Supplementary Online Content

Zhong VW, Van Horn L, Greenland P, et al. Associations of processed meat, unprocessed red meat, poultry, or fish intake with incident cardiovascular disease and all-cause mortality. *JAMA Intern Med.* Published online February 3, 2020. doi:10.1001/jamainternmed.2019.6969

eFigure 6. Association Between Each Additional 2 Servings of Unprocessed Red Meat Consumed per Week and All-Cause Mortality Among Different Subgroups

eFigure 7. Association Between Each Additional 2 Servings of Poultry Consumed per Week and All-Cause Mortality Among Different Subgroups

eFigure 8. Association Between Each Additional 2 Servings of Fish Consumed per Week and All-Cause Mortality Among Different Subgroups

This supplementary material has been provided by the authors to give readers additional information about their work.

eTable 1. Partial correlation coefficients between the 4 foods and dietary and other lifestyle factors

	Processed meat		Unprocessed red meat		Poultry		Fish	
	Coefficient[a]	*P*	Coefficient[a]	*P*	Coefficient[a]	*P*	Coefficient[a]	*P*
Foods and diet quality								
Processed meat	--	--	0.13	<.001	-0.09	<.001	-0.07	<.001
Unprocessed red meat	0.13	<.001	--	--	0.05	<.001	-0.05	<.001
Poultry	-0.09	<.001	0.05	<.001	--	--	0.20	<.001
Fish	-0.07	<.001	-0.05	<.001	0.20	<.001	--	--
Eggs	0.18	<.001	0.003	.66	-0.04	<.001	-0.04	<.001
Low-fat dairy products	-0.13	<.001	-0.14	<.001	0.006	.30	0.04	<.001
High-fat dairy products	-0.01	.19	-0.06	<.001	-0.08	<.001	-0.08	<.001
Whole grains	-0.12	<.001	-0.16	<.001	0.02	<.001	0.06	<.001
Refined grains	0.03	<.001	-0.001	.86	-0.10	<.001	-0.14	<.001
Fruits	-0.15	<.001	-0.17	<.001	0.05	<.001	0.13	<.001
Vegetables excluding potatoes	-0.11	<.001	-0.05	<.001	0.16	<.001	0.24	<.001
aHEI-2010 score[b]	-0.20	<0.0001	-0.18	<0.0001	0.18	<0.0001	0.34	<0.0001
Nutrients								
Dietary cholesterol	0.23	<.001	0.23	<.001	0.14	<.001	0.10	<.001
Saturated fat	0.28	<.001	0.27	<.001	-0.10	<.001	-0.16	<.001
Unsaturated fat	0.32	<.001	0.33	<.001	0.03	<.001	-0.04	<.001
Trans fat	0.23	<.001	0.53	<.001	0.07	<.001	0.03	<.001
Animal protein	0.05	<.001	0.43	<.001	0.46	<.001	0.41	<.001
Fiber	-0.16	<.001	-0.16	<.001	0.12	<.001	0.18	<.001
Sodium	0.15	<.001	0.006	.32	0.05	<.001	0.05	<.001
Iron	-0.03	<.001	0.001	.90	0.05	<.001	0.05	<.001
Other lifestyle factors								
Current smoking	0.09	<.001	0.03	<.001	-0.08	<.001	-0.04	<.001
Smoking pack years	0.08	<.001	0.03	<.001	-0.06	<.001	-0.02	.001
Alcohol	-0.02	.001	-0.02	<.001	-0.04	<.001	-0.01	.26
Physical acitvity level	-0.06	<.001	-0.07	<.001	0.02	<.001	0.07	<.001

[a] Adjusted for cohort, total energy intake, age, sex, and race and ethnicity.

[b] aHEI, alternate healthy eating index. Unprocessed red meat and processed meat were excluded from the calculation.

eTable 2. Key characteristics between the included and excluded participants

	Included (n=29 682)	Excluded* (n=4822)
Age, mean (SD), y	53.7 (15.7)	59.3 (15.4)
Sex, No. (%)		
Male	13 168 (44.4)	2193 (45.5)
Female	16 514 (55.6)	2629 (54.5)
Race and ethnicity, No. (%)		
Non-Hispanic White	20 581 (69.3)	2898 (60.1)
Non-Hispanic Black	7004 (23.6)	1698 (35.2)
Hispanic	1348 (4.5)	141 (2.9)
Chinese	731 (2.5)	71 (1.5)
Other	18 (0.1)	14 (0.3)
Some college or more, No. (%)	15 680 (52.8)	1994 (43.1)
Current smoker, No. (%)	6057 (20.4)	1178 (24.4)
BMI, mean (SD), kg/m^2	27.0 (5.2)	27.5 (5.3)
Diabetes, No. (%)	2570 (8.7)	546 (11.6)
SBP, mean (SD), mm Hg	123.0 (20.1)	129.5 (22.4)
Total cholesterol, mean (SD), mg/dL	203.4 (40.5)	205.2 (42.4)
Use of anti-hypertensive drugs, No. (%)	7613 (25.6)	1523 (31.8)
Use of lipid-lowering drugs, No. (%)	1659 (5.6)	272 (5.8)

BMI, body mass index; SBP, systolic blood pressure; SD, standard deviation.

*A combination of 602 participants who had extreme energy intake (<500 or >6000 kcal/day) and 4220 participants who had missing data for one or more study variables.

eTable 3. Imputation analysis for the associations between the 4 foods and incident CVD and all-cause mortality (n=34 504)

	Hazard ratio (95% CI)[a]	*P*
Processed meat		
Incident CVD	1.07 (1.03-1.10)	<.001
All-cause mortality	1.03 (1.02-1.04)	<.001
Unprocessed red meat		
Incident CVD	1.03 (1.01-1.05)	<.001
All-cause mortality	1.03 (1.01-1.04)	.003
Poultry		
Incident CVD	1.03 (1.00-1.05)	.03
All-cause mortality	0.99 (0.97-1.01)	.30
Fish		
Incident CVD	1.01 (0.99-1.02)	.54
All-cause mortality	0.99 (0.97-1.01)	.18

[a] Incident cardiovascular disease (CVD) included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were further stratified by age groups, sex, and race and ethnicity for the association between processed meat intake and all-cause mortality and further stratified by sex for the association between unprocessed red meat intake and all-cause mortality, to satisfy proportional hazards assumption. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), and hormone therapy (y/n). The association between processed meat intake and incident CVD was non-monotonic (*P* for non-linearity =.006) and thus a quadratic term for processed meat intake was added in addition to the original linear term. The interpretation was based on each additional 2 servings of the food consumed per week for all the associations except for the association between processed meat intake and incident CVD where the comparison was 2 vs 0 servings per week specifically. Ten imputed data sets were used.

eTable 4. Associations between the 4 foods and incident CVD and all-cause mortality after excluding early events and arbitrary truncations

	Excluding events within first 2 years		Excluding events within first 5 years		Censoring at 10-year follow up		Censoring at 20-year follow up	
	Hazard ratio (95% CI)[a]	*P*	Hazard ratio (95% CI)[a]	*P*	Hazard ratio (95% CI)[a]	*P*	Hazard ratio (95% CI)[a]	*P*
Processed meat								
Incident CVD	1.06 (1.02-1.10)	.001	1.07 (1.03-1.11)	.001	1.08 (1.02-1.14)	.004	1.08 (1.04-1.12)	<.001
All-cause mortality	1.03 (1.02-1.05)	<.001	1.03 (1.02-1.05)	<.001	1.04 (1.01-1.07)	.003	1.03 (1.01-1.05)	<.001
Unprocessed red meat								
Incident CVD	1.04 (1.01-1.06)	.003	1.03 (1.00-1.05)	.04	1.03 (1.00-1.07)	.05	1.03 (1.01-1.06)	.01
All-cause mortality	1.02 (1.00-1.04)	.02	1.02 (1.00-1.05)	.03	1.04 (1.01-1.07)	.02	1.03 (1.01-1.05)	.006
Poultry								
Incident CVD	1.04 (1.02-1.07)	.002	1.04 (1.01-1.07)	.007	1.04 (1.00-1.08)	.07	1.03 (1.00-1.06)	.03
All-cause mortality	0.99 (0.97-1.02)	.52	0.99 (0.96-1.01)	.36	1.01 (0.97-1.05)	.71	1.00 (0.97-1.02)	.78
Fish								
Incident CVD	1.00 (0.98-1.02)	.83	1.00 (0.98-1.02)	.99	1.00 (0.97-1.03)	.97	1.01 (0.99-1.03)	.52
All-cause mortality	0.99 (0.97-1.01)	.35	0.99 (0.97-1.01)	.39	0.95 (0.92-0.98)	.003	0.98 (0.96-1.00)	.09

[a] Incident cardiovascular disease (CVD) included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were further stratified by age groups, sex, and race and ethnicity for the association between processed meat intake and all-cause mortality and further stratified by sex for the association between unprocessed red meat intake and all-cause mortality, to satisfy proportional hazards assumption. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, and 3 of the 4 foods (processed meat, unprocessed red meat, poultry, and fish). The association between processed meat intake and incident CVD was non-monotonic (*P* for non-linearity =.006) and thus a quadratic term for processed meat intake was added in addition to the original linear term. The interpretation was based on each additional 2 servings of the food consumed per week for all the associations except for the association between processed meat intake and incident CVD where the comparison was 2 vs 0 servings per week specifically.

eTable 5. Associations between the 4 foods and incident CVD and all-cause mortality, after excluding one cohort

Cohort dropped	Remaining sample size	Incident CVD		All-cause mortality	
		HR (95% CI)[a]	*P*	HR (95% CI)[a]	*P*
Processed meat					
ARIC	17681	1.05 (1.00-1.11)	.05	1.03 (1.01-1.06)	.004
CARDIA	24950	1.07 (1.03-1.11)	<.001	1.04 (1.02-1.05)	<.001
CHS	26019	1.09 (1.05-1.14)	<.001	1.03 (1.01-1.05)	.003
FHS	29074	1.07 (1.03-1.11)	<.001	1.03 (1.02-1.05)	<.001
FOS	27122	1.06 (1.03-1.10)	<.001	1.03 (1.02-1.05)	<.001
MESA	23564	1.07 (1.04-1.12)	<.001	1.03 (1.02-1.05)	<.001
Unprocessed red meat					
ARIC	17681	1.02 (0.99-1.05)	.30	1.02 (1.00-1.05)	.11
CARDIA	24950	1.03 (1.01-1.06)	.01	1.03 (1.00-1.05)	.02
CHS	26019	1.04 (1.02-1.07)	.001	1.03 (1.00-1.05)	.02
FHS	29074	1.03 (1.01-1.06)	.003	1.03 (1.01-1.05)	.01
FOS	27122	1.03 (1.01-1.05)	.009	1.03 (1.01-1.05)	.005
MESA	23564	1.04 (1.02-1.07)	<.001	1.03 (1.01-1.06)	.001
Poultry					
ARIC	17681	1.03 (0.99-1.07)	.11	0.99 (0.96-1.02)	.48
CARDIA	24950	1.04 (1.01-1.07)	.005	0.99 (0.97-1.02)	.46
CHS	26019	1.04 (1.00-1.07)	.02	0.99 (0.96-1.02)	.51
FHS	29074	1.03 (1.01-1.06)	.02	0.99 (0.97-1.02)	.59
FOS	27122	1.03 (1.00-1.06)	.02	0.99 (0.97-1.01)	.38
MESA	23564	1.05 (1.02-1.08)	.001	1.00 (0.98-1.03)	.92
Fish					
ARIC	17681	1.00 (0.97-1.02)	.79	0.98 (0.96-1.00)	.11
CARDIA	24950	1.00 (0.98-1.02)	.94	0.99 (0.97-1.01)	.18
CHS	26019	1.01 (0.98-1.04)	.34	0.99 (0.97-1.02)	.64
FHS	29074	1.01 (0.98-1.03)	.59	0.99 (0.97-1.01)	.20
FOS	27122	1.00 (0.98-1.02)	.83	0.99 (0.97-1.01)	.16
MESA	23564	1.00 (0.98-1.02)	.99	0.99 (0.97-1.01)	.25

ARIC, Atherosclerosis Risk in Communities; CARDIA, Coronary Artery Risk Development in Young Adults; CHS, Cardiovascular Health Study; CI, confidence interval; CVD, cardiovascular disease; FHS, Framingham Heart Study; FOS, Framingham Offspring Study; HR, hazard ratio; MESA, Multi-Ethnic Study of Atherosclerosis.

[a] There were 6963 incident CVD events and 8875 all-cause deaths in the total study sample (n=29 682). Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were further stratified by age groups, sex, and race and ethnicity for the association between processed meat intake and all-cause mortality and further stratified by sex for the association between unprocessed red meat intake and all-cause mortality, to satisfy proportional hazards assumption. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, and 3 of the 4 foods (processed meat, unprocessed red meat, poultry, and fish). The association between processed meat intake and incident CVD was non-monotonic (*P* for non-linearity =.006) and thus a quadratic term for processed meat intake was added in addition to the original linear term. The interpretation was based on each additional 2 servings of the food consumed per week for all the associations except for the association between processed meat intake and incident CVD where the comparison was 2 vs 0 servings per week specifically.

eTable 6. Associations between quintiles of the intake for each of the 4 foods and incident CVD and all-cause mortality[a]

	Hazard ratio (95% confidence interval)					*P* for trend
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	
Processed meat[b]	n=5936	n=5937	n=5937	n=5936	n=5936	
Incident CVD						
Model 1[c]	1.00 (Ref)	1.06 (0.97-1.15)	1.10 (1.01-1.19)	1.20 (1.10-1.30)	1.29 (1.19-1.41)	<.001
Model 2[d]	1.00 (Ref)	1.03 (0.94-1.12)	1.04 (0.96-1.14)	1.13 (1.04-1.22)	1.16 (1.07-1.26)	<.001
Model 3[e]	1.00 (Ref)	1.03 (0.95-1.13)	1.05 (0.96-1.15)	1.13 (1.04-1.23)	1.16 (1.06-1.27)	<.001
All-cause mortality						
Model 1[c]	1.00 (Ref)	1.00 (0.93-1.08)	1.06 (0.99-1.15)	1.12 (1.04-1.20)	1.29 (1.20-1.39)	<.001
Model 2[d]	1.00 (Ref)	0.96 (0.89-1.04)	1.00 (0.93-1.08)	1.03 (0.95-1.11)	1.13 (1.05-1.22)	<.001
Model 3[e]	1.00 (Ref)	0.96 (0.89-1.03)	0.98 (0.91-1.06)	1.01 (0.93-1.09)	1.09 (1.01-1.18)	<.001
Unprocessed red meat[b]	n=5936	n=5937	n=5936	n=5936	n=5937	
Incident CVD						
Model 1[c]	1.00 (Ref)	1.08 (1.00-1.16)	1.12 (1.04-1.21)	1.19 (1.11-1.29)	1.17 (1.09-1.26)	<.001
Model 2[d]	1.00 (Ref)	1.06 (0.98-1.14)	1.08 (1.00-1.16)	1.14 (1.06-1.23)	1.11 (1.03-1.20)	.003
Model 3[e]	1.00 (Ref)	1.05 (0.97-1.14)	1.07 (0.99-1.15)	1.13 (1.05-1.22)	1.11 (1.02-1.20)	.01
All-cause mortality						
Model 1[c]	1.00 (Ref)	1.09 (1.02-1.16)	1.10 (1.03-1.18)	1.14 (1.07-1.22)	1.20 (1.13-1.29)	<.001
Model 2[d]	1.00 (Ref)	1.07 (1.00-1.14)	1.05 (0.98-1.13)	1.08 (1.01-1.16)	1.13 (1.06-1.21)	<.001
Model 3[e]	1.00 (Ref)	1.06 (0.99-1.13)	1.04 (0.97-1.12)	1.07 (1.00-1.15)	1.13 (1.05-1.21)	.001
Poultry[b]	n=5937	n=5933	n=5939	n=5937	n=5936	
Incident CVD						
Model 1[c]	1.00 (Ref)	0.94 (0.87-1.01)	0.98 (0.91-1.06)	0.93 (0.86-1.00)	0.98 (0.91-1.06)	.90
Model 2[d]	1.00 (Ref)	0.97 (0.90-1.05)	1.01 (0.93-1.09)	0.98 (0.91-1.06)	1.06 (0.98-1.15)	.06
Model 3[e]	1.00 (Ref)	0.97 (0.90-1.05)	1.01 (0.94-1.09)	0.99 (0.92-1.07)	1.09 (1.00-1.18)	.02
All-cause mortality						
Model 1[c]	1.00 (Ref)	0.87 (0.81-0.93)	0.88 (0.82-0.94)	0.82 (0.77-0.88)	0.85 (0.80-0.91)	<.001
Model 2[d]	1.00 (Ref)	0.92 (0.86-0.98)	0.91 (0.85-0.97)	0.88 (0.83-0.94)	0.95 (0.89-1.02)	.34
Model 3[e]	1.00 (Ref)	0.92 (0.86-0.98)	0.92 (0.86-0.98)	0.89 (0.84-0.96)	0.97 (0.91-1.04)	.83
Fish[b]	n=5936	n=5937	n=5936	n=5935	n=5938	
Incident CVD						
Model 1[c]	1.00 (Ref)	1.02 (0.94-1.10)	0.92 (0.85-1.00)	0.98 (0.90-1.06)	0.97 (0.90-1.06)	.64
Model 2[d]	1.00 (Ref)	1.04 (0.96-1.13)	0.97 (0.89-1.05)	1.03 (0.95-1.11)	1.03 (0.95-1.12)	.50
Model 3[e]	1.00 (Ref)	1.04 (0.96-1.13)	0.97 (0.89-1.05)	1.03 (0.95-1.12)	1.04 (0.96-1.13)	.31
All-cause mortality						

	Hazard ratio (95% confidence interval)					*P* for trend
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	
Model 1[c]	1.00 (Ref)	0.95 (0.89-1.02)	0.88 (0.82-0.95)	0.88 (0.82-0.95)	0.88 (0.82-0.94)	.001
Model 2[d]	1.00 (Ref)	0.98 (0.91-1.05)	0.93 (0.87-1.00)	0.93 (0.87-1.00)	0.93 (0.87-1.00)	.09
Model 3[e]	1.00 (Ref)	0.97 (0.90-1.04)	0.93 (0.87-1.00)	0.94 (0.87-1.01)	0.95 (0.88-1.02)	.30

[a] There were 6963 incident cardiovascular disease (CVD) events and 8875 all-cause deaths (n=29 682). Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were further stratified by age groups, sex, and race and ethnicity for the association between processed meat intake and all-cause mortality and further stratified by sex for the association between unprocessed red meat intake and all-cause mortality, to satisfy proportional hazards assumption.

[b] The unit of the 4 foods was converted into serving/day/1000 kcal before modeling. The median consumption from Quintile 1 to Quintile 5 was 0, 0.06, 0.13, 0.24 and 0.50 serving/day/1000 kcal for processed meat; 0.07, 0.16, 0.25, 0.35, and 0.54 serving/day/1000 kcal for unprocessed red meat; 0.04, 0.09, 0.16, 0.25, and 0.42 serving/day/1000 kcal for poultry; and 0.02, 0.08, 0.14, 0.24, and 0.47 serving/day/1000 kcal for fish.

[c] Model 1: age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), and education (<high school, high school, some college or more).

[d] Model 2: Model 1 plus total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), and use of hormone therapy (y/n).

[e] Model 3: Model 2 plus fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, and 3 of the 4 foods (processed meat, unprocessed red meat, poultry, and fish); a term of processed meat squared was additionally adjusted when analyzing the incident CVD outcome.

eTable 7. Energy density models for the associations between the 4 foods and incident CVD and all-cause mortality

	Hazard ratio (95% CI)[a]	*P*
Processed meat		
Incident CVD	1.03 (1.02-1.05)	<.001
All-cause mortality	1.03 (1.02-1.05)	<.001
Unprocessed red meat		
Incident CVD	1.04 (1.02-1.06)	<.001
All-cause mortality	1.03 (1.02-1.05)	<.001
Poultry		
Incident CVD	1.03 (1.01-1.05)	.009
All-cause mortality	1.00 (0.98-1.02)	.83
Fish		
Incident CVD	1.00 (0.99-1.02)	.68
All-cause mortality	0.99 (0.98-1.01)	.43

[a] The unit of the 4 foods was converted into serving/day/1000 kcal before modeling. There were 6963 incident cardiovascular disease (CVD) events and 8875 all-cause deaths (n=29 682). Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were further stratified by age groups, sex, and race and ethnicity for the association between processed meat intake and all-cause mortality and further stratified by sex for the association between unprocessed red meat intake and all-cause mortality, to satisfy proportional hazards assumption. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, and 3 of the 4 foods (processed meat, unprocessed red meat, poultry, and fish). All associations were monotonic (*P* value for non-linearity >.05). The interpretation was based on each additional 2 servings of the food consumed per week for all the associations, at daily energy consumption level of 2000 kcal.

eTable 8. Associations between the 4 foods and incident CVD, using subdistribution hazard models[a]

	Hazard ratio (95% CI)[b]	*P*
Processed meat	1.07 (1.04-1.12)	<.001
Unprocessed red meat	1.02 (0.99-1.04)	.18
Poultry	1.04 (1.01-1.06)	.01
Fish	1.01 (0.99-1.03)	.31

[a] There is no competing risk for all-cause mortality, so we only evaluated incident cardiovascular disease (CVD) using subdistribution hazard models.

[b] There were 6963 incident CVD events. Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified subdistribution hazard models were applied. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, and 3 of the 4 foods (processed meat, unprocessed red meat, poultry, and fish). The association between processed meat intake and incident CVD was non-monotonic (*P* value for non-linearity =.0005) and thus a quadratic term for processed meat intake was added in addition to the original linear term. The interpretation was based on each additional 2 servings of the food consumed per week for all the associations except for the association between processed meat intake and incident CVD where the comparison was 2 vs 0 servings per week specifically.

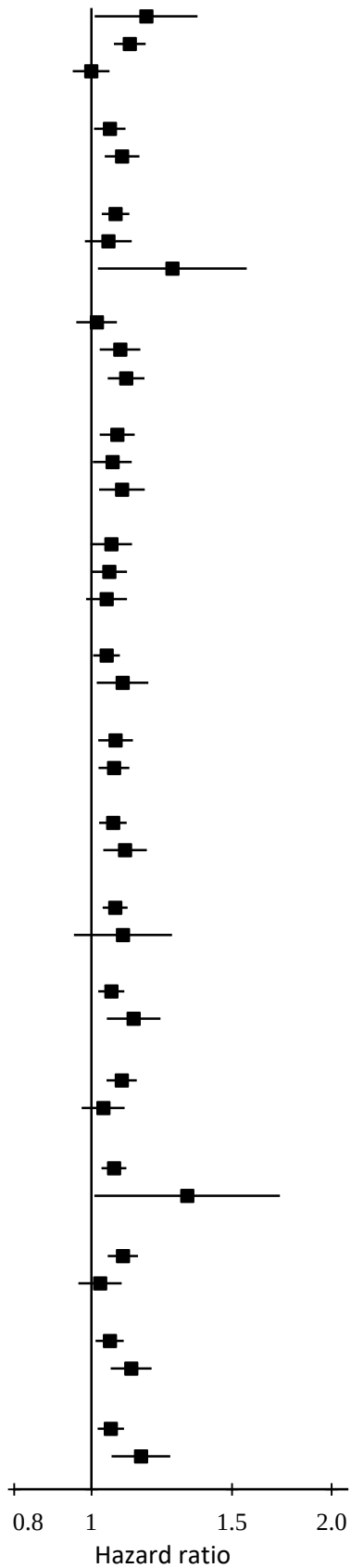
eTable 9. Associations of fatty fish or nonfatty fish intake with incident CVD and all-cause mortality

	Incident CVD		All-cause mortality	
	Hazard ratio (95% CI)[a]	*P*	Hazard ratio (95% CI)[a]	*P*
Fatty fish	1.01 (0.97-1.05)	.51	0.99 (0.95-1.02)	.43
Nonfatty fish	1.01 (0.97-1.04)	.76	0.99 (0.96-1.03)	.73

[a] There were 6963 incident cardiovascular disease (CVD) events and 8875 all-cause deaths (n=29 682). Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Cohort-stratified cause-specific hazard models for incident CVD and cohort-stratified standard proportional hazards models for all-cause mortality were applied. The models were adjusted for age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity *z* score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, processed meat, processed meat squared (for incident CVD only), unprocessed red meat, and poultry. The interpretation was based on each additional 2 servings of fish consumed per week.

eFigure 1. Association between processed meat consumed (2 vs 0 servings/week) and incident CVD among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	298/5210	1.17 (1.01-1.36)	.04	
45-64 years	3649/17025	1.12 (1.07-1.17)	<.001	.008
≥65 years	3016/7447	1.00 (0.95-1.05)	.98	
Sex				
Men	3525/13168	1.05 (1.01-1.10)	.02	.48
Women	3438/16514	1.09 (1.04-1.15)	<.001	
Race and ethnicity				
Non-Hispanic white	5228/20581	1.07 (1.03-1.12)	<.001	
Non-Hispanic black	1474/7004	1.05 (0.98-1.12)	.15	.06
Other	261/2097	1.26 (1.02-1.57)	.03	
Education level				
Less than high school	1944/5541	1.02 (0.96-1.08)	.61	
High school	2102/8461	1.09 (1.02-1.15)	.006	.17
Some college or more	2917/15680	1.11 (1.05-1.17)	<.001	
Smoking status				
Never	3017/14772	1.08 (1.02-1.13)	.004	
Former	2301/8853	1.06 (1.00-1.12)	.03	.18
Current	1645/6057	1.09 (1.02-1.17)	.009	
Weight status				
BMI <25 kg/m^2	2071/11553	1.06 (1.00-1.12)	.06	
25 ≤ BMI <30 kg/m^2	2850/11172	1.05 (1.00-1.11)	.05	.98
BMI ≥30 kg/m^2	2042/6957	1.04 (0.98-1.11)	.15	
Diabetes[b]				
No	5789/27112	1.04 (1.01-1.09)	.03	.08
Yes	1174/2570	1.09 (1.02-1.18)	.02	
Hypertension[c]				
No	2981/19000	1.07 (1.02-1.13)	.006	.99
Yes	3982/10682	1.07 (1.02-1.12)	.004	
Hyperlipidemia[d]				
No	5025/23206	1.06 (1.02-1.11)	.002	.61
Yes	1938/6476	1.10 (1.04-1.17)	.002	
Low lipids[e]				
No	6600/26862	1.07 (1.03-1.11)	<.001	.63
Yes	363/2820	1.10 (0.95-1.26)	.21	
Eating a higher quality diet[f]				
No	5574/22262	1.06 (1.02-1.10)	.003	.05
Yes	1389/7420	1.13 (1.05-1.22)	.002	
Eating a high saturated fat diet[g]				
No	5257/22342	1.09 (1.05-1.14)	<.001	.31
Yes	1706/7340	1.03 (0.97-1.10)	.28	
Eating a low saturated fat diet[h]				
No	6542/27581	1.07 (1.03-1.11)	<.001	.13
Yes	421/2101	1.32 (1.01-1.72)	.04	
Eating high fat diet[i]				
No	5251/22288	1.10 (1.05-1.14)	<.001	.20
Yes	1712/7394	1.03 (0.96-1.09)	.43	
Eating a high protein diet[j]				
No	4838/22137	1.05 (1.01-1.10)	.01	.18
Yes	2125/7545	1.12 (1.06-1.19)	<.001	
Eating a high carbohydrate diet[k]				
No	5369/22291	1.06 (1.02-1.10)	.004	.16
Yes	1594/7391	1.15 (1.06-1.26)	<.001	



BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease.

[a] Cohort-stratified cause-specific hazard models were used. Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, unprocessed red meat, poultry, and fish, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

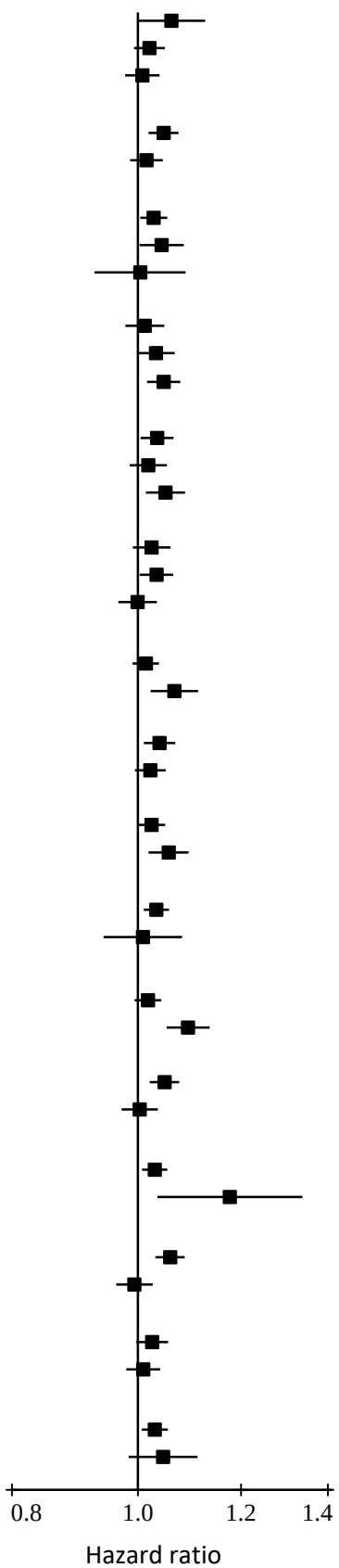
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 2. Association between each additional 2 servings of unprocessed red meat consumed per week and incident CVD among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	298/5210	1.06 (1.00-1.13)	.05	
45-64 years	3649/17025	1.02 (0.99-1.05)	.14	.28
≥65 years	3016/7447	1.01 (0.98-1.04)	.62	
Sex				
Men	3525/13168	1.05 (1.02-1.07)	<.001	.07
Women	3438/16514	1.02 (0.99-1.04)	.31	
Race and ethnicity				
Non-Hispanic white	5228/20581	1.03 (1.00-1.05)	.02	
Non-Hispanic black	1474/7004	1.04 (1.00-1.08)	.04	.64
Other	261/2097	1.00 (0.93-1.09)	.93	
Education level				
Less than high school	1944/5541	1.01 (0.98-1.05)	.49	
High school	2102/8461	1.03 (1.00-1.07)	.06	.26
Some college or more	2917/15680	1.05 (1.02-1.08)	.002	
Smoking status				
Never	3017/14772	1.03 (1.00-1.07)	.02	
Former	2301/8853	1.02 (0.99-1.05)	.28	.39
Current	1645/6057	1.05 (1.01-1.09)	.006	
Weight status				
BMI <25 kg/m^2	2071/11553	1.02 (0.99-1.06)	.16	
25 ≤ BMI <30 kg/m^2	2850/11172	1.03 (1.00-1.06)	.03	.26
BMI ≥30 kg/m^2	2042/6957	1.00 (0.97-1.03)	.98	
Diabetes[b]				
No	5789/27112	1.01 (0.99-1.04)	.24	.02
Yes	1174/2570	1.07 (1.02-1.11)	.003	
Hypertension[c]				
No	2981/19000	1.04 (1.01-1.07)	.007	.34
Yes	3982/10682	1.02 (0.99-1.05)	.11	
Hyperlipidemia[d]				
No	5025/23206	1.02 (1.00-1.05)	.05	.11
Yes	1938/6476	1.06 (1.02-1.09)	.003	
Low lipids[e]				
No	6600/26862	1.03 (1.01-1.06)	.005	.50
Yes	363/2820	1.01 (0.94-1.08)	.81	
Eating a higher quality diet[f]				
No	5574/22262	1.02 (0.99-1.04)	.14	<.001
Yes	1389/7420	1.09 (1.05-1.14)	<.001	
Eating a high saturated fat diet[g]				
No	5257/22342	1.05 (1.02-1.08)	<.001	.02
Yes	1706/7340	1.00 (0.97-1.04)	.85	
Eating a low saturated fat diet[h]				
No	6542/27581	1.03 (1.01-1.05)	.009	.04
Yes	421/2101	1.18 (1.03-1.34)	.01	
Eating high fat diet[i]				
No	5251/22288	1.06 (1.03-1.09)	<.001	<.001
Yes	1712/7394	0.99 (0.96-1.03)	.71	
Eating a high protein diet[j]				
No	4838/22137	1.03 (1.00-1.05)	.08	.38
Yes	2125/7545	1.01 (0.98-1.04)	.53	
Eating a high carbohydrate diet[k]				
No	5369/22291	1.03 (1.01-1.05)	.01	.64
Yes	1594/7391	1.05 (0.98-1.11)	.15	



BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease.

[a] Cohort-stratified cause-specific hazard models were used. Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, processed meat, processed meat squared, poultry, and fish, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

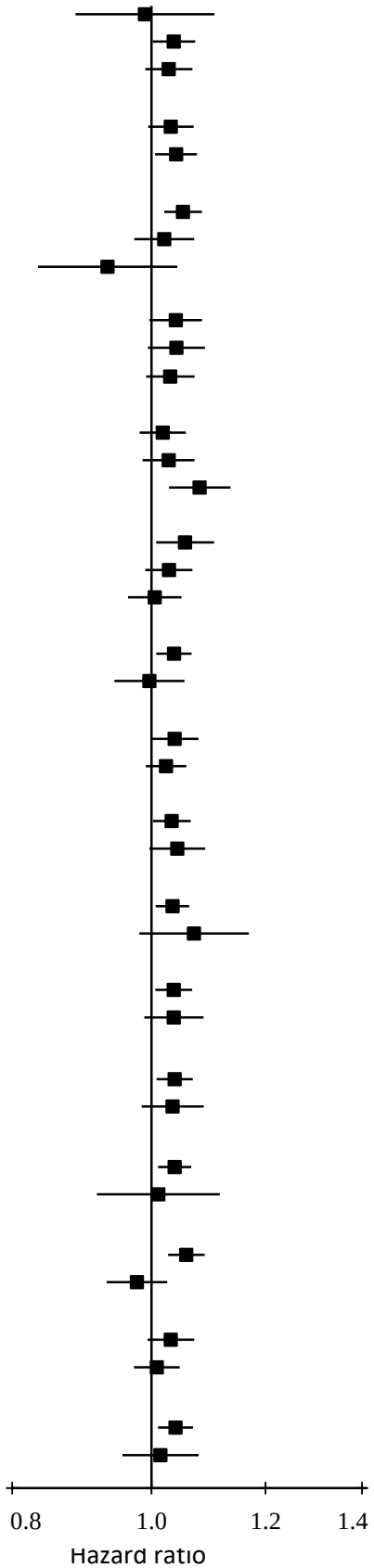
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 3. Association between each additional 2 servings of poultry consumed per week and incident CVD among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	298/5210	0.99 (0.89-1.11)	.85	
45-64 years	3649/17025	1.04 (1.00-1.07)	.04	.72
≥65 years	3016/7447	1.03 (0.99-1.07)	.15	
Sex				
Men	3525/13168	1.03 (0.99-1.07)	.09	.73
Women	3438/16514	1.04 (1.01-1.08)	.02	
Race and ethnicity				
Non-Hispanic white	5228/20581	1.05 (1.02-1.08)	.001	
Non-Hispanic black	1474/7004	1.02 (0.97-1.07)	.41	.08
Other	261/2097	0.93 (0.83-1.04)	.22	
Education level				
Less than high school	1944/5541	1.04 (1.00-1.08)	.07	
High school	2102/8461	1.04 (0.99-1.09)	.09	.93
Some college or more	2917/15680	1.03 (0.99-1.07)	.13	
Smoking status				
Never	3017/14772	1.02 (0.98-1.06)	.34	
Former	2301/8853	1.03 (0.99-1.07)	.20	.13
Current	1645/6057	1.08 (1.03-1.13)	.002	
Weight status				
BMI <25 kg/m^2	2071/11553	1.06 (1.01-1.11)	.02	
25 ≤ BMI <30 kg/m^2	2850/11172	1.03 (0.99-1.07)	.15	.29
BMI ≥30 kg/m^2	2042/6957	1.01 (0.96-1.05)	.82	
Diabetes[b]				
No	5789/27112	1.04 (1.01-1.07)	.01	.20
Yes	1174/2570	1.00 (0.94-1.05)	.91	
Hypertension[c]				
No	2981/19000	1.04 (1.00-1.08)	.06	.56
Yes	3982/10682	1.02 (0.99-1.06)	.16	
Hyperlipidemia[d]				
No	5025/23206	1.03 (1.00-1.06)	.03	.73
Yes	1938/6476	1.04 (1.00-1.09)	.07	
Low lipids[e]				
No	6600/26862	1.03 (1.01-1.06)	.01	.45
Yes	363/2820	1.07 (0.98-1.17)	.13	
Eating a higher quality diet[f]				
No	5574/22262	1.04 (1.01-1.07)	.02	.99
Yes	1389/7420	1.04 (0.99-1.09)	.14	
Eating a high saturated fat diet[g]				
No	5257/22342	1.04 (1.01-1.07)	.01	.91
Yes	1706/7340	1.03 (0.98-1.09)	.18	
Eating a low saturated fat diet[h]				
No	6542/27581	1.04 (1.01-1.07)	.01	.61
Yes	421/2101	1.01 (0.92-1.12)	.83	
Eating high fat diet[i]				
No	5251/22288	1.06 (1.03-1.09)	<.001	.004
Yes	1712/7394	0.98 (0.93-1.03)	.34	
Eating a high protein diet[j]				
No	4838/22137	1.03 (0.99-1.07)	.10	.37
Yes	2125/7545	1.01 (0.97-1.05)	.65	
Eating a high carbohydrate diet[k]				
No	5369/22291	1.04 (1.01-1.07)	.01	.46
Yes	1594/7391	1.01 (0.95-1.08)	.65	



BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease.

[a] Cohort-stratified cause-specific hazard models were used. Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, processed meat, processed meat squared, unprocessed red meat, and fish, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

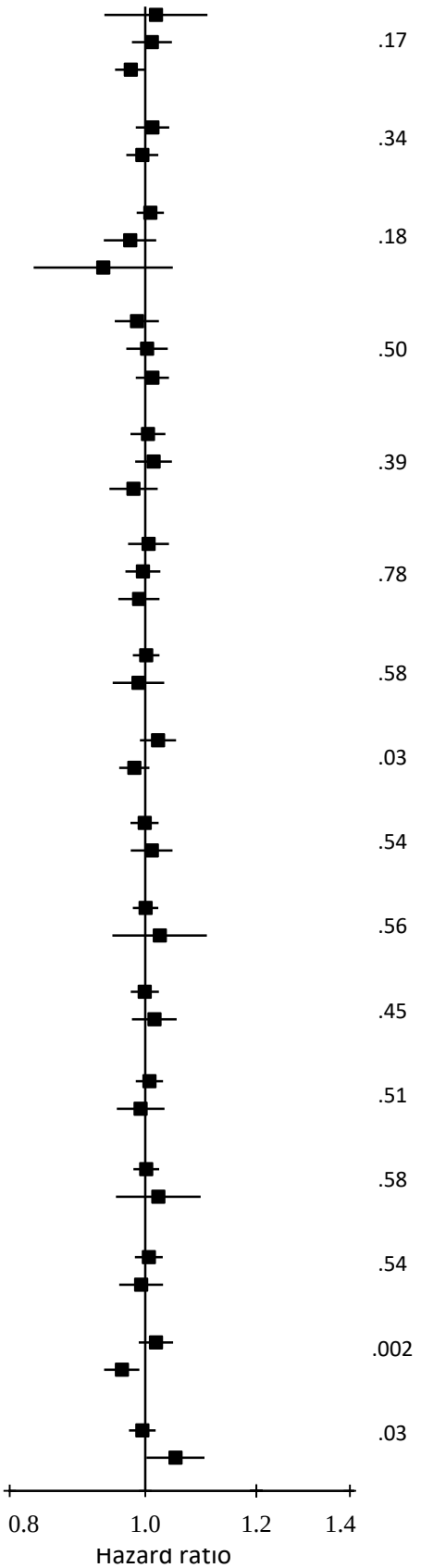
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 4. Association between each additional 2 servings of fish consumed per week and incident CVD among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* for interaction
Age				
<45 years	298/5210	1.02 (0.94-1.11)	.69	
45-64 years	3649/17025	1.01 (0.98-1.04)	.52	.17
≥65 years	3016/7447	0.98 (0.95-1.00)	.06	
Sex				
Men	3525/13168	1.01 (0.98-1.04)	.40	.34
Women	3438/16514	0.99 (0.97-1.02)	.70	
Race and ethnicity				
Non-Hispanic white	5228/20581	1.01 (0.99-1.03)	.48	
Non-Hispanic black	1474/7004	0.98 (0.93-1.02)	.25	.18
Other	261/2097	0.93 (0.83-1.05)	.24	
Education level				
Less than high school	1944/5541	0.99 (0.95-1.02)	.45	
High school	2102/8461	1.00 (0.97-1.04)	.87	.50
Some college or more	2917/15680	1.01 (0.98-1.04)	.41	
Smoking status				
Never	3017/14772	1.00 (0.98-1.03)	.78	
Former	2301/8853	1.01 (0.98-1.04)	.38	.39
Current	1645/6057	0.98 (0.94-1.02)	.34	
Weight status				
BMI <25 kg/m^2	2071/11553	1.01 (0.97-1.04)	.76	
25 ≤ BMI <30 kg/m^2	2850/11172	1.00 (0.97-1.03)	.78	.78
BMI ≥30 kg/m^2	2042/6957	0.99 (0.96-1.02)	.54	
Diabetes[b]				
No	5789/27112	1.00 (0.98-1.02)	.90	.58
Yes	1174/2570	0.99 (0.95-1.03)	.60	
Hypertension[c]				
No	2981/19000	1.02 (0.99-1.05)	.17	.03
Yes	3982/10682	0.98 (0.96-1.01)	.15	
Hyperlipidemia[d]				
No	5025/23206	1.00 (0.98-1.02)	.91	.54
Yes	1938/6476	1.01 (0.98-1.05)	.55	
Low lipids[e]				
No	6600/26862	1.00 (0.98-1.02)	.98	.56
Yes	363/2820	1.02 (0.95-1.11)	.55	
Eating a higher quality diet[f]				
No	5574/22262	1.00 (0.98-1.02)	.93	.45
Yes	1389/7420	1.01 (0.98-1.05)	.43	
Eating a high saturated fat diet[g]				
No	5257/22342	1.01 (0.98-1.03)	.56	.51
Yes	1706/7340	0.99 (0.95-1.03)	.70	
Eating a low saturated fat diet[h]				
No	6542/27581	1.00 (0.98-1.02)	.89	.58
Yes	421/2101	1.02 (0.95-1.10)	.55	
Eating high fat diet[i]				
No	5251/22288	1.01 (0.98-1.03)	.63	.54
Yes	1712/7394	0.99 (0.96-1.03)	.71	
Eating a high protein diet[j]				
No	4838/22137	1.02 (0.99-1.05)	.23	.002
Yes	2125/7545	0.96 (0.93-0.99)	.008	
Eating a high carbohydrate diet[k]				
No	5369/22291	1.00 (0.97-1.02)	.66	.03
Yes	1594/7391	1.05 (1.00-1.10)	.04	



BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease.

[a] Cohort-stratified cause-specific hazard models were used. Incident CVD included fatal and nonfatal coronary heart disease, fatal and nonfatal stroke, fatal and nonfatal heart failure, and other CVD deaths. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, processed meat, processed meat squared, unprocessed red meat, and poultry, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

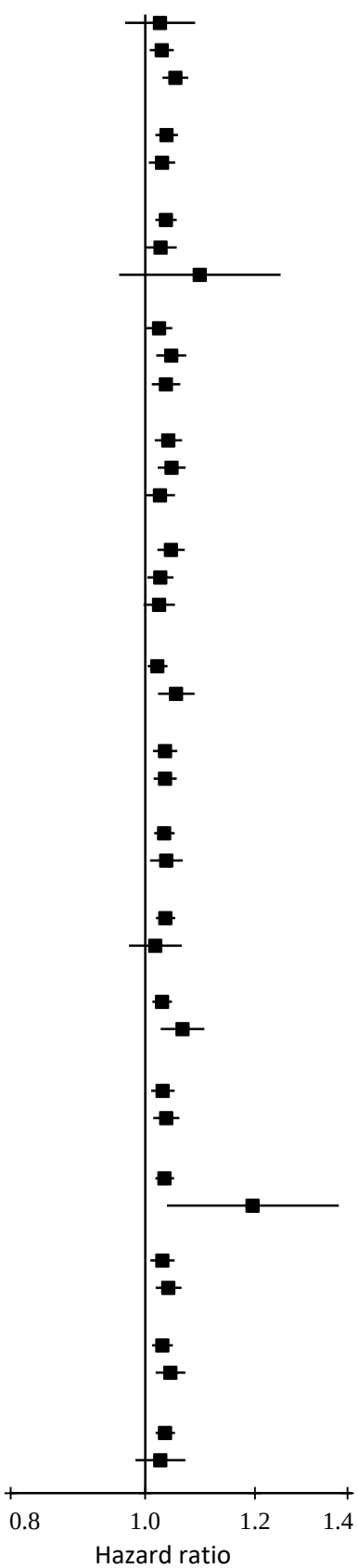
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 5. Association between each additional 2 servings of processed meat consumed per week and all-cause mortality among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	409/5210	1.03 (0.97-1.09)	.40	
45-64 years	4041/17025	1.03 (1.01-1.05)	.007	.23
≥65 years	4425/7447	1.05 (1.03-1.07)	<.001	
Sex				
Men	4439/13168	1.04 (1.02-1.06)	<.001	.58
Women	4436/16514	1.03 (1.01-1.05)	.01	
Race and ethnicity				
Non-Hispanic white	6668/20581	1.04 (1.02-1.05)	<.001	
Non-Hispanic black	1862/7004	1.03 (1.00-1.05)	.05	.59
Other	345/2097	1.10 (0.96-1.25)	.19	
Education level				
Less than high school	2525/5541	1.02 (1.00-1.05)	.04	
High school	2609/8461	1.04 (1.02-1.07)	<.001	.43
Some college or more	3741/15680	1.04 (1.01-1.06)	.004	
Smoking status				
Never	3805/14772	1.04 (1.02-1.06)	<.001	
Former	2877/8853	1.05 (1.02-1.07)	<.001	.47
Current	2193/6057	1.03 (1.00-1.05)	.04	
Weight status				
BMI <25 kg/m^2	3150/11553	1.04 (1.02-1.07)	<.001	
25 ≤ BMI <30 kg/m^2	3509/11172	1.03 (1.00-1.05)	.02	.37
BMI ≥30 kg/m^2	2216/6957	1.02 (1.00-1.05)	.08	
Diabetes[b]				
No	7501/27112	1.02 (1.00-1.04)	.02	.06
Yes	1374/2570	1.05 (1.02-1.09)	<.001	
Hypertension[c]				
No	4024/19000	1.03 (1.01-1.05)	.001	.99
Yes	4851/10682	1.03 (1.01-1.05)	<.001	
Hyperlipidemia[d]				
No	6555/23206	1.03 (1.02-1.05)	<.001	.82
Yes	2320/6476	1.04 (1.01-1.06)	.01	
Low lipids[e]				
No	8229/26862	1.03 (1.02-1.05)	<.001	.46
Yes	646/2820	1.02 (0.97-1.06)	.45	
Eating a higher quality diet[f]				
No	7051/22262	1.03 (1.01-1.05)	<.001	.07
Yes	1824/7420	1.06 (1.03-1.10)	<.001	
Eating a high saturated fat diet[g]				
No	6677/22342	1.03 (1.01-1.05)	.003	.68
Yes	2198/7340	1.04 (1.01-1.06)	.002	
Eating a low saturated fat diet[h]				
No	8294/27581	1.03 (1.02-1.05)	<.001	.04
Yes	581/2101	1.20 (1.04-1.38)	.01	
Eating high fat diet[i]				
No	6654/22288	1.03 (1.01-1.05)	.005	.46
Yes	2221/7394	1.04 (1.02-1.06)	<.001	
Eating a high protein diet[j]				
No	6301/22137	1.03 (1.01-1.05)	.001	.33
Yes	2574/7545	1.04 (1.02-1.07)	<.001	
Eating a high carbohydrate diet[k]				
No	6806/22291	1.03 (1.02-1.05)	<.001	.71
Yes	2069/7391	1.03 (0.98-1.07)	.23	



BMI, body mass index; CI, confidence interval.

[a] Cohort-stratified standard proportional hazards models were used. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, unprocessed red meat, poultry, and fish, where relevant. Models were further stratified by age groups, sex, and race and ethnicity to satisfy proportional hazards assumption.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

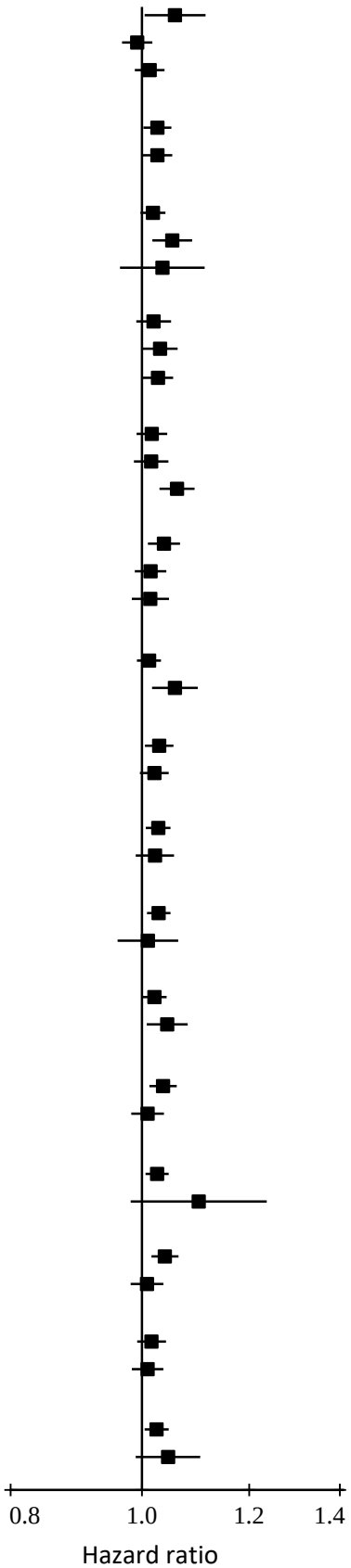
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 6. Association between each additional 2 servings of unprocessed red meat consumed per week and all-cause mortality among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	409/5210	1.06 (1.00-1.11)	.03	
45-64 years	4041/17025	0.99 (0.97-1.02)	.55	.06
≥65 years	4425/7447	1.01 (0.99-1.04)	.30	
Sex				
Men	4439/13168	1.03 (1.00-1.05)	.03	.99
Women	4436/16514	1.03 (1.00-1.05)	.04	
Race and ethnicity				
Non-Hispanic white	6668/20581	1.02 (1.00-1.04)	.08	
Non-Hispanic black	1862/7004	1.05 (1.02-1.09)	.003	.18
Other	345/2097	1.04 (0.96-1.11)	.34	
Education level				
Less than high school	2525/5541	1.02 (0.99-1.05)	.19	
High school	2609/8461	1.03 (1.00-1.06)	.04	.84
Some college or more	3741/15680	1.03 (1.00-1.05)	.04	
Smoking status				
Never	3805/14772	1.02 (0.99-1.04)	.20	
Former	2877/8853	1.02 (0.99-1.05)	.29	.03
Current	2193/6057	1.06 (1.03-1.09)	<.001	
Weight status				
BMI <25 kg/m^2	3150/11553	1.04 (1.01-1.07)	.007	
25 ≤ BMI <30 kg/m^2	3509/11172	1.01 (0.99-1.04)	.28	.33
BMI ≥30 kg/m^2	2216/6957	1.01 (0.98-1.05)	.37	
Diabetes[b]				
No	7501/27112	1.01 (0.99-1.03)	.24	.03
Yes	1374/2570	1.06 (1.02-1.10)	.005	
Hypertension[c]				
No	4024/19000	1.03 (1.01-1.06)	.02	.59
Yes	4851/10682	1.02 (1.00-1.05)	.09	
Hyperlipidemia[d]				
No	6555/23206	1.03 (1.01-1.05)	.01	.76
Yes	2320/6476	1.02 (0.99-1.06)	.18	
Low lipids[e]				
No	8229/26862	1.03 (1.01-1.05)	.005	.49
Yes	646/2820	1.01 (0.96-1.06)	.70	
Eating a higher quality diet[f]				
No	7051/22262	1.02 (1.00-1.04)	.05	.24
Yes	1824/7420	1.04 (1.01-1.08)	.02	
Eating a high saturated fat diet[g]				
No	6677/22342	1.04 (1.01-1.06)	.002	.11
Yes	2198/7340	1.01 (0.98-1.04)	.48	
Eating a low saturated fat diet[h]				
No	8294/27581	1.03 (1.01-1.05)	.01	.23
Yes	581/2101	1.10 (0.98-1.24)	.10	
Eating high fat diet[i]				
No	6654/22288	1.04 (1.02-1.06)	.001	.06
Yes	2221/7394	1.01 (0.98-1.04)	.54	
Eating a high protein diet[j]				
No	6301/22137	1.02 (0.99-1.04)	.19	.67
Yes	2574/7545	1.01 (0.98-1.04)	.47	
Eating a high carbohydrate diet[k]				
No	6806/22291	1.03 (1.00-1.05)	.02	.49
Yes	2069/7391	1.05 (0.99-1.10)	.11	



BMI, body mass index; CI, confidence interval.

[a] Cohort-stratified standard proportional hazards models were used. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, processed meat, poultry, and fish, where relevant. Models were further stratified by sex to satisfy proportional hazards assumption.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

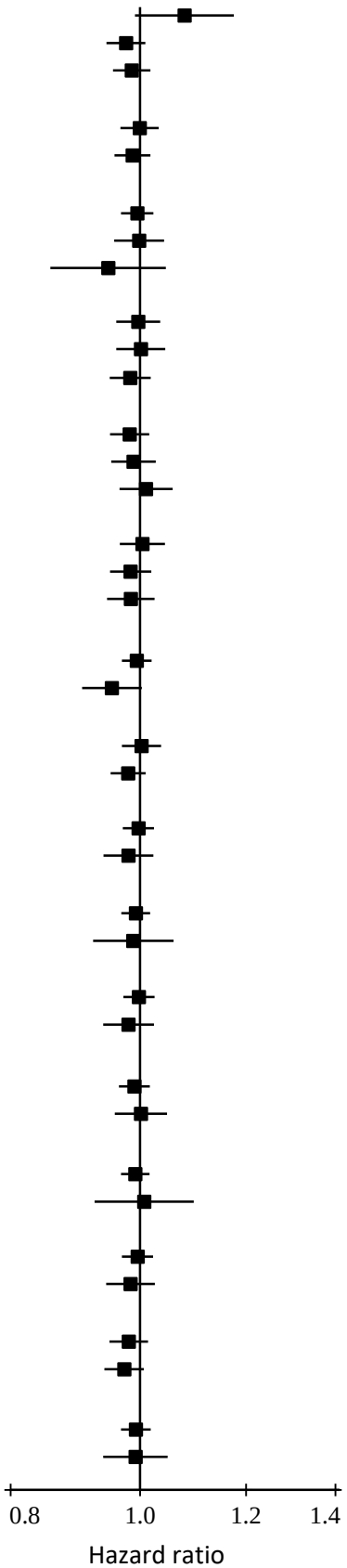
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 7. Association between each additional 2 servings of poultry consumed per week and all-cause mortality among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	409/5210	1.08 (0.99-1.18)	.08	
45-64 years	4041/17025	0.98 (0.94-1.01)	.16	.09
≥65 years	4425/7447	0.99 (0.95-1.02)	.38	
Sex				
Men	4439/13168	1.00 (0.97-1.03)	.96	.57
Women	4436/16514	0.99 (0.96-1.02)	.40	
Race and ethnicity				
Non-Hispanic white	6668/20581	1.00 (0.97-1.02)	.73	
Non-Hispanic black	1862/7004	1.00 (0.96-1.04)	.94	.61
Other	345/2097	0.95 (0.86-1.05)	.28	
Education level				
Less than high school	2525/5541	1.00 (0.96-1.04)	.87	
High school	2609/8461	1.00 (0.96-1.04)	.95	.77
Some college or more	3741/15680	0.98 (0.95-1.02)	.35	
Smoking status				
Never	3805/14772	0.98 (0.95-1.02)	.30	
Former	2877/8853	0.99 (0.95-1.03)	.57	.60
Current	2193/6057	1.01 (0.97-1.06)	.66	
Weight status				
BMI <25 kg/m^2	3150/11553	1.00 (0.97-1.04)	.85	
25 ≤ BMI <30 kg/m^2	3509/11172	0.98 (0.95-1.02)	.37	.69
BMI ≥30 kg/m^2	2216/6957	0.98 (0.94-1.03)	.45	
Diabetes[b]				
No	7501/27112	0.99 (0.97-1.02)	.67	.13
Yes	1374/2570	0.95 (0.90-1.00)	.06	
Hypertension[c]				
No	4024/19000	1.00 (0.97-1.04)	.89	.29
Yes	4851/10682	0.98 (0.95-1.01)	.18	
Hyperlipidemia[d]				
No	6555/23206	1.00 (0.97-1.02)	.83	.49
Yes	2320/6476	0.98 (0.94-1.02)	.36	
Low lipids[e]				
No	8229/26862	0.99 (0.97-1.02)	.56	.91
Yes	646/2820	0.99 (0.92-1.06)	.74	
Eating a higher quality diet[f]				
No	7051/22262	1.00 (0.97-1.03)	.88	.48
Yes	1824/7420	0.98 (0.94-1.02)	.37	
Eating a high saturated fat diet[g]				
No	6677/22342	0.99 (0.96-1.02)	.47	.66
Yes	2198/7340	1.00 (0.96-1.05)	.95	
Eating a low saturated fat diet[h]				
No	8294/27581	0.99 (0.97-1.02)	.50	.73
Yes	581/2101	1.01 (0.92-1.10)	.87	
Eating high fat diet[i]				
No	6654/22288	1.00 (0.97-1.02)	.75	.62
Yes	2221/7394	0.98 (0.94-1.03)	.44	
Eating a high protein diet[j]				
No	6301/22137	0.98 (0.95-1.01)	.25	.73
Yes	2574/7545	0.97 (0.94-1.01)	.12	
Eating a high carbohydrate diet[k]				
No	6806/22291	0.99 (0.97-1.02)	.57	.98
Yes	2069/7391	0.99 (0.94-1.05)	.78	



BMI, body mass index; CI, confidence interval.

[a] Cohort-stratified standard proportional hazards models were used. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, unprocessed red meat, processed meat, and fish, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

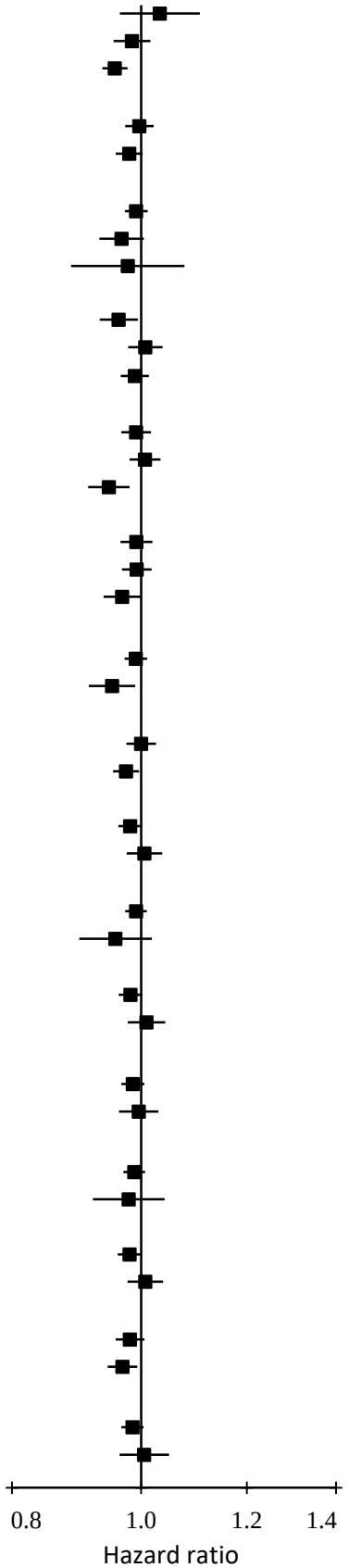
[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).

eFigure 8. Association between each additional 2 servings of fish consumed per week and all-cause mortality among different subgroups

Subgroups	Events/total	Hazard ratio (95% CI)[a]	*P* value	*P* value for interaction
Age				
<45 years	409/5210	1.03 (0.96-1.11)	.36	
45-64 years	4041/17025	0.98 (0.95-1.02)	.32	.05
≥65 years	4425/7447	0.96 (0.93-0.98)	<.001	
Sex				
Men	4439/13168	1.00 (0.97-1.02)	.79	.26
Women	4436/16514	0.98 (0.96-1.00)	.08	
Race and ethnicity				
Non-Hispanic white	6668/20581	0.99 (0.97-1.01)	.40	
Non-Hispanic black	1862/7004	0.97 (0.93-1.00)	.08	.47
Other	345/2097	0.98 (0.89-1.08)	.64	
Education level				
Less than high school	2525/5541	0.96 (0.93-0.99)	.02	
High school	2609/8461	1.01 (0.98-1.04)	.65	.10
Some college or more	3741/15680	0.99 (0.97-1.01)	.38	
Smoking status				
Never	3805/14772	0.99 (0.97-1.02)	.50	
Former	2877/8853	1.01 (0.98-1.03)	.64	.01
Current	2193/6057	0.95 (0.91-0.98)	.002	
Weight status				
BMI <25 kg/m^2	3150/11553	0.99 (0.96-1.02)	.56	
25 ≤ BMI <30 kg/m^2	3509/11172	0.99 (0.97-1.02)	.55	.38
BMI ≥30 kg/m^2	2216/6957	0.97 (0.94-1.00)	.05	
Diabetes[b]				
No	7501/27112	0.99 (0.97-1.01)	.34	.06
Yes	1374/2570	0.95 (0.91-0.99)	.01	
Hypertension[c]				
No	4024/19000	1.00 (0.97-1.03)	.99	.09
Yes	4851/10682	0.97 (0.95-1.00)	.02	
Hyperlipidemia[d]				
No	6555/23206	0.98 (0.96-1.00)	.07	.16
Yes	2320/6476	1.01 (0.98-1.04)	.73	
Low lipids[e]				
No	8229/26862	0.99 (0.97-1.01)	.34	.28
Yes	646/2820	0.96 (0.90-1.02)	.17	
Eating a higher quality diet[f]				
No	7051/22262	0.98 (0.96-1.00)	.08	.13
Yes	1824/7420	1.01 (0.98-1.04)	.59	
Eating a high saturated fat diet[g]				
No	6677/22342	0.99 (0.97-1.01)	.15	.59
Yes	2198/7340	1.00 (0.96-1.03)	.79	
Eating a low saturated fat diet[h]				
No	8294/27581	0.99 (0.97-1.01)	.21	.76
Yes	581/2101	0.98 (0.92-1.04)	.49	
Eating high fat diet[i]				
No	6654/22288	0.98 (0.96-1.00)	.06	.12
Yes	2221/7394	1.01 (0.98-1.04)	.65	
Eating a high protein diet[j]				
No	6301/22137	0.98 (0.96-1.01)	.12	.42
Yes	2574/7545	0.97 (0.94-0.99)	.01	
Eating a high carbohydrate diet[k]				
No	6806/22291	0.98 (0.97-1.00)	.12	.37
Yes	2069/7391	1.01 (0.96-1.05)	.81	



BMI, body mass index; CI, confidence interval.

[a] Cohort-stratified standard proportional hazards models were used. Adjustment covariates included age, sex, race and ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, Chinese, other), education (<high school, high school, some college or more), total energy, smoking status (current, former, never), smoking pack-years (0, 0.1-4.9, 5.0-9.9, 10-19.9, 20-29.9, 30-39.9, ≥40), cohort-specific physical activity z score, alcohol intake (gram), hormone therapy (y/n), fruits, legumes, potatoes, other vegetables excluding legumes and potatoes, nuts and seeds, whole grains, refined grains, low-fat dairy products, high-fat dairy products, sugar-sweetened beverages, eggs, unprocessed red meat, processed meat, and poultry, where relevant.

[b] Fasting glucose ≥126 mg/dL or HbA1c ≥6.5% or taking glucose-lowering drugs.

[c] Blood pressure ≥140/90 mm Hg or taking antihypertensive drugs.

[d] Total cholesterol ≥240 mg/dL or taking lipid-lowering drugs.

[e] Low density lipoprotein cholesterol <70 mg/dL or non-high density lipoprotein cholesterol <100 mg/dL, among those who did not take lipid-lowering drugs.

[f] Alternate Healthy Eating Index 2010 score in the highest quartile (a score of 51.1 or higher). The original version of the aHEI-2010 score has a range of 0-110 points. The aHEI-2010 score in this study had a range of 0-100 points due to the removal of the meat item.

[g] Percent of energy consumed from saturated fat in the highest quartile (14% or higher).

[h] Percent of energy consumed from saturated fat <7%.

[i] Percent of energy consumed from fat in the highest quartile (37.9% or higher).

[j] Percent of energy consumed from protein in the highest quartile (18.9% or higher).

[j] Percent of energy consumed from carbohydrates in the highest quartile (55.4% or higher).