Supplemental Methods:

I: *Details about physical activity assessment in each cohort*

WHI: Vigorous exercise was defined as that in which "you work up a sweat and your heart beats fast," and examples included aerobics, aerobic dancing, jogging, tennis, and swimming laps. Moderate exercise was defined as that which was "not exhausting," and examples included biking outdoors, using an exercise machine (such as a stationary bicycle or a treadmill), calisthenics, easy swimming, and popular or folk dancing. Examples of mild exercise were slow dancing, bowling, and golf.

MESA: The MESA Typical Week Physical Activity Survey has 28 items in 9 categories of activities (1, household chores; 2, lawn/yard/garden/farm; 3,care of children/adults; 4, transportation; 5, non-occupational walking; 6, dancing and sport activities; 7, conditioning activities; 8, leisure activities; 9, work). The survey also inquired about asked about the pace at which participants walked in 5 categories ranging from very slow to brisk. Where appropriate, questions differentiated between light-, moderate-, and heavy intensity activities based on the intensity of physical activity in a given category.

CHS: During the baseline examination, participants were asked whether they had engaged in any of 15 leisure time activities in the prior 2 weeks. Participants who engaged in one or more of six high-intensity activities, including swimming, hiking, aerobics, tennis, jogging, or racquetball, or who walked for exercise at a brisk (>4 mph) pace were categorized as having engaged in high intensity activity (>6 METs).

Participants who engaged in one or more of nine light- or moderate intensity activities (2-3 mph) or fairly brisk pace (>3-4 mph) were categorized as having engaged in moderate-intensity activity. Participants who did not report participating in any of the 15 leisure-time activities or who walked for exercise at a casual or strolling pace (< 2 mph) were categorized as having engaged in low-intensity activity. The intensity of each activity has been established and validated by the Minnesota Heart Survey. Participant responses regarding type of activity, frequency, and duration were used to calculate leisure time physical activity, expressed in kilocalories per week.

II. *Heart Failure outcome assessment*

WHI: All locally or centrally confirmed WHI heart failure cases and those with self-reported heart failure or cardiovascular diseases were sent to University of North Carolina for adjudication using a two-step review process. First, the available medical records for each case were abstracted by a professional medical record abstractor looking for following data elements: 1) screening for decompensation, 2) history of heart failure, 3) medical history, 4) physical exam (vital signs), 5) physical exam (findings), 6) diagnostic tests including echocardiograms, ECGs, cardiac catheterization reports, chest x-rays, lab results 7) interventions, 8) medications, 9) complications following events, and 10) administrative information. The abstracted data was reviewed by expert physicians who classified each case using ARIC classification as follows: i) *Definite decompensated heart failure* ii) *Possible decompensated heart failure*, iii) *Chronic stable heart failure*; iv) *Heart failure unlikely*; v) *Unclassifiable*, i.e., medical record documentation is missing; or there is

no decompensated heart failure AND cannot differentiated. Each case were further sub-classified as preserved ejection fraction or reduced ejection fraction heart failure using available left ventricular function data using ejection fraction (EF) cut-off of 45% (< 45% for HFrEF and ≥ for HFpEF)

MESA: The MESA criteria for heart failure were adapted from the WHI and are detailed in the MESA's manual of procedures. A diagnosis of incident heart failure required symptoms, physician diagnosis of heart failure, and another objective feature of heart failure such as evidence of abnormal left ventricular systolic or diastolic function or dilatation, pulmonary edema on chest X-ray, or heart failure treatment. Two physicians from the MESA events committee independently adjudicated each event, and any disagreement were resolved by mutual discussion between the reviewers or the full events committee. Each new heart failure diagnosis was categorized as either HFpEF (EF ≥45%) or HFrEF (EF <45%) based on available data on left ventricular EF from medical records review.

CHS: Incident heart failure events were ascertained by participant interview at semiannual study visits, medical record review, and CMS claims data review. Each event was subsequently confirmed through review of available medical records by an expert adjudication panel. A heart failure event was confirmed if a physician diagnosis was present along with reported symptoms and physical signs of heart failure, supporting clinical findings, or a medical therapy for heart failure. Events were characterized as HFpEF (EF ≥ 45%) or HFrEF (EF <45%) on the basis of clinical echocardiograms or other cardiac imaging performed within 30 days of the heart failure event.

Supplemental Table 1: Baseline characterstics of study participants across BMI categories

Baseline characteristics	Underweight	Normal weight	Overweight	Obese Class I	Obese Class II-III
Age, years	68 (60 – 74)	65 (58 – 71)	64 (57 – 70)	63 (57 – 68)	61 (56 – 66)
Men	11.5	11.7	13.1	8.3	3.1
Blacks	25.8	19.9	29.1	36.4	46.2
Study Cohort					
MESA	16.3	14.4	14.3	12.4	9.6
CHS	23.5	14.2	11.3	6.3	3.3
WHI	60.2	71.4	74.4	81.4	87.1
HTN status (yes)	24.9	27.2	37.4	46.0	55.4
Systolic BP mm Hg	121 (109 – 138)	124 (111- 138)	128 (116 – 140)	130 (119 – 142)	131 (121 – 142)

DM status (yes)	3.4	4.7	8.0	11.9	17.2
LTPA levels (MET-min/week)	510 (60 – 1260)	630 (183 – 1382)	473 (113 – 1110)	315 (30 – 855)	180 (0 – 590)
Smoking Status					
Former	28.3	34.7	38.3	38.6	41.0
Current	26.6	13.7	10.5	9.0	7.0
Current Alcohol use	31.7	36.4	30.9	23.8	17.3

Data presented as median (interquartile range) for continuous variables and % for categorical variables.

HTN: hypertension, BP: Blood pressure; MI: myocardial infarction; LTPA: leisure time physical activity; BMI: Body mass index; MESA: multiethnic study of atherosclerosis; CHS: cardiovascular health study; WHI: Women's health initiative

*Underweight: < 18.5 kg/m^2; Normal weight: 18.5 to <25 kg/m^2; Overweight: 25 to < 30.0 kg/m^2; Obese Class I: 30 to < 35.0 kg/m^2: Obese Class II/III ≥ 35 kg/m^2

Supplemental Table 2: Characteristics of pooled study participants stratified by individual cohorts

Characteristics	WHI-HF cohort	MESA	CHS
No. of participants	39,708	6,744	4,999
Women (%)	100	53	60
Study Entry	1993	2000	1989
Age at Entry	63	62	73
Follow up (years)	11	8	13
Median LTPA levels MET-min/week	375 (75 – 925)	825 (105 – 2,040)	505 (105 – 1,249)
Overall HF events	1,425	227	1,528
HFpEF/HFrEF events	622/486	109/95	521/333
HF with missing EF events	317	23	674

LPTA: leisure time physical activity; HF: heart failure; HFpEF: heart failure with preserved ejection fraction; HFrEF: heart failure with reduced ejection fraction

Supplemental Table 3: Hazard ratios for heart failure outcomes associated with different leisure time physical activity levels as observed in cohort stratified pooled analysis

	Pooled Hazard Ratios for HF outcomes					
Outcome	**LTPA Categories***			**Body mass index Categories#**		
	1 - 499 MET-min/week	**500 - 1000 MET-min/week**	**> 1000 MET-min/week**	**Over weight**	**Obese Class I**	**Obese Class II-III**
Overall HF	0.91 (0.82 – 1.00)	0.87 (0.77 – 0.97)	0.80 (0.71 – 0.88)	1.18 (1.07 – 1.29)	1.37 (1.22 – 1.53)	2.12 (1.83 – 2.40)
HFrEF#	0.84 (0.68 – 1.00)	0.83 (0.65 – 1.02)	0.86 (0.68 – 1.04)	0.97 (0.70 – 1.23)	1.11 (0.73 – 1.49)	1.23 (0.92 – 1.54)
HFpEF#	0.98 (0.82 – 1.14)	0.87 (0.70 – 1.04)	0.81 (0.66 -0.95)	1.32 (1.11 – 1.53)	1.46 (0.99 – 1.93)	2.58 (1.67 – 3.49)

Reference group for pooled analysis of LTPA categories is no physical activity (0 MET-min/week)

Reference group for pooled analysis of BMI categories is normal BMI. Cohort stratified pooled analysis was not performed for underweight vs. normal weight categories since one cohort (MESA) reported no HF events among underweight participants

Incident HF patients without data on subtype classification were excluded from the HF subtype analysis

Cox model includes following variables: age, sex, ethnicity, education level, income, hypertension status, systolic BP, diabetes status, body mass index, smoking, alcohol intake, and leisure time physical activity levels

HF: heart failure; HFpEF: Heart Failure with preserved ejection fraction; HFrEF: Heart failure with reduced ejection fraction; LTPA: Leisure time physical activity

Supplemental Table 4: Adjusted association between measures of waist hip ratio and risk of heart failure outcomes

Outcomes	**Adjusted HR (95% CI)** * per 1 SD higher WHR
Overall HF	1.13 (1.09 – 1.17)
HFpEF[#]	1.17 (1.11 – 1.23)
HFrEF[#]	1.11 (1.04 – 1.19)

HR: Hazard ratio; CI: Confidence interval; SD: Standard deviation; WHR: waist-hip ratio; HF: heart failure; HFpEF: heart failure with preserved ejection fraction; HFrEF: heart failure with reduced ejection fraction

*Separate cox proportional hazard models were created for overall HF, HFpEF and HFrEF outcomes with mortality and other HF type (for HF subtype models) as censoring events

[#]Incident HF patients without data on subtype classification were excluded from the HF subtype analysis

Model adjusted for age, sex, ethnicity, income, education, study cohort, hypertension status, systolic BP, diabetes status, smoking, alcohol intake, and leisure time physical activity levels

Supplemental Table 5: Adjusted association between measures of leisure time physical activity, body mass index, and risk of heart failure with missing ejection fraction

Adjusted Hazard Ratios (95 %CI)						
Physical activity categories (ref. group: No LTPA)				**Body mass index categories** (ref. group: Normal weight)		
1 - 499 MET-min/week	**500 - 1000 MET-min/week**	**> 1000 MET-min/week**		**Under weight**	**Over weight**	**Obese Class I**	**Obese Class II-III**
0.87 (0.73 – 1.03)	0.90 (0.74 – 1.11)	0.70 (0.57 – 0.85)		1.19 (0.59 – 2.42)	1.19 (1.01 – 1.40)	1.57 (1.29 – 1.91)	2.68 (2.14 – 3.35)

CI: Confidence intervals; LTPA: Leisure time physical activity

Multivariable adjusted Cox Model with following covariates: age, sex, ethnicity, income, education, study cohort, hypertension status, systolic BP, diabetes status, smoking, alcohol intake, body mass index, and leisure time physical activity levels. Mortality, HFpEF, and HFrEF treated as censoring events for this model