SUPPLEMENTAL MATERIAL

Supplemental Methods: Cohort Descriptions and Outcome Ascertainment

Framingham Heart Study

The Framingham Heart Study started recruiting participants in 1948 and study design and entry criteria have been detailed elsewhere.[29] For the present analysis, we included subjects starting from Exam 12 in 1970. Participants have been followed with physical examinations and blood tests every 2 to 4 years. All HF events were reviewed and adjudicated by a panel of three physicians after review of all examinations, as well as physician notes and hospital charts, using previously published criteria.[30] After excluding individuals due to prevalent CVD or HF, and missing covariates, 2,413 individuals were included (41,008 person-years).

Framingham Offspring Study

The Framingham Heart Study offspring cohort started recruiting participants in 1971 and detailed methods have been previously published.[30] Similar to the parent study, participants have been followed with physical examinations and blood tests every 2 to 4 years. At each visit, HF events were identified, all hospital records reviewed, and diagnosis of HF confirmed by a panel of three physicians.[30] After excluding individuals due to prevalent CVD or HF, and missing covariates, 4,390 individuals were included (91,857 person-years).

Multi-Ethnic Study of Atherosclerosis (MESA)

The MESA cohort recruited asymptomatic participants ages 45 to 84 years from six US communities between 2000-2002, and included white, black, Hispanic, and Asian individuals with detailed methods previously described.[31] All participants were contacted by telephone every 6 to 9 months to inquire about interim hospitalizations and medical records were obtained. HF

events were adjudicated by two physicians after review of all available study visits and medical records. Any disagreements were classified by full review committee as previously published.[32] After excluding individuals due to prevalent CVD or HF, and missing covariates, 4,282 individuals were included (56,626 person-years).

Atherosclerosis Risk in Communities Study

The ARIC Study recruited men and women ages 45 to 64 years sampled from 4 US communities with detailed methods previously published.[33] Three methods were used for ascertainment of HF events: 1) participants were contacted annually by phone and records were obtained for any hospitalizations, 2) local hospitals provided lists of hospital discharges with cardiovascular diagnoses, and 3) health department death certificate files were surveyed. Incident HF was defined as the first HF hospitalization or presence of HF code on the death certificate in any position using the *International Classification of Diseases Code, Ninth Revision (ICD-9*) code 428.x and deaths with *ICD-9/10* codes of either 428.x or I50. After excluding individuals due to prevalent CVD or HF, and missing covariates, 16,530 individuals were included (311,515 person-years).

Coronary Artery Risk Development in Young Adults Study

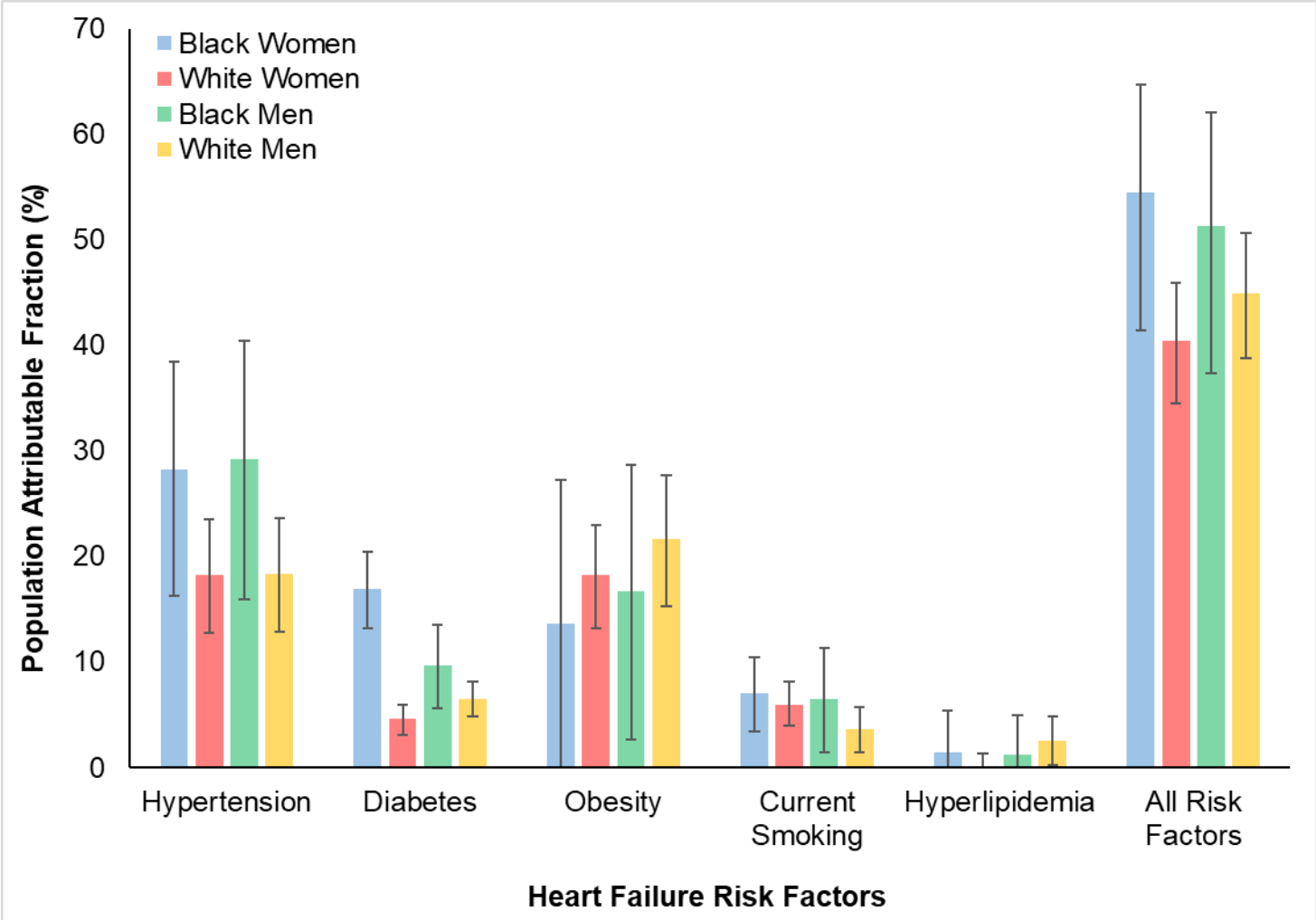
The CARDIA study recruited 5115 blacks and whites in 1985-1986 from Birmingham, Alabama; Chicago; Minneapolis; and Oakland, California with full details previously described.[34] All participants were contacted annually by telephone and during scheduled study examinations to report interim hospitalizations. Two members of the endpoint committee adjudicated all hospitalizations and deaths with disagreements resolved by consensus. Hospitalization for HF

required both that a final diagnosis of HF had been made by a physician and that medical treatment for HF had been administered during the hospitalization. Death was considered to be due to HF if the adjudicated cause was cardiovascular and if an *International Classification of Diseases, Ninth Revision* (ICD-9) code for HF (428) or cardiomyopathy (425) was noted as a contributory cause. Deaths were reported to the field centers every 6 months, and records were requested after consent had been obtained from the next of kin. After excluding individuals due to prevalent CVD or HF, and missing covariates, 4,076 individuals were included (52,276 person-years).

Cardiovascular Health Study

The CHS cohort recruited participants from four locations—Forsyth County, North Carolina; Sacramento County, California; Allegheny County, Pennsylvania; and Washington County, Maryland and detailed methods have been previously described.[35] CHS participants were classified at baseline according to the presence or absence of preexisting disease for the six cardiovascular outcomes using hospital records and physician confirmation as previously published.[36] Ascertainment of HF events and deaths were performed during clinic visits and surveillance calls and records were subsequently obtained. HF was subsequently adjudicated by the CHS Events Subcommittee.[37] After excluding individuals due to prevalent CVD or HF, and missing covariates, 4,327 individuals were included (62,541 person-years).

Supplemental Figure I. Race- and sex-specific estimates of population attributable fractions of heart failure for modifiable risk factors



Differences in population attributable fractions for major modifiable risk factors stratified by race and sex. For this analysis, hypertension was defined as SBP ≥130 or DBP ≥80 or treated. The more stringent hypertension definition increased the PAF for HF by as low as 0.9% in black men to as high as 2.4% in black women.

Supplemental Table I. Cohort Specific Heart Failure Criteria

	Heart Failure Definitions
Framingham Heart and Offspring Studies	Presence of 2 major criteria or 1 major and 2 minor criteria Major criteria: Paroxysmal nocturnal dyspnea or orthopnea, neck-vein distention, hepatojugular reflex, rales, cardiomegaly, acute pulmonary edema, S3 gallop, circulation time ≥25 seconds, weight loss ≥4.5kg in 5 days in response to treatment Minor Criteria: Ankle edema, night cough, dyspnea on exertion, hepatomegaly, pleural effusion, vital capacity < 1/3 from maximum, heart rate ≥ 120/min
Multiethnic Study of Atherosclerosis	Presence of any of the following criteria: 1. HF diagnosed by a physician and patient receiving medical treatment for HF 2. Pulmonary edema on chest radiograph 3. Dilated ventricle or poor systolic function by echocardiography or ventriculography, or evidence of diastolic dysfunction by echocardiography
Atherosclerosis Risk in Communities Study	Hospitalization discharge diagnoses were reviewed and considered eligible for validation as a HF event based on specific diagnoses codes. If certain diagnoses codes were present, trained staff reviewed the record for evidence of HF symptoms (new or worsening dyspnea, edema, paroxysmal nocturnal dyspnea, orthopnea, or hypoxia) or any mention by the treating physicians of HF as reason for hospitalization. If present, further detailed chart review was performed to look for improvement in symptoms with HF treatment (eg, diuresis).
Coronary Artery Risk Development in Young Adults	Hospitalizations were reviewed and diagnosis of HF required a physician diagnosis and administration of medical treatment of HF during the hospitalization.
Cardiovascular Health Study	Presence of symptoms (dyspnea, fatigue, orthopnea, paroxysmal nocturnal dyspnea) and physical signs (edema, rales, gallop, displaced left ventricular apical impulse) or by clinical findings such as pulmonary edema on chest radiograph or physician diagnosis of HF and medical therapy for HF.

Supplemental Table II. Prevalence and multivariable-adjusted relative risk of incident heart failure across groups by risk factors

	Black Women		White Women		Black Men		White Men	
	RR (95% CI)	**Prevalence**	**RR (95% CI)**	**Prevalence**	**RR (95% CI)**	**Prevalence**	**RR (95% CI)**	**Prevalence**
Age, per year	1.06 (1.05-1.07)	--	1.10 (1.09-1.10)	--	1.05 (1.04-1.06)	--	1.10 (1.09-1.10)	--
Education (> high school)	0.55 (0.46-0.66)	0.52	0.65 (0.58-0.73)	0.49	0.57 (0.47-0.71)	0.51	0.66 (0.58-0.74)	0.55
Hypertension*	1.80 (1.45-2.12)	0.65	1.60 (1.44-1.79)	0.48	1.84 (1.45-2.35)	0.67	1.63 (1.46-1.82)	0.55
Diabetes	2.69 (2.26-3.19)	0.15	2.05 (1.80-2.35)	0.07	2.06 (1.66-2.51)	0.16	2.19 (1.93-2.48)	0.08
Obesity	1.30 (1.02-1.66)	0.49	1.90 (1.68-2.14)	0.22	1.26 (0.98-1.62)	0.35	1.80 (1.56-2.07)	0.22
Current Smoker	1.76 (1.46-2.12)	0.22	1.78 (1.59-2.00)	0.22	1.63 (1.34-1.98)	0.30	1.54 (1.37-1.73)	0.24
Hyperlipidemia	1.05 (0.89-1.25)	0.23	0.95 (0.86-1.05)	0.27	1.07 (0.87-1.33)	0.19	1.14 (1.02-1.27)	0.22

Adjusted for age, education, all modifiable risk factors when not included as the primary exposure and competing risk of death from other causes.
*Hypertension: SBP ≥130 or DBP ≥80 mm Hg, or treated
RR: relative risk; CI: confidence interval

Supplemental Table III. Race- and sex-specific estimates of population attributable fractions of heart failure for modifiable risk factors

	Black Women PAF (95% CI)	White Women PAF (95% CI)	Black Men PAF (95% CI)	White Men PAF (95% CI)
Hypertension*	25.8 (16.3, 34.2)	17.3 (13.0, 21.4)	28.3 (18.7, 36.7)	17.3 (13.2, 21.1)
Diabetes	16.4 (12.7, 19.9)	4.4 (2.9, 5.9)	9.2 (5.1, 13.0)	6.1 (4.4, 7.7)
Obesity	13.1 (0.0, 26.8)	17.9 (12.8, 22.6)	16.2 (2.2, 28.1)	21.0 (14.6, 27.0)
Current Smoking	6.9 (3.3, 10.3)	6.2 (4.1, 8.2)	6.8 (1.8, 11.5)	3.8 (1.6, 6.0)
Hyperlipidemia	1.2 (0.0, 5.2)	0.0 (0.0, 1.3)	0.9 (0.0, 4.7)	2.3 (0.0, 4.6)
Cumulative	51.9 (39.3, 61.8)	39.3 (33.9, 44.4)	50.0 (37.6, 59.9)	43.5 (37.6, 48.8)

*Hypertension: SBP ≥140 or DBP ≥90 mm Hg, or treated
PAF: population attributable fraction, CI: confidence interval

Supplemental Table IV. Race- and sex-specific estimates of population attributable fractions of heart failure for modifiable risk factors

	Black Women PAF (95% CI)	White Women PAF (95% CI)	Black Men PAF (95% CI)	White Men PAF (95% CI)
Hypertension*	28.2 (16.3, 38.5)	18.3 (12.8, 23.5)	29.2 (15.9, 40.5)	18.4 (12.9, 23.6)
Diabetes	16.9 (13.2, 20.4)	4.6 (3.1, 6.0)	9.7 (5.6, 13.5)	6.5 (4.8, 8.1)
Obesity	13.6 (0.0, 27.3)	18.3 (13.2, 23.0)	16.7 (2.7, 28.7)	21.7 (15.3, 27.7)
Current Smoking	7.0 (3.4, 10.5)	6.0 (4.0, 8.1)	6.5 (1.4, 11.3)	3.6 (1.4, 5.7)
Hyperlipidemia	1.4 (0.0, 5.4)	0.0 (0.0, 1.3)	1.2 (0.0, 5.0)	2.6 (0.2, 4.9)
Cumulative	54.5 (41.4, 64.7)	40.4 (34.5, 45.9)	51.3 (37.4, 62.1)	45.0 (38.8, 50.7)

*Hypertension: SBP ≥130 or DBP ≥80 mm Hg, or treated
PAF: population attributable fraction, CI: confidence interval

Supplemental Table V. Race- and sex-specific estimates of population attributable fractions of heart failure by absolute count of risk factors at baseline

	Black Women PAF (95% CI)	White Women PAF (95% CI)	Black Men PAF (95% CI)	White Men PAF (95% CI)
1 Risk Factor	8.1 (2.3, 13.5)	8.9 (5.2, 12.5)	13.6 (6.4, 20.3)	15.1 (11.3, 18.7)
2 Risk Factors	22.1 (15.7, 28.1)	14.5 (11.3, 17.6)	21.4 (14.6, 27.8)	17.5 (14.7, 20.1)
≥ 3 Risk Factors	28.8 (23.5, 33.7)	12.5 (10.6, 14.3)	20.1 (15.4, 24.5)	10.3 (8.6, 11.9)

PAF: population attributable fraction, CI: confidence interval