Supplemental Files

Supplemental file 1: Search strategy

PubMed

#1	((("Overweight"[Mesh]) OR ((obesity[Title/Abstract]) OR (fat[Title/Abstract])))
#2	(("Thioctic Acid"[Mesh]) OR ((((((((((((((alpha-Lipoic Acid[Title/Abstract]) OR (Acid, alpha-Lipoic[Title/Abstract])) OR (alpha Lipoic Acid[Title/Abstract])) OR (Lipoic Acid[Title/Abstract])) OR (alpha-Liponsaure von ct[Title/Abstract])) OR (alpha Liponsaure von ct[Title/Abstract])) OR (alphaLiponsaure von ct[Title/Abstract])) OR (Liponsaure-ratiopharm[Title/Abstract])) OR (Liponsaure ratiopharm[Title/Abstract])) OR (Liponsaureratiopharm[Title/Abstract])) OR (Alpha-Liponsaure Sofotec[Title/Abstract])) OR (Alpha Liponsaure Sofotec[Title/Abstract])) OR (AlphaLiponsaure Sofotec[Title/Abstract])) OR (Thioctacide T[Title/Abstract])) OR (Thioctacid[Title/Abstract]))))
#3	("Triglycerides"[Mesh]) OR ((((((((((((((Triacylglycerols[Title/Abstract]) OR (TG[Title/Abstract])) OR (Triacylglycerol[Title/Abstract])) OR (Triglyceride[Title/Abstract])) OR (total cholesterol[Title/Abstract])) OR (TC[Title/Abstract])) OR (Cholesterol, HDL-C[Title/Abstract])) OR (HDL-C Cholesterol[Title/Abstract])) OR (High Density Lipoprotein Cholesterol[Title/Abstract])) OR (Cholesterol, LDL-C[Title/Abstract])) OR (Low Density Lipoprotein Cholesterol[Title/Abstract])) OR (LDL-C Cholesterol[Title/Abstract])) OR (Homeostasis Model Assessment of Insulin Resistance[Title/Abstract])) OR (HOMA-IR[Title/Abstract])) OR (fasting blood glucose[Title/Abstract])) OR (FBS[Title/Abstract]))
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

Embase

#1	'overweight'/exp OR 'obesity'/exp OR fat:ab,ti
#2	'alpha lipoic acid'/exp OR 'thioctic acid'/exp OR 'alpha-liponsaure von ct':ab,ti OR 'liponsaure-ratiopharm':ab,ti OR 'alpha-liponsaure softec':ab,ti OR 'thioctacide T':ab,ti OR 'thioctacid':ab,ti
#3	'triglycerides'/exp OR 'total cholesterol'/exp OR 'hdl-c':ab,ti OR 'ldl-c':ab,ti OR 'high density lipoprotein cholesterol':ab,ti OR 'low density lipoprotein cholesterol':ab,ti OR 'homeostasis model assessment of insulin resistance':ab,ti OR 'HOMA-IR':ab,ti OR 'fasting blood glucose':ab,ti OR 'FBS':ab,ti
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

Medline

#1	(MH "Overweight+") OR (MH "Obesity+") OR (obesity OR fat).ti,ab
#2	(MH "Thioctic Acid+") OR (alpha-lipoic acid OR lipoic acid OR alpha-liponsaure von ct OR liponsaure-ratiopharm OR alpha-liponsaure softec OR thioctacide T OR thioctacid).ti,ab
#3	(MH "Triglycerides+") OR (total cholesterol OR HDL-C OR LDL-C OR high density lipoprotein cholesterol OR low density lipoprotein cholesterol OR fasting blood glucose OR HOMA-IR OR FBS).ti,ab
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

APA PsycINFO

#1	DE "Overweight" OR DE "Obesity" OR obesity OR fat
#2	DE "Alpha Lipoic Acid" OR alpha-lipoic acid OR lipoic acid OR alpha-liponsaure von ct OR liponsaure-ratiopharm OR alpha-liponsaure softec OR thioctacide T OR thioctacid
#3	triglycerides OR total cholesterol OR HDL-C OR LDL-C OR high density lipoprotein cholesterol OR low density lipoprotein cholesterol OR fasting blood glucose OR HOMA-IR OR FBS
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

SocINDEX

#1	DE "Overweight" OR DE "Obesity" OR obesity OR fat
#2	DE "Alpha Lipoic Acid" OR alpha-lipoic acid OR lipoic acid OR alpha-liponsaure von ct OR liponsaure-ratiopharm OR alpha-liponsaure softec OR thioctacide T OR thioctacid
#3	triglycerides OR total cholesterol OR HDL-C OR LDL-C OR high density lipoprotein cholesterol OR low density lipoprotein cholesterol OR fasting blood glucose OR HOMA-IR OR FBS
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

CINAHL

#1	(MH "Overweight") OR (MH "Obesity") OR obesity OR fat
#2	(MH "Alpha Lipoic Acid") OR alpha-lipoic acid OR lipoic acid OR alpha -liponsaure von ct OR liponsaure-ratiopharm OR alpha-liponsaure softec OR thioctacide T OR thioctacid
#3	triglycerides OR total cholesterol OR HDL-C OR LDL-C OR high density lipoprotein cholesterol OR low density lipoprotein cholesterol OR fasting blood glucose OR HOMA-IR OR FBS
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

SSRN

#1	overweight OR obesity OR fat
#2	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#3	triglycerides OR "total cholesterol" OR HDL-C OR LDL-C OR "high density lipoprotein cholesterol" OR "low density lipoprotein cholesterol" OR "fasting blood glucose" OR HOMA-IR OR FBS
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

SocArXiv

#1	Restrictions: English language, publication dates up to October 2024.
#2	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#3	triglycerides OR "total cholesterol" OR HDL-C OR LDL-C OR "high density lipoprotein cholesterol" OR "low density lipoprotein cholesterol" OR "fasting blood glucose" OR HOMA-IR OR FBS
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

PsyArXiv

#1	overweight OR obesity OR fat
#2	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#3	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

medRxiv

#1	overweight OR obesity OR fat
#2	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#3	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
#4	#1 AND #2 AND #3

Restrictions: English language, publication dates up to October 2024.

Google Scholar

allintitle:	overweight OR obesity OR fat
	"alpha lipoic acid" OR "thioctic acid" OR "alpha-liponsaure von ct" OR "liponsaure-ratiopharm" OR "alpha-liponsaure softec" OR "thioctacide T" OR "thioctacid"
	triglycerides OR "total cholesterol" OR HDL-C OR LDL-C OR "high density lipoprotein cholesterol" OR "low density lipoprotein cholesterol" OR "fasting blood glucose" OR HOMA-IR OR FBS

Restrictions: English language only, limited to the first 30 results, publication dates up to October 2024.

Supplemental file 2: Decision rules for handling overlapping or duplicate data

When encountering studies with overlapping or duplicate data, the following decision rules were applied to ensure the selection of unique data for synthesis:

1.Population Consistency: Preference was given to studies whose populations closely aligned with the inclusion criteria.

2.Intervention Relevance: Studies that reported interventions directly related to alpha-lipoic acid (ALA) supplementation at doses relevant to our analysis were prioritized.

3.Outcome Completeness: Studies that provided the most comprehensive set of outcome data for intermediate disease markers (e.g., TG, TC, HDL-C, LDL-C, HOMA -IR, and FBS) were selected over those with incomplete data.

4.Most Recent and Comprehensive Data: When multiple publications reported on the same dataset, the most recent and comprehensive version of the data was selected, provided it contained additional or updated information compared to earlier versions.

5.Trial Quality: In cases where multiple studies appeared similar, the study with a lower risk of bias, as determined by our risk of bias assessment, was selected.

6.Subgroup analysis is also conducted to explore the potential impact of different factors on the results and to provide more detailed insights into the data.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

Supplemental file 3: Forest plots

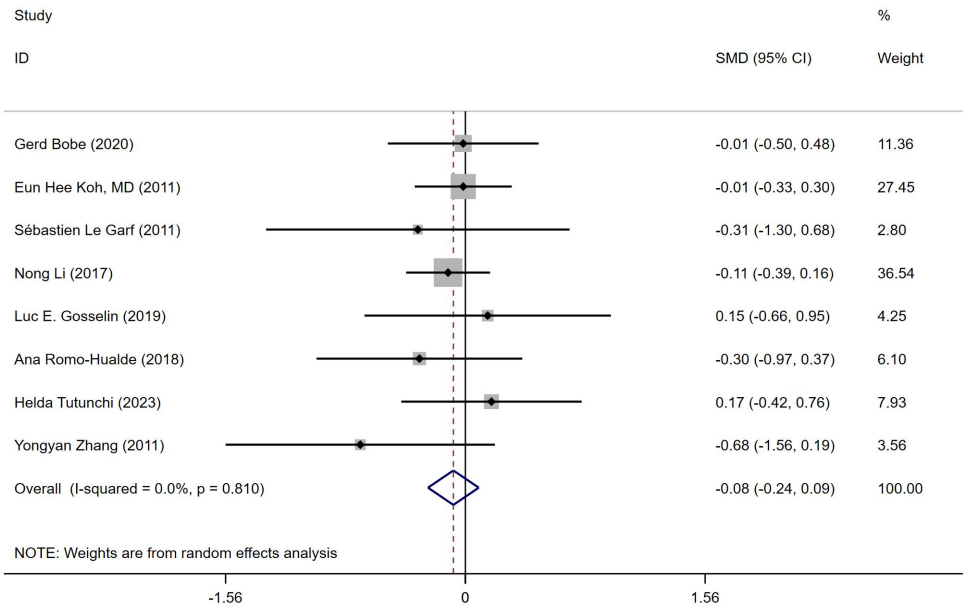

Fig. S1 The association between ALA intake and TG. Displayed values are Standardized mean and 95% CIs.

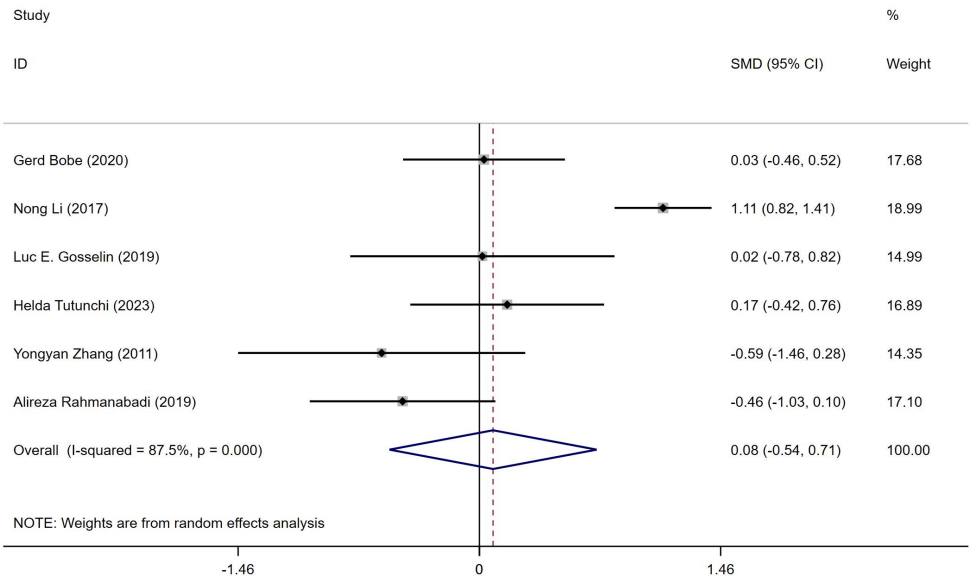

Fig. S2 The association between ALA intake and TC. Displayed values are Standardized mean and 95% CIs.

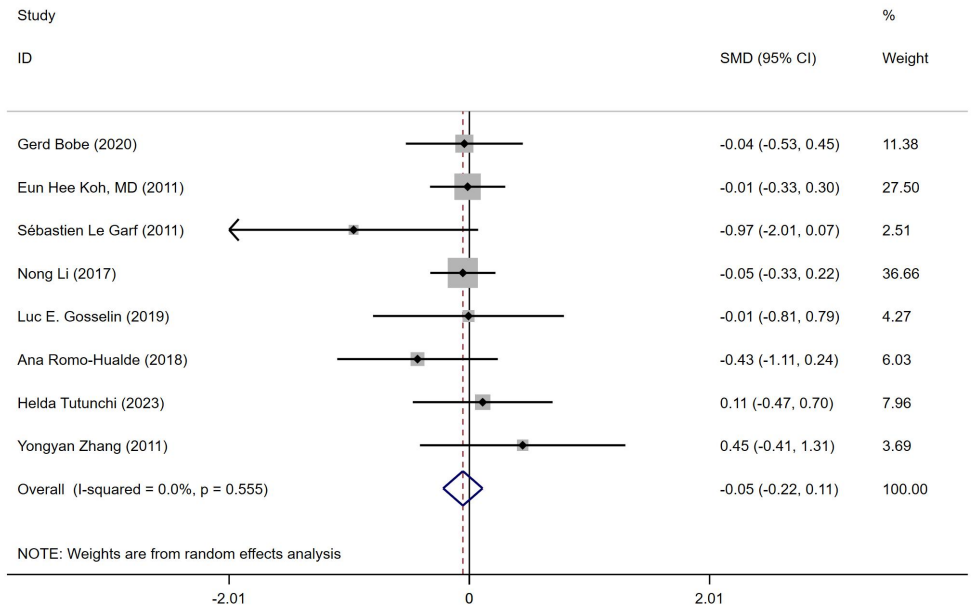

Fig. S3 The association between ALA intake and HDL. Displayed values are Standardized mean and 95% CIs.

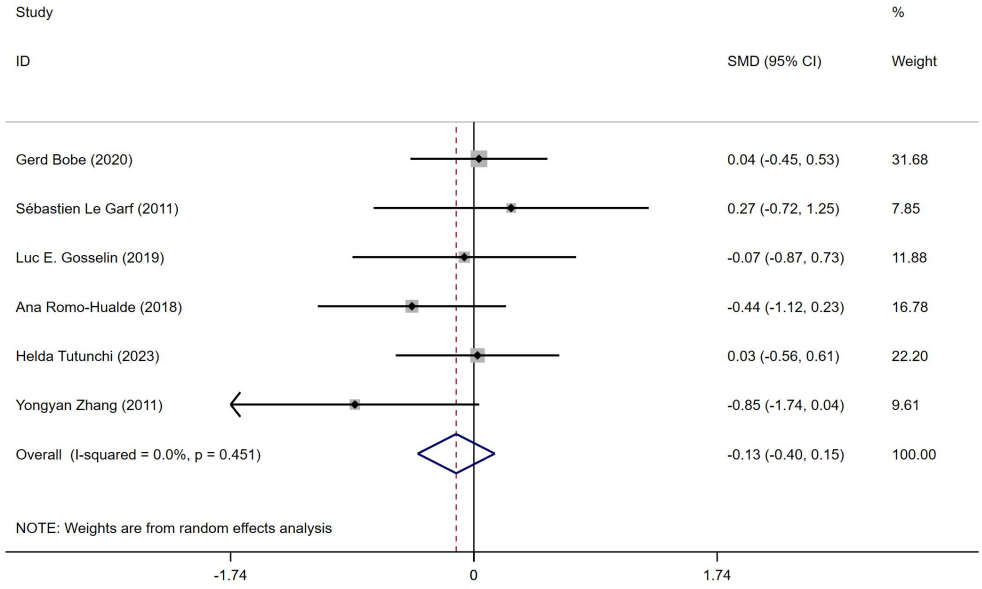

Fig. S4 The association between ALA intake and LDL. Displayed values are Standardized mean and 95% CIs.

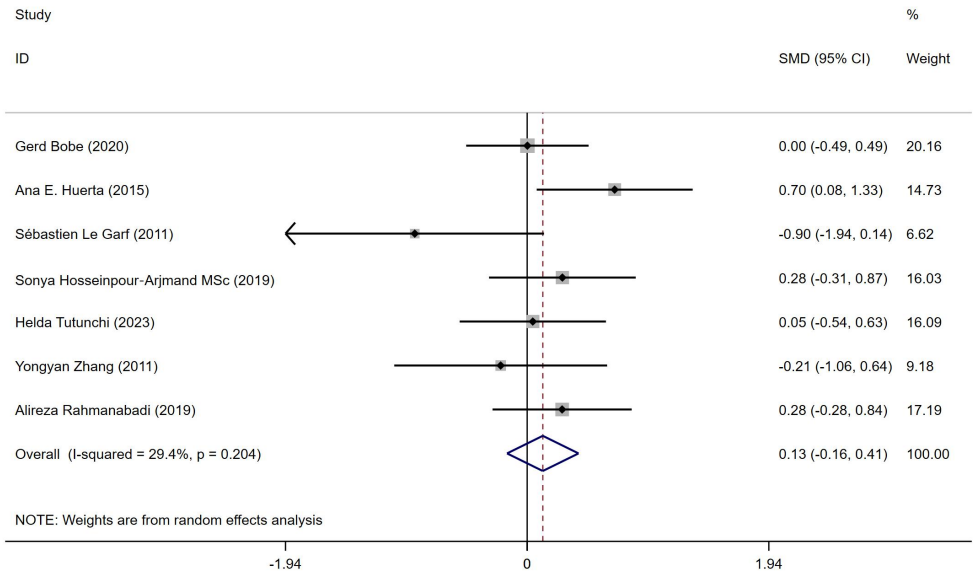

Fig. S5 The association between ALA intake and FBS. Displayed values are Standardized mean and 95% CIs.

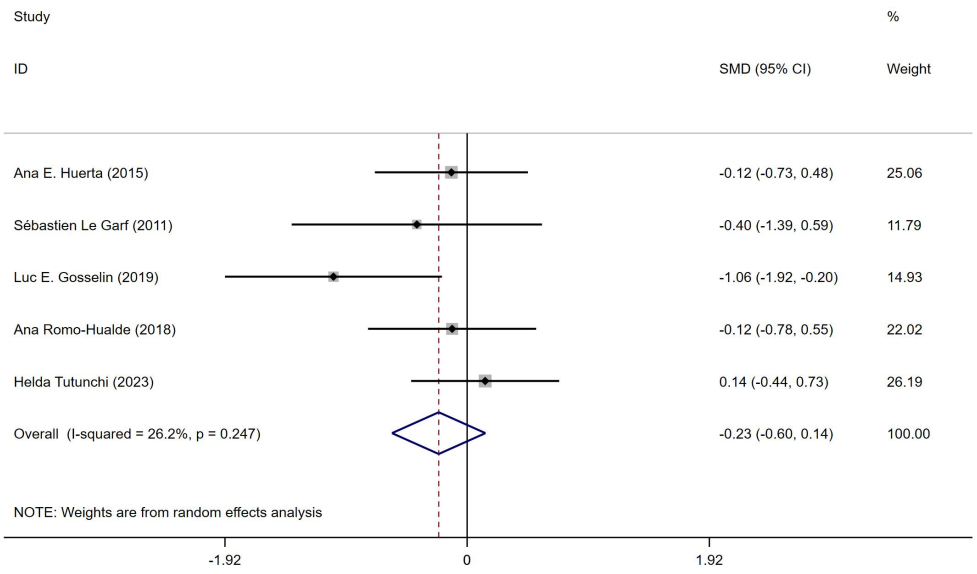

Fig. S6 The association between ALA intake and HOMA-IR. Displayed values are Standardized mean and 95% CIs.

Supplemental file 4: Funnel plots

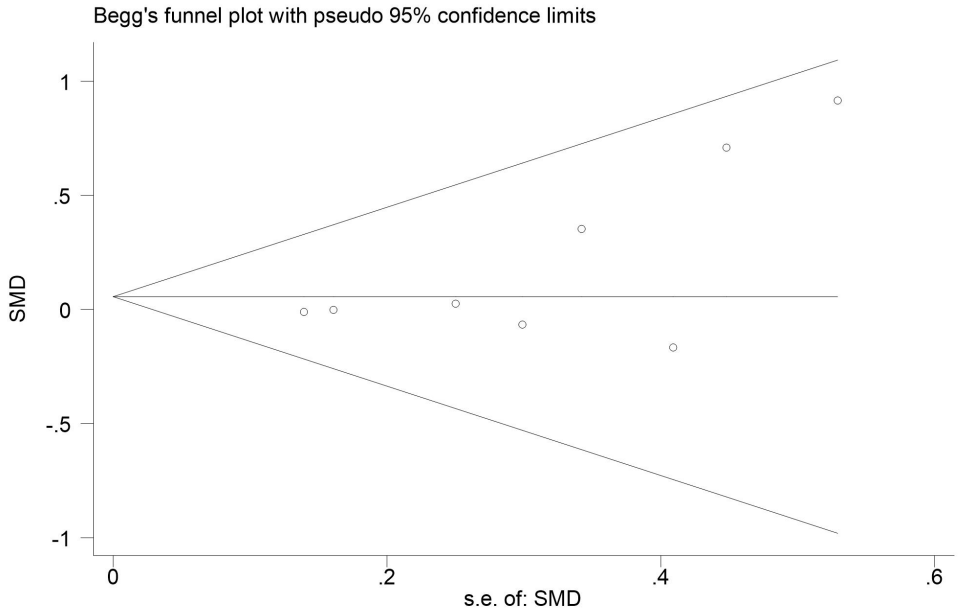

Fig. S7 Begg's Test for Small-Study Effects on TG

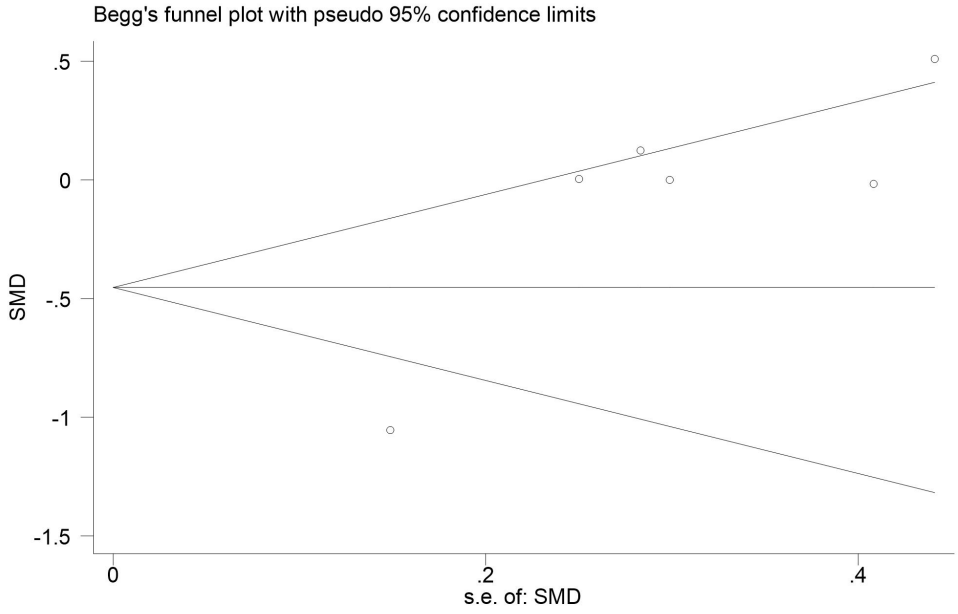

Fig. S8 Begg's Test for Small-Study Effects on TC

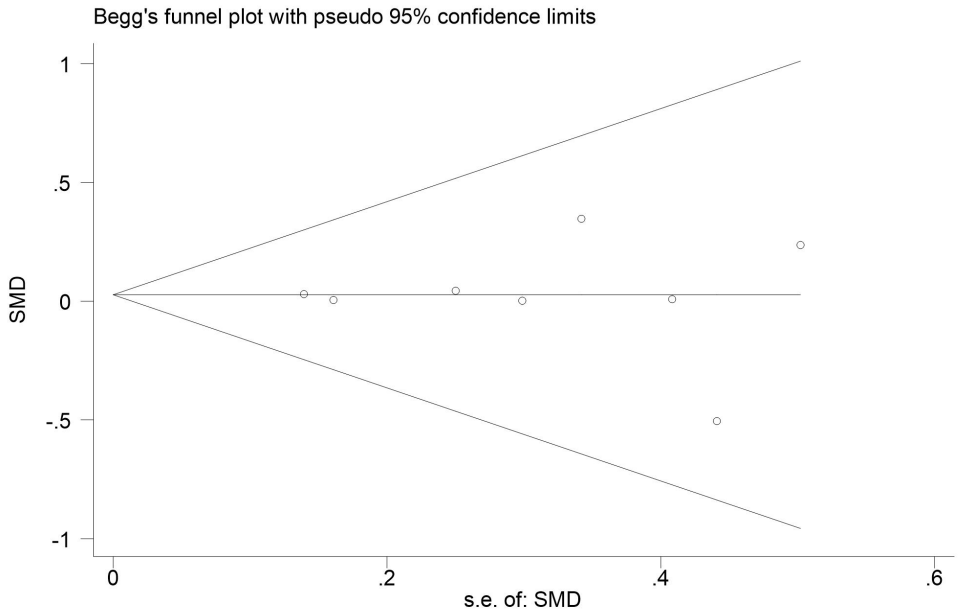

Fig. S9 Begg's Test for Small-Study Effects on HDL

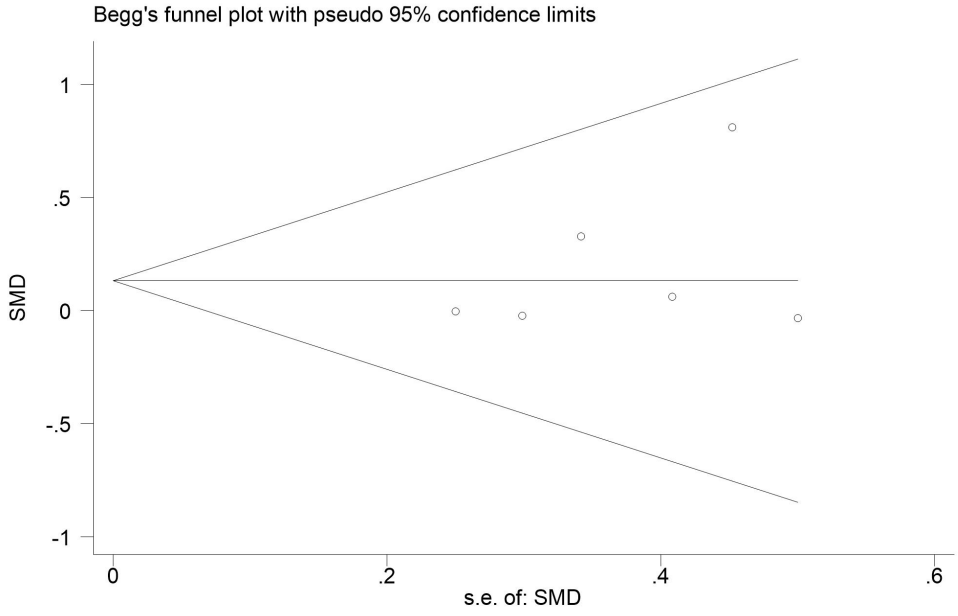

Fig. S10 Begg's Test for Small-Study Effects on LDL

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

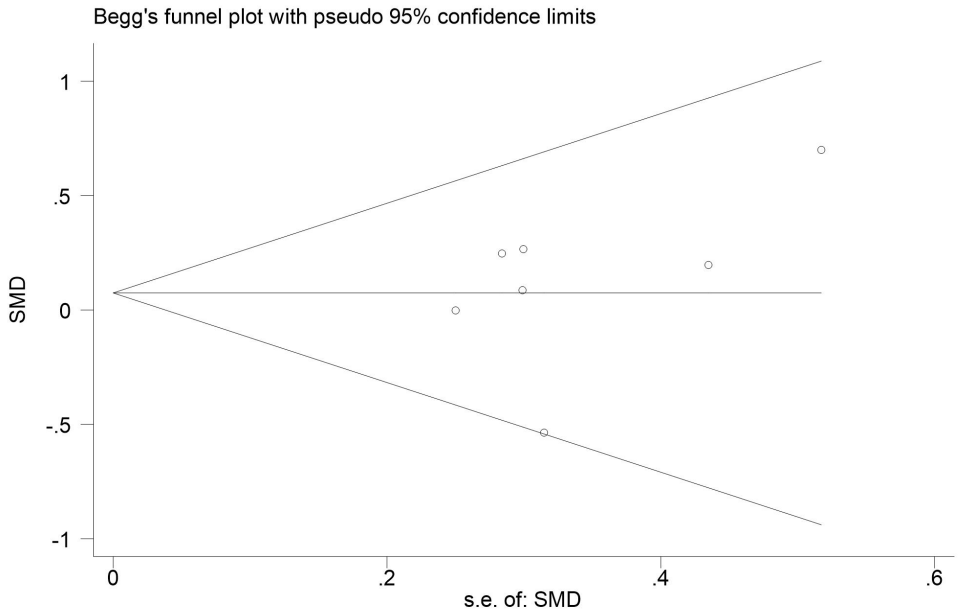

Fig. S11 Begg's Test for Small-Study Effects on FBS

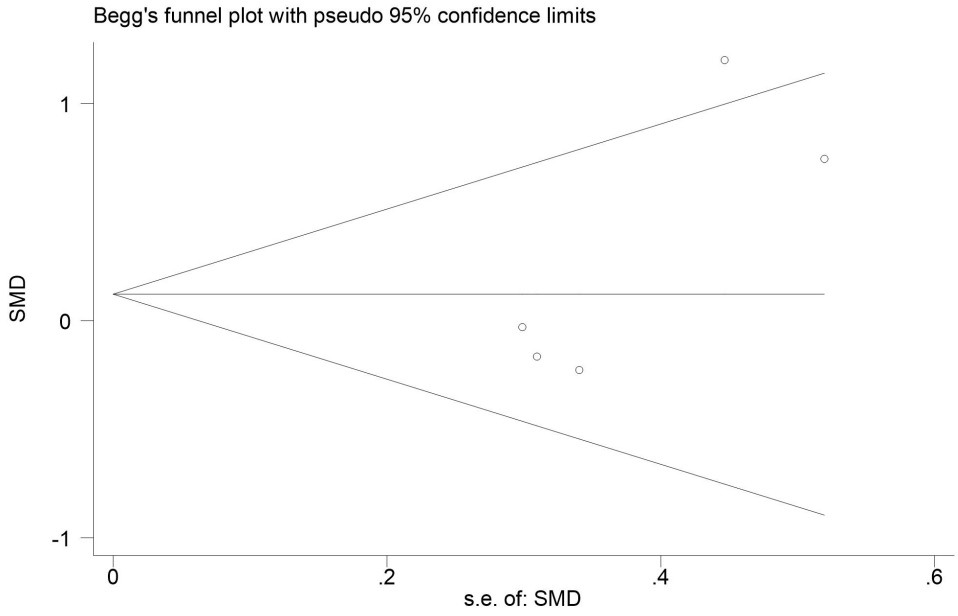

Fig. S12 Begg's Test for Small-Study Effects on HOMA-IR

Supplemental file 5: Subgroup Analysis

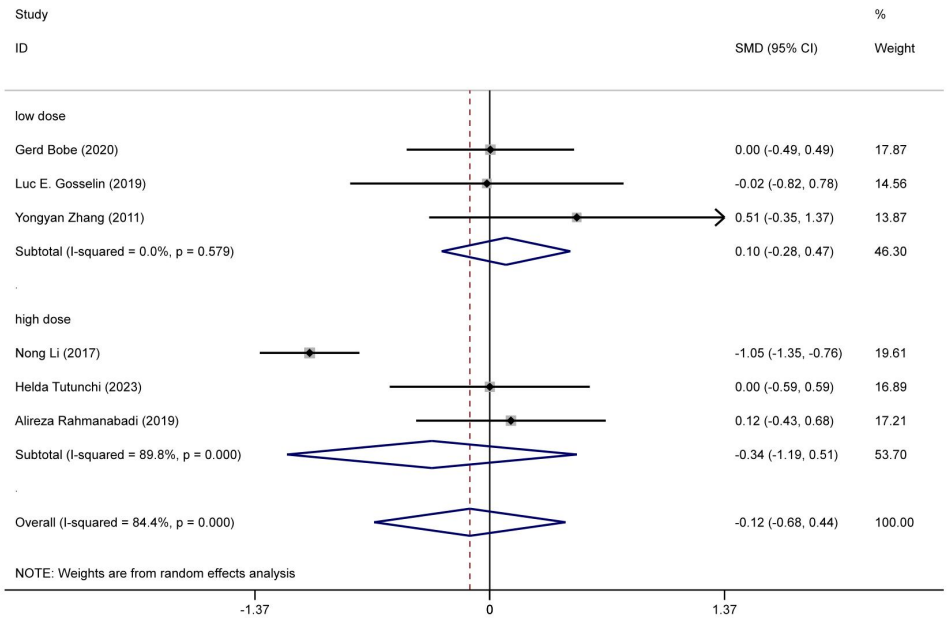

Fig. S13 Subgroup Analysis: Effect of ALA on TC (low versus high dose). Displayed values are Standardized mean and 95% CIs.

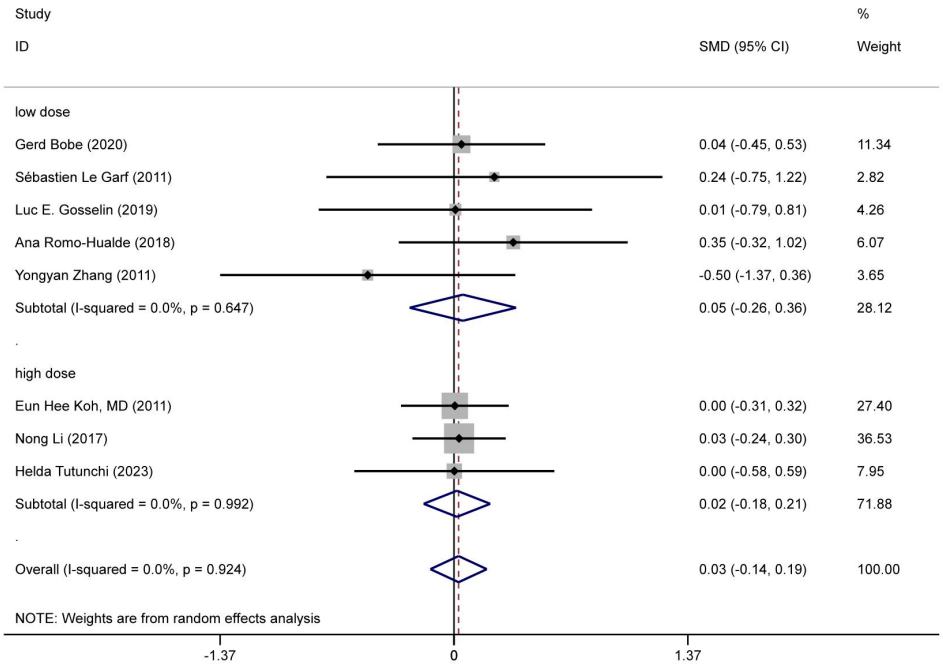

Fig. S14 Subgroup Analysis: Effect of ALA on HDL (low versus high dose). Displayed values are Standardized mean and 95% CIs.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

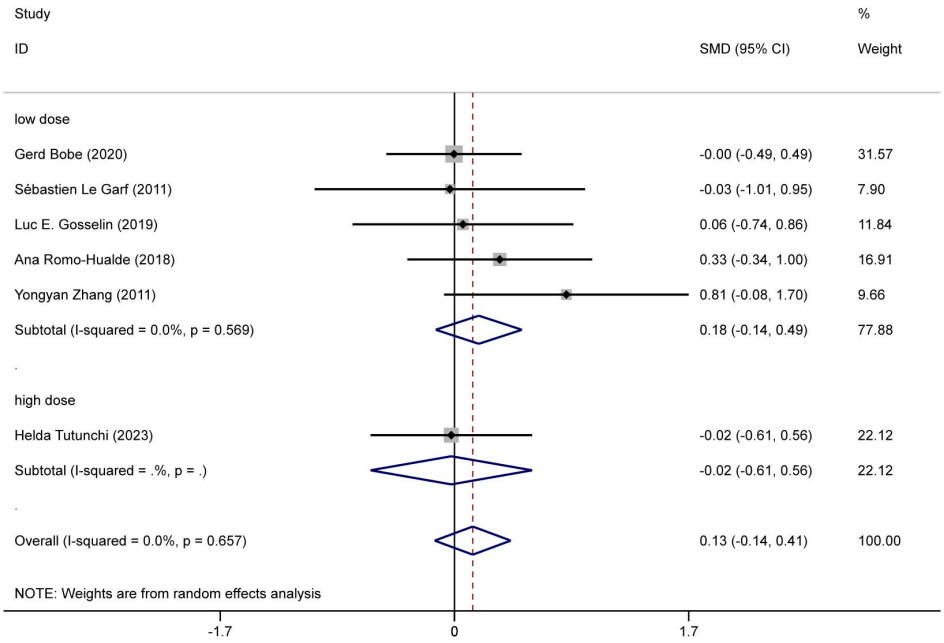

Fig. S15 Subgroup Analysis: Effect of ALA on LDL (low versus high dose). Displayed values are Standardized mean and 95% CIs.

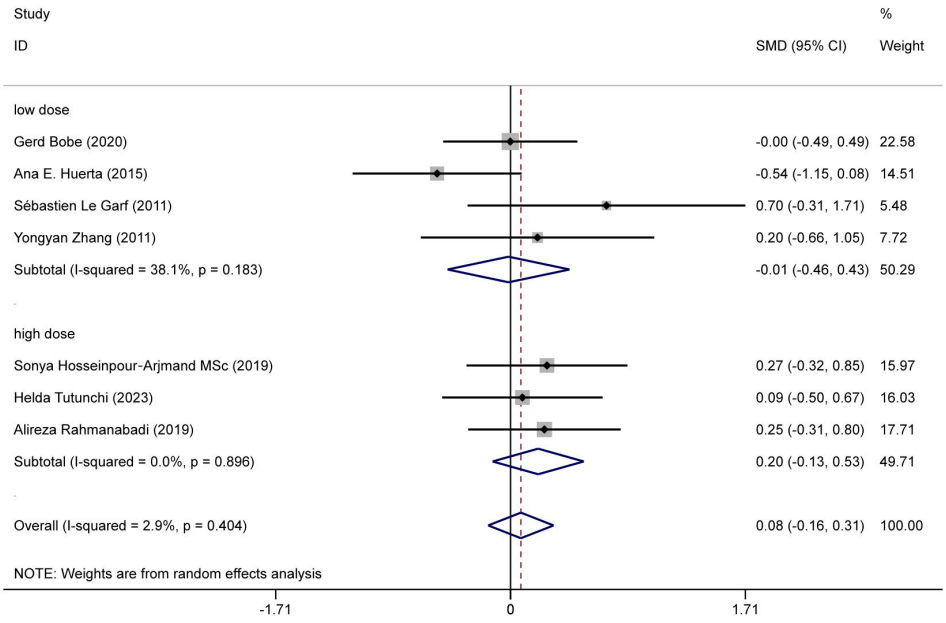

Fig. S16 Subgroup Analysis: Effect of ALA on FBS (low versus high dose). Displayed values are Standardized mean and 95% CIs.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

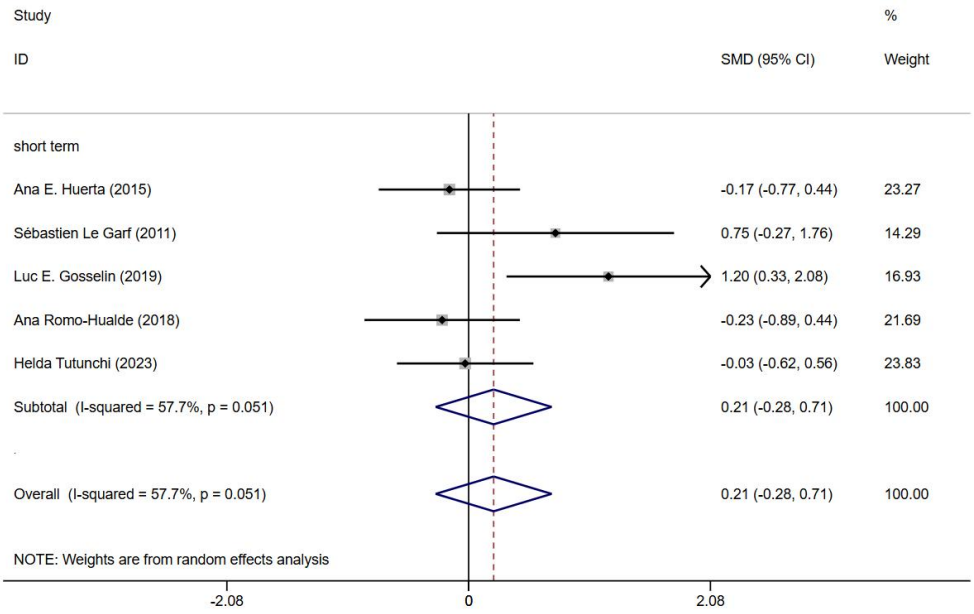

Fig. S17 Subgroup Analysis: Effect of ALA on HOMA_IR (low versus high dose). Displayed values are Standardized mean and 95% CIs.

Luo Y, *et al. BMJ Open* 2025; 15:e088363. doi: 10.1136/bmjopen-2024-088363

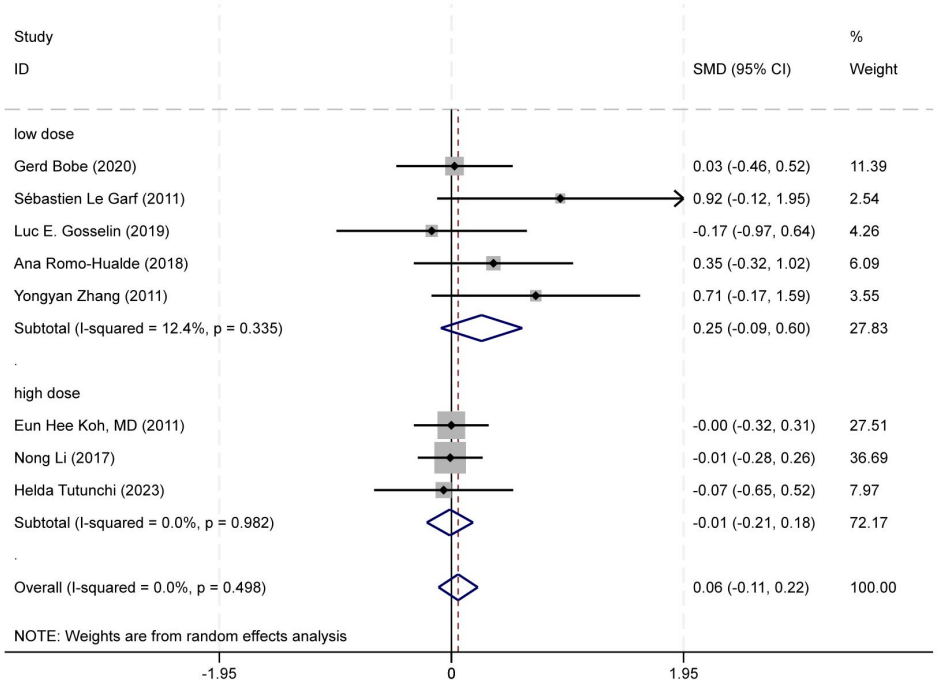

Fig. S18 Subgroup Analysis: Effect of ALA on TG (low versus high dose). Displayed values are Standardized mean and 95% CIs.

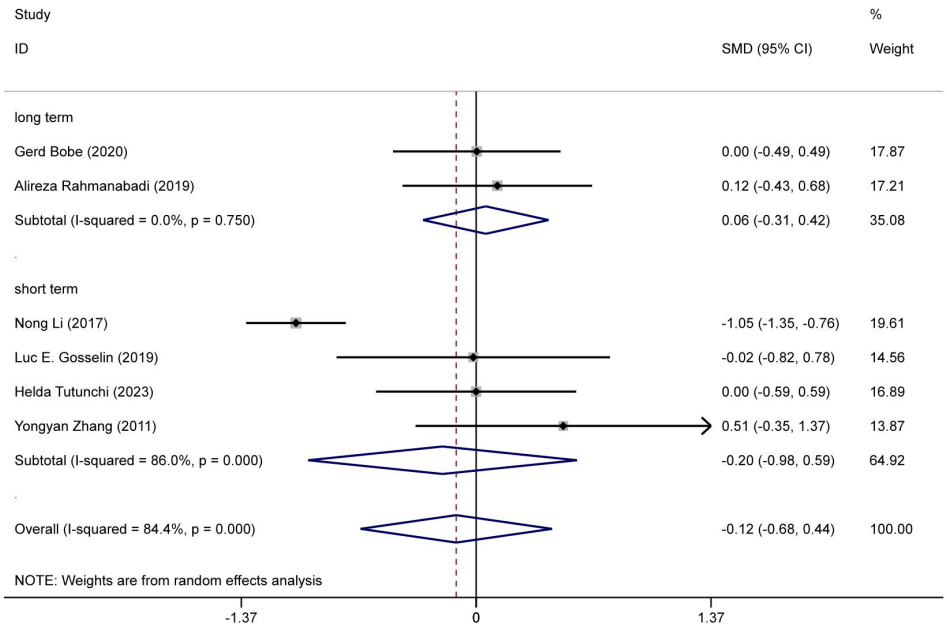

Fig. S19 Subgroup Analysis: Effect of ALA on TC (long versus short term). Displayed values are Standardized mean and 95% CIs.

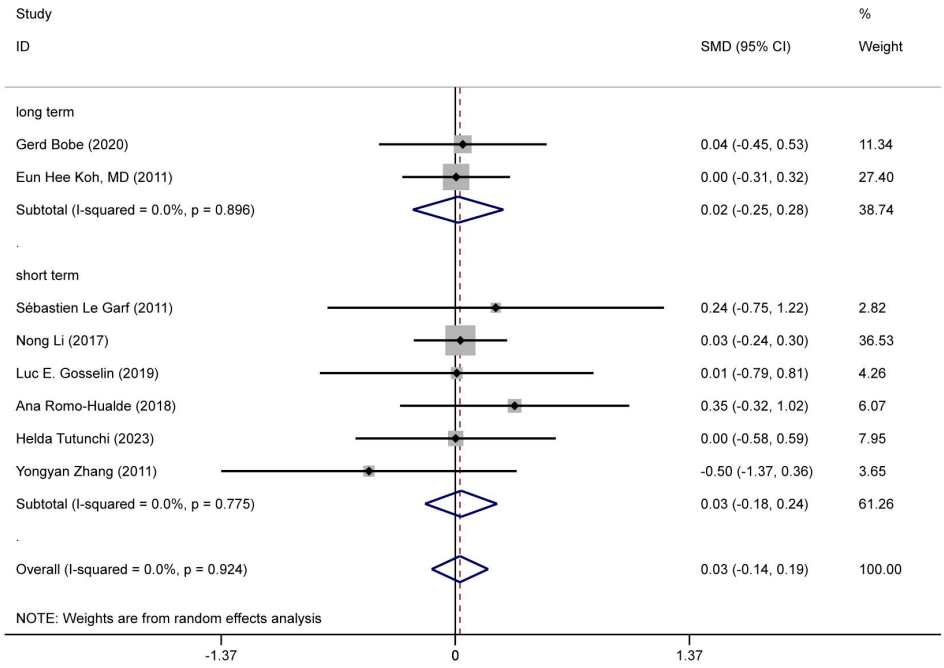

Fig. S20 Subgroup Analysis: Effect of ALA on HDL (long versus short term). Displayed values are Standardized mean and 95% CIs.

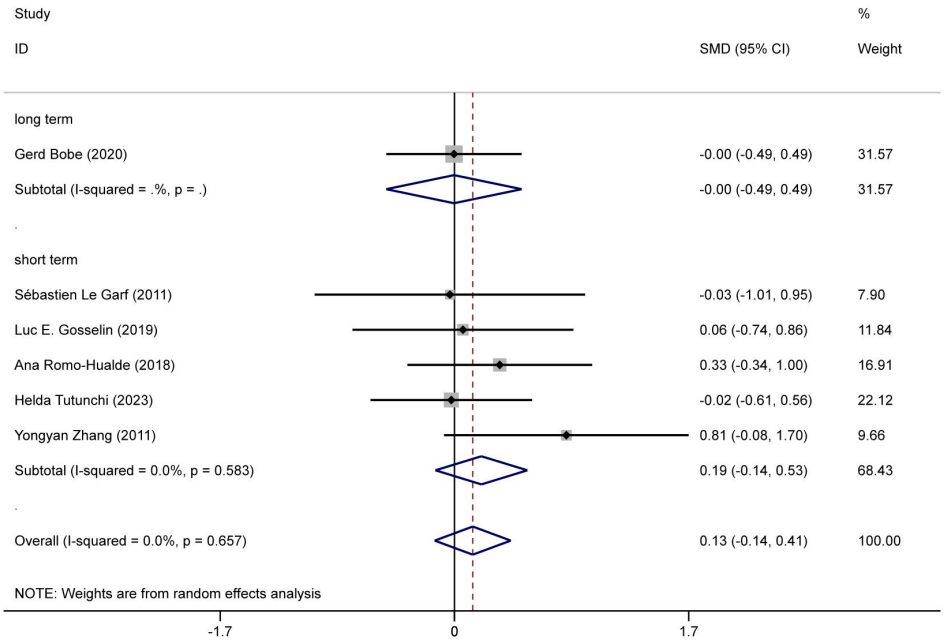

Fig. S21 Subgroup Analysis: Effect of ALA on LDL (long versus short term). Displayed values are Standardized mean and 95% CIs.

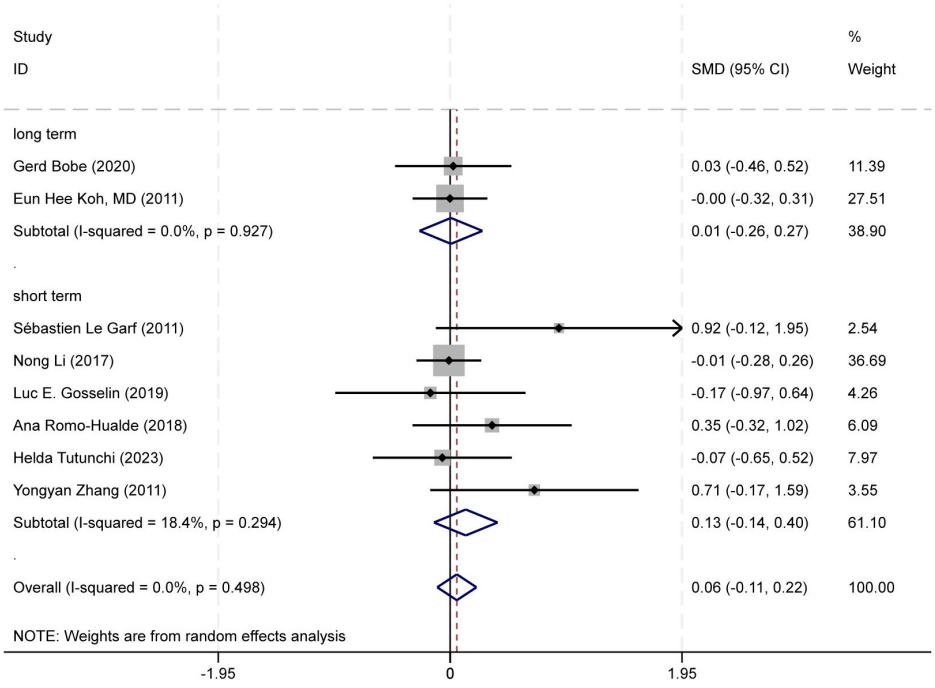

Fig. S22 Subgroup Analysis: Effect of ALA on TG (long versus short term). Displayed values are Standardized mean and 95% CIs.

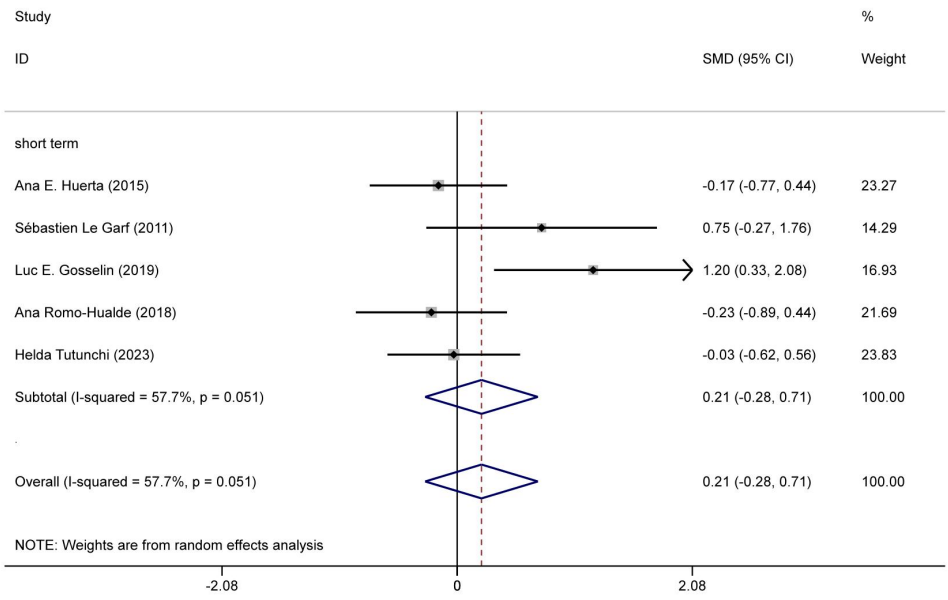

Fig. S23 Subgroup Analysis: Effect of ALA on HOMA_IR (long versus short term). Displayed values are Standardized mean and 95% CIs.

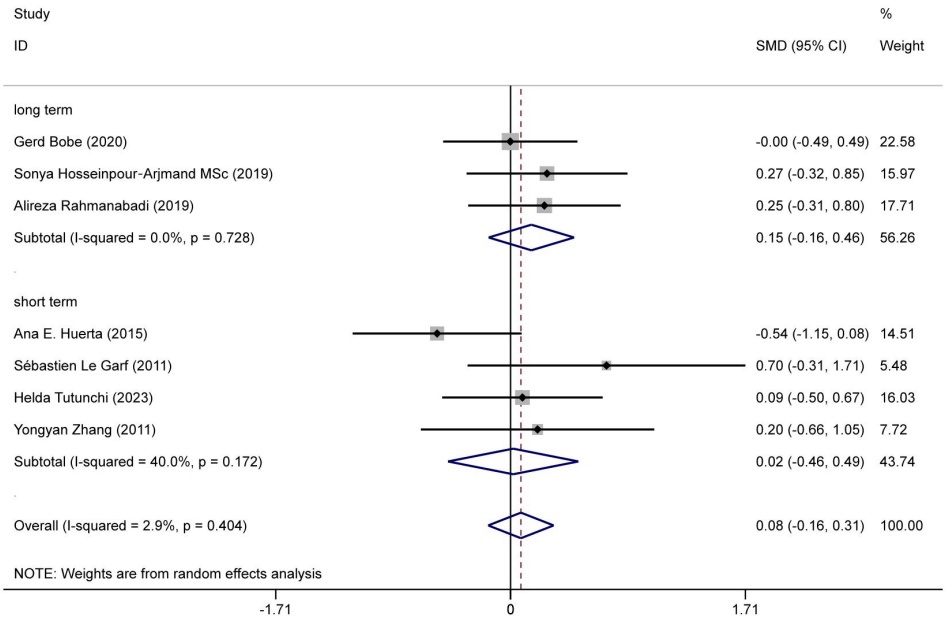

Fig. S24 Subgroup Analysis: Effect of ALA on FBS (long versus short term). Displayed values are Standardized mean and 95% CIs.

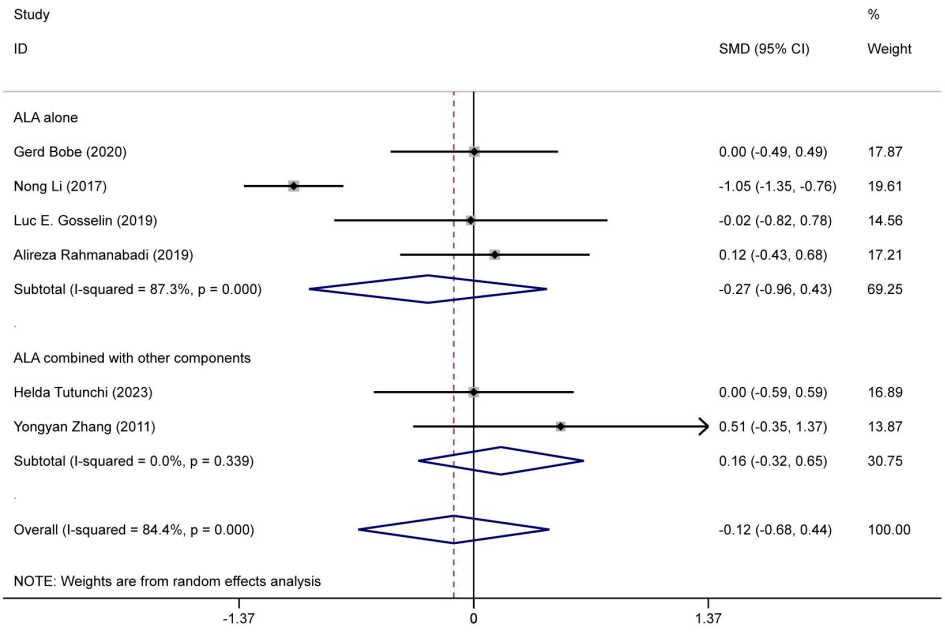

Fig. S25 Subgroup Analysis: Effect of ALA on TC (ALA alone versus ALA combined with other components). Displayed values are Standardized mean and 95% CIs.

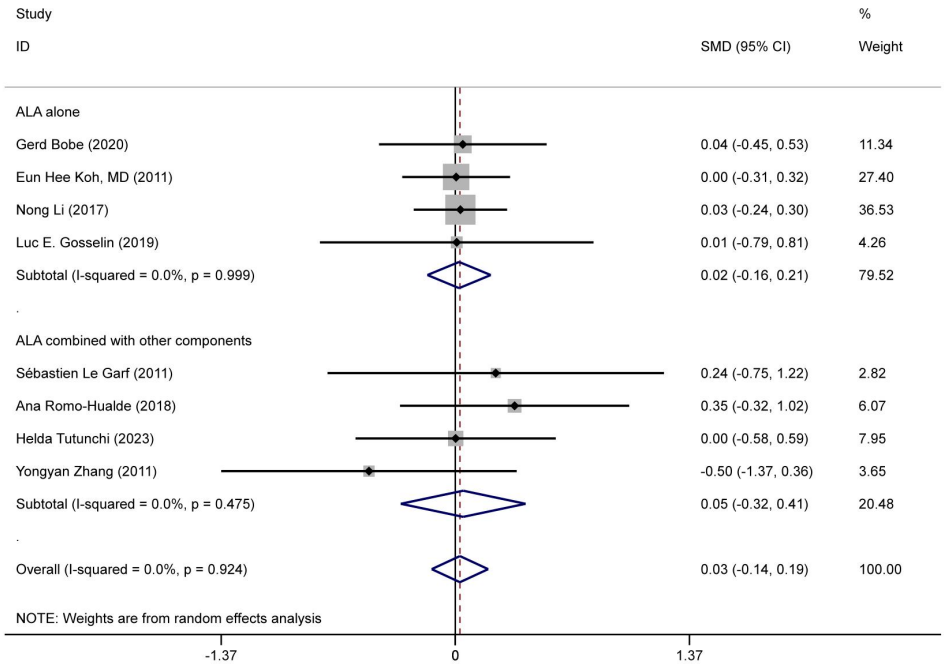

Fig. S26 Subgroup Analysis: Effect of ALA on HDL (ALA alone versus ALA combined with other components)Displayed values are Standardized mean and 95% CIs.

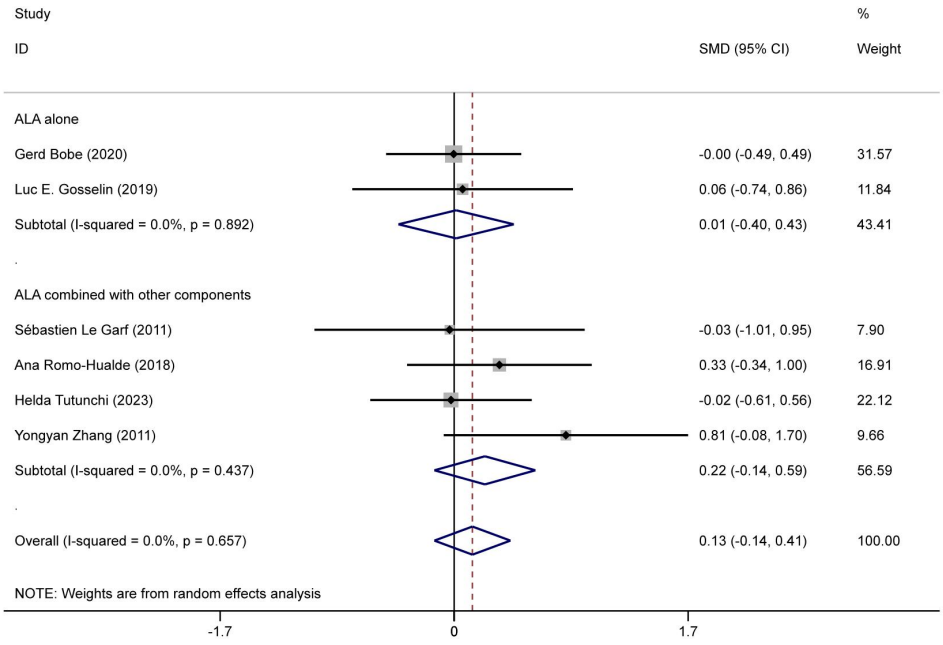

Fig. S27 Subgroup Analysis: Effect of ALA on LDL (ALA alone versus ALA combined with other components)Displayed values are Standardized mean and 95% CIs.

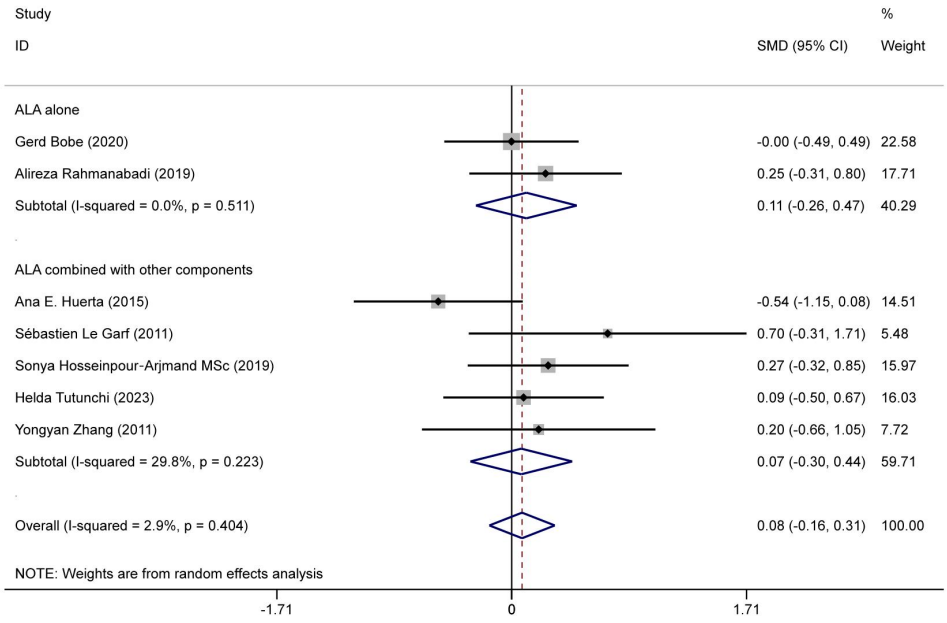

Fig. S28 Subgroup Analysis: Effect of ALA on FBS (ALA alone versus ALA combined with other components)Displayed values are Standardized mean and 95% CIs.

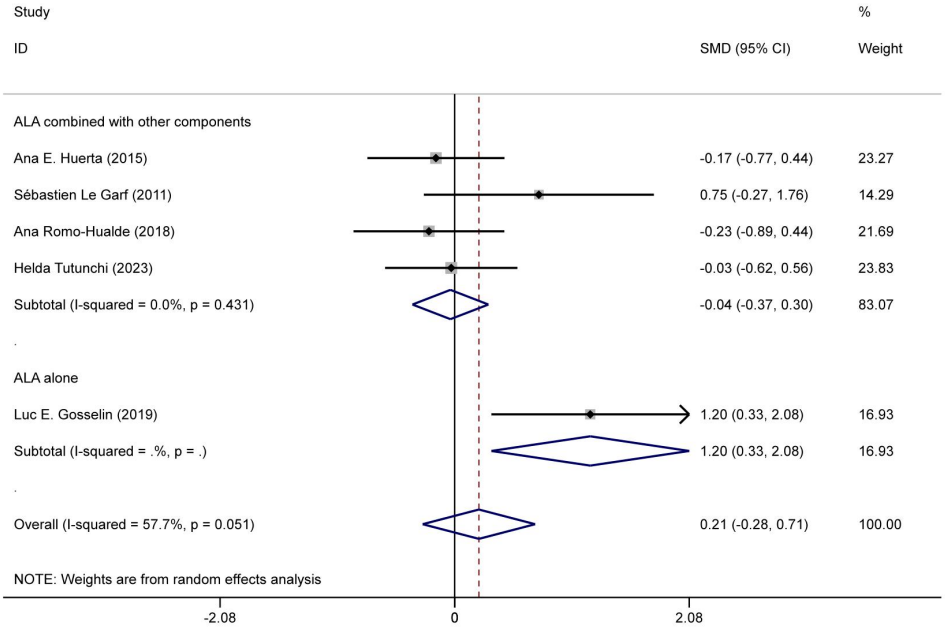

Fig. S29 Subgroup Analysis: Effect of ALA on HOMA_IR (ALA alone versus ALA combined with other components)Displayed values are Standardized mean and 95% CIs.

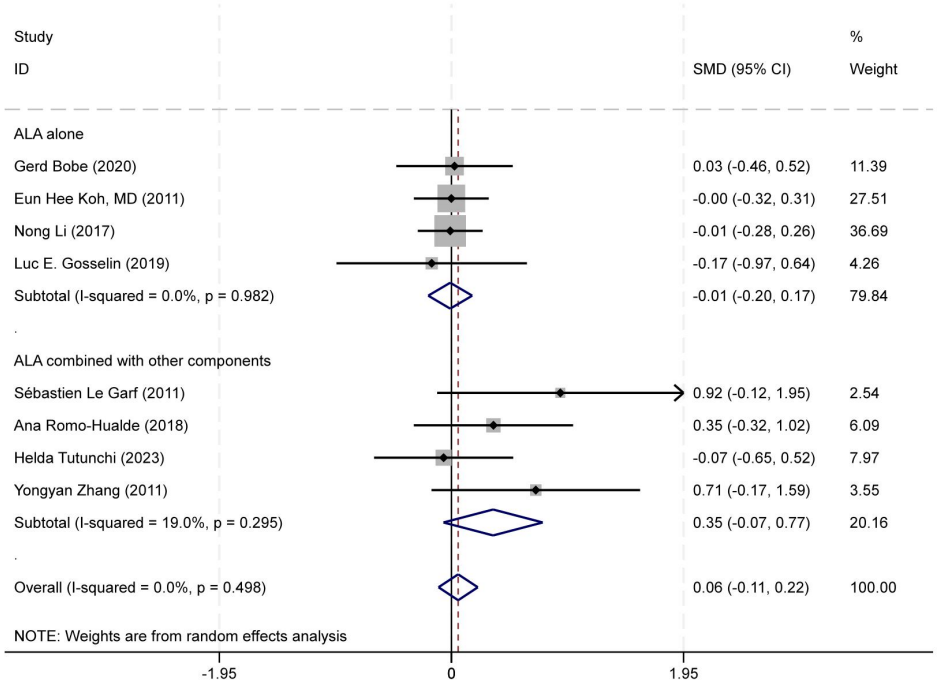

Fig. S30 Subgroup Analysis: Effect of ALA on TG (ALA alone versus ALA combined with other components)Displayed values are Standardized mean and 95% CIs.

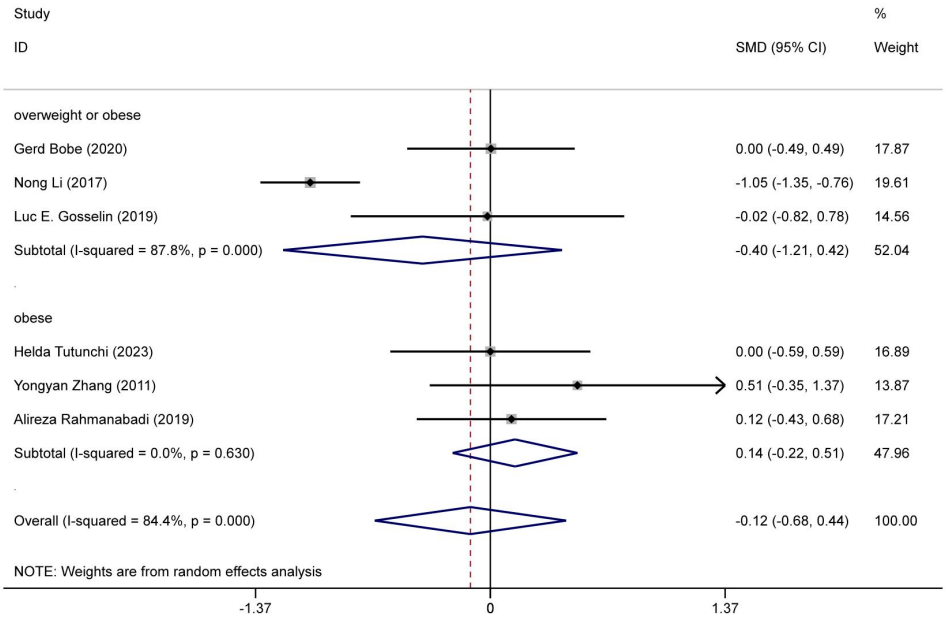

Fig. S31 Subgroup Analysis: Effect of ALA on TC (Overweight Or Obese versus Obese). Displayed values are Standardized mean and 95% CIs.

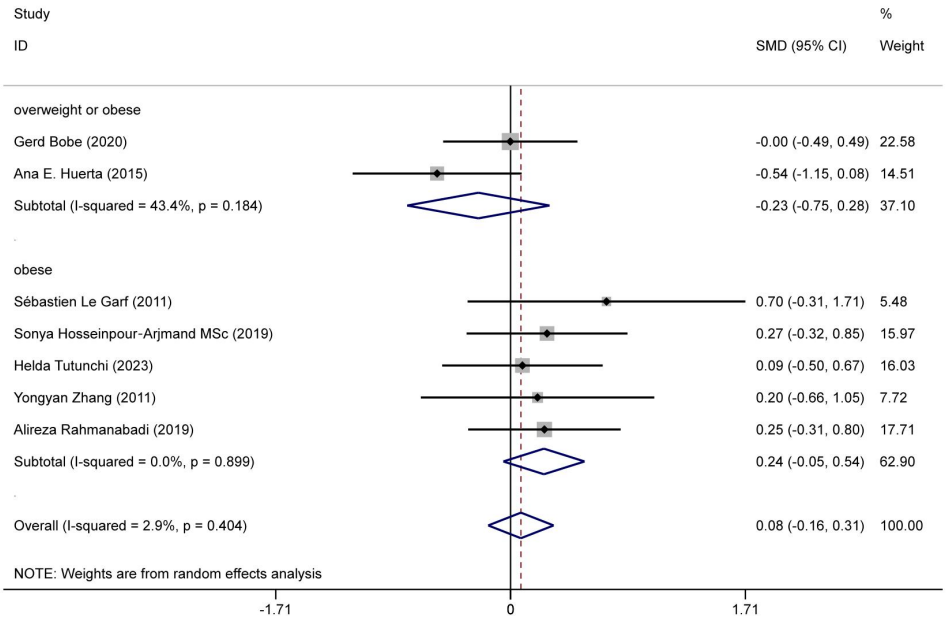

Fig. S32 Subgroup Analysis: Effect of ALA on FBS (Overweight Or Obese versus Obese). Displayed values are Standardized mean and 95% CIs.

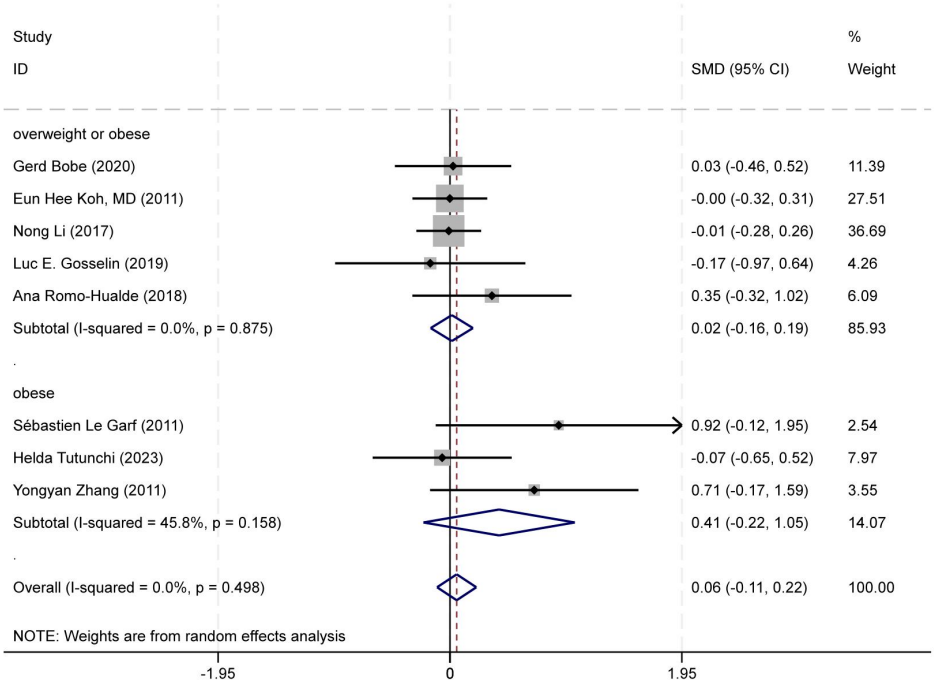

Fig. S33 Subgroup Analysis: Effect of ALA on TG (Overweight Or Obese versus Obese). Displayed values are Standardized mean and 95% CIs.

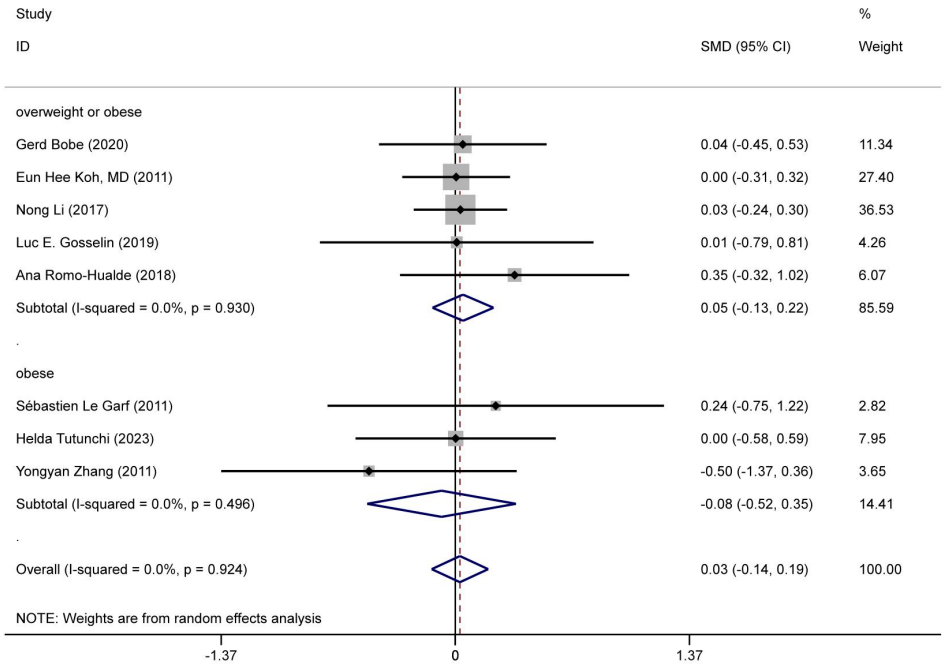

Fig. S34 Subgroup Analysis: Effect of ALA on HDL (Overweight Or Obese versus Obese). Displayed values are Standardized mean and 95% CIs.

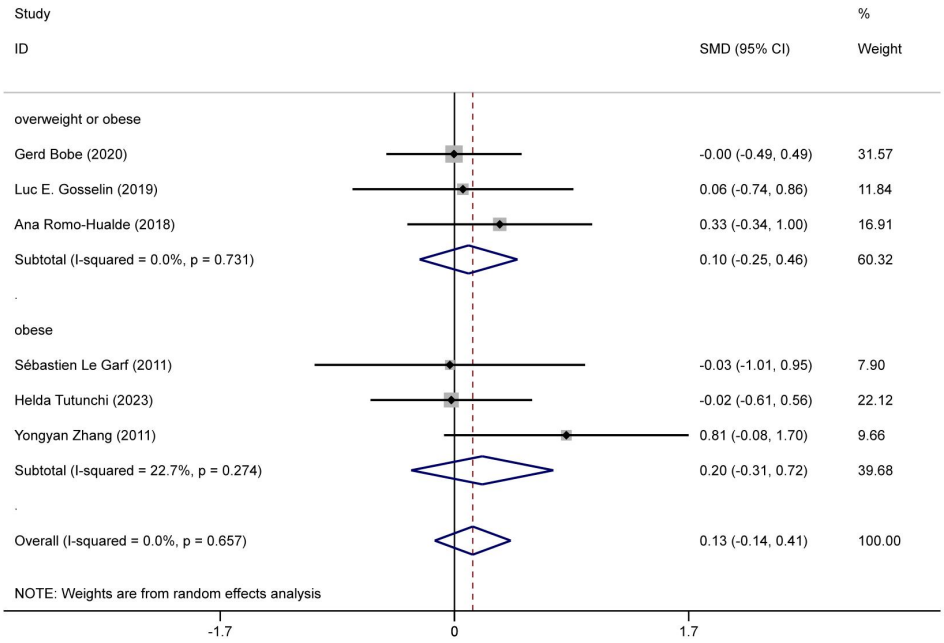

Fig. S35 Subgroup Analysis: Effect of ALA on LDL (Overweight Or Obese versus Obese).

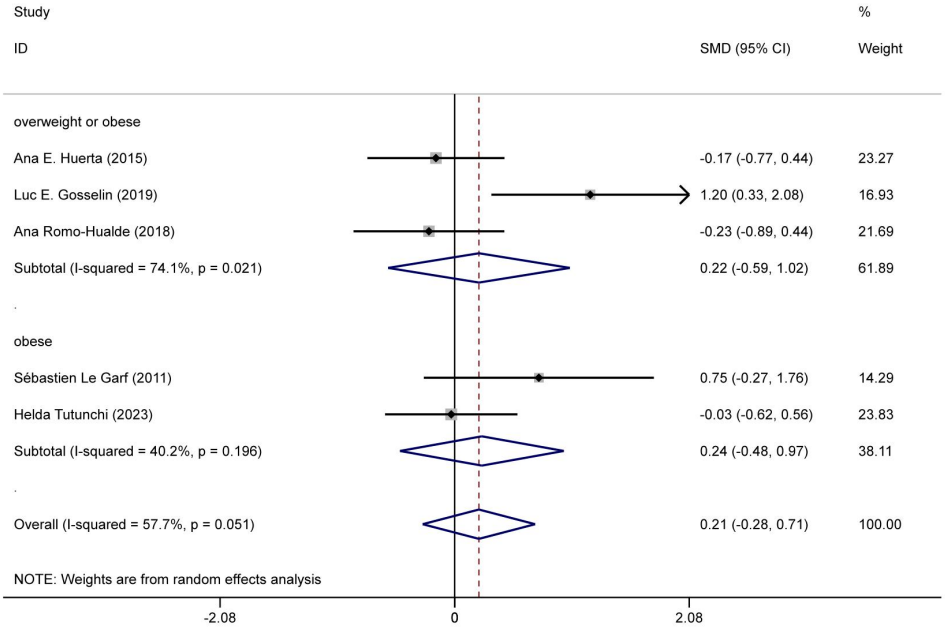

Fig. S36 Subgroup Analysis: Effect of ALA on HOMA_IR (Overweight Or Obese versus Obese). Displayed values are Standardized mean and 95% CIs.