Electronic Supplementary Material (ESI) for Food & Function.

Supplementary appendix

Comparison of the effectiveness of probiotic supplementation in glucose metabolism, lipid profile, inflammation and oxidative stress in pregnant women†

Appendix 1. The literature search strategy

PubMed

#1 ((((((((((((((((((((((((“Probiotics” [Mesh] OR “Probiotics”[tiab] OR “probiotic”[tiab] OR “lactobacillus” OR “lactobacillus”[tiab] OR “bifidobacteria”[tiab] OR “Synbiotics” [Mesh] OR “Synbiotics”[tiab] OR “Synbiotic”[tiab] OR “Prebiotics” [Mesh] OR “Prebiotics”[tiab] OR “prebiotic”[tiab] OR) OR (Enterococcus faecium)) OR (Streptococcus thermophiles)) OR (Bacillus clausii)) OR (Saccharomyces cerevisiae)) OR (Saccharomyces boulardii)) OR (Escherichia coli Nissle 1917)) OR (prebiotic)) OR (FOS)) OR (Fruc-tooligosaccharide*)) OR (Fructo-oligosaccharide*)) OR (GOS)) OR (Galactooligosaccharide*)) OR (Galacto-oligosaccharide*)) OR (XOS)) OR (Xylooligosaccharide*)) OR (Xylo-oligosaccharide*)) OR (TOS)) OR (Transgalactooligosaccharide*)) OR (Trans-galactooligosaccharide*)) OR (Inulin)) OR (Lactitol)) OR (Lactulose)) OR (Lactosucrose)) OR (Soy oligosaccharide*)

#2 (((oxidative stress indicators) OR (malondialdehyde)) OR (MDA)) OR (glutathione)) OR (GSH)) OR (nitric oxide)) OR (NO)) OR (total antioxidant capacity)) OR (TAC)) OR (hs-CRP)) OR (high-sensitivity C-reactive protein)) OR (fasting blood sugar)) OR (FBS)) OR (FBG)) OR (Fasting plasma glucose)) OR (FPG)) OR (glycated hemoglobin)) OR (HbA1C)) OR (Fasting insulin)) OR (homeostasis model assessment of insulin resistance)) OR (insulin resistance)) OR (glucose tolerance test)) OR (Serum Sirtuin1)) OR (postprandial plasma glucose)) OR (PPG) OR (quantitative insulin-sensitivity check index)) OR (QUICKI)) OR (Insulin-sensitivity)) OR (homeostatic model assessment of beta cell function) OR (low-density lipoprotein cholesterol)) OR (LDL-C)) OR (total cholesterol)) OR (TC)) OR (high-density lipoprotein cholesterol)) OR (HDL-C))OR (triglyceride)) OR (TG))OR (very low density lipoprotein cholesterol)) OR (VLDL-C)) OR (insulin)) OR (glucose)) OR (C-peptide)) OR (BMI)) OR (body mass)) OR (body weight)) OR (waist circumference)) OR (WC)) OR (systolic blood pressure)) OR (SBP)) OR (diastolic blood pressure)) OR (DBP)))

#3 (((((((((controlled trial[Title/Abstract]) OR (controlled trial[Title/Abstract])) OR (random[Title/Abstract])) OR (randomly[Title/Abstract])) OR (placebo[Title/Abstract])) OR (clinical trial[Title/Abstract])) OR (clinical trial[Title/Abstract])) OR (randomized clinical trial[Title/Abstract])) OR (RCT[Title/Abstract])) OR (trials[Title/Abstract])) OR (trial[Title/Abstract])

#4 ((((("Pregnancy"[Mesh]) OR (Pregnancies[Title/Abstract])) OR (Gestation[Title/Abstract])) OR (((("Pregnant Women"[Mesh]) OR (Pregnant Woman[Title/Abstract])) OR (Woman, Pregnant[Title/Abstract])) OR (Women, Pregnant[Title/Abstract]))) OR ((((((("Diabetes, Gestational"[Mesh]) OR (Diabetes, Pregnancy-Induced[Title/Abstract])) OR (Diabetes, Pregnancy Induced[Title/Abstract])) OR (Pregnancy-Induced Diabetes[Title/Abstract])) OR (Gestational Diabetes[Title/Abstract])) OR (Diabetes Mellitus, Gestational[Title/Abstract])) OR (Gestational Diabetes Mellitus[Title/Abstract]))) OR (GDM[Title/Abstract])

#5 #1 AND #2 AND #3 AND #4

Embase

#1 'probiotics'/exp OR 'probiotics' OR 'probiotic'/exp OR 'probiotic' OR 'lactobacillus'/exp OR 'lactobacillus' OR 'synbiotics'/exp OR 'synbiotics' OR 'synbiotic'/exp OR 'synbiotic' OR 'prebiotics'/exp OR 'prebiotics' OR 'prebiotic'/exp OR 'prebiotic' OR 'enterococcus faecium'/exp OR 'enterococcus faecium' OR 'streptococcus thermophiles'/exp OR 'streptococcus thermophiles' OR 'saccharomyces cerevisiae'/exp OR 'saccharomyces cerevisiae' OR 'saccharomyces boulardii'/exp OR 'saccharomyces boulardii' OR 'escherichia coli nissle 1917'/exp OR 'escherichia coli nissle 1917' OR 'fos'/exp OR 'fos' OR 'fruc-tooligosaccharide*' OR 'fructo-oligosaccharide*' OR 'gos' OR 'galactooligosaccharide*' OR 'galacto-oligosaccharide*' OR 'xos' OR 'xylooligosaccharide*' OR 'xylo-oligosaccharide*' OR 'tos' OR 'transgalactooligosaccharide*' OR 'trans-galactooligosaccharide*' OR 'inulin'/exp OR 'inulin' OR 'lactitol'/exp OR 'lactitol' OR 'lactulose'/exp OR 'lactulose' OR 'lactosucrose'/exp OR 'lactosucrose' OR 'soy oligosaccharide*'

#2 'pregnancy' OR 'pregnancies' OR 'gestation'/exp OR 'gestation' OR 'pregnant women'/exp OR 'pregnant women' OR 'pregnant woman'/exp OR 'pregnant woman' OR 'gestational diabetes'/exp OR 'gestational diabetes' OR 'gestational diabetes mellitus' OR 'gdm'

#3 'controlled trial' OR 'randomized' OR 'placebo' OR 'clinical trial' OR 'trial' OR 'randomized clinical trial' OR 'trials'

#4 'mda'/exp OR 'mda' OR 'glutathione' OR 'tac' OR 'hs-crp' OR 'hscrp' OR 'fasting blood sugar'/exp OR 'fasting blood sugar' OR 'fbs'/exp OR 'fbs' OR 'fbg' OR 'fasting plasma glucose'/exp OR 'fasting plasma glucose' OR 'fpg' OR 'glycated hemoglobin'/exp OR 'glycated hemoglobin' OR 'hba1c'/exp OR 'hba1c' OR 'fasting insulin'/exp OR 'fasting insulin' OR 'homeostasis model assessment of insulin resistance'

OR 'insulin resistance' OR 'glucose tolerance test'/exp OR 'glucose tolerance test' OR 'serum sirtuin1' OR 'quantitative insulin-sensitivity check index'/exp OR 'quantitative insulin-sensitivity check index' OR 'quicki'/exp OR 'quicki' OR 'insulin-sensitivity'/exp OR 'insulin-sensitivity' OR 'low-density lipoprotein cholesterol'/exp OR 'low-density lipoprotein cholesterol' OR 'ldl-c' OR 'total cholesterol'/exp OR 'total cholesterol' OR 'tc' OR 'high-density lipoprotein cholesterol'/exp OR 'high-density lipoprotein cholesterol' OR 'hdl-c' OR 'tg' OR 'very low density lipoprotein cholesterol'/exp OR 'very low density lipoprotein cholesterol' OR 'vldl-c' OR 'insulin'/exp OR 'insulin' OR 'glucose'/exp OR 'glucose' OR 'bmi' OR 'body weight' OR 'ogtt'/exp OR 'ogtt' OR '1hbg' OR '2hbg' OR 'homa-b'

#5 #1 AND #2 AND #3 AND #4

Cochrane Library

#1 Probiotics or Probiotics or Probiotic or Lactobacillus or Lactobacillus or Bifidobacteria or Synbiotics or Synbiotics or Synbiotic or Prebiotics or Prebiotics or Prebiotic or Enterococcus faecium or Streptococcus thermophiles or Bacillus clausii or Saccharomyces cerevisiae or Saccharomyces boulardii or Escherichia coli Nissle 1917 or Prebiotic or FOS or Fruc-tooligosaccharide* or Fructo-oligosaccharide* or GOS or Galactooligosaccharide* or Galacto-oligosaccharide* or XOS or Xylooligosaccharide* or Xylo-oligosaccharide* or TOS or Transgalactooligosaccharide* or Trans-galactooligosaccharide* or Inulin or Lactitol or Lactulose or Lactosucrose or Soy oligosaccharide*

#2 Pregnancy or Pregnancies or Gestation or Pregnant Women or Pregnant Woman or Woman, Pregnant or Women, Pregnant or Gestational Diabetes or Diabetes Mellitus, Gestational or Gestational Diabetes Mellitus or GDM

#3 controlled trial or Randomized or Random or Randomly or Placebo or clinical trial or Trial or randomized clinical trial or RCT or trials or trial

#4 Malondialdehyde or MDA or Glutathione or GSH or TAC or total antioxidant capacity or hs-CRP or hsCRP or fasting blood sugar or FBS or FBG or Fasting plasma glucose or FPG or glycated hemoglobin or HbA1C or Fasting insulin or homeostasis model assessment of insulin resistance or insulin resistance or glucose tolerance test or Serum Sirtuin1 or quantitative insulin-sensitivity check index or QUICKI or Insulin-sensitivity or low-density lipoprotein cholesterol or LDL-C or total cholesterol or TC or high-density lipoprotein cholesterol or HDL-C or Triglyceride or TG or very low density lipoprotein cholesterol or VLDL-C or Insulin or Glucose or BMI or OGTT or 1hBG or 2hBG or HOMA-B or NO or nitric oxide or body mass or body weight

#5 #1 AND #2 AND #3 AND #4

Web of science

#1 ((((((((((((((((((((((((((((TS=(Probiotics)) OR TS=(probiotic)) OR TS=(lactobacillus)) OR TS=(bifidobacteria)) OR TS=(Synbiotics)) OR TS=(Synbiotic)) OR TS=(Prebiotics)) OR TS=(prebiotic)) OR TS=("Enterococcus faecium")) OR TS=("Streptococcus thermophiles")) OR TS=("Bacillus clausii")) OR TS=("Saccharomyces cerevisiae")) OR TS=("Saccharomyces boulardii")) OR TS=("Escherichia coli Nissle 1917")) OR TS=(FOS)) OR TS=(Fruc-tooligosaccharide*)) OR TS=(Fructo-oligosaccharide*)) OR TS=(GOS)) OR TS=(Galactooligosaccharide*)) OR TS=(Galacto-oligosaccharide*)) OR TS=(XOS)) OR TS=(Xylooligosaccharide*)) OR TS=(Xylo-oligosaccharide*)) OR TS=(TOS)) OR TS=(Transgalactooligosaccharide*)) OR TS=(Trans-galactooligosaccharide*)) OR TS=(Inulin)) OR TS=(Lactitol)) OR TS=(Lactulose)) OR TS=(Lactosucrose)) OR TS=(Soy oligosaccharide*)

#2 ((((((((((((((TS=(Pregnancy)) OR TS=(Pregnancies)) OR TS=(Gestation)) OR TS=("Pregnant Women")) OR TS=("Pregnant Woman")) OR TS=("Woman, Pregnant")) OR TS=("Women, Pregnant")) OR TS=("Diabetes, Gestational")) OR TS=("Diabetes, Pregnancy-Induced")) OR TS=("Diabetes, Pregnancy Induced")) OR TS=("Pregnancy-Induced Diabetes")) OR TS=("Gestational Diabetes")) OR TS=(Diabetes Mellitus, Gestational)) OR TS=("Gestational Diabetes Mellitus")) OR TS=(GDM)

#3 ((((((((((TS=("controlled trial")) OR TS=(randomized)) OR TS=(random)) OR TS=(randomly)) OR TS=(placebo)) OR TS=("clinical trial")) OR TS=(Trial)) OR TS=("randomized clinical trial")) OR TS=(RCT)) OR TS=(trials)) OR TS=(trial)

#4 ((TS=(malondialdehyde)) OR TS=(MDA)) OR TS=(glutathione)) OR TS=(GSH)) OR TS=(NO)) OR TS=("nitric oxide")) OR TS=(TAC)) OR TS=("total antioxidant capacity")) OR TS=(hs-CRP)) OR TS=(hsCRP)) OR TS=("fasting blood sugar")) OR TS=(FBS)) OR TS=(FBG)) OR TS=("Fasting plasma glucose")) OR TS=(FPG)) OR TS=("glycated hemoglobin")) OR

TS=(HbA1C)) OR TS=("Fasting insulin")) OR TS=("homeostasis model assessment of insulin resistance")) OR TS=("insulin resistance")) OR TS=("glucose tolerance test")) OR TS=("Serum Sirtuin1")) OR TS=("quantitative insulin-sensitivity check index")) OR TS=(QUICKI)) OR TS=(Insulin-sensitivity)) OR TS=("low-density lipoprotein cholesterol")) OR TS=(LDL-C)) OR TS=("total cholesterol")) OR TS=(TC)) OR TS=("high-density lipoprotein cholesterol")) OR TS=(HDL-C)) OR TS=(triglyceride)) OR TS=(TG)) OR TS=("very low density lipoprotein cholesterol")) OR TS=(VLDL-C)) OR TS=(insulin)) AND TS=(glucose)) OR TS=(BMI)) OR TS=("body mass")) OR TS=("body weight")) OR TS=(OGTT)) OR TS=(1hBG)) OR TS=(2hBG)) OR TS=(HOMA-B)

#5 #1 AND #2 AND #3 AND #4

Additional works that were found during preparation of meta-analysis but were not part of initial or subsequent searches were included. These works were discovered when attempting to locate full-text versions of other works or as references in other work.

Appendix 2. GRADE assessments

For both direct and indirect comparisons, the starting point for certainty in estimates was "high". The certainty in indirect estimates was inferred from the examination of the dominant lowest-order loop. We identified the dominant lowest order loop by per comparison contribution matrix which could show the contribution percentage of each direct comparison to each indirect comparison. The certainty rating chosen was the lowest of the direct estimates contributing to the indirect comparison. For example, consider a comparison of A vs. B that is informed by A vs. C and B vs. C. If A vs. C was rated as high certainty and B vs. C as moderate certainty, the overall indirect certainty rating was moderate (moderate from the B vs. C comparison).

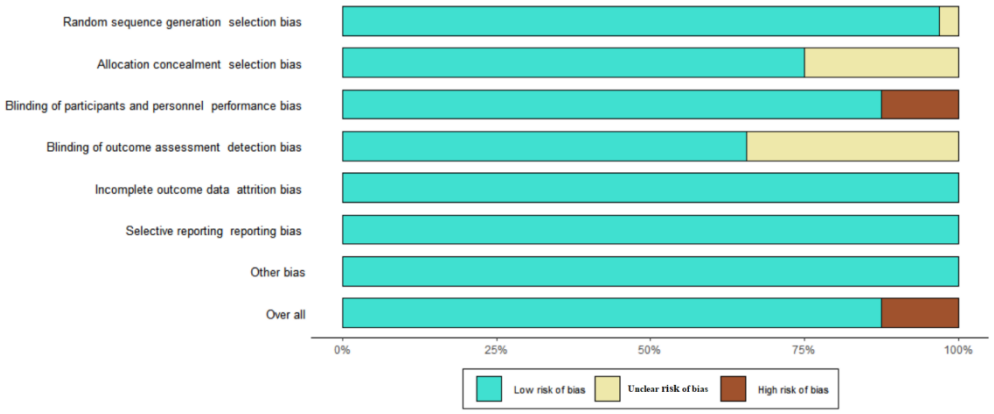
Down rating the quality rating may be rated down by −1 (serious concern) or −2 (very serious concern) for the following reasons
•**Risk of bias**: All studies blinded participants. Did not downgrade this item.
• **Inconsistency/heterogeneity**: In terms of heterogeneity, one level was downgraded when $50\% < I^2 < 90\%$, and two levels were downgraded when $I^2 \geq 90\%$.
• **Indirectness**: No significant indirectness was found.
• **Imprecision**: Among all outcomes, we rated down for imprecision among direct estimates if the credible interval passes through the invalid line.
• **Publication bias**: The findings of trim and fill method indicated that all results were reliable despite publication bias, so we have not downgraded the grade of evidence for publication bias.
GRADE certainty in estimates

High certainty: We are very confident that the true effect lies close to that of the estimate of the effect;
Moderate certainty: We are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different;
Low certainty: Our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect;
Very low certainty: We have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

References

Puhan, M. A., Schünemann, H. J., Murad, M. H., et al. (2014). A GRADE Working Group approach for rating the quality of treatment effect estimates from network Meta-analysis. BMJ 349, g5630.

Figure.S1. Risk assessment of bias using the Cochrane risk of bias

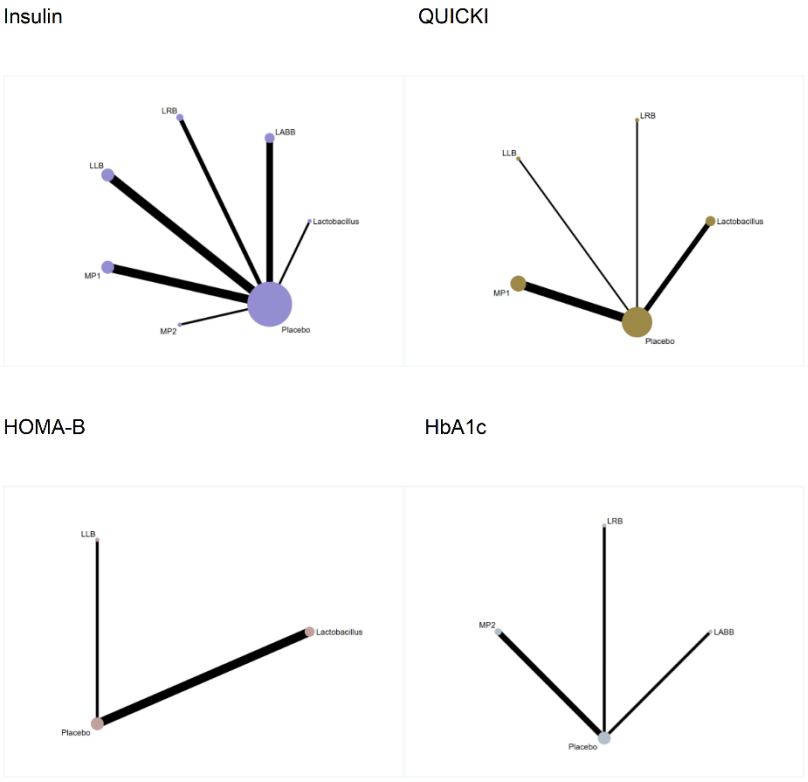


The risk of bias items of all included studies are indicated as percentages. Turquoise = low risk of bias, pale goldenrod = unclear risk of bias, sienna = high risk of bias.

Figure.S2. Network plots for other outcome measures

The thickness of the lines represents the number of trials for a specific comparison, and the size of the nodes reflects the number of pregnant women involving a particular intervention.

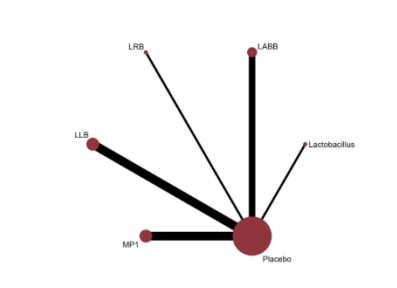
Glycemic control



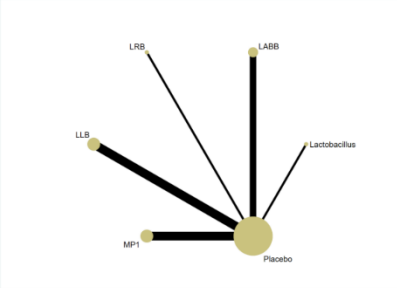
QUICKI, quantitative insulin-sensitivity check index; HOMA-B, homeostasis model assessment of beta cell; HbA1c, glycated hemoglobin A1c. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

Lipid metabolism

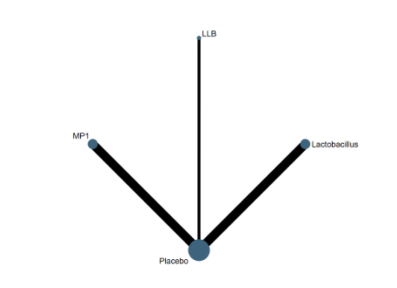
HDLC



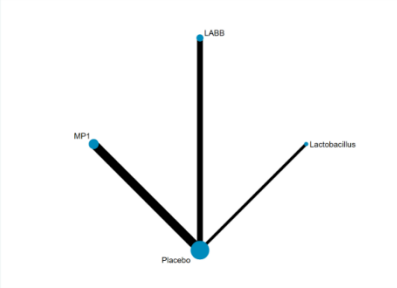
TG



VLDLC



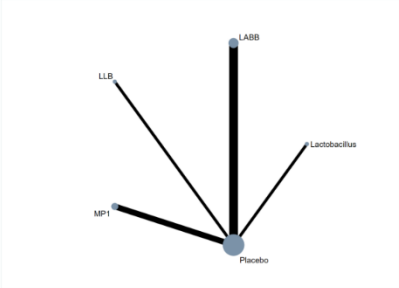
Total/HDLC



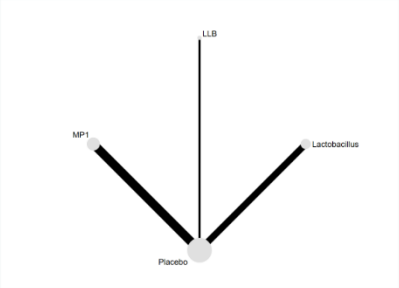
HDLC, high-density lipoprotein cholesterol; TG, triglyceride; VLDLC, very low-density lipoprotein cholesterol; Total/HDLC, total cholesterol/high-density lipoprotein cholesterol. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics.

Oxidative stress

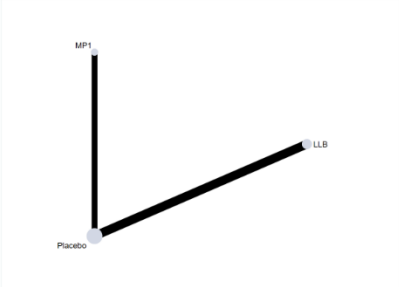
GSH



MDA



NO



GSH, glutathione; MDA, malondialdehyde; NO, nitric oxide. *LABB, Lactobacillus acidophilus and Bifidobacterium; LRB, Lacticaseibacillus rhamnosus and Bifidobacterium; LLB, Lactobacillus acidophilus, Lacticaseibacillus casei, and Bifidobacterium bifidum;* MP1, four probiotics.

Figure.S3. League tables of secondary outcomes

Insulin and QUICKI

Insulin(μIU/mL)

Lactobacillus	-4.27 (-8.8 to 0.5)	-2.47 (-5.62 to 1.08)	**-4.86 (-7.89 to -1.44)**	-2.1 (-4.36 to 0.82)	**-6.66 (-10.45 to -2.28)**	-0.6 (-2.36 to 1.73)
NR	LABB	1.84 (-3.05 to 6.84)	-0.64 (-5.46 to 4.2)	2.22 (-2.2 to 6.77)	-2.32 (-7.78 to 3.14)	3.7 (-0.36 to 7.91)
-0.01 (-0.03 to 0.01)	NR	LRB	-2.41 (-6.03 to 1.09)	0.33 (-2.66 to 3.51)	-4.2 (-8.54 to 0.29)	1.83 (-0.68 to 4.55)
0 (-0.02 to 0.02)	NR	**0.01 (0 to 0.02)**	LLB	2.77 (-0.03 to 5.87)	-1.76 (-6.05 to 2.63)	**4.28 (1.91 to 6.84)**
0.02 (-0.01 to 0.03)	NR	**0.02 (0.01 to 0.03)**	**0.01 (0 to 0.02)**	MP1	**-4.58 (-8.48 to -0.66)**	1.47 (-0.2 to 3.14)
NR	NR	NR	NR	NR	MP2	**6.05 (2.47 to 9.55)**
0.02 (0 to 0.04)	NR	**0.03 (0.02 to 0.04)**	**0.02 (0.01 to 0.02)**	**0.01 (0 to 0.01)**	NR	Placebo

QUICKI

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League table: The values in the upper triangle correspond to the difference in mean (95% CI) in Insulin (μIU/mL) between the row and columns. The values in the lower triangle correspond to the difference in mean (95% CI) in QUICKI between the column and the row. Results with significant difference are highlighted in bold and underlined. NR represents this indicator was not reported in this method among the included studies.

QUICKI, quantitative insulin-sensitivity check index. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

HOMA-B and HbA1c

HOMA-B

Lactobacillus	NR	NR	13.08 (-27.47 to 50.43)	NR	NR	30.22 (-6.33 to 64.88)
NR	LABB	NR	NR	NR	NR	NR
NR	-0.01 (-0.6 to 0.6)	LRB	NR	NR	NR	NR
NR	NR	NR	LLB	NR	NR	**16.84 (1.19 to 34.19)**
NR	NR	NR	NR	MP1	NR	NR
NR	0.28 (-0.24 to 0.82)	0.28 (-0.23 to 0.84)	NR	NR	MP2	NR
NR	-0.01 (-0.43 to 0.42)	0 (-0.43 to 0.42)	NR	NR	-0.29 (-0.62 to 0.01)	Placebo

HbA1c(μmol/L)

League table: The values in the upper triangle correspond to the difference in mean (95% CI) in HOMA-B between the row and columns. The values in the lower triangle correspond to the difference in mean (95% CI) in HbA1c (μmol/L)between the column and the row. Results with significant difference are highlighted in bold and underline. NR represents this indicator was not reported in this method among the included studies.

HOMA-B, homeostasis model assessment of beta cell; HbA1C, glycated hemoglobin A1c. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

HDLC and TG

HDLC(mg/dl)

Lactobacillus	-1.39 (-10.36 to 6.75)	-0.74 (-4.73 to 2.91)	0.85 (-2.33 to 3.89)	1.88 (-1.37 to 5.07)	NR	-0.35 (-2.32 to 1.54)
34.44 (-12.43 to 84.23)	LABB	0.48 (-8.04 to 10.13)	2.27 (-6.05 to 11.61)	3.23 (-4.97 to 12.82)	NR	1.01 (-6.96 to 10.07)
-3.14 (-17.9 to 7.38)	-37.79 (-87.63 to 9.65)	LRB	1.64 (-2.51 to 5.82)	2.62 (-1.49 to 6.96)	NR	0.41 (-2.74 to 3.84)
41.23 (24.27 to 57.81)	7.3 (-44.95 to 58.19)	**44.27 (26.24 to 64.32)**	LLB	1.01 (-2.66 to 4.68)	NR	-1.15 (-3.77 to 1.32)
22.81 (6.36 to 36.3)	-11.51 (-60.02 to 37.39)	**26.39 (8.31 to 41.77)**	-18.43 (-39.1 to 1.36)	MP1	NR	-2.22 (-4.83 to 0.36)
NR	NR	NR	NR	NR	MP2	NR
0.77 (-7.6 to 5.05)	-34 (-84.05 to 12.22)	3.77 (-6.87 to 14.73)	**-40.62 (-56.69 to -25.59)**	**-22.44 (-34.37 to -7.48)**	NR	Placebo

TG(mg/dl)

League table: The values in the upper triangle correspond to the difference in mean (95% CI) in HDLC (mg/dl) between the row and columns. The values in the lower triangle correspond to the difference in mean (95% CI) in TG (mg/dl) between the column and the row. Significant results are highlighted in bold and underlined. NR represents this indicator was not reported in this method among the included studies.

HDLC, high-density lipoprotein cholesterol; TG, triglyceride. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

VLDLC and Total/HDLC

VLDLC(mg/dl)

Lactobacillus	NR	NR	-0.67 (-10.69 to 9.49)	2.41 (-7.57 to 12.65)	NR	7.65 (-1.41 to 16.76)
0.14 (-0.67 to 0.86)	LABB	NR	NR	NR	NR	NR
NR	NR	LRB	NR	NR	NR	NR
NR	NR	NR	LLB	2.98 (-3.19 to 9.23)	NR	**8.3 (3.97 to 12.6)**
0.19 (-0.47 to 0.83)	0.06 (-0.64 to 0.78)	NR	NR	MP1	NR	**5.32 (0.88 to 9.68)**
NR	NR	NR	NR	NR	MP2	NR
-0.19 (-0.71 to 0.28)	-0.32 (-0.9 to 0.26)	NR	NR	-0.39 (-0.81 to 0.03)	NR	Placebo

Total/HDLC

League table: The values in the upper triangle correspond to the difference in mean (95% CI) in VLDLC (mg/dl) between the row and columns. The values in the lower triangle correspond to the difference in mean (95% CI) in Total/HDLC between the column and the row. Significant results are highlighted in bold and underline. NR represents this indicator was not reported in this method among the included studies.

VLDLC, very low-density lipoprotein cholesterol; Total/HDLC, total cholesterol/high-density lipoprotein cholesterol. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

GSH and MDA

GSH(μmol/L)

Lactobacillus	-227.2 (-479.61 to 32.47)	NR	**-246.98 (-468.51 to -20.74)**	**-295.04 (-526.58 to -55.59)**	NR	**-297.81 (-509.67 to -76.83)**
NR	LABB	NR	-21.18 (-151.98 to 110.27)	-69.28 (-208.89 to 77.38)	NR	-70.69 (-187.71 to 49.16)
NR	NR	LRB	NR	NR	NR	NR
-0.63 (-2.37 to 1.09)	NR	NR	LLB	-47.68 (-143.36 to 49.94)	NR	-49.79 (-105.47 to 5.5)
-0.63 (-2.17 to 1.12)	NR	NR	0.01 (-1.06 to 1.26)	MP1	NR	-2.69 (-84.05 to 76.73)
NR	NR	NR	NR	NR	MP2	NR
-1.12 (-2.6 to 0.33)	NR	NR	-0.49 (-1.38 to 0.38)	-0.5 (-1.36 to 0.17)	NR	Placebo

MDA(μmol/L)

League table: The values in the upper triangle correspond to the difference in mean (95% CI) in GSH (μmol/L) between the row and columns. The values in the lower triangle correspond to the difference in mean (95% CI) in MDA (μmol/L) between the column and the row. Significant results are highlighted in bold and underline. NR represents this indicator was not reported in this method among the included studies.

GSH, glutathione; MDA, malondialdehyde. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

League table for NO has not been done, since there were few studies included.

Figure.S4. League tables for comparisons of means of intervention

HOMA-IR

Food	0.59 (-0.25 to 1.43)	**1.03 (0.22 to 1.84)**
-0.36 (-5.79 to 5.08)	Fortified substances	**0.44 (0.21 to 0.68)**
-3.74 (-8.75 to 1.27)	**-3.38 (-5.47 to -1.30)**	Placebo

TC(mg/dl)

Food	14.65 (-9.50 to 38.80)	17.83 (-5.37 to 41.03)
-13.71 (-30.39 to 2.96)	Fortified substances	3.18 (-3.59 to 9.95)
-14.17 (-30.53 to 2.19)	-0.46 (-3.63 to 2.72)	Placebo

TAC(mmol/L)

Food	-15.19 (-88.76 to 58.39)	-15.30 (-88.87 to 58.28)
0.95 (-1.44 to 3.33)	Fortified substances	**-0.11 (-0.19 to -0.03)**
-0.73 (-3.01 to 1.56)	**-1.68 (-2.46 to -0.89)**	Placebo

FBS(mg/dl) **LDLC(mg/dl)** **hs-CRP(µg/mL)**

QUICKI

Food	-0.01 (-0.03 to 0.02)	**-0.02 (-0.05 to 0.00)**
-3.06 (-7.29 to 1.18)	Fortified substances	**-0.01 (-0.02 to -0.01)**
-4.88 (-8.91 to -0.86)	**-1.83 (-3.18 to -0.48)**	Placebo

TG(mg/dl)

Food	21.20 (-17.71 to 60.12)	35.72 (-1.36 to 72.80)
1.76 (-4.10 to 7.62)	Fortified substances	**14.51 (2.74 to 26.29)**
2.28 (-3.52 to 8.08)	0.52 (-0.31 to 1.35)	Placebo

GSH(µmol/L)

Food	-66.60 (-153.85 to 20.64)	**-106.69 (-187.82 to -25.57)**
-0.65 (-1.50 to 0.20)	Fortified substances	**-40.09 (-66.05 to -14.12)**
-1.12 (-1.90 to -0.34)	**-0.47 (-0.81 to -0.13)**	Placebo

Insulin(µIU/mL) **HDLC(mg/dl)** **MDA(µmol/L)**

HbA1c(µmol/L)

Food	-0.19 (-0.60 to 0.23)	0.01 (-0.34 to 0.36)
-12.60 (-40.65 to 15.46)	Fortified substances	0.19 (-0.02 to 0.41)
-28.92 (-55.76 to -2.08)	**-16.32 (-24.49 to -8.16)**	Placebo

Total/HDLC

Food	0.10 (-0.25 to 0.46)	**0.35 (0.09 to 0.60)**
-0.74 (-8.37 to 6.89)	Fortified substances	**0.25 (-0.00 to 0.49)**
-7.50 (-14.85 to -0.15)	**-6.76 (-8.83 to -4.69)**	Placebo

HOMA-B **VLDLC(mg/dl)**

League tables: The values correspond to the difference in mean (95% CI) between the row and columns. Significant results are highlighted in bold and underline. Food stands for supplements of probiotics in the form of food. Fortified substances mean that probiotics are supplemented by fortified substances.
FBS, fasting blood sugar; HOMA-IR, the homeostasis model assessment of insulin resistance; QUICKI, quantitative insulin-sensitivity check index; HOMA-B, homeostasis model assessment of beta cell; HbA1c, glycated hemoglobin A1c; LDLC, low-density lipoprotein cholesterol; TC, total cholesterol; HDLC, high-density lipoprotein cholesterol; TG, triglyceride; VLDLC, very low-density lipoprotein cholesterol; Total/HDLC, total cholesterol/high-density lipoprotein cholesterol; TAC, total antioxidant capacity; hs-CRP, high-sensitivity C-reactive protein; GSH, glutathione; MDA, malondialdehyde.

League table for NO has not been done, since few studies were included.

Figure.S5. Results of subgroup analysis

5.1 Study duration (<12w vs. ≥12w)

Figure.S5.1.1 Subgroup analysis of FBS on study duration

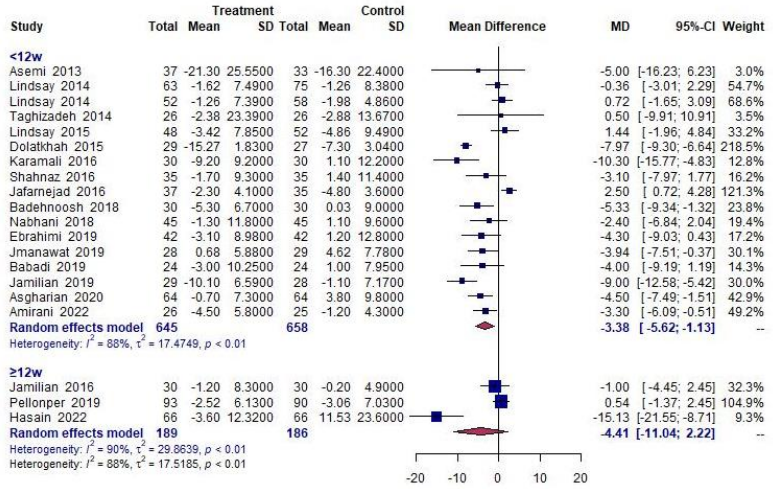


Figure.S5.1.2 Subgroup analysis of HOMA-IR on study duration

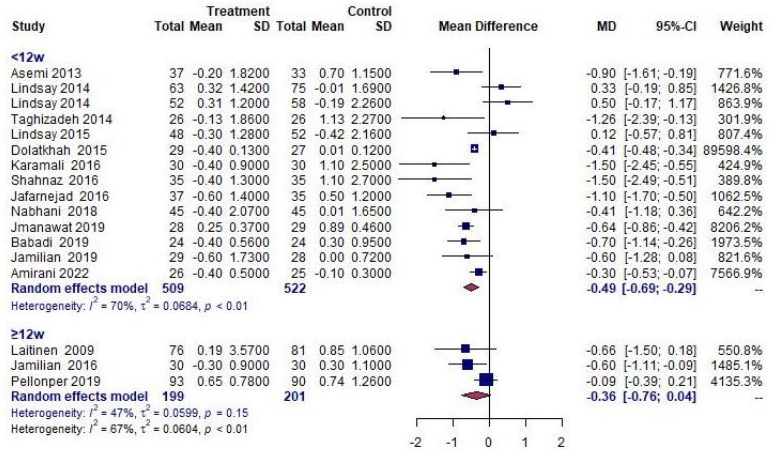


Figure.S5.1.3 Subgroup analysis of LDLC on study duration

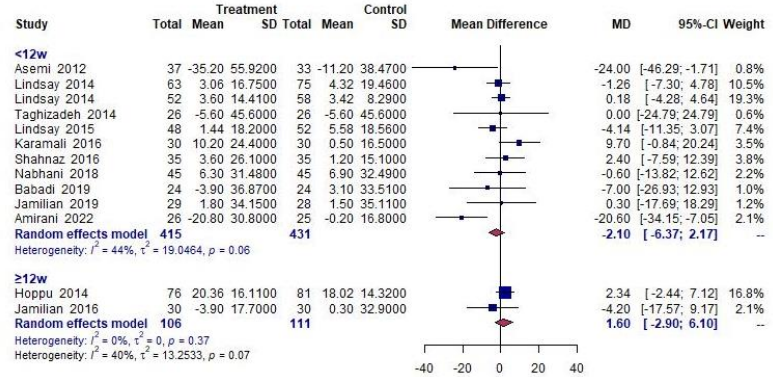


Figure.S5.1.4 Subgroup analysis of TC on study duration

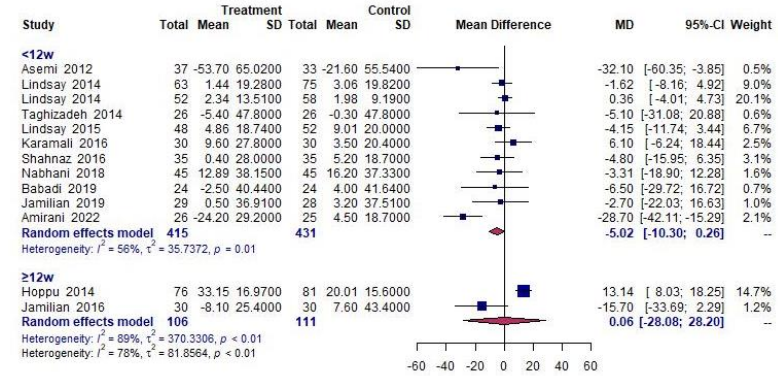


Figure.S5.1.5 Subgroup analysis of hs-CRP on study duration

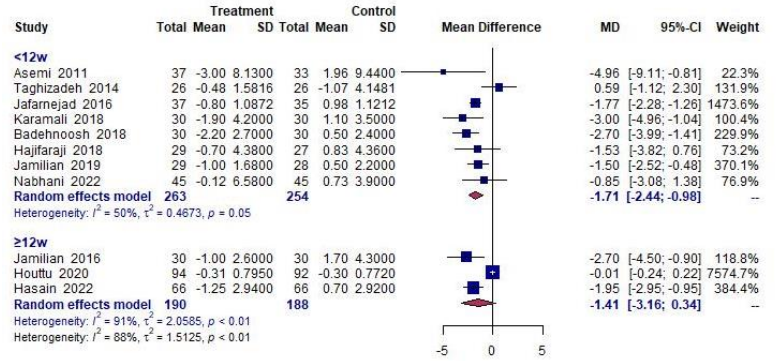


Figure.S5.1.6 Subgroup analysis of TAC on study duration

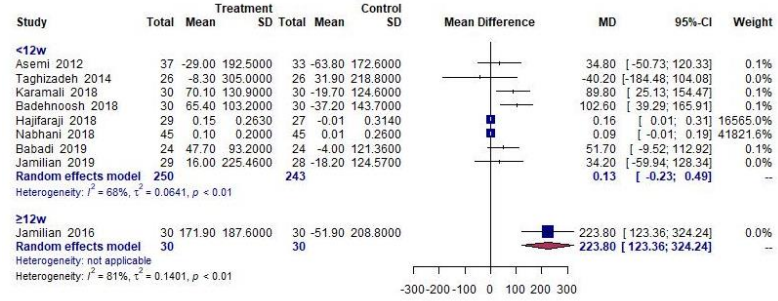


Figure.S5.1.7 Subgroup analysis of Insulin on study duration

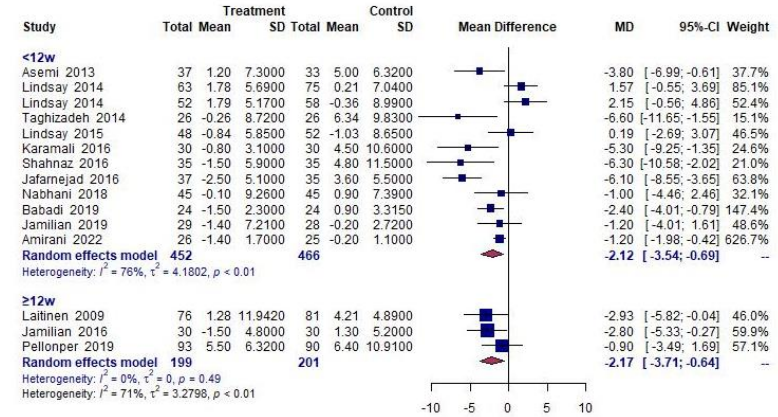


Figure.S5.1.8 Subgroup analysis of QUICKI on study duration

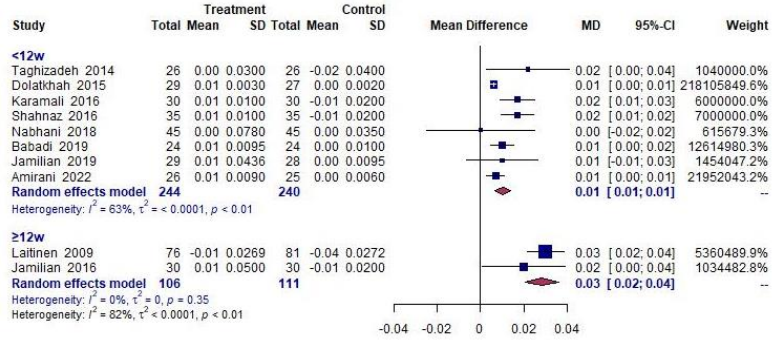


Figure.S5.1.9 Subgroup analysis of HOMA-B on study duration

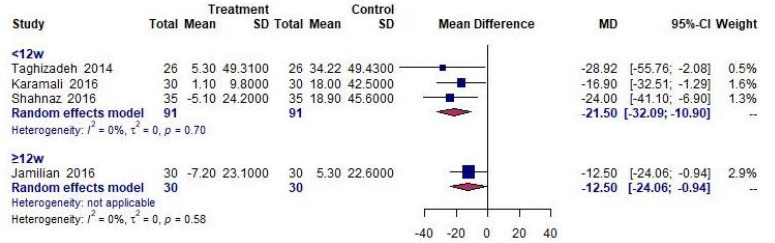


Figure.S5.1.10 Subgroup analysis of HbA1c on study duration

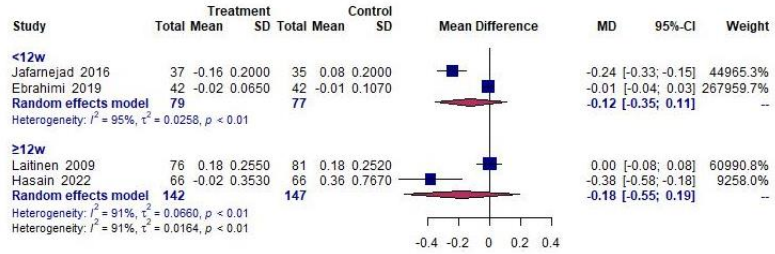


Figure.S5.1.11 Subgroup analysis of HDLC on study duration

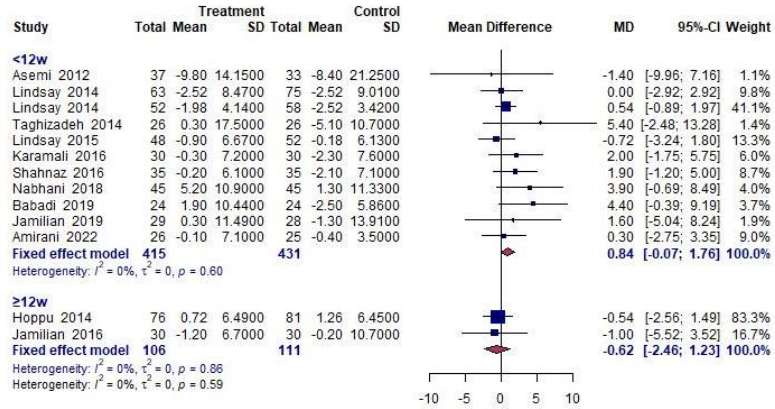


Figure.S5.1.12 Subgroup analysis of TG on study duration

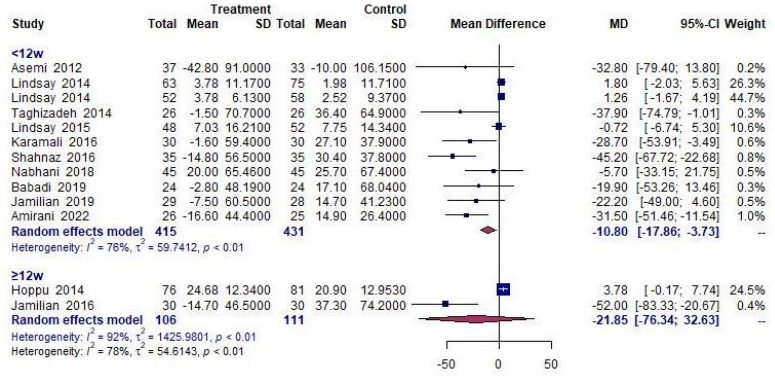


Figure.S5.1.13 Subgroup analysis of VLDLC on study duration

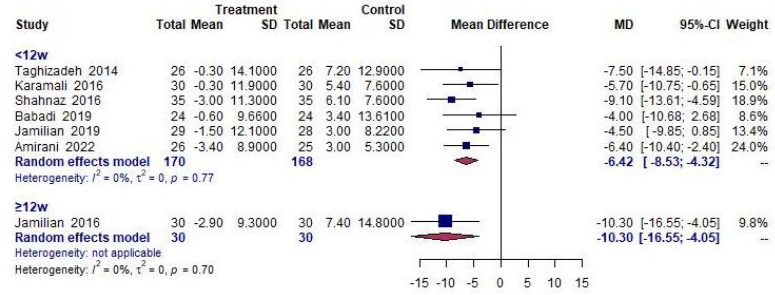


Figure.S5.1.14 Subgroup analysis of Total/HDLC on study duration

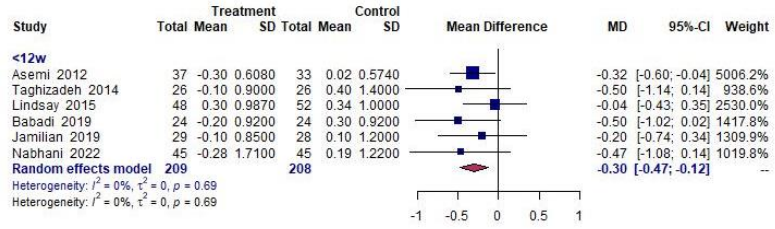


Figure.S5.1.15 Subgroup analysis of GSH on study duration

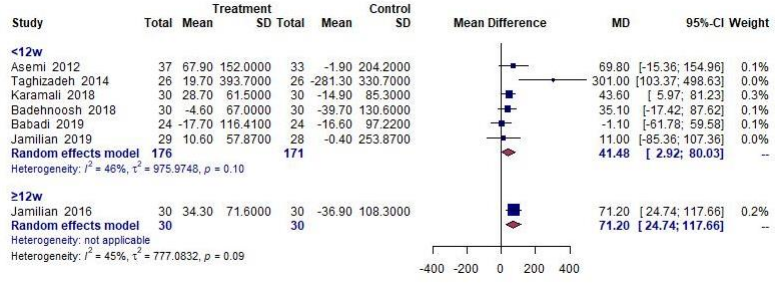


Figure.S5.1.16 Subgroup analysis of MDA on study duration

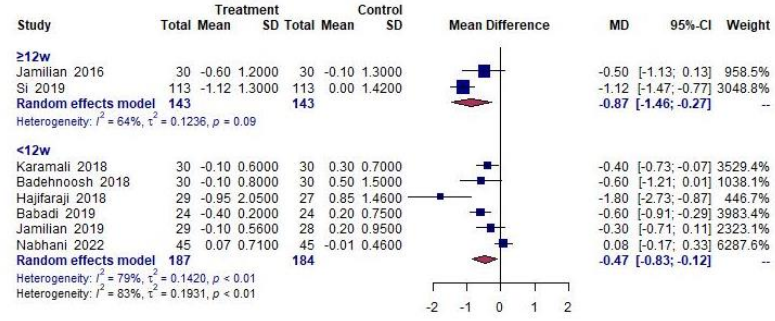
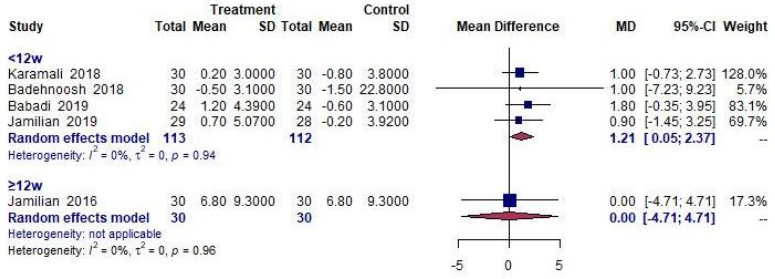


Figure.S5.1.17 Subgroup analysis of NO on study duration



5.2 Study population (GDM vs. pregnant women)

Figure.S5.2.1 Subgroup analysis of FBS on the study population

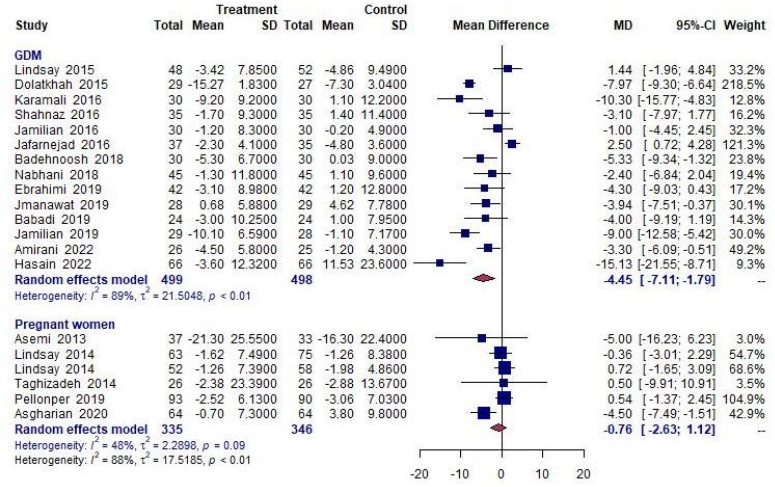


Figure.S5.2.2 Subgroup analysis of HOMA-IR on the study population

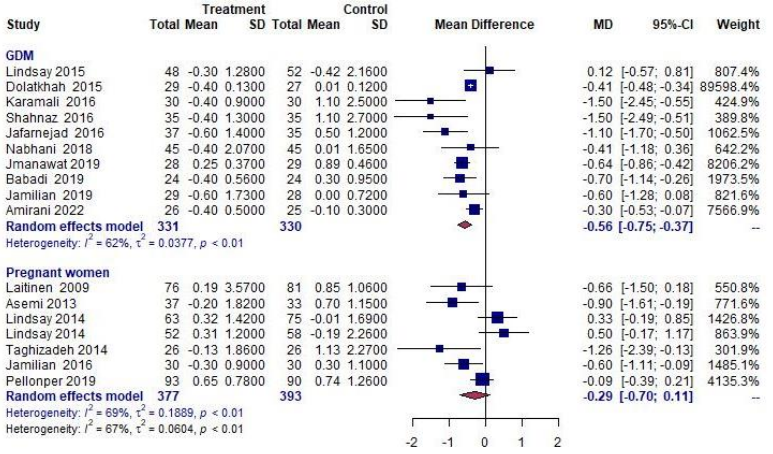


Figure.S5.2.3 Subgroup analysis of LDLC on the study population

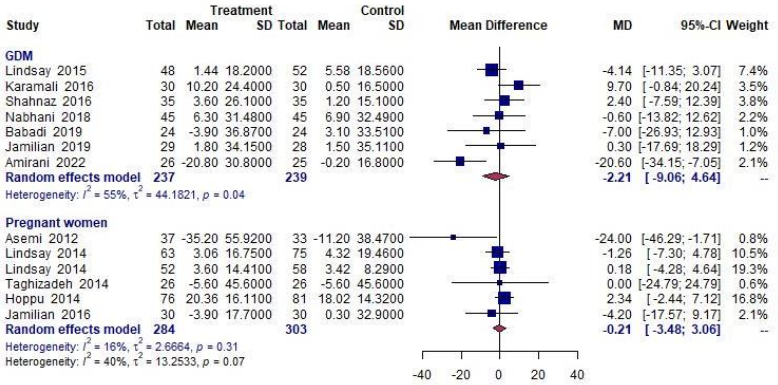


Figure.S5.2.4 Subgroup analysis of TC on the study population

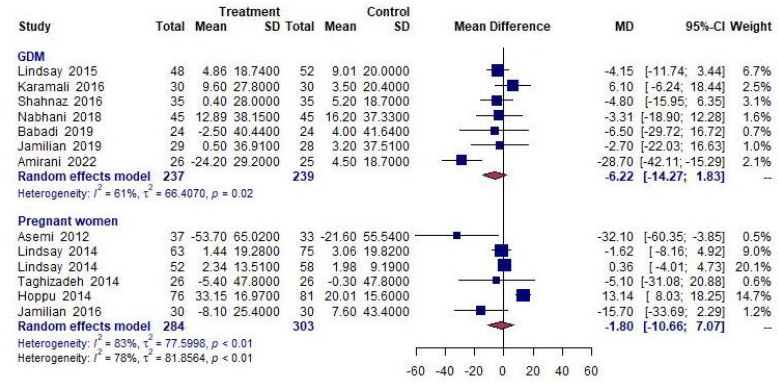


Figure.S5.2.5 Subgroup analysis of hs-CRP on the study population

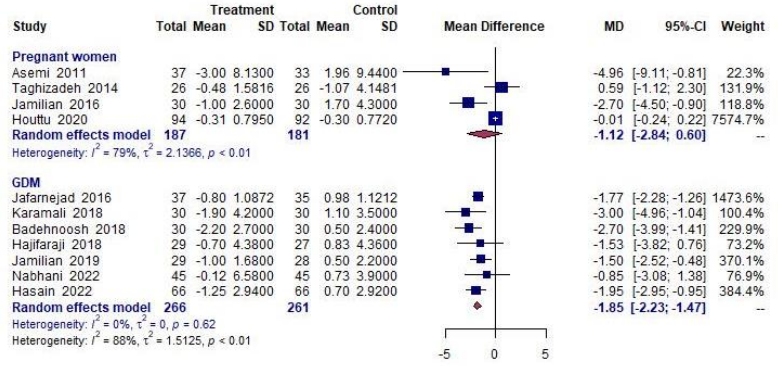


Figure.S5.2.6 Subgroup analysis of TAC on the study population

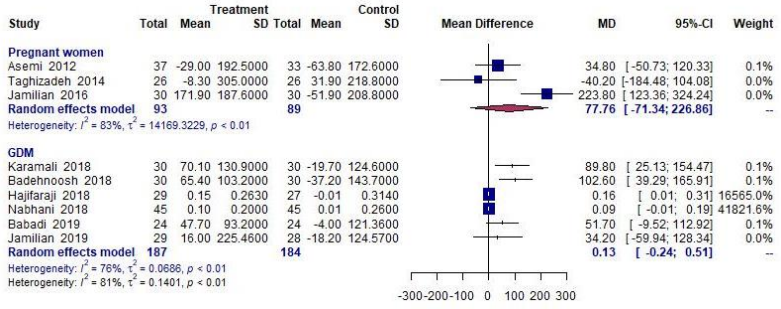


Figure.S5.2.7 Subgroup analysis of Insulin on the study population

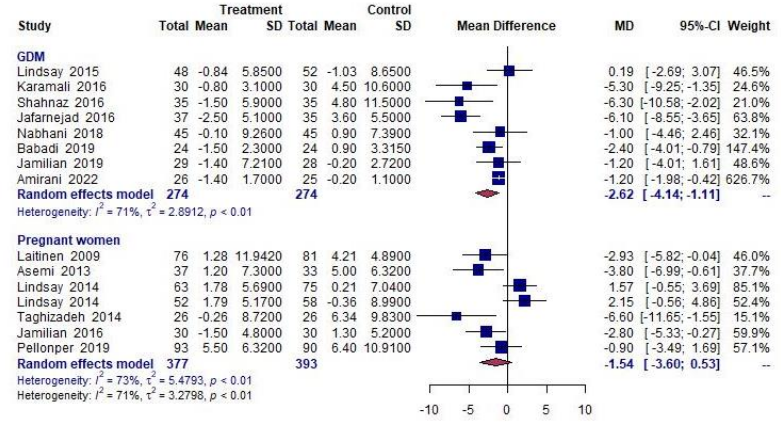


Figure.S5.2.8 Subgroup analysis of QUICKI on the study population

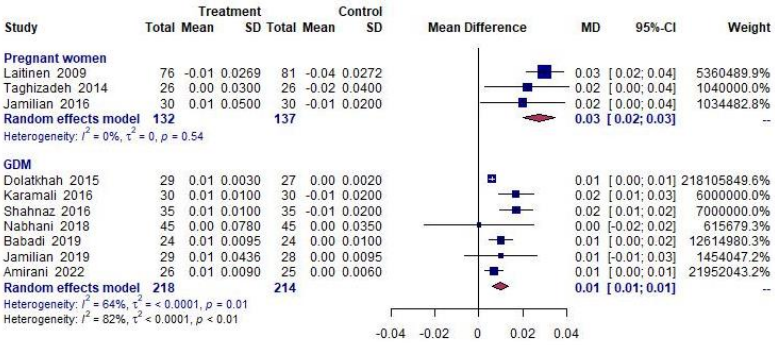


Figure.S5.2.9 Subgroup analysis of HOMA-B on the study population

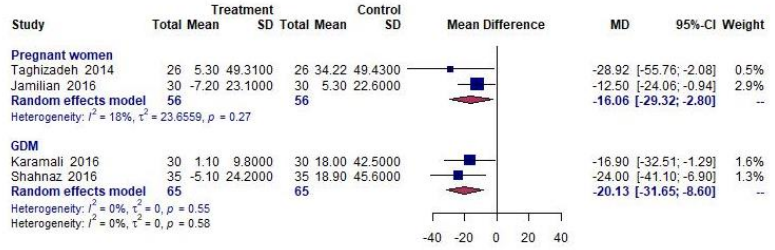


Figure.S5.2.10 Subgroup analysis of HbA1c on the study population

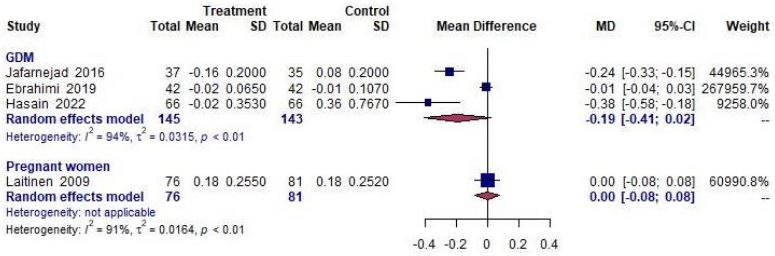


Figure.S5.2.11 Subgroup analysis of HDLC on the study population

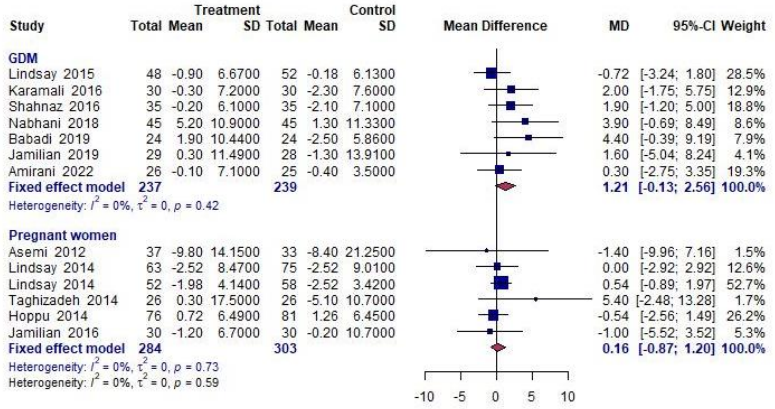


Figure.S5.2.12 Subgroup analysis of TG on the study population

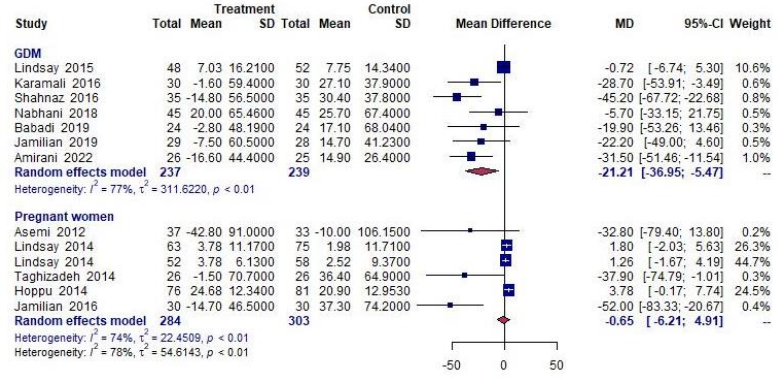


Figure.S5.2.13 Subgroup analysis of VLDLC on the study population

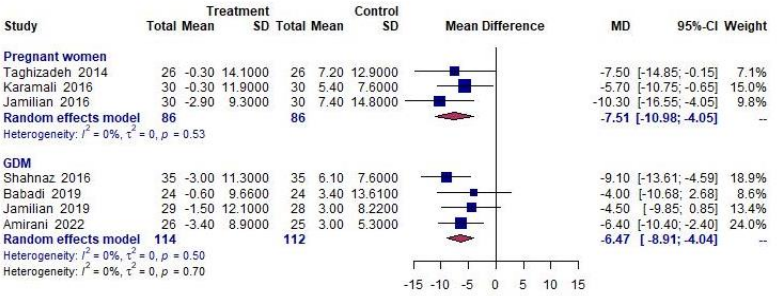


Figure.S5.2.14 Subgroup analysis of Total/HDLC on the study population

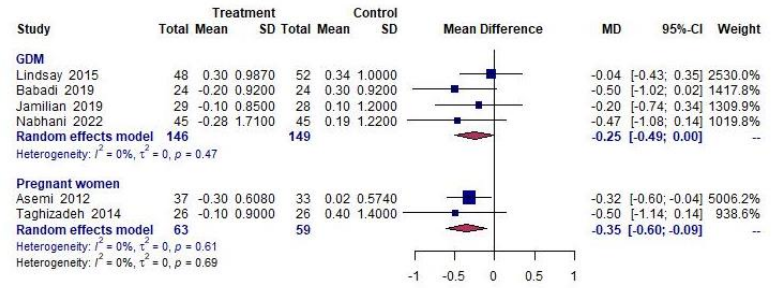


Figure.S5.2.15 Subgroup analysis of GSH on the study population

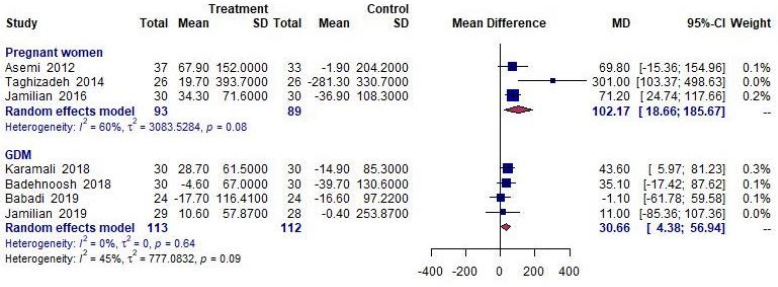


Figure.S5.2.16 Subgroup analysis of MDA on the study population

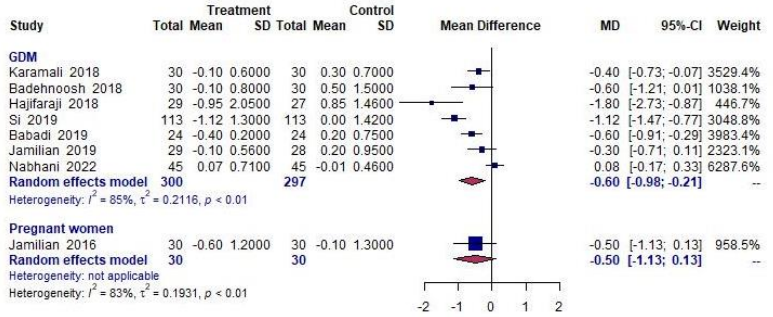
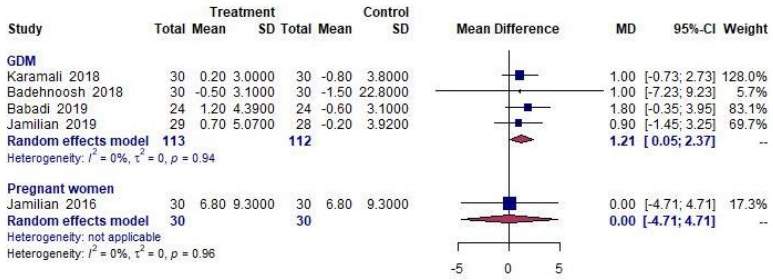


Figure.S5.2.17 Subgroup analysis of NO on the the study population



5.3 Treatment type (synbiotics vs. probiotics)

Figure.S5.3.1 Subgroup analysis of FBS on treatment type

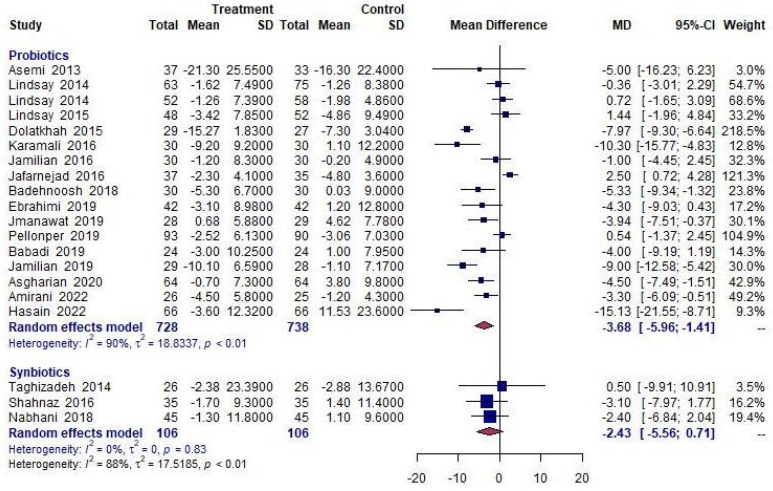


Figure.S5.3.2 Subgroup analysis of HOMA-IR on treatment type

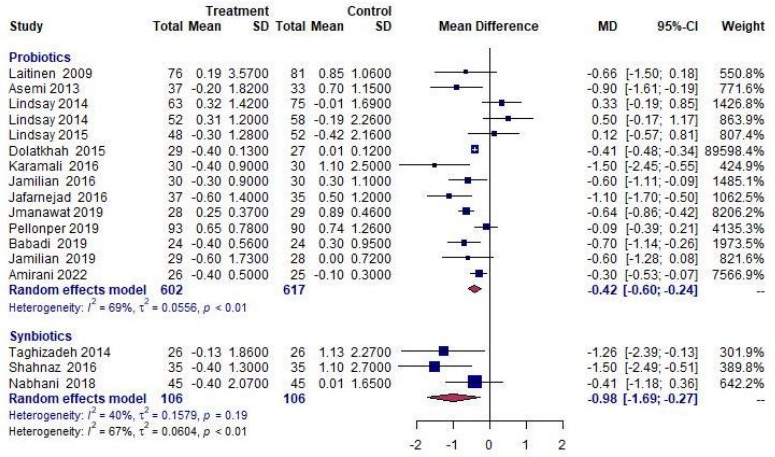


Figure.S5.3.3 Subgroup analysis of LDLC on treatment type

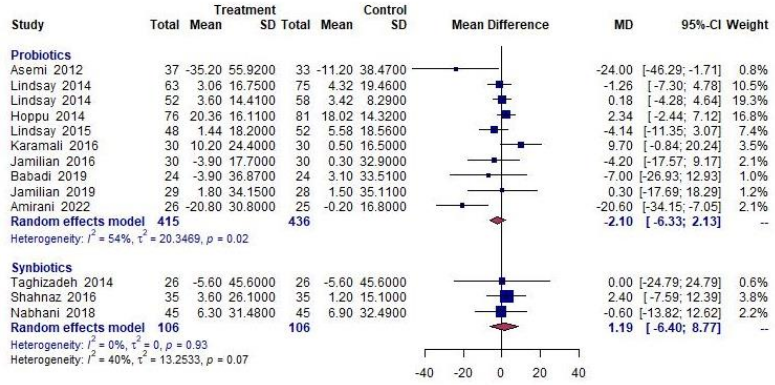


Figure.S5.3.4 Subgroup analysis of TC on treatment type

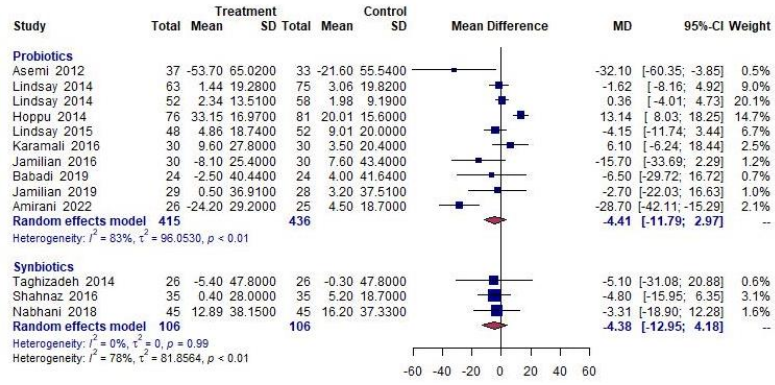


Figure.S5.3.5 Subgroup analysis of hs-CRP on treatment type

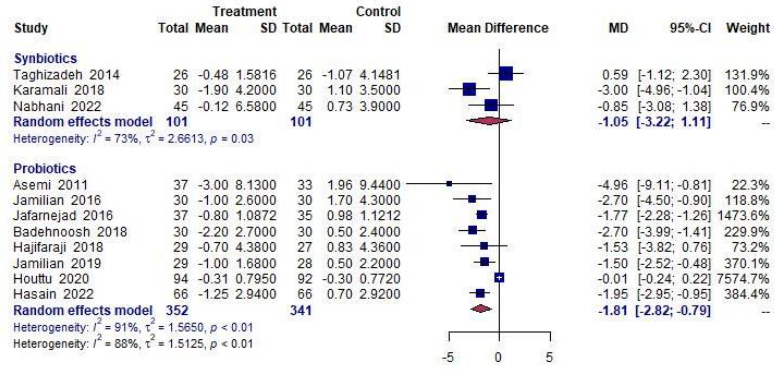


Figure.S5.3.6 Subgroup analysis of TAC on treatment type

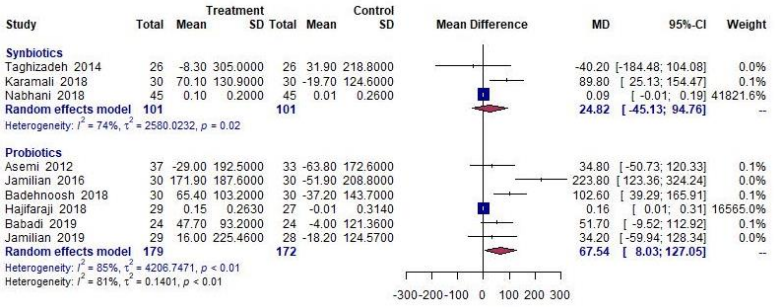


Figure.S5.3.7 Subgroup analysis of Insulin on treatment type

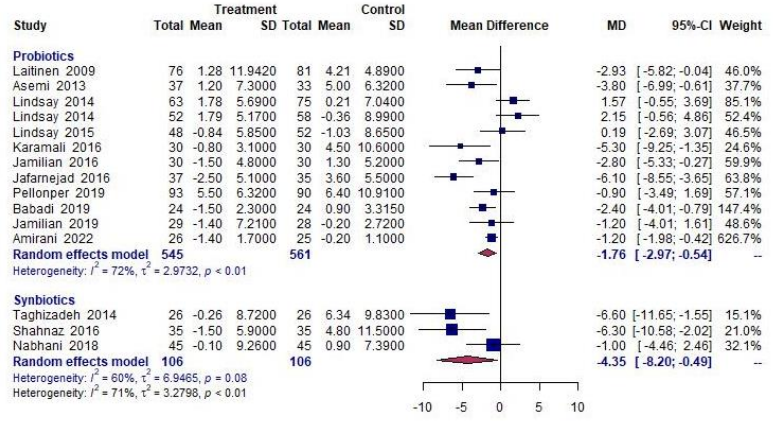


Figure.S5.3.8 Subgroup analysis of QUICKI on treatment type

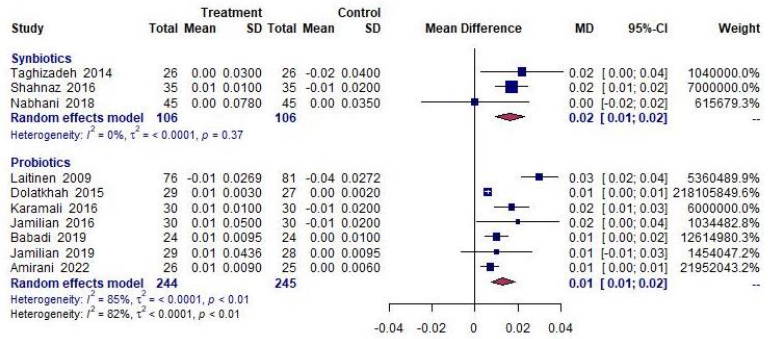


Figure.S5.3.9 Subgroup analysis of HOMA-B on treatment type

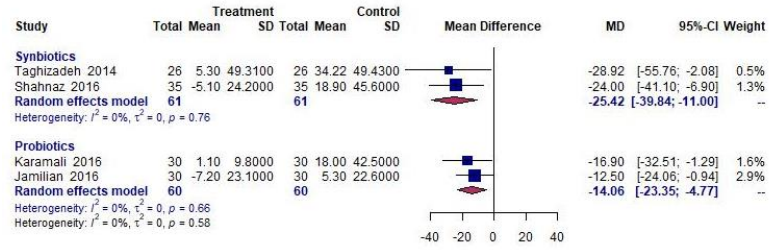


Figure.S5.3.10 Subgroup analysis of HDLC on treatment type

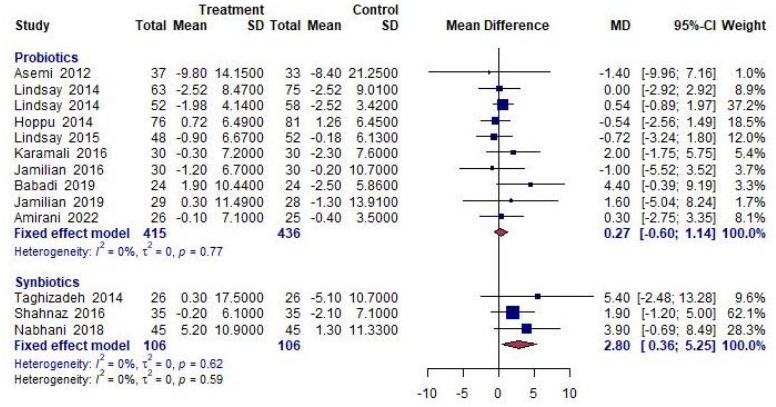


Figure.S5.3.11 Subgroup analysis of TG on treatment type

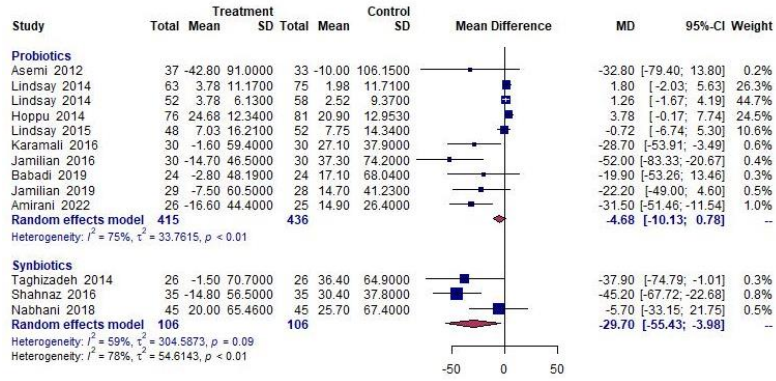


Figure.S5.3.12 Subgroup analysis of VLDLC on treatment type

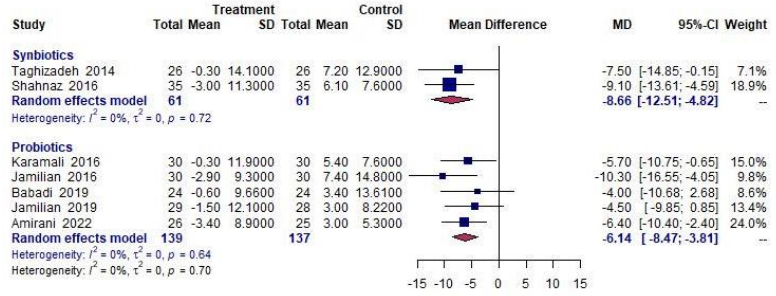


Figure.S5.3.13 Subgroup analysis of Total/HDLC on treatment type

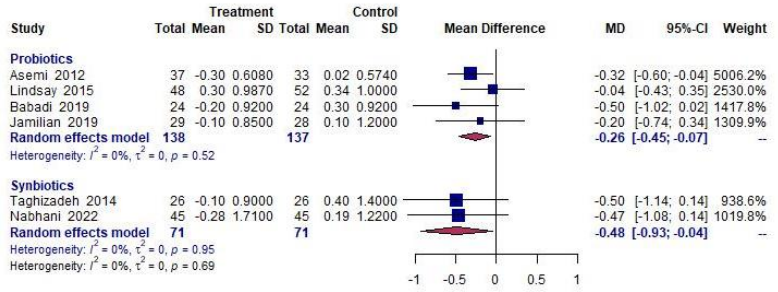


Figure.S5.3.14 Subgroup analysis of GSH on treatment type

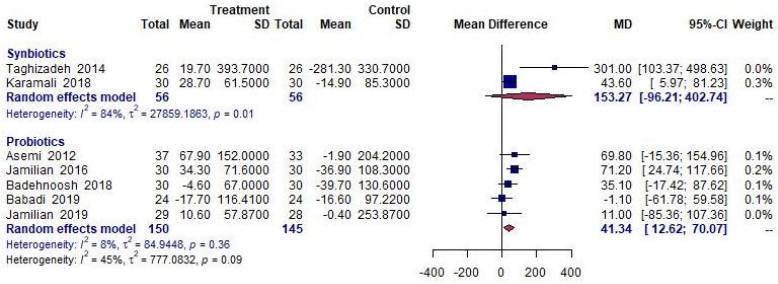


Figure.S5.3.15 Subgroup analysis of MDA on treatment type

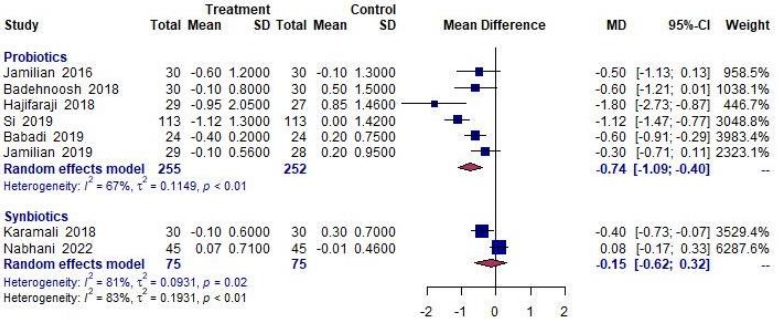
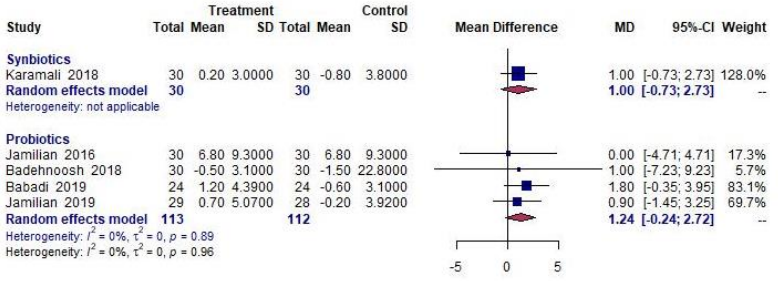


Figure.S5.3.16 Subgroup analysis of NO on treatment type



5.4 Degree of obesity (non-obese vs. overweight/obese)

Figure.S5.4.1 Subgroup analysis of FBS on degree of obesity

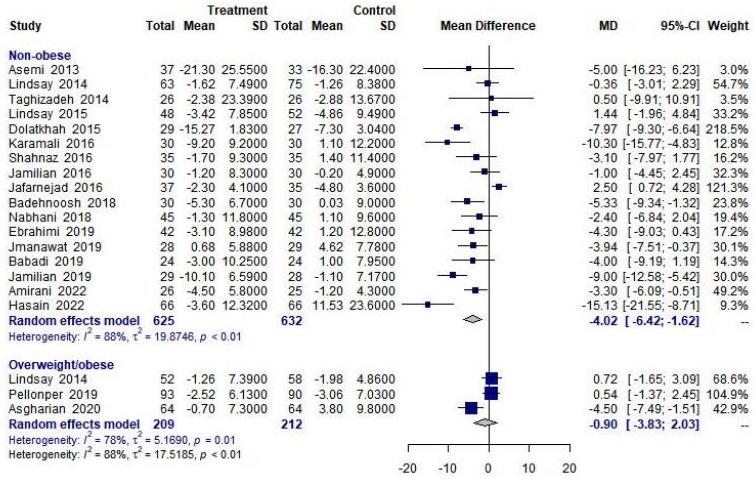


Figure.S5.4.2 Subgroup analysis of HOMA-IR on degree of obesity

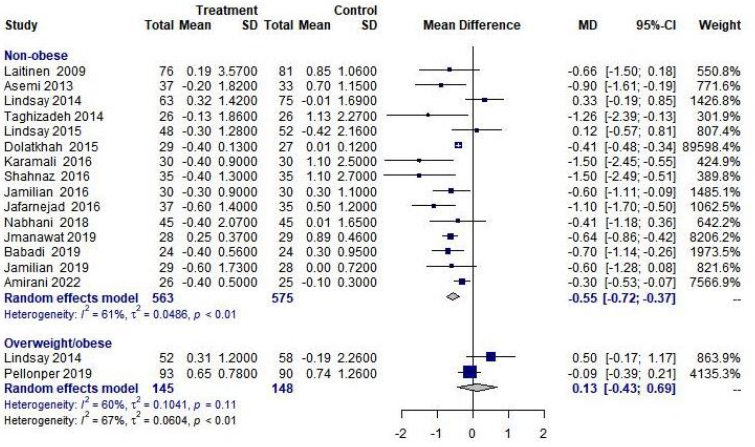


Figure.S5.4.3 Subgroup analysis of insulin on degree of obesity

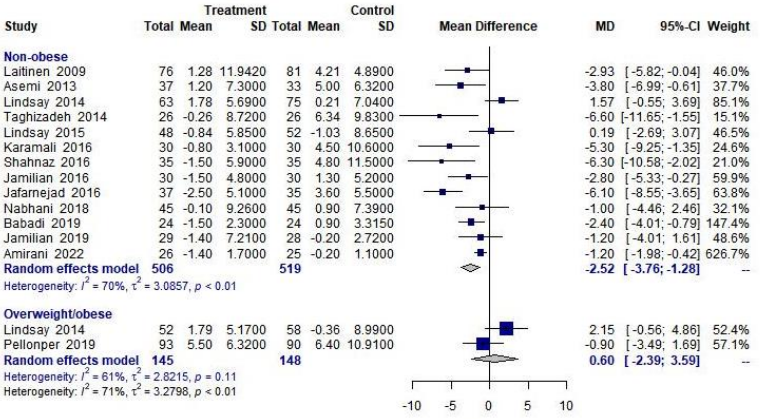


Figure.S5.4.4 Subgroup analysis of LDLC on degree of obesity

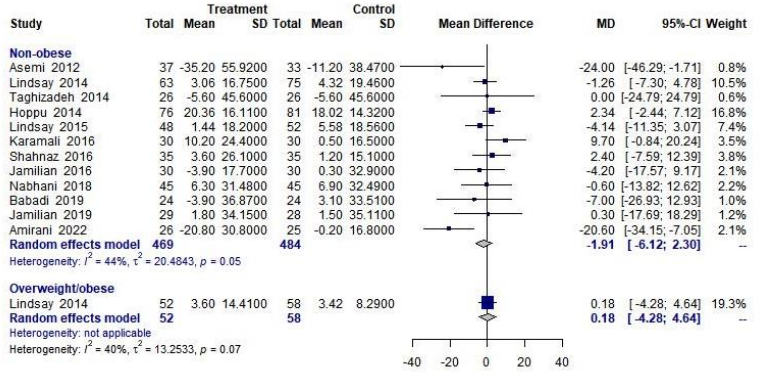


Figure.S5.4.5 Subgroup analysis of TC on degree of obesity

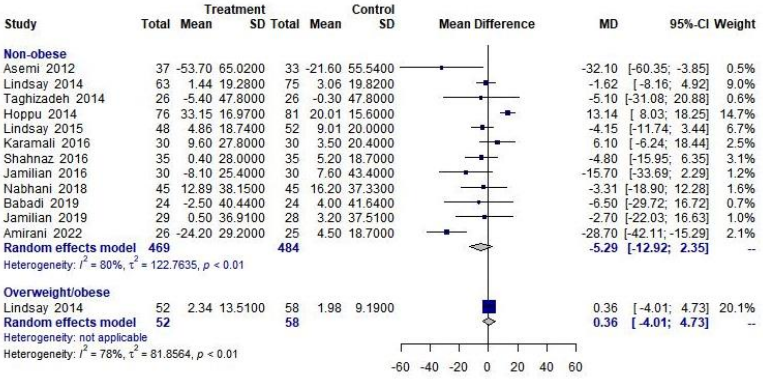


Figure.S5.4.6 Subgroup analysis of HDLC on degree of obesity

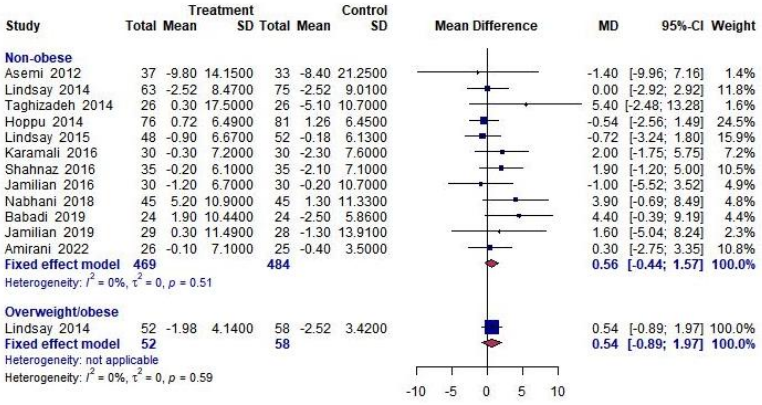


Figure.S5.4.7 Subgroup analysis of TG on degree of obesity

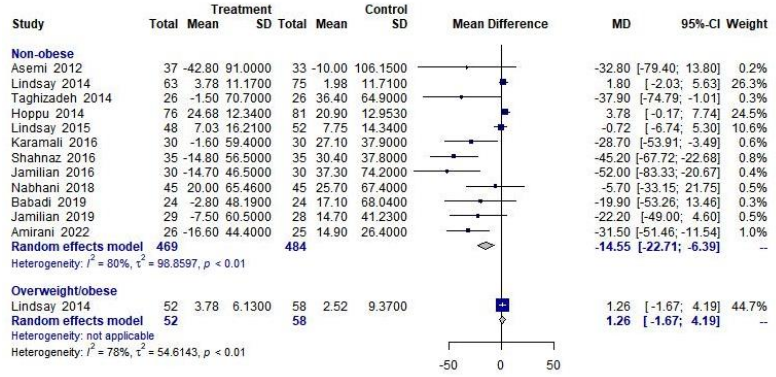


Figure.S5.4.8 Subgroup analysis of hs-CRP on degree of obesity

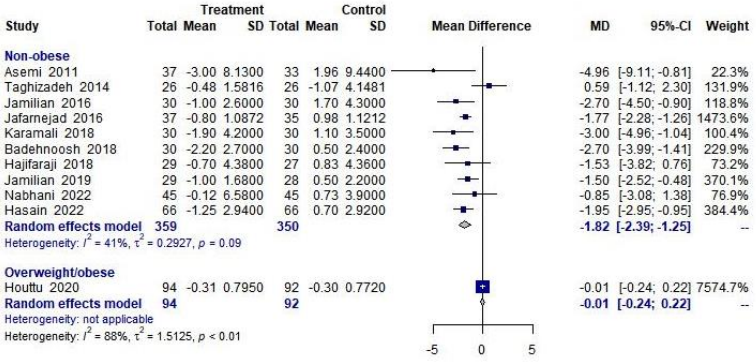
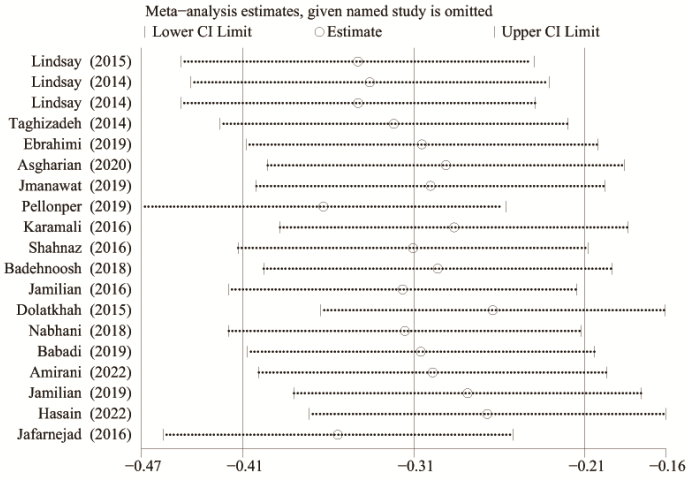
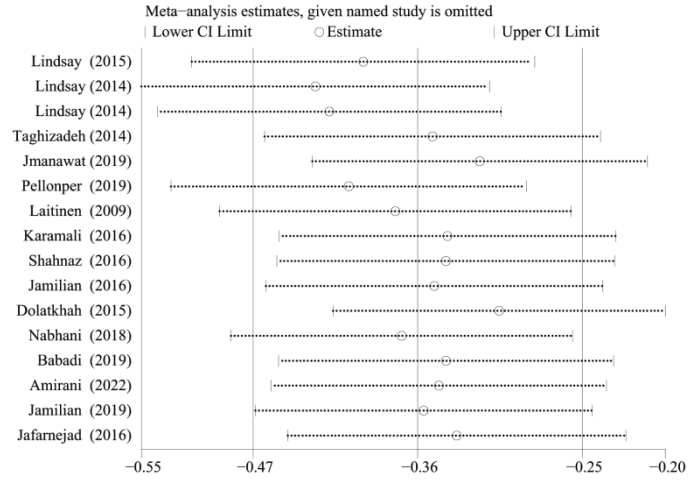


Figure.S6. Results of sensitivity analysis

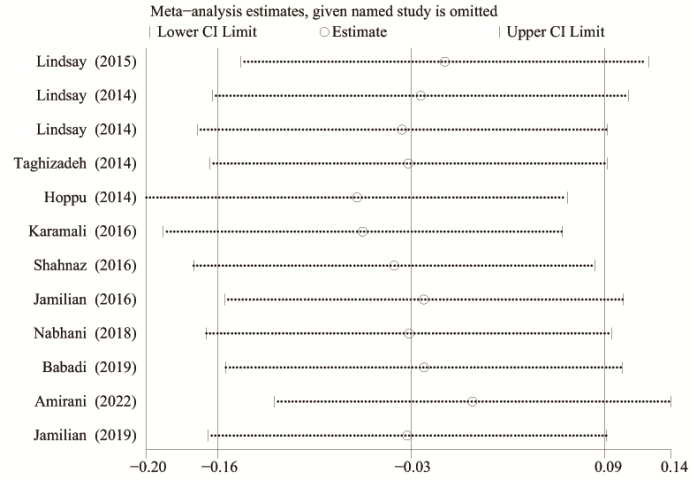
FBS



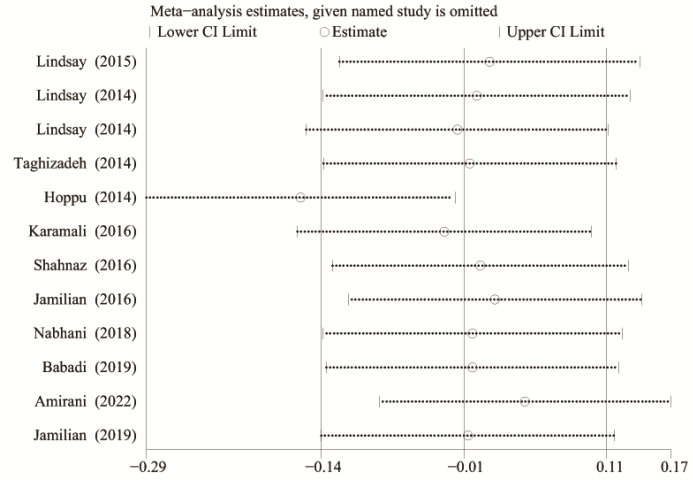
HOMA-IR



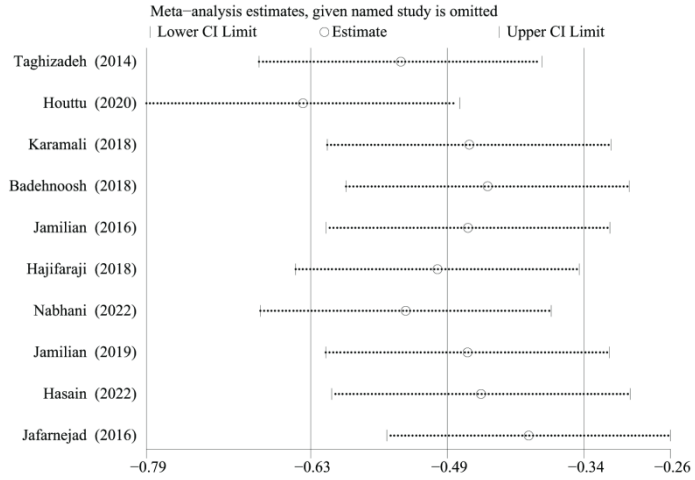
LDLC



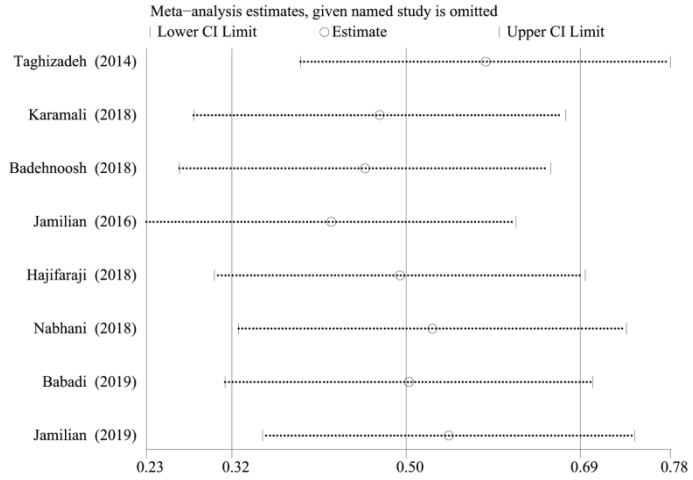
TC



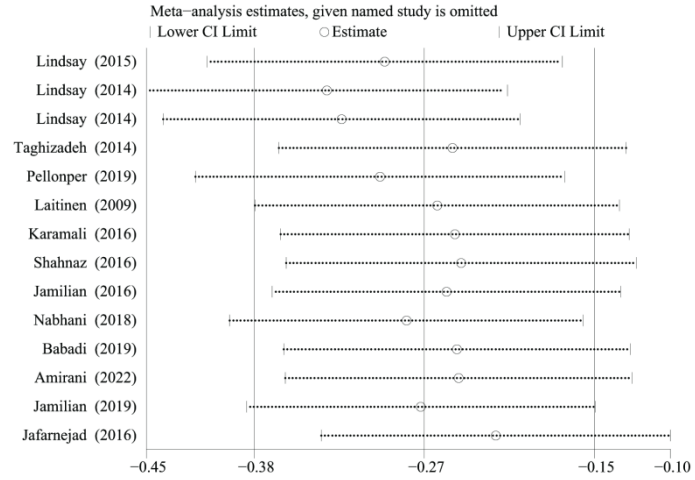
hs-CRP



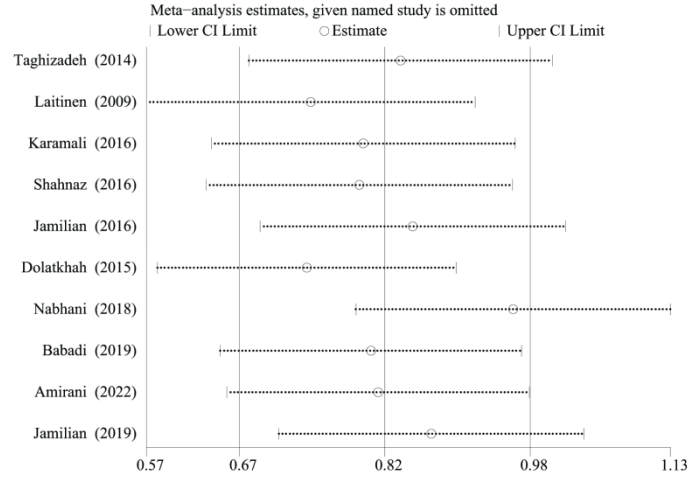
TAC



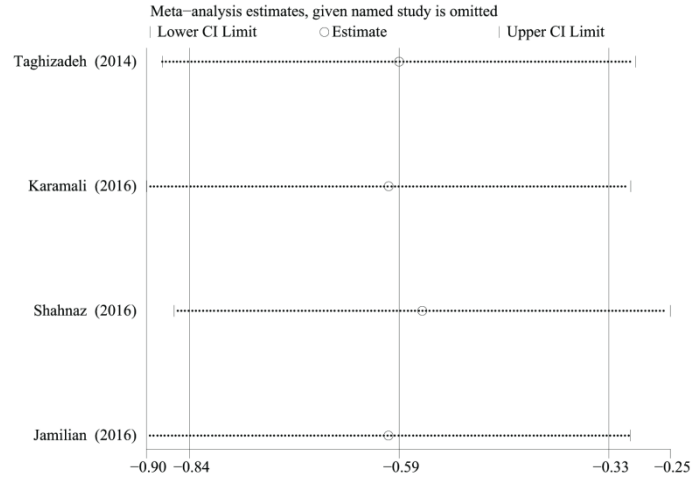
Insulin



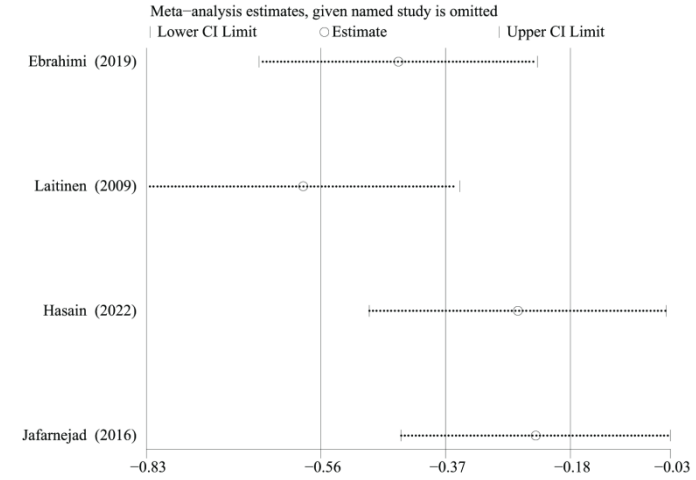
QUICKI



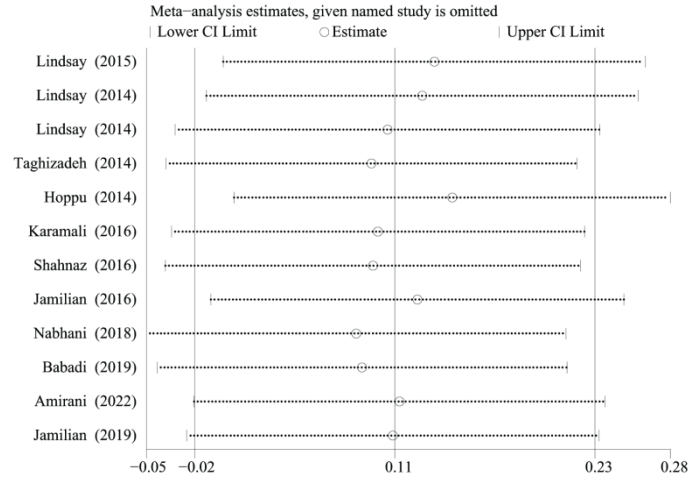
HOMA-B



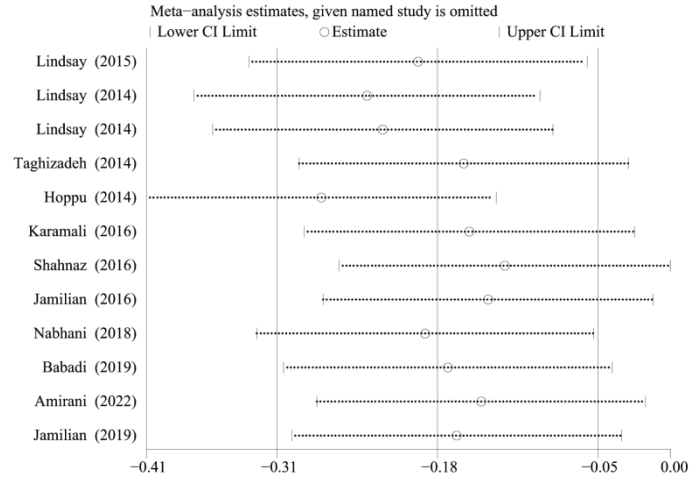
HbA1c



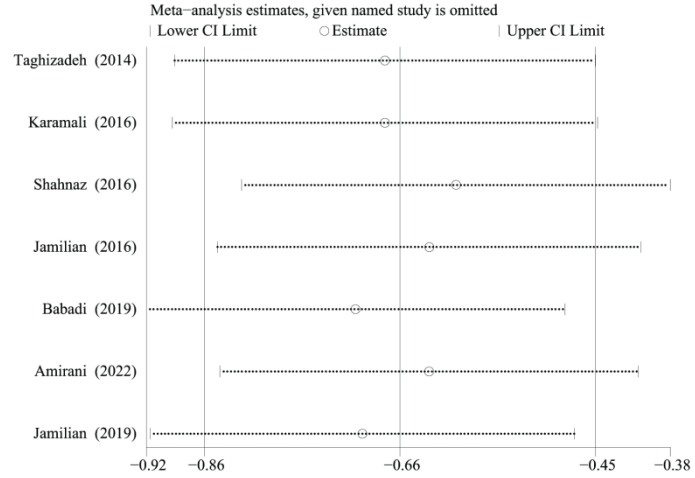
HDLC



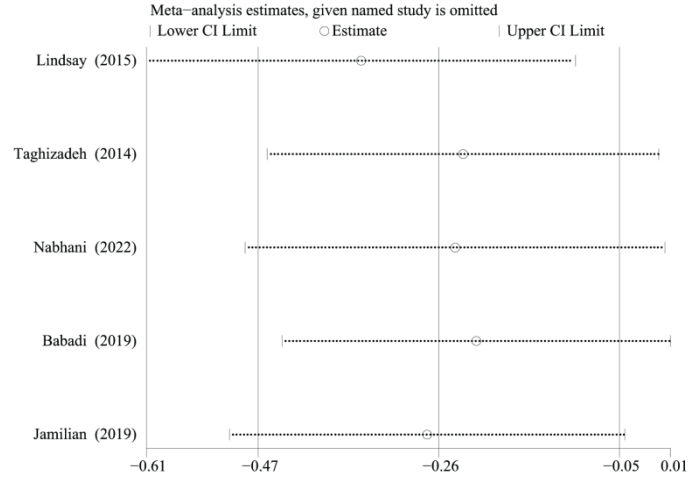
TG



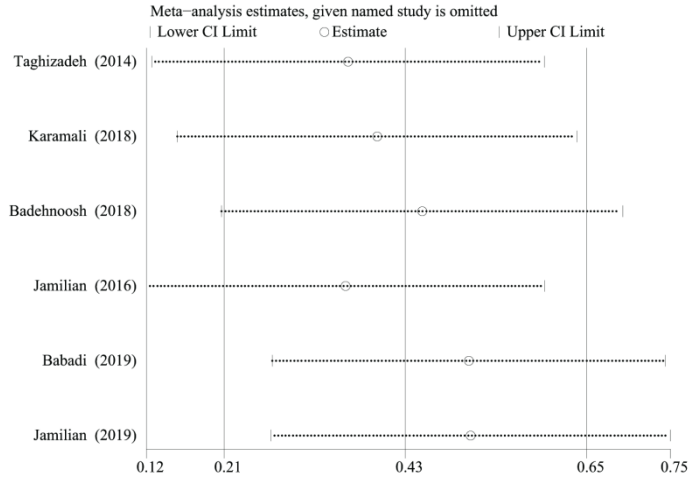
VLDLC



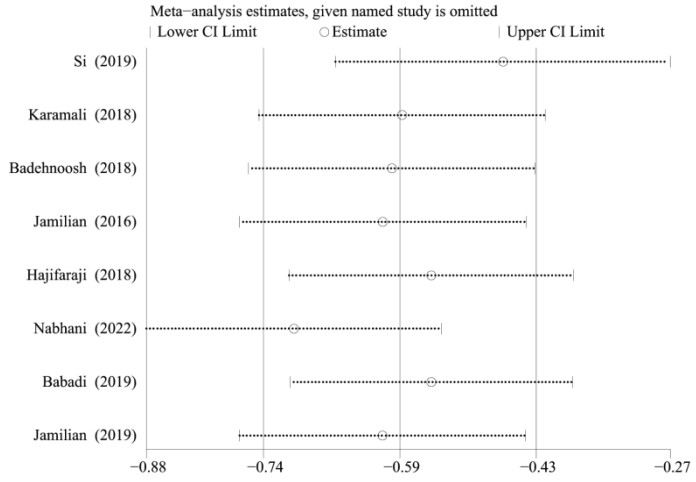
Total/HDLC



GSH


Meta−analysis estimates, given named study is omitted
Lower CI Limit
Estimate
Upper CI Limit
Taghizadeh (2014)
Karamali (2018)
Badehnoosh (2018)
Jamilian (2016)
Babadi (2019)
Jamilian (2019)
0.12
0.21
0.43
0.65
0.75

MDA


Meta−analysis estimates, given named study is omitted
Lower CI Limit
Estimate
Upper CI Limit
Si (2019)
Karamali (2018)
Badehnoosh (2018)
Jamilian (2016)
Hajifaraji (2018)
Nabhani (2022)
Babadi (2019)
Jamilian (2019)
−0.88
−0.74
−0.59
−0.43
−0.27

NO

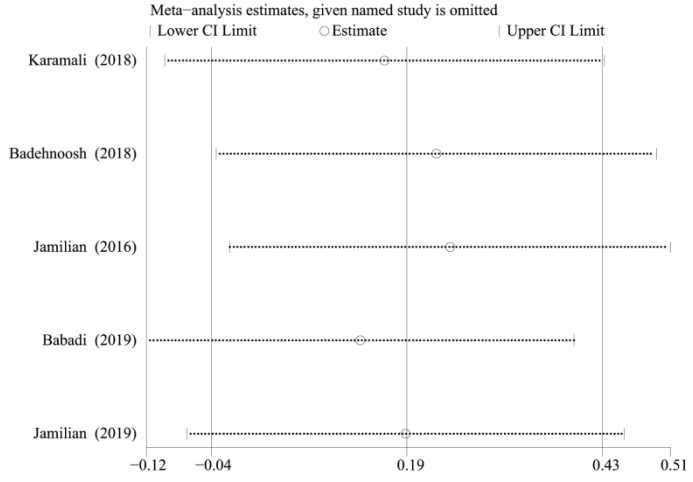
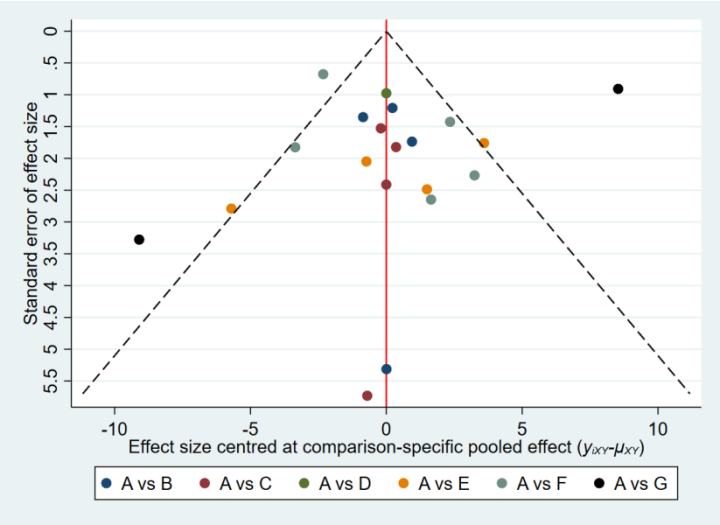

Meta−analysis estimates, given named study is omitted
Lower CI Limit
Estimate
Upper CI Limit
Karamali (2018)
Badehnoosh (2018)
Jamilian (2016)
Babadi (2019)
Jamilian (2019)
−0.12
−0.04
0.19
0.43
0.51

Figure.S7. Publication bias: funnel plot

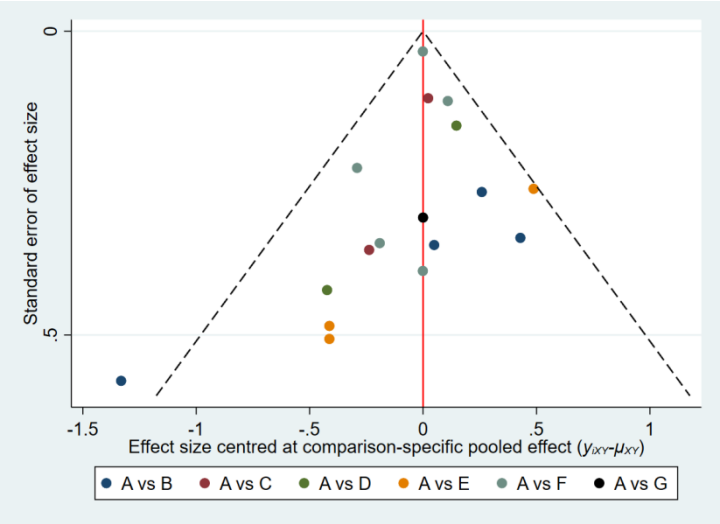
Outcome: FBS



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”; G = “MP2”

P = 0.023 (Egger)

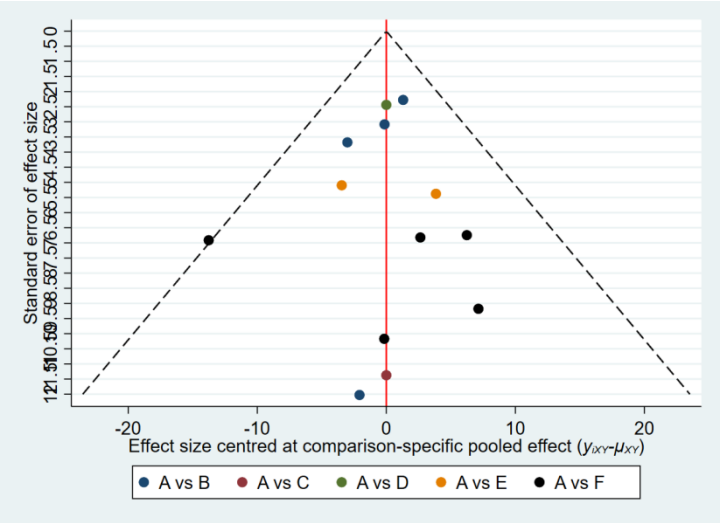
Outcome: HOMA-IR



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”; G = “MP2”

P = 0.955 (Egger)

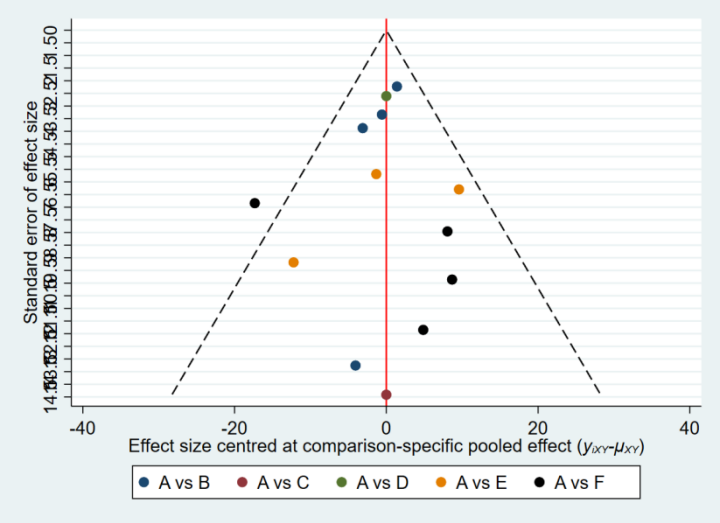
Outcome: LDLC



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”

P = 0.002(Egger)

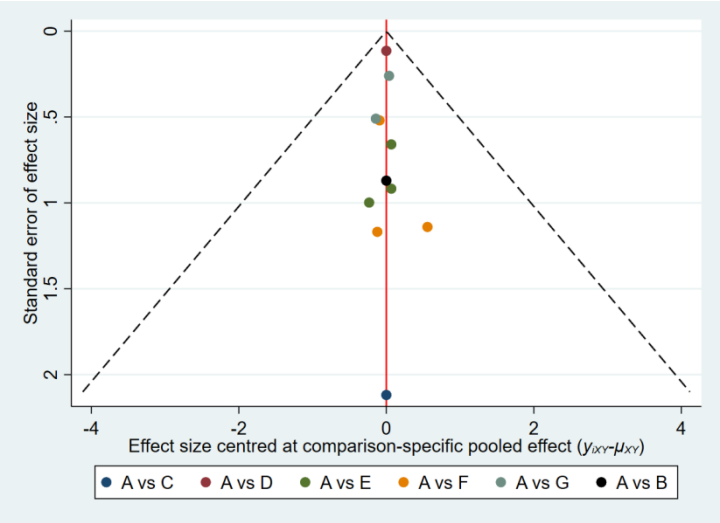
Outcome: TC



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”

P = 0.014 (Egger)

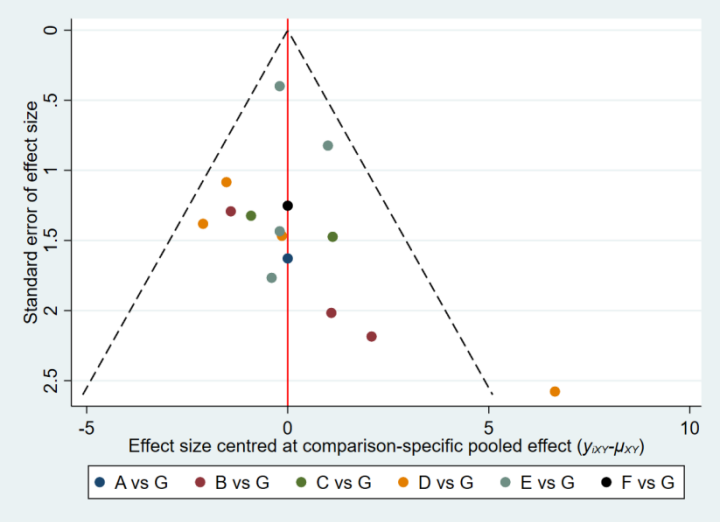
Outcome: hs-CRP



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”; G = “MP2”

P = 0.089 (Egger)

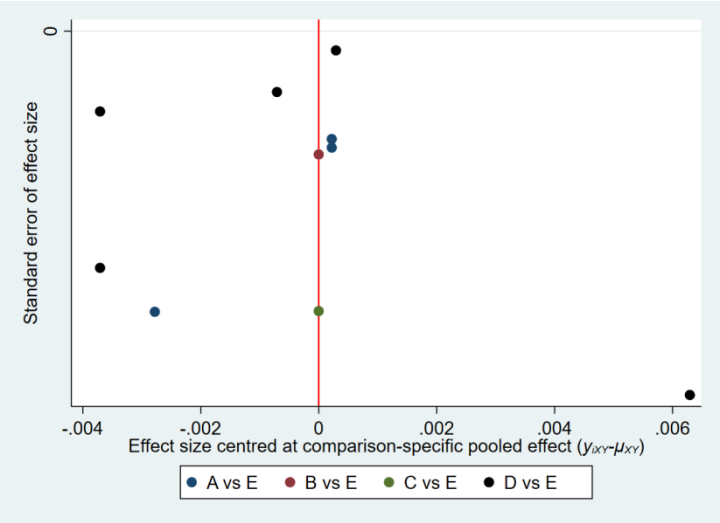
Outcome: Insulin



Notes: A = “Placebo”; B = “Lactobacillus”; C = “LABB”; D = “LRB”; E = “LLB”; F = “MP1”; G = “MP2”

P = 0.486 (Egger)

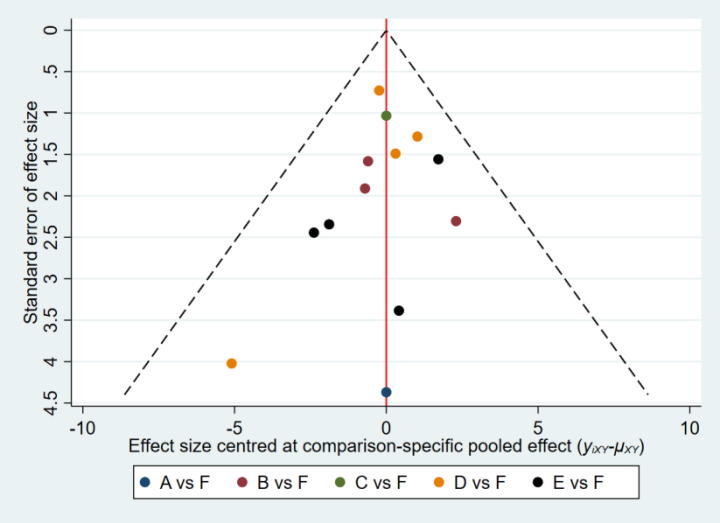
Outcome: QUICKI



Notes: A = “LLB”; B = “LRB”; C = “Lactobacillus”; D = “MP1”; E = “Placebo”

P = 0.099 (Egger)

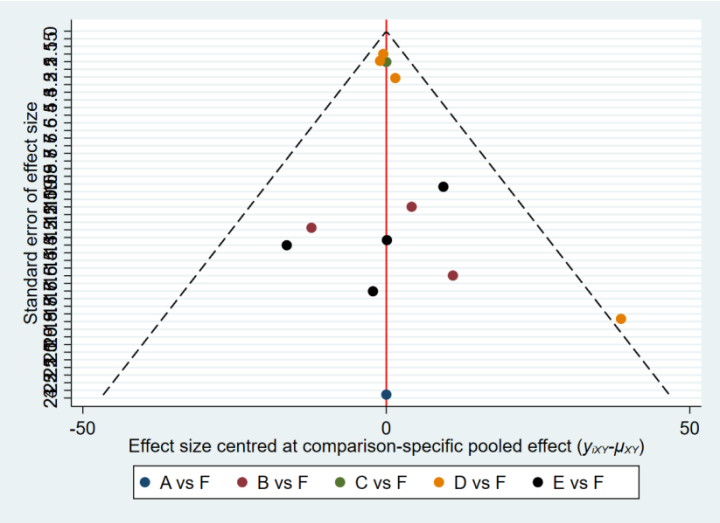
Outcome: HDLC



Notes: A = “LABB”; B = “LLB”; C = “LRB”; D = “Lactobacillus”; E = “MP1”; F = “Placebo”

P = 0.144 (Egger)

Outcome: TG



Notes: A = “LABB”; B = “LLB”; C = “LRB”; D = “Lactobacillus”; E = “MP1”; F = “Placebo”

P = 0.072 (Egger)

There were less than 10 studies on other indicators. Funnel plots were not done.

Outcome: TAC *P* = 0.252 (Egger)

Outcome: MDA *P* = 0.143 (Egger)

Outcome: GSH *P* = 0.044 (Egger)

Outcome: VLDLC *P* = 0.362 (Egger)

Outcome: Total/HDLC *P* = 0.572 (Egger)

Outcome: NO *P* = 0.054 (Egger)

Outcome: HOMA-B *P* = 0.642 (Egger)

Outcome: HbA1c *P* = 0.230 (Egger)

Figure.S8. Certainty of evidence for direct and indirect estimates

FBS

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	4	no	no	no	serious	no	moderate
	LABB：Placebo	4	no	no	no	serious	no	moderate
	LRB：Placebo	1	no	no	no	serious	no	moderate
	LLB：Placebo	4	no	no	no	no	serious	moderate
	MP1：Placebo	5	no	no	no	no	serious	moderate
	MP2：Placebo	2	no	no	no	serious	very serious	very low
Indirect comparisons	LABB: Lactobacillus	0						moderate
	LRB: Lactobacillus	0						moderate
	LLB: Lactobacillus	0						moderate
	MP1: Lactobacillus	0						moderate
	MP2: Lactobacillus	0						very low
	LRB: LABB	0						moderate
	LLB: LABB	0						moderate
	MP1: LABB	0						moderate
	MP2: LABB	0						very low
	LLB: LRB	0						moderate
	MP1: LRB	0						moderate
	MP2: LRB	0						very low
	MP1: LLB	0						moderate
	MP2: LLB	0						very low
	MP1:MP2	0						very low

FBS, fasting blood sugar. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics

HOMA-IR

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	4	no	no	no	serious	serious	low
	LABB：Placebo	2	no	no	no	no	no	high
	LRB：Placebo	2	no	no	no	serious	no	moderate
	LLB：Placebo	3	no	no	no	no	serious	moderate
	MP1：Placebo	5	no	no	no	no	no	high
	MP2：Placebo	1	no	no	no	no	no	high
Indirect comparisons	LABB: Lactobacillus	0						low
	LRB: Lactobacillus	0						low
	LLB: Lactobacillus	0						low
	MP1: Lactobacillus	0						low
	MP2: Lactobacillus	0						low
	LRB: LABB	0						moderate
	LLB: LABB	0						moderate
	MP1: LABB	0						high
	MP2: LABB	0						high
	LLB: LRB	0						moderate
	MP1: LRB	0						moderate
	MP2: LRB	0						moderate
	MP1: LLB	0						moderate
	MP2: LLB	0						moderate
	MP1:MP2	0						high

HOMA-IR, the homeostasis model assessment of insulin resistance. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

LDLC

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	4	no	no	no	serious	no	moderate
	LABB：Placebo	1	no	no	no	no	no	high
	LRB：Placebo	1	no	no	no	serious	no	moderate
	LLB：Placebo	3	no	no	no	serious	no	moderate
	MP1：Placebo	4	no	no	no	serious	no	moderate
Indirect comparisons	LABB: Lactobacillus	0						moderate
	LRB: Lactobacillus	0						moderate
	LLB: Lactobacillus	0						moderate
	MP1: Lactobacillus	0						moderate
	LRB: LABB	0						moderate
	LLB: LABB	0						moderate
	MP1: LABB	0						moderate
	LLB: LRB	0						moderate
	MP1: LRB	0						moderate
	MP1: LLB	0						moderate

LDLC, low-density lipoprotein cholesterol. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus case*i, and *Bifidobacterium bifidum*; MP1, four probiotics

TC

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	4	no	no	no	serious	no	moderate
	LABB：Placebo	1	no	no	no	serious	no	moderate
	LRB：Placebo	1	no	no	no	serious	no	moderate
	LLB：Placebo	3	no	no	no	serious	serious	low
	MP1：Placebo	4	no	no	no	no	serious	moderate
Indirect comparisons	LABB: Lactobacillus	0						moderate
	LRB: Lactobacillus	0						moderate
	LLB: Lactobacillus	0						low
	MP1: Lactobacillus	0						moderate
	LRB: LABB	0						moderate
	LLB: LABB	0						low
	MP1: LABB	0						moderate
	LLB: LRB	0						low
	MP1: LRB	0						moderate
	MP1: LLB	0						low

TC, total cholesterol.LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, L*actobacillus acidophilus, Lacticaseibacillus casei,* and *Bifidobacterium bifidum;* MP1, four probiotics

hs-CRP

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	1	no	no	no	serious	no	moderate
	LABB：Placebo	1	no	no	no	no	no	high
	LRB：Placebo	1	no	no	no	serious	no	moderate
	LLB：Placebo	3	no	no	no	no	no	high
	MP1：Placebo	3	no	no	no	no	no	high
	MP2：Placebo	2	no	no	no	no	no	high
Indirect comparisons	LABB: Lactobacillus	0						moderate
	LRB: Lactobacillus	0						moderate
	LLB: Lactobacillus	0						moderate
	MP1: Lactobacillus	0						moderate
	MP2: Lactobacillus	0						moderate
	LRB: LABB	0						moderate
	LLB: LABB	0						high
	MP1: LABB	0						high
	MP2: LABB	0						high
	LLB: LRB	0						moderate
	MP1: LRB	0						moderate
	MP2: LRB	0						moderate
	MP1: LLB	0						high
	MP2: LLB	0						high
	MP1:MP2	0						high

hs-CRP, high-sensitivity C-reactive protein. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus, Lacticaseibacillus casei,* and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics

TAC

	Comparison	Number of	Risk of bias	Publication bias	Indirectness	Imprecision	Inconsistency	Confidence rating
Direct comparisons	Lactobacillus：Placebo	1	no	no	no	serious	no	moderate
	LABB：Placebo	1	no	no	no	serious	no	moderate
	LLB：Placebo	3	no	no	no	no	serious	moderate
	MP1：Placebo	4	no	no	no	serious	serious	low
Indirect comparisons	LABB: Lactobacillus	0						moderate
	LLB: Lactobacillus	0						moderate
	MP1: Lactobacillus	0						low
	LLB: LABB	0						moderate
	MP1: LABB	0						low
	MP1: LLB	0						low

TAC, total antioxidant capacity. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics

Table S1. Description of outcomes

	Outcomes	Description
Glycemic indices	Fasting blood sugar	The abbreviation was "FBS ". The unit was standardized as "mg/dl".
	The homeostasis model assessment of insulin resistance	The abbreviation was "HOMA-IR ".
	Insulin	The unit was standardized as "μIU/mL".
	Quantitative insulin-sensitivity check index	The abbreviation was "QUICKI ".
	Homeostasis model assessment of beta cell	The abbreviation was "HOMA-B ".
	Glycated hemoglobin A1c	The abbreviation was "HbA1c ". The unit was standardized as "μmol/L".
Lipid parameters	Low-density lipoprotein cholesterol	The abbreviation was "LDLC ". The unit was standardized as "mg/dl".
	Total cholesterol	The abbreviation was "TC ". The unit was standardized as "mg/dl".
	High-density lipoprotein cholesterol	The abbreviation was "HDLC ". The unit was standardized as "mg/dl".
	Triglyceride	The abbreviation was "TG ". The unit was standardized as "mg/dl".
	Very low-density lipoprotein cholesterol	The abbreviation was "VLDLC ". The unit was standardized as "mg/dl".
	Total cholesterol/high-density lipoprotein cholesterol	The abbreviation was "Total/HDLC".
Inflammation and oxidative stress indices	Glutathione	The abbreviation was "GSH ". The unit was standardized as "μmol/L".
	High-sensitivity C-reactive protein	The abbreviation was "hs-CRP ". The unit was standardized as "μg/mL".
	Total antioxidant capacity	The abbreviation was "TAC ". The unit was standardized as "mmol/L".
	Malondialdehyde	The abbreviation was "MDA ". The unit was standardized as "μmol/L".
	Nitric oxide	The abbreviation was "NO ". The unit was standardized as "μmol/L".

Table S2. Definition of treatments

Treatment	Detailed definition	Abbreviation	Number of studies
Lactobacillus	A genus of *Lactobacillus* was used alone.	Lactobacillus	6
Lactobacillus acidophilus and *Bifidobacterium*	*Lactobacillus acidophilus* and *Bifidobacterium* were used together.	LABB	7
Lacticaseibacillus rhamnosus and *Bifidobacterium*	*Lacticaseibacillus rhamnosus* and *Bifidobacterium* were used together.	LRB	4
Lactobacillus acidophilus, Lacticaseibacillus casei, and *Bifidobacterium bifidum*	*Lactobacillus acidophilus, Lacticaseibacillus casei,* and *Bifidobacterium bifidum* were used.	LLB	5
Four probiotics	Four kinds of probiotics were used.	MP1	8
Six or more probiotics	Six or more kinds of probiotics were used.	MP2	2

Table S3. The individual assessment of risk of bias

study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Over all
Lindsay et al 2015	low	low	low	low	low	low	low	low
Lindsay et al 2014	unclear	low	low	low	low	low	low	low
Lindsay et al 2014	low	unclear	low	unclear	low	low	low	low
Taghizadeh et al 2014	low	low	low	low	low	low	low	low
Taghizadeh et al 2014	low	low	low	low	low	low	low	low
Si et al. 2019	low	low	low	low	low	low	low	low
Ebrahimi et al 2019	low	low	low	low	low	low	low	low
Asgharian et al 2020	low	low	low	low	low	low	low	low
Asemi et al 2012	low	unclear	high	unclear	low	low	low	high
Asemi et al 2013	low	unclear	high	unclear	low	low	low	high
Asemi et al 2011	low	unclear	high	unclear	low	low	low	high
Asemi et al 2012	low	unclear	high	unclear	low	low	low	high
Jmanawat et al 2019	low	unclear	low	low	low	low	low	low
Pellonper et al 2019	low	unclear	low	low	low	low	low	low
Houttu et al 2020	low	unclear	low	low	low	low	low	low
Laitinen et al 2009	low	low	low	low	low	low	low	low
Hoppu et al 2014	low	low	low	low	low	low	low	low
Karamali et al 2018	low	low	low	unclear	low	low	low	low

Table S3. The individual assessment of risk of bias (*Continued*)

study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias	Over all
Karamali et al 2016	low	low	low	low	low	low	low	low
Shahnaz et al 2016	low	low	low	unclear	low	low	low	low
Badehnoosh et al 2018	low	low	low	unclear	low	low	low	low
Jamilian et al 2016	low	low	low	unclear	low	low	low	low
Hajifaraji et al 2018	low	low	low	low	low	low	low	low
Dolatkhah et al 2015	low	low	low	low	low	low	low	low
Hajifaraji et al 2017	low	low	low	low	low	low	low	low
Nabhani et al 2022	low	low	low	low	low	low	low	low
Nabhani et al 2018	low	low	low	low	low	low	low	low
Babadi et al 2019	low	low	low	low	low	low	low	low
Amirani et al 2022	low	low	low	low	low	low	low	low
Jamilian et al 2019	low	low	low	unclear	low	low	low	low
Hasain et al 2022	low	low	low	low	low	low	low	low
Jafarnejad et al 2016	low	low	low	unclear	low	low	low	low

Table S4. The SUCRAs of secondary outcomes

Glycemic indices

Treatment	Glycemic indices			
	Insulin (%)	QUICKI (%)	HOMA-B (%)	HbA1c (%)
Lactobacillus	8.2	69.4	**85.1**	NR
LABB	69.7	NR	NR	38.3
LRB	45.7	**93.3**	NR	35.7
LLB	77.4	59.1	62.5	NR
MP1	41.7	27.6	NR	NR
MP2	**92.6**	NR	NR	**93.2**
Placebo	14.7	0.6	3.4	32.9

The strategies ranking first are marked in bold. NR represents this indicator was not reported in this method among the included studies.
SUCRA, surface under the cumulative ranking probabilities analysis. QUICKI, quantitative insulin-sensitivity check index; HOMA-B, homeostasis model assessment of beta cell; HbA1c, glycated hemoglobin A1c. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

Lipid parameters

Treatment	Lipid parameters			
	HDLC (%)	TG (%)	VLDLC (%)	Total/HDLC (%)
Lactobacillus	47.6	25.1	67.8	47.8
LABB	33.3	77.8	NR	65.0
LRB	29.4	8.5	NR	NR
LLB	69.6	**91.5**	**81.0**	NR
MP1	**83.9**	66.4	48.9	**76.6**
MP2	NR	NR	NR	NR
Placebo	36.2	30.7	2.3	10.6

The strategies ranking first are marked in bold. NR represents this indicator was not reported in this method among the included studies.
SUCRA, surface under the cumulative ranking probabilities analysis. HDLC, high-density lipoprotein cholesterol; TG, triglyceride; VLDLC, very low-density lipoprotein cholesterol; Total/HDLC, total cholesterol/high-density lipoprotein cholesterol. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus casei*, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

Oxidative stress indices

Treatment	Oxidative stress indices		
	GSH (%)	MDA (%)	NO (%)
Lactobacillus	**99.0**	**86.8**	NR
LABB	60.7	NR	NR
LRB	NR	NR	NR
LLB	55.3	52.3	18.2
MP1	20.8	55.4	54.8
MP2	NR	NR	NR
Placebo	15.2	6.6	**77.0**

The strategies ranking first are marked in bold. NR represents this indicator was not reported in this method among the included studies.
SUCRA, the surface under the cumulative ranking probabilities analysis. GSH, glutathione; MDA, malondialdehyde; NO, nitric oxide. LABB, *Lactobacillus acidophilus* and *Bifidobacterium*; LRB, *Lacticaseibacillus rhamnosus* and *Bifidobacterium*; LLB, *Lactobacillus acidophilus*, *Lacticaseibacillus*

casei, and *Bifidobacterium bifidum*; MP1, four probiotics; MP2, six or more probiotics.

Table.S5. The SUCRAs for comparison of means of intervention

Indices	Treatment		
	Food (%)	Fortified substances (%)	Placebo (%)
FBS	**74.7**	71.6	3.6
HOMA-IR	**96.2**	53.7	0.1
Insulin	**95.9**	53.5	0.6
QUICKI	**86.2**	62.3	1.5
HOMA-B	**88.4**	60.7	0.9
HbA1c	34.0	**90.0**	26.0
LDLC	**95.4**	33.0	21.6
TC	**90.3**	48.3	11.4
HDLC	**74.0**	59.5	16.5
TG	**90.4**	57.4	2.2
VLDLC	**78.1**	70.4	1.5
Total/HDLC	**86.1**	62.7	1.2
hs-CRP	45.6	**90.2**	15.2
TAC	65.5	**67.6**	17.9
GSH	**96.5**	53.2	0.2
MDA	**95.7**	53.9	0.4

The strategies ranking first are marked in bold. Food stands for supplements of probiotics in the form of food. Fortified substances mean that probiotics are supplemented by fortified substances.

SUCRA, surface under the cumulative ranking probabilities analysis. FBS, fasting blood sugar; HOMA-IR, the homeostasis model assessment of insulin resistance; QUICKI, quantitative insulin-sensitivity check index; HOMA-B, homeostasis model assessment of beta cell; HbA1c, glycated hemoglobin A1c; LDLC, low-density lipoprotein cholesterol; TC, total cholesterol; HDLC, high-density lipoprotein cholesterol; TG, triglyceride; VLDLC, very low-density lipoprotein cholesterol; Total/HDLC, total cholesterol/high-density lipoprotein cholesterol; TAC, total antioxidant capacity; hs-CRP, high-sensitivity C-reactive protein; GSH, glutathione; MDA, malondialdehyde.