

SUPPLEMENTAL MATERIAL

Table S1. Search strategy for the systematic review.

Search	Keywords	Thesaurus (MeSH)	Textwords
#1	Exposure	Body Composition/ Body Weights and Measures/ Adipose Tissue/ Obesity/ Obesity Hypoventilation Syndrome/ Obesity, Abdominal/ Obesity, Metabolically Benign/ Obesity, Morbid/ Obesity Management/ Bariatrics/ Metabolic Syndrome/ Adipocytes/ Adiposity/ Body Fat Distribution/ Anthropometry/ exp Subcutaneous Fat/ exp Subcutaneous Fat, Abdominal/ Body Mass Index/ Body Weight/ Body Height/ Waist Circumference/ Waist-Height Ratio/ Waist-Hip Ratio/ Body Constitution/ Somatotypes/ Body Size/ Overweight/ Abdominal Fat/ Body Weight Changes/ Sarcopenia/ Thinness/ Cachexia/ Intra-Abdominal Fat/	((body or abdom* or intraabdom* or central or truncal or trunk or appendicular or subcutaneous or sub- cutaneous or visceral or limb or arm or leg or peripheral or android or gynoid) adj fat?).mp body composition* body weight and measure* adipos* obes* metabolic syndrome* overweight* BMI* adipocyt* fat distribution* fat mass* anthropometr* quetelet* index* body weight* body height* waist circumference* waist-height ratio* hip circumference* waist-hip ratio* body constitution* Somatotypes* body size* body mass* sarcop?enia* thinness* muscle mass* muscle bulk* lean mass* fat-free mass* skeletal bulk* heart failure* cardiac failure* diastolic HF* systolic HF* pulmonary o?dema HFrEF* HFpEF* HFmEF* ventricular failure* biventricular failure* cardiac dysfunction* ventricular dysfunction* cardiomyopath* cardiorenal syndrome* cardiomegaly* ventricular* hypertrophy* cardia* hypertrophy* ventricular function ventricular remodeling* cardia* remodeling* BNP* NT-BNP* natriuretic peptide* cohort* longitudinal* prospective* follow-up* observational * incidence stud*
#2	Outcomes	exp Heart Failure/ Pulmonary Edema/ Ventricular Dysfunction/ Ventricular Dysfunction, Left/ Ventricular Dysfunction, Right/ exp Cardiomyopathies/ Cardiomegaly/ Hypertrophy, Left Ventricular/ Hypertrophy, Right Ventricular/ exp Ventricular Function/	
#3	Study type	exp Cohort Studies/ Observational Study/	
#4		#1 AND #2 AND #3	

Table S2. Quality grading of included studies.

S/No	Quality measure (met=1, not met=0)									
	First author (publication year)	Study selection				Group comparability	Outcome assessment			Total quality score (max. 9)
		Representative study ^a	Detailed description of participant selection and eligibility	Standardised or validated method of composition measurement	Absent HF at baseline		Record linkage or standardised adjudication used for outcome	Follow-up, >5 years	Adequate follow-up (complete follow-up or <10% loss to follow-up)	
1	Chen (1999) ⁶⁷ , USA, The New Haven Cohort	0	1	0	1	2	1	1	0	6
2	He (2001) ⁶⁶ , USA, NHANES 1 Epidemiologic follow-up Study	1	1	1	1	1	1	1	1	8
3	Kenchaiah (2002) ¹⁰³ , USA, Framingham Heart Study	1	1	1	1	1	1	1	1	8
4	Ingelsson (2005) ⁵⁶ , Sweden, The Uppsala Longitudinal Study of Adult Men cohort	1	1	0	1	0	1	1	1	6
5	Nicklas (2006) ⁵ , USA, The Health, Aging and Body Composition study	0	1	1	1	2	1	1	0	7
6	Murphy (2006) ⁵⁷ , Scotland UK, Renfrew–Paisley study	1	1	1	0	2	1	1	0	7
7	Thrainsdottir (2007) ⁵⁸ , Iceland, Reykjavík Study	1	1	0	1	0	1	1	0	5
8	Douglas Lee (2007) ⁶¹ , USA, Framingham Heart Study	1	1	1	1	1	1	1	0	7
9	Kenchaiah (2009) ⁶² , USA, Physicians' Health	0	1	0	1	2	1	1	0	6
10	Levitan (2009) ⁵⁹ , Sweden Swedish Mammography Cohort	1	1	0	1	2	1	1	0	7
11	Levitan (2009) ⁵⁹ , Sweden, Cohort of Swedish Men	1	1	0	1	2	1	1	0	7
12	Loehr (2009) ⁷³ , USA, Atherosclerosis Risk in Communities (ARIC)	1	1	1	1	2	0	1	0	7
13	Hu (2010) ⁶⁰ , Finland, Finnish Population Survey	1	1	1	1	2	1	1	0	8
14	Wang (2010) ⁴⁷ , Finland, Kuopio Finnish Cohort	1	1	1	1	2	0	1	0	7
15	Baena-Diez (2010) ⁴⁸ , Barcelona Spain, Zona Franca Cohort Study	1	1	1	1	1	0	1	0	6
16	Van Lieshout (2011) ⁴⁹ , Netherlands, Rotterdam Study	0	1	1	1	2	1	1	0	6
17	Voulgari (2011) ⁵⁰ , Greece, Athens Cohort	1	1	1	1	2	0	1	0	7
18	Wannamethee (2011) ⁵¹ , UK, The British Regional Heart Study	0	1	1	1	2	1	1	1	8
19	Djoussé (2012) ⁶³ , USA, The Cardiovascular Health Study (CHS)	0	1	1	1	2	1	1	0	7
20	Brouwers (2013) ⁵² , Groningen The Netherlands, PREVEND cohort	1	1	0	0	1	1	1	0	5
21	Ebong (2013) ⁶⁴ , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	1	1	1	0	2	1	1	0	7

22	Borne (2014) ⁵³ Ahead of print 2012, Sweden, Malmo Diet and Cancer (MDC) cohort	1	1	1	1	2	1	1	0	8
23	Mørkedal (2014) ⁵⁴ , Norway, HUNT (Nord-Trøndelag Health Study)	1	1	1	1	1	1	1	0	7
24	Joshy (2014) ⁶⁸ , Australia, 45 and Up Study	1	1	0	1	2	1	0	0	6
25	Björck (2015) ¹⁹ , Gothenburg Sweden, Multifactor Primary Prevention Study	0	1	1	1	2	1	1	1	8
26	Del Gobbo (2015) ²⁰ , USA, Cardiovascular Health Study	1	1	1	1	2	1	1	0	8
27	Eaton (2016) ²⁷ , USA, Women's Health Initiative	0	1	0	1	2	1	1	0	6
28	Ndumele (2016) ²⁸ , USA, Atherosclerosis Risk in Communities (ARIC)	1	1	1	1	2	1	1	0	8
29	Janszky (2016) ²⁹ , Norway (HUNT2)	1	1	1	1	2	1	1	0	8
30	Krishnamoorthy (2016) ³⁰ , USA, Jackson Heart Study	1	1	1	1	2	1	1	0	8
31	Pandey (2017) ²¹ , USA, Cooper Center Longitudinal Study	1	1	1	0	1	1	1	0	6
32	Rao (2018) ³ , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	1	1	1	1	2	1	1	0	8
33	Flotsos (2018) ²² , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	1	1	1	1	2	1	1	0	8
34	Gong (2018) ⁷¹ , Australia, SCREEN-HF study	0	1	1	1	0	1	0	0	4
35	Pandey (2018) ⁴ , USA, Jackson Heart Study	1	1	1	1	1	1	1	1	8
36	Kokkinos (2019) ²³ , USA, ETHOS Veteran cohort	0	1	1	1	2	1	1	0	7
37	Kubicki (2020) ⁶⁵ , USA, Southern Community Cohort Study (SCCS)	1	1	0	1	2	1	1	0	7
38	Campbell (2019) ¹¹ , Australia, SCREEN-HF	0	1	0	1	0	1	0	0	3
39	Halldin (2020) ²⁴ , Gothenburg Sweden, Prospective Population Study of Women in Gothenburg (PPSWG)	0	1	1	1	1	1	1	0	6
40	Ergatoudes (2020) ²⁵ , Gothenburg Sweden, Men born in Gothenburg 1913 cohort	0	1	1	1	2	1	1	0	7
41	Chen (2020) ²⁶ , Sweden, The Study of men born in 1943	0	1	1	1	2	1	1	0	7
42	Rao (2021) ⁶⁹ Jackson Heart Study	1	1	1	1	2	1	1	0	8
43	Kenchaiah (2021) ⁷⁰ , MESA	1	1	1	1	2	1	1	1	9
44	Suthahar (2022) ⁷² , The Netherlands, PREVEND	1	1	1	1	1	1	1	0	8
45	Xing (2023) ⁵⁵ , UK, The UK Biobank	1	1	1	1	2	1	1	1	9

^aRepresentative cohort defined as general adult population.

^bDefined as adjustment for at least age and sex (except for studies done in specific sexes or specific age group only). One extra point given for additional adjustment for other lifestyle confounders.

Table S3. Comparison of observed and predicted means of adiposity categories in relevant studies.

Author	Sex	BMI					WC					WHR				
		Categories	Minimum	Maximum	Reported mean	Calculated mean	Categories	Minimum	Maximum	Reported mean	Calculated mean	Categories	Minimum	Maximum	Reported mean	Calculated mean
Kenchiah (2002) ¹⁰³	women	normal	18.5	24.9	22.3	21.7										
	women	overweight	25	29.9	27.1	27.5										
	women	obese	30	34.9	34.1	32.5										
	men	normal	18.5	24.9	23.2	21.7										
	men	overweight	25	29.9	27.2	27.5										
	men	obese	30	34.9	32.7	32.5										
Murphy (2006) ⁵⁷	women	normal	18.5	24.9	22.5	21.7										
	women	overweight	25	29.9	27.1	27.5										
	women	obese	30	34.9	33.6	32.5										
	men	normal	18.5	24.9	22.8	21.7										
	men	overweight	25	29.9	27.1	27.5										
	men	obese	30	34.9	32.1	32.5										
	both sexes	normal	18.5	24.9	22.6	21.7										
	both sexes	overweight	25	29.9	27.1	27.5										
	both sexes	obese	30	34.9	33	32.5										
Kenchiah (2009) ⁶²	both sexes	lean	18.5	24.9	23	21.7										
	both sexes	overweight	25	29.9	26.6	27.5										
	both sexes	obese	30	34.9	32.4	32.5										
Loehr (2009) ⁷³ white women	white women	normal weight	18.5	25	22.2	21.7	first tertile	74	86.9	78.9	80.45	first tertile	0.79	0.85	0.8	0.82
	white women	overweight	25	29.9	27.2	27.5	second tertile	87	99.9	92.6	93.45	second tertile	0.86	0.92	0.89	0.89
	white women	obese	30	34.9	34.4	32.5	third tertile	100	112.9	111.2	106.45	third tertile	0.93	0.99	0.98	0.96
Loehr (2009) ⁷³ black women	black women	normal weight	18.5	25	22.7	21.7	first tertile	74	86.9	79.4	80.45	first tertile	0.79	0.85	0.8	0.82
	black women	overweight	25	29.9	27.5	27.5	second tertile	87	99.9	93.2	93.45	second tertile	0.86	0.92	0.89	0.89
	black women	obese	30	34.9	35.8	32.5	third tertile	100	112.9	113.4	106.45	third tertile	0.93	0.99	0.98	0.96
Loehr (2009) ⁷³ white men	white men	normal weight	18.5	25	23.1	21.7	first tertile	86.9	94.9	88.9	90.9	first tertile	0.9	0.93	0.91	0.915
	white men	overweight	25	29.9	27.3	27.5	second tertile	95	103	98.4	99	second tertile	0.94	0.97	0.96	0.955
	white men	obese	30	34.9	33	32.5	third tertile	103.1	111.1	110.4	107.1	third tertile	0.98	1.01	1.02	0.995

Table S4. Characteristics of studies included in the systematic review.

S/No	First author(Publication year), country, cohort name	Recruitment Year	Study size (% men or women), mean age- years (SD/IQR)	Mean/Median follow-up (years)	Exclusions	Body composition measure	Study outcome	Outcome ascertainment method	Count of incident HF	HF type/aetiologies	Adjustments	Shape of associations	Type of HR	Hazard/Risk Ratio (95%CI)	Study Quality score
1	Chen (1999) ⁶⁷ , USA, The New Haven Cohort	1982	1749 (59% women), 74.2 (6.8) years	7.9 years	Prevalent HF, or ischaemic heart disease	BMI	Incident heart failure	Electronic record linkage and review of hospital records	173	N/A	Age, sex, diabetes, pulse pressure, type of housing	N/A	Per strata	BMI categories BMI <24: ref BMI 24-27.9: 1.1 (0.7-1.6) BMI ≥28: 1.6 (1.0-2.4)	6
2	He (2001) ⁶⁶ , USA, NHANES 1 Epidemiologic Follow-up Study	1971-1975	13,643 (59.4% women) Men: 52.2 (15.2) years Women: 48.1 (15.4) years	9 years	Prevalent HF in the 6 months before recruitment, loss to follow-up	BMI	Incident HF	Participants/proxy interviews, review of hospital/nursing home records and death certificates	1382	N/A	Age, sex, race time-dependent history of coronary heart disease	N/A	Overweight (BMI ≥27.3 in women/ ≥27.8 in men) vs normal weight (BMI <27.3 in women/ <27.8 in men)	BMI categories Normal weight: ref Overweight women: 1.24 (1.01-1.51) Overweight men: 1.43 (1.19-1.72) Overweight overall: 1.35 (1.17-1.55)	8
3	Kenchaiah (2002) ¹⁰³ , Framingham Heart Study	1976-1979 and 1979-1983)	5881 (54.0% women),	14 years	Under-30 years old, underweight, prevalent HF, missing co-variates, lack of follow-up data	BMI	Incident HF	Adjudication by study panel physicians using Framingham criteria	496	N/A	Age, sex, alcohol, serum total cholesterol, cigarette smoking, valve disease, hypertension, diabetes, electrocardiographic Left ventricular hypertrophy and myocardial infarction	linear	per 1 kg/m ² increase of BMI and per strata of BMI	Per unit higher BMI Women: 1.07 (1.04-1.07) Men: 1.05 (1.02-1.09) Total: 1.06 (1.04-1.09) BMI categories Normal weight (18.5-24.9): ref Overweight (25.0-29.9): 1.34 (1.08-1.67) Obese (≥30.0): 2.04 (1.59-2.63)	8
4	Ingelsson (2005) ⁶⁸ , Sweden, The Uppsala Longitudinal Study of Adult Men cohort	1970-1974	1187 (100% men), ≥70 years	8.9 years (range, 0.01- 11.4 years)	Prevalent HF and valvular disease	BMI	Incident HF hospitalisation	Blinded adjudication of hospital discharge register	104	N/A	Diabetes plus prior acute MI, hypertension, electrocardiographic LVH, smoking, and serum cholesterol level	linear	per SD	BMI 1.35 (1.11-1.65); WC 1.36 (1.10-1.69)	6
5	Nicklas (2006) ⁵ , USA, The Health, Aging and Body Composition study	1997-1998	2435 (56% women), No HF: 74.1 (2.8) years HF: 74.6 (3.0) years	6.1 ± 1.4	Missing last contact date, prevalent adjudicated acute MI, coronary heart disease, heart failure or pacemaker	BMI, WC, waist-thigh ratio (WTR), TFM, BF%, VAT area, SAT area (DXA for fat quantification)	Incident adjudicated chronic HF	Adjudicated HF hospitalisations	166 (54 were diastolic HF)	N/A	age, sex, race, site, education, smoking, and chronic obstructive pulmonary disorder (COPD)	positive	per 4.88 kg/m ² increase of BMI, per 7.93% increase of BF%, per 8.76 kg increase of BFM, per 13.38 cm increase of WC, per 0.23 increase of WTR, per 66.37 cm ² increase of VAT area, per 124.19 cm ² increase of SAT area	BMI: 1.31 (1.13–1.52) WC: 1.33 (1.17–1.50) WTR: 1.19 (1.03–1.38) BF%: 1.55 (1.22–1.96) BFM: 1.31 (1.12–1.54) VAT area: 1.25 (1.08-1.45) SAT area: 1.27 (1.07–1.50)	7
6	Murphy (2006) ⁵⁷ , Scotland UK, Renfrew–Paisley study	1972-1976	15144 (53.8% women), 54(6) years	20	Underweight	BMI	Incident HF	Electronic health linkage	594	N/A	sex, age, adjusted FEV1, number of cigarettes smoked per day and social class.	linear	Per strata	Normal weight: Ref Overweight: 1.26 (1.05-1.50) Obese: 2.09 (1.68-2.59)	7
7	Thrainsdottir (2007) ⁶⁹ , Iceland, Reykjavik Study	1967-1980	7060 (45% women), 33-84 years	13 ± 8 years	diabetes, abnormal glucose regulation or HF at first visit	BMI	Incident HF diagnosis	adjudicated	489	N/A	Sex, IHD, hypertension, cholesterol and smoking	positive	Per 1Kg/m ² increase	1.09 (1.07–1.11)	5
8	Douglas Lee (2007) ⁶¹ , USA, Framingham Heart Study	1968-1994	3362 (57% women), 62 years	20	Prevalent HF, less than 3 BP and BMI measurements in preceding (1970s) and remote (1960s) decades.	BMI	incident HF	Adjudication of medical histories, physical examinations at the heart study, hospitalization records, and communication with personal physicians using the Framingham criteria.	518	N/A	age, sex, serum cholesterol, systolic and diastolic BP, hypertension treatment, diabetes, smoking, valve disease, and previous myocardial infarction (all defined at the baseline examination) and for incidence of an interim myocardial infarction on follow-up.	linear increase	per Kg/m2	Baseline BMI: 1.05 (1.03-1.07)	6
9	Kenchaiah (2009) ⁶² , USA, Physicians' Health	1982	21094 (100% men), 53 years	20.5±5.4 years	Missing height, weight or physical activity at baseline, missing information on other covariates and HF before baseline examination	BMI	incident HF diagnoses	Adjudicated self-reported diagnoses and symptoms	1109	N/A	age,smoking, alcohol, parental history of myocardial infarction, trial group assignment	linear increase	per unit increase and per strata	BMI per unit increase 1.13 (1.11–1.15); BMI categories: Lean- reference overweight 1.62 (1.43–1.83) obese 3.38 (2.71–4.21)	5
10	Levitán (2009) ⁵⁹ , Sweden Swedish Mammography Cohort	1997-1998	36873 (100 % women), 48-83 years	7	Prevalent HF, underweight, HF hospitalisation or death in first 2 years of follow-up, absent or incorrect national identification numbers, implausible energy intakes, previous diagnosis of cancer (other than non-melanoma skin cancer)	BMI, WC, WHR, WHtR	incident HF admissions and deaths	Electronic record linkage to the Swedish inpatient and cause of-death registers.	382 women,	N/A	age, education, smoking, alcohol consumption, total physical activity, postmenopausal hormone therapy, living alone, and family history of myocardial infarction.	linear increase	per unit increase in BMI, per 10cm increase in WC, per IQR increase in WHR, per IQR increase in WHtR	BMI: 1.03 (1.01-1.05) WC: 1.19 (1.08-1.31), WHR: 1.05 (0.95-1.15), WHtR: 1.21 (1.06-1.38)	6
11	Levitán (2009) ⁵⁹ , Sweden, Cohort of Swedish Men	1997-1998	43487 (100% men), 45-79 years	7	Prevalent HF, underweight, HF hospitalisation or death in first 2 years of follow-up, absent or incorrect national identification numbers, implausible energy intakes, previous diagnosis of cancer (other than non-melanoma skin cancer)	BMI, WC, WHR, WHtR	incident HF admissions and deaths	Electronic record linkage to the Swedish inpatient and cause of-death registers.	718 men	N/A	age, education, smoking, alcohol consumption, total physical activity, marital status, and family history of myocardial infarction.	linear increase	per unit increase in BMI, per 10cm increase in WC, per IQR increase in WHR, per IQR increase in WHtR	BMI: 1.07 (1.05-1.08) WC: 1.30 (1.21-1.38), WHR: 1.10 (1.03-1.18), WHtR: 1.35 (1.25-1.46)	6
12	Loehr (2009) ⁷³ , USA, Atherosclerosis Risk in Communities (ARIC)	1987 and 1989	14641, 54% men with incident HF, 44% men without incident HF),	16	Non-White and non-Black ethnicities, Blacks outside Jackson or Forsyth County, missing anthropometry, prevalent HF, missing criteria to define prevalent HF	BMI, WC	Incident HF (hospitalised and fatal)	Review of participants’ interviews, hospital discharges and death certificate files	1528	N/A	age, alcohol use, educational level, smoking status, and center	positive	per SD	BMI: Women 1.49 (1.39, 1.59) Men (1.39, 1.57) WC:	6

			Incident HF group: 56.8 (5.4) years												Women 1.54 (1.44, 1.66)	
			Non-cases group: 53.8 (5.7) years												Men 1.52 (1.43, 1.62)	
															WHR:	
															Women 1.59 (1.46, 1.72)	
															Men 1.50 (1.41, 1.60)	
13	Hu (2010) ⁶⁰ , Finland, Finnish Population Survey	Surveys done in 1972, 1977, 1982, 1987, 1992, 1997, and 2002.	59178 (51.3% women), 45 (11) years	18.4	Prevalent HF, underweight, incomplete data	BMI, WC, WHR	Incident HF	Electronic record linkage to Finnish Hospital Discharge Register and the National Social Insurance Institution's Register and the Finnish Death Register	3614	N/A	age, study year, education, smoking, alcohol consumption, history of myocardial infarction, valvular heart disease, and diabetes mellitus, systolic blood pressure, total cholesterol, and physical activity.	N/A	Per strata		BMI: Men <25 ref, 25-29.9 1.25 (1.12-1.39) ≥30 1.99 (1.74-2.27) Women <25 ref, 25-29.9 1.33 (1.16-1.51) ≥30 1.99 (1.80-2.37) WC quartiles: Men Q1 1.06 (0.69-1.64) Q2 ref Q3 1.21 (0.84-1.76) Q4 1.85 (1.32-2.61) Women Q1 0.48 (0.21-1.13) Q2 ref Q3 1.18 (0.71-1.96) Q4 1.64 (1.02-2.64) WHR: Men Q1 0.88 (0.58-1.31) Q2 ref Q3 1.06 (0.74-1.50) Q4 1.71 (1.23-2.37) Women Q1 0.61 (0.31-1.19) Q2 ref Q3 0.98 (0.59-1.63) Q4 1.88 (1.17-3.01)	8
14	Wang (2010) ⁴⁷ , Finland, Kuopio Finnish Cohort	1986-1988	1032, 61.4% women with incident HF, 61.9% women without incident HF), Incident HF group: 69.1 (2.8) years Non-cases group: 68.8 (2.9) years	20	Prevalent HF	WC	Incident HF	Incident HF identified from medical records of the Kuopio University Hospital	303	N/A	age, gender, physical activity during leisure time, smoking, alcohol consumption, antihypertensive medications, total cholesterol and prevalent diabetes	N/A	Per strata		Waist circumference≥94cm (women:≥80 cm): 1.36 (1.03–1.79) Waist circumference≥102cm (women:≥88 cm) 1.40 (1.09–1.80) Waist-to-hip ratio > 0.90 (women: > 0.85) 1.29 (0.94–1.78) BMI≥30 kg/m² 1.55 (1.19–2.02)	7
15	Baena-Diez (2010) ⁴⁸ , Barcelona Spain, Zona Franca Cohort Study	1998	932 (BMI <25 61.2% women, BMI 25-29.9 51% women, BMI ≥30 64.4% women), 58 years	9.98	Prevalent HF	BMI	incident HF	Framingham criteria	26 (14 with systolic HF and 12 with non-systolic HF)	analyses presented as any incident HF	age, sex, hypertension, ischaemic heart disease, DM	linear	per unit and per strata		BMI per unit increase: 1.06 (1.01–1.10); BMI categories BMI <25: reference BMI 25-29.9: 0.79 (0.21–3.00) BMI ≥30:2.45 (1.02–5.61)	8
16	Van Lieshout (2011) ⁴⁹ , Netherlands, Rotterdam Study	1989-1993	5868	10.9 (4.4)	Prevalent HF	BMI, WC, WHR	incident HF	Adjudication of clinical symptoms and signs, hospital discharge letters and notes from general practitioners	765 (373 women, 392 men)	N/A	age, sex, cholesterol, DM, smoking, antihypertensive medications	linear	per SD		BMI 1.20 (1.11 – 1.29) WC 1.21 (1.12 – 1.30) WHR 1.11 (1.02-1.21) Association stronger in men than women; and in middle-aged than elderly	6
17	Voulgari (2011) ⁵⁰ , Greece, Athens Cohort	2003-2005	550	6	Cardiovascular disease, prevalent HF, valvular disease, CKD (eGFR <60ml/min), NSAIDs or corticosteroids in previous 3 months	BMI	Incident HF	Clinical assessment by study physician, LV systolic or diastolic dysfunction by echocardiography	185	N/A	age, sex, impaired glucose tolerance, dyslipidemia, hypertension, current cigarette smoking, physical inactivity, left ventricular hypertrophy and function	N/A	per strata		Normal No MetS Ref(1.00); Normal+MetS 2.33(1.25–4.36) Overweight NoMetS 1.12(0.35–1.33) Overweight+MetS 2.66 (1.73–4.13) Obese No MetS 0.41(0.10–1.31) Obese+MetS 2.13(1.29–3.17)	8
18	Wannamethee (2011) ⁵¹ , UK, The British Regional Heart Study	1998 -2000	4080 (720 pre-existing CHD 3360 no pre-existing CHD), 100% men, 60-79 years	9	Prevalent HF, underweight, missing BMI	BMI, WC	incident HF	Doctor confirmed diagnosis of HF from primary care records via electronic record linkage.	228 (80 CHD associated HF, 148 non CHD associated HF)	CHD associated HF, non CHD associated HF	age, smoking, physical activity, social class, antihypertensive treatment, prevalent diabetes, prevalent stroke, left ventricular hypertrophy, atrial fibrillation, use of beta-blockers, and FEV1	linear	per unit, per SD and per strata		Men without CHD: BMI per SD: 1.19 (1.04–1.37) BMI per unit 1.05 (1.01–1.10) WC per SD 1.17 (0.99–1.37) WC per unit 1.02 (0.99–1.03) Men with pre-existing CHD: BMI per SD: 1.32 (1.04–1.66) BMI per unit 1.07 (1.01–1.14) WC per SD 1.30 (1.06–1.59) WC per unit 1.03 (1.00–1.05)	8
19	Djoussé (2012) ⁶³ , USA, The Cardiovascular Health Study (CHS)	1989-1990; 1992-1993	4861 (42.5% men), mean age in men 73.0 (5.6) years, women (72.3 (5.4) years	11.3	Prevalent HF, missing BMI or WC, moderate/severe aortic or mitral regurgitation or stenosis on echocardiography, missing covariates	BMI, WC,	incident HF	Adjudication and review of self-reported physician diagnosed HF	1381	all HF, HFpEF, HFrEF	age, gender, clinic site, ethnicity,education, alcohol, smoking, physical activity, eGFR, vavular disease, atrial fibrillation, aspirin use, oestrogen use (for women)	linear	per SD		WC: all 1.23 (1.16–1.30) men 1.31 (1.19–1.45) women 1.20 (1.11–1.29) HFrEF 1.19 (1.07–1.33), HFpEF 1.27 (1.13–1.42) BMI all 1.22 (1.15–1.29), men 1.28 (1.16–1.42), women 1.19 (1.11–1.28) WHR All 1.89 (1.03-3.46)- additionally adjusted for BMI	7
20	Brouwers (2013) ⁵² , Groningen The Netherlands, PREVEND cohort	1997-1998	8592 (28-75 years old)	11.5 (range 10.8– 11.9)	Insulin dependent diabetes mellitus, pregnant women, and subjects unable or unwilling to participate	BMI used to define obesity as 30Kg/m2	New onset HF	Adjudication of clinical symptoms and signs, hospital records and echocardiographic records	374 subjects. 125 (34%) were classified as HFpEF and 241 (66%) as HFrEF	HFpEF, HFrEF	age and sex	not given	per strata (obesity vs no obesity)		All HF 1.93 (1.37–2.73) HRs of HFpEF, HFrEF not reported	6

21	Ebong (2013) ⁶⁴ , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	2000-2002	6809, 45-84 years old	7.6	Participants without baseline measurements of obesity, and those for whom no follow-up was completed	BMI, WC	HF hospitalisation s, HF deaths or outpatient diagnosis of HF	Adjudication of hospital records	176	N/A	age, ethnicity, educational status, cigarette smoking, intentional exercise and center .	linear	Per SD	BMI Men: 1.33 (1.10-1.61) Women: 1.70 (1.33-2.17) WC Men: 1.38 (1.18-1.62) Women: 1.64 (1.29-2.08)	
22	Borne (2014) ⁵³ Ahead of print 2012, Sweden, Malmo Diet and Cancer (MDC) cohort	March 1991 to September 1996	26653 (61.6% women), 45-73 years old	14	history of cardiovascular events (MI or stroke), or HF before baseline exam, missing values of anthropometric measurements and covariates	BMI, WC, WHR, BF%	incident HF hospitalisation as primary diagnosis	Electronic record linkage to Swedish Hospital Discharge Register	727 individuals (398 men and 329 women)	N/A	age, sex, civil status, education level, immigrant status, smoking habits, alcohol consumption, physical activities, blood pressure-lowering medication, lipid-lowering medication, systolic blood pressure, leucocyte count and diabetes mellitus	N/A	per strata	BMI quintiles Q1 ref(1.00) Q2 0.98 (0.76–1.25) Q3 1.12 (0.88–1.42) Q4 1.80 (1.45–2.24) WC quintiles Q1 1.00 (ref) Q2 0.92 (0.71–1.19) Q3 1.15 (0.90–1.46) Q4 1.87 (1.50–2.34) WHR quintiles Q1 1.00 (ref) Q2 1.04 (0.82–1.32) Q3 1.13 (0.90–1.42) Q4 1.77 (1.43–2.19) BF% quintiles Q1 1.00(ref) Q2 0.98 (0.77–1.24) Q3 1.18 (0.95–1.47) Q4 1.35 (1.09–1.68)	7
23	Mørkedal (2014) ⁵⁴ , Norway, HUNT (Nord-Trøndelag Health Study)	August 1995 to June 1997	61299 (53.9% women), ≥20 years	12.3	missing information on BMI and individuals with a history of AMI, HF or cerebral stroke at baseline	BMI	first HF hospitalisation	Electronic record to medical records and national death registry. HF was diagnosed by cardiologists using European Society of Cardiology guidelines	1201	N/A	age and sex	N/A	per strata	BMI categories BMI <25 metabolically healthy reference BMI <25 metabolically unhealthy 1.3(0.9–1.8) BMI metabolically healthy 25-29.9 1.0(0.8–1.2) BMI 25-29.9 metabolically unhealthy 1.2(1.0–1.4) BMI >30 metabolically healthy 1.6(1.3–2.0) BMI >30 metabolically unhealthy 1.7(1.4–2.0)	8
24	Joshy (2014) ⁶⁸ , Australia, 45 and Up Study	1 January 2006 to 31 December 2008	158546, mean age 57.8 (13.9) years	3.4	invalid age and/or date of recruitment, extreme measures of BMI (<15 kg/m ² or >50 kg/m ²), cancer or CVD at baseline	BMI	HF hospitalisation	Electronic record linkage	320	N/A	age, sex, region of residence, household income, education, smoking, alcohol intake and health insurance.	J-shape	Per strata	BMI categories 15-19.99: 1.72 (1.09-2.72) 20.0-22.49: Ref 22.5-24.99: 0.91 (0.62-1.32) 25.0-27.49: 1.13 (0.78-1.64) 27.5-29.99: 0.96 (0.63-1.47) 30.0-32.49: 1.63 (1.06-2.51) 32.5-50: 3.52 (2.39-5.19)	6
25	Björck (2015) ¹⁹ , Gothenburg Sweden, Multifactor Primary Prevention Study	1970	7495 (100% men), 51.1 (2.3) years	35	Prevalent HF	BMI	Primary or secondary diagnosis of HF	Electronic record linkage to Swedish national Inpatient Register (IPR) and the Swedish Cause of Death register	1855 total, 851 non ischaemic, 1004 ischaemic	any HF, non-ischaemic HF, ischaemic HF	age, IHD, smoking, physical activity and occupational status	linear	per strata	BMI categories BMI <22.5 1.00 (ref) BMI 22.5-24.99 1.19 (1.02-1.39) BMI 25-27.49 1.30 (1.11-1.52) BMI 27.5-29.9 1.51 (1.28-1.79) BMI ≥30 1.61 (1.32-1.96) Risk higher in ischaemic than non-ischaemic HF	8
26	Del Gobbo (2015) ²⁰ , USA, Cardiovascular Health Study	1989-1990, also recruited 687 African Americans in 1992	4490 (61% women) mean age 72 years	21.5	prevalent HF or moderate and/or severe mitral or aortic regurgitation at baseline, missing information on lifestyle risk factors, or implausible energy intake	BMI and WC	incident HF	Adjudication of outpatient and inpatient medical records, diagnostic tests, clinical consultations, and interviews	1380 (336 in obese, 1044 in non-obese)	N/A	age, sex, race, enrolment site, education, annual income	N/A	per strata	BMI categories BMI ≥30: reference, BMI 30: 0.66 (0.62 to 0.82) WC categories WC < 88cm women, < 92cm men: 0.76 (0.68-0.86) WC ≥ 88cm women, ≥ 92cm men: 1.0 (ref)	7
27	Eaton (2016) ²⁷ , USA, Women's Health Initiative	1993-1998	42170 (100% women), 50-79 years old	13.2	Self-reported prevalent HF, chronic HF on first adjudication, self-reported race: Asian/Pacific islander, Native American, or unknown race/ethnicity	BMI	hospitalised HF	Adjudication of self-reported HF hospitalisation	1952 in total, 902(46.2%) HFpEF, 508 (26.0%) HFrEF, 533 (27.3%) HF unknown ejection fraction, and 9 HF with recovered HF	HFpEF and HFrEF	age, education, family income, history of MI, history of CHD, stroke ever, hypertension, treated diabetes mellitus, history of cancer, hysterectomy, oophorectomy, atrial fibrillation, chronic lung disease, anemia, comorbidity index, diuretic use, beta blocker use, aspirin use, current hormone therapy, any insurance, alcohol intake, total energy expenditure/week from physical activity, age at screening and heart rate	N/A	per strata	HFpEF BMI <25 reference BMI 25-<30 1.11 (0.88–1.40) BMI 30-<35 1.35 (1.06–1.72) BMI ≥35 2.36 (1.84–3.03) HFrEF BMI <25 reference, BMI 25-<30 0.91 (0.68–1.21) BMI 30-<35 1.00 (0.74–1.36) BMI ≥35 0.87 (0.61–1.24)	5

28	Ndumele (2016) ²⁸ , USA, Atherosclerosis Risk in Communities (ARIC)	1987 to 1989	13730	23	Prevalent HF or cardiovascular disease, missing BMI, underweight (BMI <18.5Kg/m²), not of either black or white race	BMI and WC	incident first hospitalization or death related to HF	Adjudication of discharge codes from hospitalizations and death certificates	2235	N/A	age, race, sex, alcohol use, smoking status, physical activity, occupation, and education level	linear increase	per strata	BMI categories normal weight Reference; overweight 1.38 (1.23–1.54); obese 2.10 (1.85–2.38); severely obese 3.74 (3.24–4.31) Sex-specific WC quartiles Q1 1.0 (Ref); Q2 1.43 (1.23–1.67); Q3 1.74 (1.50–2.00) Q4 3.01 (2.63–3.44)	8
29	Janszky (2016) ²⁹ , Norway (HUNT2)	August 1995 to June 1997	26097 (56.3% women), 61.0 (12.2) years	11.4	Underweight BMI, missing information on BMI and individuals with a history of AMI, HF or stroke at baseline.	BMI	incident HF	Electronic record linkage to the two hospitals of Nord-Trøndelag County	946	N/A	sex, age, smoking status, level of education, marital status, physical activity, and alcohol consumption	U shaped for average BMI and HF risk	per strata	BMI <24.9 Reference BMI 25.0-27.4: 1.07 (0.84-1.36) BMI 27.5-29.9: 1.26 (0.98-1.61) BMI 30.0-32.4: 1.26 (0.93-1.70) BMI 32.5-34.9: 1.84 (1.30-2.59) BMI ≥35: 2.65 (1.86-3.77)	8
30	Krishnamoorthy (2016) ³⁰ , USA, Jackson Heart Study	September 2000 and January 2013	5184	7	HF at baseline	BMI categorised into normal (<25 kg/m2), overweight (25 to<30 kg/m2),obese (30 to<35 kg/m2), and morbidly obese (≥35 kg/m2)	HF hospitalisation	Adjudication of HF hospitalisations using modified Gothenburg criteria	214	N/A	age, sex, prior myocardial infarction, hypertension, prior stroke, diabetes mellitus, chronic lung disease, smoking status, systolic blood pressure, pulse, sodium, estimated glomerular filtration rate, haemoglobin, glucose, high-sensitivity C-reactive protein, triglycerides, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, left ventricular ejection fraction, left ventricular hypertrophy, left ventricular diameter, beta-blocker, angiotensin-converting enzyme inhibitor or angiotensin II receptor blocker, statin, antiplatelet agent, missing medication status and prevalent HF at examination 1	U shaped	per Kg/m2 increase and per strata	BMI per unit increase: crude 1.03 (1.01-1.04), adjusted 1.02 (1.01-1.04); BMI categories (adjusted) normal 1.00 [Reference] overweight 0.79 (0.54–1.14), obese 0.68 (0.46–1.02), morbidly obese 0.97 (0.66–1.44)	6
31	Pandey (2017) ²¹ , USA, Cooper Center Longitudinal Study	1970-2009	19485, individuals ≥65 years old	6.67	self-reported history of myocardial infarction or stroke at study entry, <65 years of age (due to Medicare coverage for disability, endstage renal disease, and other factors), Individuals lacking both Part A and B Medicare coverage and those with Health Maintenance Organization exclusions	BMI	HF hospitalisation	Electronic record linkage to Medicare heart failure billing codes	1038	N/A	age and sex	linear	per 3Kg/m2	BMI per 3Kg/m2 increase: 1.25 (1.17 to 1.32)	6
32	Rao (2018) ³ , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	2002-2004, and between 2004-2005	1806 (48.4% men), 64.5 (9.6) years	10.5	Cardiovascular disease at baseline, HF event before the abdominal CT scan date, missing subcutaneous fat and visceral fat for all slices, missing ejection fraction at time of HF diagnosis, or missing other covariates in main analysis	BMI, WC, WHR, subcutaneous fat, visceral fat	incident HF	Adjudication of medical records	Total HF=70 (34 HFpEF, 36 HFrEF)	HFpEF, HFrEF	age, sex, race/ethnicity, smoking, and physical activity	linear increase	per SD	All HF: BMI 1.43 (1.11, 1.84) WC 1.40 (1.08, 1.81) WHR 1.22 (0.93, 1.61) SAT at L2-L3 1.22 (0.92, 1.63) SAT sum of 6 pcs 1.02 (0.73, 1.42) VAT at L2-L3 1.50 (1.16, 1.93) VAT sum of 6 pcs 1.46 (1.15, 1.86) HFpEF: BMI 1.73 (1.23–2.42) WC 1.74 (1.23–2.46) WHR 1.54 (1.04–2.30) SAT at L2-L3 1.31 (0.89–1.93) SAT sum of 6 pcs 1.23 (0.79–1.90) VAT at L2-L3 2.06 (1.44–2.95) VAT sum of 6 pcs 1.98 (1.40–2.79) HFrEF: BMI 1.14 (0.77–1.68) WC 1.08 (0.74–1.58) WHR 0.95 (0.65–1.39) SAT at L2-L3 1.12 (0.73–1.70) SAT sum of 6 pcs 0.80 (0.47–1.35) VAT at L2-L3 1.08 (0.75–1.55) VAT sum of 6 pcs 1.07 (0.76–1.52)	7
33	Flotsos (2018) ²² , USA, Multi-Ethnic Study of Atherosclerosis (MESA)	2000-2002	6437 (47.4% men), 62.2 (10.2) years	13	missing self-reported weight at age 20 or 40 years, had no follow-up information for atherosclerotic cardiovascular disease or HF, or were missing key covariates	baseline BMI	definite or probable HF (hospitalized)	Adjudication of medical records, telephone interviews every 9 to 12 months regarding interim hospital admissions, outpatient cardiovascular diagnoses	290	all HF, HFpEF, HFrEF	adjusted for age at baseline, sex, race/ethnicity, center, and education	curvilinear	per 5units change	All HF: 1.43 (1.28, 1.60) BMI categories normal: reference overweight 1.24 (0.90, 1.71) obese 1.86 (1.34, 2.60), HFpEF: 1.61 (1.36, 1.91) BMI categories	8

								and procedures, and deaths;							normal: reference	
															overweight 1.27 (0.77, 2.10)	
															obese 1.862.09 (1.24, 3.52),	
															HFrEF : 1.21 (1.01, 1.46)	
															BMI categories	
															normal: reference	
															overweight 0.96 (0.59, 1.57	
															obese 1.39 (0.84, 2.30)	
34	Gong (2018) ⁷¹ , Australia, SCREEN-HF study	May 2007-January 2010	3847 (56.6% men) ≥60 years	4.5	Prevalent HF, LVEF < 50%, significant valve abnormality	Baseline BMI and waist circumference	Incident HF	Adjudication of HF events using ESC criteria of 2012	162 (73 HFpEF, 53 HFrEF, 36 Vavular HF)	All, HFpEF, HFrEF and valvular HF	univariate	N/A	log BMI per doubling	HFpEF	4	
													per 10cm higher waist circumference	BMI: 15 (6-35)		
														WC: 1.6 (1.3-1.8)		
														HFrEF		
														BMI: 2.0 (0.7-5.4)		
														WC: 1.4 (1.1-1.7)		
														Valvular HF		
														BMI: 0.5 (0.1-2.0)		
														WC: 0.9 (0.7-1.2)		
35	Pandey (2018) ⁴ , USA, Jackson Heart Study	2005-2009 (visit 2)	2602 (35% men), 59 years	7.1	Weight >350pounds, pregnancy/unknown pregnancy status, age <40 years in women or <35 years in men, prevalent HFand loss to follow up	BMI, visceral fat (VAT) and abdominal subcutaneous fat (SAT)	Incident HF	Adjudication of HF events	122	N/A	Age and sex	linear	per strata	VAT: 1.29 (1.09-1.52)		
													per SD of VAT and SAT	Tertile 1: ref		
													per 1kg/m² BMI	Tertile 2: 1.40 (0.84-2.32)		
														Tertile 3: 1.82 (1.14-2.92)		
														SAT: 1.21 (0.99-1.48)		
														Tertile 1: ref		
														Tertile 2: 0.81 (0.49-1.32)		
														Tertile 3 1.69 (1.07-2.67)		
														BMI: 1.05 (1.02-1.08)		
36	Kokkinos (2019) ²³ , USA, ETHOS Veteran cohort	veterans who underwent treadmill tes between 1987 and 2017	20 254 (100% men), 58 (11.3) years	mean 3.6 ± 7.7 years, with a median of 13.4 years,	existing HF at the time of exercise testing or developed HF within 3months after the exercise test, BMI <18.5Kg/m², unstable or required emergent intervention or were unable to complete the test for orthopaedic, neurologic, or other reasons, exercise capacity <2METs, implanted pacemaker,lost to follow-up or missing data	BMI	Incident HF	Review of VA Computerized Patient Record System (CPRS) using ICD codes for HF	2979	N/A	age, BMI, ethnic origin, beta-blockers, calcium channel block-ers, angiotensin-converting enzyme inhibitors, angiotensin receptor blockers,diuretics, lipid-lowering agents, hypoglycaemic agents, smoking status, type 2 diabetes, dyslipidaemia, and hypertension	linear	per Kg/m2	1.02 (1.01 –1.03)	7	
37	Campbell (2019) ¹¹ , Australia, SCREEN-HF		3842 (55% men), 70 (65-75) years	Total 5.6 (IQR: 4.5–6.3); HFpEF 4.5 (interquartile range: 2.9–5.5)	known heart failure, ejection fraction <50% or more than mild valve abnormality	BMI, WC	Incident HF (ambulatory and hospital diagnosed)	Adjudication by 2 HF specialists according to European Society of Cardiology (ESC) criteria of 2012	162 (73 with HFpEF, 53 with HFrEF and 36 with VHF)	HFpEF	age, hypertension, diabetes, myocardial infarction, atrial fibrillation, serum amino-terminal pro-B-type natriuretic peptide (NT-proBNP) quintile, haemoglobin, and calcium channel blocker therapy	positive increase across categories	per strata	BMI	6	
														BMI <25 (ref),		
														BMI 25-27.4 : 2.5 (0.9-6.8)		
														BMI 27.5-29.9: 5.4 (2.1-13.8)		
														BMI ≥30: 7.6 (3.3-17.8);		
														WC quintiles		
														Q1. 66–94 in men; 57–83 in women: 1(ref)		
														Q2. 95–100 in men; 84–90 in women: 2.8 (0.8-9.7)		
														Q3. 101–105 in men; 91–96 in women: 5.0 (1.6-15.5)		
														Q4. 106–112 in men; 97–104 in women: 4.4 (1.4-13.7)		
														Q5. 113–155 in men; 105–146 in women: 10.2 (3.5-29.6)		
38	Kubicki (2020) ⁶⁵ , USA, Southern Community Cohort Study (SCCS)	2002-2009	27,078 (62.6% women), 69% black, 54 (47-65) years	5.2 (3.1, 6.7) years	Prevalent HF	BMI	Incident HF	Electronic health record linkage	4341	N/A	Age, sex, race, history of myocardial infarction or coronary artery bypass graft, stroke, transient iscahemic attack, education, annual household income, marital status, enrolment source, diabtes, hypertension, underactivity, smoking, poor diet and serum cholesterol	N/A	BMI ≥25 kg/m² vs normal BMI <25 kg/m²	BMI <25 kg/m²: ref	7	
														BMI ≥25 kg/m² :1.12 (1.03-1.22)		
39	Halldin (2020) ²⁴ , Gothenburg Sweden, Prospective Population Study of Women in Gothenburg (PPSWG)	PPSWG (1968-1969); PPSWG (1980-1981)	1968-1980 cohort 1132; 1980-1992 cohort 932 (100% women)	1968 to 1980 cohort: 44 years; 1980 to 1992: 32 years	previous history, sign or diagnosis of HF	BMI	hospitalisation or mortality for HF	Electronic record linkage to Swedish Hospital Discharge Registry and Swedish National Board of Health and Welfare register of causes of death	1968-1980 cohort 271, 1980-1992 cohort 174	N/A	age	N/A	per strata	1968-1980 cohort	6	
														BMI <25: reference		
														BMI 25- <30: 1.26 (0.90–1.72)		
														BMI ≥30: 1.21 (0.73–1.99)		
														1980-1992 cohort		
														BMI <25: reference		
														BMI 25- <30: 1.01 (0.66–1.54)		
														BMI ≥30: 1.27 (0.72–2.21)		
40	Ergatoudes (2020) ²⁵ , Gothenburg Sweden, Men born in Gothenburg 1913 cohort	1963	855 (100% men), 50 years old	21	Not mentioned	BMI	Incident HF hospitalisation or HF death	Electronic record linkage to National Hospital Discharge Register or National Cause of Death Register	80	N/A	hypertension, SBP, smoking, cholesterol, physical activity, alcohol, diabetes, AF and IHD	linear	Per unit BMI	HR per unit: 1.11 (1.04-1.19)	6	
														Obese vs non-obse BMI: HR 2.25 (1.13-4.51)		

41	Chen (2020) ²⁶ , Sweden, The Study of men born in 1943	1993	798 (100% men),	21	Not mentioned	BMI	HF hospitalisation or HF death or cardiac dysfunction at age 71 years	Electronic record linkage to National Hospital Discharge Register or National Cause of Death Register	92	N/A	smoking, BMI, systolic BP, hyperlipidemia, sedentary lifestyle, and diabetes	linear	Per unit BMI	HR per unit: 1.14 (1.07–1.22)	8
42	Rao (2021) ⁶⁹ , USA, Jackson Heart Study	Exam 2 (2005–2008)	2882 (35% men), 59.4 years	10.6 years	Prevalent HF at exam 2, missing measures for BMI, waist, or hip circumference	Visceral fat (VAT), subcutaneous fat (SAT), pericardial fat (PAT)	All-cause death, HF hospitalisation	Adjudication of HF events	168 HF hospitalisations (in VAT and SAT analyses) and 77 HF hospitalisations in PAT analyses	HFpEF, HFrEF	age, sex, education, and smoking status	linear	VAT- per 100 cm ³ SAT- per 100 cm ³ PAT- per 10 cm ³	HF VAT: 1.07 (1.03–1.11) SAT: 1.02 (1.00–1.04) PAT: 1.10 (1.04–1.15) HFpEF VAT: 1.10 (1.04–1.15) PAT: 1.13 (1.06–1.21) HFrEF VAT: 1.08 (1.01–1.13) PAT: 1.06 (0.96–1.17)	8
43	Kenchaiah (2021) ⁷⁰ , USA, MESA	July 17, 2000, and August 31, 2002,	6,785 participants (3,584 women and 3,201 men), ages 45 to 84	mean: 13.4 (4.6) years; median: 15.7 years; interquartile range: 11.7 to 16.5 years; maximum: 17.5 years	Clinical cardiovascular disease at baseline, no cardiac CT at baseline, participants with suboptimal image quality for pericardial fat volume (PFV) measurement, missing information on newly diagnosed HF during follow-up.	Pericardial fat volume (PFV)	Incident HF	Independent adjudication of HF events	385 participants (5.7%; 164 women and 221 men)	HFpEF, HFrEF, HFmEF, HFuEF	age (for every 1-year increase), sex, race (White [referent], Black, Hispanic, Chinese), cigarette smoking (no [referent], past, current), alcohol consumption (no or past [referent], mild-to-moderate, heavy), and vigorous physical activity at baseline	linear	PFV per SD (1 SD = 42 cm ³) higher	HF Men: 1.24 (1.12–1.37) Women: 1.68 (1.42–1.98) Both sexes: 1.34 (1.23–1.46) HFpEF : 1.52 (1.35–1.72) HFrEF : 1.15 (1.00–1.33) HFmEF : 1.44 (1.12–1.85) HFuEF : 1.23 (0.89–1.70)	9
44	Suthahar (2022) ⁷² , Groningen, The Netherlands, PREVEND	1997–1998	8295 participants (4134 women), 49.8% women, 50 (13) years	11.3 ± 3.1 years	Insulin use, pregnancy, no consent, serious mental illness, life expectancy <1 year, treatment for malignancies (other than non-melanoma skin cancer), HF at baseline, underweight, waist circumference <40cm, missing covariates	BMI, WC, WHR, body shape index (BSI), weight-adjusted-waist index (WWI), body roundness index (BRI) and relative fat mass (RFM)	Incident HF	Independent adjudication of HF events using ESC guidelines	363 incident HF	HFpEF, HFrEF	age, sex	linear	HRs per SD higher adiposity measures	HF BMI: 1.39 (1.26, 1.54) WC: 1.49 (1.32, 1.68) WHR: 1.57 (1.37, 1.80) BSI: 1.25 (1.10, 1.43) WWI 1.44 (1.27, 1.63) BRI: 1.46 (1.32, 1.62) RFM: 1.93 (1.60, 2.33) HFpEF BMI: 1.46 (1.24, 1.72) WC: 1.56 (1.28, 1.90) WHR: 1.48 (1.17, 1.86) BSI: 1.20 (0.97, 1.48) WWI: 1.38 (1.13, 1.69) BRI: 1.48 (1.25, 1.75) RFM: 2.04 (1.48, 2.81) HFrEF BMI: 1.34 (1.18, 1.52) WC: 1.44 (1.24, 1.67) WHR: 1.61 (1.36, 1.91) BSI: 1.29 (1.10, 1.52) WWI: 1.46 (1.25, 1.71) BRI: 1.43 (1.26, 1.63) RFM: 1.84 (1.46, 2.32)	8
45	Xing (2023) ³⁵ , UK, The UK Biobank,	2006–2010	483,316 participants, 55.4% women, 56.3 years	12.1 years (IQR 11.6–13.1 years)	Prevalent HF, prevalent cardiovascular diseases, lack of bioimpedance analysis data, and loss of follow-up	BMI, Arm fat index (AFI), Trunk fat index (TFI), leg fat index (LFI)	Incident HF	Electronic health record linkage	3134	-	Age, race, sex, BMI	J-shaped	HRs per SD higher adiposity measures	BMI: 1.67 (1.63–1.71) AFI: 1.00 (0.96–1.05) TFI: 1.00 (0.93–1.07) LFI: 0.78 (0.72–0.84)	9

Table S5. Other subgroup analyses of BMI, waist circumference, and waist-hip ratio and incident heart failure.

[illegible]

Yes	12	1.36 (1.33-1.39)	84.8	<0.001	<0.001	7	1.24 (1.20-1.28)	68.4	0.004	0.002	6	1.22 (1.17-1.28)	85.8	<0.001	<0.001
No	20	1.47 (1.45-1.50)	95.7	<0.001		7	1.32 (1.28-1.35)	76.4	<0.001		3	1.47 (1.40-1.55)	97.8	<0.001	
Adjustment for potential mediators															
Hypertension															
Yes	9	1.21 (1.17-1.24)	89.9	<0.001	<0.001	1	1.38 (1.10-1.72)	0.0	-	0.53	0	-	-	-	-
No	23	1.48 (1.46-1.50)	93.2	<0.001		13	1.28 (1.26-1.31)	77.5	<0.001		8	1.33 (1.28-1.37)	94.9	<0.001	
Blood pressure															
Yes	5	1.33 (1.28-1.37)	89.9	<0.001	<0.001	2	1.38 (1.28-1.49)	0.0	0.89	0.05	2	1.67 (1.47-1.89)	0.0	0.93	<0.001
No	27	1.44 (1.42-1.46)	94.7	<0.001		12	1.28 (1.25-1.30)	77.5	<0.001		7	1.30 (1.26-1.35)	95.8	<0.001	
Diabetes															
Yes	14	1.26 91.23-1.29)	87.6	<0.001	<0.001	6	1.27 (1.21-1.33)	44.9	0.11	0.59	3	1.26 (1.18-1.36)	92.8	<0.001	0.13
No	18	1.49 (1.47-1.52)	94.5	<0.001		8	1.29 (1.26-1.31)	84.2	<0.001		6	1.35 (1.30-1.40)	96.1	<0.001	
Ischaemic heart disease															
Yes	10	1.30 (1.27-1.34) 1.46 (1.44-1.48)	87.8	<0.001	<0.001	2	1.37 (1.23-1.53)	0.0	0.96	0.21	1	1.66 (1.39-1.98)	95.4	-	0.01
No	22		95.0	<0.001		12	1.28 (1.25-1.30)	78.9	<0.001		8	1.32 (1.27-1.36)	100.0	<0.001	
Atrial fibrillation															
Yes	3	1.24 (1.18-1.29)	91.4	<0.001	0.001	1	1.17 (1.12-1.22)	100	-	<0.001	0	-	-	-	-
No	29	1.44 (1.42-1.46)	94.2	<0.001		13	1.31 (1.28-1.34)	62.5	0.001		9	1.33 (1.28-1.37)	94.9	<0.001	
Valvular heart disease															
Yes	3	1.33 (1.29-1.38)	84.2	0.002	<0.001	2	1.19 (1.14-1.24)	82.5	0.02	<0.001	1	1.66 (1.39-1.98)	100.0	-	0.01
No	29	1.44 (1.42-1.46)	94.6	<0.001		12	1.31 (1.28-1.34)	65.1	0.001		8	1.32 (1.27-1.36)	95.4	<0.001	
Left ventricular hypertrophy															
Yes															
No	4	1.19 (1.11-1.26)	78.8	<0.001	<0.001	2	1.30 (1.15-1.48)	0.0	0.55	0.80	0	-	-	-	-
	28	1.44 (1.42-1.45)	94.6	0.003		12	1.28 (1.26-1.31)	79.3	<0.001		9	1.33 (1.28-1.37)	94.9	<0.001	
Cholesterol															
Yes	9	1.27 (1.23-1.30)	91.4	<0.001	<0.001	4	1.24 (1.17-1.30)	40.3	0.17	0.14	2	1.20 (1.11-1.29)	93.8	<0.001	0.004
No	23	1.47 (1.45-1.50)	93.9	<0.001		10	1.29 (1.26-1.32)	80.6	<0.001		7	1.36 (1.31-1.41)	95.5	<0.001	
Lipid lowering drugs															
Yes	3	1.14 (1.09-1.18)	89.4	<0.001	<0.001	1	1.39 (1.26-1.53)	0.0	-	0.12	1	1.68 (1.41-2.00)	100.0	-	0.008
No	29	1.46 (1.44-1.48)	92.7	<0.001		13	1.28 (1.25-1.30)	76.5	<0.001		8	1.32 (1.27-1.36)	95.3	<0.001	
Adjustment for key intermediate factors [‡]															
Yes	7	1.30 (1.26-1.34)	89.7	<0.001	<0.001	2	1.37 (1.23-1.53)	0.0	0.96	0.21	1	1.66 (1.39-1.98)	100.0	-	0.01
No	25	1.45 (1.43-1.47)	94.7	<0.001		12	1.28 (1.25-1.30)	78.9	<0.001		8	1.32 (1.27-1.36)	95.4	<0.001	

N= number of studies in subgroup meta-analysis (this is not always equal to the total number of studies in the overall analysis). BMI indicates body mass index; CI, confidence interval; and RR, relative risk.

*P for heterogeneity within each subgroup.

†P for heterogeneity between subgroups.

‡Adjustment for key intermediate factors (BP/hypertension, diabetes and ischaemic heart disease)

§P for heterogeneity between adjudicated and record linkage (excluding self-reported HF events)

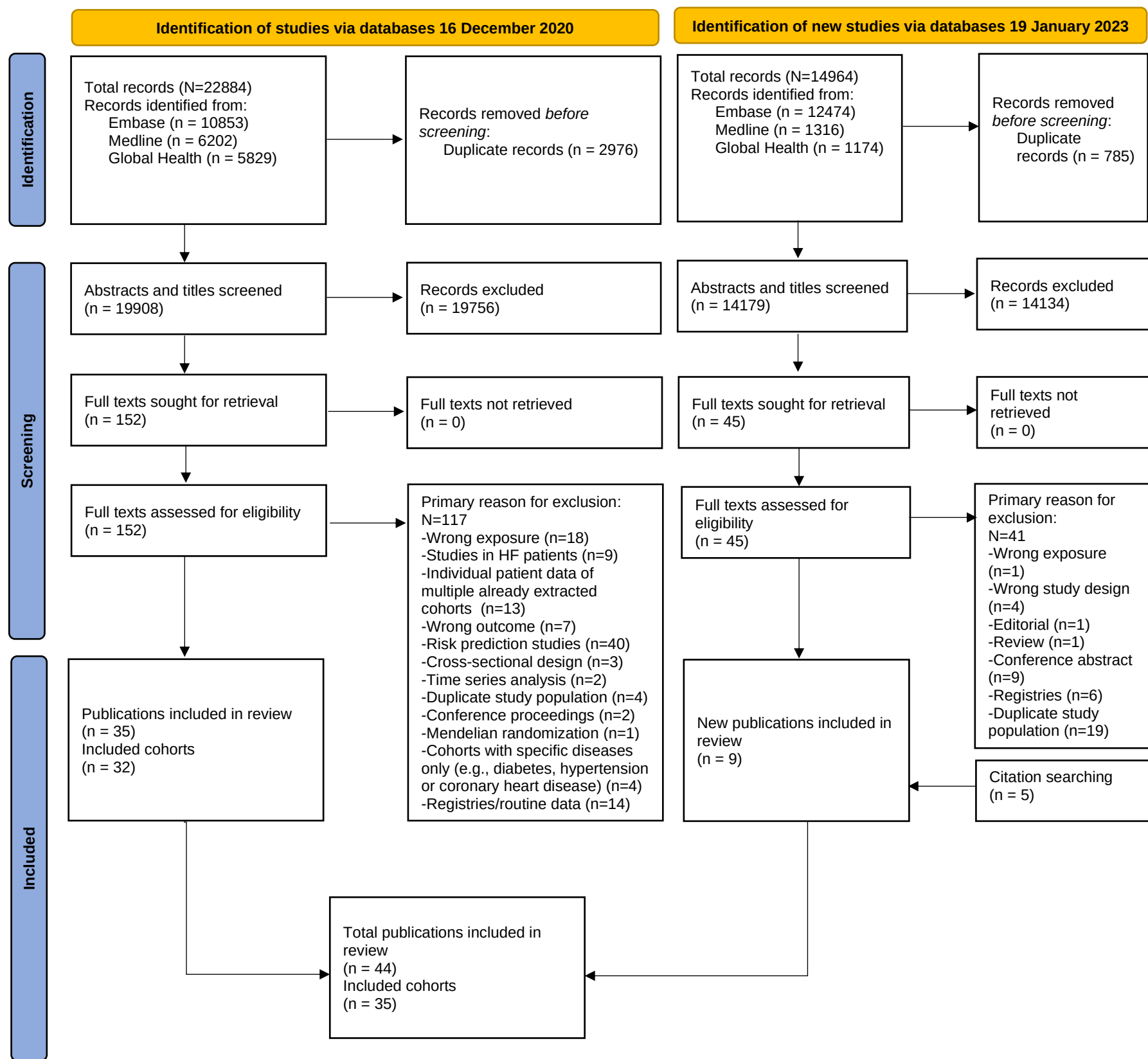
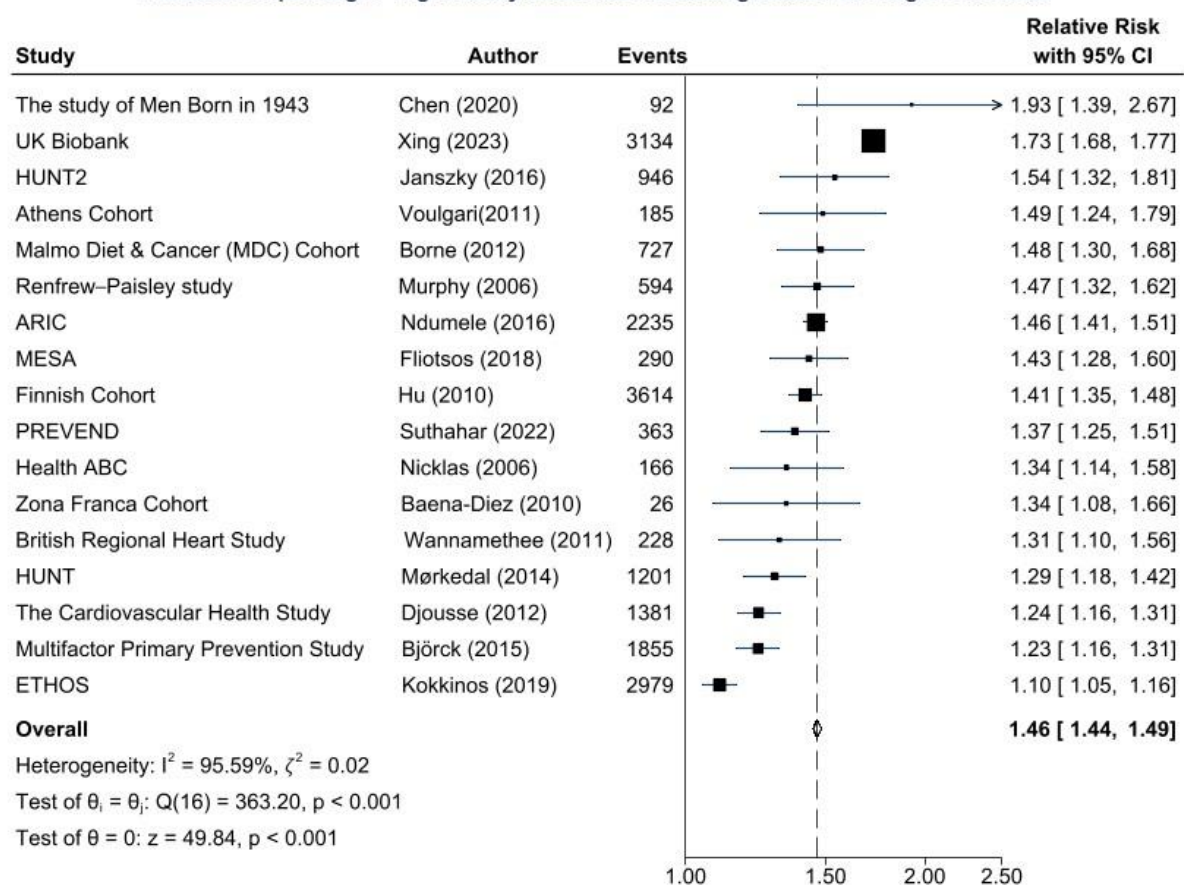


Figure S1: PRISMA flowchart of study selection

Relative risk per 5Kg/m² higher body mass index excluding studies with high risk of bias



Fixed-effects inverse-variance model

Figure S2: Dose-response meta-analysis of BMI and HF incidence excluding studies with high risk of bias

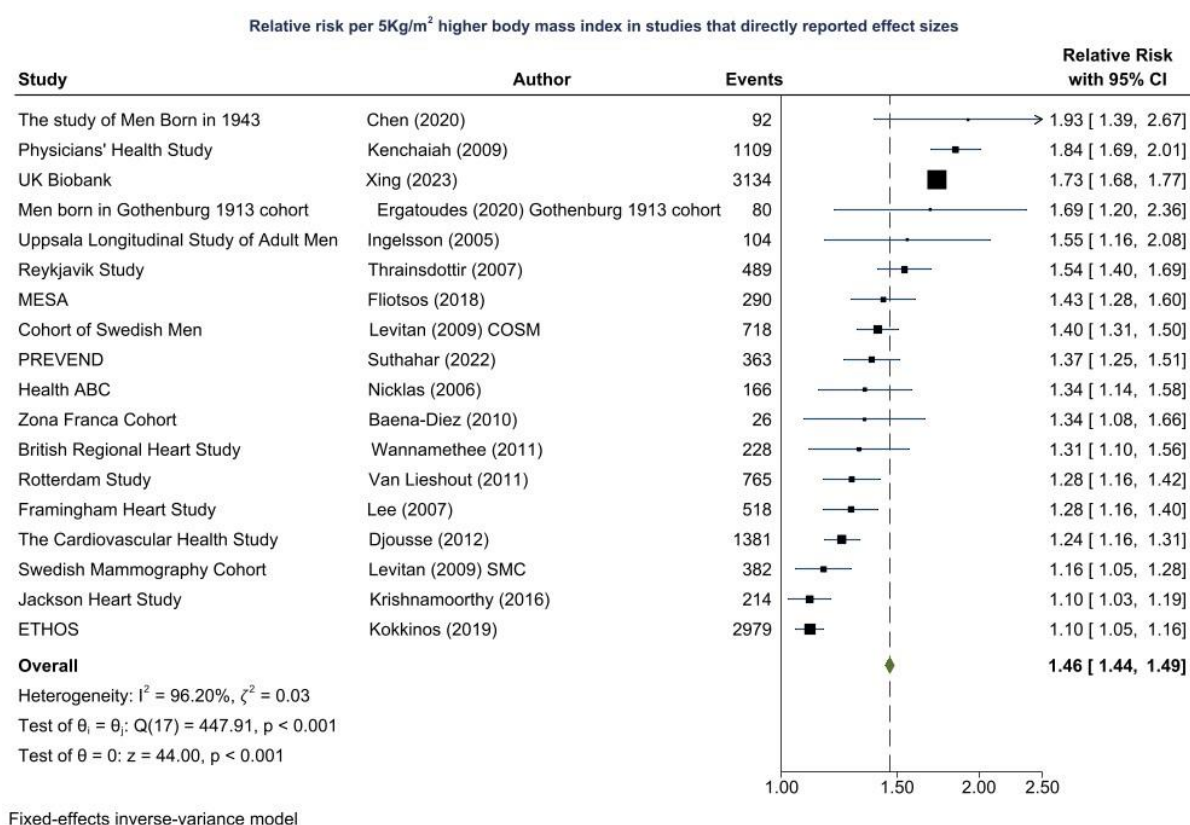
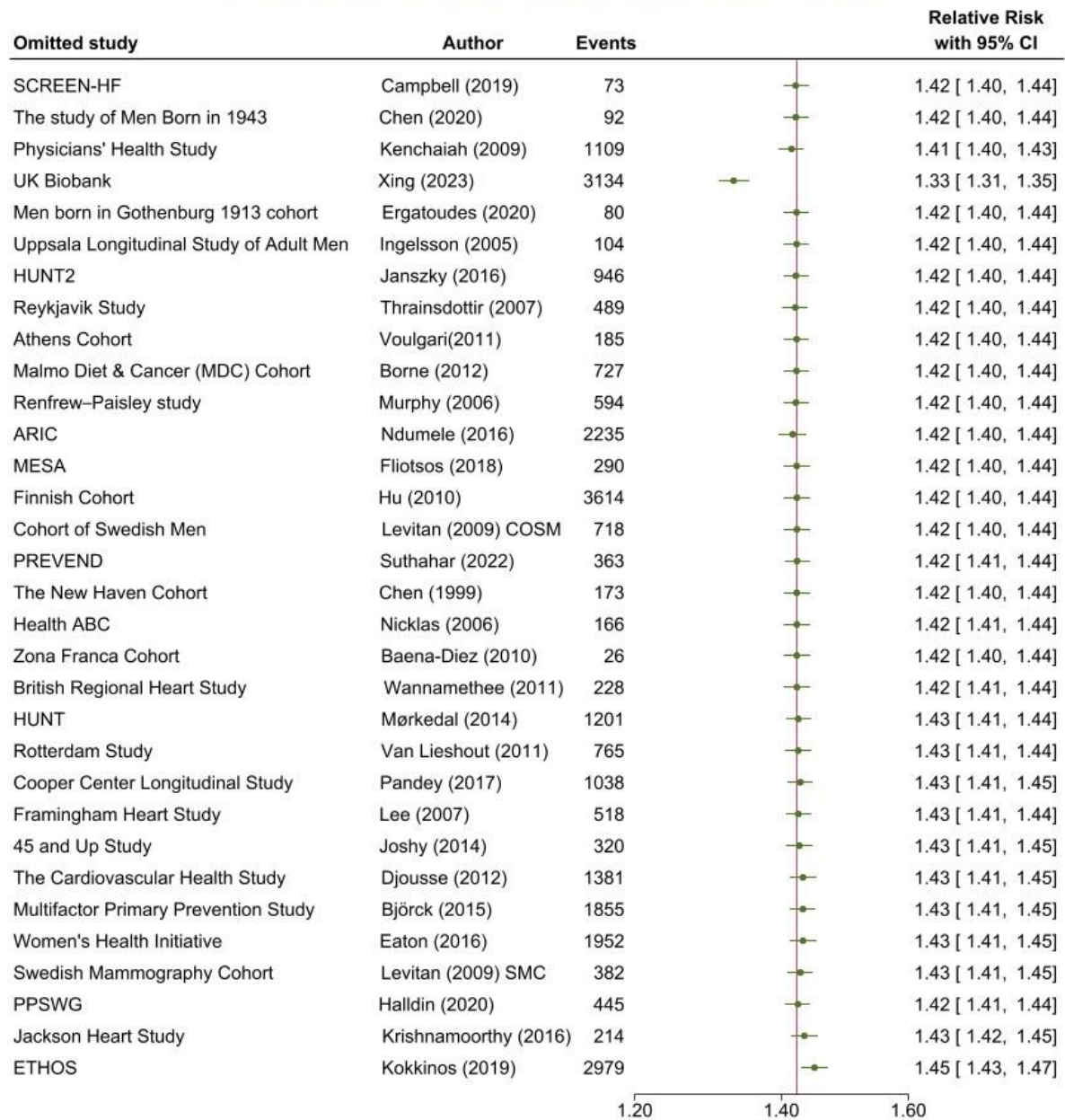


Figure S3: Dose-response meta-analysis of BMI and HF incidence in studies that directly reported effect sizes

Relative risk per 5Kg/m² higher body mass index excluding one study at a time



Fixed-effects inverse-variance model

Figure S4: Meta-analysis of BMI and HF risk excluding one study at a time

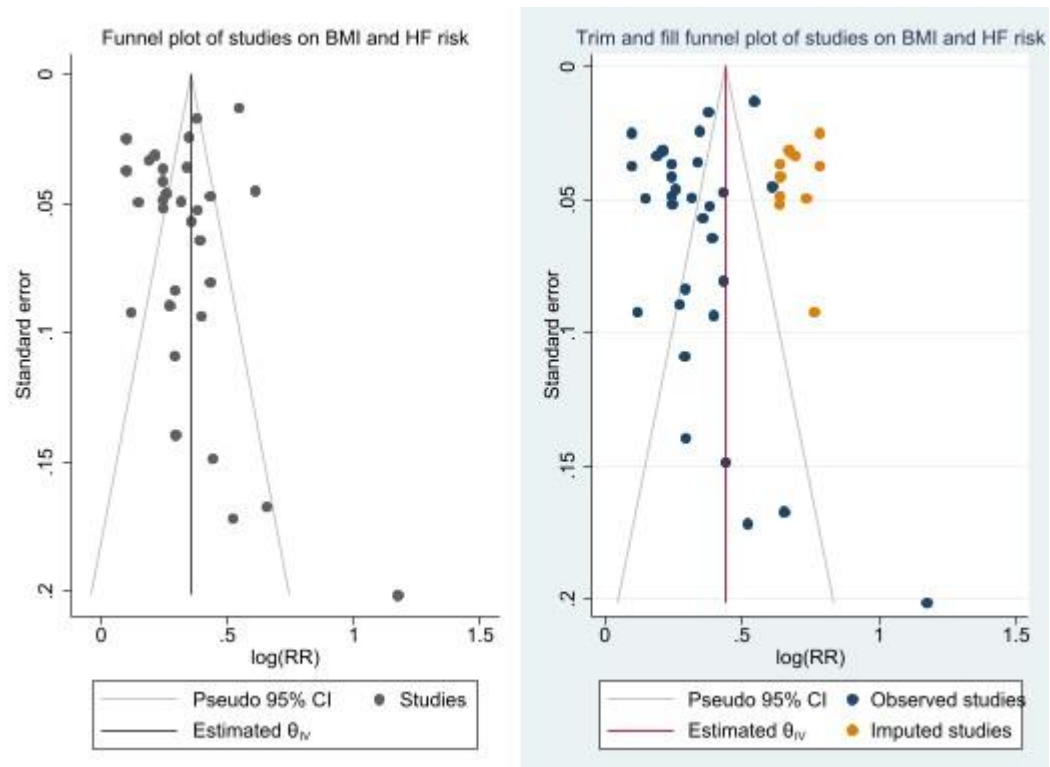
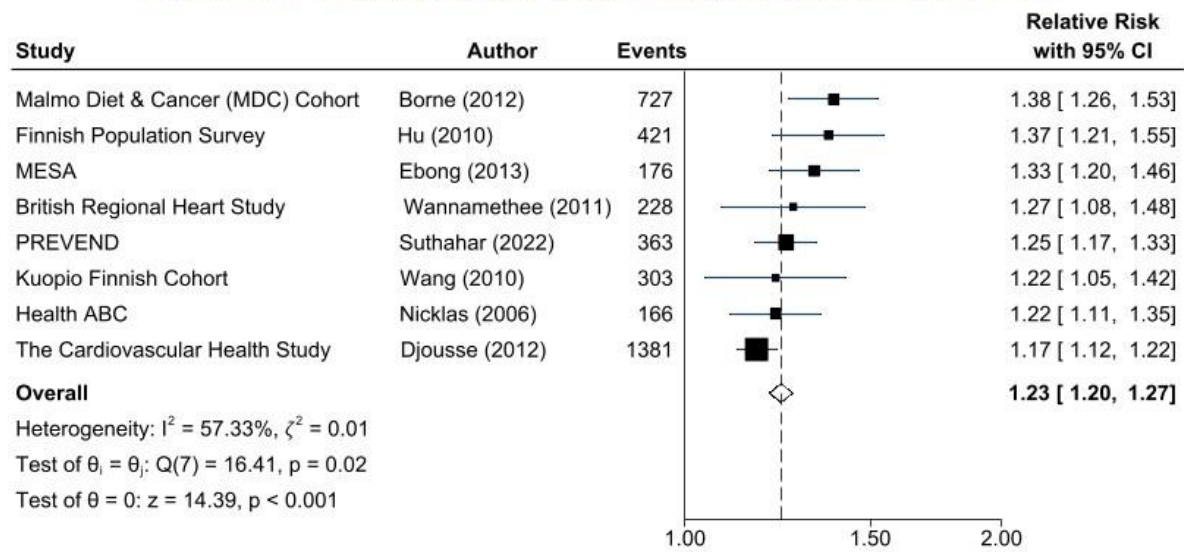


Figure S5: Funnel plot and Trim and fill plot of studies on BMI and HF risk

Relative risk per 10cm higher waist circumference excluding studies with high risk of bias



Fixed-effects inverse-variance model

Figure S6: Dose-response meta-analysis of waist circumference and HF incidence excluding studies with high risk of bias

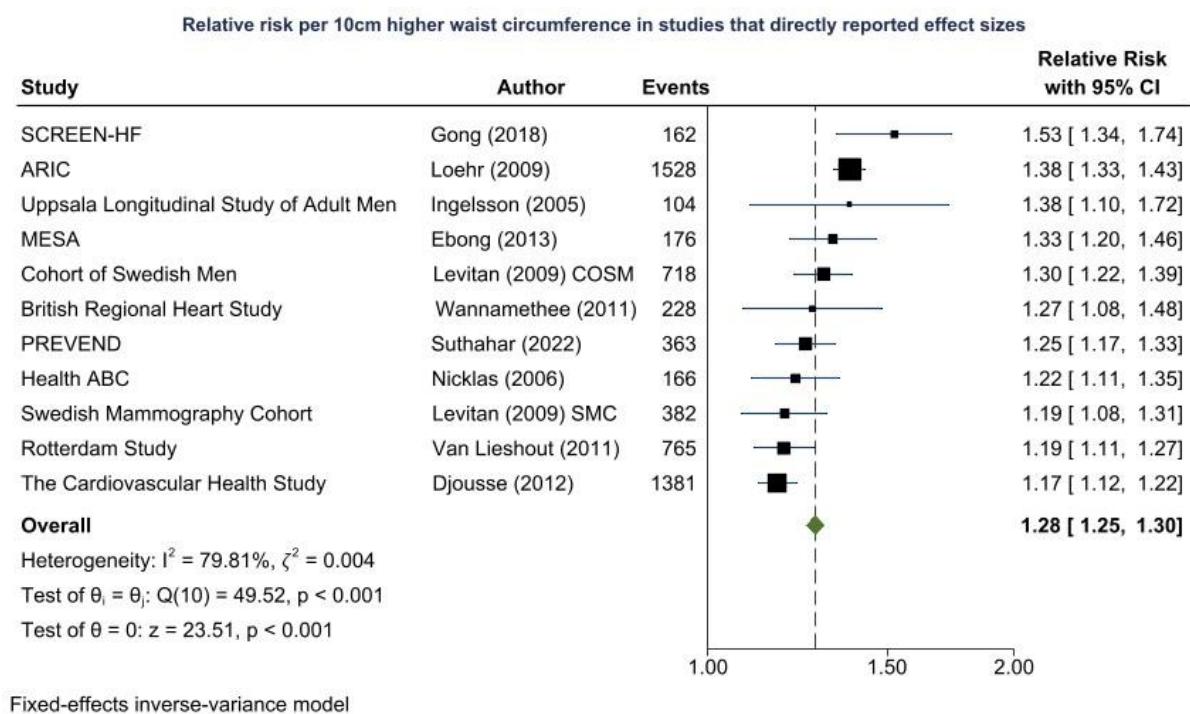


Figure S7: Dose-response meta-analysis of waist circumference and HF incidence in studies that directly reported effect sizes

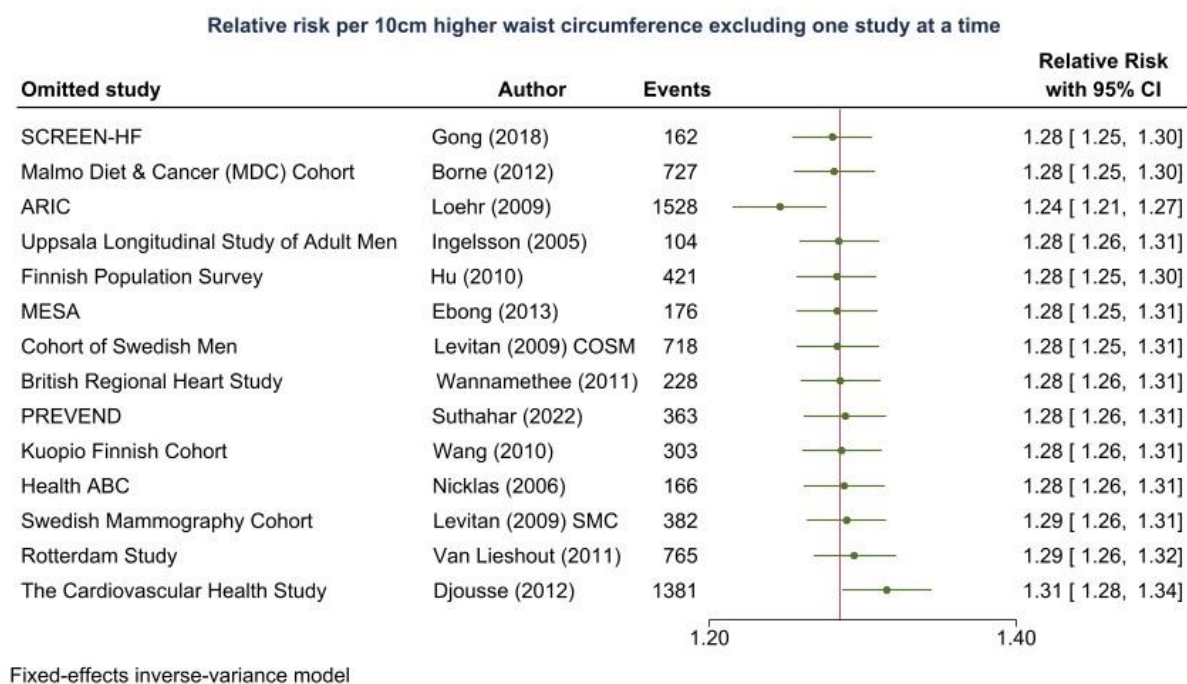


Figure S8: Meta-analysis of waist circumference and HF risk excluding one study at a time

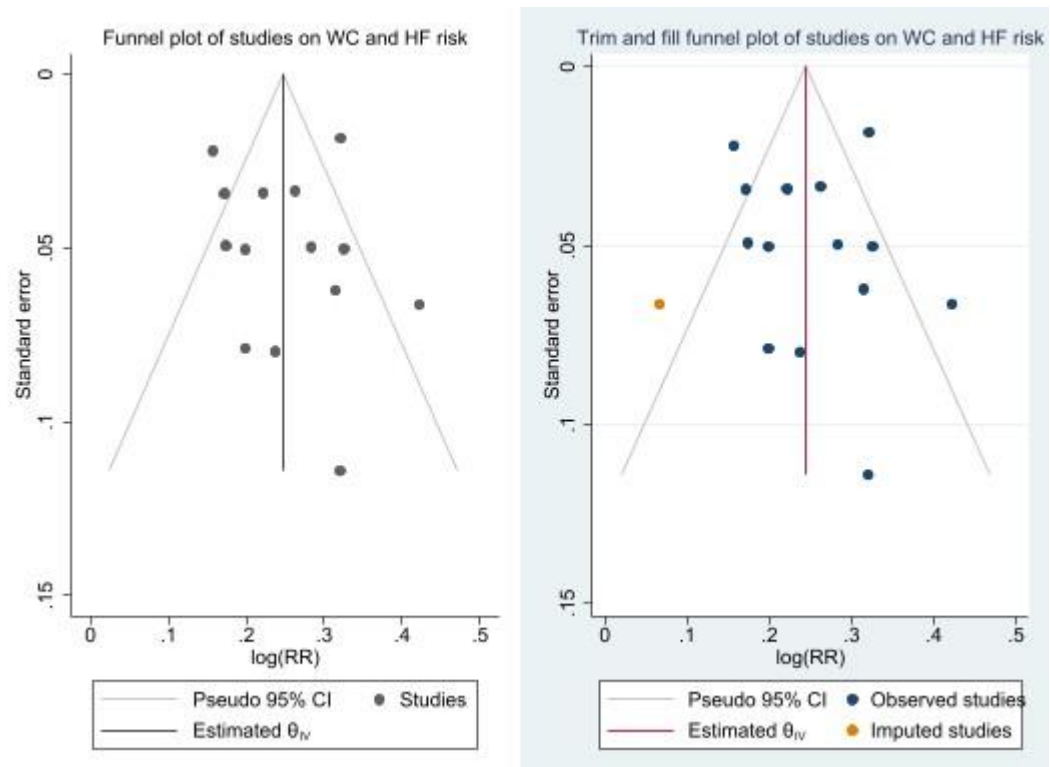


Figure S9: Funnel plot and Trim and fill plot of studies on waist circumference and HF risk

Relative risk per 0.1unit higher waist-hip ratio excluding studies with high risk of bias

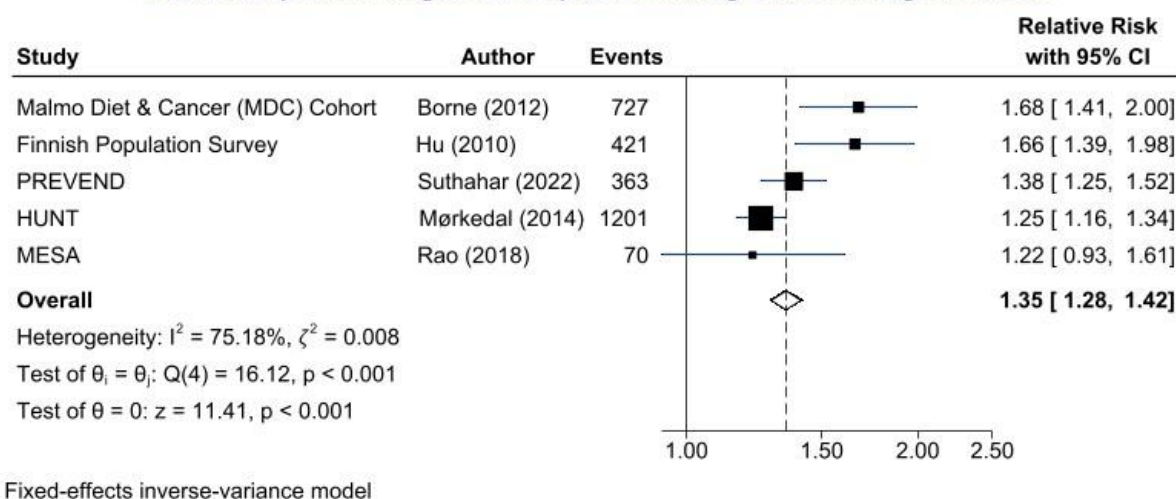


Figure S10: Dose-response meta-analysis of waist-hip ratio and HF excluding studies with high risk of bias

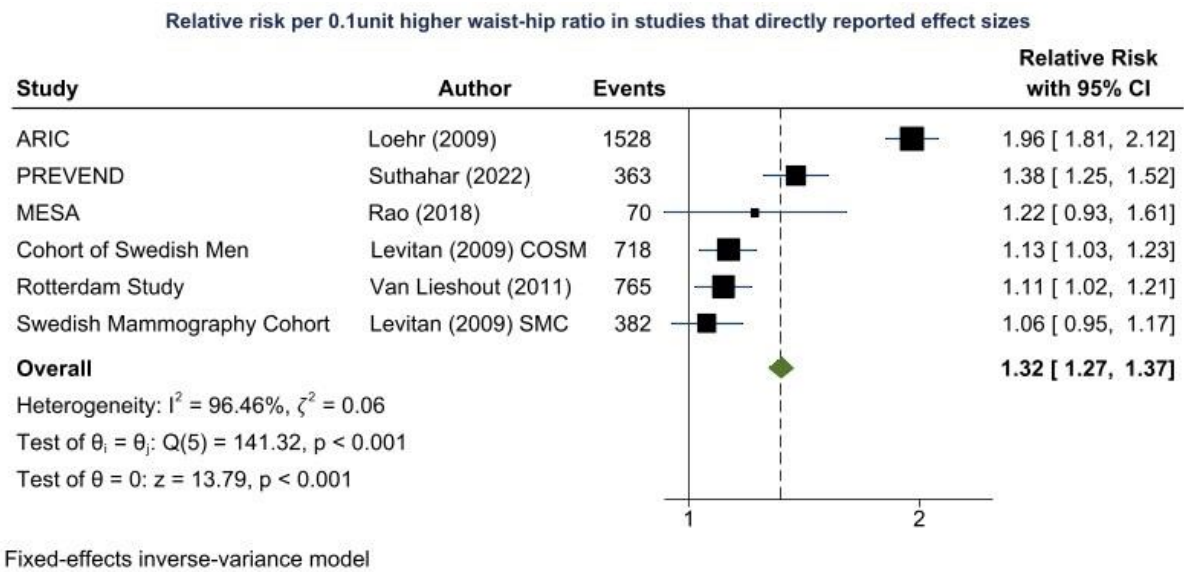


Figure S11: Dose-response meta-analysis of waist-hip ratio and HF incidence in studies that directly reported effect sizes

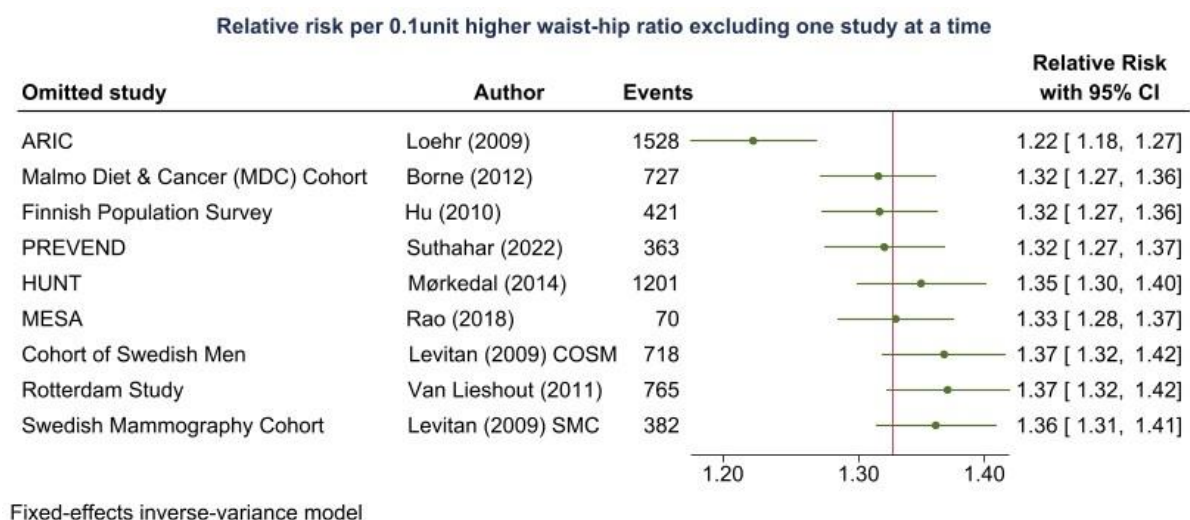


Figure S12: Meta-analysis of waist-hip ratio and HF risk excluding one study at a time

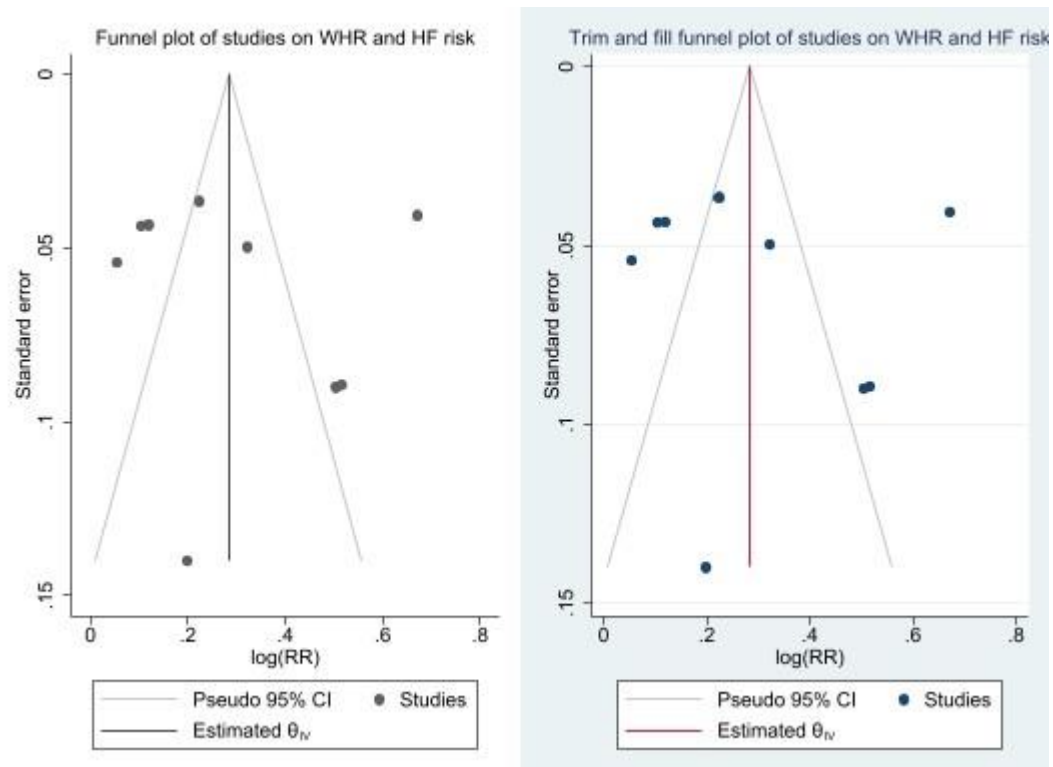


Figure S13: Funnel plot and Trim and fill plot of studies on waist-hip ratio and HF risk