**Supplementary file 1: The study search strategy.**

**Scopus**

(TITLE-ABS-KEY(probio\*) OR TITLE-ABS-KEY(synbio\*) OR TITLE-ABS-KEY(symbio\*) OR TITLE-ABS-KEY(lactobacillus) OR TITLE-ABS-KEY(“lactic acid bacter\*”) OR TITLE-ABS-KEY(Lactococcus) OR TITLE-ABS-KEY(bifidobacter\*) OR TITLE-ABS-KEY(saccharomyces) OR TITLE-ABS-KEY(enterococcus) OR TITLE-ABS-KEY(streptococcus) OR TITLE-ABS-KEY(Enterococcus)) AND (ALL(“appetite”) OR TITLE-ABS-KEY(“hormone\*”) OR ALL(“satiety”) OR ALL(“hunger”) OR ALL(“fullness”) OR ALL(“desire to eat”) OR ALL(“prospective food consumption”) OR ALL(“energy intake\*”) OR ALL(“caloric intake\*”) OR ALL(“dietary intake\*”) OR ALL(“food intake\*”) OR ALL(“appetite hormone\*”) OR ALL(“gut hormone\*”) OR ALL(“amylin”) OR ALL(“cholecystokinin”) OR ALL(“CCK”) OR ALL(“corticotropin releasing factor”) OR ALL(“CRF”) OR ALL(“dopamine”) OR ALL(“ghrelin”) OR ALL(“glucose-dependent insulinotropic polypeptide”) OR ALL(“GIP”) OR ALL(“glucagon-like peptide 1”) OR ALL(“GLP-1”) OR ALL(“GLP-2”) OR ALL(“glucagon”) OR ALL(“insulin”) OR ALL(“leptin”) OR ALL(“oxyntomodulin”) OR ALL(“pancreatic polypeptide”) OR ALL(“OXM”) OR ALL(“PP”) OR ALL(“peptide YY”) OR ALL(“PYY”) OR ALL(“serotonin”) OR ALL(“gastrin”) OR ALL(“transit time”) OR ALL(“gastrointestinal emptying time”) OR ALL(“NPY”) OR ALL(“neuropeptide-Y”) OR ALL(“neuropeptide Y”) OR ALL(“gastric emptying time”) OR ALL(“adiponectin) ” OR ALL (adiponect\*)”) AND (TITLE-ABS-KEY(Randomized) OR TITLE-ABS-KEY(random\*) OR TITLE-ABS-KEY(Intervention) OR TITLE-ABS-KEY(“Clinical trial”) OR TITLE-ABS-KEY(“Randomized controlled trial”) OR TITLE-ABS-KEY(“Randomized controlled trials”) OR TITLE-ABS-KEY(trial) OR TITLE-ABS-KEY(Placebo\*) OR TITLE-ABS-KEY(“Double-blind”) OR TITLE-ABS-KEY(“Single-blind”) OR TITLE-ABS-KEY(“single blind”) OR TITLE-ABS-KEY(“Randomised”) OR TITLE-ABS-KEY(“Randomised clinical trials”) OR TITLE-ABS-KEY(“Randomised clinical trial”) OR TITLE-ABS-KEY(“controlled”)) AND (NOT TITLE-ABS-KEY(child\*) OR NOT TITLE-ABS-KEY(children\*) OR NOT TITLE-ABS-KEY(adolescents\*) OR NOT TITLE-ABS-KEY(pediatric\*) OR NOT TITLE-ABS-KEY(rodent) OR NOT TITLE-ABS-KEY(mice) OR NOT TITLE-ABS-KEY(mouce) OR NOT TITLE-ABS-KEY(animal) OR NOT TITLE-ABS-KEY(pig) OR NOT TITLE-ABS-KEY(chicken))

Results: 203

Date: December 5, 2021

**PubMed**

(probio\*[tiab] OR synbio\*[tiab] OR symbio\*[tiab] OR lactobacillus[tiab] OR "lactic acid bacter\*"[tiab] OR Lactococcus[tiab] OR bifidobacter\*[tiab] OR saccharomyces[tiab] OR enterococcus[tiab] OR streptococcus[tiab] OR Enterococcus[tiab] OR probiotics/administration and dosage[MeSH] OR probiotics/adverse effects[MeSH] OR probiotics/therapeutic use[MeSH] OR probiotics/pharmacology[MeSH] OR lactobacillus[MeSH] OR Lactococcus[MeSH] OR bifidobacterium[MeSH] OR saccharomyces[MeSH] OR enterococcus[MeSH] OR streptococcus[MeSH] OR Enterococcus[MeSH]) AND ("appetite"[tw] OR hormone\*[tiab] OR "satiety"[tw] OR "hunger"[tw] OR "fullness"[tw] OR "desire to eat"[tw] OR "prospective food consumption" [tw] OR "energy intake\*" [tw] OR "caloric intake\*" [tw] OR "dietary intake\*" [tw] OR "food intake\*" [tw] OR "appetite hormone\*" [tw] OR "gut hormone\*" [tw] OR "amylin" [tw] OR "cholecystokinin" [tw] OR "CCK" [tw] OR "corticotropin releasing factor" [tw] OR "CRF" [tw] OR "dopamine" [tw] OR "ghrelin" [tw] OR "glucose-dependent insulinotropic polypeptide" [tw] OR "GIP" [tw] OR "glucagon-like peptide 1" [tw] OR "GLP-1" [tw] OR "GLP-2" [tw] OR "glucagon" [tw] OR "insulin" [tw] OR "leptin" [tw] OR "oxyntomodulin" [tw] OR "adiponectin" [tw] OR adiponect\* [tw] OR adiponect\* [tiab] OR "OXM" [tw] OR "pancreatic polypeptide" [tw] OR "PP" [tw] OR "peptide YY" [tw] OR "PYY" [tw] OR "serotonin" [tw] OR "gastrin" [tw] OR "transit time" [tw] OR "NPY" [tw] OR "neuropeptide-Y" [tw] OR "neuropeptide Y" [tw]) AND (Randomized [tiab] OR random\*[tiab] Intervention[tiab] OR "Clinical trial"[tiab] OR "Randomized controlled trial"[tiab] OR "Randomized controlled trials"[tiab] OR trial[tiab] OR Placebo\*[tiab] OR "Double-blind"[tiab] OR "Single-blind"[tiab] OR "single blind"[tiab] OR Clinical trial [Mesh] OR "Random Allocation" [Mesh] OR Randomised [tiab] OR "Randomised clinical trials"[tiab] OR "Randomised clinical trial"[tiab] OR controlled [tiab] OR "Clinical Trial" [Publication Type] OR "Clinical Trials as Topic"[Mesh] OR "Pragmatic Clinical Trial" [Publication Type]) NOT (child\*[tiab] OR children\*[tiab] OR adolescents\*[tiab] OR pediatric\*[tiab] OR review [Publication Type] OR rodent [tiab] OR mice [tiab] OR mouce [tiab] OR animal [tiab] OR pig [tiab] OR chicken [tiab])

Results: 705

Date: December 5, 2021

Total: 908

Duplicate: 5

**Supplementary file 2: The PRISMA checklist.**

| **Section and Topic**  | **Item #** | **Checklist item**  | **Location where item is reported**  |
| --- | --- | --- | --- |
| **TITLE**  |  |
| Title  | 1 | Identify the report as a systematic review. | Page 1 |
| **ABSTRACT**  |  |
| Abstract  | 2 | See the PRISMA 2020 for Abstracts checklist. | Page 3 |
| **INTRODUCTION**  |  |
| Rationale  | 3 | Describe the rationale for the review in the context of existing knowledge. | Page 4-5 |
| Objectives  | 4 | Provide an explicit statement of the objective(s) or question(s) the review addresses. | Page 5 |
| **METHODS**  |  |
| Eligibility criteria  | 5 | Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses. | Page 6-7, Table 1 |
| Information sources  | 6 | Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted. | Page 6 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, including any filters and limits used. | Page 6 and Supplementary files 1 |
| Selection process | 8 | Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process. | Page 6-7, Table 1 |
| Data collection process  | 9 | Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process. | Page 7-9 |
| Data items  | 10a | List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect. | Page 6-8 |
| 10b | List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information. | Page 6-8 |
| Study risk of bias assessment | 11 | Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process. | Page 7-8 |
| Effect measures  | 12 | Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results. | Page 8-10 |
| Synthesis methods | 13a | Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)). | Page 8-10 |
| 13b | Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions. | Page 8-10 |
| 13c | Describe any methods used to tabulate or visually display results of individual studies and syntheses. | Page 8-10 |
| 13d | Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used. | Page 8-10 |
| 13e | Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression). | Page 8-10 |
| 13f | Describe any sensitivity analyses conducted to assess robustness of the synthesized results. | Page 8-10 |
| Reporting bias assessment | 14 | Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases). | Page 8-10 |
| Certainty assessment | 15 | Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome. | Page 8-10 |
| **RESULTS**  |  |
| Study selection  | 16a | Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram. | Page 11, Figure 1, Table 2  |
| 16b | Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded. | Page 11, Figure 1, Table 2  |
| Study characteristics  | 17 | Cite each included study and present its characteristics. | Page 11, Figure 1, Table 2  |
| Risk of bias in studies  | 18 | Present assessments of risk of bias for each included study. | Page 12, Table 3 |
| Results of individual studies  | 19 | For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots. | Page 12-14, Figures 2-4, Tables 4-5, Supplemntary files 5-6 |
| Results of syntheses | 20a | For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies. | Page 12-14, Figures 2-4, Tables 4-5, Supplemntary files 5-6 |
| 20b | Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | Page 12-14, Figures 2-4, Tables 4-5, Supplemntary files 5-6 |
| 20c | Present results of all investigations of possible causes of heterogeneity among study results. | Page 12-14, Figures 2-4, Tables 4-5, Supplemntary files 5-6 |
| 20d | Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results. | Page 14, Supplementary File 4, Supplementary Figure 2-4.  |
| Reporting biases | 21 | Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed. | Page 13-14, Supplementary File 3, Supplementary Figure 1a-c. |
| Certainty of evidence  | 22 | Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed. | Page 9-10 and 12-13, Supplementary file 7 |
| **DISCUSSION**  |  |
| Discussion  | 23a | Provide a general interpretation of the results in the context of other evidence. | Page 15-17 |
| 23b | Discuss any limitations of the evidence included in the review. | Page 15-18 |
| 23c | Discuss any limitations of the review processes used. | Page 18 |
| 23d | Discuss implications of the results for practice, policy, and future research. | Page 18-19 |
| **OTHER INFORMATION** |  |
| Registration and protocol | 24a | Provide registration information for the review, including register name and registration number, or state that the review was not registered. | Page 6, registration number CRD42022334123 (Supplementary File 2) |
| 24b | Indicate where the review protocol can be accessed, or state that a protocol was not prepared. | Page 6, registration number CRD42022334123 (Supplementary File 2) |
| 24c | Describe and explain any amendments to information provided at registration or in the protocol. | -- |
| Support | 25 | Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review. | Page 20 |
| Competing interests | 26 | Declare any competing interests of review authors. | Page 20 |
| Availability of data, code and other materials | 27 | Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review. | Page 20 |

*From:*  Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71

For more information, visit: <http://www.prisma-statement.org/>

**Supplementary file 3. Publication bias assessment using funnel plots of main outcomes using random effect models.**

**Supplementary Figure 1.a. Adiponectin funnel plot.**



**Number of studies = 18 Root MSE = 2.252**

**------------------------------------------------------------------------------**

 **Std\_Eff | Coefficient Std. err. t P>|t| [95% conf. interval]**

**-------------+----------------------------------------------------------------**

 **slope | -.4024072 .5293159 -0.76 0.458 -1.524507 .7196924**

 **bias | 2.273686 2.005817 1.13 0.274 -1.978455 6.525828**

**------------------------------------------------------------------------------**

**Test of H0: no small-study effects P = 0.274**

**Supplementary Figure 1.b. Leptin funnel plot.**



**Number of studies = 17 Root MSE = 1.766**

**------------------------------------------------------------------------------**

 **Std\_Eff | Coefficient Std. err. t P>|t| [95% conf. interval]**

**-------------+----------------------------------------------------------------**

 **slope | .2871783 .4684699 0.61 0.549 -.7113415 1.285698**

 **bias | -2.175392 1.627128 -1.34 0.201 -5.643533 1.29275**

**------------------------------------------------------------------------------**

**Test of H0: no small-study effects P = 0.201**

**Supplementary Figure 1.c. Desire to eat score funnel plot**

****

**Number of studies = 5 Root MSE = .999**

**------------------------------------------------------------------------------**

 **Std\_Eff | Coefficient Std. err. t P>|t| [95% conf. interval]**

**-------------+----------------------------------------------------------------**

 **slope | -.4808808 .4220562 -1.14 0.337 -1.824052 .8622904**

 **bias | 3.071273 1.615685 1.90 0.153 -2.070558 8.213104**

**------------------------------------------------------------------------------**

**Test of H0: no small-study effects P = 0.153**

**Supplementary file 4. Influence/Sensitivity analyses results.**

**Supplementary figure 2.a. A leave-one-out sensitivity analysis of the impact of probiotic/synbiotic administration on serum/plasma adiponectin**

****

**Supplementary figure 3.a. A leave-one-out sensitivity analysis of the impact of probiotic/synbiotic administration on serum/plasma leptin.**

****

**Supplementary figure 4.a. A leave-one-out sensitivity analysis of the impact of probiotic/synbiotic administration on desire to eat score.**

****

**Supplementary file 5. Subgroup analysis results.**

**Supplementary Figure 5.a. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma adiponectin according to health conditions of participants (subgrouped as the studies on patients with overweight or obesity, non-alcoholic fatty liver disease (NAFLD), or diabetes mellitus).**

****

**Supplementary Figure 5.b. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma adiponectin according to form of intervention (subgrouped as probiotic foods or dietary supplements).**

****

**Supplementary Figure 5.c. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma adiponectin according to follow up duration (less than 12 weeks or ≥12 weeks).**

****

**Supplementary Figure 5.d. Forest plot depicting w standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma adiponectin according to total dose of bacteria prescribed (low dose (less than 1×1010 CFU/day) vs. high dose more than 1×1010 CFU/day)).**

****

**Supplementary Figure 5.e. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma adiponectin according to included studies quality (high risk of bias vs. low risk of bias).**

****

**Supplementary Figure 6.a. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma leptin according to health conditions of participants (subgrouped as the studies on patients with overweight or obesity, non-alcoholic fatty liver disease (NAFLD), or diabetes mellitus).**

****

**Supplementary Figure 6.b. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma leptin according to form of intervention (subgrouped as probiotic foods or dietary supplements).**

****

**Supplementary Figure 6.c. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma leptin according to follow up duration (less than 12 weeks or ≥12 weeks).**

****

**Supplementary Figure 6.d. Forest plot depicting w standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma leptin according to total dose of bacteria prescribed (low dose (less than 1×1010 CFU/day) vs. high dose more than 1×1010 CFU/day)).**

****

**Supplementary Figure 6.e. Forest plot depicting standardized mean differences (SMD) and the 95% confidence interval (CI) for the impact of probiotic/synbiotic administration on serum/plasma leptin according to included studies quality (high risk of bias vs. low risk of bias).**

****

**Supplementary file 6. Meta-regression analysis.**

**Supplementary figure 10 (a, b). A random-effects meta-regression to investigate the relationship between potential moderators (a. age and b. body mass index (BMI)) and estimated net changes in serum/plasma adiponectin using unrestricted maximum likelihood method.**

1. **Age.**

****

**b. BMI.**



**Supplementary figure 11 (a, b). A random-effects meta-regression to investigate the relationship between potential moderators (a. age and b. body mass index (BMI)) and estimated net changes in serum/plasma leptin using unrestricted maximum likelihood method.**

1. **Age.**

****

**b. BMI.**



**Supplementary figure 11 (a, b). A random-effects meta-regression to investigate the relationship between potential moderators (a. age and b. body mass index (BMI)) and estimated net changes in desire to eat score using unrestricted maximum likelihood method.**

1. **Age.**

****

1. **BMI.**

****

**Supplementary file 7. Results of GRADE assessment for the effect of probiotics and synbiotics supplementation on appetite-regulating hormones and appetite related scores.**

**Question:** Probiotic or synbiotic compared to Placebo for appetite-regulating hormones and desire to eat

**Setting:** General population

| **Certainty assessment** | **№ of patients** | **Effect** | **Certainty** |
| --- | --- | --- | --- |
| **№ of studies** | **Study design** | **Risk of bias** | **Inconsistency** | **Indirectness** | **Imprecision** | **Other considerations** | **Probiotic or synbiotic** | **Placebo** | **SMD(95% CI)** |
| **Adiponectin** |
| 17 | Randomized trials | not serious | not serious a | not serious | Serious b | None  | 546 | 543 | 0.25 (-0.04, 0.53) | ⨁⨁⨁◯Moderate |
| **Leptin** |
| 16 | Randomized trials | not serious | not serious c | not serious | Serious d | None  | 442 | 425 | -0.38 (-0.64, -0.12) | ⨁⨁⨁◯Moderate |
| **Desire to eat** |
| 5 | Randomized trials | not serious | not serious | not serious | Serious e | None  | 151 | 149 | 0.34 (0.03, 0.66)  | ⨁⨁⨁◯Moderate |

#### CI: confidence interval

#### Explanations

a. Serious consistency since *I*2=80.6. However, the value of *I*2 was <50% in the low-dose subgroup, and the significance, direction, and magnitude of the effect remained unchanged (SMD:0.42, 95% CI: -0.08, 0.93, n=10, I2=0.0), therefore, not downgraded.

b. Nonsignificant. Downgraded

c. Serious consistency since I2=69.4. However, the value of I2 was <50% in the low-dose subgroup, and the significance, direction, and magnitude of the effect remained unchanged (SMD: -0.23, 95% CI: 0.42, -0.04, n=11 I2=28.5), therefore, not downgraded.

d. Serious imprecision, since CI include two different interpretation zone.

e. Serious imprecision since CI include two different interpretation zone and sample size is less than 400 (n= 305)