

Figure S1 Forest plots of the overall meta-analysis and subgroup analyses for the association between ALT and MAFLD risk. (A) Pooled analysis of the association between ALT level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. (D) Pooled analysis of the association between ALT elevation and MAFLD risk. (E) Subgroup analysis of (D) by adjustment for confounding factors. ALT, alanine aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

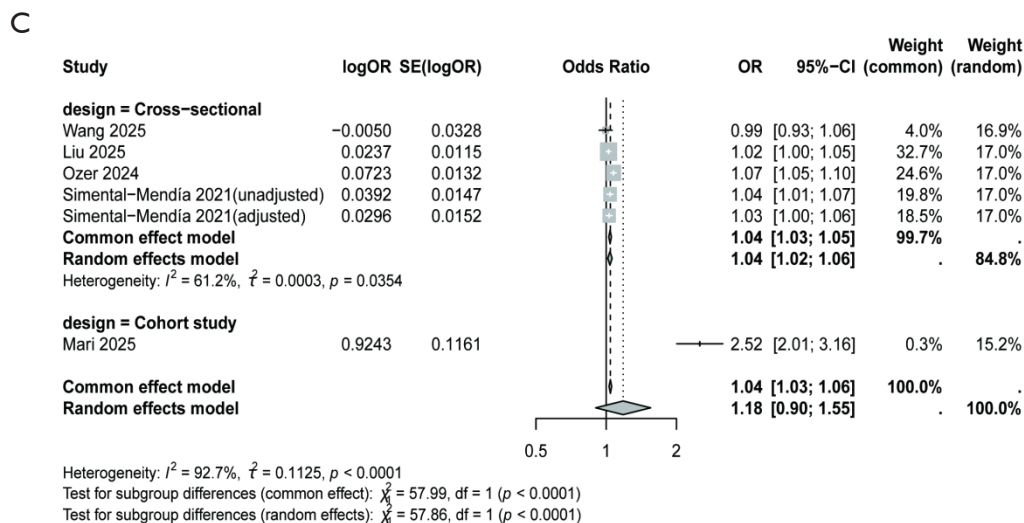
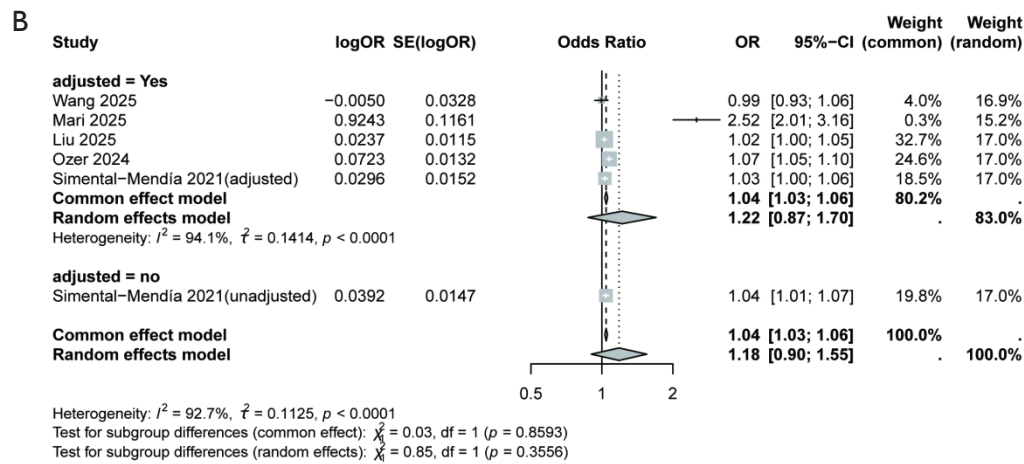
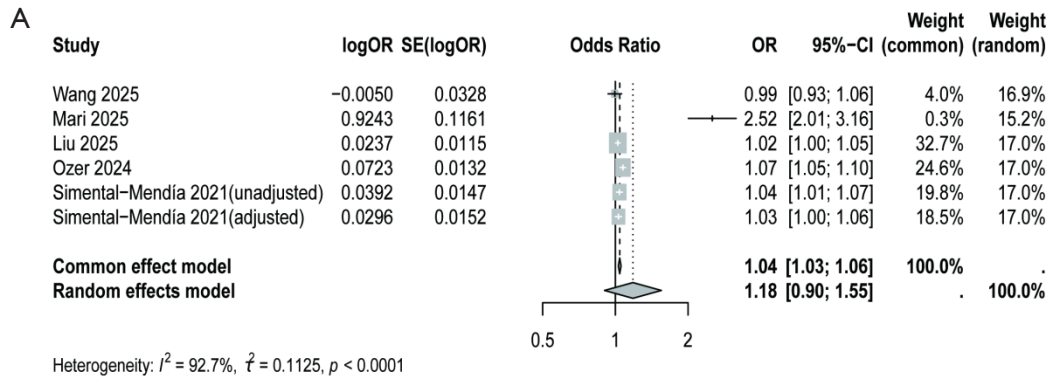


Figure S2 Forest plots of the overall meta-analysis and subgroup analyses for the association between AST and MAFLD risk. (A) Pooled analysis of the association between AST level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. AST, aspartate aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

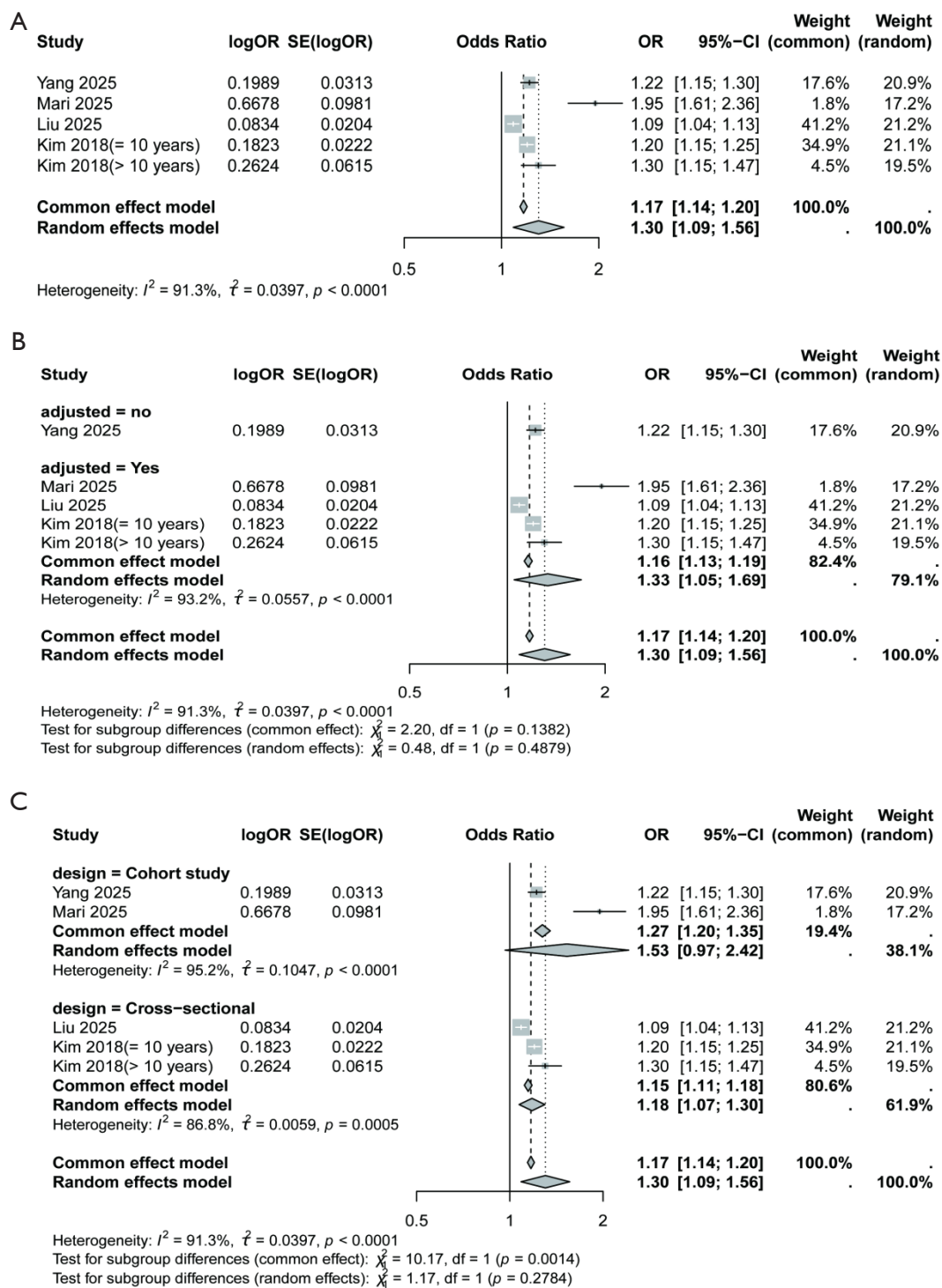


Figure S3 Forest plots of the overall meta-analysis and subgroup analyses for the association between GGT and MAFLD risk. (A) Pooled analysis of the association between GGT level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. CI, confidence interval; GGT, gamma-glutamyl transferase; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

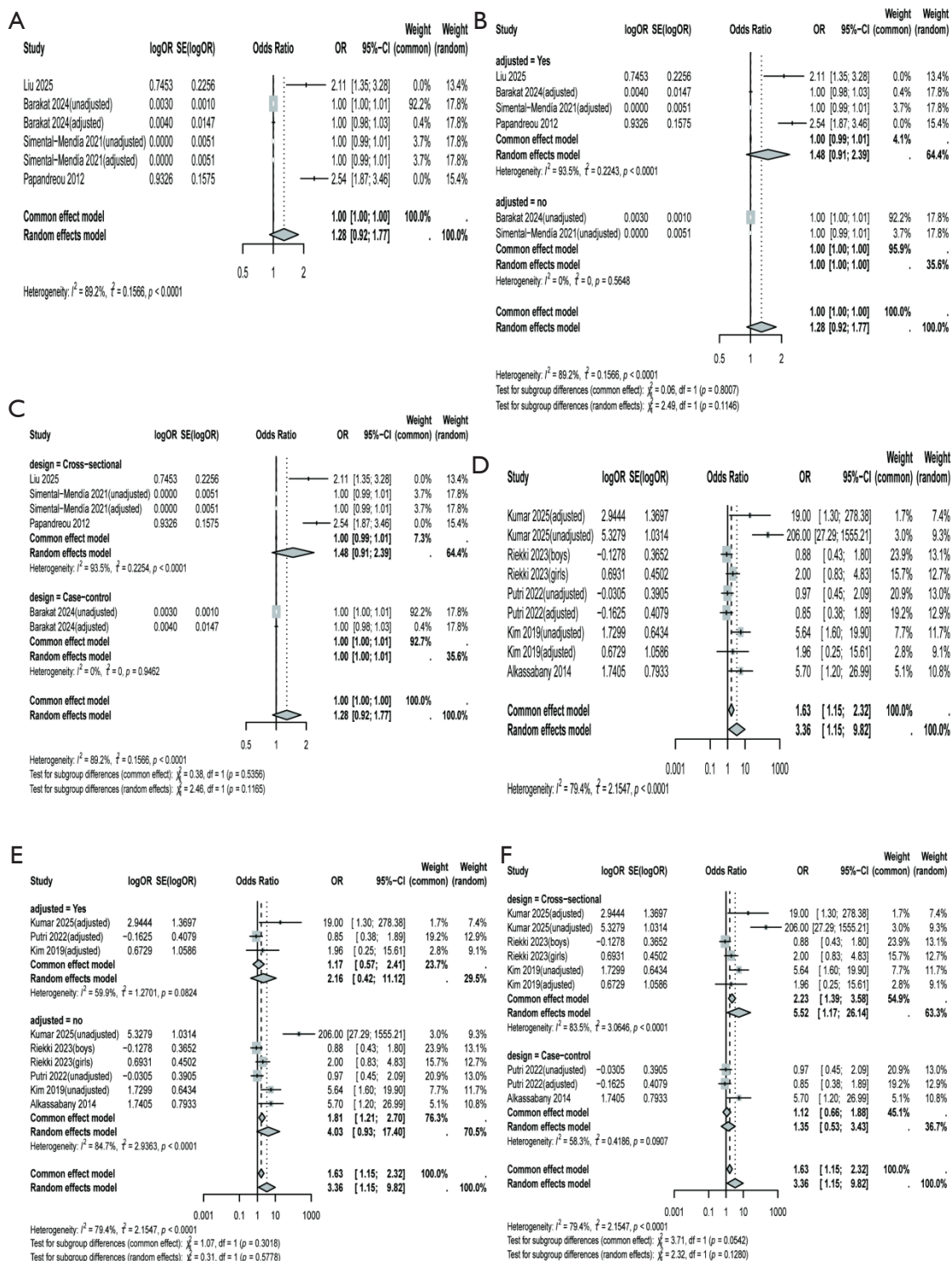


Figure S4 Forest plots of the overall meta-analysis and subgroup analyses for the association between TC and MAFLD risk. (A) Pooled analysis of the association between TC level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. (D) Pooled analysis of the association between TC elevation and MAFLD risk. (E) Subgroup analysis of (D) by adjustment for confounding factors. (F) Subgroup analysis of (D) by study design. CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error; TC, total cholesterol.

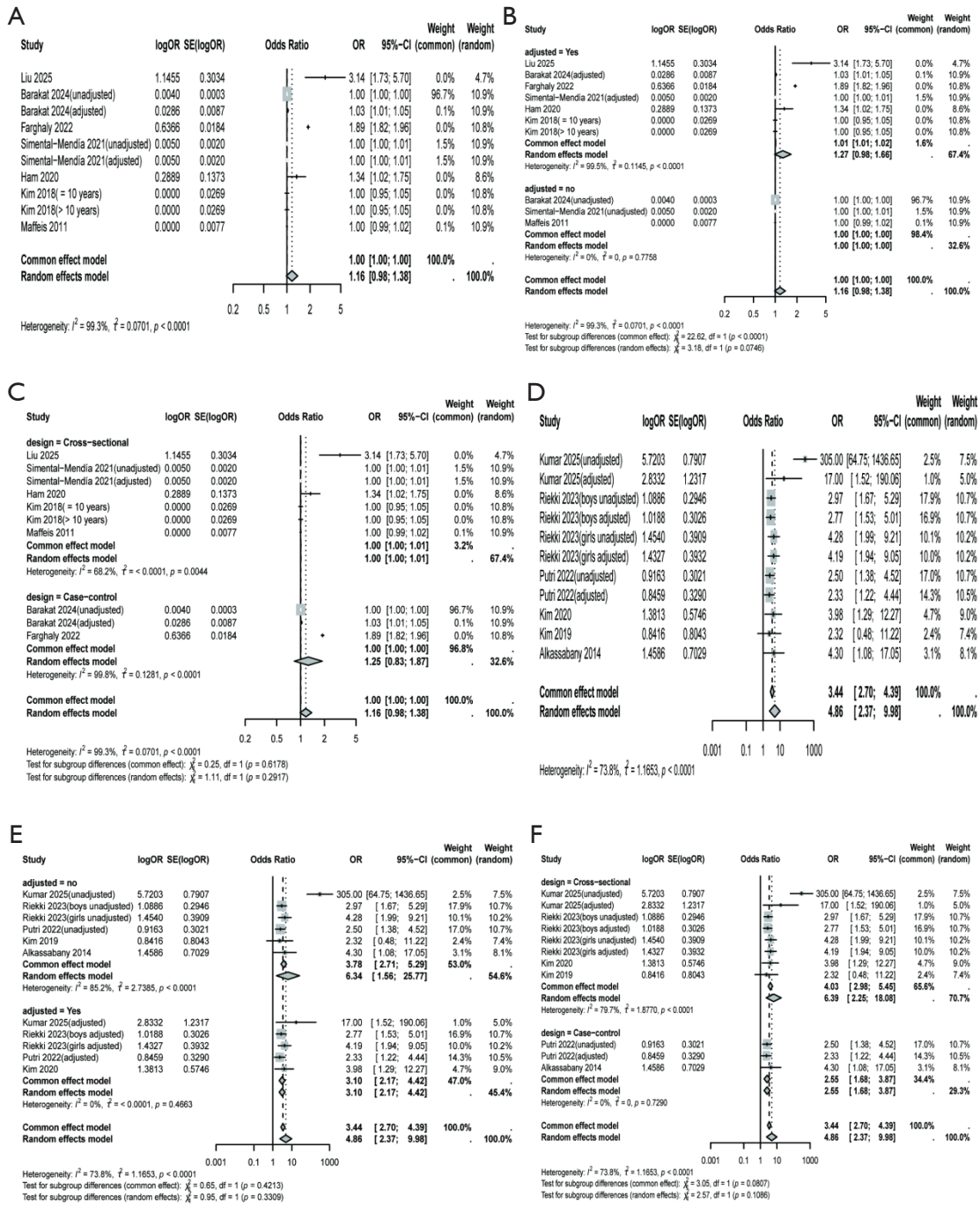


Figure S5 Forest plots of the overall meta-analysis and subgroup analyses for the association between TG and MAFLD risk. (A) Pooled analysis of the association between TG level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. (D) Pooled analysis of the association between TG elevation and MAFLD risk. (E) Subgroup analysis of (D) by adjustment for confounding factors. (F) Subgroup analysis of (D) by study design. CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error; TG, triglycerides.

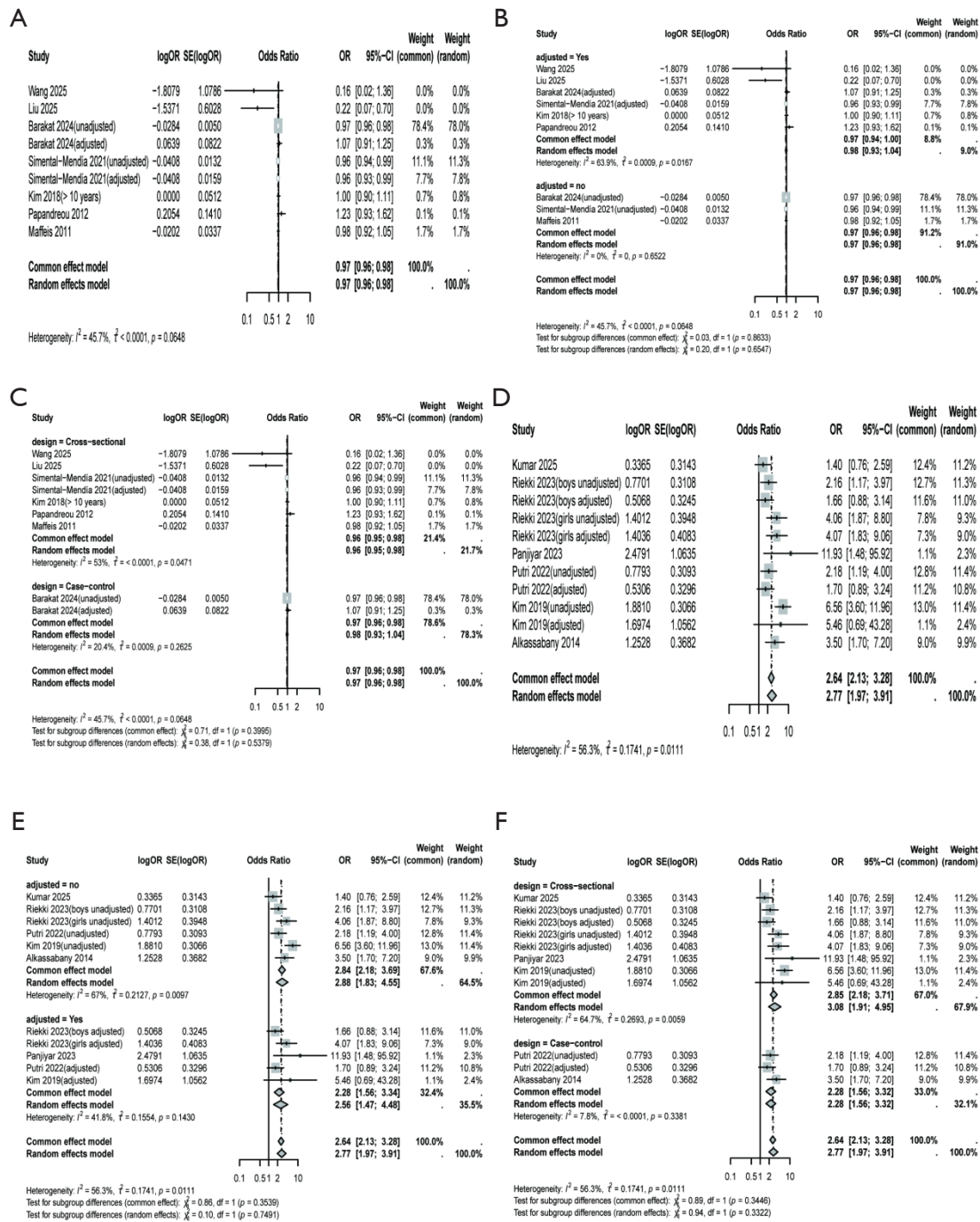


Figure S6 Forest plots of the overall meta-analysis and subgroup analyses for the association between HDL and MAFLD risk. (A) Pooled analysis of the association between HDL level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Subgroup analysis of (A) by study design. (D) Pooled analysis of the association between HDL decreases and MAFLD risk. (E) Subgroup analysis of (D) by adjustment for confounding factors. (F) Subgroup analysis of (D) by study design. CI, confidence interval; HDL, high-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

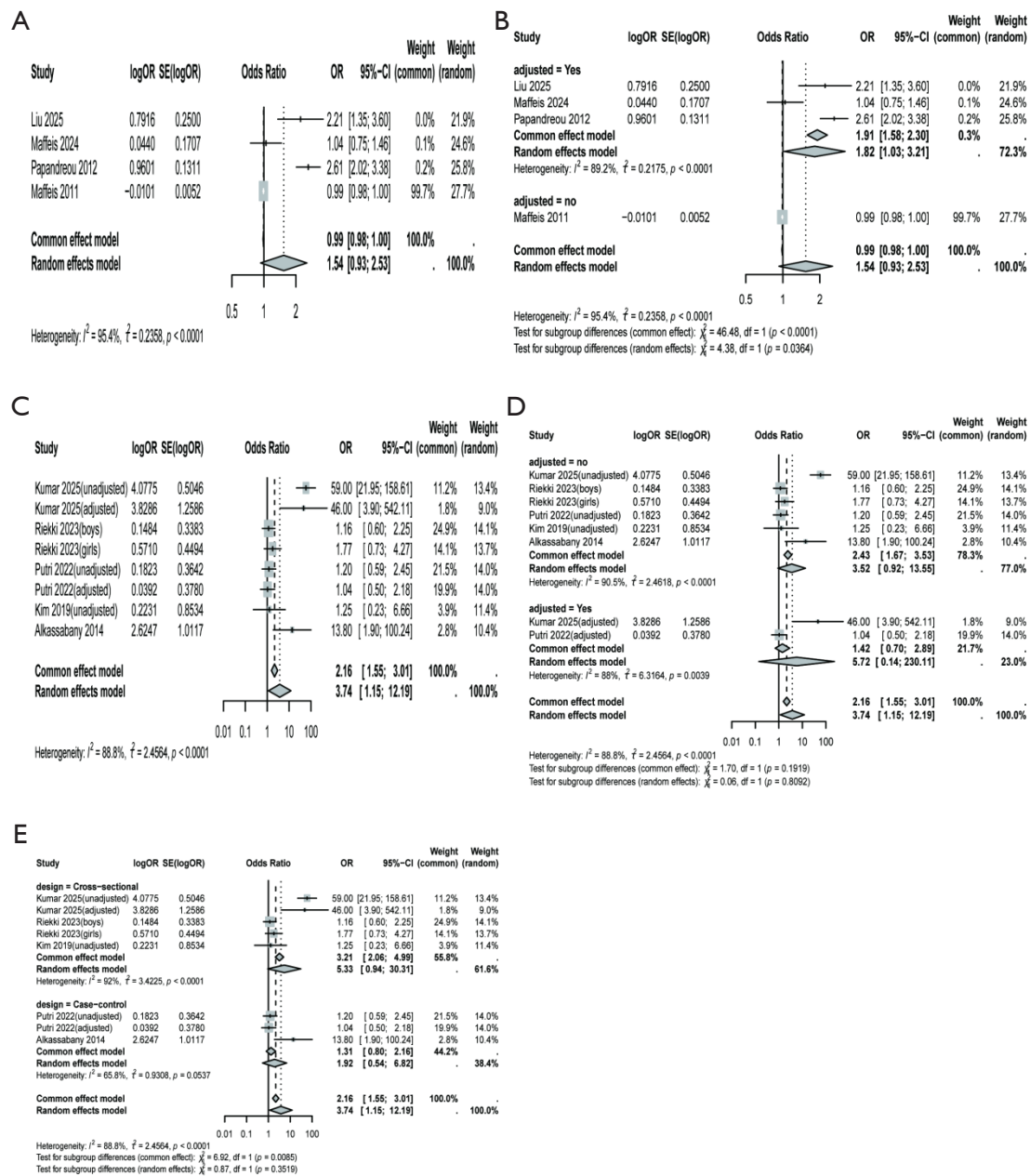


Figure S7 Forest plots of the overall meta-analysis and subgroup analyses for the association between LDL and MAFLD risk. (A) Pooled analysis of the association between LDL level and MAFLD risk. (B) Subgroup analysis of (A) by adjustment for confounding factors. (C) Pooled analysis of the association between LDL elevation and MAFLD risk. (D) Subgroup analysis of (C) by adjustment for confounding factors. (E) Subgroup analysis of (C) by study design. CI, confidence interval; LDL, low-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

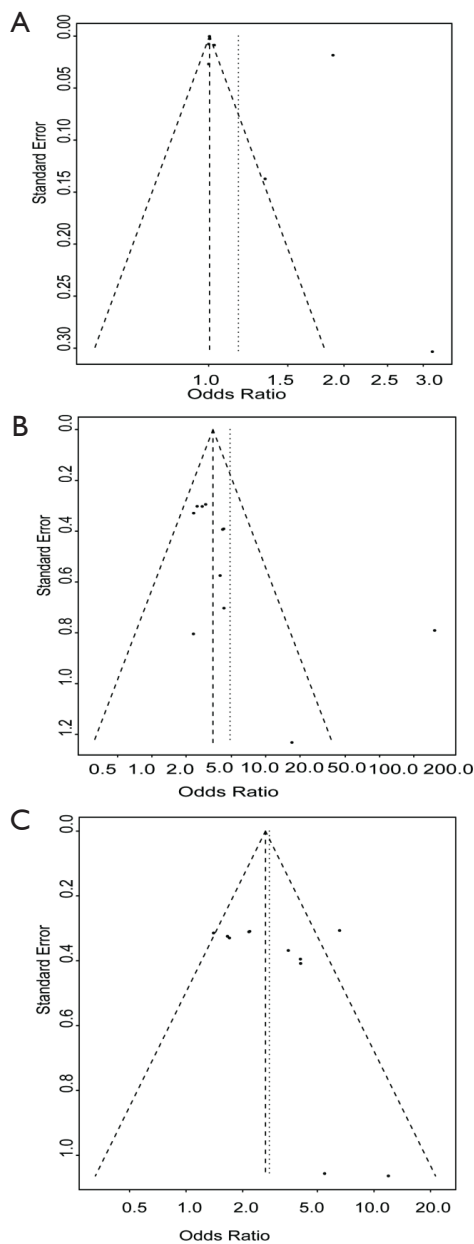


Figure S8 Funnel plots evaluating potential publication bias for the associations between liver function indicators and MAFLD risk. (A) TG level and MAFLD risk. (B) TG elevation and MAFLD risk. (C) HDL level and MAFLD risk. HDL, high-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; TG, triglycerides.

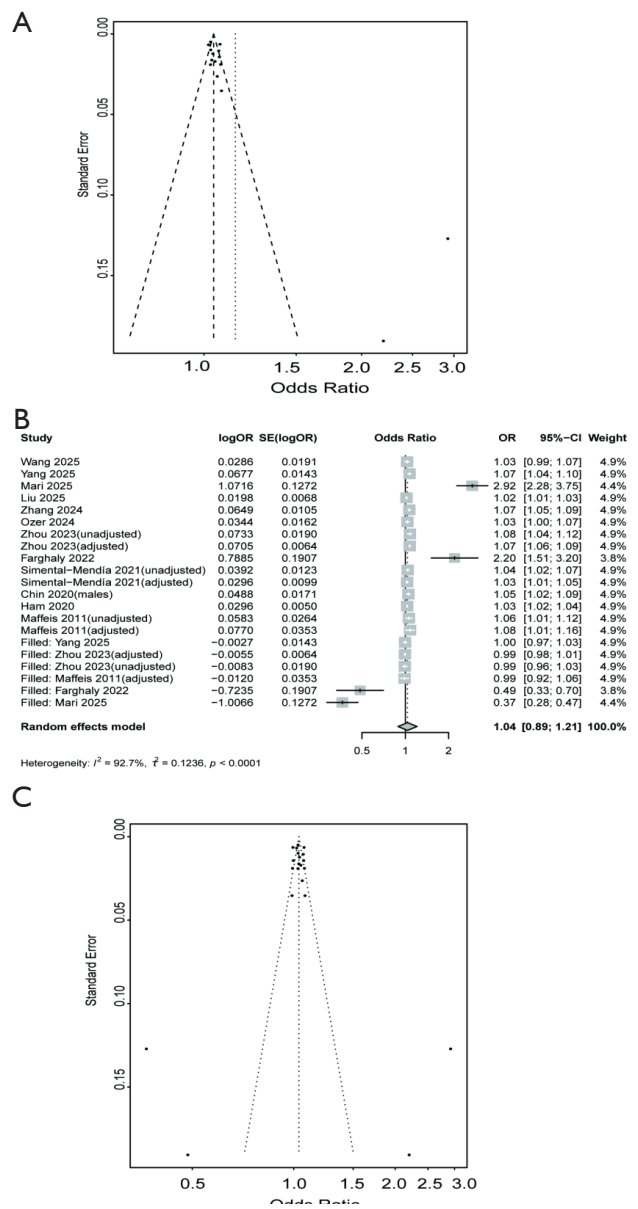


Figure S9 Funnel plot, trim-and-fill adjusted forest plot, and adjusted funnel plot for the association between ALT level and MAFLD risk. (A) Funnel plot of the standard meta-analysis. (B) Forest plot after trim-and-fill imputation. (C) Funnel plot after trim-and-fill imputation. ALT, alanine aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; SE, standard error.

Embase		
#	Query	Results
1	'child'/exp	3,723,724
2	child:ab,ti OR children:ab,ti	2,187,317
3	'adolescent'/exp	2,128,500
4	adolescent:ab,ti OR adolescents:ab,ti OR adolescence:ab,ti OR 'female adolescent':ab,ti OR 'female adolescents':ab,ti OR 'male adolescent':ab,ti OR 'male adolescents':ab,ti OR youth:ab,ti OR youths:ab,ti OR teens:ab,ti OR teen:ab,ti OR teenagers:ab,ti OR teenager:ab,ti	641,028
5	#1 OR #2 OR #3 OR #4	5,268,537
6	'fatty liver'/exp	143,480
7	'fatty liver':ab,ti OR 'fat liver':ab,ti OR 'fatty change in liver':ab,ti OR 'fatty hepatic infiltration':ab,ti OR 'fatty infiltration of liver':ab,ti OR 'fatty infiltration of the liver':ab,ti OR 'fatty liver disease':ab,ti OR 'fatty liver infiltration':ab,ti OR 'fatty liver syndrome':ab,ti OR 'fatty metamorphosis of the liver':ab,ti OR 'hepatic fatty infiltration':ab,ti OR 'hepatic lipidosis':ab,ti OR 'hepatic lipomatosis':ab,ti OR hepatic lipomatosis:ab,ti OR hepatic lipomatous lesion:ab,ti OR 'hepatic steatosis':ab,ti OR hepatolipidosis:ab,ti OR hepatosteatois:ab,ti OR 'liver fatty change':ab,ti OR 'liver fatty infiltration':ab,ti OR 'liver fatty replacement':ab,ti OR 'liver lipidosis':ab,ti OR 'liver ipomatosis':ab,ti OR 'liver steatosis':ab,ti OR steatohepatopathy:ab,ti OR steatohepatosis:ab,ti OR 'steatotic hepatopathy':ab,ti OR 'steatotic liver':ab,ti OR steatohepatitis:ab,ti OR steatohepatitides:ab,ti OR 'steatosis of liver':ab,ti OR 'visceral steatosis':ab,ti OR 'visceral steatoses':ab,ti OR 'liver steatoses':ab,ti	117,819
8	#6 OR #7	157,182
9	'risk factor'/exp	1,583,903
10	'relative risk':ab,ti OR 'risk factors':ab,ti OR 'risk factor':ab,ti OR 'population at risk':ab,ti OR 'populations at risk':ab,ti OR 'risk scores':ab,ti OR 'risk score':ab,ti OR 'risk factor scores':ab,ti OR 'risk factor score':ab,ti OR 'health correlates':ab,ti OR 'social risk factor':ab,ti	1,456,223
11	'association'/exp	47,569
12	association:ab,ti OR associations:ab,ti OR associat*:ab,ti OR cue:ab,ti OR cues:ab,ti OR 'paired associate':ab,ti OR 'visual cue':ab,ti	8,879,188
13	'odds ratio'/exp	36,182
14	'odds ratio':ab,ti OR 'odds ratios':ab,ti OR 'relative odds':ab,ti OR 'risk ratio':ab,ti OR 'risk ratios':ab,ti	590,459
15	#9 OR #10 OR #11 OR #12 OR #13 OR #14	10,101,975
16	'triacylglycerol'/exp	300,982
17	triacylglycerol:ab,ti OR 'fatty acid triglyceride':ab,ti OR 'triacyl glyceride':ab,ti OR triglyceride:ab,ti OR triglycerides:ab,ti OR tryglyceride:ab,ti OR triacylglycerols:ab,ti	236,059
18	'cholesterol'/exp	444,014
19	cholesterol:ab,ti OR '3 hydroxy 5 cholestene':ab,ti OR '3beta hydroxy 5 cholestene':ab,ti OR '3beta hydroxycholest 5 ene':ab,ti OR '5 cholesten 3beta ol':ab,ti OR 'beta cholesterol':ab,ti OR 'cholest 5 en 3beta ol':ab,ti OR 'cholest 5 ene 3 ol':ab,ti OR cholesterolin:ab,ti OR cholesterine:ab,ti OR 'cholesterol release':ab,ti OR dythol:ab,ti OR 'nsc 8798':ab,ti OR epicholesterol:ab,ti	412,393
20	'alanine aminotransferase'/exp	202,538
21	'alanine 2 oxoglutarate aminotransferase':ab,ti OR 'alanine 2 oxoisovalerate aminotransferase':ab,ti OR 'alanine alpha ketoglutarate transaminase':ab,ti OR 'alanine alpha oxoglutarate transaminase':ab,ti OR 'alanine amino transferase':ab,ti OR 'alanine transaminase':ab,ti OR 'alanine transpeptidase':ab,ti OR 'glutamate alanine transaminase':ab,ti OR 'glutamate pyruvate aminotransferase':ab,ti OR 'glutamate pyruvate transaminase':ab,ti OR 'glutamate pyruvatetransaminase':ab,ti OR 'glutamic alanine aminotransferase':ab,ti OR 'glutamic pyruvate transaminase':ab,ti OR 'glutamic pyruvic aminotransferase':ab,ti OR 'glutamic pyruvic transaminase':ab,ti OR 'alanine 2 oxoglutarate aminotransferase':ab,ti OR 'alanine aminotransferase':ab,ti OR gpt:ab,ti OR sgpt:ab,ti	81,797
22	'aspartate aminotransferase'/exp	180,218
23	'aspartate aminotransferase':ab,ti OR 'aspartate amino transferase':ab,ti OR 'aspartate aminotransferases':ab,ti OR 'aspartic aminotransferase':ab,ti OR 'aspartic transaminase':ab,ti OR 'glutamate aspartate transaminase':ab,ti OR 'glutamate oxal':ab,ti OR 'glutamatoxalacetate transaminase':ab,ti OR 'glutamic aspartic aminotransferase':ab,ti OR 'glutamic aspartic transaminase':ab,ti OR 'glutamic oxal acetatic transaminase':ab,ti OR 'glutamic oxal':ab,ti OR 'glutamine oxaloacetic transaminase':ab,ti OR 'glutaminic oxaloacetic transaminase':ab,ti OR got:ab,ti OR 'l aspartate 2 oxoglutarate transaminase':ab,ti OR 'l aspartate 2 oxoglutarate aminotransferase':ab,ti OR 'l aspartate aminotransferase':ab,ti OR 'levo aspartate aminotransferase':ab,ti OR sgot:ab,ti OR 'serum glutamic oxaloacetic transaminase':ab,ti	102,985
24	'lipoprotein'/exp	358,361
25	lipoprotein:ab,ti OR lipopolypeptide:ab,ti OR 'lipoprotein complex':ab,ti OR 'lipoprotein polypeptide':ab,ti OR lipoproteins:ab,ti OR 'circulating lipoproteins':ab,ti OR ldl:ab,ti OR hdl:ab,ti	334,343
26	'bilirubin'/exp	140,134
27	bilirubin:ab,ti OR 'bilirubin acid':ab,ti OR 'bilirubin delta':ab,ti OR 'bilirubin ixalpa':ab,ti OR 'bilirubin pigment':ab,ti OR 'bilirubin sulfate isomer':ab,ti OR 'bilirubin sulphate isomer':ab,ti OR bilirubinate:ab,ti OR bilirubine:ab,ti OR bilirubinoid:ab,ti OR 'calcium bilirubinate':ab,ti OR haematoidin:ab,ti OR hematoidin:ab,ti OR 'indirect bilirubin':ab,ti OR mesobilirubin:ab,ti OR 'unconjugated bilirubin':ab,ti OR 'bilirubin ix alpha':ab,ti OR 'calcium salt bilirubin':ab,ti OR 'delta bilirubin':ab,ti OR 'monosodium salt bilirubin':ab,ti OR 'disodium salt bilirubin':ab,ti	87,919
28	#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27	1,271,605
29	#5 AND #8 AND #15 AND #28	3159

Cochrane Library		
#	Query	Results
1	MeSH descriptor: [Child] explode all trees	82,650
2	(Child):ti,ab,kw OR (Children):ti,ab,kw	199,189
3	MeSH descriptor: [Adolescent] explode all trees	137,456
4	((Adolescents):ti,ab,kw OR (Adolescence):ti,ab,kw OR (Female Adolescent):ti,ab,kw OR (Female Adolescents):ti,ab,kw OR (Male Adolescent):ti,ab,kw OR (Male Adolescents):ti,ab,kw OR (Youth):ti,ab,kw OR (Youths):ti,ab,kw OR (Teens):ti,ab,kw OR (Teen):ti,ab,kw OR (Teenagers):ti,ab,kw OR (Teenager)):ti,ab,kw	166,919
5	#1 OR #2 OR #3 OR #4	314,416
6	MeSH descriptor: [Fatty Liver] explode all trees	2,479
7	((fat liver):ti,ab,kw OR (fatty change in liver):ti,ab,kw OR (fatty hepatic infiltration):ti,ab,kw OR (fatty infiltration of liver):ti,ab,kw OR (fatty infiltration of the liver):ti,ab,kw OR (fatty liver disease):ti,ab,kw OR (fatty liver infiltration):ti,ab,kw OR (fatty metamorphosis of the liver):ti,ab,kw OR (fatty liver syndrome):ti,ab,kw OR (hepatic fatty infiltration):ti,ab,kw OR (hepatic lipidosis):ti,ab,kw OR (hepatic lipomatosis):ti,ab,kw OR (hepatic lipomatous lesion):ti,ab,kw OR (hepatic steatosis):ti,ab,kw OR (hepatolipidosis):ti,ab,kw OR (hepatosteatois):ti,ab,kw OR (liver fatty change):ti,ab,kw OR (liver fatty infiltration):ti,ab,kw OR (liver fatty replacement):ti,ab,kw OR (liver lipidosis):ti,ab,kw OR (liver lipomatosis):ti,ab,kw OR (liver steatosis):ti,ab,kw OR (steatohepatopathy):ti,ab,kw OR (steatohepatosis):ti,ab,kw OR (steatotic hepatopathy):ti,ab,kw OR (steatotic liver):ti,ab,kw OR (Steatohepatitis):ti,ab,kw OR (Steatohepatitides):ti,ab,kw OR (Steatosis of Liver):ti,ab,kw OR (Visceral Steatosis):ti,ab,kw OR (Visceral Steatoses):ti,ab,kw OR (Liver Steatoses):ti,ab,kw	9,799
8	#6 OR #7	9,794
9	MeSH descriptor: [Risk Factors] explode all trees	37,977
10	(relative risk):ti,ab,kw OR (risk factors):ti,ab,kw OR (Risk Factor):ti,ab,kw OR (Population at Risk):ti,ab,kw OR (Populations at Risk):ti,ab,kw OR (Risk Scores):ti,ab,kw OR (Risk Score):ti,ab,kw OR (Risk Factor Scores):ti,ab,kw OR (Risk Factor Score):ti,ab,kw OR (Health Correlates):ti,ab,kw OR (Social Risk Factor):ti,ab,kw	202,343
11	MeSH descriptor: [Association] explode all trees	537
12	(Associations):ti,ab,kw OR (Associat*):ti,ab,kw OR (cue):ti,ab,kw OR (cues):ti,ab,kw OR (paired associate):ti,ab,kw OR (visual cue):ti,ab,kw	383,324
13	MeSH descriptor: [Odds Ratio] explode all trees	4,426
14	(Odds Ratio):ti,ab,kw OR (Odds Ratios):ti,ab,kw OR (Relative Odds):ti,ab,kw OR (Risk Ratio):ti,ab,kw OR (Risk Ratios):ti,ab,kw	79,198
15	#9 OR #10 OR #11 OR #12 OR #13 OR #14	529,791
16	MeSH descriptor: [Triglycerides] explode all trees	7,877
17	(fatty acid triglyceride):ti,ab,kw OR (triacyl glyceride):ti,ab,kw OR (triglyceride):ti,ab,kw OR (triglycerides):ti,ab,kw OR (tryglyceride):ti,ab,kw OR (triacylglycerol):ti,ab,kw OR (Triacylglycerols):ti,ab,kw	31,770
18	MeSH descriptor: [Cholesterol] explode all trees	12,808
19	(cholesterol):ti,ab,kw OR (3 hydroxy 5 cholestene):ti,ab,kw OR (3beta hydroxy 5 cholestene):ti,ab,kw OR (3beta hydroxycholest 5 ene):ti,ab,kw OR (5 cholesten 3beta ol):ti,ab,kw OR (beta cholesterol):ti,ab,kw OR (cholest 5 en 3beta ol):ti,ab,kw OR (cholest 5 ene 3 ol):ti,ab,kw OR (cholesterin):ti,ab,kw OR (cholesterine):ti,ab,kw OR (dythol):ti,ab,kw OR (cholesterol release):ti,ab,kw OR (nsc 8798):ti,ab,kw OR (Epicholesterol):ti,ab,kw	45,194
20	MeSH descriptor: [Alanine Transaminase] explode all trees	1,983
21	(alanin aminotransferase):ti,ab,kw OR (alanine 2 oxoglutarate aminotransferase):ti,ab,kw OR (alanine 2 oxoisovalerate aminotransferase):ti,ab,kw OR (alanine alpha ketoglutarate transaminase):ti,ab,kw OR (alanine alpha oxoglutarate transaminase):ti,ab,kw OR (alanine amino transferase):ti,ab,kw OR (alanine transaminase):ti,ab,kw OR (alanine transpeptidase):ti,ab,kw OR (glutamate alanine transaminase):ti,ab,kw OR (glutamate pyruvate aminotransferase):ti,ab,kw OR (glutamate pyruvate transaminase):ti,ab,kw OR (glutamate pyruvatetransaminase):ti,ab,kw OR (glutamic alanine aminotransferase):ti,ab,kw OR (glutamic pyruvate transaminase):ti,ab,kw OR (glutamic pyruvic aminotransferase):ti,ab,kw OR (glutamic pyruvic transaminase):ti,ab,kw OR (glutamopyruvic transaminase):ti,ab,kw OR (l alanine 2 oxoglutarate aminotransferase):ti,ab,kw OR (alanine aminotransferase):ti,ab,kw OR (GPT):ti,ab,kw OR (SGPT):ti,ab,kw	13,228
22	MeSH descriptor: [Aspartate Aminotransferases] explode all trees	1,247
23	(Aspartate Transaminase):ti,ab,kw OR (aspartate amino transferase):ti,ab,kw OR (aspartate aminotransferases):ti,ab,kw OR (aspartic aminotransferase):ti,ab,kw OR (aspartic transaminase):ti,ab,kw OR (glutamate aspartate transaminase):ti,ab,kw OR (glutamate oxal):ti,ab,kw OR (glutamatoxalacetate transaminase):ti,ab,kw OR (glutamic aspartic aminotransferase):ti,ab,kw OR (glutamic aspartic transaminase):ti,ab,kw OR (glutamic oxal acetatic transaminase):ti,ab,kw OR (glutamic oxal):ti,ab,kw OR (glutamine oxaloacetic transaminase):ti,ab,kw OR (glutaminic oxaloacetic transaminase):ti,ab,kw OR (GOT):ti,ab,kw OR (l aspartate 2 oxoglutarate transaminase):ti,ab,kw OR (l aspartate 2 oxoglutarate aminotransferase):ti,ab,kw OR (levo aspartate aminotransferase):ti,ab,kw OR (l aspartate aminotransferase):ti,ab,kw OR (SGOT):ti,ab,kw OR (Serum Glutamic Oxaloacetic Transaminase):ti,ab,kw	9,228
24	MeSH descriptor: [Lipoproteins] explode all trees	12,462
25	(lipopolypeptide):ti,ab,kw OR (lipoprotein complex):ti,ab,kw OR (lipoprotein polypeptide):ti,ab,kw OR (lipoproteins):ti,ab,kw OR (lipoprotein):ti,ab,kw OR (Circulating Lipoproteins):ti,ab,kw OR (LDL):ti,ab,kw OR (HDL):ti,ab,kw	42,322
26	MeSH descriptor: [Bilirubin] explode all trees	1,072
27	(bilirubin acid):ti,ab,kw OR (bilirubin delta):ti,ab,kw OR (bilirubin ix alpha):ti,ab,kw OR (bilirubin ixalpa):ti,ab,kw OR (bilirubin pigment):ti,ab,kw OR (bilirubin sulfate isomer):ti,ab,kw OR (bilirubin sulphate isomer):ti,ab,kw OR (bilirubinate):ti,ab,kw OR (bilirubine):ti,ab,kw OR (bilirubinoid):ti,ab,kw OR (calcium bilirubinate):ti,ab,kw OR (haematoidin):ti,ab,kw OR (hematoidin):ti,ab,kw OR (indirect bilirubin):ti,ab,kw OR (mesobilirubin):ti,ab,kw OR (unconjugated bilirubin):ti,ab,kw OR (Bilirubin IX alpha):ti,ab,kw OR (Calcium Salt Bilirubin):ti,ab,kw OR (delta Bilirubin):ti,ab,kw OR (Monosodium Salt Bilirubin):ti,ab,kw OR (Disodium Salt Bilirubin):ti,ab,kw	2,180
28	#16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24 OR #25 OR #26 OR #27	77,389
29	#5 AND #8 AND #15 AND #28	217

#	Query	Results
1	Child(Topic) OR Children(Topic) OR Adolescent(Topic) OR Adolescent(Topic) OR Adolescents(Topic) OR Adolescence(Topic) OR "Female Adolescent"(Topic) OR "Female Adolescents"(Topic) OR "Male Adolescent"(Topic) OR "Male Adolescents"(Topic) OR Youth(Topic) OR Youths(Topic) OR Teens(Topic) OR Teen(Topic) OR Teenagers(Topic) OR Teenager(Topic)	5,633,960
2	"Fatty Liver"(Topic) OR "fat liver"(Topic) OR "fatty change in liver"(Topic) OR "fatty hepatic infiltration"(Topic) OR "fatty infiltration of liver"(Topic) OR "fatty infiltration of the liver"(Topic) OR "fatty liver disease"(Topic) OR "fatty liver infiltration"(Topic) OR "fatty liver syndrome"(Topic) OR "fatty metamorphosis of the liver"(Topic) OR "hepatic fatty infiltration"(Topic) OR "hepatic lipidosis"(Topic) OR "hepatic lipomatosis"(Topic) OR "hepatic lipomatous lesion"(Topic) OR "hepatic steatosis"(Topic) OR hepatolipidosis(Topic) OR hepatosteatois(Topic) OR "liver fatty change"(Topic) OR "liver fatty infiltration"(Topic) OR "liver fatty replacement"(Topic) OR "liver lipidosis"(Topic) OR "liver lipomatosis"(Topic) OR "liver steatosis"(Topic) OR steatohepatopathy(Topic) OR steatohepatosis(Topic) OR "steatotic hepatopathy"(Topic) OR "steatotic liver"(Topic) OR Steatohepatitis(Topic) OR Steatohepatitides(Topic) OR "Steatosis of Liver"(Topic) OR "Visceral Steatosis"(Topic) OR "Visceral Steatoses"(Topic) OR "Liver Steatoses"(Topic)	144,637
3	"Risk Factors"(Topic) OR "relative risk"(Topic) OR "Risk Factor"(Topic) OR "Population at Risk"(Topic) OR "Populations at Risk"(Topic) OR "Risk Scores"(Topic) OR "Risk Score"(Topic) OR "Risk Factor Scores"(Topic) OR "Risk Factor Score"(Topic) OR "Health Correlates"(Topic) OR "Social Risk Factor"(Topic) OR Association(Topic) OR Associations(Topic) OR Associat(Topic) OR cue(Topic) OR cues(Topic) OR "paired associate"(Topic) OR "visual cue"(Topic) OR "Odds Ratio"(Topic) OR "Odds Ratios"(Topic) OR "Relative Odds"(Topic) OR "Risk Ratio"(Topic) OR "Risk Ratios"(Topic)	11,638,697
4	Triglycerides(Topic) OR "fatty acid triglyceride"(Topic) OR "triacyl glyceride"(Topic) OR triglyceride(Topic) OR triglycerides(Topic) OR tryglyceride(Topic) OR triacylglycerol(Topic) OR Triacylglycerols(Topic) OR "Cholesterol OR 3 hydroxy 5 cholestene"(Topic) OR "3beta hydroxy 5 cholestene"(Topic) OR "3beta hydroxycholest 5 ene"(Topic) OR "5 cholesten 3beta ol"(Topic) OR "beta cholesterol"(Topic) OR "cholest 5 en 3beta ol"(Topic) OR "cholest 5 ene 3 ol"(Topic) OR cholesterolin(Topic) OR cholesterine(Topic) OR "cholesterol release"(Topic) OR dythol(Topic) OR "nsc 8798"(Topic) OR Epicholesterol(Topic) OR "Alanine Transaminase"(Topic) OR "alanin aminotransferase"(Topic) OR "alanine 2 oxoglutarate aminotransferase"(Topic) OR "alanine 2 oxoisovalerate aminotransferase"(Topic) OR "alanine alpha ketoglutarate transaminase"(Topic) OR "alanine alpha oxoglutarate transaminase"(Topic) OR "alanine amino transferase"(Topic) OR "alanine transeptidase"(Topic) OR "glutamate alanine transaminase"(Topic) OR "glutamate pyruvate aminotransferase"(Topic) OR "glutamate pyruvate transaminase"(Topic) OR "glutamate pyruvatetransaminase"(Topic) OR "glutamic alanine aminotransferase"(Topic) OR "glutamic pyruvate transaminase"(Topic) OR "glutamic pyruvic aminotransferase"(Topic) OR "glutamic pyruvic transaminase"(Topic) OR "glutamopyruvic transaminase"(Topic) OR "l alanine 2 oxoglutarate aminotransferase"(Topic) OR "alanine aminotransferase"(Topic) OR GPT(Topic) OR SGPT(Topic) OR "Aspartate Transaminase"(Topic) OR "aspartate amino transferase"(Topic) OR "aspartate aminotransferases"(Topic) OR "aspartic aminotransferase"(Topic) OR "aspartic transaminase"(Topic) OR "glutamate aspartate transaminase"(Topic) OR "glutamate oxal"(Topic) OR "glutamatoxalacetate transaminase"(Topic) OR "glutamic aspartic aminotransferase"(Topic) OR "glutamic aspartic transaminase"(Topic) OR "glutamic oxal acetatic transaminase"(Topic) OR "glutamic oxal"(Topic) OR "glutamine oxaloacetic transaminase"(Topic) OR "glutaminic oxalacetic transaminase"(Topic) OR GOT(Topic) OR "l aspartate 2 oxoglutarate transaminase"(Topic) OR "l aspartate 2 oxoglutarate aminotransferase"(Topic) OR "l aspartate aminotransferase"(Topic) OR "levo aspartate aminotransferase"(Topic) OR SGOT(Topic) OR "Serum Glutamic Oxaloacetic Transaminase"(Topic) OR Lipoproteins(Topic) OR lipopolypeptide(Topic) OR "lipoprotein complex"(Topic) OR "lipoprotein polypeptide"(Topic) OR lipoprotein(Topic) OR "Circulating Lipoproteins"(Topic) OR LDL(Topic) OR HDL(Topic) OR Bilirubin(Topic) OR "bilirubin acid"(Topic) OR "bilirubin delta"(Topic) OR "bilirubin ix alpha"(Topic) OR "bilirubin ixalpha"(Topic) OR "bilirubin pigment"(Topic) OR "bilirubin sulfate isomer"(Topic) OR "bilirubin sulphate isomer"(Topic) OR bilirubinate(Topic) OR bilirubinoid(Topic) OR "calcium bilirubinate"(Topic) OR haematoidin(Topic) OR hematooidin(Topic) OR "indirect bilirubin"(Topic) OR mesobilirubin(Topic) OR "unconjugated bilirubin"(Topic) OR "Bilirubin IX alpha"(Topic) OR "Calcium Salt Bilirubin"(Topic) OR "delta Bilirubin"(Topic) OR "Monosodium Salt Bilirubin"(Topic) OR "Disodium Salt Bilirubin"(Topic)	1,537,697
5	#1 AND #3 AND #5 AND #6	2,446

Appendix 2: NIH quality assessment tool for studies

NIH quality assessment tool for observational cohort and cross-sectional studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Overall
Kumar, 2025	Yes	Yes	Yes	Yes	Yes	Other	Other	Yes	Yes	Other	Yes	Other	Other	Yes	Fair
Wang, 2025	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Other	Fair
Yang, 2025	Yes	Yes	Other	Yes	Other	Yes	Other	No	Yes	No	Yes	Other	Yes	Yes	Fair
Mari, 2025	Yes	Yes	Other	Yes	Other	Yes	Other	No	Yes	No	Yes	Other	Yes	Yes	Fair
Liu, 2025	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Zhang, 2024	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Ozer, 2024	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Maffei, 2024	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Riekk, 2023	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Panjiyar, 2023	Yes	Yes	Other	Yes	Other	Other	Other	Yes	Yes	Other	Yes	Other	Other	Yes	Fair
Simental-Mendiá, 2021	Yes	Yes	Other	Yes	Other	Other	Other	Yes	Yes	Other	Yes	Yes	Other	Yes	Fair
Kim, 2020	Yes	Yes	Other	Yes	Other	Other	Other	Yes	Yes	Other	Yes	Other	Other	Yes	Fair
Chin, 2020	Yes	Yes	Yes	Yes	Yes	Other	Other	Yes	Yes	Other	Yes	Yes	Other	Yes	Good
Barretto, 2020	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Ham, 2020	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Kim, 2019	Yes	Yes	Other	Yes	Other	Other	Other	Yes	Yes	Other	Yes	Other	Other	Yes	Fair
Kim, 2018	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Jain, 2018	Yes	Yes	Other	Yes	Other	Other	Other	Yes	Yes	Other	Yes	Other	Other	Yes	Fair
Papandreou, 2012	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Maffei, 2011	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Other	Other	Yes	Fair
Fu, 2009	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Yes	Other	Yes	Fair
Sartorio, 2007	Yes	Yes	Other	Yes	Other	Other	Other	No	Yes	Other	Yes	Yes	Other	Yes	Fair

Q1: Was the research question or objective in this paper clearly stated? Q2: Was the study population clearly specified and defined? Q3: Was the participation rate of eligible persons at least 50%? Q4: Were all the subjects selected or recruited from the same or similar populations (including the same time period)? Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants? Q5: Was a sample size justification, power description, or variance and effect estimates provided? Q6: For the analyses in this paper, were the exposure(s) of interest measured prior to the outcome(s) being measured? Q7: Was the timeframe sufficient so that one could reasonably expect to see an association between exposure and outcome if it existed? Q8: For exposures that can vary in amount or level, did the study examine different levels of the exposure as related to the outcome (e.g., categories of exposure, or exposure measured as continuous variable)? Q9: Were the exposure measures (independent variables) clearly defined, valid, reliable, and implemented consistently across all study participants? Q10: Was the exposure(s) assessed more than once over time? Q11: Were the outcome measures (dependent variables) clearly defined, valid, reliable, and implemented consistently across all study participants? Q12: Were the outcome assessors blinded to the exposure status of participants? Q13: Was loss to follow-up after baseline 20% or less? Q14: Were key potential confounding variables measured and adjusted statistically for their impact on the relationship between exposure(s) and outcome(s)?

NIH quality assessment tool for case-control studies

Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Overall
Barakat, 2024	Yes	Yes	Yes	Yes	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Good
Zhou, 2023	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Good
Putri, 2022	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Good
Farghaly, 2022	Yes	Yes	Other	Yes	Yes	Yes	Other	Yes	Yes	Yes	Yes	Yes	Good
Alkassabany, 2014	Yes	Yes	Other	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Other	Other	Good

Q1: Was the research question or objective in this paper clearly stated and appropriate? Q2: Was the study population clearly specified and defined? Q3: Did the authors include a sample size justification? Q4: Were controls selected or recruited from the same or similar population that gave rise to the cases (including the same timeframe)? Q5: Were the definitions, inclusion and exclusion criteria, algorithms or processes used to identify or select cases and controls valid, reliable, and implemented consistently across all study participants? Q6: Were the cases clearly defined and differentiated from controls? Q7: If less than 100 percent of eligible cases and/or controls were selected for the study, were the cases and/or controls randomly selected from those eligible? Q8: Was there use of concurrent controls? Q9: Were the investigators able to confirm that the exposure/risk occurred prior to the development of the condition or event that defined a participant as a case? Q10: Were the measures of exposure/risk clearly defined, valid, reliable, and implemented consistently (including the same time period) across all study participants? Q11: Were the assessors of exposure/risk blinded to the case or control status of participants? Q12: Were key potential confounding variables measured and adjusted statistically in the analyses? If matching was used, did the investigators account for matching during study analysis?

Appendix 3: main characteristics of eligible studies

Study	Country	HDI	Study design	Population	Group	Study size	Sex (male/female), n	Age (years)	BMI (kg/m ²)	NIH quality score
Kumar, 2025	India	0.685	Cross-sectional	Overweight or obesity	MAFLD	103	67/36	NR	NR	Fair
					Non-MAFLD	127	82/45			
Wang, 2025	China	0.797	Cross-sectional	Obesity	MAFLD	86	86/0	11.24±1.45	32.08±4.49	Fair
					Non-MAFLD	69	69/0	10.86±1.61	27.85±4.21	
Yang, 2025	China	0.797	Cohort study	Children	MAFLD	113	85/28	10.36±1.51	NR	Fair
					Non-MAFLD	995	482/513	9.37±1.80		
Mari, 2025	Italy	0.915	Cohort study	Severe obesity	MAFLD	295	162/133	NR	NR	Fair
					Non-MAFLD	463	142/321			
Liu, 2025	China	0.797	Cross-sectional	Obesity	MAFLD	104	64/40	11.7 [10.5, 13.4]	27.41 [24.76, 29.74]	Fair
					Non-MAFLD	118	53/65	10.8 [9.8, 12.7]	24.11 [21.39, 27.14]	
Zhang, 2024	China	0.797	Cross-sectional	Obesity	MAFLD	357	273/84	11.41±2.22	29.75 [27.21, 32.26]	Fair
					Non-MAFLD	147	94/53	9.74±2.47	26.26 [24.35, 29.31]	
Ozer, 2024	Turkey	0.853	Cross-sectional	Obesity	MAFLD	121	53/68	13.9 [11.3, 15.6]	NR	Fair
					Non-MAFLD	90	14/76	13.2 [9.76, 15.4]		
Maffei, 2024	Italy	0.915	Cross-sectional	Type 1 diabetes	MAFLD	67	32/35	16.2±3.1	22.3±3.9	Fair
					Non-MAFLD	177	97/80	16.2±3.2	21.9±3.3	
Barakat, 2024	Egypt	0.754	Case-control	Obesity	MAFLD	100	54/46	10.557±3.068	NR	Good
					Non-MAFLD	100	65/35	9.780±3.107		
Zhou, 2023	China	0.797	Case-control	Obesity	MAFLD	214	179/35	11.17 [9.90, 12.17]	27.60 [25.68, 29.89]	Good
					Non-MAFLD	815	402/413	9.50 [8.50, 10.92]	22.20 [20.67, 24.24]	
Riekk, 2023	Finland	0.948	Cross-sectional	Overweight	MAFLD	105	71/34	12.8 [10.7, 14.4]	NR	Fair
					Non-MAFLD	598	330/268	11.3 [8.3, 13.5]		
Panjiyar, 2023	India	0.685	Cross-sectional	Psoriasis	MAFLD	17	NR	NR	NR	Fair
					Non-MAFLD	87				
Putri, 2022	Sweden	0.959	Case-control	Obesity	MAFLD	76	55/21	10.8±3.28	NR	Good
					Non-MAFLD	241	171/70	10.8±3.01		
Farghaly, 2022	Egypt	0.754	Case-control	Obesity	MAFLD	98	56/42	11.41±2.349	NR	Good
					Non-MAFLD	142	98/44	10.52±2.52		
Simental-Mendía, 2021	Mexico	0.789	Cross-sectional	Overweight or obesity	MAFLD	100	70/30	8.8±2.1	26.2±3.9	Fair
					Non-MAFLD	77	41/36	9.1±2.5	24.8±3.0	
Kim, 2020	Korea	0.937	Cross-sectional	Obesity	MAFLD	113	92/21	12.3±2.2	27.2±3.9	Fair
					Non-MAFLD	67	40/27	12.4±3.0	25.4±2.6	
Chin, 2020	Australia	0.958	Cross-sectional	Adolescents	MAFLD	176	63/113	NR	NR	Good
					Non-MAFLD	991	528/463			
Barretto, 2020	Brazil	0.786	Cross-sectional	Overweight	MAFLD	36	20/16	14.0 [12.0, 16.0]	NR	Fair
					Non-MAFLD	36	16/20	12.5 [10.2, 14.7]		
Ham, 2020	China	0.797	Cross-sectional	Obesity	MAFLD	261	205/56	11.3±2.1	29.8±3.8	Fair
					Non-MAFLD	259	171/88	10.1±2.4	27.1±3.7	
Kim, 2019	Korea	0.937	Cross-sectional	Non-obesity	MAFLD	26	24/2	13 [10, 17]	NR	Fair
					Non-MAFLD	NR	NR	NR		
Kim, 2018	Korea	0.937	Cross-sectional	Obesity and overweight	MAFLD	192	143/49	NR	NR	Fair
					Non-MAFLD	164	90/74			
Jain, 2018	India	0.685	Cross-sectional	Overweight	MAFLD	130	91/39	12.0±1.6	28.6±4.5	Fair
					Non-MAFLD	78	51/27	11.6±1.4	25.7±3.2	
Alkassabany, 2014	Egypt	0.754	Case-control	Children	MAFLD	75	21/54	12.9±3.1	NR	Good
					Non-MAFLD	75	20/55	12.6±3.1		
Papandreou, 2012	Greece	0.908	Cross-sectional	Obesity	MAFLD	38	20/18	11.5±1.1	31±2.9	Fair
					Non-MAFLD	47	25/22	11±2.1	25±3.6	
Maffei, 2011	Italy	0.915	Cross-sectional	Obesity	MAFLD	29	8/21	10.39±1.9	30.17±4.19	Fair
					Non-MAFLD	30	13/17	10.67±1.99	27.49±3.36	
Fu, 2009	China	0.797	Cross-sectional	Adolescents	MAFLD	86	NR	NR	27.6±5.5	Fair
					Non-MAFLD	130			22.8±4.2	
Sartorio, 2007	Italy	0.915	Cross-sectional	Obesity	MAFLD	119	69/50	NR	37.9 [8.7]	Fair
					Non-MAFLD	149	49/100		34.2 [6.1]	

Data are presented as number, mean ± SD, or median [interquartile range]. BMI, body mass index; HDI, Human Development Index; MAFLD, metabolic (dysfunction)-associated fatty liver disease; NIH, National Institutes of Health; NR, not reported; SD, standard deviation.

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Appendix 5: leave-one-out sensitivity analysis of the associations between liver function indicators and MAFLD risk

Leave-one-out sensitivity analysis of the association between ALT level and MAFLD risk					
Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Wang 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Yang 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.9
Omitting Mari 2025	1.05 (1.04, 1.06)	<0.0001	0.0003	0.02	80.5
Omitting Liu 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	89
Omitting Zhang 2024	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.8
Omitting Ozer 2024	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Zhou 2023 (unadjusted)	1.16 (1.00, 1.33)	0.04	0.07	0.26	90
Omitting Zhou 2023 (adjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	88.1
Omitting Farghaly 2022	1.11 (0.99, 1.24)	0.06	0.04	0.20	88.9
Omitting Simental-Mendía 2021 (unadjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.2
Omitting Simental-Mendía 2021 (adjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90
Omitting Chin 2020 (males)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Ham 2020	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.4
Omitting Maffei 2011 (unadjusted)	1.16 (1.01, 1.33)	0.0409	0.07	0.26	90.1
Omitting Maffei 2011 (adjusted)	1.16 (1.00, 1.33)	0.04	0.07	0.26	90.1
REM	1.15 (1.01, 1.30)	0.03	0.06	0.25	89.4

ALT, alanine aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Appendix 5: leave-one-out sensitivity analysis of the associations between liver function indicators and MAFLD risk

Leave-one-out sensitivity analysis of the association between ALT level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Wang 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Yang 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.9
Omitting Mari 2025	1.05 (1.04, 1.06)	<0.0001	0.0003	0.02	80.5
Omitting Liu 2025	1.16 (1.01, 1.33)	0.04	0.07	0.26	89
Omitting Zhang 2024	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.8
Omitting Ozer 2024	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Zhou 2023 (unadjusted)	1.16 (1.00, 1.33)	0.04	0.07	0.26	90
Omitting Zhou 2023 (adjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	88.1
Omitting Farghaly 2022	1.11 (0.99, 1.24)	0.06	0.04	0.20	88.9
Omitting Simental-Mendía 2021 (unadjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.2
Omitting Simental-Mendía 2021 (adjusted)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90
Omitting Chin 2020 (males)	1.16 (1.01, 1.33)	0.04	0.07	0.26	90.1
Omitting Ham 2020	1.16 (1.01, 1.33)	0.04	0.07	0.26	89.4
Omitting Maffeis 2011 (unadjusted)	1.16 (1.01, 1.33)	0.0409	0.07	0.26	90.1
Omitting Maffeis 2011 (adjusted)	1.16 (1.00, 1.33)	0.04	0.07	0.26	90.1
REM	1.15 (1.01, 1.30)	0.03	0.06	0.25	89.4

ALT, alanine aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between ALT elevation and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Kumar 2025 (unadjusted)	4.80 (2.24, 10.27)	<0.0001	0.24	0.49	54.2
Omitting Kim 2020	26.65 (1.58, 450.20)	0.02	7.22	2.69	89.9
Omitting Jain 2018	37.20 (2.85, 485.23)	0.01	5.69	2.39	87.3
Omitting Fu 2009	35.88 (2.67, 482.33)	0.01	5.91	2.43	90.1
Omitting Kumar 2025 (adjusted)	15.17 (1.34, 171.21)	0.03	5.66	2.38	89.3
REM	20.63 (2.39, 178.09)	0.01	5.13	2.27	87.1

ALT, alanine aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between AST level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Wang 2025	1.23 (0.88, 1.70)	0.22	0.14	0.37	94.0
Omitting Mari 2025	1.04 (1.02, 1.06)	0.0007	0.0003	0.02	61.2
Omitting Liu 2025	1.22 (0.88, 1.70)	0.24	0.14	0.37	93.8
Omitting Ozer 2024	1.21 (0.86, 1.69)	0.27	0.14	0.38	93.5
Omitting Simental-Mendía 2021 (unadjusted)	1.22 (0.87, 1.70)	0.25	0.14	0.38	94.1
Omitting Simental-Mendía 2021 (adjusted)	1.22 (0.88, 1.70)	0.24	0.14	0.37	94.1
REM	1.18 (0.90, 1.55)	0.23	0.11	0.35	92.7

AST, aspartate aminotransferase; CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between GGT level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Yang 2025	1.33 (1.05, 1.69)	0.02	0.06	0.24	93.2
Omitting Mari 2025	1.19 (1.11, 1.27)	<0.0001	0.004	0.06	83.8
Omitting Liu 2025	1.37 (1.11, 1.68)	0.003	0.04	0.20	87.6
Omitting Kim 2018 (≤10 years)	1.34 (1.06, 1.69)	0.02	0.05	0.23	93.2
Omitting Kim 2018 (>10 years)	1.31 (1.03, 1.66)	0.03	0.06	0.24	93.0
REM	1.30 (1.09, 1.56)	0.004	0.04	0.20	91.3

CI, confidence interval; GGT, gamma-glutamyl transferase; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between TC level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Liu 2025	1.18 (0.85, 1.64)	0.33	0.14	0.37	88.7
Omitting Barakat 2024 (unadjusted)	1.35 (0.91, 2.01)	0.13	0.19	0.43	91.3
Omitting Barakat 2024 (adjusted)	1.35 (0.91, 2.01)	0.13	0.19	0.43	91.4
Omitting Simental-Mendía 2021 (unadjusted)	1.35 (0.91, 2.01)	0.13	0.19	0.43	91.3
Omitting Simental-Mendía 2021 (adjusted)	1.35 (0.91, 2.01)	0.13	0.19	0.43	91.3
Omitting Papandreou 2012	1.00 (0.99, 1.01)	0.24	<0.0001	0.002	65.1
REM	1.28 (0.92, 1.77)	0.14	0.16	0.40	89.2

CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model; TC, total cholesterol.

Leave-one-out sensitivity analysis of the association between TC elevation and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Kumar 2025 (adjusted)	2.92 (0.96, 8.92)	0.06	2.16	1.47	80.3
Omitting Kumar 2025 (unadjusted)	1.81 (0.98, 3.37)	0.06	0.42	0.65	56.7
Omitting Riekki 2023 (boys)	4.15 (1.27, 13.55)	0.02	2.31	1.52	80.0
Omitting Riekki 2023 (girls)	3.74 (1.07, 13.03)	0.04	2.64	1.62	81.9
Omitting Putri 2022 (unadjusted)	4.10 (1.24, 13.55)	0.02	2.37	1.54	80.9
Omitting Putri 2022 (adjusted)	4.16 (1.28, 13.51)	0.02	2.29	1.51	80.4
Omitting Kim 2019 (unadjusted)	3.23 (0.95, 10.99)	0.06	2.55	1.60	79.9
Omitting Kim 2019 (adjusted)	3.65 (1.09, 12.18)	0.04	2.53	1.59	82.0
Omitting Alkassabany 2014	3.23 (0.96, 10.90)	0.06	2.53	1.59	80.7
REM	3.36 (1.15, 9.82)	0.03	2.15	1.47	79.4

CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model; TC, total cholesterol.

Leave-one-out sensitivity analysis of the association between TG level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Liu 2025	1.11 (0.96, 1.23)	0.17	0.05	0.22	99.3
Omitting Barakat 2024 (unadjusted)	1.19 (0.98, 1.45)	0.08	0.08	0.29	99.3
Omitting Barakat 2024 (adjusted)	1.19 (0.98, 1.45)	0.09	0.08	0.29	99.3
Omitting Farghaly 2022	1.06 (1.00, 1.01)	0.001	<0.0001	0.003	70.7
Omitting Simental-Mendía 2021 (unadjusted)	1.19 (0.98, 1.45)	0.08	0.08	0.23	99.3
Omitting Simental-Mendía 2021 (adjusted)	1.19 (0.98, 1.45)	0.08	0.08	0.29	99.3
Omitting Ham 2020	1.15 (0.95, 1.39)	0.14	0.08	0.28	99.3
Omitting Kim 2018 (≤10 years)	1.19 (0.98, 1.45)	0.08	0.08	0.29	99.3
Omitting Kim 2018 (>10 years)	1.19 (0.98, 1.45)	0.08	0.08	0.29	99.3
Omitting Maffeis 2011	1.19 (0.98, 1.45)	0.08	0.08	0.29	99.3
REM	1.16 (0.98, 1.38)	0.08	0.07	0.26	99.3

CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model; TG, triglycerides.

Leave-one-out sensitivity analysis of the association between TG elevation and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Kumar 2025 (unadjusted)	3.07 (2.40, 3.93)	<0.0001	0	0	0
Omitting Kumar 2025 (adjusted)	4.56 (2.17, 9.62)	<0.0001	1.20	1.09	75.3
Omitting Riekki 2023 (boys unadjusted)	5.25 (2.31, 11.93)	<0.0001	1.40	1.19	76.2
Omitting Riekki 2023 (boys adjusted)	5.29 (2.34, 11.97)	<0.0001	1.39	1.18	76.0
Omitting Riekki 2023 (girls unadjusted)	5.04 (2.21, 11.50)	0.0001	1.43	1.20	76.2
Omitting Riekki 2023 (girls adjusted)	5.05 (2.21, 11.52)	0.0001	1.43	1.20	76.2
Omitting Putri 2022 (unadjusted)	5.35 (2.38, 12.02)	<0.0001	1.36	1.17	75.5
Omitting Putri 2022 (adjusted)	5.38 (2.40, 12.02)	<0.0001	1.34	1.16	75.3
Omitting Kim 2020	5.06 (2.24, 11.41)	<0.0001	1.41	1.19	76.3
Omitting Kim 2019	5.24 (2.38, 11.51)	<0.0001	1.33	1.15	76.2
Omitting Alkassabany 2014	5.00 (2.24, 11.20)	<0.0001	1.39	1.18	76.3
REM	4.86 (2.37, 9.98)	<0.0001	1.17	1.08	73.8

CI, confidence interval; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model; TG, triglycerides.

Leave-one-out sensitivity analysis of the association between HDL level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Wang 2025	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0003	41.7
Omitting Liu 2025	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0009	17.4
Omitting Barakat 2024 (unadjusted)	0.96 (0.95, 0.98)	0.0002	<0.0001	0.0013	50.9
Omitting Barakat 2024 (adjusted)	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0027	47.8
Omitting Simental-Mendía 2021 (unadjusted)	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0005	49.9
Omitting Simental-Mendía 2021 (adjusted)	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0027	50.8
Omitting Kim 2018 (>10 years)	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0025	51.3
Omitting Papandreou 2012	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.001	41.3
Omitting Maffei 2011	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0003	52.2
REM	0.97 (0.96, 0.98)	<0.0001	<0.0001	0.0008	45.7

CI, confidence interval; HDL, high-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between HDL decrease and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Kumar 2025	3.01 (2.13, 4.26)	<0.0001	0.15	0.38	50.6
Omitting Riekki 2023 (boys unadjusted)	2.88 (1.96, 4.23)	<0.0001	0.21	0.46	59.8
Omitting Riekki 2023 (boys adjusted)	2.96 (2.05, 4.27)	<0.0001	0.18	0.42	56.2
Omitting Riekki 2023 (girls unadjusted)	2.67 (1.85, 3.86)	<0.0001	0.19	0.43	58.4
Omitting Riekki 2023 (girls adjusted)	2.68 (1.85, 3.86)	<0.0001	0.19	0.43	58.5
Omitting Panjiyar 2023	2.68 (1.90, 3.77)	<0.0001	0.17	0.41	56.9
Omitting Putri 2022(unadjusted)	2.88 (1.96, 4.23)	<0.0001	0.21	0.46	59.9
Omitting Putri 2022 (adjusted)	2.95 (2.04, 4.26)	<0.0001	0.18	0.43	56.9
Omitting Kim 2019 (unadjusted)	2.37 (1.80, 3.12)	<0.0001	0.05	0.21	29.7
Omitting Kim 2019 (adjusted)	2.73 (1.92, 3.87)	<0.0001	0.18	0.42	59.9
Omitting Alkassabany 2014	2.72 (1.86, 3.96)	<0.0001	0.20	0.45	59.6
REM	2.77 (1.97, 3.91)	<0.0001	0.17	0.42	56.3

CI, confidence interval; HDL, high-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between LDL level and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Liu 2025	1.39 (0.75, 2.57)	0.30	0.28	0.53	96.3
Omitting Maffei 2024	1.75 (0.94, 3.24)	0.08	0.27	0.52	96.9
Omitting Papandreou 2012	1.26 (0.79, 1.99)	0.33	0.14	0.37	80.7
Omitting Maffei 2011	1.82 (1.03, 3.21)	0.04	0.22	0.47	89.2
REM	1.54 (0.93, 2.53)	0.09	0.24	0.49	95.4

CI, confidence interval; LDL, low-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.

Leave-one-out sensitivity analysis of the association between LDL elevation and MAFLD risk

Study	OR (95% CI)	P value	Tau ²	Tau	I ² (%)
Omitting Kumar 2025 (unadjusted)	1.43 (1.00, 2.02)	0.04	<0.0001	0.002	57.7
Omitting Kumar 2025 (adjusted)	2.91 (0.90, 9.44)	0.08	2.19	1.48	89.4
Omitting Riekki 2023 (boys)	4.58 (1.21, 17.32)	0.02	2.71	1.65	89.7
Omitting Riekki 2023 (girls)	4.29 (1.10, 16.75)	0.04	2.89	1.70	90.4
Omitting Putri 2022 (unadjusted)	4.55 (1.20, 17.27)	0.03	2.73	1.65	89.9
Omitting Putri 2022 (adjusted)	4.64 (1.24, 17.32)	0.02	2.66	1.63	89.6
Omitting Kim 2019 (unadjusted)	4.37 (1.17, 16.39)	0.03	2.76	1.66	90.3
Omitting Alkassabany 2014	3.23 (0.90, 11.64)	0.07	2.61	1.62	89.8
REM	3.74 (1.15, 12.19)	0.03	2.46	1.57	88.8

CI, confidence interval; LDL, low-density lipoprotein; MAFLD, metabolic (dysfunction)-associated fatty liver disease; OR, odds ratio; REM, random-effects model.