

Supplemental Material

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Search Strategy

To identify relevant studies evaluating the association between estimated glucose disposal rate (eGDR) and cardiovascular outcomes in individuals with type 1 diabetes, a comprehensive literature search was conducted across four major databases: PubMed, Scopus, Embase, and Cochrane Library. The search strategy combined terms related to cardiovascular diseases and glucose disposal rate, without language or date restrictions. The search was conducted on March 6, 2025. Detailed search syntaxes and the number of retrieved results per database are presented below.

6 March 2025

Database	Search Syntax	Result
PubMed	((("Cardiovascular Diseases"[MeSH Terms] OR "Cardiovascular Disease"[Title/Abstract] OR "Heart Disease"[Title/Abstract] OR "Cardiovascular Condition"[Title/Abstract] OR "Coronary Artery Disease"[MeSH Terms] OR "Coronary Artery Disease"[Title/Abstract] OR "Coronary Heart Disease"[Title/Abstract] OR "Ischemic Heart Disease"[Title/Abstract] OR "Ischemic Cardiomyopathy"[Title/Abstract] OR "Chronic Ischemic Heart Disease"[Title/Abstract] OR "Angina Pectoris"[MeSH Terms] OR "Angina Pectoris"[Title/Abstract] OR "Stable Angina"[Title/Abstract] OR "Unstable Angina"[Title/Abstract] OR "Myocardial Infarction"[MeSH Terms] OR "Myocardial Infarction"[Title/Abstract] OR "STEMI"[Title/Abstract] OR "NSTEMI"[Title/Abstract] OR "Silent Myocardial Infarction"[Title/Abstract] OR "Heart Attack"[Title/Abstract] OR "Cardiac Infarction"[Title/Abstract] OR "Acute Coronary Syndrome"[MeSH Terms] OR "Acute Coronary Syndrome"[Title/Abstract] OR "ACS"[Title/Abstract] OR "Stroke"[MeSH Terms] OR "Stroke"[Title/Abstract] OR "Ischemic Stroke"[Title/Abstract] OR "Hemorrhagic Stroke"[Title/Abstract] OR "Atherosclerosis"[MeSH Terms] OR "Atherosclerosis"[Title/Abstract] OR "Carotid Atherosclerosis"[Title/Abstract] OR "Peripheral Arterial Disease"[MeSH Terms] OR "Peripheral Arterial Disease"[Title/Abstract] OR "Peripheral Vascular Disease"[Title/Abstract] OR "Arterial Stenosis"[Title/Abstract] OR "Aortic Aneurysm"[Title/Abstract] OR "Aortic Dissection"[Title/Abstract] OR "Hypertension"[MeSH Terms] OR "Hypertension"[Title/Abstract] OR "Pulmonary Hypertension"[Title/Abstract] OR "Essential Hypertension"[Title/Abstract] OR "Resistant Hypertension"[Title/Abstract] OR "Hypertensive Crisis"[Title/Abstract] OR "Cardiac Arrhythmia"[MeSH Terms] OR "Cardiac Arrhythmia"[Title/Abstract] OR "Atrial Fibrillation"[Title/Abstract] OR "Atrial Flutter"[Title/Abstract] OR "Ventricular Tachycardia"[Title/Abstract] OR "Sudden Cardiac Arrest"[Title/Abstract] OR "Cardiac Arrest"[Title/Abstract] OR "Bradycardia"[Title/Abstract] OR "Tachycardia"[Title/Abstract] OR "Heart Block"[Title/Abstract] OR "Cardiomyopathy"[MeSH Terms] OR "Cardiomyopathy"[Title/Abstract] OR "Dilated Cardiomyopathy"[Title/Abstract] OR "Hypertrophic Cardiomyopathy"[Title/Abstract] OR "Restrictive Cardiomyopathy"[Title/Abstract] OR "Heart Failure"[MeSH Terms] OR "Heart Failure"[Title/Abstract] OR "Congestive Heart Failure"[Title/Abstract] OR "Right Heart Failure"[Title/Abstract] OR "Left Heart Failure"[Title/Abstract] OR "Systolic Heart Failure"[Title/Abstract] OR "Diastolic Heart Failure"[Title/Abstract] OR "Cardiac Dysfunction"[Title/Abstract] OR "End-Stage Heart Failure"[Title/Abstract])	611

	OR "Ventricular Dysfunction"[Title/Abstract] OR "Valvular Heart Disease"[MeSH Terms] OR "Valvular Heart Disease"[Title/Abstract] OR "Aortic Stenosis"[Title/Abstract] OR "Mitral Regurgitation"[Title/Abstract] OR "Tricuspid Regurgitation"[Title/Abstract] OR "Pulmonary Stenosis"[Title/Abstract] OR "Vascular Disease"[Title/Abstract] OR "CVD"[Title/Abstract] OR "Chronic Cardiovascular Disease"[Title/Abstract] OR "Acute Cardiovascular Event"[Title/Abstract] OR "Thrombosis"[MeSH Terms] OR "Thrombosis"[Title/Abstract] OR "Deep Vein Thrombosis"[Title/Abstract] OR "DVT"[Title/Abstract] OR "Pulmonary Embolism"[Title/Abstract] OR "Diabetic Cardiomyopathy"[Title/Abstract] OR "Inflammatory Heart Disease"[Title/Abstract] OR "Myocarditis"[Title/Abstract] OR "Pericarditis"[Title/Abstract] OR "Endocarditis"[Title/Abstract] OR "Vascular Calcification"[Title/Abstract] OR "Microvascular Dysfunction"[Title/Abstract] OR "Cardiovascular Outcomes"[Title/Abstract] OR "Cardiovascular Event"[Title/Abstract] OR "Major Adverse Cardiovascular Event"[Title/Abstract] OR "MACE"[Title/Abstract] OR "Hospitalization"[MeSH Terms] OR "Hospitalization"[Title/Abstract] OR "Cardiovascular Hospitalization"[Title/Abstract] OR "Readmission"[Title/Abstract] OR "30-day Readmission"[Title/Abstract] OR "Heart Failure Hospitalization"[Title/Abstract] OR "Acute Care"[Title/Abstract] OR "Emergency Admission"[Title/Abstract]) AND ("Glucose Disposal Rate" OR "GDR"))	
Scopus	TITLE-ABS-KEY ("Cardiovascular Disease*" OR "Heart Disease*" OR "Cardiovascular Condition*" OR "Cardiovascular Outcome*" OR "Cardiovascular Event*" OR "Coronary Artery Disease*" OR "Coronary Heart Disease*" OR "Ischemic Heart Disease*" OR "Ischemic Cardiomyopath*" OR "Chronic Ischemic Heart Disease*" OR "Angina Pectoris" OR "Stable Angina*" OR "Unstable Angina*" OR "Stable Angina Pectoris" OR "Unstable Angina Pectoris" OR "Variant Angina Pectoris" OR "Myocardial Dis*" OR "Myocardial Infarction*" OR "Heart Infarct*" OR "STEMI" OR "NSTEMI" OR "ST-Elevation" OR "ST Elevation Myocardial Infarction" OR "ST Segment Elevation Myocardial Infarction" OR "non ST Elevation Myocardial Infarction" OR "ST elevation" OR "non ST elevation" OR "non-ST elevation" OR "non ST Segment Elevation Myocardial Infarction" OR "non STEMI" OR "Non-STEMI" OR "Silent Myocardial Infarction" OR "Myocardial Ischemia" OR "Heart Attack*" OR "Cardiac Infarction*" OR "Acute Coronary Syndrome" OR "Chronic Coronary Syndrome" OR "Acute Coronary Disease" OR "Chronic Coronary Disease" OR "Acute Coronary Event" OR "ACS" OR "CCS" OR "Stroke" OR "Ischemic Stroke" OR "Hemorrhagic Stroke" OR "Transient Ischemic Attack" OR "TIA" OR "Cerebrovascular Disorder*" OR "Cerebrovascular Accident*" OR "CVA" OR "Atheroscler*" OR "Coronary Atheroscler*" OR "Carotid Atheroscler*" OR "Aortic Atheroscler*" OR "Peripheral Arterial Disease*" OR "Peripheral Arterial Occlusion" OR "PAD" OR "Peripheral Vascular Disease*" OR "Arterial Steno*" OR "Aortic Aneurysm*" OR "Aorta aneurysm" OR "Arterial aneurysm" OR "Aneurysm*" OR "Aortic Dissect*" OR "Hypertens*" OR "Hypertensive Crisis*" OR "Cardiac Arrhythm*" OR "Heart Arrhythm*" OR "Atrial Fibril*" OR "Atrial Flutter*" OR "AFib" OR "AF" OR "Ventricular Tachycard*" OR "Ventricular Fibril*" OR "Sudden Cardiac Arrest*" OR "Cardiac Arrest*" OR "Heart Arrest*" OR "Bradycard*" OR "Tachycard*" OR "Heart Block*" OR "Cardiomyopath*" OR "Dilated Cardiomyopath*" OR "Hypertrophic Cardiomyopath*" OR "Restrictive Cardiomyopath*" OR "Heart Failure*" OR "Congestive Heart Failure*" OR "Chronic Heart Failure" OR "Right Heart Failure*" OR "Left	1007

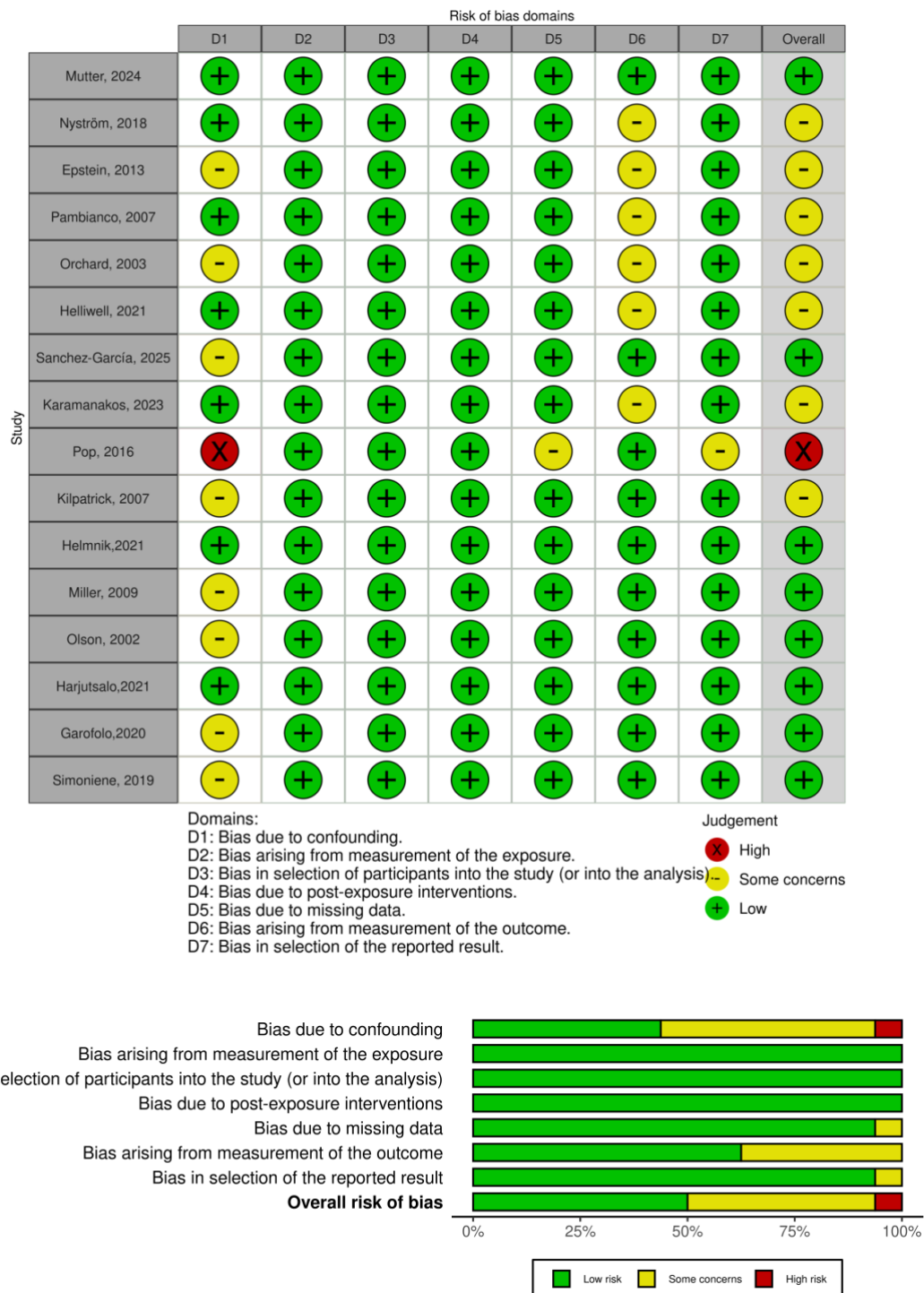
	Heart Failure*" OR "Systolic Heart Failure*" OR "Diastolic Heart Failure*" OR "decompensated heart failure*" OR "HFpEF" OR "HFrEF" OR "HFmrEF" OR "right-sided heart failure" OR "left-sided heart failure" OR "cardiac failure" OR "Cardiac Dysfunction*" OR "End-Stage Heart Failure*" OR "Ventricular Dysfunction*" OR "Valvular Heart Disease*" OR "Aortic Stenosis*" OR "Mitral Regurgitation*" OR "Tricuspid Regurgitation*" OR "Pulmonary Stenosis*" OR "Mitral insuffici*" OR "Tricuspid insuffici*" OR "Vascular Disease*" OR "CVD" OR "Chronic Cardiovascular Disease*" OR "Acute Cardiovascular Event*" OR "Thrombo*" OR "Deep Vein Thrombosis" OR "Vein Thrombosis" OR "Artery Thrombosis" OR "DVT" OR "Pulmonary Embolism" OR "Lung Embolism" OR "Diabetic Cardiomyopath*" OR "Cardiac Fibro*" OR "Vascular Calcif*" OR "Microvascular Dysfunction" OR "Microangiopath*" OR "Microvascular angiopath*" OR "Microvascular dis*" OR "cardiac hospital*" OR "cardiac mortal*" OR "Cardiac death*") AND TITLE-ABS-KEY ("Glucose Disposal Rate" OR "Glucose Disposal" OR "GDR")	
Embase	('cardiovascular disease':ab,ti OR 'cardiovascular disease' OR 'heart disease':ab,ti OR 'heart disease' OR 'coronary artery disease':ab,ti OR 'coronary artery disease' OR 'ischemic heart disease':ab,ti OR 'ischemic heart disease' OR 'coronary heart disease':ab,ti OR 'coronary heart disease' OR (coronary AND ('heart':ab,ti OR heart) AND ('disease':ab,ti OR disease)) OR 'ischemic cardiomyopathy':ab,ti OR 'ischemic cardiomyopathy' OR 'chronic ischemic heart disease':ab,ti OR 'chronic ischemic heart disease' OR 'angina pectoris':ab,ti OR 'angina pectoris' OR (('angina':ab,ti OR angina) AND pectoris) OR 'stable angina pectoris':ab,ti OR 'stable angina pectoris' OR 'unstable angina pectoris':ab,ti OR 'unstable angina pectoris' OR 'myocardial infarction':ab,ti OR 'myocardial infarction' OR (myocardial AND ('infarction':ab,ti OR infarction)) OR 'st segment elevation myocardial infarction':ab,ti OR 'st segment elevation myocardial infarction' OR 'non st segment elevation myocardial infarction':ab,ti OR 'non st segment elevation myocardial infarction' OR 'stemi':ab,ti OR stemi OR nsemi OR 'silent myocardial infarction':ab,ti OR 'silent myocardial infarction' OR 'heart infarction':ab,ti OR 'heart infarction' OR 'heart attack':ab,ti OR 'heart attack' OR (('heart':ab,ti OR heart) AND attack) OR 'cardiac infarction':ab,ti OR 'cardiac infarction' OR (('cardiac':ab,ti OR cardiac) AND ('infarction':ab,ti OR infarction)) OR 'acute coronary syndrome':ab,ti OR 'acute coronary syndrome' OR 'acs':ab,ti OR acs OR 'cerebrovascular accident':ab,ti OR 'cerebrovascular accident' OR 'stroke':ab,ti OR stroke OR 'ischemic stroke':ab,ti OR 'ischemic stroke' OR 'brain hemorrhage':ab,ti OR 'brain hemorrhage' OR 'atherosclerosis':ab,ti OR 'atherosclerosis' OR 'peripheral arterial disease':ab,ti OR 'peripheral arterial disease' OR 'peripheral vascular disease':ab,ti OR 'peripheral vascular disease' OR 'arterial stenosis':ab,ti OR 'arterial stenosis' OR 'aortic aneurysm':ab,ti OR 'aortic aneurysm' OR 'aortic dissection':ab,ti OR 'aortic dissection' OR 'hypertension':ab,ti OR 'hypertension' OR 'hypertensive crisis':ab,ti OR 'hypertensive crisis' OR 'heart arrhythmia':ab,ti OR 'heart arrhythmia' OR 'cardiac arrhythmia':ab,ti OR 'cardiac arrhythmia' OR (('cardiac':ab,ti OR cardiac) AND ('arrhythmia':ab,ti OR arrhythmia)) OR 'heart atrium flutter':ab,ti OR 'heart atrium flutter' OR 'heart ventricle tachycardia':ab,ti OR 'heart ventricle tachycardia' OR 'atrial fibrillation':ab,ti OR 'atrial fibrillation' OR (atrial AND ('fibrillation':ab,ti OR fibrillation)) OR 'atrial flutter':ab,ti OR 'atrial flutter' OR (atrial AND ('flutter':ab,ti OR flutter)) OR 'ventricular tachycardia':ab,ti OR 'ventricular tachycardia' OR (ventricular AND ('tachycardia':ab,ti OR tachycardia)) OR	885

	'sudden cardiac death':ab,ti OR 'sudden cardiac death' OR 'heart arrest':ab,ti OR 'heart arrest' OR 'cardiac arrest':ab,ti OR 'cardiac arrest' OR ('cardiac':ab,ti OR cardiac) AND ('arrest':ab,ti OR arrest)) OR 'bradycardia':ab,ti OR 'bradycardia' OR 'tachycardia':ab,ti OR 'tachycardia' OR 'heart block':ab,ti OR 'heart block' OR 'cardiomyopathy':ab,ti OR 'cardiomyopathy' OR 'dilated cardiomyopathy':ab,ti OR 'dilated cardiomyopathy' OR 'hypertrophic cardiomyopathy':ab,ti OR 'hypertrophic cardiomyopathy' OR 'restrictive cardiomyopathy':ab,ti OR 'restrictive cardiomyopathy' OR 'diabetic cardiomyopathy':ab,ti OR 'diabetic cardiomyopathy' OR 'heart failure':ab,ti OR 'heart failure' OR 'congestive heart failure':ab,ti OR 'congestive heart failure' OR 'heart right ventricle failure':ab,ti OR 'heart right ventricle failure' OR 'heart left ventricle failure':ab,ti OR 'heart left ventricle failure' OR 'systolic heart failure':ab,ti OR 'systolic heart failure' OR 'diastolic heart failure':ab,ti OR 'diastolic heart failure' OR 'cardiac dysfunction':ab,ti OR 'cardiac dysfunction' OR 'end stage heart failure':ab,ti OR 'end stage heart failure' OR 'heart ventricle function':ab,ti OR 'heart ventricle function' OR 'ventricle dysfunction' OR (ventricle AND dysfunction) OR 'valvular heart disease':ab,ti OR 'valvular heart disease' OR 'aortic stenosis':ab,ti OR 'aortic stenosis' OR 'mitral valve regurgitation':ab,ti OR 'mitral valve regurgitation' OR 'tricuspid valve regurgitation':ab,ti OR 'tricuspid valve regurgitation' OR 'pulmonary valve stenosis':ab,ti OR 'pulmonary valve stenosis' OR 'pulmonary stenosis':ab,ti OR 'pulmonary stenosis' OR (pulmonary AND ('stenosis':ab,ti OR stenosis)) OR 'tricuspid regurgitation':ab,ti OR 'tricuspid regurgitation' OR (tricuspid AND ('regurgitation':ab,ti OR regurgitation)) OR 'mitral regurgitation':ab,ti OR 'mitral regurgitation' OR (mitral AND ('regurgitation':ab,ti OR regurgitation)) OR 'vascular disease':ab,ti OR 'vascular disease' OR cvd OR 'chronic cardiovascular disease' OR (chronic AND ('cardiovascular':ab,ti OR cardiovascular) AND ('disease':ab,ti OR disease)) OR 'acute cardiovascular event' OR (acute AND ('cardiovascular':ab,ti OR cardiovascular) AND event) OR 'thrombosis':ab,ti OR 'thrombosis' OR 'deep vein thrombosis':ab,ti OR 'deep vein thrombosis' OR dvt OR 'lung embolism':ab,ti OR 'lung embolism' OR 'pulmonary embolism':ab,ti OR 'pulmonary embolism' OR (pulmonary AND ('embolism':ab,ti OR embolism)) OR 'heart muscle fibrosis':ab,ti OR 'heart muscle fibrosis' OR 'cardiac fibrosis':ab,ti OR 'cardiac fibrosis' OR (('cardiac':ab,ti OR cardiac) AND ('fibrosis':ab,ti OR fibrosis)) OR 'blood vessel calcification':ab,ti OR 'blood vessel calcification' OR 'vascular calcification':ab,ti OR 'vascular calcification' OR (vascular AND ('calcification':ab,ti OR calcification)) OR 'microvascular dysfunction':ab,ti OR 'microvascular dysfunction' OR (microvascular AND dysfunction) OR 'hospitalization':ab,ti OR 'hospitalization' OR 'mortality':ab,ti OR 'mortality') AND ('glucose disposal rate':ab,ti OR 'glucose disposal rate' OR gdr)	
Cochrane	(hospitalization rate):ti,ab,kw OR (cardiovascular accident):ti,ab,kw OR (cardiovascular disease):ti,ab,kw OR (CVD):ti,ab,kw OR (CVD risk):ti,ab,kw OR (heart-disease):ti,ab,kw OR (heart-diseases):ti,ab,kw OR (coronary artery disease):ti,ab,kw OR (coronary heart disease):ti,ab,kw OR (ischemic heart disease):ti,ab,kw OR (ischemic cardiomyopathy):ti,ab,kw OR (angina pectoris):ti,ab,kw OR (stable angina pectoris):ti,ab,kw OR (unstable angina):ti,ab,kw OR (unstable angina pectoris):ti,ab,kw OR (stable angina):ti,ab,kw OR (myocardial infarction):ti,ab,kw OR (STEM):ti,ab,kw OR (ST elevation):ti,ab,kw OR (ST-elevation):ti,ab,kw OR (NSTEMI):ti,ab,kw OR (non ST elevation):ti,ab,kw OR (non ST segment elevation):ti,ab,kw OR (non-ST elevation):ti,ab,kw OR (non-ST segment elevation):ti,ab,kw OR (ST segment elevation):ti,ab,kw OR (ST segment elevation MI):ti,ab,kw OR (ST segment elevation myocardial	200

	infarction):ti,ab,kw OR (ST segment resolutions):ti,ab,kw OR (silent myocardial ischaemia):ti,ab,kw OR (silent myocardial ischaemias):ti,ab,kw OR (silent myocardial ischemia):ti,ab,kw OR (heart attack):ti,ab,kw OR (cardiac infarction):ti,ab,kw OR (acute coronary event):ti,ab,kw OR (acute coronary infarction):ti,ab,kw OR (acute coronary syndrome):ti,ab,kw OR (ACS):ti,ab,kw OR (stroke):ti,ab,kw OR (ischemic stroke):ti,ab,kw OR hemorrhagic stroke):ti,ab,kw OR (atherosclerosis):ti,ab,kw OR (peripheral arterial disease):ti,ab,kw OR (peripheral artery disease):ti,ab,kw OR (peripheral vascular disease):ti,ab,kw OR (aortic aneurysm):ti,ab,kw OR (hypertension):ti,ab,kw OR (arrhythmia):ti,ab,kw OR (arrhythmias):ti,ab,kw OR (atrial fibrillation):ti,ab,kw OR (atrial flutter):ti,ab,kw OR (ventricular tachyarrhythmia):ti,ab,kw OR (ventricular tachycardia):ti,ab,kw OR (ventricular tachycardia event):ti,ab,kw OR (sudden cardiac arrest):ti,ab,kw OR (cardiac arrest):ti,ab,kw OR (cardiac-arrest):ti,ab,kw OR (cardiac-arrests):ti,ab,kw OR (tachycardia):ti,ab,kw OR (bradycardia):ti,ab,kw OR (complete heart block):ti,ab,kw OR (heart block):ti,ab,kw OR (third degree atrioventricular block):ti,ab,kw OR (third degree heart block):ti,ab,kw OR (cardiomyopathy):ti,ab,kw OR (dilated cardiomyopathy):ti,ab,kw OR (dilated cardiomyopathies):ti,ab,kw OR (hypertrophic cardiomyopathy):ti,ab,kw OR (hypertrophic cardiomyopathies):ti,ab,kw OR (restrictive cardiomyopathy):ti,ab,kw OR (restrictive cardiomyopathies):ti,ab,kw OR (heart failure):ti,ab,kw OR (heart-failure):ti,ab,kw OR (congestive cardiac failure):ti,ab,kw OR (congestive heart failure):ti,ab,kw OR (cardiac failure):ti,ab,kw OR (right heart failure):ti,ab,kw OR (left heart failure):ti,ab,kw OR (systolic heart failure):ti,ab,kw OR (cardiac dysrhythmia):ti,ab,kw OR (valvular heart disease):ti,ab,kw OR (aortic stenosis):ti,ab,kw OR (mitral regurgitation):ti,ab,kw OR (tricuspid insufficiency):ti,ab,kw OR (tricuspid regurgitation):ti,ab,kw OR (mitral insufficiency):ti,ab,kw OR (pulmonary stenosis):ti,ab,kw OR (vascular disease):ti,ab,kw OR (acute cardiovascular disease):ti,ab,kw OR (thrombosis):ti,ab,kw OR (deep vein thromboses):ti,ab,kw OR (pulmonary emboli):ti,ab,kw OR (pulmonary embolism):ti,ab,kw OR (vascular calcification):ti,ab,kw OR (cardiovascular event rate):ti,ab,kw AND ("glucose disposal rate"):ti,ab,kw OR (glucose disposal rates):ti,ab,kw OR (glucose disposal):ti,ab,kw OR (GDR):ti,ab,kw	
Total		2703

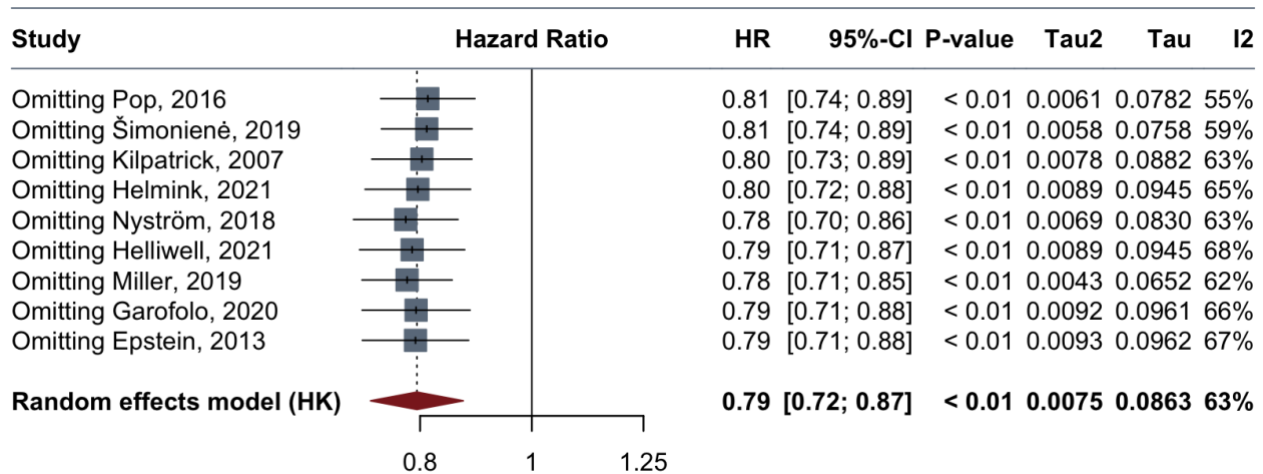
Quality Assessment

Supplemental Figure 1. Risk of bias assessment using ROBINS-E. Green (+) indicates low risk (no or minimal concerns), yellow (-) indicates some concerns (potential but unclear risk), and red (×) indicates high risk (important methodological limitations). Domains D1–D7 represent confounding, exposure measurement, participant selection, post-exposure interventions, missing data, outcome measurement, and selective reporting, respectively. Most concerns arose in D1 and D6. One study was rated high risk, seven had some concerns, and eight were deemed low risk overall.



Association Between eGDR and MACE in Type 1 Diabetes

Supplementary Figure 2.1. Sensitivity analysis with Leave-One-Out method for MACE outcome.

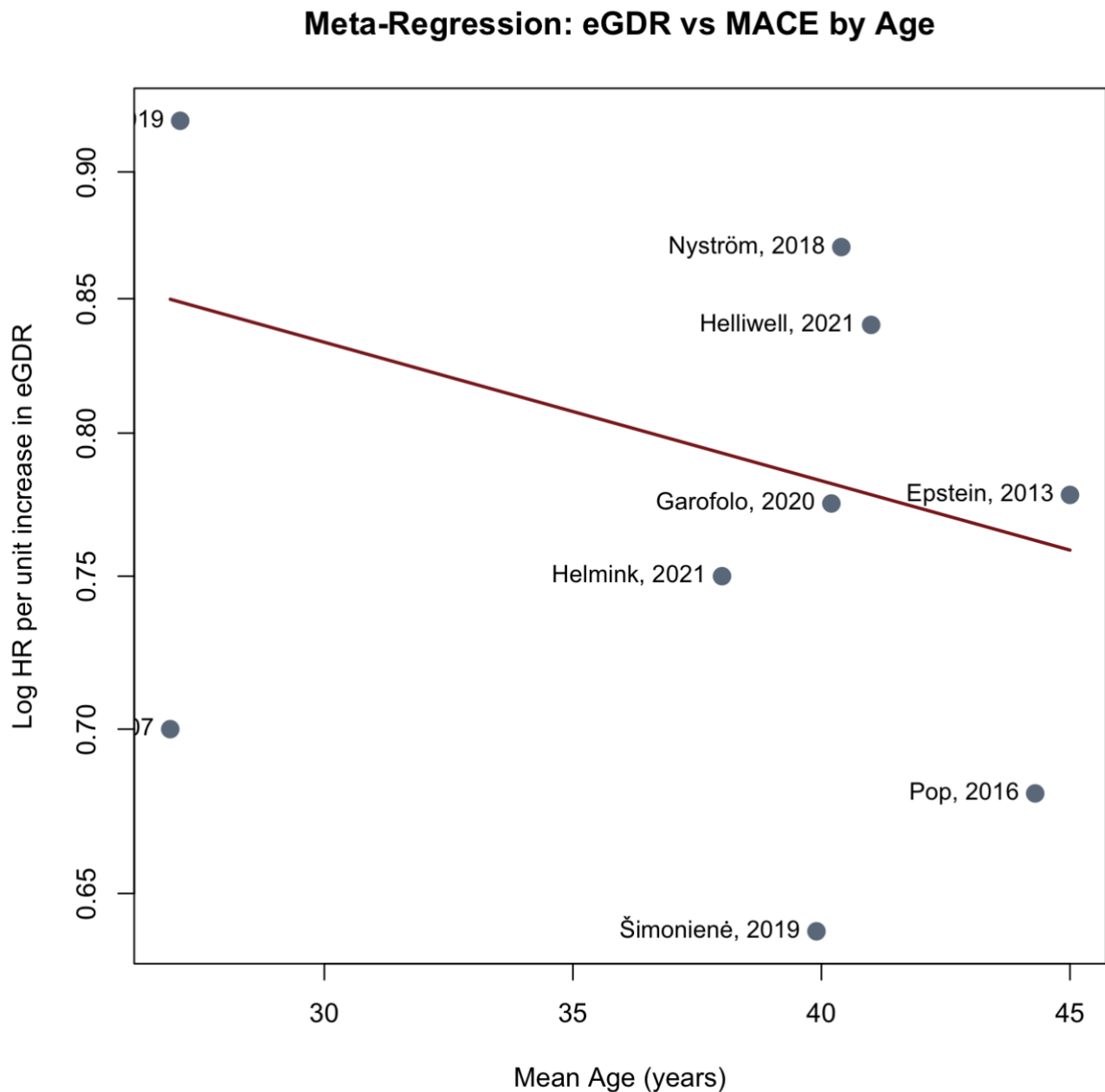


Supplementary Table 2. Findings of meta-regression analyses.

Variable	Estimate	SE	p-value	R ² (amount of heterogeneity accounted for):	I ² (residual heterogeneity / unaccounted variability):
Mean Age	-0.0063	0.0063	0.3514	0%	58.09%
Male %	-0.0009	0.0095	0.9249	0%	70.17%
Mean duration of diabetes	0.0081	0.0178	0.6644	0%	58.50%
Mean HDL (mg/dl)	0	0.0099	0.9963	0%	66.13%
BMI	0.0043	0.0379	0.9138	0%	65.10%

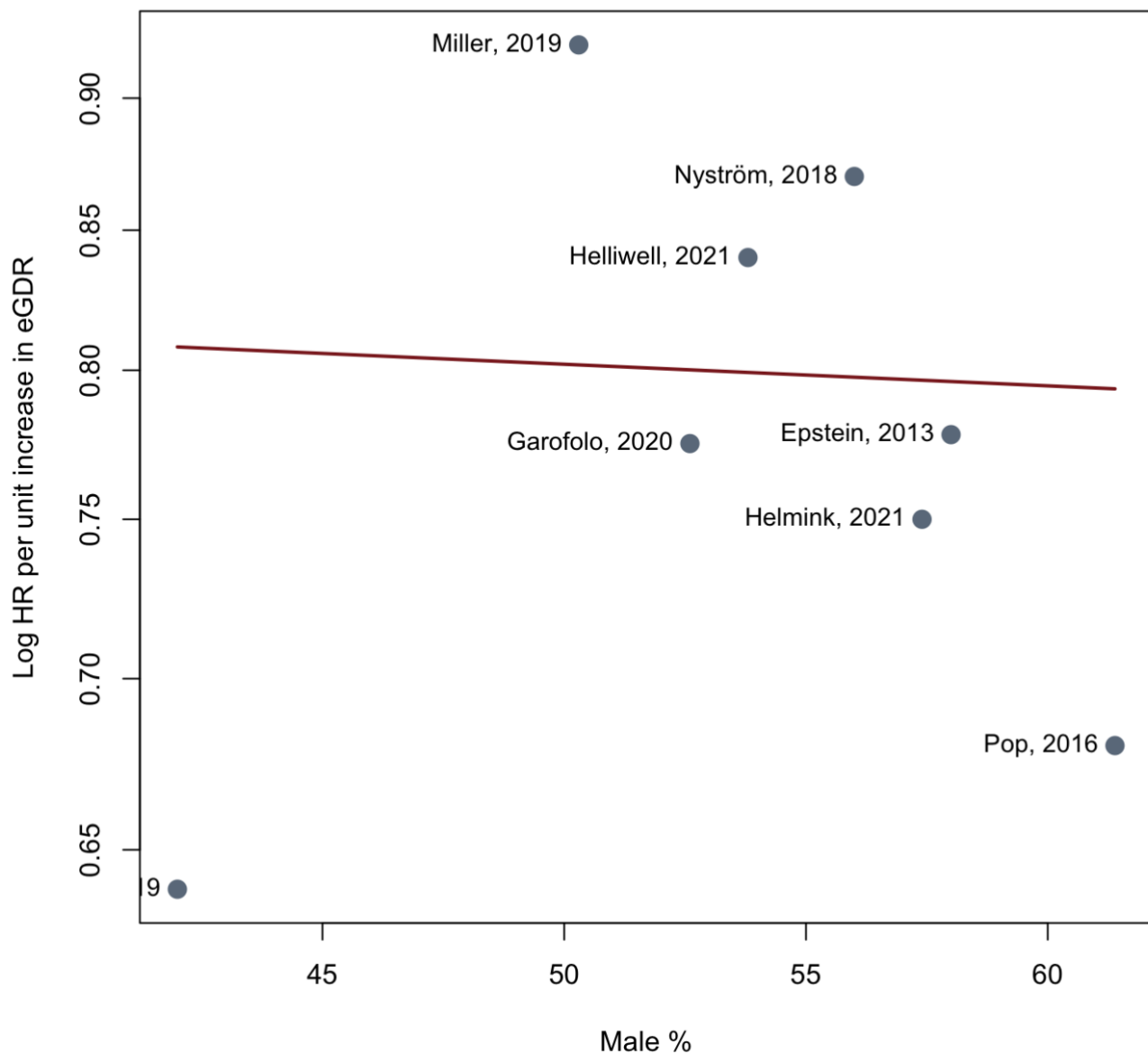
Meta-regression analyses showed that none of the evaluated study-level covariates—mean age, male percentage, diabetes duration, HDL level, or BMI—significantly explained the between-study heterogeneity in the association between eGDR and MACE risk (all p-values > 0.35). The R² values were 0% for all variables, indicating that these factors did not account for any meaningful portion of the observed variance. Residual heterogeneity (I² values ranging from ~58% to 70%) suggests other unmeasured factors may contribute to between-study differences.

Supplementary Figure 2.2. Bubble plot from meta-regression assessing the association between eGDR and MACE by *mean age*. The x-axis represents the mean age (years) of participants in each study; the y-axis shows the log-transformed HR per unit increase in eGDR. Bubble size is inversely proportional to the variance (i.e., larger bubbles represent more precise estimates).



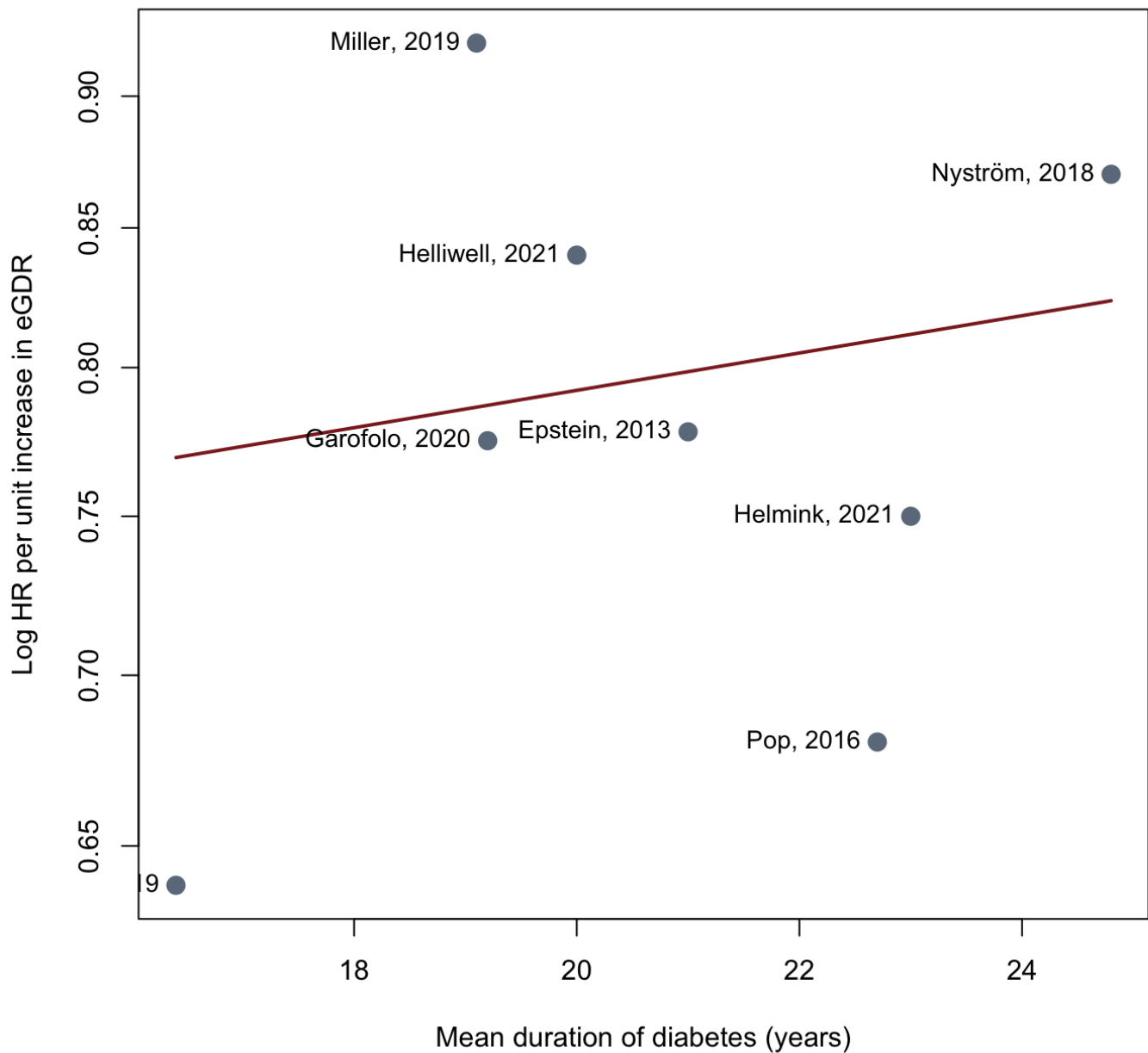
Supplementary Figure 2.3. Bubble plot from meta-regression assessing the association between eGDR and MACE by *male percentage*. The x-axis shows the percentage of male participants; the y-axis shows the log HR per unit increase in eGDR. Bubble size reflects inverse variance weighting.

Meta-Regression: eGDR vs MACE by Male %

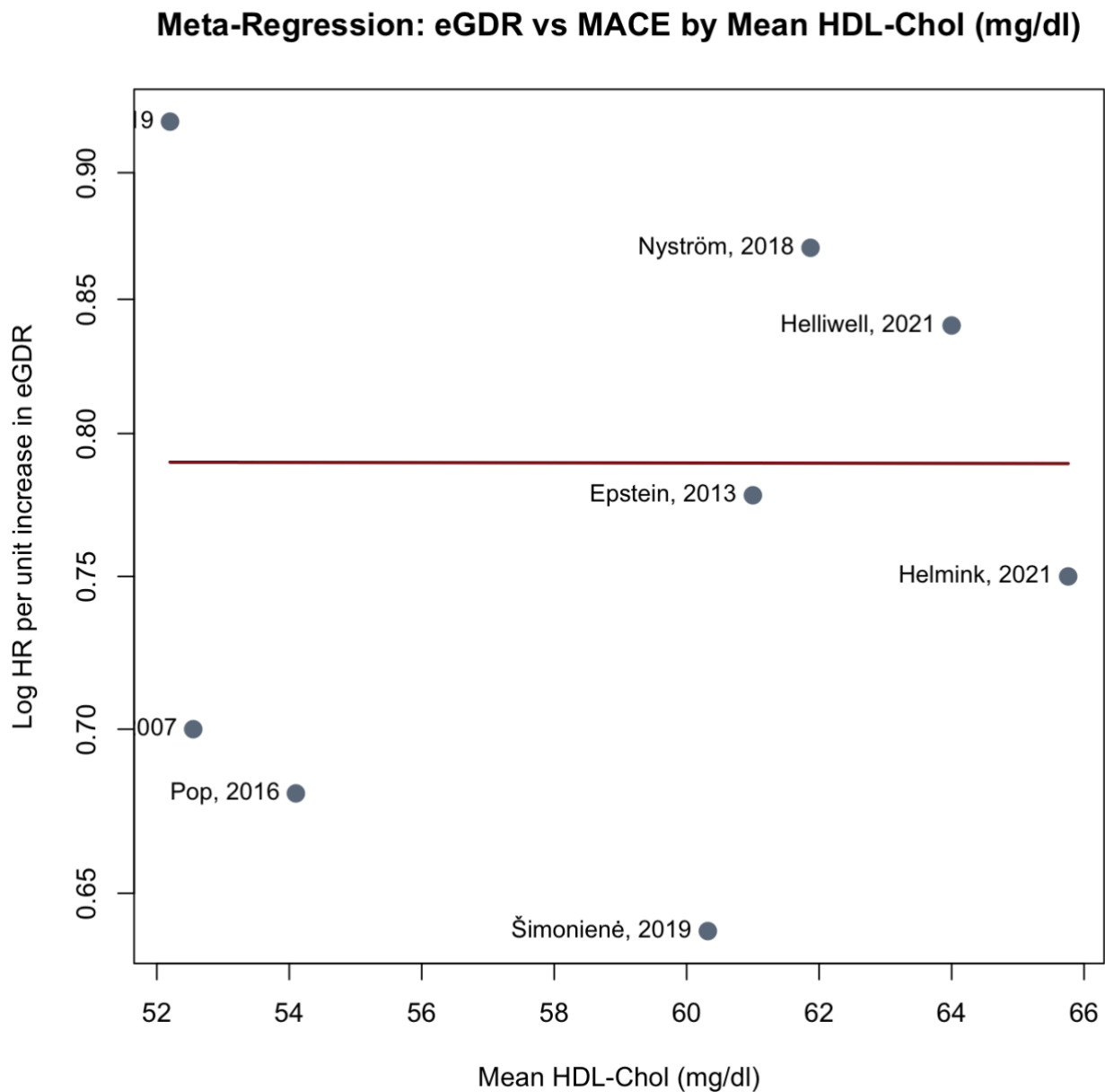


Supplementary Figure 2.4. Bubble plot from meta-regression assessing the association between eGDR and MACE by *mean duration of diabetes* (years). The x-axis represents mean diabetes duration, and the y-axis displays the log HR per unit increase in eGDR. Bubble sizes indicate study precision (inverse variance).

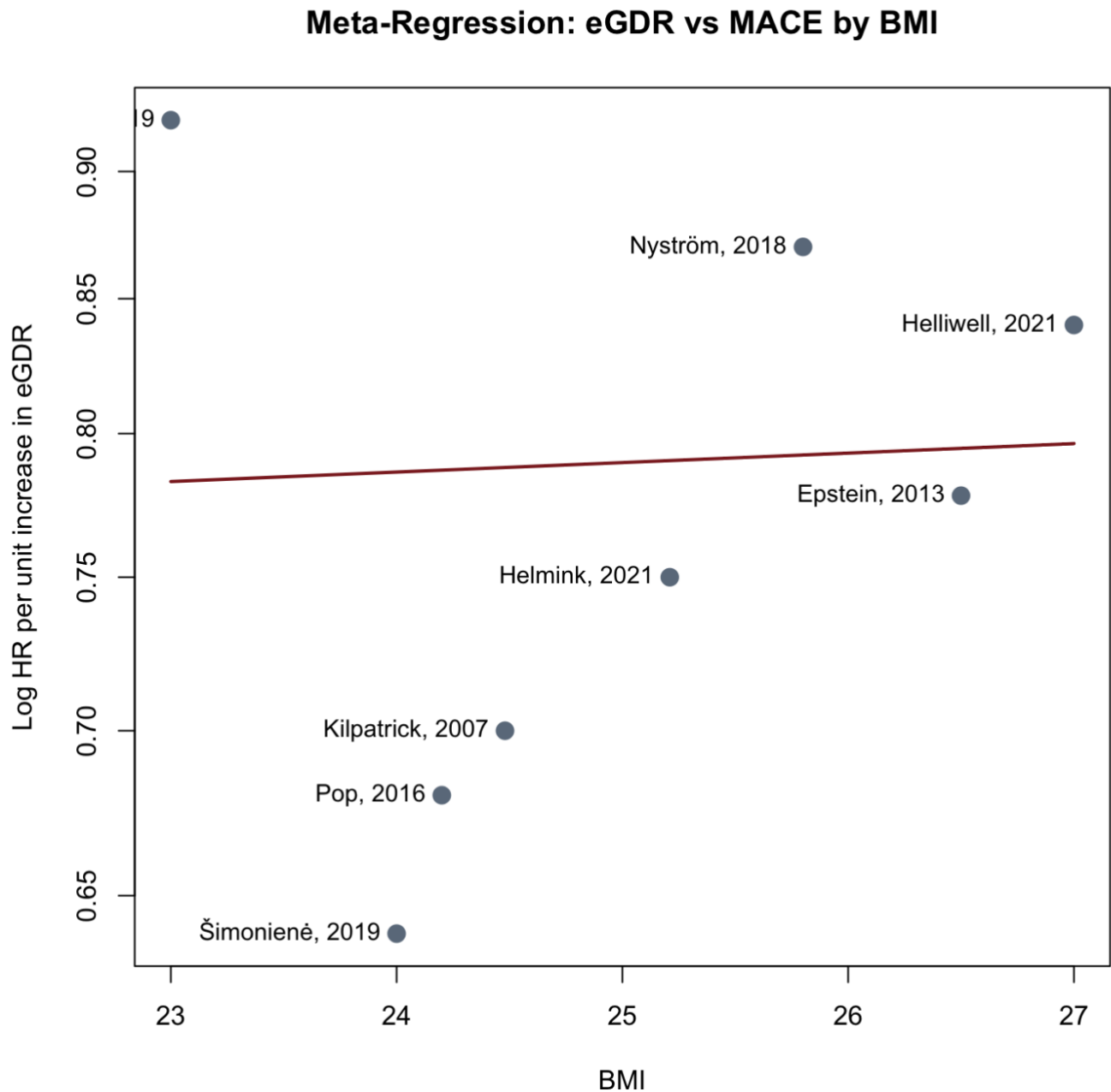
Meta-Regression: eGDR vs MACE by Mean duration of diabetes (years)



Supplementary Figure 2.5. Bubble plot from meta-regression assessing the association between eGDR and MACE by *mean HDL cholesterol level* (mg/dL). The x-axis displays HDL levels; the y-axis shows log HRs. Bubble size corresponds to the inverse of the variance.

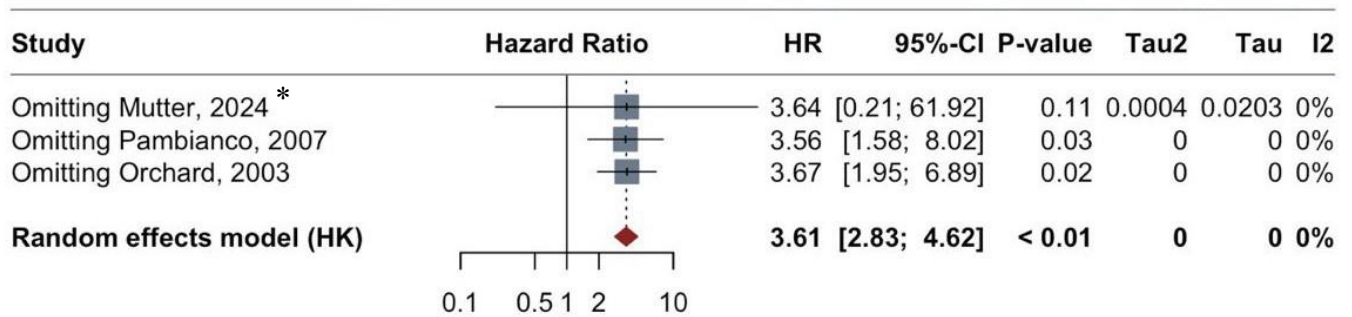


Supplementary Figure 2.6. Bubble plot from meta-regression assessing the association between eGDR and MACE by *mean BMI* (kg/m²). The x-axis shows BMI; the y-axis indicates log HR per unit increase in eGDR. Larger bubbles denote studies with smaller variance.



Association Between eGDR and CAD in Type 1 Diabetes

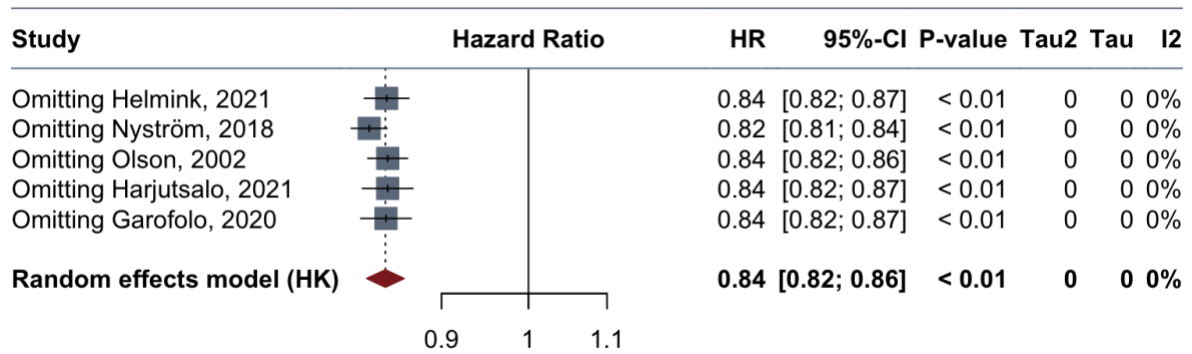
Supplementary Figure 3. Sensitivity analysis with the Leave-One-Out method for CAD outcome



* Indicates the study whose exclusion changed the statistical significance of the pooled outcome.

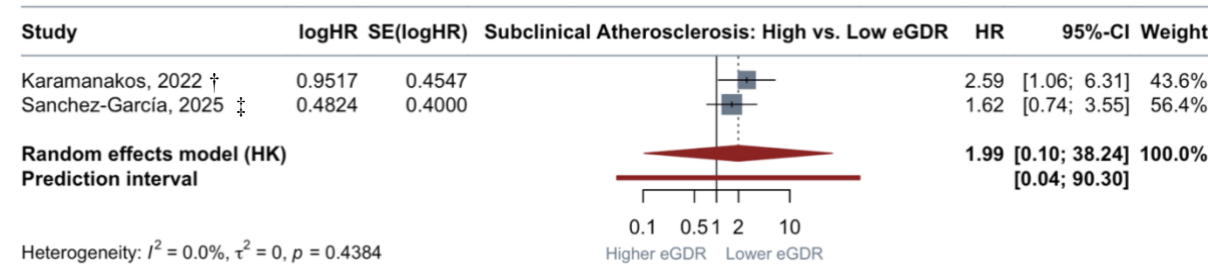
Association Between eGDR and All-Cause Mortality in Type 1 Diabetes

Supplementary Figure 4. Sensitivity analysis with the Leave-One-Out method for all-cause mortality outcome.



Association Between eGDR and Subclinical Atherosclerosis in Type 1 Diabetes

Supplementary Figure 5. Forest plot showing the risk of subclinical atherosclerosis in T1DM patients, comparing high versus low eGDR groups.



† Karamanakos et al. evaluated subclinical atherosclerosis using carotid-femoral pulse wave velocity (PWV), a functional vascular marker.

‡ Sánchez-García et al. assessed carotid intima-media thickness (CIMT), a structural marker of subclinical atherosclerosis.

Excluded Studies After Full-text Review

Supplementary Table 3. List of studies excluded after full-text screening and reasons for exclusion.

Study (Author, Year)	Title	Reason for exclusion
Duṭa, 2015	The association between insulin resistance and advanced renal disease in type 1 diabetes	The study examined an irrelevant outcome.
Duṭa, 2015 (Duplicate)	The association between insulin resistance and advanced renal disease in type 1 diabetes	The study examined an irrelevant outcome.
Krochik, 2015	Association between insulin resistance and risk of complications in children and adolescents with type 1 diabetes	The study examined an irrelevant outcome.
Cantley, 2021	The association between overweight/obesity and double diabetes in adults with type 1 diabetes; a cross-sectional study	The study examined an irrelevant outcome.
Barmpagianni, 2021	The association of insulin resistance with early predictors of cardiovascular, renal and neurologic complications in patients with type 1 diabetes	It was an oral presentation.
Zeng, 2024	Body composition and metabolic syndrome in patients with type 1 diabetes	This study did not assess the relation between GDR and CVD.
Ruppert, 2007	Cardiovascular disease risk prediction in type 1 diabetes: Accounting for the differences	There was no analyzable data in the study.
Lembo, 1996	Insulin and the sympathetic nervous system in the pathophysiology of hypertension	The study was a review article.
Pearson, 2022	The contribution of insulin resistance and glycaemia on fibrin related clot parameters in young adults with type 1 diabetes	The study examined an irrelevant outcome.
Banerji, 1991	Coronary heart disease risk factor profiles in black patients with non-insulin-dependent diabetes mellitus: Paradoxical patterns	The study examined the wrong population.
Li, 2022	The Correlation Between Estimated Glucose Disposal Rate and Coagulation Indexes in Type 2 Diabetes Mellitus	The study examined the wrong population and irrelevant outcome.
Dejgaard, 2022	The Effect of Adjunctive Therapy with Liraglutide on Insulin Sensitivity in Overweight Persons with Type 1 Diabetes	The study examined an irrelevant outcome.
Moan, 1996	The effect of angiotensin II receptor antagonism with losartan on glucose metabolism and insulin sensitivity	The study examined an irrelevant outcome.
Moan, 1994	The effect of angiotensin II receptor blockade on insulin sensitivity and sympathetic nervous system activity in primary hypertension	The study examined an irrelevant outcome.
Zander, 1990	The effect of antihypertensive treatment on kidney function in insulin-dependent (type I) diabetics with renal failure	The study examined an irrelevant outcome.
Blixt, 2021	The effect of glucose control in liver surgery on glucose kinetics and insulin resistance	The study examined an irrelevant outcome.
Laakso, 1989	Essential hypertension and insulin resistance in non-insulin-dependent diabetes	The study examined the wrong population.
O'Mahoney, 2021	Estimated glucose disposal rate as a candidate biomarker for thrombotic biomarkers in T1D: a pooled analysis	The study examined an irrelevant outcome.
Stühlinger, 2002	Relationship between insulin resistance and an endogenous nitric oxide synthase inhibitor	The study examined an irrelevant outcome.
Yu, 2003	The relationship between insulin resistance and endothelium-dependent vasodilatation in obese subjects	The language of study wasn't English.

McLaughlin, 2001	Relationship between insulin resistance, weight loss, and coronary heart disease risk in healthy, obese women	The aim of the study was different from our investigation.
Bulum, 2011	Relationship between insulin sensitivity and lipid profile in euthyroid type 1 diabetic patients	The study examined an irrelevant outcome.
Fossum, 1998	Relationship between insulin sensitivity and maximal forearm blood flow in young men	The study examined an irrelevant outcome.
Maaten, 1998	Relationship between insulin's haemodynamic effects and insulin-mediated glucose uptake	The study examined an irrelevant biomarker.
Garg, 1998	Relationship between lipoprotein levels and in vivo insulin action in normal young white men	The study examined an irrelevant biomarker and outcome.
Herlitz, 1996	Relationship between sodium-lithium countertransport and insulin sensitivity in mild hypertension	The study examined an irrelevant outcome.
Gandecha, 2017	The relationship between sudomotor function and insulin resistance in adults with type 1 diabetes	It was an abstract.
Wajcberg, 2007	Relationship between vascular reactivity and lipids in Mexican-Americans with type 2 diabetes treated with pioglitazone	The study examined unfavorable outcomes and had a different target. (effect of pioglitazone)
Ozkaya, 2024	Relationship between visceral adiposity index and glycemic and metabolic control in children and adolescents with type 1 diabetes mellitus	The study examined an irrelevant outcome.
Ozkaya, 2024 (Duplicated)	Relationship between visceral adiposity index and glycemic and metabolic control in children and adolescents with type 1 diabetes mellitus	The study examined an irrelevant outcome.
Howard, 1998	Relationships between insulin resistance and lipoproteins in nondiabetic african americans, hispanics, and non-hispanic whites: The insulin resistance atherosclerosis study	The study examined an irrelevant outcome.
Fiorentino, 2019	Relationships of surrogate indexes of insulin resistance with insulin sensitivity assessed by euglycemic hyperinsulinemic clamp and subclinical vascular damage	The study examined an irrelevant outcome.
Janson, 2021	Remnant cholesterol predicts progression of diabetic nephropathy and retinopathy in type 1 diabetes	The study data didn't align with our study.
Ruggenenti, 2017	Renal and Systemic Effects of Calorie Restriction in Patients With Type 2 Diabetes With Abdominal Obesity: a Randomized Controlled Trial	The study data didn't align with our study (GDR reported in standard diet and restricted diet)
NCT, 2005	Renal and Systemic Effects of NCX4016 in Patients With Type 2 Diabetes and Early Nephropathy	It was a clinical trial registered in Cochrane. We couldn't find the main study.
Mirowska, 2016	Renal denervation for resistant hypertension fails to improve insulin resistance as assessed by hyperinsulinemic-euglycemic step clamp	The study examined an unfavorable population and had a different target.
Ter Maaten, 1997	Renal handling of urate and sodium during acute physiological hyperinsulinaemia in healthy subjects	The study examined an irrelevant outcome.
Ter Maaten, 1997 (Duplicated)	Renal handling of urate and sodium during acute physiological hyperinsulinaemia in healthy subjects	The study examined an irrelevant outcome.
NCT, 2019	RESIST! Blood-flow Restriction Resistance Training for Improving Insulin Sensitivity in Type 2 Diabetes	It was a clinical trial registered in Cochrane. We couldn't find the main study.
Shen, 1988	Resistance to insulin-stimulated-glucose uptake in patients with hypertension	The study examined an irrelevant outcome and biomarker.
Reynolds, 2004	Resistance training enhances insulin-mediated glucose disposal with minimal effect on the tumor necrosis factor-alpha system in older hypertensives	The study examined unfavorable outcome, biomarker, and had a different target.

Conroy, 2011	Retinol binding protein 4 is associated with adiposity-related co-morbidity risk factors in children	The study examined unfavorable outcome and had a different index.
Donaghue, 2009	Risk modelling for diabetes complications: Predictors and confounders	It was a presentation.
NCT, 2023	Role of BCAA in glucose homeostasis	It was a clinical trial registered in Cochrane. We couldn't find the main study.
Kim, 1994	The role of beta 2-adrenoceptor on the pathogenesis of insulin resistance in essential hypertension	The language of study wasn't English.
Mertens, 2021	The role of egdr as a predictor of insulin resistance and cardiovascular disease	It was an abstract.
Alam, 2012	Role of glycemia in insulin sensitivity in adolescents with type 1 and type 2 diabetes	It was a book chapter.
Euctr, 2017	THE ROLE OF HYPERGLYCEMIA, HYPERINSULINEMIA AND ELEVATED FREE FATTY ACIDS FOR CARDIAC FUNCTION IN PATIENTS WITH TYPE 2 DIABETES	It was a clinical trial registered in Cochrane. We couldn't find the main study.
Bartz, 2015	Role of insulin resistance and hyperandrogenemia in early vascular dysfunction in adolescents with PCOS	It was a conference abstract.
Mertens, 2020	The role of insulin resistance and NAFLD in the cardiometabolic risk profile of type 1 diabetes	It was a conference abstract.
Raji, 2003	Rosiglitazone improves insulin sensitivity and lowers blood pressure in hypertensive patients	The study had a different target. (effect of Rosiglitazone on IR)
Townsend, 2007	Salt intake and insulin sensitivity in healthy human volunteers	The study examined an irrelevant outcome.
Fuenmayor, 1998	Salt sensitivity is associated with insulin resistance in essential hypertension	The study examined unfavorable outcomes and had a different target.
Yamasaki, 1998	Selective alpha 1-adrenergic inhibition improves decrease glucose disposal in patients with essential hypertension	It was an interventional study.
Yamasaki, 1998 (Duplicated)	Selective alpha 1-adrenergic inhibition improves decrease glucose disposal in patients with essential hypertension	It was an interventional study.
Haenni, 2001	Serum aldosterone changes during hyperinsulinemia are correlated to body mass index and insulin sensitivity in patients with essential hypertension	The study examined an irrelevant outcome.
Haluzik, 2002	Serum leptin levels in patients with primary hyperaldosteronism before and after treatment: Relationships to insulin sensitivity	The study examined unfavorable outcomes and had a different target.
Eldin, 2023	Serum neuregulin 1 in relation to ventricular function and subclinical atherosclerosis in type 2 diabetes patients	The study examined an irrelevant outcome.
Höiegggen, 2003	Serum uric acid and hemorheology in borderline hypertensives and in subjects with established hypertension and left ventricular hypertrophy	The study examined an irrelevant outcome.
Mertens, 2024	The 13C Glucose Breath Test Accurately Identifies Insulin Resistance in People With Type 1 Diabetes	The study examined an irrelevant outcome.
Szadkowska, 2009	Ambulatory arterial stiffness index and insulin sensitivity in type 1 diabetes mellitus	The study was retracted.
NCT, 2015	The Anabolic Effect Of Perioperative Nutrition With Insulin In Patients Undergoing CABG	The study examined unfavorable outcomes and had a different target.
Lind, 2006	The apolipoprotein B/AI ratio and the metabolic syndrome independently predict risk for myocardial infarction in middle-aged men	The study examined unfavorable outcomes and had a different target.
Pietrzak, 2012	Arterial stiffness is negatively related to insulin sensitivity in young type 1 diabetic patients	The study examined an irrelevant outcome.

Maurovich-Horvat, 2010	Assessment of coronary artery calcification using dual-source computed tomography in adult asymptomatic patients with type 1 diabetes mellitus	The study examined an irrelevant outcome.
Jiang, 2025	Assessment of six insulin resistance surrogate indexes for predicting stroke incidence in Chinese middle-aged and elderly populations with abnormal glucose metabolism: a nationwide prospective cohort study	The study examined an irrelevant outcome.
Akiniranye, 2019	Assessment of the correlation with insulin resistance and chronic complications among the black African population	The study examined an irrelevant outcome and population.
Chatchomchuan, 2024	Assessment of Various Insulin Resistance Surrogate Indices in Thai People with Type 2 Diabetes Mellitus	The study examined an irrelevant outcome and population.
Kamenova, 2005	Factor analysis of the components of metabolic syndrome in type 2 diabetes mellitus	The study examined an unfavorable population and had a different target.
Mutter, 2023	Formulae to estimate the glucose disposal rate and future coronary artery disease in type 1 diabetes	It was a conference abstract.
Gaillard, 1998	Gender differences in cardiovascular risk factors in obese, nondiabetic first degree relatives of African Americans with type 2 diabetes mellitus	The study examined an unfavorable population and had a different target.
Reims, 2021	Glucose disposal rates calculated from 60- to 90-minute isoglycemic hyperinsulinemic glucose clamp correlate with cardiovascular risk factors in borderline hypertensive young men	The study examined an unfavorable population and had a different target.
Stiefel, 2004	Glucose effectiveness is strongly related to left ventricular mass in subjects with stage I hypertension or high-normal blood pressure	The study examined an irrelevant biomarker.
Arslanian, 2001	Glucose intolerance in obese adolescents with polycystic ovary syndrome: Roles of insulin resistance and β -cell dysfunction and risk of cardiovascular disease	The study examined an irrelevant outcome and biomarker.
Kietsiriroje, 2022	Glucose variability is associated with an adverse vascular profile but only in the presence of insulin resistance in individuals with type 1 diabetes: An observational study	The study examined an irrelevant outcome.
Olson, 2002	Glycemia (or, in women, estimated glucose disposal rate) predict lower extremity arterial disease events in type 1 diabetes	The study had a different target.
Olson, 2002 (Duplicated)	Glycemia (or, in women, estimated glucose disposal rate) predict lower extremity arterial disease events in type 1 diabetes	The study had a different target.
Grass, 2019	The Great Molasses Flood: Volume overload and pulmonary symptoms after high dose insulin therapy in amlodipine poisoning	The study examined an irrelevant biomarker and population.
Birkeland, 2003	Heterogeneity of non-insulin-dependent diabetes expressed as variability in insulin sensitivity, β -cell function and cardiovascular risk profile	The study examined an irrelevant biomarker and population.
Sesti, 2014	High circulating irisin levels are associated with insulin resistance and vascular atherosclerosis in a cohort of nondiabetic adult subjects	The study examined an irrelevant biomarker and population.
Niedzwiecki, 2016	The higher insulin resistance the lower cardiac output in adults with type 1 diabetes during maximal exercise test	The study examined unfavorable outcomes and had a different target.
Uruska, 2018	The higher insulin sensitivity the higher exercise capacity in patients with type 1 diabetes	The study examined unfavorable outcomes and had a different target.
Dengel, 1994	Impaired insulin sensitivity and maximal responsiveness in older hypertensive men	The study had a different target.

Wohlin, 2003	Impaired insulin sensitivity is an independent predictor of common carotid intima-media thickness in a population sample of elderly men	The study examined an irrelevant outcome.
Cefalo, 2024	Impaired insulin sensitivity measured by estimated glucose disposal rate is associated with decreased myocardial mechano-energetic efficiency in non-diabetic individuals	The study examined an irrelevant outcome.
Succurro, 2023	Impaired insulin-stimulated myocardial glucose metabolic rate is associated with reduced estimated myocardial energetic efficiency in subjects with different degrees of glucose tolerance	The study examined an irrelevant outcome.
Leroux, 2015	In adult patients with type 1 diabetes healthy lifestyle associates with a better cardiometabolic profile	The study examined an irrelevant outcome.
Baumann, 1973	The influence of acute psychic stress situations on biochemical and vegetative parameters of essential hypertensives at the early stage of the disease	The study examined an unfavorable population and had a different target.
Nevalainen, 1997	The influence of peritoneal dialysis and the use of subcutaneous and intraperitoneal insulin on glucose metabolism and serum lipids in type 1 diabetic patients	The study examined unfavorable outcomes and had a different target.
Stochmal, 2007	The influence of physical training on metabolic indices in men with myocardial infarction and impaired glucose tolerance	The study had a different target.
Ishibashi, 1997	Inhibitory effects of insulin on intracellular calcium and aggregatory response of platelets are impaired in hypertensive subjects with insulin resistance	The study examined an irrelevant outcome.
NCT, 2023	SGLT2 Inhibitors, Ketogenesis, and Ketoacidosis	The study examined unfavorable outcomes and had a different target.
Zhang, 2024	Usefulness of estimated glucose disposal rate in detecting heart failure: results from national health and nutrition examination survey 1999-2018	Duplicated.
Safdar, 2024	Short, frequent, light-intensity walking activity improves postprandial vascular-inflammatory biomarkers in people with type 1 diabetes: the SIT-LESS randomized controlled trial	It was an interventional study.
Eriksson, 2024	Short-term effects of obesity surgery versus low-energy diet on body composition and tissue-specific glucose uptake: a randomised clinical study using whole-body integrated 18F-FDG-PET/MRI	It was an interventional study.
Wilson, 2023	Unmet Needs and Communication Preferences for mHealth Self-Management Solutions in People with Type 1 Diabetes and Insulin Resistance	The study had a different target.
Antani, 2023	Utility of apolipoprotein ratio in predicting metabolic risk and microvascular complications in Indian children and young adults with type 1 diabetes mellitus	The study examined an irrelevant biomarker.
Sagar, 2022	Sub-optimal glycaemic control and insulin resistance in young adults with type 1 diabetes increases platelet expression of P-selectin and phosphatidylserine	The study examined unfavorable outcomes and had a different target.
Johansen, 2022	Short-Acting Exenatide Added Three Times Daily to Insulin Therapy Improves Insulin Sensitivity in Type 1 Diabetes	It was an interventional study.
Jimenez, 2022	SKIN MICROVASCULAR FLOWMOTION IS UNALTERED IN ABDOMINALLY OBESE MEN	The study examined unfavorable outcomes and had a different target.
Komosinska-vassev, 2020	The usefulness of diagnostic panels based on circulating adipocytokines/regulatory peptides, renal function tests, insulin resistance indicators and	The study examined unfavorable outcomes and had a different target.

	lipid-carbohydrate metabolism parameters in diagnosis and prognosis of type 2 diabetes mellitus with obesity	
Köken, 2020	Utility of estimated glucose disposal rate for predicting metabolic syndrome in children and adolescents with type-1 diabetes	The study examined an irrelevant outcome.
Köken, 2020 (Duplicated)	Utility of estimated glucose disposal rate for predicting metabolic syndrome in children and adolescents with type-1 diabetes	The study examined an irrelevant outcome.
Ding, 2020	Study on factors associated with urinary albumin-to-creatinine ratio among adults with type 1 diabetes mellitus	The study examined unfavorable outcomes and had a different target.
Llauradó, 2019	Specific nuclear magnetic resonance lipoprotein subclass profiles and central arterial stiffness in type 1 diabetes mellitus: A case control study	The study examined an irrelevant outcome.
Llauradó, 2016	Type 1 diabetes: Specific plasma lipoprotein subclass profiles associate with insulin resistance and arterial stiffness	The study examined an irrelevant outcome.
Llauradó, 2016 (Duplicated)	Weight loss improves impaired muscle capillary recruitment in abdominally obese men: effects on metabolic insulin resistance	The study examined an irrelevant outcome.
Kusters, 2016	Statin treatment is associated with insulin sensitivity decrease in type 1 diabetes mellitus: A prospective, observational 56-month follow-up study	It was an interventional study.
Duvnjak, 2016	The use of statins is associated with insulin sensitivity decrease in type 1 diabetes mellitus: Prospective observational study	It was an interventional study.
Duvnjak, 2016 (Duplicated)	Shorter sleep duration is associated with decreased insulin sensitivity in healthy white men	It was an interventional study.
Wong, 2015	Utility of estimated glucose disposal rate and fat mass percentage for predicting metabolic syndrome in children and adolescents with type 1 diabetes	The study examined an irrelevant outcome.
Koken, 2015	Type 1 diabetes: Specific plasma lipoprotein subclass profiles associate with insulin resistance and arterial stiffness	The study examined an irrelevant outcome.
Cade, 2013	Substrate metabolism during basal and hyperinsulinemic conditions in adolescents and young-adults with Barth syndrome	The study examined unfavorable outcomes and population, and had a different target.
Masi, 2012	Similar patterns of myocardial metabolism and perfusion in patients with type 2 diabetes and heart disease of ischaemic and non-ischaemic origin	The study examined unfavorable population and had a different target.
Mäkinen, 2012	Sphingomyelin is associated with kidney disease in type 1 diabetes (The FinnDiane Study)	The study examined an irrelevant outcome.
Girgis, 2012	Utility of the estimated glucose disposal rate as a marker of microvascular complications in young adults with type 1 diabetes	The study examined an irrelevant outcome.
Girgis, 2012 (Duplicated)	Utility of the estimated glucose disposal rate as a marker of microvascular complications in young adults with type 1 diabetes	The study examined an irrelevant outcome.
Bulum, 2012	White blood cell count is independently associated with insulin resistance in type 1 diabetic patients	The study examined an irrelevant outcome.
Kotnik, 2011	Variability in daily insulin dose is associated with insulin resistance in type 1 diabetes adolescents on insulin pump therapy	The study examined an irrelevant outcome.
Voytovich, 2005	Short-term treatment with rosiglitazone improves glucose tolerance, insulin sensitivity and endothelial function in renal transplant recipients	It was an interventional study.

McLaughlin, 2003	Use of metabolic markers to identify overweight individuals who are insulin resistant	The study examined unfavorable outcomes and population, and had a different target.
Fragasso, 2003	Short- and long-term beneficial effects of trimetazidine in patients with diabetes and ischemic cardiomyopathy	It was an interventional study.
Tchernof, 2002	Weight loss reduces C-reactive protein levels in obese postmenopausal women	The study examined unfavorable outcomes and population, and had a different target.
Olson, 2002	Subclinical atherosclerosis and estimated glucose disposal rate as predictors of mortality in type 1 diabetes	The study examined an irrelevant outcome. (Just all-cause mortality)
Koistinen, 2000	Subcutaneous adipose tissue expression of plasminogen activator inhibitor-1 (PAI-1) in nondiabetic and Type 2 diabetic subjects	The study examined unfavorable outcomes and population, and had a different target.
Brochu, 2000	Visceral adipose tissue is an independent correlate of glucose disposal in older obese postmenopausal women	The study examined an irrelevant outcome.
Bøtker, 2000	Short-term effects of growth hormone on myocardial glucose uptake in healthy humans	It was an interventional study.
Bakker, 1999	Triiodothyronine: A link between the insulin resistance syndrome and blood pressure?	The study examined an irrelevant outcome.
Natali, 1998	Vasodilation with sodium nitroprusside does not improve insulin action in essential hypertension	It was an interventional study.
Høieggen, 1998	Whole-blood viscosity and the insulin-resistance syndrome	The study examined an irrelevant outcome.
Vestergaard, 1995	Whole-body Glucose Metabolism in Obese Patients with Type 2 Diabetes Mellitus: the Impact of Hypertension and Strict Blood Glucose Control	The study examined an irrelevant outcome.
Mattiasson, 1992	Sodium-lithium countertransport and platelet cytosolic free calcium concentration in relation to peripheral insulin sensitivity in postmenopausal women	The study examined an irrelevant outcome.
Landin, 1991	Treating insulin resistance in hypertension with metformin reduces both blood pressure and metabolic risk factors	The study examined an irrelevant outcome.
Ferrannini, 1987	Insulin Resistance in Essential Hypertension	The study examined an irrelevant biomarker.
Laakso, 1990	Insulin resistance is associated with lipid and lipoprotein abnormalities in subjects with varying degrees of glucose tolerance	The study examined an irrelevant outcome.
Pollare, 1990	Insulin resistance is a characteristic feature of primary hypertension independent of obesity	The study examined an irrelevant outcome.
Mattiasson, 1992	Insulin resistance and Na ⁺ -K ⁺ -ATPase in hypertensive women: A difference in mechanism depending on the level of glucose tolerance	There was no analyzable data in the study.
Mattiasson, 1992 (Duplicated)	Insulin resistance and Na ⁺ -K ⁺ -ATPase in hypertensive women: A difference in mechanism depending on the level of glucose tolerance	There was no analyzable data in the study.
Fuh, 1993	Insulin resistance, glucose intolerance, and hyperinsulinemia in patients with microvascular angina	The study examined an irrelevant biomarker.
Moan, 1995	Insulin sensitivity, sympathetic activity, and cardiovascular activity in young men	The study examined an irrelevant outcome.
Sekiya, 1995	Insulin resistance in essential hypertensive patients with impaired glucose tolerance	The study examined an irrelevant biomarker.
Quiñones Galvan, 1996	Insulin sensitivity in cardiological syndrome X	It has been concluded that cardiovascular events in Syndrome X are associated with GDR, and the results are not general.

Quiñones Galvan, 1996 (Duplicated)	Insulin sensitivity in cardiometabolic syndrome X	It has been concluded that cardiovascular events in Syndrome X are associated with GDR, and the results are not general.
Mattiasson, 2001	Insulin sensitivity with respect to glucose metabolism in hypertension-prone men did not predict the blood pressure increase in 5 years	GDR was not assessed directly.
Orchard, 2003	Insulin resistance-related factors, but not glycemia, predict coronary artery disease in type 1 diabetes: 10-year follow-up data from the Pittsburgh Epidemiology of Diabetes Complications Study	Duplicated.
Osredkar, 2009	Insulin resistance and blood pressure variability	It was a conference abstract.
Uruska, 2010	Insulin resistance is associated with microangiopathy in type 1 diabetic patients treated with intensive insulin therapy from the onset of disease	The study examined an irrelevant outcome.
Sanhueza, 2011	Insulin resistance in type 1 diabetic patients carriers of metabolic syndrome	It was a conference abstract.
Araszkiewicz, 2012	Insulin resistance is associated with macroangiopathy in type 1 diabetic patients treated with intensive insulin therapy from the onset of the disease	It was a conference abstract.
Bulum, 2013	Insulin resistance in patients with type 1 diabetes: Relationship with metabolic and inflammatory parameters	It was a conference abstract.
Gutaj, 2016	Insulin resistance in the early pregnancy and subsequent preeclampsia in women with type 1 diabetes	It was a conference abstract.
Williams, 2017	Insulin resistance in prevalent coronary artery disease and overt nephropathy in type 1 diabetes	It was a book chapter.
Orchard, 2018	Insulin resistance and CVD risk: A time varying analysis in type 1 diabetes	It was a conference abstract.
Garofolo, 2019	Insulin sensitivity is a predictor for major vascular events in type 1 diabetes: a single-centre 10-year follow-up study	It was a conference abstract.
Kietsirirote, 2020	Insulin resistance and altered fibrin clot properties in overweight individuals with type 1 diabetes: A potential mechanism for increased vascular complications?	It was a conference abstract.
Helmink, 2021	Insulin resistance and risk of vascular events, interventions and mortality in type 1 diabetes	Duplicated.
Helmink, 2021 (Duplicated)	Insulin resistance and risk of vascular events, interventions and mortality in type 1 diabetes	Duplicated.
Llaurado, 2021	Insulin resistance associates with arterial stiffness in type 1 diabetes: A novel component of double diabetes	It was a conference abstract.
Penno, 2021	Insulin resistance, diabetic kidney disease, and all-cause mortality in individuals with type 2 diabetes: a prospective cohort study	The study examined an irrelevant outcome.
Penno, 2021 (Duplicated)	Insulin resistance, diabetic kidney disease, and all-cause mortality in individuals with type 2 diabetes: a prospective cohort study	The study examined an irrelevant outcome.
Zabala, 2021	Insulin resistance and risk of first stroke in type 2 diabetes: A nationwide cohort study	It was a conference abstract.
Kietsirirote, 2022	Insulin resistance links to procoagulant clot properties in young adult with type 1 diabetes: A cross-sectional observation study	The study examined an irrelevant outcome.
Popa, 2023	Insulin resistance and hepatic steatosis in type 1 diabetes mellitus and their association with diabetic chronic complications	The study examined an irrelevant outcome.

Lu, 2024	Insulin Resistance Estimated by Estimated Glucose Disposal Rate Predicts Outcomes in Acute Ischemic Stroke Patients	The study examined an irrelevant population.
Schmechel, 1993	Retinopathy and nephropathy in 772 insulin-treated diabetic patients in relation to the type of diabetes	The study examined an irrelevant outcome.
Shi, 2023	Value of estimated glucose disposal rate to detect prevalent left ventricular hypertrophy: implications from a general population	The study examined an irrelevant population.
Sun, 2023	Estimated glucose disposal rate and risk of arterial stiffness and long-term all-mortality: a 10-year prospective study	The study examined an irrelevant population.
Kong, 2024	Estimated glucose disposal rate and risk of cardiovascular disease and mortality in U.S. adults with prediabetes: a nationwide cross-sectional and prospective cohort study	The study examined an irrelevant population.
Garofolo, 2019	Estimated glucose disposal rate and major vascular events in type 1 diabetes: A 10-year follow-up study	It was a conference abstract.
Bujawansa, 2012	Associations between estimated glucose disposal rate and chronic diabetes-related complications in the Golden Years Cohort (Type 1 diabetes > 50 years' duration)	We couldn't find the article.
Mao, 2022	Changes of insulin resistance status and development of complications in type 1 diabetes mellitus: Analysis of DCCT/EDIC study	The study examined an irrelevant outcome.
Garofolo, 2018	Estimated glucose disposal rate as a predictor of all-cause mortality in type 1 diabetes-a 10-year follow-up study	It was a conference abstract.
Stochmal, 2005	Association of coronary atherosclerosis with insulin resistance in patients with impaired glucose tolerance	The study examined an irrelevant population.
L. Ntyintyane 2009	Postprandial hyperglycemia in urban South African blacks with and without coronary artery disease	The study examined an irrelevant outcome.
P. Singer 1985	Postprandial hyperinsulinemia in patients with mild essential hypertension	The study examined an irrelevant population.
G. J. Dietze 1996	Potential role of bradykinin in forearm muscle metabolism in humans	The study was a Review article.
J. Yamamoto 2002	PPARgamma2 pro12Ala polymorphism and insulin resistance in Japanese hypertensive patients	The study examined an irrelevant population.
S. Subramanian 2006	PPARα activation elevates blood pressure and does not correct glucocorticoid-induced insulin resistance in humans	The study examined an irrelevant outcome.
M. M. Kelsey 2011	Predictors of adipose tissue insulin resistance in obese adolescents with and without type 2 diabetes	The study examined an irrelevant outcome.
L. Cielonko 2022	Predictors of Epicardial Adipose Thickness in Overweight and Obese Youth with Type 1 Diabetes	The study examined an irrelevant outcome.
I. Pietrzak 2006	Prehypertension risk factors in children and adolescents with type 1 diabetes	The study examined an irrelevant population.
M. Soop 2001	Preoperative oral carbohydrate treatment attenuates immediate postoperative insulin resistance	The study examined an irrelevant outcome.
R. R. Townsend 1993	Pressor doses of angiotensin II increase insulin-mediated glucose uptake in normotensive men	The study examined an irrelevant outcome.
T. McLaughlin 2004	Prevalence of Insulin Resistance and Associated Cardiovascular Disease Risk Factors among Normal Weight, Overweight, and Obese Individuals	The study examined an irrelevant outcome.
S. Surandran 2024	Prevalence of insulin resistance, contributing factors and its association with metabolic profile in children with type 1 diabetes	The study examined an irrelevant population.

K. Katsumori 1995	Prevalence of macro- and microvascular diseases in non-insulin-dependent diabetic and borderline glucose-intolerant subjects with insulin resistance syndrome	The study examined an irrelevant outcome.
M. Karguppikar 2022	Prevalence of nephropathy in Indian children and youth with type 1 diabetes mellitus	The study examined an irrelevant population.
H. Amir 2023	Primary Prevention of Type 2 Diabetes and Cardiometabolic-Based Chronic Disease Using Lifestyle Medicine	The study was a book chapter.
T. Jirawatwarakul 2023	Progression of insulin resistance in individuals with type 1 diabetes: A retrospective longitudinal study on individuals from Thailand	The study examined an irrelevant outcome.
M. D. Robertson 2002	Quantitative kinetics of glucose appearance and disposal following a 13C-labelled starch-rich meal: Comparison of male and female subjects	The study examined an irrelevant population.
M. A. G. Helmink 2022	Quantity of adipose tissue and adipose tissue dysfunction and the risk of cancer in individuals at high risk of cardiovascular disease	The study examined an irrelevant outcome.
K. K. Danielson 2010	Racial and ethnic differences in an estimated measure of insulin resistance among individuals with type 1 diabetes	The study examined an irrelevant outcome.
M. F. Saad 1991	Racial differences in the relation between blood pressure and insulin resistance	The study examined an irrelevant outcome.
T. P. Solomon 2009	Randomized trial on the effects of a 7-d low-glycemic diet and exercise intervention on insulin resistance in older obese humans	The study examined an irrelevant outcome.
M. J. Quon 2006	Reciprocal relationships between insulin resistance and endothelial dysfunction: Insights from therapeutic interventions	The study was a Review article.
J. A. Kim 2006	Reciprocal relationships between insulin resistance and endothelial dysfunction: Molecular and pathophysiological mechanisms	The study was a Review article.
M. Canessa 1993	Red blood cell sodium-proton exchange in hypertensive blacks with insulin-resistant glucose disposal	The study examined an irrelevant outcome.
M. Canessa 1995	Red cell sodium-lithium countertransport and cardiovascular risk factors in essential hypertension	The study was a Review article.
E. Succurro 2020	Reduction in global myocardial glucose metabolism in subjects with 1-hour postload hyperglycemia and impaired glucose tolerance	The study examined an irrelevant outcome.
G. Targuer 2001	Relation between soluble adhesion molecules and insulin sensitivity in type 2 diabetic individuals: Role of adipose tissue	The study examined an irrelevant outcome.
P. Kamenova 2008	Relationship between common carotid artery intima-media thickness and insulin sensitivity in type 2 diabetes mellitus	The study examined an irrelevant population.
M. Chandalia 1999	Relationship between generalized and upper body obesity to insulin resistance in Asian Indian men	The study examined an irrelevant outcome.
J. Yamamoto 2002	PPAR γ 2 Pro12Ala polymorphism and insulin resistance in Japanese hypertensive patients	DUPLICATE
G. Pambianco 2007	The prediction of major outcomes of type 1 diabetes: a 12-year prospective evaluation of three separate definitions of the metabolic syndrome and their components and estimated glucose disposal rate: the Pittsburgh Epidemiology of Diabetes Complications Study experience	DUPLICATE
B. Zhu 2025	The predictive value of estimated glucose disposal rate for all-cause and cardiovascular mortality in the	DUPLICATE

	US non-diabetic population aged ≥ 60 years: A population-based cohort study	
Sampaio et al 2018	Metabolic syndrome in patients with DM1 treated in SUS: Evaluation of diagnostic criteria by EGDR (estimated glucose elimination rate)	The study was a congress abstract.
Sampaio et al 2018	Metabolic syndrome in patients with type 1 diabetes treated in SUS: Risk factor for microvascular complications?	The study was a congress abstract.
Duvnjak et al 2012	The metabolic syndrome is associated with high-normal urinary albumin excretion and retinopathy in normoalbuminuric type 1 diabetic patients	The study examined an irrelevant outcome.
Ntyintyane et al 2007	The metabolic syndrome using the National Cholesterol Education Program and International Diabetes Federation definitions among urbanised black South Africans with established coronary artery disease	The study examined an irrelevant outcome.
Fiorentino et al 2016	One-hour post-load hyperglycemia combined with HbA1c identifies pre-diabetic individuals with a higher cardio-metabolic risk burden	The study examined an irrelevant population.
Russell et al 2018	Oral glucose challenge impairs skeletal muscle microvascular blood flow in healthy people	The study examined an irrelevant population.
Yokoyama et al 1998	Organ-specific insulin resistance in patients with noninsulin-dependent diabetes mellitus and hypertension	The study examined an irrelevant population.
Yokoyama et al 1998	Organ-specific insulin resistance in patients with noninsulin-dependent diabetes mellitus and hypertension	DUPLICATE
Ebert et al 2024	Outcomes With Finerenone in Patients With Chronic Kidney Disease and Type 2 Diabetes by Baseline Insulin Resistance	DUPLICATE
Klimontov et al 2024	OVERWEIGHT AND OBESITY IN PATIENTS WITH TYPE 1 DIABETES: ASSOCIATIONS WITH VASCULAR COMPLICATIONS AND BIOMARKERS OF VASCULAR REMODELING	The study examined an irrelevant outcome.
Tigno et al 2006	Paradoxical increase in dermal microvascular flow in pre-diabetes associated with elevated levels of CRP	The study examined an irrelevant population.
Deakin et al 2002	Paraoxonase-1 L55M polymorphism is associated with an abnormal oral glucose tolerance test and differentiates high risk coronary disease families	The study examined an irrelevant outcome.
Valente et al 2022	Parents' cardiovascular risk factors are related to overweight and obesity in young Brazilians with type 1 diabetes	DUPLICATE
Weidmann et al 1993	The Pathogenesis of Hypertension in Obese Subjects	The study was a Review article.
Chaiken et al 1991	Patterns of glucose and lipid abnormalities in black NIDDM subjects	The study examined an irrelevant outcome.
Kohlhoff et al 1990	Perinatal hyperinsulinism and perinatal obesity as risk factors for hyperinsulinaemia in later life	The study examined an irrelevant outcome.
Della-Morte et al 2014	Pharmacogenomics and pharmacogenetics of thiazolidinediones: Role in diabetes and cardiovascular risk factors	The study examined an irrelevant outcome.
Dvorak et al 1999	Phenotypic characteristics associated with insulin resistance in metabolically obese but normal-weight young women	The study examined an irrelevant outcome.
Helleputte et al 2024	Physical activity and sedentary behaviour in relation to body composition, estimated insulin sensitivity and arterial stiffness in adults with type 1 diabetes	The study examined an irrelevant outcome.

Rizza et al 2011	Pioglitazone improves endothelial and adipose tissue dysfunction in pre-diabetic CAD subjects	The study examined an irrelevant population.
Tripathy et al 2013	Pioglitazone improves glucose metabolism and modulates skeletal muscle TIMP-3-TACE dyad in type 2 diabetes mellitus: A randomised, double-blind, placebo-controlled, mechanistic study	The study examined an irrelevant outcome.
Zanchi et al 2012	Pioglitazone improves insulin sensitivity, reduces visceral fat and stimulates lipolysis in non diabetic dialyzed patients	The study examined an irrelevant population.
Naoumova et al 2007	Pioglitazone improves myocardial blood flow and glucose utilization in nondiabetic patients with combined hyperlipidemia: a randomized, double-blind, placebo-controlled study	The study examined an irrelevant population.
Abbasi et al 1999	Plasma homocysteine concentrations in healthy volunteers are not related to differences in insulin-mediated glucose disposal	The study examined an irrelevant population.
Andreozzi et al 2006	Plasma interleukin-6 levels are independently associated with insulin secretion in a cohort of Italian-Caucasian nondiabetic subjects	The study examined an irrelevant population.
Paoliss et al 1999	Plasma leptin level is associated with myocardial wall thickness in hypertensive insulin-resistant men	The study examined an irrelevant outcome.
Olukoga et al 1991	Plasma urate in diabetes: relationship to glycaemia, glucose disposal, microvascular complications and the variations following oral glucose	The study examined an irrelevant outcome.
Lo Presti et al 2002	Polymorphonuclear leukocyte membrane fluidity, at baseline and after in vitro activation, in obesity with or without diabetes mellitus	The study examined an irrelevant outcome.
Toft et al 1999	Population-Based Study of the Relationship among Muscle Morphology, Insulin Action, and Hypertension	The study examined an irrelevant outcome.
Nagasawa et al 2007	Possible involvement of 12-lipoxygenase activation in glucose-deprivation/reload-treated neurons	The study examined an irrelevant outcome.
Jacober et al 1991	Postpartum blood pressure and insulin sensitivity in african-american women with recent preeclampsia	The study examined an irrelevant population.
Karelis, 2005	The metabolically healthy but obese individual presents a favorable inflammation profile	The study examined an irrelevant outcome.
Gauthier, 2014	The metabolically healthy but obese phenotype is associated with lower plasma levels of persistent organic pollutants as compared to the metabolically abnormal obese phenotype	The study examined an irrelevant outcome.
Januszewski, 2012	Non-invasive measures of tissue autofluorescence are increased in Type 1 diabetes complications and correlate with a non-invasive measure of vascular dysfunction	The study examined an irrelevant outcome.
González-Ortiz, 2020	Plant-based diets, insulin sensitivity and inflammation in elderly men with chronic kidney disease	The study examined an irrelevant outcome.
Ziegelsch, 1982	On the influence of the heredity of diabetes on the cardiovascular risk profile of newly-detected diabetic patients	The study examined an irrelevant population and had a different target.
Valente, 2022	Parents' cardiovascular risk factors are related to overweight and obesity in young Brazilians with type 1 diabetes	The study examined an irrelevant population and had a different target.
Karsidag, 1996	Peripheral insulin resistance levels in non-obese hypertensive patients and normotensive obese patients	The study examined an irrelevant population and had a different target.
NCT, 2014	IR and Microvascular Blood Flow in SCI	We couldn't find the article.

Yao, 2024	Association between estimated glucose disposal rate control level and stroke incidence in middle-aged and elderly adults	The study examined an irrelevant population.
Fu, 2025	Association between estimated glucose disposal rate with the all-cause and cause-specific mortality among the population with cardiometabolic syndrome	The study examined an irrelevant population.
Yan, 2025	Association between the changes in the estimated glucose disposal rate and new-onset cardiovascular disease in middle-aged and elderly individuals: A nationwide prospective cohort study in China	The study examined an irrelevant population.
Zhang, 2025	Association between the cumulative estimated glucose disposal rate and incident cardiovascular disease in individuals over the age of 50 years and without diabetes: data from two large cohorts in China and the United States	The study examined an irrelevant population.
Li, 2024	Association between various insulin resistance indices and cardiovascular disease in middle-aged and elderly individuals: evidence from two prospectives nationwide cohort surveys	The study examined an irrelevant population.
Le, 2024	Association of estimated glucose disposal rate with incident cardiovascular disease under different metabolic and circadian rhythm states: findings from a national population-based prospective cohort study	The study examined an irrelevant population.
Chen, 2025	Association of estimated glucose disposal rate with metabolic syndrome prevalence and mortality risks: a population-based study	The study examined an irrelevant population and had a different target.
Song, 2024	Associations between estimated glucose disposal rate and arterial stiffness and mortality among US adults with non-alcoholic fatty liver disease	The study examined an irrelevant population.
Zheng, 2024	Changes in the estimated glucose disposal rate and incident cardiovascular disease: two large prospective cohorts in Europe and Asia	The study examined an irrelevant population.
Xu, 2014	Clinical correlates of insulin sensitivity and its association with mortality among men with CKD stages 3 and 4	The study examined an irrelevant population.
Rodrigues, 2010	Coronary artery calcification is associated with insulin resistance index in patients with type 1 diabetes	The study examined an irrelevant outcome.
Liu, 2022	Correlation between estimated glucose disposal rate and in-stent restenosis following percutaneous coronary intervention in individuals with non-ST-segment elevation acute coronary syndrome	The study examined an irrelevant population.
Bisu, 2016	Estimated glucose disposal rate (eGDR) - A marker for the assessment of insulin resistance in type 1 diabetes mellitus	The study had a different target.
He, 2024	The additive effect of the triglyceride-glucose index and estimated glucose disposal rate on long-term mortality among individuals with and without diabetes: a population-based study	The study examined an irrelevant population.
Ren, 2022	Estimated glucose disposal rate and risk of cardiovascular disease: evidence from the China Health and Retirement Longitudinal Study	The study examined an irrelevant population.
Zabala, 2021	Estimated glucose disposal rate and risk of stroke and mortality in type 2 diabetes: a nationwide cohort study	The study examined an irrelevant population.
He, 2024	Analyzing the impact of glycemic metabolic status on cardiovascular mortality and all-cause mortality	The study examined an irrelevant population.

	related to the estimated glucose disposal rate: a nationwide cohort study	
Xing, 2025	Correlation between estimated glucose disposal rate, insulin resistance, and cardiovascular mortality among individuals with metabolic syndrome: a population-based analysis, evidence from NHANES 1999-2018	The study examined an irrelevant population.
Han, 2024	Relationship between stroke and estimated glucose disposal rate: results from two prospective cohort studies	The study examined an irrelevant population.
Abd el Ghaffar, 2010	Renal Doppler indices in diabetic children with insulin resistance syndrome	The study examined an irrelevant population.
Yip, 1998	Resistance to insulin-mediated glucose disposal as a predictor of cardiovascular disease	The study examined an irrelevant population.
Liu, 2025	Sarcopenia and Insulin Resistance Collective Effect on Atrial Fibrillation Risk: A Non-Diabetic Elderly Cohort Study	The study examined an irrelevant population.
Ji, 2025	Association Between a New Model of Insulin Sensitivity and Hypertension in Patients With Type 2 Diabetes: A Cross-Sectional Study	The study examined an irrelevant population.
Liao, 2025	Association between estimated glucose disposal rate and cardiovascular diseases in patients with diabetes or prediabetes: a cross-sectional study	The study examined an irrelevant population.
Guo, 2024	Association between estimated glucose disposal rate and cardiovascular mortality across the spectrum of glucose tolerance in the US population	The study examined an irrelevant population.
Tian, 2025	Association between estimated glucose disposal rate and prediction of cardiovascular disease risk among individuals with cardiovascular-kidney-metabolic syndrome stage 0–3: a nationwide prospective cohort study	The study examined an irrelevant population.
Kim, 2025	Association between estimated glucose disposal rate and subclinical coronary atherosclerosis	The study examined an irrelevant population.
Florentiu, 2012	Estimated glucose disposal rate is associated with macro-and microvascular complications in adult type 1 diabetes patients	There was no analyzable data in the study.
Nyström, 2017	Estimated glucose disposal rate and long-term survival in type 2 diabetes after coronary artery bypass grafting	The study examined an irrelevant population.
Liu, 2023	Estimated glucose disposal rate, a novel biomarker for insulin sensitivity, predicts risk for incident heart failure in patients with type 2 diabetes	The study examined an irrelevant population.
Xu, 2024	Estimated glucose disposal rate, high sensitivity C-reactive protein and cardiometabolic multimorbidity in middle-aged and older Chinese adults: A nationwide prospective cohort study	The study examined an irrelevant population.
Feng, 2024	Evaluation of Estimated Glucose Disposal Rate with Neutrophil-to-Lymphocyte Ratio Integrated for Prognosticating Adverse Cardiovascular and Cerebrovascular Events and Risk Stratification Among Acute Coronary Syndrome with Type 2 Diabetes Mellitus Following Percutaneous Coronary Intervention	The study examined an irrelevant population.
Wang, 2025	Estimated glucose disposal rate, a novel biomarker for insulin sensitivity, predicts risk for incident heart failure in patients with type 2 diabetes	The study examined an irrelevant population.
Xuan, 2024	Estimated glucose disposal rate, high sensitivity C-reactive protein and cardiometabolic multimorbidity	The study examined an irrelevant population.

	in middle-aged and older Chinese adults: A nationwide prospective cohort study	
Zhang, 2024	Usefulness of estimated glucose disposal rate in detecting heart failure: results from national health and nutrition examination survey 1999-2018	The study examined an irrelevant population.
Llauradó, 2017	Type 1 diabetes: Developing the first risk-estimation model for predicting silent myocardial ischemia. The potential role of insulin resistance	The study had a different target.
Jia, 2014	Validation of insulin sensitivity surrogate indices and prediction of clinical outcomes in individuals with and without impaired renal function	The study examined an irrelevant outcome and biomarker.
Ebert, 2024	Outcomes With Finerenone in Patients With Chronic Kidney Disease and Type 2 Diabetes by Baseline Insulin Resistance	The study examined an irrelevant population.
Nordby, 1995	Insulin resistance and sympathetic nervous system activity in hypertensive and normotensive premenopausal women	The study examined an irrelevant population.
Ingelsson, 2005	Insulin resistance and risk of congestive heart failure	The study examined an irrelevant population.
Chillarón, 2011	Insulin resistance and hypertension in patients with type 1 diabetes	There was no analyzable data in the study.
Pané, 2020	Insulin resistance is associated with preclinical carotid atherosclerosis in patients with type 1 diabetes	The study examined an irrelevant outcome.
Lu, 2023	Insulin resistance estimated by estimated glucose disposal rate predicts outcomes in acute ischemic stroke patients	The study examined an irrelevant population.
Gudenkauf, 2024	Insulin resistance is associated with subclinical myocardial dysfunction and reduced functional capacity in heart failure with preserved ejection fraction	The study examined an irrelevant population.
Yi, 2024	Insulin resistance assessed by estimated glucose disposal rate and risk of atherosclerotic cardiovascular diseases incidence: the multi-ethnic study of atherosclerosis	The study examined an irrelevant population.
Zhang, 2024	Insulin resistance assessed by estimated glucose disposal rate and risk of incident cardiovascular diseases among individuals without diabetes: findings from a nationwide, population based, prospective cohort study	The study examined an irrelevant population.
Cutruzzola, 2024	The potential of glucose management indicator for the estimation of glucose disposal rate in people with type 1 diabetes	The study examined an irrelevant outcome and had different target.
Huang, 2025	The predictive value of estimated glucose disposal rate and its association with myocardial infarction, heart failure, atrial fibrillation and ischemic stroke	The study examined an irrelevant population.
Zhu, 2024	The predictive value of estimated glucose disposal rate for all-cause and cardiovascular mortality in the US non-diabetic population aged ≥ 60 years: A population-based cohort study	The study examined an irrelevant population.
Liu, 2022	Predictive worth of estimated glucose disposal rate: evaluation in patients with non-ST-segment elevation acute coronary syndrome and non-diabetic patients after percutaneous coronary intervention	The study examined an irrelevant population.
Bonora, 2002	Predictors of insulin sensitivity in Type 2 diabetes mellitus	The study examined an irrelevant population.
Kupfer, 2017	Predictors of subclinical atherosclerosis evaluated by carotid intima-media thickness in asymptomatic young women with type 1 diabetes mellitus	The study examined an irrelevant outcome.

Pathak, 2022	Prevalence of Insulin Resistance in Type 1 Diabetes Mellitus and Its Correlation with Metabolic Parameters: The Double Trouble	The study examined an irrelevant outcome.
Koca, 2019	Physical activity, insulin sensitivity, and metabolic control in type 1 diabetes mellitus	The study had a different target.
Chen, 2024	Prognostic Value of Estimated Glucose Disposal Rate and Systemic Immune-Inflammation Index in Non-Diabetic Patients Undergoing PCI for Chronic Total Occlusion	The study examined an irrelevant population.
Liu, 2023	Prognostic Value of Estimated Glucose Disposal Rate in Patients with Non-ST-Segment Elevation Acute Coronary Syndromes Undergoing Percutaneous Coronary Intervention	The study examined an irrelevant population.
Gaboury, 1994	Relation of pressor responsiveness to angiotensin II and insulin resistance in hypertension	The study examined an irrelevant population and had a different target.
Reims, 2004	Relations between insulin sensitivity, fitness and autonomic cardiac regulation in healthy, young men	The study examined an irrelevant population.
Birkeland, 1992	Relationship between blood pressure and in vivo action of insulin in type II (non-insulin-dependent) diabetic subjects	The study examined an irrelevant population.
Lind, 1993	Is it hyperinsulinemia or insulin resistance that is related to hypertension and other metabolic cardiovascular risk factors?	The study examined an irrelevant population.
Paolisso, 1995	Left ventricular hypertrophy is associated with a stronger impairment of non-oxidative glucose metabolism in hypertensive patients	The study examined an irrelevant population.
Grabia, 2023	Metabolic Syndrome as a Factor of Impairment of Antioxidant Defense System in Youth with T1DM	The study examined an irrelevant outcome.
Egan, 1996	Obesity hypertension is related more to insulin's fatty acid than glucose action	The study had a different target.
Mao, 2025	Obesity, Metabolic Health, and Diabetic Complications in People With Type 1 Diabetes	The study examined an irrelevant outcome.
Peng, 2024	Estimated glucose disposal rate for predicting cardiovascular events and mortality in patients with non-diabetic chronic kidney disease: a prospective cohort study	The study examined an irrelevant population.

PRISMA 2020 Checklist

Supplementary Table 4. Completed Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist outlining adherence to reporting standards for this systematic review and meta-analysis.

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Page1
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	Introduction, Paragraph 2 and 3, Page1 and 2
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	Introduction, Paragraph 3, Page 2
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	Methods, Paragraph 3, Page 3
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	Methods, Paragraph 2, Page 2
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Methods, Paragraph 2, Page 2 and Supplementary Material (Page 4)
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	Methods, Paragraph 4, Page 3
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	Methods, Paragraph 5, Page 4
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Methods, Paragraph 7, Page5
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	Methods, Paragraph 8, Page5
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	Methods, Paragraph 6, Page 4
Effect	12	Specify for each outcome the effect measure(s) (e.g. risk ratio,	Methods,

Section and Topic	Item #	Checklist item	Location where item is reported
measures		mean difference) used in the synthesis or presentation of results.	Paragraph 9, Page 5
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	Methods, Paragraph 10, Page 6
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	Methods, Paragraph 10, Page 6
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	-
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	Methods, Paragraph 9, 10, and 12, Page 5 and 6
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	Methods, Paragraph 11, Page 6
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	Methods, Paragraph 11, Page 6
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	Methods, Paragraph 6, Page 4
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	Methods, Paragraph 6, Page 4
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Results, Paragraph 1, Page 7
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	Results, Paragraph 1, Page 7
Study characteristics	17	Cite each included study and present its characteristics.	Table 1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Supplementary Material (Supplementary Figure 1)
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Table 1
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	Results, Paragraph 3, Page 7
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	Results, Page 8 - 11
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	Results, Page 8 - 11
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	Results, Paragraph 4,

Section and Topic	Item #	Checklist item	Location where item is reported
			10, and 11, Page 8 and 10
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	Results, Paragraph 3, Page 7
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	Results, Paragraph 3, Page 7
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	Discussion, Paragraph 1, Page 11
	23b	Discuss any limitations of the evidence included in the review.	Discussion, Paragraph 5, Page 14
	23c	Discuss any limitations of the review processes used.	Discussion, Paragraph 5, Page 14
	23d	Discuss implications of the results for practice, policy, and future research.	Discussion, Paragraph 6, Page 14
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	Methods, Paragraph 1, Page 2
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	Methods, Paragraph 1, Page 2
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	Methods, Paragraph 1, Page 2
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	-
Competing interests	26	Declare any competing interests of review authors.	-
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	-

Summary of Findings

Supplementary Table 5. GRADE summary of findings table.

Certainty assessment							№ of patients	Relative effect (95% CI)	Certainty
№ of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations			
Major adverse cardiovascular events (MACE) risk (Per unit increase)									
9	non-randomized studies	not serious	not serious	not serious	not serious	none	22790 participants	HR 0.79 (0.72 to 0.87) [Major adverse cardiovascular events (MACE) risk]	⊕⊕⊕⊕ High
Coronary artery disease (CAD) incidence (Low vs. High eGDR category)									
3	non-randomized studies	not serious	not serious	not serious	not serious	none	4634 participants	HR 3.61 (2.83 to 4.62) [coronary artery disease (CAD) incidence]	⊕⊕⊕⊕ High
All-cause mortality (Per unit increase)									
5	non-randomized studies	not serious	not serious	not serious	not serious	none	19403 participants	HR 0.84 (0.82 to 0.86) [All-cause mortality]	⊕⊕⊕⊕ High
Subclinical atherosclerosis risk (Low vs. High eGDR category)									
2	non-randomized studies	not serious	serious	not serious	serious	none	267 participants	HR 1.99 (0.10 to 38.24) [Subclinical atherosclerosis risk]	⊕⊕○○ Low