Supplemental Table S1. Myocardial fibrosis measures of diabetes and no diabetes groups

Publication	Diabetes assessment*	%with diabetes	Diabetes group	no Diabetes group	Mean difference/effect measure
	Histology CVF (%)				
Nunoda 1985(1)	not specified	56	19.9 ± 8.2	9.3 ± 3.2	**10.60 (4.74; 16.46)**
Shimizu 1993(2)	FPG	67	17.0 ± 2.8 (SE)	7.2 ± 1.9 (SE)	**9.80 (7.60; 12.00)**
**Kawaguchi 1997(3)	FPG		1.31 ± 0.72[d,e]	0.33 ± 0.45[e,f]	**0.98 (0.52; 1.44)**
van Heerebeek 2008(4)	ADMs or FPG[c]	64	15.75 ± 5.5[d,g]	13.68 ± 4.74[f,g]	2.07 (-0.55; 4.69)
Falcao 2011(5)	ADMs or FPG	28	18.2 ± 2.6 (SE)	12.9 ± 1.1 (SE)	5.30 (-0.23; 10.83)
Sakakibara 2011(6)	ADMs or FPG	33	6.9 ± 1.8	5.2 ± 1.6	**1.70 (0.96; 2.44)**
Frustaci 2016(7)	medical records	50	10.1 ± 8.5	3.2 ± 1.6	**6.90 (1.25; 12.55)**
**Wang 2019(8)	ADA		33%[h]	31.5%[h]	**1.5 (0.15; 2.86)**
	CMR-ECV (%)				
Shah 2013(9)	ADA	33	37.3 ± 6.02	28.7 ± 4.02	**8.56 (4.64; 12.50)**
Wong 2014(10)	medical records	20	30.2[26.9-32.7]	28.1 [25.9 - 31.0]	**1.60 (0.99; 2.21)** **β (95% CI)= 1.40 (0.40; 2.40)**
Levelt 2016(11)	WHO	70	29 ± 2	29 ± 3	0 (-1.44; 1.44)
Swoboda 2017(12)	not specified	77	26.1 ± 3.4[d]	23.3 ± 3.0	**2.89 (1.77; 3.83)**
Vasanji 2017(13)	medical records[a]	50	22.1 ± 1.8 (SE)	20.1 ± 2.1 (SE)	2.00 (-3.42; 7.42)
Cao 2018(14)	WHO	61	27.4 ± 2.5	24.6 ± 2.2	**2.80 (1.77; 3.83)**
Storz 2018(15)	WHO	11	22.8 ± 3.0	24.3 ± 2.73[f]	-1.54 (-2.71; -0.37)
**Ambale-Venkatesh 2019(16)	WHO	16			*synthetic ECV* Untreated DM (β = -0.26, p= 0.70) Treated DM (β = 0.20, p = 0.40)
Chirinos 2019(17)	ADMs or FPG	60	30.4 ± 4.5	27.1 ± 5.6	**3.30 (0.44; 6.16)**
Gao 2019(18)	WHO	80	34.16 ± 4.14	29.73 ± 2.28	**4.43 (3.08; 5.78)**
Gulsin 2019(19)	medical records	53	28 ± 5	DM 28 ± 5	0 (-2; 2)
Lam 2019(20)	not specified	73	25 ± 3	26 ± 2	-1.00 (-2.68; 0.69)
Jiang 2020(21)	ADA	71	32.6 ± 4.6	27.5 ± 3.1	**5.1 (4.4; 5.7)**
Khan 2020(22)	ADA	16	30.4 ± 3.9	28.4 ± 3.8[f]	**1.9 (1.54 ; 2.26)** **β (95%CI)= 1.72 (0.67; 2.78)** **β (95%CI)= 1.33 (0.22; 2.44)**
	Native T1 time (ms)				
Khan 2014(23)	ADMs	42	944.03 ± 93.00	971.6 ± 105.7	-27.54 (-105.24; 49.16)
Levelt 2016(11)	WHO	70	1194 ± 32	1184 ± 28	10.00 (-5.37; 25.37
Swoboda 2017(12)	not specified	77	1242.2 ± 53.9	1209.7 ± 47.4	**32.50 (12.52; 52.48)**
Vasanji 2017(13)	medical records[a]	50	1211 ± 44 (SE)	1172 ± 43 (SE)	39.00 (-46.3; 124.3)
Cao 2018(14)	WHO	63	1026.9 ± 30.0	1011.8 ± 26.0	**15.10 (2.62; 27.58)**
Storz 2018(15)	WHO	14	1199.7 ± 53.9	1201.7 ± 44.39[f]	-2.03 (-18.24; 14.19)
**Ambale-Venkatesh 2019(16)	ADMs or FPG	16			Untreated DM (β = -18.8, p= 0.08) **Treated DM (β = 7.6, p = 0.045)**
**Contti 2019(24)	not specified		1329 ±31[h]	1337 ±54.8	8 (-23.8 ; 39.8)
Gao 2019(18)	WHO	80	1285.22±61.71[d]	1279.83 ±121.85	5.39 (-49.69; 60.48)
Lam 2019(20)	not specified	73	1016 ±23	1050 ±45	**-34.00 (-63.21; -4.79)**
Jiang 2020(21)	ADA	71	1242.63 ±230.3	1209.2 ±181.74	33.4 (-28.4; 95.2)
Khan 2020(22)	ADA	19	1138.3 ±193	1136.4±153.9[f]	2.9 (-19.9; 25.7)
Kropidlowski 2020(25)	not specified[b]	16	994.0 ±43.2	974.0 ±37.4	**20 (5.9; 34.11)**
Kucukseymen 2020(26)	HbA_{1c}	61	1148.1.6 ±32.5	1070.1 ±27.9	**78.0 (42.7; 113.3)**
	Postcontrast T1 time (ms)				
Ng 2012(27)	WHO	72	425 ± 72	504 ± 34	**-79.00 (-104.14; -53.86)**
Khan 2014(23)	ADMs, medical	42	454.33 ± 82.67	430.7 ± 88.0	23.59 (-42.51; 89.69)

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	records				
Vasanji 2017(13)	medical records	50	632 ±37 (SE)	606 ±50 (SE)	26.00 (-95.91; 147.91)
Cao 2018(14)	WHO	61	460.2 ± 24.7	459.9 ± 26.1	0.30 (-11.04; 11.64)
**Ambale-Venkatesh 2019(16)	ADMs or FPG	16			Untreated DM (β = -60.9, p= 0.11) Treated DM (β = 3.3, p = 0.84)
Gao 2019(18)	WHO	80	510.34 ± 52.56	503.50 ±24.2	6.85 (-8.82; 22.50)
Lam 2019(20)	not specified	73	423 ± 32	449 ± 26	-26.00 (-46.13; -5.87)
Jiang 2020(21)	ADA	71	501.2 ± 40.1	515.0 ± 37.9	-13.8 (-53.45; 25.89)

Results by group are shown as mean ± SD, mean ± (SE), or median [interquartile range]. Effect estimates are shown as mean difference (95% CI), unless otherwise specified, and are shown in **bold** if statistically significant ($p < 0.05$)

* Type 2 Diabetes, unless otherwise specified. Type 2 Diabetes diagnostic criteria used:

ADA – American Diabetes Association diagnostic criteria for diabetes: fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) or 2-hour post-load plasma glucose ≥ 11.1 mmol/L (200 mg/dL), or Hba1c ≥ 48 mmol/mol (6.5%) or a random blood glucose ≥ 11.1 mmol/L (200 mg/dL) in the presence of signs and symptoms. Prediabetes: 2-hour post load glucose 7.8 ≤ X < 11.0 mmol/L (140 ≤ X < 200 mg/dL) or 5.6 ≤ X ≤ 6.9 mmol/L (140 ≤ X < 200 mg/dL) or FPG 5.6–6.9 mmol/L(100–125 mg/dL) or HbA1C 5.7–6.4% (39–47 mmol/mol) or ≥ 10% increase in HbA_{1c}

WHO – World Health Organization 2011/2016 diagnostic criteria for diabetes: fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) or 2-hour post-load plasma glucose ≥ 11.1 mmol/L (200 mg/dL), or Hba1c ≥ 48 mmol/mol (6.5%) or a random blood glucose ≥ 11.1 mmol/L (200 mg/dL) in the presence of signs and symptoms. Prediabetes: 2-hour post load glucose 7.8 ≤ X ≤ 11.0 mmol/L (140 ≤ X < 200 mg/dL) AND FPG > 7.0 mmol/L(<126 mg/dL) or FPG 6.1 ≤ X ≤ 6.9 mmol/L(110 ≤ X ≤ 125 mg/dL) or <7.8 mmol/L (140 mg/dL)

FPG - Diabetes was defined as having fasting plasma glucose ≥ 126 mg/dL, except for Shimizu, 1993 (≥ 140 mg/dL), and Kawaguchi, 1997 (≥ 120 mg/dL)

ADMs – Diabetes was defined as use of antidiabetic medications

** Not included in meta-analysis

[a] type 1 Diabetes Mellitus

[b] mixed type 1 and type 2 Diabetes Mellitus populations

[c] unspecified diabetes type

[d] Pooled Mean ± SD of two diabetes groups

[e] Semi-quantitative scale of fibrosis: 0 – none, +1 = focal or minimal fibrosis ,+ 4 = more than half of specimen area covered by fibrosis, +2 and +3 = intermediate between +1 and +4

[f] Pooled Mean ± SD of two no diabetes groups

[g] Converted from Mean ± SE to Mean ± SD

[h] Visual approximation

Abbreviations: *ARIC – atherosclerosis risk in communities; β – linear regression coefficient; CI, confidence interval; CMR – cardiovascular magnetic resonance; CVF% – collagen volume fraction; DM – Diabetes mellitus; ECV% – extracellular volume fraction; eGFR – estimated glomerular filtration rate; HTN – hypertension; LAV – left atrial volume; LVCO – left ventricular cardiac output; LVEDV – left ventricular end diastolic volume; LVEF – left ventricular ejection fraction; LVS – left ventricular scar; SD – standard deviation; SE – standard error*

Supplemental Table S2. Myocardial fibrosis degree among diabetes, prediabetes, and normoglycaemic groups

Publication	Country	n	Study population	Mean age / % Female	MF assessment	normo-glycaemia	pre-DM*	DM*	Mean difference Pre-DM vs normoglycemia	Mean difference DM vs pre-DM
Storz 2018(15)	Germany	343	General population	59.1/31	ECV%	24.3 ± 2.8[a]	23.9 ± 2.5[a]	22.8 ± 3.0[a]	-0.4 (-1.3; 0.5)[a]	-0.1 (-1.3; 1.1)[a]
					Native T1	1202.2 ± 46	1200.4 ± 40	1199.7 ± 53.9	-1.8 (-12.5; 8.9)	-0.7 (-18.4; 17.0)
Ambale-Venkatesh 2019(16)	USA	1345	General population		ECV%		β =-0.32 (-0.7; 0.1)			
					Native T1	*reference*	β = 3.2 (-2.9; 9.3)			
					Postcontrast T1		**β =-29.9(-56.9;-2.9)**			
Khan 2020(22)	USA	442	Patients referred for CMR at tertiary hospital	60.2/52	ECV%	28.3 ± 3.8	29.0 ± 3.7	**30.4 ± 3.9**	0.7 (-0.2; 1.7)	**1.4 (0.1; 2.6)**
					Native T1	1141 ± 155	1120 ± 150	1139 ± 191	-20.7 (-58.7; 17.3)	19.3 (-36.6; -75.3)
					univariable	*reference*	β=0.68 (-0.34; 1.70)	-	-	-
					multivariable	*reference*	β=0.59 (-0.41; 1.59)[b]	-	-	-

Results by group are shown as mean ± SD. Effect estimates are shown as mean difference (95% CI), or regression coefficient (95% CI), and are shown in **bold** if statistically significant ($p < 0.05$)

[a] Adjusted for age, sex, HTN, BMI

[b] Adjusted for history of dyslipidemia, eGFR, ARIC, LAV, LVEDV, LVEF, LVCO, LVS

* Diabetes diagnostic criteria used:

- ADA – American Diabetes Association diagnostic criteria for diabetes: fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) or 2-hour post-load plasma glucose ≥ 11.1 mmol/L (200 mg/dL), or HbA_{1c} ≥ 48 mmol/mol (6.5%) or a random blood glucose ≥ 11.1 mmol/L (200 mg/dL) in the presence of signs and symptoms. Prediabetes: 2-hour post load glucose 7.8 ≤ X < 11.0 mmol/L (140 ≤ X < 200 mg/dL) or 5.6 ≤ X ≤ 6.9 mmol/L (140 ≤ X < 200 mg/dL) or FPG 5.6–6.9 mmol/L(100–125 mg/dL) or HbA1C 5.7–6.4% (39–47 mmol/mol) or ≥ 10% increase in HbA_{1c}
- WHO – World Health Organization 2011/2016 diagnostic criteria for diabetes: fasting plasma glucose ≥ 7.0 mmol/L (126 mg/dL) or 2-hour post-load plasma glucose ≥ 11.1 mmol/L (200 mg/dL), or HbA_{1c} ≥ 48 mmol/mol (6.5%) or a random blood glucose ≥ 11.1 mmol/L (200 mg/dL) in the presence of signs and symptoms. Prediabetes: 2-hour post load glucose 7.8 ≤ X ≤ 11.0 mmol/L (140 ≤ X < 200 mg/dL) AND FPG > 7.0 mmol/L(<126 mg/dL) or FPG 6.1 ≤ X ≤ 6.9 mmol/L(110 ≤ X ≤ 125 mg/dL) or <7.8 mmol/L (140 mg/dL)

Abbreviations: *ARIC – atherosclerosis risk in communities; β – linear regression coefficient; MR – cardiovascular magnetic resonance imaging; DM – Diabetes mellitus; ECV% – extracellular volume fraction; eGFR – estimated glomerular filtration rate; FPG – fasting plasma glucose; HbA_{1c} – glycosylated hemoglobin; HTN – hypertension; LAV – left atrial volume; LVCO – left ventricular cardiac output; LVEDV – left ventricular end diastolic volume; LVEF – left ventricular ejection fraction; LVS – left ventricular scar; pre-DM – prediabetes; SD – standard deviation*

Supplemental Table S3. Association of glycaemic control with myocardial fibrosis among patients with diabetes

Publication	Country	n	Study population	Mean age / % Female	MF assessment	Results		Matched (Adjusted)
Al-Badri 2018(28)	USA	47	Patients from veteran's hospital	65.8/11	ECV%	HbA_{1c} > 58mmol/mol (7.5%)	**28 (24.5; 31.5)***	age sex BMI SBP DBP eGFR
						HbA_{1c} 48-58mmol/mol (6.5%-7.5%)	**27.4 (24.4; 30.4)**	
						HbA_{1c} < 48mmol/mol (6.5%)	20.9 (17.1; 24.6)	
Cao 2018(14)	China	82	Patients in tertiary hospital and community controls	54.6/45	ECV% Native T1		**β (95%CI) = 0.39 (0.12; 0.66)** **β (95%CI)= 0.37 (0.07; 0.67)**	(age, HR, BMI, DM duration, heart volume/ function parameters, biochemical indices, diabetes complications or medications)
Gao 2019(18)	China	100	Patients in tertiary hospital and healthy volunteers	57.4/59	ECV%		**β (95%CI)= 0.36 (0.22; 1.01)**	(age, sex, BMI, DM duration, DBP, TG, TC, LVESV, EF)

Results are presented as mean difference (95% confidence interval), unless otherwise specified, and are shown in **bold** if statistically significant ($p < 0.05$) * $p < 0.05$ vs DM with HbA_{1c} < 58mmol/mol (7.5%)

Abbreviations: *β – linear regression coefficient; CABG – coronary artery bypass graft; CI, confidence interval; DBP – diastolic blood pressure; DM – Diabetes mellitus; EF – ejection fraction; eGFR – estimated glomerular filtration rate; HbA_{1c} – glycosylated hemoglobin; HR – heart rate; LVESV – left ventricular end systolic volume; SBP – systolic blood pressure; TC – total cholesterol; TG – triglycerides*

Supplemental Table S4. Association of antidiabetic medications with myocardial fibrosis

Publication	Country	Design	n (total = 181)	Study population	Mean age/ %Female	Intervention	Control	MF assessment	Results*
Cohen 2019**(29)**	Australia	nonrandomized trial	25	type 2 diabetes patients from diabetes clinics	66.3/36	Empagliflozin[a]	SHT[a]	Native T1	28.7 (-51; 108)
Hsu 2019**(30)**	Taiwan	uncontrolled trial	35	type 2 diabetes patients from tertiary hospital	63.5/52	Empagliflozin[b]	*NA*	ECV%	0.3 (-1.2; 1.8)
Paiman 2019**(31)**	Netherlands	double-blind RCT	47	type 2 diabetes patients from outpatient and general practice clinics, local hospitals	55.0/60	Liraglutide[c]	Placebo[c]	ECV% Native T1	-0.2 (-1.4; 1.0) 7 (-7; 21)
Mason 2021**(32)**	Canada	double-blind RCT	74	type 2 diabetes + CAD patients with inadequate glycaemic control	62.9/8	Empagliflozin[d]	Placebo[d]	ECV% Native T1	**1.4 (0.14; 2.6)** 5.20 (-11.5; 21.9)

* After 26 weeks of follow-up. Results are shown as mean difference (95% confidence interval), and are shown in **bold** if statistically significant ($p < 0.05$)

a Standard hypoglycaemic therapy consists of metformin, sulfonylurea, dideptidyl peptidase-4 inhibitor, glucagon-like peptide agonist, insulin, thiazolidinedione

b Standard hypoglycaemic therapy consists of metformin, sulfonylurea, glinide, thiazolidinedione, insulin

c Standard hypoglycaemic therapy consists of metformin, sulfonylurea, insulin

d Standard hypoglycaemic therapy consists of metformin, insulin

Abbreviations: *CAD – coronary artery disease; ECV% – extracellular volume fraction; RCT – randomized controlled trial; SHT – standard hypoglycaemic therapy*

Supplemental Table S5. Quality Assessment for Observational Studies

Publication	Selection (out of 4)	Comparability (out of 2)	Outcome (out of 3)	NOS† Score	Quality rating‡
Histology studies					
Falcao 2011 (5)	*	**	***	6	poor
Frustaci 2016 (7)	*	**	***	6	poor
Nunoda 1985 (1)	*	*	***	5	poor
Sakakibara 2011 (6)	*	**	***	6	poor
Shimizu 1993 (2)	*	**	*	4	poor
Kawaguchi 1997 (3)	**	**	***	7	fair
van Heerebeek 2008 (4)	*	**	***	6	poor
Wang 2019 (8)	*	**	***	6	poor
CMR T1 mapping studies					
Al-badri 2018 (28)	*	**	***	6	poor
Ambale-Venkatesh 2019 (16)	***	**	***	8	good
Cao 2018 (14)	**	**	***	7	fair
Chirinos 2019 (17)	**	*	***	6	fair
Contti 2019 (24)	*	**	**	5	poor
Gao 2019 (18)	**	*	***	6	fair
Gulsin 2019 (33)	***	*	***	7	good
Jiang 2020 (21)	***	**	***	8	good
Khan 2020 (22)	***	*	***	7	good
Khan 2014 (23)	*	**	***	6	poor
Kropidlowski 2020 (25)	*	**	***	6	poor
Kucukseymen 2020 (26)	***	**	***	8	good
Lam 2019 (20)	**	-	***	5	poor
Levelt 2016 (11)	*	*	***	5	poor
Ng 2012 (27)	**	**	***	7	fair
Shah 2013 (9)	*	*	***	5	poor
Storz 2018 (15)	***	**	***	8	good
Swoboda 2017 (12)	**	**	***	7	fair
Vasanji 2017 (13)	**	**	***	7	fair
Wong 2014 (10)	***	**	***	8	good

† Adapted from the Newcastle–Ottawa Quality Assessment Scale (NOS) for cohort studies

‡ The thresholds for converting the Newcastle–Ottawa Scale scores into the Agency for Healthcare Research and Quality standards were as follows: (I) good quality: 3 or 4 stars in the selection domain, and 1 or 2 stars in the comparability domain, and 2 or 3 stars in the exposure/outcome domain. (II) Fair quality: 2 stars in the selection domain, and 1 or 2 stars in the comparability domain, and 2 or 3 stars in the exposure/outcome domain. (III) Poor quality: 0 or 1 star in the selection domain, or 0 star in the comparability domain, or 0 or 1 star in the exposure/outcome domain. Poor, fair, and good quality of studies are considered to have high, moderate, and low risk of bias, respectively.

Supplemental Table S6. Risk of bias assessment of intervention studies*

RoB 2 assessment

Publication	*Design*	*Randomization*	*Missing outcome data*	*Outcome measurement*	*Selection of reported result*	*Overall*
Paiman 2019 (31)	RCT	low	low	low	low	low
Mason 2021 (32)	RCT	low	low	low	low	low

ROBINS-I assessment

Publication	*Design*	*Confounding*	*Participant selection*	*Intervention classification*	*Deviation from intervention*	*Missing data*	*Outcome measurement*	*Selection of reported result*	*Overall*
Cohen 2019 (29)	nonrandomized trial	moderate	critical	moderate	moderate	critical	low	low	critical
Hsu 2019 (30)	uncontrolled trial	critical	low	low	low	low	low	low	critical

* Risk of Bias tools, RoB 2 and ROBINS-I were used to assess relevant domains for potential risks of bias. RoB 2 is a tool for systematic assessment of bias in reported trial effects in five bias domains: randomization, deviation from intervention, missing outcome data, outcome measurement, and selection of reported result. Each study is assessed against signalling questions that are answered with yes/probably yes, no/probably no, and other. These responses form the basis of domain-level risk of bias. Risk of bias judgment is made based on the domain-level bias, and studies are categorized as having low risk of bias, some concerns, or high risk of bias. ROBINS-I is tool for systematic assessment of bias in reported non-randomized trial effects in seven bias domains: confounding, participant selection, intervention classification, deviation from intervention, missing data, outcome measurement, and selection of reported result. Each study is assessed as having low, moderate, serious, critical, and no information on risk of bias. Overall assessment of studies is as follows: a) low risk of bias if all domains have low risk of bias b) moderate - if domains have low or moderate risk of bias c) serious – if at least one domain has serious risk of bias but not critical in any domain, and d) critical – if at least one domain has critical risk of bias.

Supplemental Table S7. Meta-regression of clinical variables on pooled effect estimates

Clinical parameter	Parameter	Univariable		Multivariable	
		β	p	β	p
ECV% (n=13 studies)					
Age	*continuous*	-0.12	0.09	-0.14	0.07
Sex (%female)	*continuous*	-0.05	0.42	-0.07	0.25
BMI	*continuous*	-0.04	0.85	-0.08	0.66
HbA_{1c} (%) of diabetes group	*continuous*	1.1	0.28	0.10	0.93
LVEF of diabetes group	*continuous*	-0.2	0.11	-0.18	0.17
Native T1 time (n=12 studies)					
Age	*continuous*	1.4	0.42	3.7	0.12
Sex (%female)	*continuous*	0.4	0.55	0.6	0.45
BMI	*continuous*	1.8	0.68	7.9	0.27
HbA_{1c} (%) of diabetes group	*continuous*	5.5	0.69	7.9	0.69
LVEF of diabetes group	*continuous*	-0.7	0.71	-2.2	0.38

Abbreviations: *CMR – cardiovascular magnetic resonance; ECV – extracellular volume fraction;* HbA_{1c} *– glycosylated hemoglobin, LVEF – left ventricular ejection fraction*

Supplemental Table S8. Subgroup and sensitivity analyses on the association of diabetes with myocardial fibrosis assessed by ECV% and native T1 time

Study characteristics	Nr of Studies	Nr of participants	Pooled result (WMD 95% CI)	Heterogeneity I^2 (p-value)	Univariate metaregression p-value
CMR-ECV (%)					
All participants	13	2684	**2.1 (0.9, 3.3)**	90% (<0.001)	
Mean age					0.8
<55	6	1422	**1.7 (0.2, 3.3)**	84% (<0.001)	
≥55	7	1262	**2.3 (0.4, 4.2)**	93% (<0.001)	
Mean HbA_{1c} of diabetes group					0.2
<53mmol/mol (7.0%)	2	693	0.2 (-3.2,3.6)	95%(<0.001)	
≥53mmol/mol (7.0%)[b]	11	1991	**2.5 (1.3, 3.7)**	88% (<0.001)	
Insulin use[a]					0.7
Yes	1	28	**2.0 (-3.4, 7.4)**		
Mixed	8	1791	**2.2 (0.8, 3.6)**	89% (<0..000)	
No	2	196	1.4 (-1.2, 4.2)	88% (0.004)	
Type 2 diabetes only	12	2656	**2.1 (0.9, 3.3)**	91% (<0.001)	0.97
BMI ≥30kg/m^2 excluded[c]	10	2502	**1.8 (0.6; 3.1)**	82% (<0.001)	0.4
Uncontrolled hypertension excluded	7	649	**3.0 (1.6;4.4)**	83% (<0.001)	0.2
Left ventricular hypertrophy excluded	10	2380	**2.4 (1.2; 3.5)**	87% (<0.001)	0.4
Prior MI					0.7
Excluded	10	1359	**2.3 (0.7, 3.9)**	92% (<0.000)	
Not excluded	3	1325	**1.5 (0.1, 2.8)**	47% (0.152)	
Prior MI or existing HF excluded	9	917	**2.4 (0.5, 4.2)**	93% (<0.001)	0.7
MRI Magnet strength					0.6
1.5T	5	1376	**1.6 (0.3, 3.0)**	74% (0.004)	
3.0T	8	1308	**2.4 (0.6, 4.3)**	93% (<0.000)	
Acquisition sequence[d]					0.1
MOLLI	11	2623	**1.8 (0.6, 3.0)**	91% (<0.000)	
LL or SASHA	2	2562	**5.6 (-0.9, 12.0)**	73% (0.055)	
LGE or infarcted areas excluded from ECV estimation	9	2371	**1.6 (0.4, 2.7)**	87% (<0.000)	0.2
Matching					0.6
Matched	7	692	**2.6 (1.1, 4.1)**	86% (<0.001)	
Unmatched	6	1992	1.5 (-0.2, 3.2)	89% (<0.000)	
Publication bias					0.9
w/in pseudo 95% CI	7	2007	**2.1 (1.4, 2.7)**	41% (0.051)	
outside pseudo 95% CI	6	677	2.4 (-0.4, 5.2)	95% (0.000)	
Quality					0.8
Fair or Good	10	2548	**2.3 (1.0, 3.5)**	90% (<0.001)	
Poor	3	136	2.0 (-1.7, 5.6)	90% (<0.000)	
Native T1 time (ms)					
All participants	12	1712	21.7 (-1.23, 44.8)	93% (<0.001)	
Mean age					0.5
<55	5	237	**16.3 (6.2, 26.3)**	11% (0.341)	
≥55	7	1475	25.6 (-8.5, 59.7)	93% (<0.001)	
Mean HbA_{1c} of diabetes group[a]					0.2
<53mmol/mol (7.0%)	2	785	-1.6 (-16.9, 13.8)	0.0% (0.847)	
≥53mmol/mol (7.0%)[b]	9	864	**27.4 (0.5, 54.4)**	93% (<0.001)	
Insulin use[a]					0.3
Yes	1	28	39 (-81,6 159.6)		
Mixed	4	965	8.4 (-1.2, 17.9)	0% (0.266)	
No	2	196	20.3 (-1.7, 42.3)	67% (0.08)	
Sensitivity analysis					
Type 2 diabetes	10	1621	21.3 (-4.0, 46.5)	94% (0.000)	1.0
BMI ≥30kg/m^2 excluded[c]	11	1686	**24.3 (0.8; 47.8)**	93% (<0.001)	0.3
Uncontrolled hypertension excluded	7	473	**16.4 (8.3; 24.6)**	**0.0%** (0.567)	0.3
Left ventricular hypertrophy excluded	11	1369	**24.6 (1.0; 48.3)**	92% (<0.001)	0.3
Prior MI					**<0.000**
Excluded	11	1505	**15.3 (6.9, 23.7)**	21% (0.245)	
Not excluded	1	207	**78.0 (69.7, 86.3)**	**-**	
Prior MI or existing HF excluded	10	1063	**15.9 (6.9, 24.8)**	27% (<0.001)	**0.02**
MRI Magnet strength					0.2
1.5T	6	441	30.5 (-4.4, 65.5)	94% (<0.000)	

3.0T	6	1271	12.0 (-1.1, 25.1)	34% (<0.178)	
Acquisition sequence[d]					0.8
MOLLI	10	1477	**15.3 (6.4, 24.1)**	28% (<0.000)	
SASHA or STONE	2		**77.8 (69.5, 86.1)**	0% (0.527)	
Matching					0.2
Matched	7	761	29.2 (-4.5, 62.9)	93% (<0.001)	
Unmatched	5	951	12.6 (-0.6, 25.9)	45% (0.125)	
Publication bias					0.7
w/in pseudo 95% CI	8	1016	**26.1 (14.4, 37.8)**	**0.0% (0.710)**	
outside pseudo 95% CI	4	696	25.6 (-16.4, 67.6)	98% (<0.000)	
Quality					0.6
Fair or Good	8	1520	25.5 (-6.0, 57.0)	94% (<0.001)	
Poor	4	192	18.0 (2.8, 33.2)	32% (0.221)	

Effect estimates are shown as WMD (95% confidence interval), and are shown in **bold** if statistically significant ($p < 0.05$). Heterogeneity was explored by assessing I^2 and univariate metaregression p-value. Study characteristics (categorical) as independent variable and effect estimate as the dependent variable were used in the univariate metaregression.

[a] Studies with missing information were not included in the sensitivity analyses

[b] HbA_{1c} cut-off of 53mmol/mol (7.0%) was used based on ADA guidelines on glycaemic target (34)

[c] Mean population BMI cut-off of 30kg/m^2 was used based on ADA guidelines on obesity management (35)

[d] For ECV, 1 study used SASHA sequence while 1 study used Look-Locker sequence. For native T1, 1 study used SASHA sequence and 1 study used STONE sequence

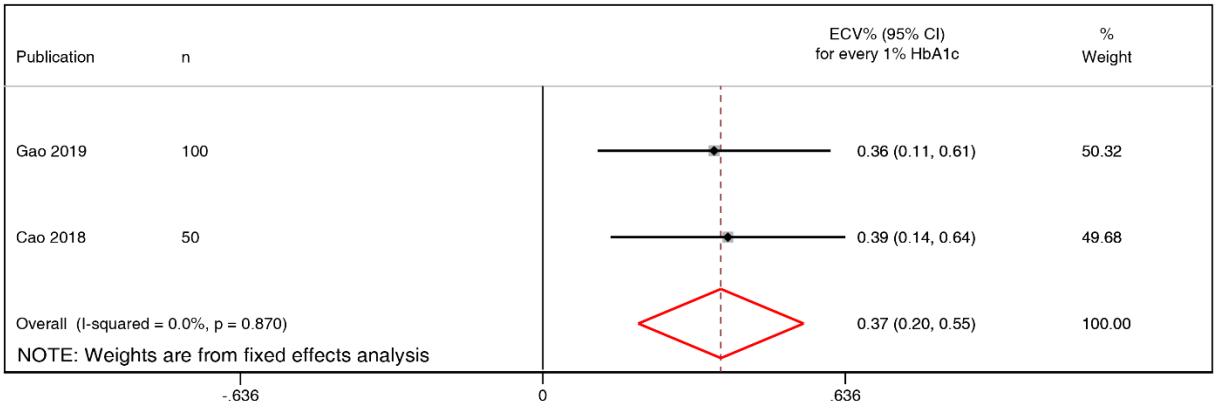
Abbreviations: *BMI – body mass index; CI – confidence interval; CVF% - collagen volume fraction; ECV% - extracellular volume fraction; HbA_{1c} – glycosylated hemoglobin; HF – heart failure; MOLLI – modified Look-Locker inversion recovery; RAAS – renin angiotensin aldosterone system; SASHA – saturation recovery single-shot acquisition, STONE – Slice-interleaved T1, WMD – weighted mean difference*

Supplemental Table References

[4] American Diabetes A (2021) 6. Glycaemic Targets: Standards of Medical Care in Diabetes-2021. Diabetes Care 44: S73-S84

[5] American Diabetes A (2021) 8. Obesity Management for the Treatment of Type 2 Diabetes: Standards of Medical Care in Diabetes-2021. Diabetes Care 44: S100-S110

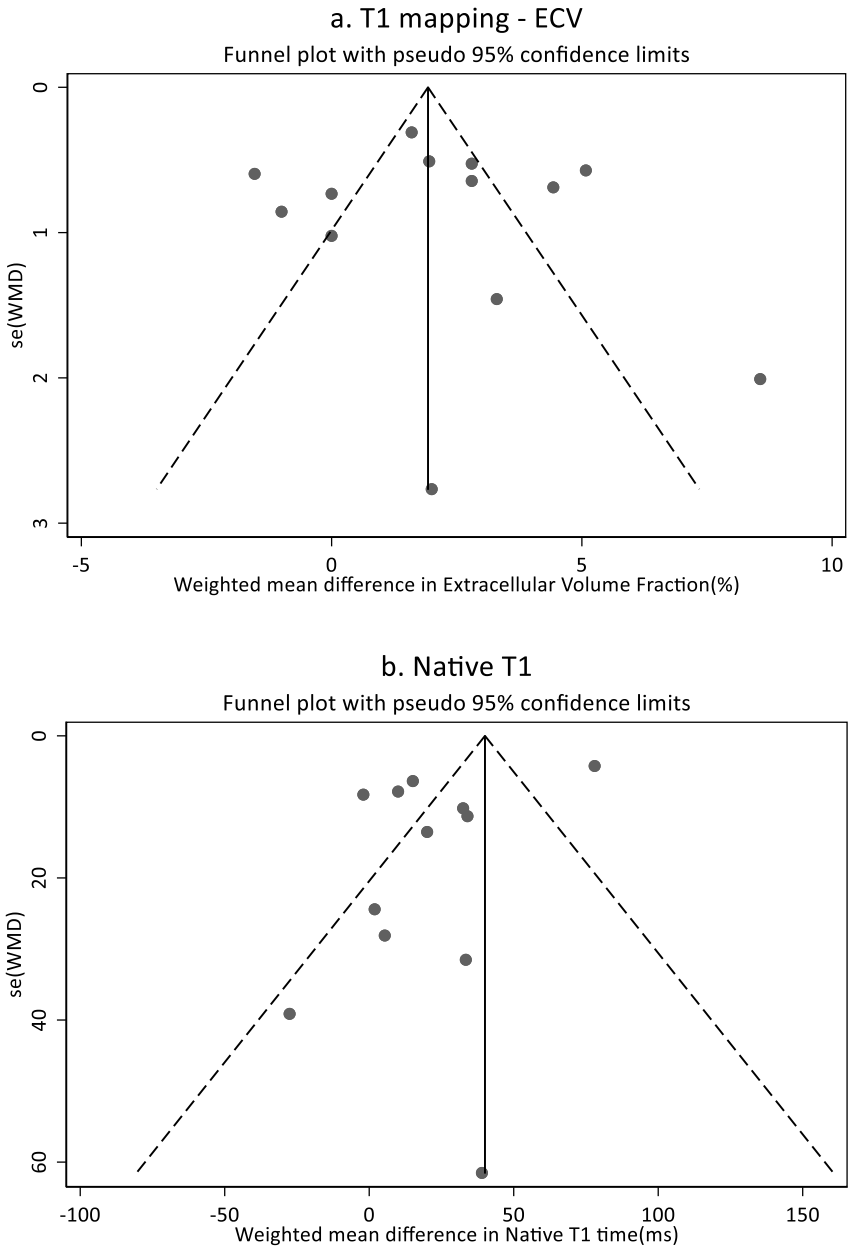
Supplemental Figure S1. Meta-analysis of HbA_{1c} (%) and myocardial fibrosis assessed using ECV%



Linear regression β-coefficients of studies were pooled.

Abbreviations: *CMR – cardiovascular magnetic resonance; ECV – extracellular volume fraction; HbA_{1c} – glycosylated hemoglobin*

Supplemental Figure S2. Funnel plots on the association of diabetes with myocardial fibrosis.

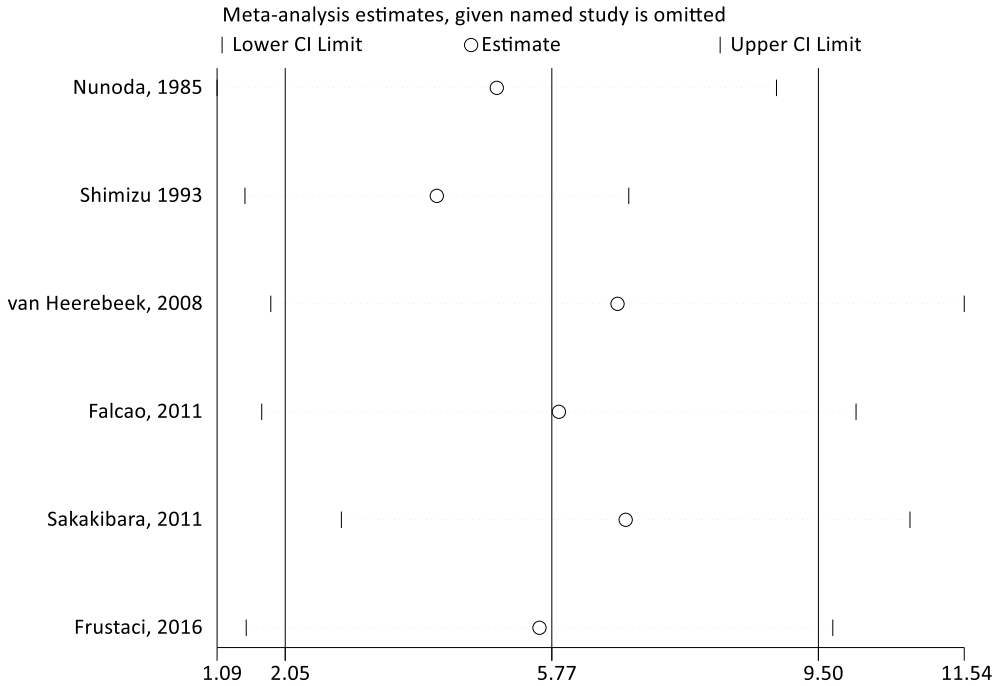


Weighted mean differences (WMDs) were plotted against standard error or the WMDs. The dashed lines represent pseudo-95% confidence interval of the pooled WMDs. Egger test results: a. ECV% p=0.76, b. Native T1 time p=0.12

Abbreviations: *ECV – extraceullar volume fraction; se(WMD) – standard error of the weighted mean difference*

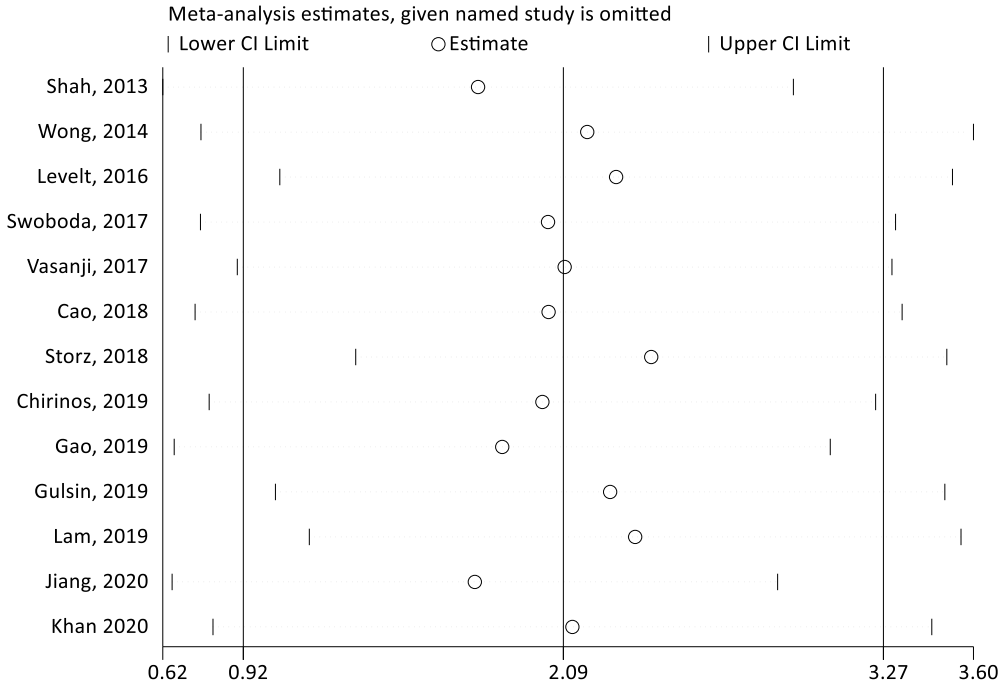
Supplemental Figure S3. Leave-one-out sensitivity analysis.

a. MF assessed using histology



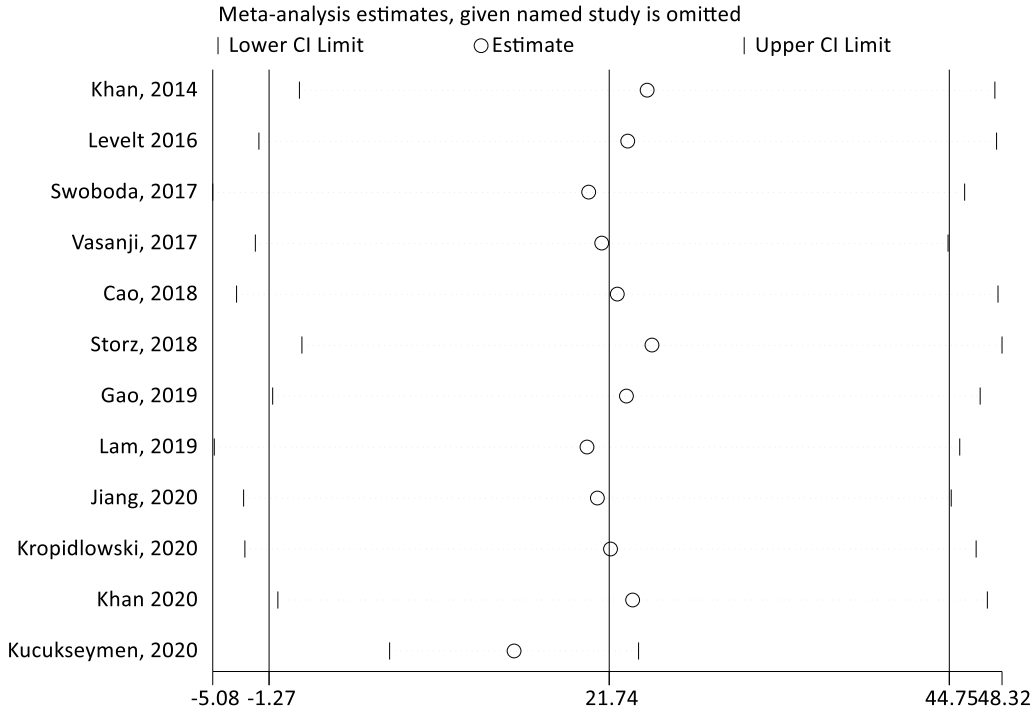
The effect in overall meta-analysis estimates is shown if one of the studies is removed from the pooled analysis.

b. MF assessed using T1 mapping-ECV



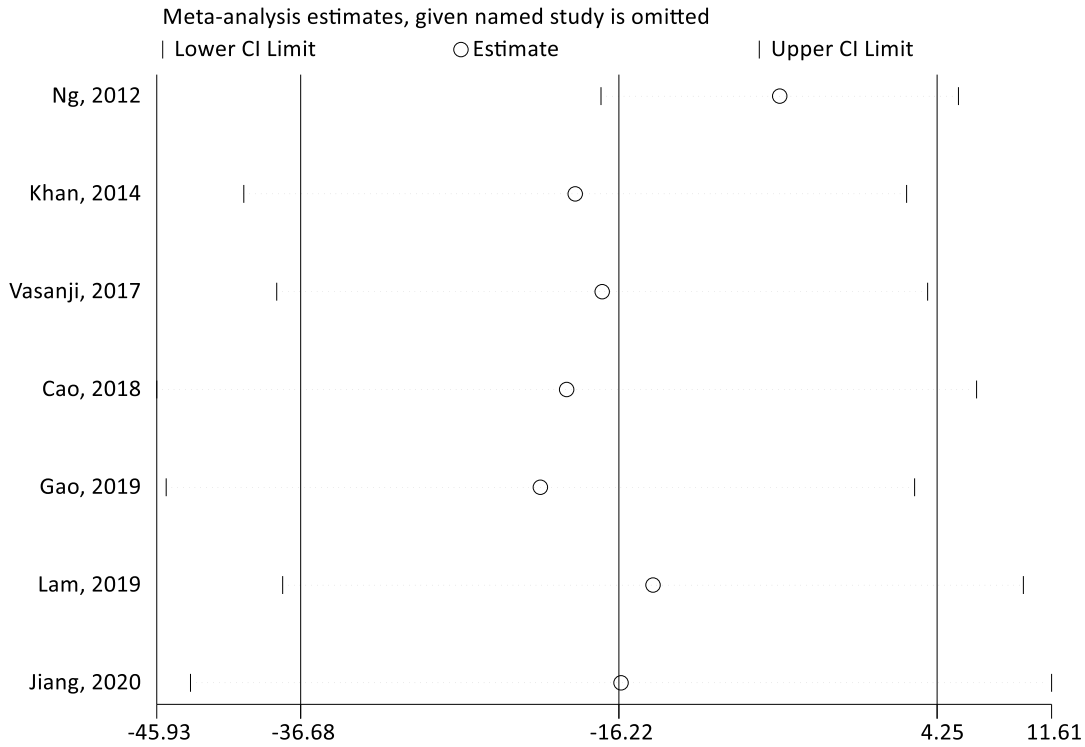
The effect in overall meta-analysis estimates is shown if one of the studies is removed from the pooled analysis.

c. MF assessed using T1 mapping-native T1



The effect in overall meta-analysis estimates is shown if one of the studies is removed from the pooled analysis. Removing the study by Kucukseymen et al. 2020 resulted in significant difference in native T1 time between diabetes and no diabetes groups.

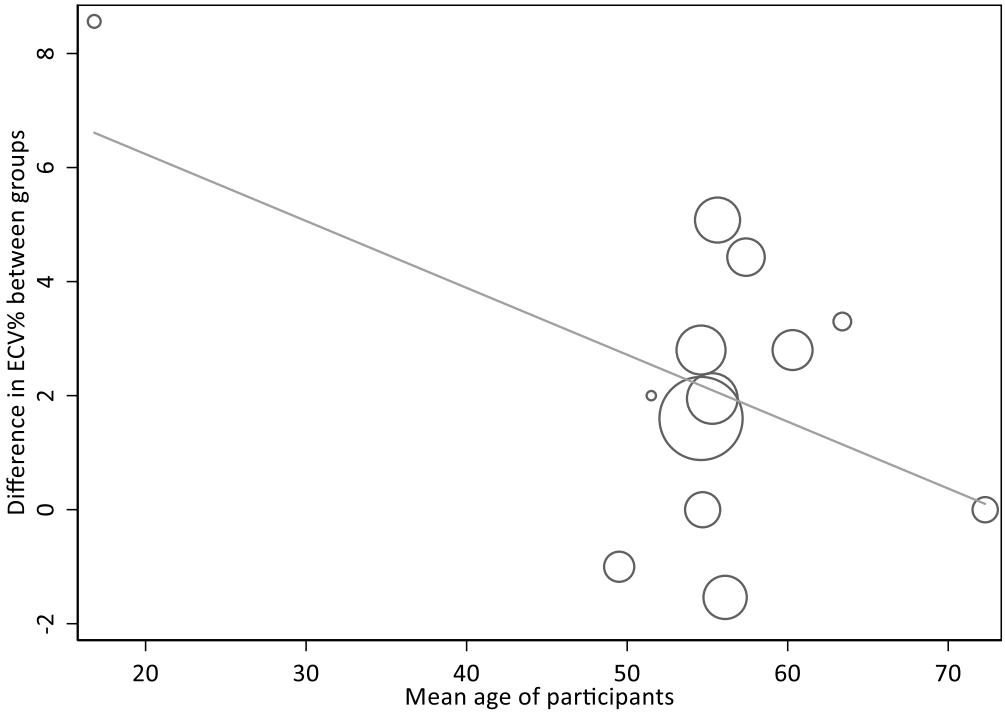
d. MF assessed using T1 mapping-postcontrast T1



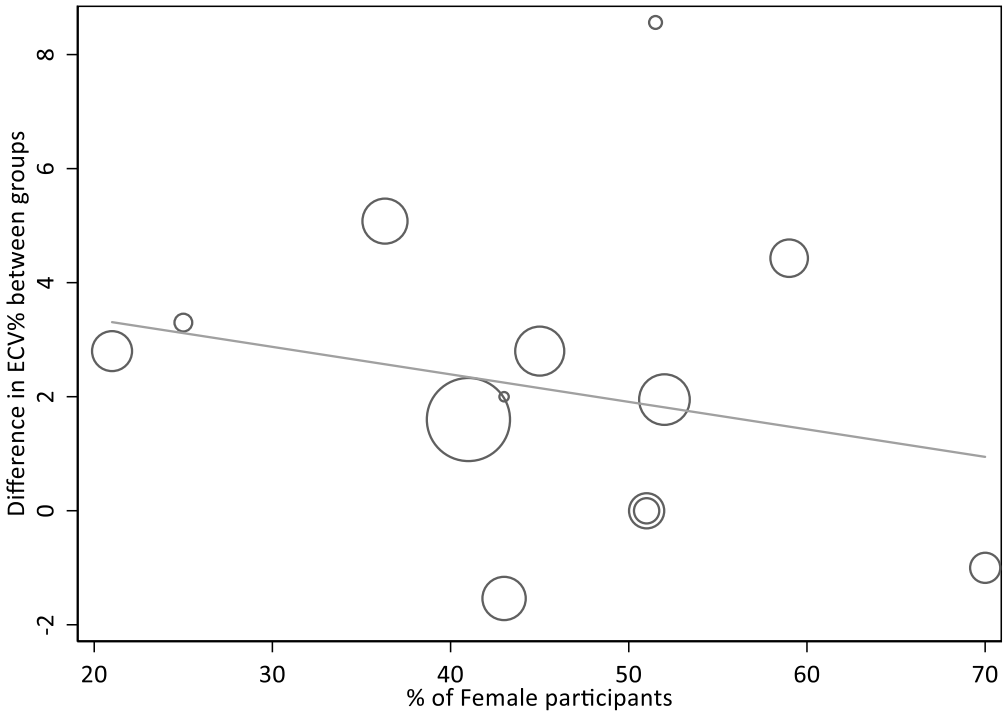
The effect in overall meta-analysis estimates is shown if one of the studies is removed from the pooled analysis.

Supplemental Figure S4. Bubble plot of study characteristics against effect estimates

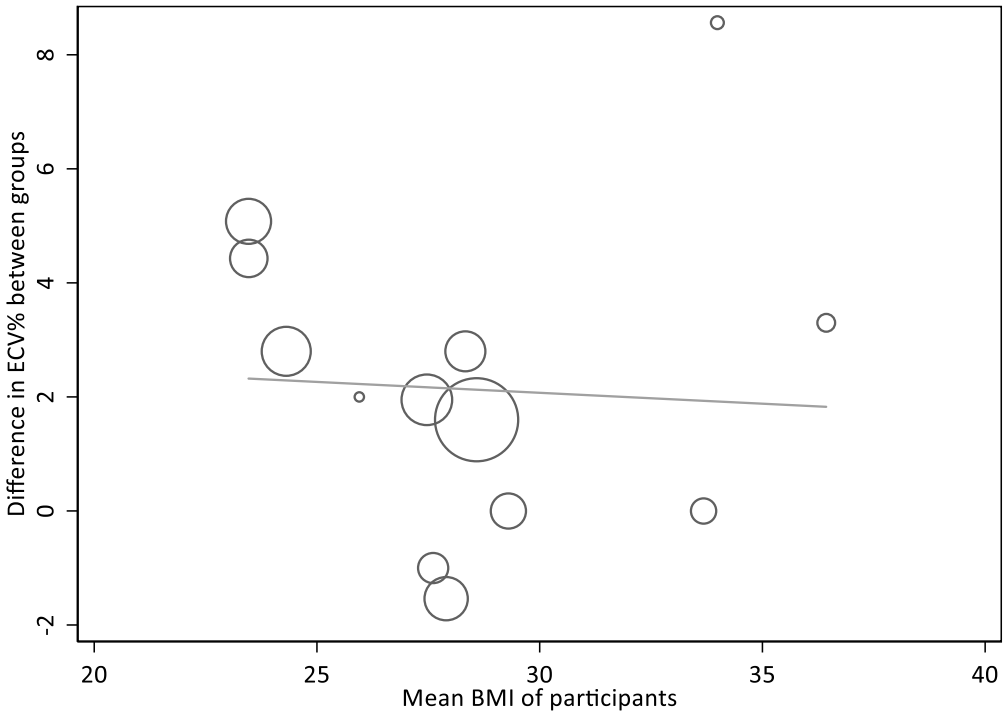
a. Difference in ECV% (diabetes – no diabetes) by age (years)



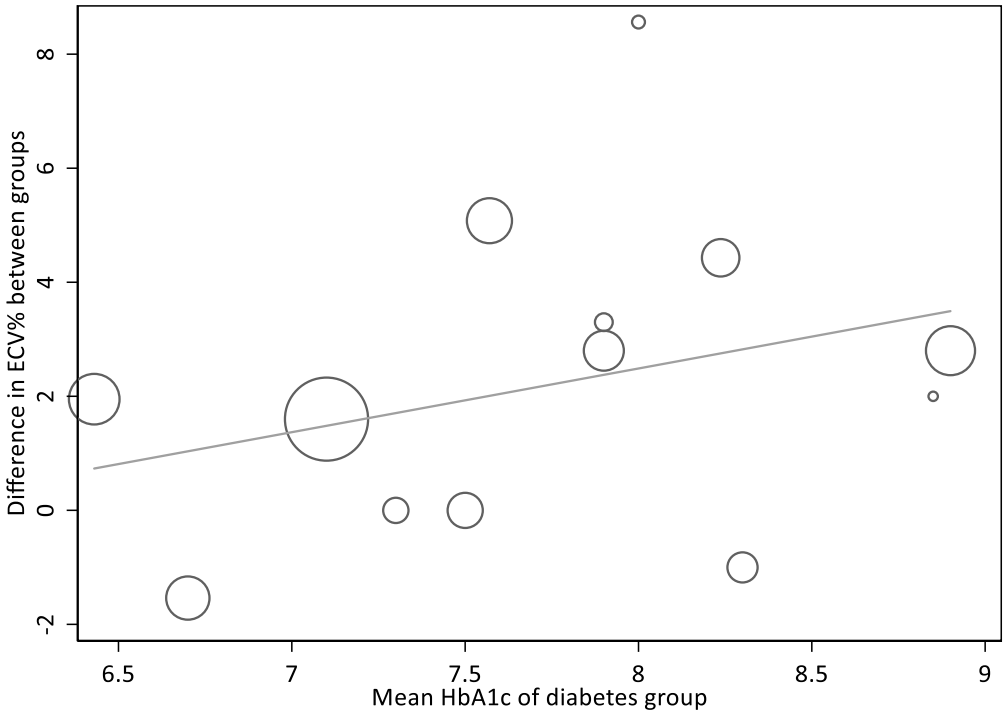
b. Difference in ECV% (diabetes – no diabetes) by proportion of female participants (%)



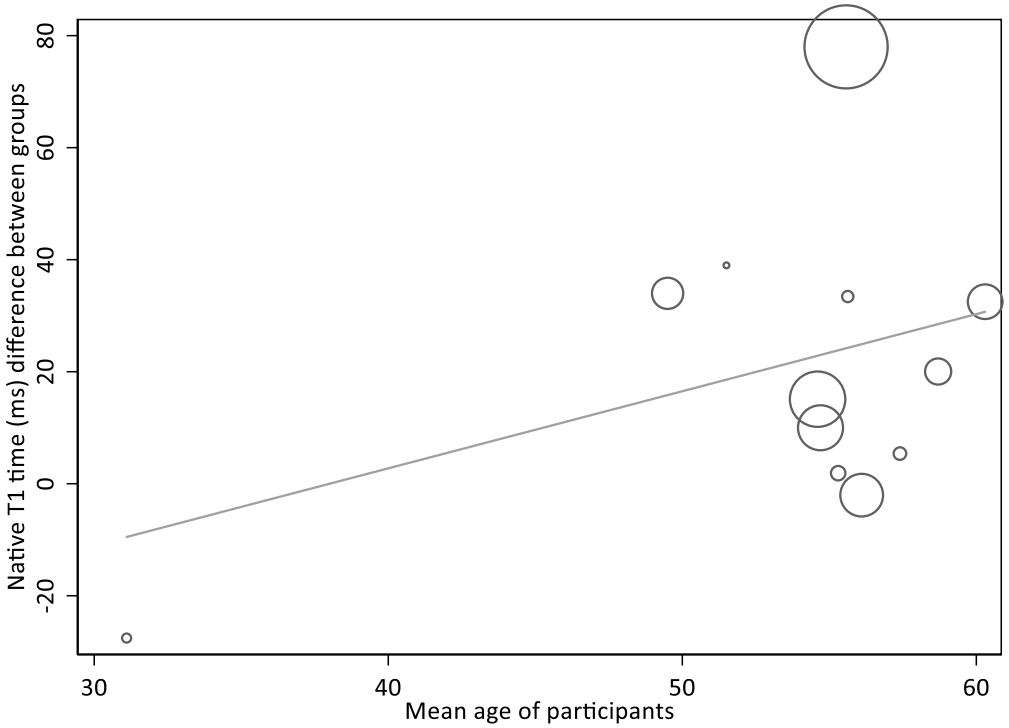
c. Difference in ECV% (diabetes – no diabetes) by BMI (kg/m^2)



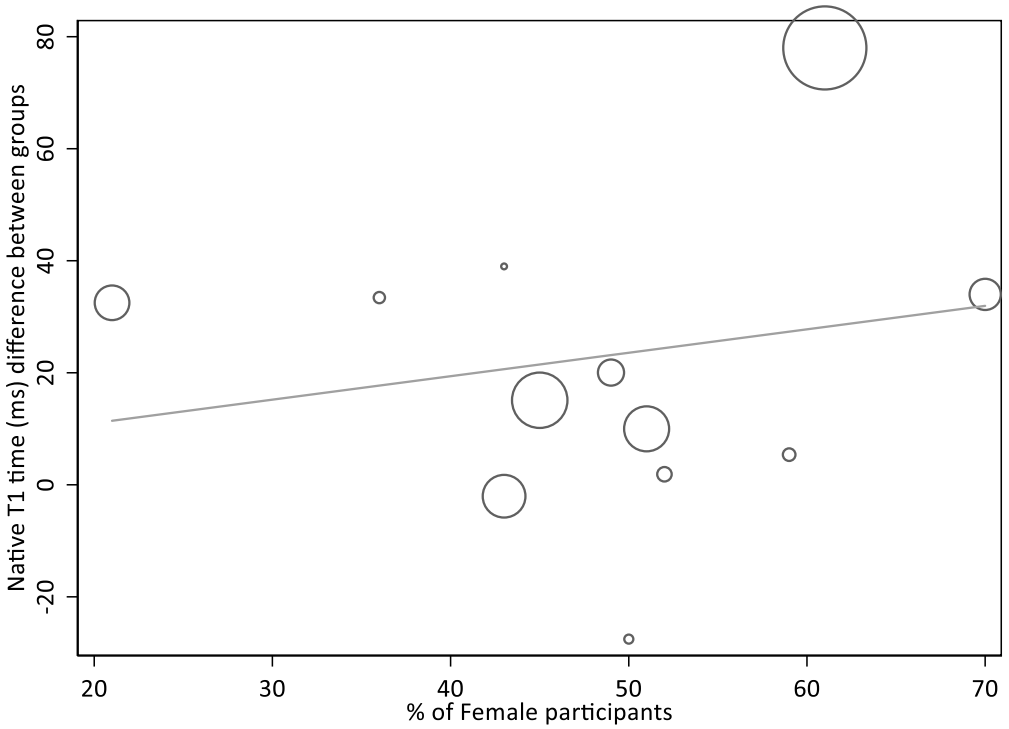
d. Difference in ECV% (diabetes – no diabetes) by HbA_{1c} (%)



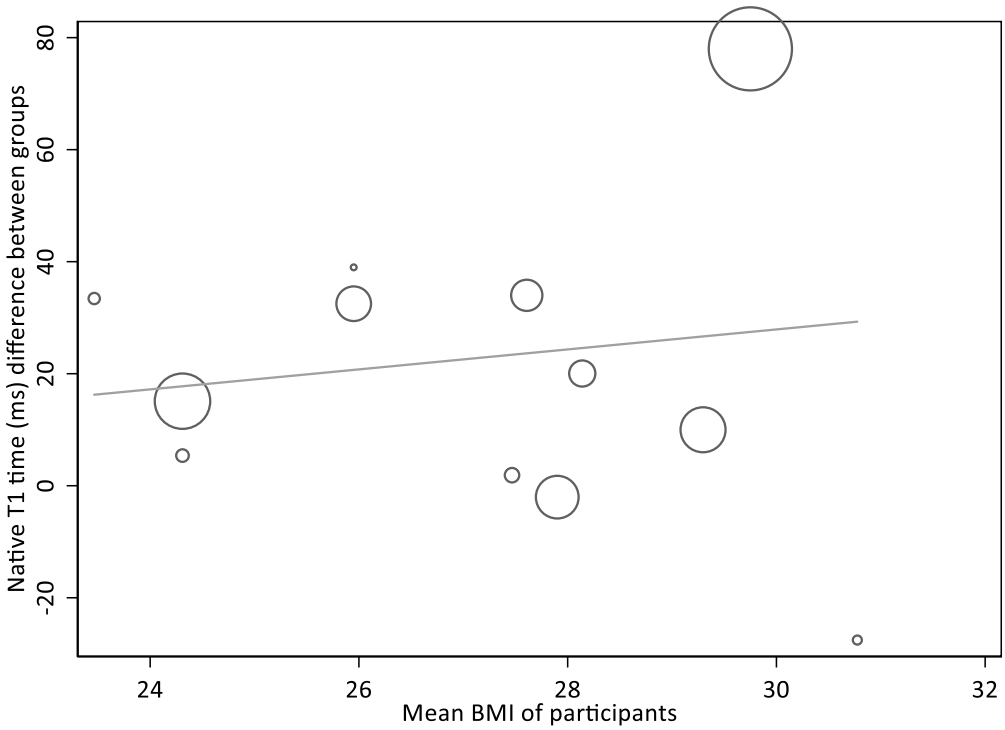
e. Difference in native T1 time (diabetes – no diabetes) by age (years)



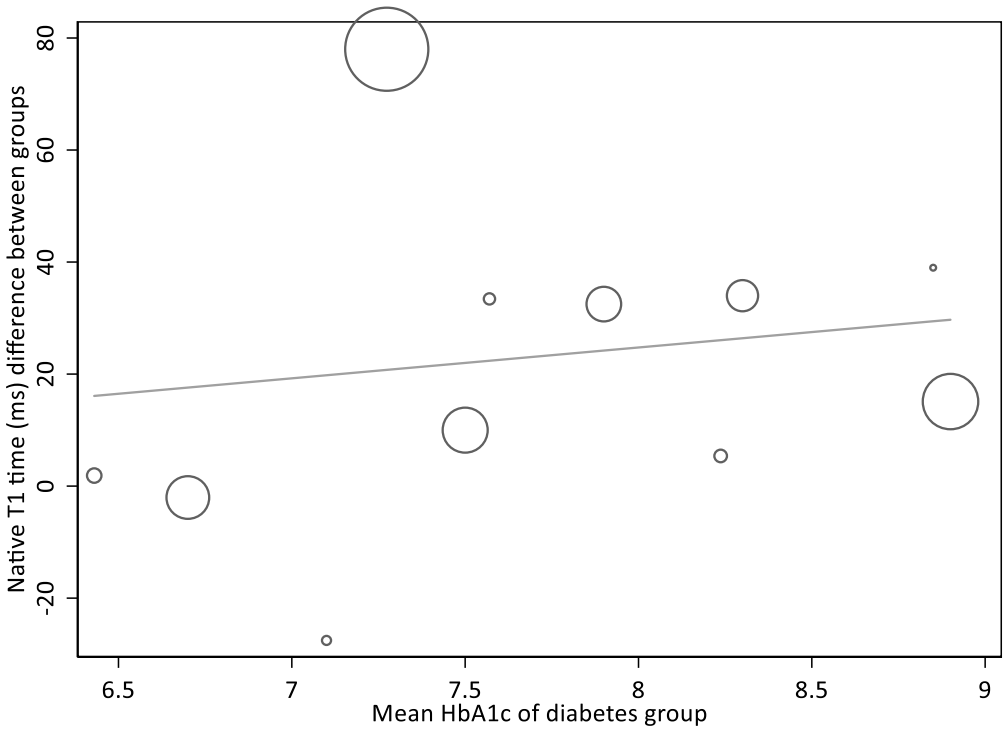
f. Difference in native T1 time (diabetes – no diabetes) by proportion of female participants (%)



g. Difference in native T1 time (diabetes – no diabetes) by BMI (kg/m^2)



h. Difference in native T1 time (diabetes – no diabetes) by HbA_{1c} (%)



Appendix A. Search Strategy

We combined diabetes-related terms such as “diabetes mellitus”, “glycosylated hemoglobin”, “fasting plasma glucose”, “antidiabetic medications” and myocardial fibrosis-related terms such as “myocardial fibrosis”, “interstitial fibrosis” “extracellular volume”, “T1 mapping” and we searched the databases as follows:

a. EMBASE

('oral antidiabetic agent'/exp OR 'biguanide'/de OR 'alpha glucosidase inhibitor'/exp OR 'insulin secretagogue'/exp OR 'sulfonylurea derivative'/exp OR 'dipeptidyl carboxypeptidase inhibitor'/exp OR 'glucagon like peptide receptor agonist'/exp OR 'sodium glucose cotransporter inhibitor'/exp OR 'insulin dependent diabetes mellitus'/exp OR 'non insulin dependent diabetes mellitus'/de OR 'impaired glucose tolerance'/de OR 'hyperglycemia'/de OR 'fasting glucose'/de OR 'glycosylated hemoglobin'/exp OR 'glycemic control'/de OR 'glucose blood level'/de OR 'homa ir'/de OR (anti-diabet* OR antidiabet* OR diabet* OR hypoglycemi* OR hypoglycaemi* OR hyperglycemi* OR hyperglycaemi* OR antihyperglycemi* OR prediabet* OR pre-diabet* OR IDDM OR NIDDM OR MODY OR T1DM OR T2DM OR ((glucose OR insulin) NEAR/3 (level* OR concentration OR plasma OR blood OR serum OR metabolism OR tolerance OR intolerance OR sensitivit* OR insensitivity* OR resistance OR homeosta*)) OR HOMA-IR OR 'fasting glucose' OR 'glycated hemoglobin' OR 'glycated haemoglobin' OR HbA1c OR 'Hb A1c' OR 'hemoglobin A1c' OR 'haemoglobin A1c' OR 'glycemic control' OR 'glycaemic control'):ab,ti) AND ('heart muscle fibrosis'/exp OR (cardiomyofibrosis OR cardiosclerosis OR ((cardiac OR myocard* OR endomyocard* OR heart OR subendocard* OR interstiti*) NEAR/6 (fibrosis OR scarring OR scar)) OR ((heart OR cardiac OR myocardial) AND ('extracellular matri*' OR 'extracellular volume*' OR ecv OR ecvf OR 't1 mapping' OR 'native t1' OR 'precontrast t1' OR 'postcontrast t1' OR 'global t1')) OR ((heart OR cardiac OR myocardial OR myocardium) NEAR/2 (interstitium OR interstitial)) OR (fibrotic AND (heart OR myocardium))):ab,ti) NOT ([animals]/lim NOT [humans]/lim) NOT ([Conference Abstract]/lim OR [Letter]/lim OR [Note]/lim OR [Editorial]/lim)

b. Medline Ovid

(Hypoglycemic Agents/ OR Biguanides/ OR Glycoside Hydrolase Inhibitors/ OR exp Sulfonylurea Compounds/ OR Angiotensin-Converting Enzyme Inhibitors/ OR Glucagon-Like Peptide-1 Receptor/ OR Sodium-Glucose Transporter 2 Inhibitors/ OR diabetes mellitus, type 1/ or diabetes mellitus, type 2/ OR Glucose Intolerance/ OR exp Hyperglycemia/ OR Glycated Hemoglobin A/ OR Blood Glucose/ OR (anti-diabet* OR antidiabet* OR diabet* OR hypoglycemi* OR hypoglycaemi* OR hyperglycemi* OR hyperglycaemi* OR antihyperglycemi* OR prediabet* OR pre-diabet* OR IDDM OR NIDDM OR MODY OR T1DM OR T2DM OR ((glucose OR insulin) ADJ3 (level* OR concentration OR plasma OR blood OR serum OR metabolism OR tolerance OR intolerance OR sensitivit* OR insensitivity* OR resistance OR homeosta*)) OR HOMA-IR OR fasting glucose OR glycated hemoglobin OR glycated haemoglobin OR HbA1c OR Hb A1c OR hemoglobin A1c OR haemoglobin A1c OR glycemic control OR glycaemic control).ab,ti.) AND ((Fibrosis/ AND Cardiomyopathies/) OR Diabetic Cardiomyopathies/ OR (cardiomyofibrosis OR cardiosclerosis OR ((cardiac OR myocard* OR endomyocard* OR heart OR subendocard* OR interstiti*) ADJ6 (fibrosis OR scarring OR scar)) OR ((heart OR cardiac OR myocardial) AND (extracellular matri* OR extracellular volume* OR ecv OR ecvf OR t1 mapping OR native t1 OR precontrast t1 OR postcontrast t1 OR global t1)) OR ((heart OR cardiac OR myocardial OR myocardium) ADJ2 (interstitium OR interstitial)) OR (fibrotic AND (heart OR myocardium)) OR myocardial fibrosis OR cardiac fibrosis OR heart fibrosis).ab,ti,kw) NOT (exp animals/ NOT humans/) NOT (letter* OR news OR comment* OR editorial* OR congres*).pt.

c. Cochrane Library

((anti-diabet* OR antidiabet* OR diabet* OR hypoglycemi* OR hypoglycaemi* OR hyperglycemi* OR hyperglycaemi* OR antihyperglycemi* OR prediabet* OR pre-diabet* OR IDDM OR NIDDM OR MODY OR T1DM OR T2DM OR ((glucose OR insulin) NEAR/3 (level* OR concentration OR plasma OR blood OR serum OR metabolism OR tolerance OR intolerance OR sensitivit* OR insensitivity* OR resistance OR homeosta*)) OR HOMA-IR OR "fasting glucose" OR "glycated hemoglobin" OR "glycated haemoglobin" OR HbA1c OR "Hb A1c" OR "hemoglobin A1c" OR "haemoglobin A1c" OR "glycemic control" OR "glycaemic control"):ab,ti) AND ((cardiomyofibrosis OR cardiosclerosis OR ((cardiac OR myocard* OR endomyocard* OR heart OR subendocard* OR interstiti*) NEAR/6 (fibrosis OR scarring OR scar)) OR ((heart OR cardiac OR myocardial) AND (extracellular NEXT matri* OR extracellular NEXT volume* OR ecv OR ecvf OR "t1 mapping" OR "native t1" OR "precontrast t1" OR "postcontrast t1" OR "global t1")) OR ((heart OR cardiac OR myocardial OR myocardium) NEAR/2 (interstitium OR interstitial)) OR (fibrotic AND (heart OR myocardium))):ab,ti)

d. Web-of-Science

TS=(((anti-diabet* OR antidiabet* OR diabet* OR hypoglycemi* OR hypoglycaemi* OR hyperglycemi* OR hyperglycaemi* OR antihyperglycemi* OR prediabet* OR pre-diabet* OR IDDM OR NIDDM OR MODY OR T1DM OR T2DM OR ((glucose OR insulin) NEAR/3 (level* OR concentration OR plasma OR blood OR serum OR metabolism OR tolerance OR intolerance OR sensitivit* OR insensitivity* OR resistance OR homeosta*)) OR HOMA-IR OR "fasting glucose" OR "glycated hemoglobin" OR "glycated haemoglobin" OR HbA1c OR "Hb A1c" OR "hemoglobin A1c" OR "haemoglobin A1c" OR "glycemic control" OR "glycaemic control")) AND ((cardiomyofibrosis OR cardiosclerosis OR ((cardiac OR myocard* OR endomyocard* OR heart OR subendocard* OR interstiti*) NEAR/6 (fibrosis OR scarring OR scar)) OR ((heart OR cardiac OR myocardial) AND ("extracellular matri*" OR "extracellular volume*" OR ecv OR ecvf OR "t1 mapping" OR "native t1" OR "precontrast t1" OR "postcontrast t1" OR "global t1")) OR ((heart OR cardiac OR myocardial OR myocardium) NEAR/2 (interstitium OR interstitial)) OR (fibrotic AND (heart OR myocardium))))) NOT TS=((animal* OR rats OR mice OR dogs OR pigs OR swine) NOT (human* OR patient*)) AND DT=article

e. Google Scholar

(First 200 results out of 14’400 results, according to relevance ranking)

diabetes|diabetic|prediabetic|prediabetes|"fasting glucose"|"glucose|insulin level|blood|tolerance|sensitivity|resistance|metabolism" "cardiac|myocardial|heart fibrosis" -rats -mice -dogs -pigs -swine -rabbits

Appendix B. Quality Assessment

Adapted Newcastle-Ottawa Quality Assessment Scale

Selection (max 4 stars)

1. *Representativeness of the exposed cohort*
   a. Truly representative of the average in the target population (all subjects or random sampling)*
   b. Somewhat representative of the average in the target population (nonrandom sampling)*
   c. Selected group of users
   d. No description of the derivation of the cohort
2. *Sample size*
   a. Justified and satisfactory*
   b. Not satisfied
3. *Ascertainment of the exposure (risk factor)*
   a. Secure record (eg, medical records)*
   b. Structured interview*
   c. Written self-report
   d. No description of the measurement tool
4. *Nonrespondents*
   a. Comparability between respondent and nonrespondent characteristics is established, and the response rate is satisfactory*
   b. The response rate is unsatisfactory, or the comparability between respondents and nonrespondents is unsatisfactory
   c. No description of the response rate or the characteristics of the respondents and nonrespondents

Comparability (max 2 stars)

1. *The subjects in the different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled*
   a. Study controls for the most important factors (age, sex)*
   b. Study controls for additional relevant factors**
   c. Inadequate degree of control

Outcome (max 3 stars)

1. *Assessment of the outcome*
   a. Independent or blind assessment stated in the paper, or confirmation of the outcome by reference to secure records (eg, X-rays, medical records)**
   b. Record linkage (eg, identified through ICD codes on database records)**
   c. Self-report (ie, no reference to original medical records or X-rays to confirm the outcome)*
   d. No description
2. *Statistical test*
   a. The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including the probability level (p-value)*
   b. The statistical test is not appropriate, not described or incomplete

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This scale has been adapted from Newcastle Ottawa Quality Assessment Scale (36,37). Each study can obtain a maximum of 4 stars on the selection domain, 2 stars on the comparability domain, and 3 stars on exposure or outcome domains. Scores on each domain were used to categorize the studies as good, fair, or poor. The thresholds for converting the NOS scores into the Agency for Healthcare Research and Quality (AHRQ) standards were as follows: (I) good quality: 3 or 4 stars in the selection domain, and 1 or 2 stars in the comparability domain, and 2 or 3 stars in the outcome domain. (II) Fair quality: 2 stars in the selection domain, and 1 or 2 stars in the comparability domain, and 2 or 3 stars in the exposure/outcome domain. (III) Poor quality: 0 or 1 star in the selection domain, or 0 star in the comparability domain, or 0 or 1 star in the exposure/outcome domain (36,38).

Appendix C. Studies excluded in the meta-analyses

Publication	**Reasons for exclusion in the meta-analysis**
Kawaguchi, 1997(3)	Outcomes measured using a different scale
Al-badri 2018 (28)	Different effect estimate parameters (no linear regression coefficients)
Ambale-Venkatesh, 2019(16)	Missing information on number of participants per subgroup; outcomes measured differently using synthetic ECV%; only linear regression coefficients were presented as effect estimates
Contti, 2019(24)	Effect estimates were derived from figures based on a visual approximation
Wang 2019(8)	Effect estimates were derived from figures based on a visual approximation

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