OR BMI OR "body mass index")
	#3	TS=(random* OR RCT OR "controlled trial")
	#4	#1 AND #2 AND #3
PUBMED	#1	("Soccer"[Mesh] OR soccer[Title/Abstract] OR football[Title/Abstract] OR "small-sided soccer"[Title/Abstract] OR "small-sided football"[Title/Abstract] OR "recreational soccer"[Title/Abstract] OR "recreational football"[Title/Abstract])
	#2	("Overweight"[Mesh] OR overweight[Title/Abstract] OR "Obesity"[Mesh] OR obese[Title/Abstract] OR obesity[Title/Abstract] OR "Body Mass Index"[Mesh] OR "body mass index"[Title/Abstract] OR BMI[Title/Abstract])
	#3	("Randomized Controlled Trial"[Publication Type] OR "Randomized Controlled Trials as Topic"[Mesh] OR random*[Title/Abstract] OR RCT[Title/Abstract])
	#4	#1 AND #2 AND #3
Scopus	#1	TITLE-ABS-KEY (soccer OR football OR "small-sided soccer" OR "small-sided football" OR "recreational soccer" OR "recreational football")
	#2	TITLE-ABS-KEY (overweight OR obesity OR obese OR BMI OR "body mass index")
	#3	TITLE-ABS-KEY (random* OR RCT OR trial OR "controlled trial")
	#4	#1 AND #2 AND #3
Embase	#1	('soccer'/exp OR soccer:ti,ab OR 'football'/exp OR football:ti,ab OR 'small-sided soccer':ti,ab OR 'small-sided football':ti,ab OR 'recreational soccer':ti,ab OR 'recreational football':ti,ab)
	#2	('overweight'/exp OR overweight:ti,ab OR 'obesity'/exp OR obese:ti,ab OR obesity:ti,ab OR 'body mass index':ti,ab OR BMI:ti,ab)
	#3	('randomized controlled trial'/exp OR random*:ti,ab OR RCT:ti,ab OR trial:ti,ab)
	#4	#1 AND #2 AND #3
SPORTDiscus (via EBSCOhost)	#1	XB (soccer OR football OR "small-sided soccer" OR "small-sided football" OR "recreational soccer" OR "recreational football")
	#2	XB (overweight OR obesity OR obese OR BMI OR "body mass index")
	#3	XB (random* OR RCT OR "controlled trial")
	#4	#1 AND #2 AND #3

BMI, body mass index; RCT, randomized controlled trial; MeSH, Medical Subject Headings; XB, title or abstract field in EBSCOhost.

Supplementary Table S2. **Detailed RoB 2 assessment by study, outcome, and domain.**

Study	Outcome	D1	D2	D3	D4	D5	Overall RoB
Seabra et al. (2014)	BMI	High risk	Low risk	Low risk	Low risk	Some concerns	High risk
Seabra et al. (2014)	BFP	High risk	Low risk	Low risk	Low risk	Some concerns	High risk
Seabra et al. (2014)	LBM	High risk	Low risk	Low risk	Low risk	Some concerns	High risk
Seabra et al. (2016)	BFP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	LBM	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	WC	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	TG	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	TC	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	LDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	HDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	SBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Seabra et al. (2016)	DBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Knoepfli-Lenzin et al. (2010)	BFP	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Knoepfli-Lenzin et al. (2010)	LBM	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Knoepfli-Lenzin et al. (2010)	WC	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Knoepfli-Lenzin et al. (2010)	TC	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Knoepfli-Lenzin et al. (2010)	LDL-C	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Knoepfli-Lenzin et al. (2010)	HDL-C	Some concerns	Low risk	High risk	Low risk	Low risk	Some concerns
Weintraub et al. (2008)	BMI	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Vasconcellos et al. (2016)	BMI	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	BFP	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	LBM	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	TG	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	TC	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	LDL-C	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	HDL-C	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	SBP	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2016)	DBP	Low risk	Low risk	Low risk	Low risk	Some concerns	Some concerns
Vasconcellos et al. (2021)	BMI	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Vasconcellos et al. (2021)	BFP	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk

Supplementary Table S2. **Continue…**

Study	Outcome	D1	D2	D3	D4	D5	Overall RoB
Vasconcellos et al. (2021)	WC	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Vasconcellos et al. (2021)	TG	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Vasconcellos et al. (2021)	HDL-C	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Vasconcellos et al. (2021)	DBP	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Soares et al. (2023)	BMI	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Soares et al. (2023)	BFP	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Soares et al. (2023)	WC	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Soares et al. (2023)	LBM	Low risk	Low risk	Low risk	Low risk	Low risk	Low risk
Lousa et al. (2017)	BMI	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Lousa et al. (2017)	BFP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Lousa et al. (2017)	WC	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Randers et al. (2010)	BFP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Randers et al. (2010)	TG	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Randers et al. (2010)	TC	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Randers et al. (2010)	LDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Randers et al. (2010)	HDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Cvetković et al. (2018)	BMI	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Cvetković et al. (2018)	BFP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Cvetković et al. (2018)	LBM	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Cvetković et al. (2018)	SBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Cvetković et al. (2018)	DBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Faude et al. (2010)	BMI	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	BMI	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	BFP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	LBM	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	TC	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	LDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	HDL-C	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	SBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Krustrup et al. (2009)	DBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Hansen et al. (2013)	BMI	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Hansen et al. (2013)	SBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Hansen et al. (2013)	DBP	Some concerns	Low risk	Low risk	Low risk	Some concerns	Some concerns
Wang et al. (2023)	BMI	Some concerns	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Wang et al. (2023)	BFP	Some concerns	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Wang et al. (2023)	LBM	Some concerns	Some concerns	Low risk	Low risk	Some concerns	Some concerns
Andersen et al. (2014)	BMI	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2014)	BFP	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2014)	LBM	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	BMI	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	BFP	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	LBM	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	TG	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	TC	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	LDL-C	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	HDL-C	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	SBP	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns
Andersen et al. (2016)	DBP	Some concerns	Low risk	Low risk	Low risk	Low risk	Some concerns

D1, bias arising from the randomization process; D2, bias due to deviations from the intended interventions; D3, bias due to missing outcome data; D4, bias in measurement of the outcome; D5, bias in selection of the reported result.