Supplementary Table S1. Characteristics of tomato-based interventions and lycopene exposure in interventional human clinical studies

Study	Type supplementation	Quantity[1]	Lycopene content	Lycopene intake	Duration
Pourahmadi Z. et al., 2015	Tomato juice (Takdaneh, Iran)	330	181.8	60	2.9
Upritchard J.E. et al., 2000	Tomato juice (Campbell's, Australia)	500	*NS*	*NS*	4
Tomato juice (mean ± SD)		**415.0 ± 120.2 mL/d**	**181.8 mg/L**	**60.0 mg LYC/d**	**3.5 ± 0.8 w**
Chen C-Y. & Chien Y-W., 2024	Raw tomato	200	55	11	8
Yang T.H. et al., 2020	Raw beefsteak tomato	250	*NS*	*NS*	8
Cuevas-Ramos D. et al., 2013	Raw tomato (Roma variety)	300	*NS*	*NS*	4
Fresh raw tomato (mean ± SD)		**250.0 ± 50.0 g/d**	**55.0 mg/kg**	**11.0 mg LYC/d**	**6.7 ± 2.3 w**
Ried K. et al., 2009	Tomato extract (Lyc-o-Mato®, LycoRed, Israel)	1 capsule	15 mg LYC/capsule	15	8
Thies F. et al., 2012	Tomato extract (Holland and Barret)	1 capsule	10 mg LYC/capsule	10	12
Engelhard Y.N. et al., 2005	Tomato extract (Lyc-o-Mato®, LycoRed, Israel)	1 capsule	15 mg LYC/capsule	15	8
Yu Y. et al., 2024	Tomato extract (Fruitflow®, DSM, China)	1 capsule	0 mg LYC/capsule	0	6.4
Tomato extract (mean ± SD)		**1 capsule/d**	**10.0 ± 7.1 mg/capsule**	**10.0 ± 7.1 mg LYC/d**	**8.6 ± 2.4 w**
Thies F. et al., 2012	Tomato products (tomato sauces, soups, juices, ketchup, etc.)	*NS*	*NS*	*NS*	12
Park E. et al., 2012	Tomato products (tomato juice and tomato sauce)	≥ 1 serving/d	*NS*	20.6	13
Combinaison of tomato-based products (mean ± SD)		**≥ 1 servings/d**	***NS***	**20.6 mg LYC/d**	**12.5 ± 0.7 w**
López-Yerena A. et al., 2023	**Sofrito (mean ± SD)**	**100 g/d**	**215.6 mg/kg**	**21.6 mg LYC/d**	**6 w**

[1] When quantities were not explicitly reported in the original articles, mean intake values were used.

Supplementary Table S2. Sensitivity analysis of pooled effect estimates from randomized controlled trials to the assumed pre–post correlation coefficient (r).

Outcome	N of studies	*P*-values			Interpretation
		r = 0.25	r = 0.50	r = 0.75	
BW (kg)	7	0.32	0.31	0.29	Robust (NS)
BMI (kg/m2)	8	0.98	0.96	0.90	Robust (NS)
BFM (%)	3	0.81	0.83	0.89	Robust (NS)
BFM (kg)	3	0.37	0.37	0.37	Robust (NS)
HC (cm)	3	0.64	0.64	0.63	Robust (NS)
WC (cm)	5	0.04	0.04	0.04	Robust (NS)
WHR	4	0.70	0.63	0.48	Robust (NS)
SBP (mmHg)	8	0.15	0.12	0.09	Robust (NS)
DBP (mmHg)	8	0.85	0.93	0.99	Robust (NS)
TG (mg/dL)	7	0.95	0.97	0.79	Robust (NS)
TC (mg/dL)	8	0.50	0.46	0.44	Robust (NS)
LDL-C (mg/dL)	8	0.85	0.91	0.94	Robust (NS)
HDL-C (mg/dL)	7	0.15	0.14	0.16	Robust (NS)
ApoA-I (mg/dL)	3	0.83	0.79	0.73	Robust (NS)
ApoB-100 (mg/dL)	3	0.28	0.18	0.06	Robust (NS)
FBG (mg/dL)	5	0.60	0.51	0.34	Robust (NS)
Insulin (µU/mL)	3	0.71	0.65	0.59	Robust (NS)
QUICKI	3	0.27	0.28	0.28	Robust (NS)
CRP (mg/dL)	3	0.41	0.32	0.23	Robust (NS)
IL-6 (pg/L)	2	0.53	0.44	0.28	Robust (NS)
Ox-LDL (mmol/L)	2	0.96	0.95	0.93	Robust (NS)
Creatinine (mg/dL)	2	0.25	0.23	0.18	Robust (NS)
Urea (mg/dL)	2	0.81	0.78	0.69	Robust (NS)
Uric acid (mg/dL)	2	0.36	0.36	0.38	Robust (NS)

ALT, Alanine aminotransferase; **Apo**, Apolipoprotein; **AST**, Aspartate aminotransferase; **BFM**, Body fat mass; **BMI**, Body mass index; **BW**, Body weight; **CRP**, C reactive protein; **DBP**, Diastolic blood pressure; **FBG**, Fasting blood glucose; **HbA1C**, Glycated hemoglobin, **HC**, Hip circumference; **HOMA-IR**, Homeostatic model assessment for insulin resistance; **HDL-C**, High-density lipoprotein cholesterol; **IL**, Interleukin; **LDL-C**, Low-density lipoprotein cholesterol; **Ox-LDL**, Oxidized low-density lipoprotein; **QUICKI**, Quantitative insulin sensitivity check index; **SBP**, Systolic blood pressure; **TC**, Total cholesterol; **TG**, Triglycerides; **WC**, Waist circumference; **WHR**, Waist-to-hip ratio.

[1] P-values for pooled effect estimates from randomized controlled trials obtained under different assumptions for the pre–post correlation coefficient (r = 0.25, 0.50, and 0.75).

[2] Outcomes were considered sensitive to r when statistical significance varied across *p*-values of r values; otherwise, results were considered robust.

Supplementary Table S3: Meta-regression analyses of study-level moderators for the meta-analysis.

Moderator	Outcome[1]	Number of studies[2]	Effect estimate[3]	P-value[4]
Mean baseline of BMI	BMI (kg/m^2)	8	0.054 [-0.025 ; 0.133]	0.17
	BW (kg)	7	0.266 [-0.396 ; 0.927]	0.43
	DBP (mmHg)	8	0.645 [-0.260 ; 1.551]	0.16
	SBP (mmHg)	8	0.377 [-1.436 ; 2.190]	0.68
	TG (mg/dL)	7	5.936 [-0.217 ; 12.089]	0.06
	TC (mg/dL)	8	1.760 [-1.437 ; 4.956]	0.28
	LDL-C (mg/dL)	8	-0.348 [-2.14 ; 1.444]	0.70
	HDL-C (mg/dL)	7	0.015 [-1.501 ; 1.531]	0.98
Type of supplementation	BMI (kg/m^2)	8	1.77 (3)	0.62
	BW (kg)	7	0.93 (4)	0.92
	SBP (mmHg)	8	9.47 (3)	**0.02**
	DBP (mmHg)	8	8.62 (3)	**0.03**
	TG (mg/dL)	7	0.77 (3)	0.85
	TC (mg/dL)	8	0.63 (3)	0.89
	LDL-C (mg/dL)	8	1.44 (3)	0.69
	HDL-C (mg/dL)	7	4.81 (3)	0.18

BMI, Body mass index; **BW**, Body weight; **DBP**, Diastolic blood pressure; **HDL-C**, High-density lipoprotein cholesterol; **LDL-C**, Low-density lipoprotein cholesterol; **SBP**, Systolic blood pressure; **TC**, Total cholesterol; **TG**, Triglycerides.

[1] Random-effects models were primarily estimated using restricted maximum likelihood (REML).

[2] Meta-regression analyses were conducted only for outcomes with at least 7 studies available. For some outcomes, certain moderator analyses could not be performed due to insufficient or missing study-level information.

[3] For continuous moderator, effect estimates are reported as regression coefficients with 95% confidence intervals (β [95% CI]). For categorical moderator, results are summarized using the omnibus QM statistic with corresponding degrees of freedom (QM (df)), which quantifies the overall contrast in effect estimates across groups.

[4] For continuous moderators, p-values correspond to Wald tests of the regression coefficient (β), whereas for categorical moderators p-values are derived from the omnibus test of moderators (QM).

Supplementary Table S4. Epidemiological observational studies assessing the relationship between tomato and tomato-based products consumption and anthropometric outcomes and cardiometabolic risk factors.

Study	Country	Cohort	Participants and subgroup	Exposure assesment	Main results
Sesso et al., 2012 [104]	United States	Women's Health Study (WHS) cohort	**27 261 ♀** Female health professionals, ≥45 years, free of CVD and cancer at baseline, postmenopausal or not intending pregnancy • Low consumption tomato (1.5-4servings/w) (average BMI 25.9 kg/m²): 14 218 ♀ • Moderate consumption tomato (4-7servings/w) (average BMI 26.0 kg/m²): 11 377 ♀ • High consumption tomato (7-10servings/w) (average BMI 26.1 kg/m²): 4 589 ♀ • Very high consumption tomato (≥10servings/w) (average BMI 26.1 kg/m²): 1 719 ♀	Tomato consumption assessed using a **FFQ**	**Anthropometry parameters:** BMI, hypertension, hypercholesterolemia, and diabetes showed a U-shaped distribution across intake categories **Other parameters:** ↓ TC levels (-0.13 mmol/L between ≥ 10 vs <1.5 servings /week) ↓ TC/HDL-C ratio (-0.14 between ≥ 10 vs <1.5 servings /week) ↓ HbA1c (-0.11% between ≥ 10 vs <1.5 servings /week) *NS in TG, LDL-C, HDL-C, fibrinogen, CRP and ICAM-1 levels* ↑ Tomato intake associated with ↑ Physical activity, intakes of fruits /vegetables, fiber, vitamin C and lycopene ↓ Age, smoking rates
Mazidi et al. 2019 and Mazidi M. et al., 2020 [105,106]	United States	National Health and Nutrition Examination Surveys (NHANES)	**23,935 adults (11 1680 ♂, 12 255 ♀)** Mean age 47.6 years, 3 403 deaths during 76.4 months follow-up • Low consumption tomato (0.02 cups/d) (average BMI 27.9 kg/m²): 7 869 (3 651 ♂, 4 218 ♀) • Moderate consumption tomato (0.03 cups/d) (average BMI 28.4 kg/m²): 7 991 (3 668 ♂, 4 323 ♀) • High consumption tomato (1.8 cups/d) (average BMI 28.3 kg/m²): 8 075 (4 280 ♂, 3 795 ♀)	Tomato intake assessed via **24-h dietary recalls** using the USDA Automated Multiple-Pass Method (AMPM)	**Anthropometry parameters:** *NS in BMI, WC, abdominal visceral adipose tissue* **Other parameters:** ***Cardio-metabolic parameters (ANCOVA):*** ↓ SBP and DBP (SBP: 124.1 → 120.6 mmHg across tomato intake categories) ↑ HDL-C (51.6 → 53.6 mg/dL across tomato intake categories) ↓ FBG and insulin levels (with higher tomato intake) ***Mortality outcomes (Cox regression):*** ↑ Tomato intake associated with ↓ Total mortality (RR=0.86, 95% CI 0.81;0.92) ↓ CHD mortality (RR=0.76, 95% CI 0.70;0.85) ↓ Stroke mortality (RR=0.70, 95% CI 0.62;0.81) ↓ Cancer mortality (HR=0.68, 95% CI 0.60;0.79) *NS in TG levels*
Madlala H.P. et al., 2021 [107]	South Africa	Prospective cohort of pregnant women	**989 ♀** Pregnant women, median age 29 years, median BMI 29 kg/m² • HIV: 479 ♀ • Without HIV: 510 ♀	Dietary intake assessed at first visit using a 30-item **FFQ**	**Anthropometric parameters:** ***In women with HIV:*** ↑ Tomato consumption (raw/cooked, 4–7 days/week) associated with ↓ Overweight/obesity (aOR=0.50, 95% CI 0.30;0.84) ↓ Excessive gestional weight gain (aOR=0.48, 95% CI 0.24;0.96)
Popiolek-	Poland	Europid	**89 adults (37 ♂, 55 ♀)**	Flavonols	**Anthropometric parameters:**

Kalisz J., 2023 [108]		adults, ambulatory	Non-smokers, mean age 45.8 years, mean BMI 25.34 kg/m² • With MetS: 32 (17 ♂, 15 ♀) • Without MetS: 57 (sex NS)	intake assessed using a dedicated **FFQ (140 flavonol sources)**	Participants without MetS ate significantly more tomatoes (0.94 ± 0.76 portions/d) than those with MetS (0.58 ± 0.72 portions/d) ↑ Tomato consumption correlated with ↓ Number of MetS criteria fulfilled (R=-0.30, 95% CI -0.483; -0.103) ↓ MetS advancement in overweight subgroup (R=-0.47, 95% CI -0.712; -0.122) **Other parameters:** ***In overweight subgroup:*** ↑ Tomato consumption correlated with ↓ TC (R=-0.68, 95% CI -0.897; -0.214) ↓ TG (R=-0.64, 95% CI -0.882; -0.144) ↓ LDL-C (R=-0.58, 95% CI -0.858; -0.047)

aOR: Adjusted odds ratio, **BMI**: Body mass index, **CHD**: Coronary heart disease, **CVD**: Cardiovascular disease, **DBP**: Diastolic blood pressure, **FBG**: Fasting blood glucose, **FFQ**: Food frequency questionnaire, **HDL-C**: High-density lipoprotein cholesterol, **HbA1c**: Glycated hemoglobin, **HIV**: Human immunodeficiency virus, **HR**: Hazard ratio, **LDL-C**: Low-density lipoprotein cholesterol**, MetS**: Metabolic syndrome, **RR**: Risk ratio, **SBP**: Systolic blood pressure, **TC**: Total cholesterol, **TG**: Triglycerides.

Supplementary Table S5. Preclinical studies investigating the impact of tomato and tomato-derived products on metabolic dysfunction parameters associated with obesity

Study	Animals	N per group and sex	Control group regimen	Period[2]	Type of supplementation	Dosage	Main results[3]
Brenière T. et al., 2024 [65]	**Mice** C57BL/6	**10 ♂**	**HFD** (45% kcal fat)	**12 w**	**Tomato powder** (Freeze-dried process; France) **from 4 genotypes (*H1311, M82, IL6-2, IL12-4*)**	**5% (w/w)** *(223.0, 165.5, 93.2 and 104.7µg LYC intake/d)* into diet	**Morphometric parameters:** ↓ BW gain (-30.7% for *IL6-2*) ↓ Relative weight of retroperitoneal and sWAT (-38.6, -44.3g for *IL6-2*) ↓ Adiposity index (-33.0% for *IL6-2*) *No significant changes in BW gain and liver and eWAT weight* **Other parameters:** ↓ Glucose, insulin plasma, HOMA-IR (-31mg/dL, -0.04ng/mL, -2.3 for *IL6-2*) ↑ Glucose tolerance (glucose AUC after OGTT) (for *M82* and *IL6-2*) ↓ Liver lipids fraction (for -27.6, -34.0 and -34.0% for *M82*, *IL6-2* and *IL12-4*) ↓ Inflammation WAT (*Lep*, *Fabp5*, *Saa3* mRNA for all forms) *No significant changes in TG and NEFA plasma*
Das D. et al., 2024 [114]	**Rats** Wistar albino	**6 (3 ♂, 3 ♀)**	**HFD** (65% kcal fat)	**16 w**	**Standardized aqueous extract** (Fruitflow®; Provexis, UK)	**150mg/kg BW/d** *(LYC free)* into drinking water	**Morphometric parameters:** ↓ BW (in females) *NS in water and food intake* **Other parameters:** ↓ TG and VLDL-C serum ↓ TBARS and ICAM-1 levels and von Willebrand factor (vWF) activity in heart *NS in TC, HDL-C, LDL-C, ApoA-1, ApoB, LDH, AST, ALT, CR, CK-MB, leptin serum, TNF-a, total ROS levels, SOD and CAT activity in heart*
Di Majo D. et al., 2024 [66]	**Rats** Wistar	**8 ♂**	**HFD** (60% kcal fat)	**5 w** (after 8w HFD)	**Tomato juice** of ***Golden tomato*** (Hot break process and pasteurized)	**2mL/kg BW/d** *(LYC NS)* by gavage	**Morphometric parameters:** ↓ BW (-10%) ↑ Food intake **Other parameters:** ↓ TG, TC and LDL-C plasma ↑ HDL-C plasma ↑ Glucose tolerance (↓ AUC glucose after OGTT) ↓ Leptin plasma ↓ Steatosis (-38%) ↑ β-oxydation in liver (+47% *Ppara* mRNA) ↓ Oxidative stress in liver (↓ MDA and RONS levels) and plasma (↓ dROMs and LP-CHOLOX levels and ↑ Thiols (SHp) and BAP (antioxidant capacity))
Luis	**Rats**	**18 ♂**	**HFD**	**3 m**	**Tomato extract**	**Equivalent to**	**Morphometric parameters:**

Heriberto V.M. et al., 2024 [67]	Wistar		(50% kcal fat) **+ 30% sucrose** in drinking water	(after 3m HFD)	of **tomato powder** (Lipid extract; Saladette tomato variety), **mixed with corn oil (60% w/v)**	**5mg LYC/kg BW/d** by gavage	↓ Gonadal adipose tissue weight (-2.95g) ↑ Testicular weight (+0.51g) *NS in BW, food and water intake and retroperitoneal and visceral WAT* **Other parameters:** ↓ TC serum (-10%) ↓ Oxidative stress (MDA and NO_2^- in testicles and spermatozoa) *NS in TG and glucose serum*
Gambino G. et al., 2023 [68]	**Rats** Wistar	**6 ♂**	**HFD** (60% kcal fat)	**4 w** (after 8w HFD)	**Tomato powder** of ***Golden Tomato*** (From veraison stage) **dissolved in water (1:20)**	**200mg/kg BW/d** *(3 333.0mg LYC/kg tomato powder)* by gavage	**Morphometric parameters:** ↓ BW gain (-11.6g) **Other parameters:** ↑ TC plasma and HDL-C (+38.2 and +26.8mg/dL) ↓ LDL-C plasma (-4.1mg/dL) ↓ Glucose plasma AUC and 120min after OGTT ↓ Hepatic steatosis ↓ Oxidative stress in liver (↓MDA and RONS levels and ↑ GSH/GSSG ratio) *NS in TG plasma*
Kayode O.T. et al., 2023 [69]	***Drosophila melanogaster*** Harwich	**50 ♂**	**HFD /HSD** (kcal fat NS)	**5 d** (after 10 d of HFD /HSD)	**Tomato powder**	**20% (w/v)** *(LYC NS)* into diet	**Morphometric parameters:** ↓ BW **Other parameters:** ↑ HDL-C levels ↓ LDL-C levels ↓ Oxidative stress (↓ MAD and NO levels and ↑ CAT activity) *NS in TG and TC levels and atherogenic index*
Pipitone M. et al., 2023 [70]	**Rats** Wistar	**5 ♂**	**HFD** (60% kcal fat)	**4 w** (after 8w HFD)	**Tomato powder** of ***Red*** **(*R*)** (High in carotenoids) or ***Golden tomato*** **(*G*)** (High in polyphenols) (Freeze-dried process) **dissolved in water (1:1)**	**200mg/kg BW/d** *(3 330mg and 19 710mg LYC/kg* [68]*)* by gavage	**Morphometric parameters:** ↓ BW gain at 4 and 5 weeks (*R* and *G*) **Other parameters:** ↓ TG plasma (-40.0 and -26.6mg/dL for *R* and *G*) ↑ TC plasma (+16.9mg/dL for *G*) ↓ LDL-C plasma (-14.8 and -18.2mg/dL for *R* and *G*) ↑ HDL-C plasma (+23.1 and +40.4mg/dL for *R* and *G*) ↓ Glucose plasma (-42.3mg/dL for *G*) and HOMA-IR (for *R* and *G*) ↓ Hepatic steatosis (Macrovesicular → Microvesicular, for *R* and *G*) ↑ Metabolic/Inflammatory genes in liver (*Gk*, *Hnf4a*, *Lepr*, *Il6*, *Tnfa* mRNA for *R* and *G*)
Ferron, A.J.T. et al., 2019 and 2020 [72,73]	**Rats** Wistar	**10 ♂**	**HSD** (27.8 % kcal fat with 8% sucrose) **+25% sucrose** in drinking water	**10 w** (after 20w HSF)	**Standardized tomato extract** (Lyc-O-Mato® 6% dewaxed; Lipid extract; LycoRed Natural Products Industries, Israel)	**Equivalent to 10mg/kg BW/d of LYC** by gavage	**Morphometric parameters:** *NS in BW and adiposity index* **Other parameters:** ↓ HOMA-IR ↓ Inflammation heart (↓*Tnfa*, *Il6, Mcp1* mRNA) Improvement cardiac function (↓ Remodeling; ↑ Systolic/Diastolic function and calcium handling)

					mixed with maize oil		↓ Oxidative stress markers plasma and heart (CML, AOPP, MDA levels) *NS in glucose levels and BP*
Jesuz V.A. et al., 2019 [119]	**Rats** Wistar	**10 ♀**	**WD** (36% kcal fat estimated)	**60 d**	**Tomato sauce** (Local market, Brazil) **in acqueous solution with 20% of refined sugar**	**Equivalent to 2mg LYC/d** *(LYC NS)* into liquid diet or by gavage	**Morphometric parameters:** ↑ Heart weight (+0.16g) *NS in BW and liver and heart weight* **Other parameters:** ↑ TC serum (+15mg/dL) ↓ Glucose serum (-15.5mg/dL) ↓ Inflammation serum (IL-1β) *NS in TG, LDL-C, HDL-C, AST, ALT and TNF-a levels in serum*
Róvero Costa M. et al., 2019 [75]	**Rats** Wistar	**6 ♂**	**HSF** (34% kcal fat with 8% sucrose) **+ 25% sucrose** in drinking water	**10 w** (after 20w HFD)	**Standardized tomato extract** (Lyc-O-Mato® 6% dewaxed; Lipid extract; LycoRed Natural Products Industries, Israel) **mixed with corn oil**	**Equivalent to 10mg LYC/kg BW/d** by gavage	**Morphometric parameters:** *NS in BW, BW gain and adiposity index* **Other parameters:** ↓ TG plasma (-19.1mg/dL) ↑ TC and HDL-C plasma (+14.8 and +9.1mg/dL) ↓ Inflammation (TNF-α levels in liver) ↓ Microvesicular steatosis ↓ Oxidative stress in liver (↓MDA and ↑ CAT, SOD and antioxidant capacity) *NS in TG, non HDL-C, glucose, AST, ALT, creatinine, urea, uric acid, albumin, total proteins plasma and IL-6 levels in liver*
Elvira-Torales L.I. et al., 2018 [76]	**Rats** Sprague-Dawley	**6 ♂**	**HFD/HCD** (43% kcal fat with 1.25 % cholesterol)	**5 w**	**Tomato juice** (Juver Alimentación, Spain)	**Ad libitum** (average intake of **78.8mL/d**) *(120mg LYC /L tomato juice equiv. to 9.46mg LYC/d)* as a substitute for water	**Morphometric parameters:** *NS in BW, BW gain and liver weight* **Other parameters:** ↑ Excreted urine (+18.1mL/day) ↑ Cholesterol transport and metabolism gene in liver (*Nr1h4* mRNA) *NS in TG, TC, LDL-C, HDL-C, VLDL-C, glucose, AST, ALT plasma, urinary isoprostanes, MDA and lipid metabolism genes liver*
Li C-C. et al., 2018 [77]	**Mice** BCO1$^{-/-}$ BCO2$^{-/-}$ double KO	**9 ♂**	**HFD** (60% kcal fat)	**24 w**	**Tomato powder** (Kagome, Japan)	**4.19% (w/w)** *(2 388mg LYC /kg tomato powder, equiv. to 100.1mg LYC/kg diet)* into diet	**Morphometric parameters:** *NS in BW, BW gain and liver, visceral WAT weight* **Other parameters:** ↓ TG in liver and steatosis score (-1 hepatic steatosis score grade) ↑ β-oxidation genes liver (*Cpt1*, *Acox1*, *Ppara* mRNA, APMK phosphorylation) ↓ Lipogenesis (↓ *Dgat1* mRNA, ↑ ACC phosphorylation, FoxO1 acetylation and *Adipor2* mRNA) and FA-transport in liver (*Cd36* mRNA) ↑ Anti-inflammatory WAT and liver (*Adipoq*, *Il10*, *Pparr* and *Nampt* mRNA) ↓ Pro-inflammatory genes in WAT and liver (*Tnfa*, *Il1b*, *Il6* mRNA) ↑ Richess of intestinal microbiome (OTUs and ACE)
Mohri S. et al., 2018	**Mice** C57BL/6	**8-10 ♂**	**HFD** (60% kcal fat)	**10 w**	**Tomato extract** (From freeze-	**1% (w/w)** *(LYC NS)*	**Morphometric parameters:** *No significant changes in BW, and WAT, BAT, liver and kidney weight*

[78]					dried powder; Ethanol extract)	into diet	**Other parameters:** ↓ TG plasma ↓ Glucose plasma ↓ Inflammation WAT (*Nos2* mRNA) *No significant changes in NEFA plasma levels and Mcp1 mRNA in WAT*
Fenni S. et al., 2017 [18]	**Mice** C57BL/6	**10 ♂**	**HFD** (45% kcal fat)	**12 w**	**Tomato powder** (Spray-drying process; Tomato 404, Naturex, France)	**5% (w/w)** *(214mg LYC/kg diet)* into diet	**Morphometric parameters:** ↓ Adiposity index (-34%) and relative weight of eWAT *No significant changes in BW, and liver and perirenal WAT weight* **Other parameters:** ↓ TG plasma (-9.8ng/dL) ↓ Glucose and insulin plasma and HOMA-IR (-21.1mg/dL, -0.08ng/mL and -2) ↓ Inflammation liver (↓ *Mcp1* mRNA) and WAT (↓ *Il6*, *Mcp1*, *Ccl5*, *Cxcl10*, *Mmp3*, *Mmp9*, *Hp*, *Retn* mRNA and activation NF-κB; ↑ *Il-10, TGFβ* mRNA) ↓ Oxidative stress plasma (-98pg/mL 8-iso-PGF2α) ↓ Lipogenesis liver (*Acaca*, *Fasn*, *Srebp1* mRNA) and in WAT *(Acaca*, *Pparg*, *Cd36*, *aP2, Lpl* mRNA) ↑ β-oxydation genes in liver (*Cpt1*, *Acox*, *Ppara* mRNA) ↓ Number of lipid droplet in liver (Hepatic steatosis from grade 2 to 1) ↓ Number of adipocyte (Adipocyte hypertrophy) *No significant changes in TC, NEFA plasma*
García-Alonso F.J., et al., 2017 [82]	**Rats** Sprague-Dawley	**6 ♂**	**HFD/HCD** (43% kcal fat with 1.25 % cholesterol)	**5 w**	**Tomato juice** (Juver Alimentación, Spain)	**Ad libitum drinking** (average intake of **29.0mL/d**) *(101mg LYC /kg tomato juice equiv. to 2.9mg LYC intake/d)* as a substitute for water	**Morphometric parameters:** *NS in BW, BW gain and liver weight* **Other parameters:** ↑ Lactobacillus species in intestinal microbiota (+11%) ↓ Acetate SCFAs in large intestin (-18%) ↓ Acetate/Propionate ratio (-17%) ↑ Caproate, isobutyrate, valeronate and isovaleronate SCFAs in large intestin *NS in AST, ALT plasma*
Zidani S. et al., 2017 [86]	**Mice** BALB/c	**10 ♂**	**WD/HCD** (34% kcal fat estimated with 1.2 % cholesterol)	**12 w**	**Tomato powder** of **tomato peel** (Freeze-dried process; Local market, Algeria)	**9% (*TP1*)** or **17% (*TP2*) (w/w)** *(46.0 and 84.0mg LYC /kg tomato powder, equiv. to ~4.14 and 14.28mg LYC /kg diet and ~0.010 and*	**Morphometric parameters:** ↓ Liver weight (-0.6g for *TP2*) ↓ Adipose tissue relative weight (-0.02g for *TP1* and *2*) *NS in BW, BW gain and liver relative weight* **Other parameters:** ↓ TG, TC and LDL-C plasma (for *TP1* and *2*) ↑ HDL-C and NEFA plasma (for *TP2*) ↓ Glucose and insulin plasma and HOMA-IR index (for *TP1* and *2*) ↑ Glucose tolerance (glucose AUC after OGTT) (for *TP1* and *2*) ↑ Insulin sensibility (glucose AUC after ITT) (for *TP1* and *2*) ↓ AST (-99.1U/L for *TP2*), ALT and ALP plasma (for *TP1* and *2*)

						0.036mg LYC intake/d, based on food intake) into diet	*NS in liver steatosis*
Aborehab N.M. et al., 2016 [83]	**Rats** Albino	**6 ♂**	**HFD** (58 % kcal fat)	**12 w** (8w HFD followed by 4w CD with tomato extract)	**Tomato extract** (Aqueous extract)	**200mg/kg BW/d (*T2*)** or **400 mg/kg BW/d (*T4*)** *(LYC NS)* into diet	**Morphometric parameters:** ↓ BW gain (-49.9 and -54.4g for *T2* and *T4*) ↓ Adiposity index (-1.5 and -1.8 for *T2* and *T4*) **Other parameters:** ↓ TG, TC and LDL-C serum (-65.5, -61.5 and -53.7mg/dL for *T2*, and -94.0, -84.7 and -75.0mg/dL for *T4*) ↑ HDL-C serum (+9.2 and +10.0mg/dL for *T2* and *T4*) ↓ Glucose serum (-31.0 and -69.7mg/dL for *T2* and *T4*) ↓ Insulin serum (-32.0 and -37.4mIU/mL for *T2* and *T4*) ↓ HOMA-IR (-14.4 and -16.8 for *T2* and *T4*) ↑ R-QUICKI index (+0.06 and +0.10 for *T2* and *T4*) ↓ Resistin serum (-7.1 and -9.7ng/mL for *T2* and *T4*) ↓ Leptin serum (-102.2 and -124.3pg/mL for *T2* and *T4*) ↑ Adiponectin serum (+67.7 and +103.2pg/mL for *T2* and *T4*)
Bajerska, J. et al., 2015 [84]	**Rats** Wistar	**10 ♂**	**HFD** (51.5% kcal fat)	**8 w**	**Freeze-dried** of **tomato pomace** (Agros-Nova, Poland)	**2.97% (w/w)** *(2 700mg LYC /kg diet, equiv. to ~48.87mg LYC intake/d, based on food intake)* into diet	**Morphometric parameters:** ↓ Apparent energy digestibility (-4%) ↓ Apparent fat digestibility (-4.3%) *NS in BW gain, food efficiency and visceral WAT, liver weight* **Other parameters:** *NS in TG, HDL-C, glucose, insulin and homocysteine plasma, HOMA-IR, atherogenic index of plasma, lipid, SAM and SAH liver*
Luvizotto R.A.M. et al., 2015 [90]	**Rats** Wistar	**6 ♂**	**WD** (49.7% kcal fat with 24.7% kcal SFA) **+30% sugar** in drinking water	**6 w** (after 6w HFD)	**Standardized tomato extract** (Lyc-O-Mato® 6% dewaxed; Lipid extract; LycoRed Natural Products Industries, Israel) **mixed with corn oil**	**Equivalent to 10mg/kg BW/d of LYC** by gavage	**Morphometric parameters:** *NS in BW and adiposity index* **Other parameters:** ↑ Adiponectin plasma (+3.4µg/mL) ↓ Inflammation WAT (↑ *Adipoq*, *Sirt1, Foxo1* mRNA) ↑ FA uptake eWAT (↑ *Cd36* mRNA) ↓ Adipogenesis eWAT (↓ *Pparg* mRNA)
Smith B.W. et al., 2015 [87]	**Mice** ApoE-/-	**10 ♂**	**WD** (45.8% kcal fat with 34% sucrose and 1.5% cholesterol)	**4 w**	**Tomato powder** (Drum-dried process; FutureCeuticals, USA)	**10% (w/w)** *(LYC NS)* into diet	**Morphometric parameters:** *NS in BW gain and adipose tissues weight* **Other parameters:** ↑ TC plasma ↑ Cholesterol transporter genes in liver (*Abcg5*, *Abcg8* mRNA) *No significant changes in TG, SAA plasma and lipid liver*

Pierine D.T. et al., 2014 [89]	**Rats** Wistar	**7 ♂**	**HFD** (50% kcal fat) **+ 30% sucrose** in drinking water	**6** (after 6w HFD)	**Standardized tomato extract** (Lyc-O-Mato® 6% dewaxed; Lipid extract; LycoRed Natural Products Industries, Israel) **mixed with corn oil**	**Equivalent to 10mg LYC/kg BW for 5d/w** by gavage	**Morphometric parameters:** ↓ Water intake (-8.4mL/day) *NS in BW, adiposity index and food intake* **Other parameters:** ↓ Inflammation kidney (RAGE and TNF-α levels) *NS in SBP, GFR, TC, glucose, TNF-α, RAGE plasma, glucose levels post-OGTT and oxidative stress markers in plasma, kidney and urine*
Vilahur G. et al., 2014 [88]	**Swine** Crossbred commercial	**9 ♀**	**WD** (49% kcal fat with 20% SFA and 2% cholesterol)	**10 d**	**Sofrito** (Gallina Blanca Star, Spain)	**100g/d** *(215.6mg LYC/kg sofrito equiv. to 21.56mg LYC intake/d)*	**Morphometric parameters:** *NS in BW and BW gain* **Other parameters:** ↑ Endothelial/Vascular function (Coronary vasodilatation induces by acetylcholine and calcium ionophore and eNOS expression and activation) ↓ Oxidative stress biomarkers (DNA oxidative damage in endothelial cells [8-OHdG] and lipid peroxidation [TBARS, -12.2nmol MDA])
Bernal C. et al., 2013 and Martín-Pozuelo G. et al., 2014 [91,92]	**Rats** Sprague-Dawley	**5 ♂**	**HFD/HCD** (43% kcal fat with 1.25% cholesterol)	**5 w** (after 2w HFD /HCD)	**Tomato juice** (Juver Alimentación, Spain)	**Ad libitum** (average intake of **34.1mL/d**) *(108mg LYC/kg tomato juice equiv. to 3.2mg LYC intake/d)* as a substitute for water	**Morphometric parameters:** *NS in BW* **Other parameters:** ↑ HDL-C plasma (+9.1mg/dL) ↓ Oxidative stress (-5.7ng/mg isoprostanes urine) Impairment endothelial function (↑+0.4pg/mL sICAM-1 plasma) *NS in TG, TC, LDL-C, VLDL-C, glucose, AST, ALT, IL-6, TNF-a, PON, MDA, sVCAM-1 and ORAC plasma, atherogenic index and MDA levels in liver*
Choi K-M. et al., 2013 [93]	**Mice** C57BL/6	**10 ♂**	**HFD/HCD** (45.4% kcal fat with 0.5% cholesterol)	**13 w** (after 4w HFD)	**Tomato extract** of ***Red*** **(*R*)** (High carotenoids) or ***Green tomato*** **(*G*)** (High glycoalkaloids) (Aqueous extract)	**2% (w/w)** *(LYC NS)* into diet	**Morphometric parameters:** ↓ BW, BW gain and eWAT weight (-4.2g, -22.5% and -27.5% for *G*) *NS in brain, kidney, lung ang liver weight* **Other parameters:** ↓ TC in liver (-114.3mg/dL for *GTE*) ↓ Lipogenesis in liver (↑ p-AMPK, p-ACC and ↓ *Hmgcr* mRNA for *G*) ↓ Adipogenesis in WAT (↓ *Pparg*, *Cebpa* and *Plin* mRNA for *R* and *G*) *NS in lipid profile serum, TG levels in liver*
Choi S-K. and Seo J-S., 2013 [94]	**Gerbils** Mongolian	**10 ♂**	**HFD** (45% kcal fat)	**6 w**	**Standardized tomato extract** (Lyc-O-Mato Beads®; Lipid extract; LycoRed Natural Products Industries, Israel)	**0.5 g/kg diet /d** *(50mg LYC/kg bead, equiv. to 25mg LYC/kg diet)* into diet	**Morphometric parameters:** ↓ Mesenteric WAT weight (-0.5g) *NS in eWAT weight* **Other parameters:** ↓ Oxidative stress in liver, erythrocytes and plasma (↓ -5.5, -2.1nmol/mg lipid peroxide liver and erythrocyte; ↑ +0.1nmol/mL total antioxidant status (TAS) plasma and +0.05U/min/mg protein GST activity in liver) *NS in other oxidative stress markers in liver and erythrocyte*

Luvizotto R.A.M. et al., 2013 [95]	**Rats** Wistar	**6 ♂**	**WD** (49.7% kcal fat with 24.7% kcal SFA) **+ 30% sugar** in drinking water	**6 w** (after 6w HFD)	**Standardized tomato extract** (Lyc-O-Mato® 6% dewaxed; Lipid extract; LycoRed Natural Products Industries, Israel) **mixed with maize oil**	**2mL/kg BW/d** *(equiv. to 10mg LYC/kg BW/d)* by gavage	**Morphometric parameters:** *NS in BW and heart weight* **Other parameters:** ↓ Inflammation in plasma (-3.1 and -2.6ng/mL for leptin and resistin and -18pg/mL for IL-6) and in eWAT (*Lep*, *Retn*, *Il6* and *Mcp1* mRNA) *NS in glucose, insulin, TNF-a plasma, Tnfa mRNA in eWAT*
Shao D. et al., 2013 [97]	**Hamsters** Golden Syrian	**8-10 ♂**	**HFD/HCD** (60% kcal fat with 1% cholesterol)	**3 w**	**Tomato powder** of **tomato pomace** (Hot-break and hot air drying processes)	**41.7% (w/w)** *(100.2mg LYC/kg tomato powder, equiv to 41.8mg LYC/kg diet and ~0.9mg LYC intake/d, based on food intake)* into diet	**Morphometric parameters:** ↑ BW gain (+8.1g) ↑ Food efficiency (BW gain/food intake) (+0.04) *NS in food intake and liver, retroperitoneal and eWAT weight* **Other parameters:** ↓ HDL-C plasma (-14%) ↓ Total lipids (-18%), TC and free cholesterol in liver (-21 and -16%) ↑ Total lipids, TG, TC and free cholesterol feces (+370, +932, +46 and +77%) ↑ Fecal bile acid excretion (+471%) *No NS in TG, TC, LDL-C, VLDL-C plasma and TG liver*
Hsu Y.M. et al., 2008 [99]	**Hamsters** Golden Syrian	**8 (sex NS)**	**HFD** (NS kcal fat with 0.2 % cholesterol)	**8 w**	**Tomato powder** of **tomato paste** (Freeze-dried process)	**3% and 9% (w/w)** *(1 087.5mg LYC/kg tomato powder, equiv. to 32.6 and 97.9mg LYC/kg diet)* into diet	**Morphometric parameters:** *NS in BW* **Other parameters:** ↓ TC and LDL-C serum (-35.5 and -9.3mg/dL for 9% dose) ↑ HDL-C serum (+14.6 and +21.6mg/dL for 3 and 9% doses) ↓ Oxidative stress in serum (↑ +190.1min lag time LDL oxidation, CAT and GSH-Px activities [for 9% dose] and ↓ TBARS [for 3 and 9% doses]) *NS in TG and HDL-C serum, SOD activity*
Suganuma H. and Inakuma T., 1999 [100]	**Mice** ICR	**10 ♂**	**HFD/HCD** (41% kcal fat estimated with 1.5% cholesterol)	**4 m**	**Tomato powder** of **concentrated tomato juice** (Freeze-dried process)	**20 % (w/w)** *(1 600mg LYC/kg tomato powder, equiv. to 320mg LYC/kg diet)* into diet	**Morphometric parameters:** *NS in BW* **Other parameters:** ↓ Oxidative stress (TBARS plasma) Improvment endothelial function (↑ Acetylcholine-induced relaxation) *NS in TC serum and aortic norepinephrine-induced vaso-contraction*

4-HNE: 4-hydroxynonenal, **8-OHdG**: 8-hydroxy-2′-deoxyguanosine, **Abcg5**: ATP-binding cassette subfamily G member 5, **Abcg8**: ATP-binding cassette subfamily G member 8, **ACC**: Acetyl-CoA carboxylase, **Acaca**: Acetyl-CoA carboxylase alpha, **Adipoq**: Adiponectin, **AOM**: Azoxymethane, **AOPP**: Advanced oxidation protein products, **ALT**: Alanine aminotransferase, **ALP**: Alkaline phosphatase, **AST**: Aspartate aminotransferase, **AUC**: Area under the curve, **BAT**: Brown adipose tissue, **BAP**: Biological antioxidant potential, **BP**:

Blood pressure, **BW**: Body weight, **CAT**: Catalase, **CD**: Chow diet, **CK-MB**: Creatine kinase–myocardial band, **CML**: Carboxymethyl-lysine, **CR**: Creatinine, **Cpt1**: Carnitine palmitoyltransferase-1, **DBP**: Diastolic blood pressure, **Dgat**: Diacylglycerol O-acyltransferase, **dROMs**: Reactive oxygen metabolites, **eWAT**: Epididymal white adipose tissue, **FA**: Fatty acids, **Fasn**: Fatty acid synthase, **FGF21**: Fibroblast growth factor 21, **Gk**: Glycerol kinase, **GSH**: Reduced glutathione, **GSH-Px**: Glutathione peroxidase, **GSSG**: Oxidized glutathione, **GST**: Glutathione S-transferase, **HCD**: High-cholesterol diet, **HFD**: High-fat diet, **HDL-C**: High-density lipoprotein cholesterol, **Hnf4a**: Hepatocyte nuclear factor 4 alpha, **HOMA-IR**: Homeostasis model assessment–insulin resistance, **HSF**: High-sucrose/fat diet, **HSD**: High-sugar diet, **ICAM-1**: Intercellular adhesion molecule-1, **IL**: Interleukin, **ITT**: Insulin tolerance test, **LDH**: Lactate dehydrogenase, **LDL-C**: Low-density lipoprotein cholesterol, **Lep**: Leptin, **LP-CHOLOX**: Lipoperoxides (lipid hydroperoxides/oxidized cholesterol products), **Lpl**: Lipoprotein lipase, **LYC**: Lycopene, **Mcp1**: Monocyte chemoattractant protein-1, **MDA**: Malondialdehyde, **Nampt**: Nicotinamide phosphoribosyltransferase, **NEFA**: Non-esterified fatty acids, **NF-κB**: Nuclear factor kappa B, **NO**: Nitric oxide, **NOx**: Nitrite/nitrate metabolites, **NOS2**: Inducible nitric oxide synthase, **NS**: Not significative, **OGTT**: Oral glucose tolerance test, **ONOO⁻**: Peroxynitrite, **ORAC**: Oxygen radical absorbance capacity, **OTUs**: Operational taxonomic units, **Pklr**: Pyruvate kinase, liver and red blood cell isoform, **PPAR**: Peroxisome proliferator-activated receptor gamma, **Ppargc**: PPAR gamma coactivator, **R-QUICKI**: Revised quantitative insulin sensitivity check index, **Retn**: Resistin, **RONS**: Reactive oxygen and nitrogen species, **ROS**: Reactive oxygen species, **SAA**: Serum amyloid A, **SAH**: S-adenosylhomocysteine, **SAM**: S-adenosylmethionine, **SBP**: Systolic blood pressure, **SCFAs**: Short-chain fatty acids, **sICAM-1**: Soluble intercellular adhesion molecule-1, **SOD**: Superoxide dismutase, **SREBP-1c**: Sterol regulatory element-binding protein-1c, **Srebf1**: Sterol regulatory element-binding transcription factor 1, **TAS**: Total antioxidant status, **TBARS**: Thiobarbituric acid reactive substances, **TC**: Total cholesterol, **TG**: Triglycerides, **TNF-α**: Tumor necrosis factor alpha, **VCAM-1**: Vascular cell adhesion molecule-1, **VLDL-C**: Very-low-density lipoprotein cholesterol, **vWAT**: Visceral white adipose tissue, **WAT**: White adipose tissue, **WD**: Western diet, **sWAT**: Subcutaneous white adipose tissue

[1] Studies derived from the same cohort but reporting different outcomes were consolidated, and both publication years are indicated.

[2] Duration is expressed as follows: **d**, days; **w**, weeks; **m**, months.

[3] The results presented reflect values that differ significantly from those of the control group; the differential values represent the magnitude of change between the intervention treatment and the control diet.

Supplementary Figure S1. Risk of bias assessment of clinicals trials in the meta-analysis (Rob2).

	D1	DS	D2	D3	D4	D5	Overall
Cross-over studies							
López-Yerena A. et al., 2023	+	+	+	+	+	+	+
Parallel studies							
Chen C-Y. and Chien Y-M., 2024	-		-	+	+	!	-
Yu Y. et al., 2024	+		!	+	+	+	!
Yang T.H. et al., 2020	-		-	+	+	!	-
Pourahmadi et al., 2015	+		+	+	+	+	+
Cuevas-Ramos D. et al., 2013	+		+	+	+	!	!
Park E. et al., 2012	+		+	+	+	+	+
Thies F. et al., 2012	!		-	+	+	!	-
Ried K. et al., 2009	+		+	+	+	+	+
Upritchard J.E. et al., 2000	+		+	+	+	+	+
Engelhard Y.N. et al., 2005	-		!	!	+	+	-

Domains

D1 : Bias arising from the randomization process

DS : Bias arising from period and carryover effects

D2 : Bias due to deviations from the intended intervention

D3 : Bias due to missing outcome data

D4 : Bias in measurement of the outcome

D5 : Bias in selection of the reported result

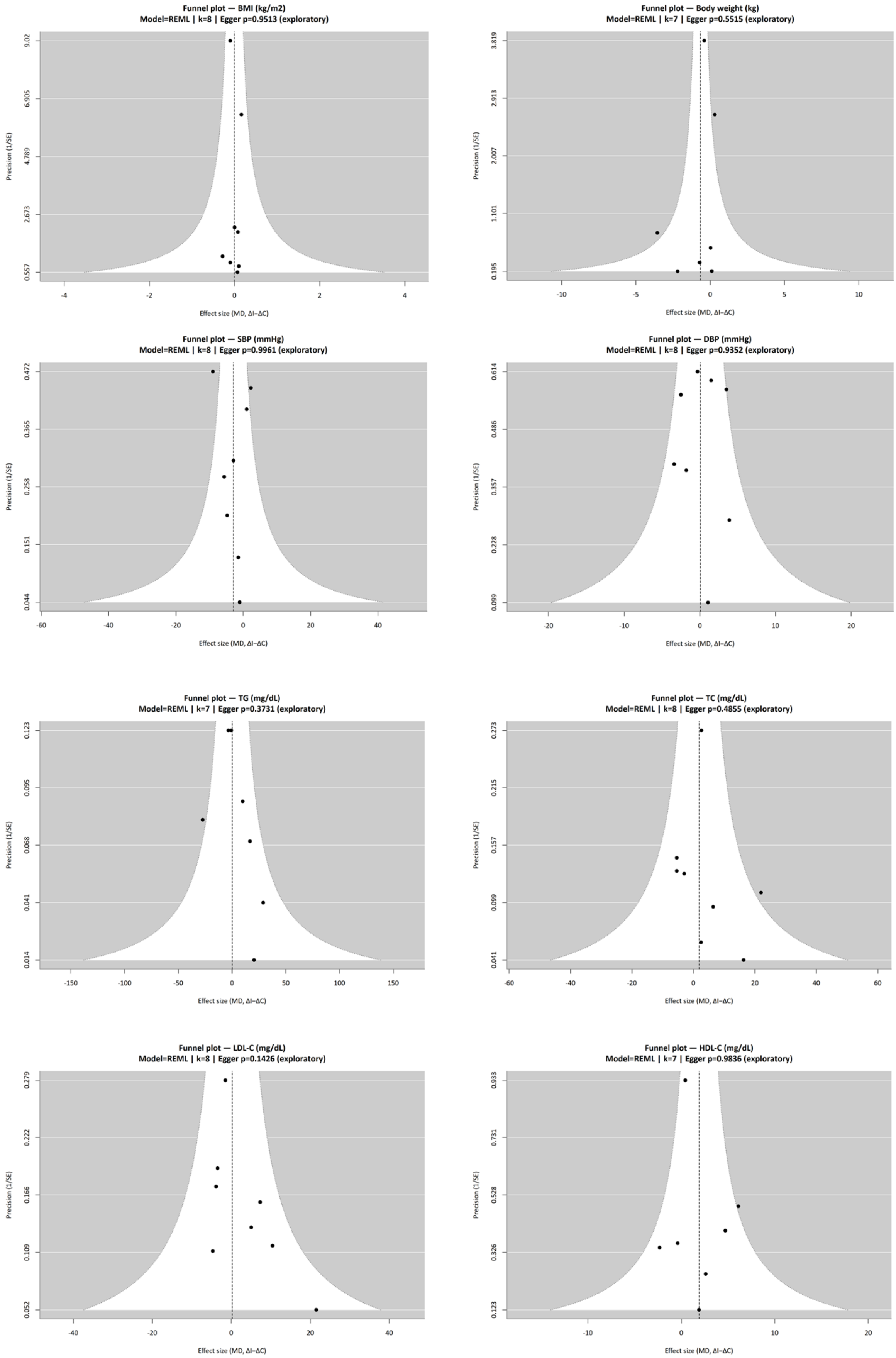
Judgment

+ Low risk

! Some concerns

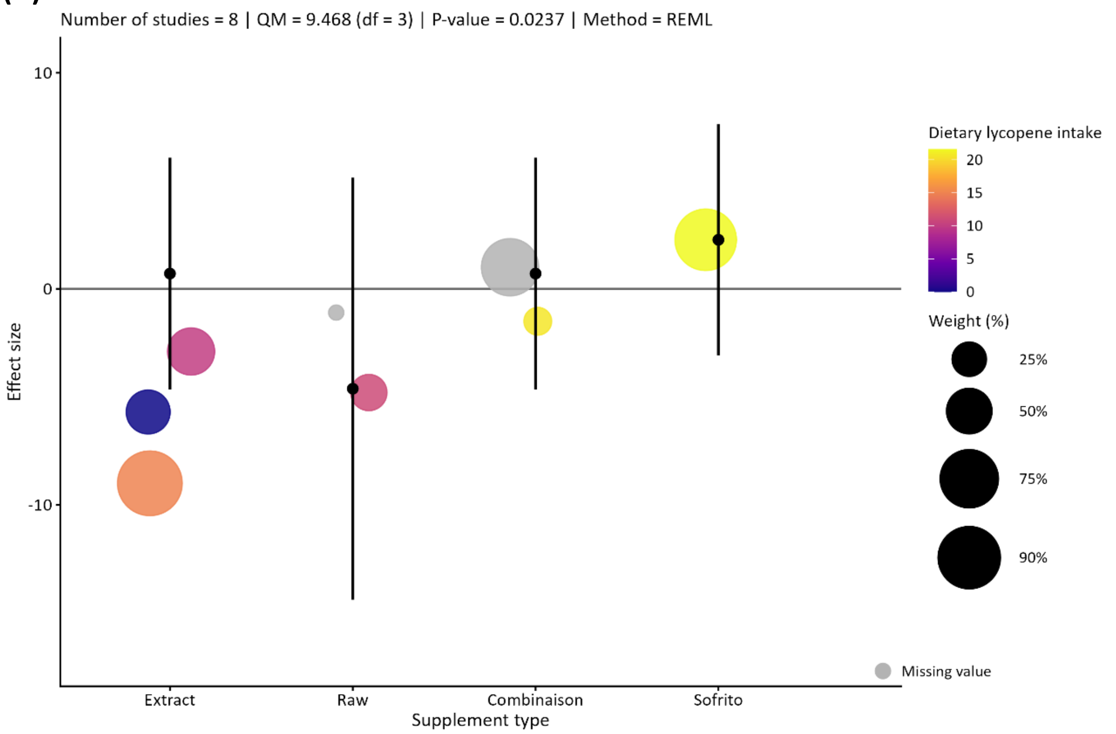
- High risk

Supplementary Figure S2. Funnel plots assessing potential publication bias in meta-analysis.

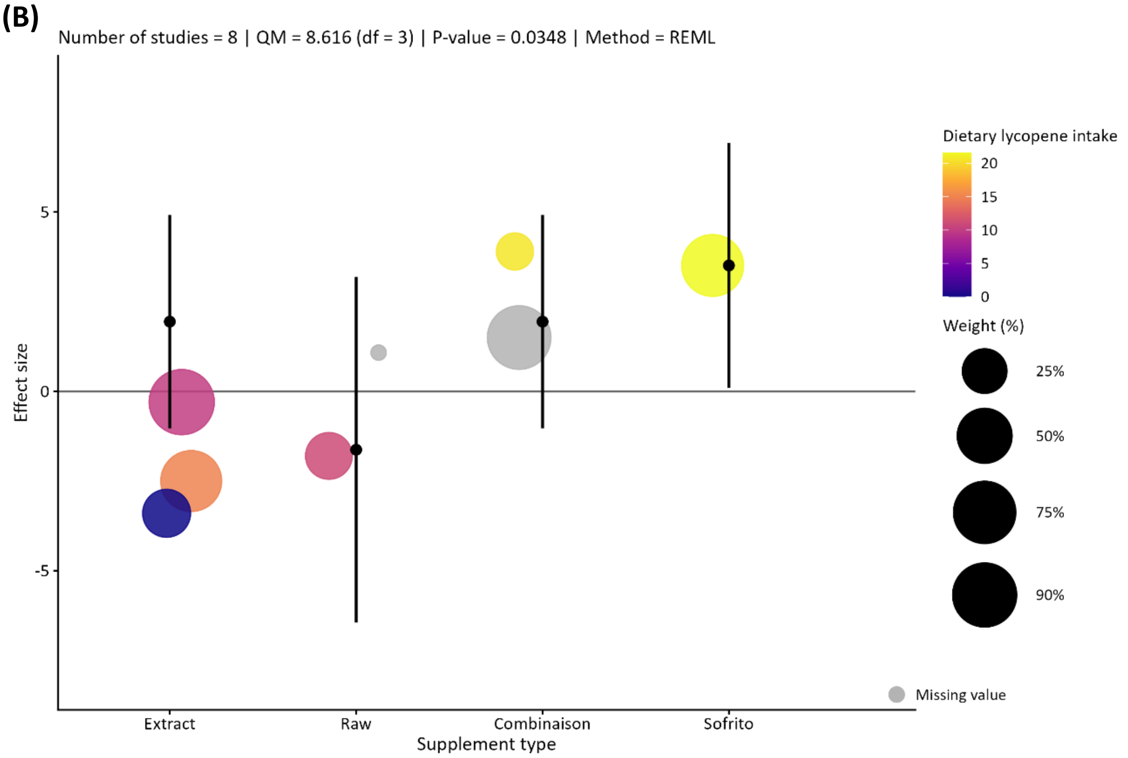


Supplementary Figure S3. Meta-regression bubble plots of the association between supplement type and changes in systolic (A) and diastolic (B) blood pressure in the meta-analysis.

(A)

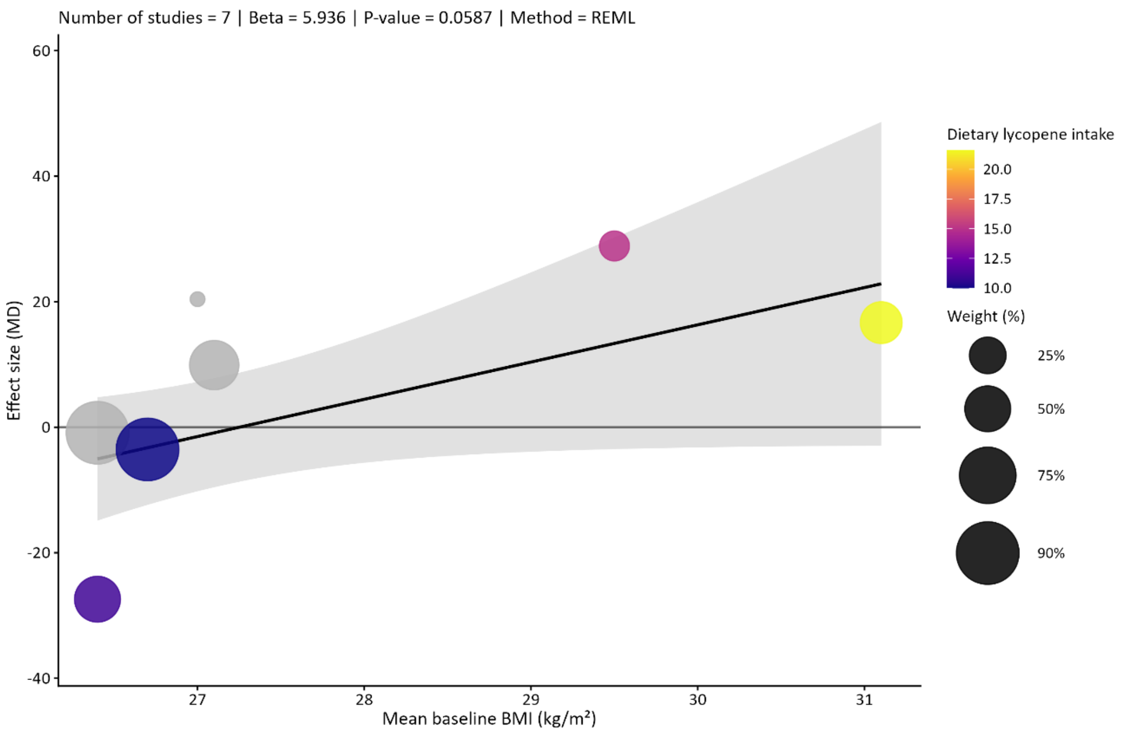


(B)



Bubble plots from meta-regression analyses in which each circle represents an individual study. Bubble size reflects the inverse-variance weight (as a percentage of the maximum weight), colour represents dietary lycopene intake, and grey circles indicate missing moderator data. Black points and vertical bars represent category-specific predicted effects estimated using random-effects meta-regression (REML), with corresponding 95% confidence intervals.

Supplementary Figure S4. Meta-regression bubble plot of the association between mean baseline of body mass index and changes in triglycerides levels in the meta-analysis.



Bubble plots from meta-regression analyses in which each circle represents an individual study. Bubble size reflects the inverse-variance weight (as a percentage of the maximum weight), colour represents dietary lycopene intake, and grey circles indicate missing moderator data. The black line represents the fitted meta-regression estimate obtained using a restricted maximum likelihood (REML) model, with the grey shaded area indicating the 95% confidence interval. **MD**, Mean difference.