SUPPLEMENTAL MATERIAL

Table S1. Definition of cardiovascular health metrics according to the American Heart Association for ascertainment of cardiovascular health status.

Metric	Optimal	Intermediate	Poor
	2 point	1 point	0 point
Smoking	Never or quit ≥12 months	Quit <12 months	Current smokers
Body mass index	<25 kg/m^2	25-29.9 kg/m^2	≥30 kg/m^2
Physical activity [a]	≥75 min/week of vigorous activity, ≥150 min/week of moderate activity or a combination of the two	1–74 min/week vigorous activity, 1–149 min/week moderate activity or a combination of the two	None
Blood pressure [b]	<120/80 mmHg, untreated	<120/80 mmHg on treatment or 120-139/80-89 mmHg	≥140/90 mmHg
Fasting glucose [c]	<100 mg/dL, untreated	100-126 mg/dL or <100 mg/dL treated	≥126 mg/dL
Total cholesterol [c]	200mg/dL, untreated	200-240 mg/dL or <200mg/dL treated	>240 mg/dL

a. Physical activity was assessed using questions on frequency and duration of participation in mildly energetic (e.g., weeding, general housework, bicycle repair), moderately energetic (e.g., dancing, cycling, leisurely swimming), and vigorous physical activity (e.g., running, hard swimming, playing squash).

b. Systolic blood pressure was measured twice with a sphygmomanometer in the sitting position after 5 min rest, and the average of the two readings was used in the present analyses.

c. Fasting blood glucose and total cholesterol were measured using standardized methods.

SI conversion factor: To convert cholesterol to millimoles per liter, multiply by 0.0259.

SI conversion factor: To convert glucose to millimoles per liter, multiply by 0.0555.

Table S2. Definitions and ICD-10 codes used for defining the comorbidities and clinical outcomes.

	Definitions	ICD-10 codes or conditions
Comorbidities		
Atrial fibrillation [12,14,30]	Defined from diagnosis*	ICD-10: I48
Heart failure [14,30]	Defined from diagnosis*	ICD-10: I11.0, I50, I97.1
Hypertension [14,15,30]	Defined from diagnosis*	ICD-10: I10, I11, I12, I13, I15 and antihypertensive medication
Diabetes mellitus [14,30]	Defined from diagnosis* plus treatment	ICD-10: E10, E11, E12, E13, E14 Treatment: all kinds of oral antidiabetics and insulin.
Dyslipidemia [14,30]	Defined from diagnosis*	ICD-10: E78
Ischemic stroke [14,30]	Defined from diagnosis*	ICD-10: I63, I64
Transient ischemic attack [14,30]	Defined from diagnosis*	ICD-10: G45
Hemorrhagic stroke	Defined from diagnosis*	ICD-10: I60, I61, I62
Myocardial infarction [31]	Defined from diagnosis*	ICD-10: I21, I22, I25.2
Coronary heart disease	Defined from a history of acute myocardial infarction, coronary revascularization, or chronic ischemic heart disease.	Acute myocardial infarction: admission diagnosis (ICD-10: I21, I22) concurrently with coronary angiography (HA670, HA680, HA681) Coronary revascularization: percutaneous coronary intervention (M6551, M6552, M6561, M6563, M6562, M6564, M6571, M6572), thrombolytic treatment (M6634), or coronary artery bypass graft (O1641, OA641, O1642, OA642, O1647, OA647) Chronic ischemic heart disease: diagnosis* (ICD-10: I25.2, I25.5, I25.6, I25.8, I25.9)
Peripheral arterial disease [14,30]	Defined from diagnosis*	ICD-10: I70.0, I70.1, I70.2, I70.8, I70.9
Chronic kidney disease [14,30]	Defined from eGFR or diagnosis* (if laboratory value was not available, diagnosis code was used)	eGFR <60 mL/min per 1.73 m^2 ICD-10: N18, N19
End-stage renal disease [32]	Defined from national registry for severe illness.	Patients with end-stage renal disease undergoing chronic dialysis or received a kidney transplant.
Hypertrophic cardiomyopathy [33]	Defined from at least one records of either inpatient or outpatient diagnoses	ICD-10: I42.1, I42.2
Sleep apnea	Defined from diagnosis*	ICD-10: G47.3
Proteinuria	Defined from laboratory data (if laboratory value was not available, diagnosis code was used)	Urine dipstick proteinuria 1+ or higher (ICD-10: N06, N391, N392, R80)

Osteoporosis [34]	Defined from diagnosis*	ICD-10: M80, M81, M82 (except M82.0)
Hyperthyroidism	Defined from diagnosis*	ICD-10: E05
Hypothyroidism	Defined from diagnosis*	ICD-10: E03
Chronic Liver disease	Defined from diagnosis of chronic liver disease, cirrhosis, and hepatitis	ICD-10: B18, K70, K71, K72, K73, K74, K76.1
Chronic obstructive pulmonary disease [35]	Defined from diagnosis* plus treatment	ICD-10: J42, J43(except J43.0), J44 Treatment: SABA, SAMA, LABA, LAMA, ICS, ICS+LABA, or methylxanthine (>1 months).
Malignancy	Defined from diagnoses of cancer (non-benign)	ICD-10: C00-C97
Clinical outcomes		
Coronary heart disease	Defined from an event of acute myocardial infarction, coronary revascularization, or death of which the cause was recorded as a coronary artery disease or myocardial infarction	Acute myocardial infarction: admission diagnosis (ICD-10: I21, I22) concurrently with coronary angiography (HA670, HA680, HA681) Coronary revascularization: percutaneous coronary intervention (M6551, M6552, M6561, M6563, M6562, M6564, M6571, M6572), thrombolytic treatment (M6634), or coronary artery bypass graft (O1641, OA641, O1642, OA642, O1647, OA647) Coronary artery disease or myocardial infarction: ICD-10: I20, I21, I22, I23, I25
Ischemic stroke [12, 30]	Defined from any discharge diagnoses with concomitant imaging studies	ICD-10: I63, I64
Systemic embolism	Defined from admission diagnosis or related death	ICD-10: I74, N280 (including renal infarction)

Abbreviations: eGFR, estimated glomerular filtration rate; ICD-10, International Classification of Diseases-10th Revision.

*To ensure accuracy, comorbidities were established based on one inpatient or two outpatient records of ICD-10 codes in the database.

Table S3. Characteristics and cardiovascular health status at baseline and follow-up.

Characteristics	1st (n=208,673)	2nd (n=109,431)	3rd (n=119,826)	4th (n=92,731)	5th (n=34,265)
Age, mean (SD), year	70.6 (5.4)	72.5 (4.4)	73.1 (4.5)	74.4 (4.2)	75.6 (3.9)
Men	88671 (42.5)	44867 (41.0)	52484 (43.8)	44604 (48.1)	18263 (53.3)
Economic status, 0-10	7 (4, 9)	7 (4, 9)	8 (4, 9)	8 (4, 9)	8 (4, 9)
Low, 0-4	65564 (31.4)	33793 (29.9)	31813 (27.4)	23504 (26.1)	8679 (26.0)
Middle, 5-7	48104 (23.1)	24715 (21.9)	25416 (21.9)	19170 (21.3)	6745 (20.2)
High, 8-10	95005 (45.5)	54372 (48.2)	58715 (50.6)	47348 (52.6)	17911 (53.7)
Living area					
Small city or rural area	126996 (60.9)	65923 (58.4)	71273 (61.5)	58135 (64.6)	21319 (64.0)
Metropolitan city	81677 (39.1)	46957 (41.6)	44671 (38.5)	31887 (35.4)	12016 (36.0)
Hypertension	90995 (43.6)	59834 (58.1)	66663 (59.8)	56099 (64.5)	22009 (68.2)
Diabetes mellitus	28664 (13.7)	18134 (16.1)	20601 (17.8)	17694 (19.7)	7060 (21.2)
Dyslipidemia	63800 (30.6)	46957 (41.6)	57936 (50.0)	51774 (57.5)	20538 (61.6)
Osteoporosis	60875 (29.2)	42228 (37.4)	49993 (43.1)	43267 (48.1)	16697 (50.1)
CVH status, No. of ideal metrics [a]					
Low, 0-2	85729 (41.1)	44096 (40.3)	32602 (28.4)	23604 (26.3)	8509 (25.6)
Moderate, 3-4	111048 (53.2)	59028 (53.9)	67736 (58.9)	54012 (60.1)	20090 (60.4)
High, 5-6	11896 (5.7)	6307 (5.8)	14641 (12.7)	12283 (13.7)	4685 (14.1)
No. of ideal metrics, Median (IQR) [a]	3 (2, 4)	3 (2,4)	3 (2,4)	3 (2,4)	3 (2,4)
12-Point CVH score, Median (IQR) [b]	7 (6, 9)	8 (6,9)	9 (7,10)	9 (8,10)	9 (8,10)

Abbreviations: CVH, cardiovascular health; IQR, interquartile range, SD, standard deviation.

Values are reported as No. (%) unless otherwise indicated.

a. The cardiovascular health metrics included nonsmoking, body weight, physical activity, blood pressure, fasting blood glucose, and total cholesterol.

b. The continuous 12-point CVH score (range, higher score indicating higher CVH) was calculated by assigning 0 (poor), 1 (intermediate), and 2 (ideal) points to each of the 6 metrics and summing them.

Table S4. The time to cardiovascular disease and all-cause mortality according to measures of baseline cardiovascular health.

	The Time (years) to Cardiovascular Disease			The Time (years) to All-Cause Mortality		
	60~74 years (No./Total No.= 14,260/173,109)	≥ 75 years (No./Total No.= 6,234/45,379)	p-value	60~74 years (No./Total No.= 15,641/173,109)	≥ 75 years (No./Total No.= 11,507/45,379)	p-value
CVH status, No. of ideal metrics						
Low, 0-2	2.7 [1.2; 4.2]	2.6 [1.4; 4.0]	0.627	3.2 [1.8; 4.6]	3.2 [1.8; 4.7]	0.792
Moderate, 3-4	2.9 [1.4; 4.3]	2.5 [1.2; 4.1]	0.001	3.3 [2.0; 4.7]	3.1 [1.7; 4.4]	0.001
High, 5-6	2.6 [1.3; 4.2]	2.6 [1.5; 4.2]	0.963	3.4 [1.8; 4.8]	2.8 [1.6; 4.3]	0.139
CVH status per No. of ideal metrics						
0	2.5 [1.1; 3.9]	2.6 [1.4; 4.4]	0.614	3.6 [2.1; 4.7]	3.4 [1.3; 4.9]	0.611
1	2.6 [1.2; 4.1]	2.8 [1.3; 4.0]	0.714	3.3 [1.8; 4.6]	3.5 [1.8; 4.7]	0.423
2	2.7 [1.3; 4.2]	2.6 [1.4; 4.0]	0.623	3.2 [1.8; 4.6]	3.1 [1.8; 4.6]	0.566
3	2.8 [1.4; 4.3]	2.4 [1.2; 4.1]	0.003	3.3 [2.0; 4.7]	3.1 [1.7; 4.4]	0.001
4	2.9 [1.4; 4.4]	2.8 [1.3; 4.0]	0.108	3.4 [1.9; 4.7]	3.2 [1.8; 4.4]	0.018
5 & 6	2.6 [1.3; 4.2]	2.6 [1.5; 4.2]	0.963	3.4 [1.8; 4.8]	2.8 [1.6; 4.3]	0.139
CVH status per points on the CVH score						
≤4	2.6 [1.3; 4.1]	2.7 [1.4; 4.0]	0.724	3.4 [1.9; 4.7]	3.6 [1.7; 4.7]	0.927
5 or 6	2.8 [1.3; 4.2]	2.6 [1.2; 3.9]	0.070	3.3 [1.9; 4.7]	3.2 [1.8; 4.6]	0.365
7 or 8	2.8 [1.4; 4.3]	2.6 [1.3; 4.1]	0.081	3.3 [1.9; 4.7]	3.1 [1.8; 4.5]	0.037
9 or 10	2.8 [1.3; 4.4]	2.5 [1.3; 4.1]	0.375	3.3 [1.9; 4.6]	3.0 [1.6; 4.3]	0.003
≥11	2.3 [1.0; 3.9]	2.1 [1.4; 3.3]	0.865	3.1 [1.6; 4.8]	2.5 [1.6; 3.9]	0.357

Abbreviations: CVH, cardiovascular health.

Table S5. Time-varying Cox proportional hazard model for incident coronary heart disease and ischemic stroke / systemic embolism as separate outcomes.

	Adjusted Subhazard Ratio [a] (95% CI)				
	CVH Status, No. of Ideal Metrics			Per Additional Ideal Metric	Per 1-Point Increase in the CVH Score
	Low, 0-2	Moderate, 3-4	High, 5-6		
Coronary heart disease					
Elderly (60~74 years) (No./total No.= 6,764/167,317)	1 (Ref)	0.66 (0.56-0.76)	0.80 (0.75-0.86)	0.79 (0.78-0.81)	0.83 (0.81-0.84)
Very-elderly (≥ 75 years) (No./total No.=3,168/41,356)	1 (Ref)	0.81 (0.56-1.18)	0.83 (0.69-0.99)	0.87 (0.84-0.91)	0.88 (0.85-0.90)
Ischemic stroke / systemic embolism					
Elderly (60~74 years) (No./total No.=8,192/167,317)	1 (Ref)	0.86 (0.73-1.01)	0.90 (0.83-0.97)	0.84 (0.82-0.86)	0.85 (0.84-0.86)
Very-elderly (≥ 75 years) (No./total No.= 3,330/41,356)	1 (Ref)	0.70 (0.80-0.97)	0.78 (0.67-0.91)	0.88 (0.84-0.91)	0.87 (0.85-0.89)

Abbreviations: CI, confidence interval; CVH, cardiovascular health.

a. Subhazard ratios were adjusted for sex, age, economic status, Hospital Frailty Score, living in metropolitan cities, and competing risk of death.

Table S6. Time-varying Cox proportional hazard model for cause-specific mortality.

Cause of death	Elderly (60~74 years) (n=167,317)		Very-elderly (≥ 75 years) (n=41,356)	
	No. event	Adjusted HR (95% CI)	No. event	Adjusted HR (95% CI)
Cardiovascular death	2774		2421	
Cardiovascular health status				
Low (0-2 ideal metrics)		1 (Ref)		1 (Ref)
Moderate (3-4 ideal metrics)		0.79 (0.73-0.86)		0.86 (0.79-0.93)
High (5-6 ideal metrics)		0.56 (0.48-0.66)		0.63 (0.52-0.76)
Per additional ideal metric		0.86 (0.83-0.89)		0.90 (0.87-0.93)
Per end-point increase in CVH score		0.84 (0.83-0.86)		0.89 (0.87-0.91)
Cancer	6230		2588	
Cardiovascular health status				
Low (0-2 ideal metrics)		1 (Ref)		1 (Ref)
Moderate (3-4 ideal metrics)		0.97 (0.92-1.03)		1.01 (0.93-1.10)
High (5-6 ideal metrics)		0.84 (0.76-0.93)		1.01 (0.86-1.18)
Per additional ideal metric		0.97 (0.95-0.99)		1.0 (0.97-1.04)
Per end-point increase in CVH score		0.94 (0.93-0.95)		0.97 (0.95-0.99)
Other causes	5434		4778	
Cardiovascular health status				
Low (0-2 ideal metrics)		1 (Ref)		1 (Ref)
Moderate (3-4 ideal metrics)		0.87 (0.82-0.92)		0.95 (0.90-1.01)
High (5-6 ideal metrics)		0.73 (0.66-0.81)		0.73 (0.64-0.83)
Per additional ideal metric		0.93 (0.91-0.95)		0.95 (0.93-0.98)
Per end-point increase in CVH score		0.88 (0.87-0.90)		0.94 (0.92-0.95)

Abbreviations: CI, confidence interval; CVH, cardiovascular health; HR, hazard ratio.

Table S7. Time-varying Cox proportional hazard models for the association between individual cardiovascular health metrics and incident cardiovascular disease and all-cause mortality.

Level of cardiovascular health metric	Adjusted Subhazard Ratio (95% CI) [a]		Adjusted Hazard Ratio (95% CI) [b]	
	Incident cardiovascular disease		All-cause mortality	
	Elderly (60~74 years) (No./Total No.= 14,260/173,109)	Very-elderly (≥ 75 years) (No./Total No.= 6,234/45,379)	Elderly (60~74 years) (No./Total No.= 15,641/173,109)	Very-elderly (≥ 75 years) (No./Total No.= 11,507/45,379)
Smoking				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.79 (0.71-0.87)	0.79 (0.64-0.98)	0.71 (0.67-0.75)	0.71 (0.67-0.75)
Ideal	0.76 (0.71-0.81)	0.73 (0.64-0.83)	0.69 (0.67-0.71)	0.69 (0.67-0.71)
Body mass index				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.91 (0.78-1.04)	0.80 (0.59-1.08)	0.89 (0.80-0.99)	1.0 (0.86-1.18)
Ideal	0.81 (0.70-0.94)	0.87 (0.65-1.16)	1.08 (0.97-1.19)	1.29 (1.10-1.50)
Physical activity				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.82 (0.77-0.87)	0.82 (0.72-0.93)	0.75 (0.72-0.78)	0.92 (0.87-0.97)
Ideal	0.73 (0.68-0.78)	0.80 (0.70-0.92)	0.75 (0.71-0.78)	0.80 (0.75-0.85)
Blood pressure				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.82 (0.77-0.86)	0.87 (0.79-0.96)	0.93 (0.90-0.97)	0.96 (0.92-1.0)
Ideal	0.59 (0.54-0.65)	0.65 (0.53-0.78)	0.87 (0.82-0.91)	0.98 (0.91-1.05)
Total cholesterol				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.79 (0.73-0.85)	0.90 (0.78-1.04)	0.93 (0.88-0.98)	0.97 (0.90-1.03)
Ideal	0.72 (0.67-0.77)	0.87 (0.75-1.01)	1.06 (1.01-1.12)	1.13 (1.06-1.21)
Fasting glucose				
Poor	1 (Ref)	1 (Ref)	1 (Ref)	1 (Ref)
Intermediate	0.71 (0.66-0.77)	0.73 (0.66-0.84)	0.69 (0.65-0.72)	0.76 (0.71-0.80)
Ideal	0.59 (0.55-0.64)	0.67 (0.58-0.77)	0.61 (0.58-0.64)	0.69 (0.65-0.73)

Abbreviations: CI, confidence interval.

a. Each individual cardiovascular health metric was included as a time-varying variable. Subhazard ratios were adjusted for sex, age, economic status, Hospital Frailty Score, living in metropolitan cities, and competing risk of death.

b. Each individual cardiovascular health metric was included as a time-varying variable. Hazard ratios were adjusted for sex, age, economic status, Hospital Frailty Score, and living in metropolitan cities.

Table S8. Baseline characteristics of included and excluded study participants for the analysis of change in cardiovascular health.

Characteristics	Included (N=109431)	Excluded [a]			P-value [b]
		All (N=99242)	Exclusion due to no second examination (N=97566)	Exclusion due to CVD event within interval (N=1676)	
Baseline characteristics					
Age, mean (SD), y	70.4 (4.4)	70.8 (6.3)	70.8 (6.3)	71.3 (4.6)	<0.001
Men	49296 (45.0)	39375 (39.7)	38431 (39.4)	944 (56.3)	<0.001
Economic status, 0-10	7 (4, 9)	7 (4, 9)	7 (4, 9)	7 (4, 9)	0.015
Hypertension	46978 (42.9)	44017 (44.4)	43103 (44.2)	914 (54.5)	<0.001
Diabetes mellitus	14207 (13.0)	14457 (14.6)	14115 (14.5)	342 (20.4)	<0.001
Dyslipidemia	33779 (30.9)	30021 (30.3)	29363 (30.1)	658 (39.3)	<0.001
Chronic kidney disease	1076 (1.0)	1144 (1.2)	1122 (1.1)	22 (1.3)	0.615
Anemia	16376 (15.0)	17420 (17.6)	17179 (17.6)	241 (14.4)	0.001
History of bleeding	2190 (2.0)	2177 (2.2)	2142 (2.2)	35 (2.1)	0.831
Hyperthyroidism	2614 (2.4)	2510 (2.5)	2470 (2.5)	40 (2.4)	0.767
Hypothyroidism	2701 (2.5)	2510 (2.5)	2469 (2.5)	41 (2.4)	0.889
COPD	7048 (6.4)	7176 (7.2)	7020 (7.2)	156 (9.3)	0.001
Liver disease	22698 (20.7)	19677 (19.8)	19271 (19.8)	406 (24.2)	<0.001
Hypertrophic cardiomyopathy	187 (0.2)	174 (0.2)	167 (0.2)	7 (0.4)	0.036
Osteoporosis	32097 (29.3)	28778 (29.0)	28305 (29.0)	473 (28.2)	0.497
Baseline cardiovascular health					
CVH status, No. of ideal metrics [c]					<0.001
Low, 0-2	44096 (40.3)	41633 (42.0)	40828 (41.8)	805 (48.0)	
Moderate, 3-4	59028 (53.9)	52020 (52.4)	51194 (52.5)	826 (49.3)	
High, 5-6	6307 (5.8)	5589 (5.6)	5544 (5.7)	45 (2.7)	
No. of ideal metrics, median (IQR) [c]	3 (2, 4)	3 (2, 4)	3 (2, 4)	3 (2, 3)	<0.001
12-Point CVH score, median (IQR) [d]	8 (6, 9)	7 (6, 9)	7 (6, 9)	7 (6, 8)	<0.001

Abbreviations: COPD, chronic obstructive pulmonary disease; CVD, cardiovascular disease; CVH, cardiovascular health; IQR, interquartile range, SD, standard deviation.

a. Excluded participants are comprised of those who died in the interval (n=248), those who had a CVD event in the interval (n=468), those who dropped out (n=924) and those with incomplete CVH metrics (n=1290).

b. P-value for contrast between included and excluded participants, derived from Pearson, chi-square and t-test where appropriate.

c. The cardiovascular health metrics included nonsmoking, body weight, physical activity, blood pressure, fasting blood glucose, and total cholesterol.

d. The continuous 12-point CVH score (range, higher score indicating higher CVH) was calculated by assigning 0 (poor), 1 (intermediate), and 2 (ideal) points to each of the 6 metrics and summing them.

Table S9. Baseline characteristics by pattern of change in cardiovascular health.

Pattern of change	Low-Low (N=25909)	Low-Mod (N=17331)	Low-High (N=856)	Mod-Low (N=13560)	Mod-Mod (N=39760)	Mod-High (N=5708)	High-Low (N=440)	High-Mod (N=3872)	High-High (N=1995)
Age, mean (SD)	70.2 (4.3)	70.5 (4.4)	70.5 (4.4)	70.3 (4.4)	70.6 (4.5)	70.6 (4.4)	70.8 (4.7)	70.4 (4.4)	70.2 (4.1)
Men	12096 (46.7)	7940 (45.8)	416 (48.6)	6538 (48.2)	17211 (43.3)	2398 (42.0)	232 (52.7)	1658 (42.8)	807 (40.5)
Economic Status, 0-10	7 (3, 9)	7 (4, 9)	7 (4, 9)	7 (3, 9)	7 (4, 9)	7 (4, 9)	7 (4, 9)	7 (4, 9)	8 (4, 9)
Hypertension	15808 (61.0)	8246 (47.6)	159 (18.6)	5943 (43.8)	14934 (37.6)	1040 (18.2)	68 (15.5)	584 (15.1)	196 (9.8)
Diabetes mellitus	7171 (27.7)	2390 (13.8)	19 (2.2)	1522 (11.2)	2963 (7.5)	67 (1.2)	5 (1.1)	53 (1.4)	17 (0.9)
Dyslipidemia	11826 (45.6)	5592 (32.3)	150 (17.5)	4108 (30.3)	10112 (25.4)	974 (17.1)	65 (14.8)	610 (15.8)	342 (17.1)
Chronic kidney disease	348 (1.3)	154 (0.9)	7 (0.8)	139 (1.0)	348 (0.9)	47 (0.8)	3 (0.7)	21 (0.5)	9 (0.5)
Anemia	2891 (11.2)	2286 (13.2)	130 (15.3)	1873 (13.8)	6783 (17.1)	1077 (18.9)	84 (19.1)	807 (20.8)	445 (22.3)
History of bleeding	548 (2.1)	322 (1.9)	11 (1.3)	257 (1.9)	802 (2.0)	121 (2.1)	7 (1.6)	84 (2.2)	38 (1.9)
Hyperthyroidism	663 (2.6)	433 (2.5)	13 (1.5)	326 (2.4)	920 (2.3)	106 (1.9)	3 (0.7)	91 (2.4)	59 (3.0)
Hypothyroidism	632 (2.4)	459 (2.6)	6 (0.7)	322 (2.4)	987 (2.5)	126 (2.2)	10 (2.3)	100 (2.6)	59 (3.0)
COPD	1800 (6.9)	1182 (6.8)	50 (5.8)	926 (6.8)	2408 (6.1)	331 (5.8)	24 (5.5)	220 (5.7)	107 (5.4)
Liver disease	6207 (24.0)	3668 (21.2)	161 (18.8)	2777 (20.5)	7646 (19.2)	1029 (18.0)	84 (19.1)	742 (19.2)	384 (19.2)
Hypertrophic cardiomyopathy	51 (0.2)	40 (0.2)	0 (0.0)	18 (0.1)	61 (0.2)	14 (0.2)	0 (0.0)	2 (0.1)	1 (0.1)
Osteoporosis	7279 (28.1)	5090 (29.4)	251 (29.3)	3758 (27.7)	12018 (30.2)	1749 (30.6)	117 (26.6)	1169 (30.2)	666 (33.4)
Venous thromboembolism	189 (0.7)	124 (0.7)	5 (0.6)	89 (0.7)	221 (0.6)	30 (0.5)	3 (0.7)	19 (0.5)	6 (0.3)
Coagulation or platelet defect	227 (0.9)	148 (0.9)	9 (1.1)	105 (0.8)	330 (0.8)	63 (1.1)	4 (0.9)	36 (0.9)	14 (0.7)

Abbreviations: COPD, chronic obstructive pulmonary disease, SD, standard deviation.

Low stands for low cardiovascular health, mod for moderate cardiovascular health, high for high cardiovascular health.

Values are presented as median (Q1, Q3, quartiles [25th and 75th percentiles]) or number (%).

Table S10. Change in cardiovascular health status, and association with subsequent incident cardiovascular disease and all-cause mortality after weighting to account for attrition.

Change in CVH Status	Cardiovascular Disease				All-Cause Mortality			
	No./Total No.	Incidence Rate per 1000 Person-Years (95% CI)	ARD per 1000 Person-Years (95% CI)	Adjusted sHR (95% CI) [a]	No./Total No.	Incidence Rate per 1000 Person-Years (95% CI)	ARD per 1000 Person-Years (95% CI)	Adjusted HR (95% CI) [b]
Elderly (60~74 years)	5942/91634				6020/91634			
Consistently low	1937/22470	18.0 (17.2-18.8)	Ref	1 (Ref)	1619/22470	14.5 (13.8-15.2)	Ref	1 (Ref)
Low to moderate	1011/14715	14.9 (14.0-15.8)	-3.2 (-4.4 to -1.9)	0.81 (0.75-0.88) †	1019/14715	14.5 (13.7-15.5)	0.1 (-1.1 to 1.2)	1.00 (0.92-1.08)
Low to high	29/716	9.2 (6.2-13.2)	-8.8 (-13.5 to -4.1)	0.50 (0.35-0.73) †	38/716	11.9 (8.4-16.3)	-2.6 (-6.8 to 1.6)	0.84 (0.61-1.15)
Moderate to low	845/11329	15.3 (14.3-16.3)	-2.7 (-4.1 to -1.4)	0.83 (0.77-0.90) †	809/11329	14.2 (13.2-15.2)	-0.3 (-1.5 to 0.9)	0.95 (0.87-1.03)
Consistently moderate	1811/32576	11.8 (11.3-12.4)	-6.2 (-7.1 to -5.2)	0.65 (0.61-0.70) †	2043/32576	13.0 (12.5-13.6)	-1.4 (-2.3 to -0.5)	0.91 (0.85-0.97) †
Moderate to high	155/4658	7.6 (6.5-8.9)	-10.4 (-12.3 to -8.5)	0.43 (0.37-0.51) †	247/4658	12.0 (10.5-13.6)	-2.5 (-4.2 to -0.7)	0.88 (0.77-1.00)
High to low	9/336	5.5 (2.5-10.4)	-12.6 (-19.0 to -6.1)	0.30 (0.16-0.56) †	15/336	9.0 (5.0-14.8)	-5.5 (-11.3 to 0.3)	0.57 (0.35-0.94)
High to moderate	108/3160	7.5 (6.1-9.0)	-10.5 (-12.8 to -8.3)	0.42 (0.35-0.51) †	178/3160	12.2 (10.4-14.1)	-2.3 (-4.4 to -0.2)	0.87 (0.75-1.01)
Consistently high	38/1674	5.6 (4.0-7.7)	-12.4 (-15.6 to -9.2)	0.32 (0.23-0.44) †	52/1674	5.7 (5.7-9.9)	-6.9 (-9.8 to -4.0)	0.58 (0.44-0.77) †
Very-elderly (≥ 75 years)	1846/17695				2953/17695			
Consistently low	493/3898	30.0 (27.4-32.8)	Ref	1 (Ref)	679/3898	39.4 (36.5-42.5)	Ref	1 (Ref)
Low to moderate	286/2808	24.9 (22.1-28.2)	-4.9 (-8.9 to -0.9)	0.82 (0.70-0.95) †	467/2808	39.4 (35.9-43.1)	0.0 (-4.7 to 4.6)	0.96 (0.85-1.09)
Low to high	10/142	18.2 (8.7-33.4)	-11.8 (-26.5 to 2.8)	0.59 (0.31-1.15)	24/142	42.4 (27.2-63.1)	3.0 (-13.6 to 19.6)	1.03 (0.69-1.54)
Moderate to low	239/2077	27.7 (24.3-31.4)	-2.3 (-6.8 to 2.1)	0.90 (0.77-1.05)	362/2077	40.2 (36.2-44.6)	0.9 (-4.2 to 5.9)	0.95 (0.83-1.08)
Consistently moderate	704/6870	25.3 (23.5-27.3)	-4.7 (-7.8 to -1.5)	0.82 (0.73-0.92) †	1179/6870	40.9 (38.6-43.3)	1.5 (-2.3 to 5.3)	0.97 (0.88-1.07)

Moderate to high	54/980	14.5 (10.9-18.9)	-15.5 (-21.4 to -9.7)	0.48 (0.36-0.63) †	127/980	33.3 (27.8-39.7)	-6.1 (-12.9 to 0.8)	0.81 (0.67-0.99)
High to low	3/85	8.6 (1.8-25.2)	-21.4 (-40.0 to -3.1)	0.26 (0.09-0.79)	13/85	37.0 (19.7-63.3)	-2.4 (-23.3 to 18.6)	0.78 (0.45-1.32)
High to moderate	44/585	20.4 (14.8-27.4)	-9.6 (-17.2 to -2.0)	0.66 (0.49-0.90) †	77/585	34.8 (27.5-43.5)	-4.6 (-13.3 to 4.1)	0.81 (0.63-1.03)
Consistently high	12/250	13.0 (6.7-22.8)	-17.1 (-28.5 to -5.8)	0.42 (0.23-0.74) †	24/250	25.8 (16.5-38.3)	-13.6 (-26.6 to 0.7)	0.60 (0.39-0.91)

Abbreviations: ARD, absolute rate difference; CI, confidence interval, CVH, cardiovascular health; HR, hazard ratio; sHR, subhazard ratio.

a. sHRs were adjusted for sex, age, economic status, Hospital Frailty Score, living in metropolitan cities, and competing risk of death.

b. HRs were adjusted for sex, age, economic status, Hospital Frailty Score, and living in metropolitan cities.

† P<0.0083 for differences reported.

Table S11. Number of participants according to change in the level of individual cardiovascular health metrics between first and second examinations.

Pattern of change	Low-Low	Low-Mod	Low-High	Mod-Low	Mod-Mod	Mod-High	High-Low	High-Mod	High-High
Elderly (60~74 years)									
Smoking	10085 (10.9%)	1664 (1.8%)	3943 (4.3%)	940 (1%)	2722 (2.9%)	3082 (3.3%)	3182 (3.4%)	3926 (4.2%)	62926 (68.1%)
Body mass index	3662 (4%)	879 (1%)	1117 (1.2%)	828 (0.9%)	23167 (25.1%)	5855 (6.3%)	1319 (1.4%)	5336 (5.8%)	50307 (54.4%)
Physical activity	24819 (26.8%)	12130 (13.1%)	10247 (11.1%)	5349 (5.8%)	9910 (10.7%)	8642 (9.3%)	2945 (3.2%)	5528 (6%)	12900 (14%)
Blood pressure	30285 (32.8%)	15663 (16.9%)	4766 (5.2%)	14215 (15.4%)	11410 (12.3%)	2933 (3.2%)	4612 (5%)	3062 (3.3%)	5524 (6%)
Total cholesterol	4978 (5.4%)	5764 (6.2%)	1991 (2.2%)	5471 (5.9%)	22392 (24.2%)	10301 (11.1%)	1281 (1.4%)	9513 (10.3%)	30779 (33.3%)
Fasting glucose	4495 (4.9%)	3703 (4%)	1083 (1.2%)	3878 (4.2%)	14801 (16%)	10990 (11.9%)	1117 (1.2%)	12597 (13.6%)	39806 (43%)
Very-elderly (≥ 75 years)									
Smoking	1340 (7.9%)	259 (1.5%)	735 (4.3%)	127 (0.7%)	424 (2.5%)	643 (3.8%)	511 (3%)	788 (4.6%)	12134 (71.5%)
Body mass index	1009 (5.9%)	140 (0.8%)	481 (2.8%)	123 (0.7%)	2863 (16.9%)	1029 (6.1%)	619 (3.6%)	852 (5%)	9845 (58%)
Physical activity	4820 (28.4%)	2664 (15.7%)	2074 (12.2%)	734 (4.3%)	1652 (9.7%)	1414 (8.3%)	478 (2.8%)	1092 (6.4%)	2033 (12%)
Blood pressure	6055 (35.7%)	2996 (17.7%)	768 (4.5%)	2752 (16.2%)	2023 (11.9%)	445 (2.6%)	743 (4.4%)	447 (2.6%)	732 (4.3%)
Total cholesterol	877 (5.2%)	973 (5.7%)	383 (2.3%)	975 (5.7%)	3861 (22.8%)	1827 (10.8%)	218 (1.3%)	1681 (9.9%)	6166 (36.4%)
Fasting glucose	746 (4.4%)	722 (4.3%)	320 (1.9%)	705 (4.2%)	2776 (16.4%)	2136 (12.6%)	296 (1.7%)	2430 (14.3%)	6830 (40.3%)

Low stands for low cardiovascular health, mod for moderate cardiovascular health, high for high cardiovascular health.
Values are reported as No. (%).

Table S12. Incidence rates for cardiovascular disease and all-cause mortality according to change in the individual cardiovascular health metrics between first and second examinations.

Pattern of change	Incidence Rate per 1000 Person-Years (95% confidence intervals)								
	Low-Low	Low-Mod	Low-High	Mod-Low	Mod-Mod	Mod-High	High-Low	High-Mod	High-High
Incident cardiovascular disease									
Elderly (60~74 years)									
Smoking	20.5 (19.2-21.9)	17.3 (14.2-20.7)	16.7 (15.0-18.7)	18.2 (14.5-22.6)	15.8 (13.4-18.6)	16.0 (14.0-18.2)	16.4 (14.5-18.5)	16.1 (14.2-18.1)	12.0 (11.6-12.4)
Body mass index	15.4 (12.9-18.2)	13.0 (9.8-16.8)	29.4 (11.8-60.6)	13.3 (10.1-17.3)	14.0 (13.3-14.7)	14.2 (12.8-15.6)	30.3 (14.5-55.7)	13.2 (11.9-14.7)	13.6 (13.2-14.1)
Physical activity	15.6 (14.5-16.3)	13.6 (12.7-14.5)	13.7 (12.7-14.8)	14.3 (13.0-15.7)	10.7 (9.8-11.7)	12.4 (11.2-13.6)	13.9 (12.2-15.8)	13.2 (11.7-14.9)	12.0 (10.9.13.1)
Blood pressure	17.4 (16.5-18.4)	15.4 (14.5-16.3)	12.3 (10.1-14.9)	15.1 (14.1-16.1)	13.4 (12.8-14.0)	9.4 (8.3-10.6)	14.0 (11.4-17.0)	9.8 (8.7-11.0)	7.2 (6.2-8.4)
Total cholesterol	18.9 (17.2-20.8)	14.1 (12.8-15.6)	16.5 (14.0-19.3)	13.6 (12.2-15.1)	13.4 (12.7-14.1)	13.7 (12.7-14.8)	18.0 (14.8-21.7)	14.2 (13.1-15.3)	12.7 (12.2-13.3)
Fasting glucose	23.6 (21.5-25.9)	20.2 (18.1-22.5)	15.2 (12.1-18.9)	20.1 (18.1-22.3)	15.5 (14.6-16.5)	12.3 (11.3-13.3)	18.5 (15.1-22.5)	12.6 (11.8-13.6)	11.6 (11.1-12.1)
Very-elderly (≥ 75 years)									
Smoking	38.5 (33.1-44.6)	36.8 (25.4-51.7)	30.7 (24.9-37.6)	26.5 (14.5-44.4)	25.3 (17.5-35.3)	30.8 (24.2-38.6)	25.7 (19.5-33.1)	26.4 (20.8-33.0)	23.6 (22.3-24.9)
Body mass index	29.2 (19.7-41.6)	23.3 (12.8-39.1)	42.0 (8.7-122.6)	32.4 (18.9-51.9)	21.0 (18.6-23.7)	29.2 (24.5-34.5)	37.8 (10.3-9.7)	28.1 (23.0-33.9)	26.1 (24.7-27.7)
Physical activity	29.0 (27.0-31.2)	25.6 (22.8-28.7)	22.5 (19.4-25.9)	25.0 (20.3-30.5)	22.6 (18.6-27.1)	20.7 (16.6-25.6)	32.1 (25.4-40.1)	22.2 (17.2-28.2)	20.7 (17.1-24.8)
Blood pressure	29.3 (26.4-32.5)	28.6 (25.8-31.6)	20.6 (13.8-29.6)	28.1 (25.1-31.4)	23.5 (21.5-25.6)	20.5 (15.8-26.1)	28.0 (19.5-38.9)	17.9 (13.5-23.3)	15.4 (10.9-21.0)
Total cholesterol	26.9 (21.9-32.6)	27.4 (22.5-33.0)	27.1 (19.6-26.6)	27.7 (22.8-33.3)	24.9 (22.5-27.5)	23.3 (20.0-27.0)	29.1 (18.8-42.9)	26.9 (23.2-31.0)	25.3 (23.3-27.3)
Fasting glucose	39.0 (32.1-46.9)	30.7 (24.9-37.5)	34.2 (25.2-45.5)	33.7 (27.4-41.1)	26.5 (23.6-29.7)	23.1 (20.1-26.6)	28.0 (19.4-39.1)	24.4 (21.5-27.7)	23.0 (21.3-24.9)
All-cause mortality									
Elderly (60~74 years)									
Smoking	25.7 (24.3-27.3)	21.9 (18.5-25.7)	21.3 (19.4-23.5)	19.2 (15.4-23.5)	15.0 (12.7-17.7)	16.2 (14.2-18.4)	19.4 (17.4-21.6)	16.0 (14.2-18.0)	10.5 (10.1-10.9)
Body mass index	10.7 (8.7-13.0)	10.4 (7.6-13.8)	16.2 (4.4-41.4)	13.0 (9.8-16.9)	10.3 (9.7-10.9)	14.2 (12.8-15.6)	8.3 (1.8-24.3)	11.8 (10.5-13.1)	15.5 (15.0-16.0)
Physical activity	15.8 (15.2-16.5)	14.0 (13.1-15.0)	13.3 (12.3-14.4)	13.9 (12.6-15.3)	10.6 (9.7-11.6)	11.3 (10.2-12.5)	13.9 (12.2-15.8)	12.2 (10.7-13.7)	11.5 (10.5-12.6)
Blood pressure	14.8 (13.9-15.7)	14.5 (13.6-15.3)	14.7 (12.3-17.5)	14.0 (13.1-15.0)	13.3 (12.7-13.9)	12.3 (11.0-13.7)	14.2 (11.7-17.2)	11.9 (10.7-13.3)	12.1 (10.8-13.6)
Total cholesterol	12.2 (10.8-13.6)	11.4 (10.2-12.8)	13.6 (11.4-16.2)	11.6 (10.3-12.9)	10.7 (10.1-11.3)	14.0 (13.0-15.1)	18.2 (15.1-21.8)	13.1 (12.1-14.2)	16.7 (16.0-17.3)
Fasting glucose	21.5 (19.5-23.6)	18.9 (16.9-21.1)	19.8 (16.3-23.9)	17.5 (15.7-19.5)	14.7 (13.8-15.7)	13.2 (12.3-14.2)	19.7 (16.2-23.7)	12.6 (11.7-13.5)	11.7 (11.2-12.2)
Very-elderly (≥ 75 years)									
Smoking	66.5 (59.5-74.1)	53.1 (39.4-70.0)	55.0 (47.3-63.6)	74.4 (53.4-101.0)	45.7 (35.1-58.5)	49.2 (41.1-58.5)	49.8 (41.3-59.6)	48.3 (40.8-56.8)	33.6 (32.1-35.2)

Body mass index	19.4 (12.0-29.6)	24.1 (13.5-39.8)	54.4 (14.8-13.9)	32.4 (19.2-51.2)	25.9 (23.3-28.8)	44.4 (38.7-50.7)	53.8 (19.7-11.7)	39.0 (33.2-45.6)	43.5 (41.7-45.5)
Physical activity	47.1 (44.5-49.8)	38.7 (35.2-42.4)	32.8 (29.1-36.8)	39.9 (34.0-46.6)	35.5 (30.6-41.0)	29.9 (25.0-35.6)	45.8 (37.9-54.9)	32.2 (26.2-39.1)	27.6 (23.5-32.2)
Blood pressure	39.0 (35.7-42.6)	42.1 (38.8-45.7)	48.1 (37.5-60.8)	40.2 (36.7-44.1)	37.0 (34.5-39.6)	39.5 (33.0-46.9)	41.5 (31.2-54.2)	39.1 (32.5-46.6)	38.2 (31.0-46.5)
Total cholesterol	34.7 (29.1-41.0)	32.8 (27.6-38.8)	42.0 (32.7-53.1)	34.7 (29.3-40.7)	29.7 (27.1-32.5)	38.2 (34.0-42.7)	53.4 (39.4-70.8)	40.2 (35.7-45.1)	47.8 (45.2-50.6)
Fasting glucose	57.5 (49.3-66.7)	45.5 (38.5-53.4)	41.4 (31.6-53.3)	53.9 (46.0-62.8)	39.6 (36.1-43.4)	37.3 (33.4-41.5)	52.4 (40.5-66.7)	37.1 (33.5-41.0)	36.0 (33.8-38.3)

Low stands for low cardiovascular health, mod for moderate cardiovascular health, high for high cardiovascular health.

Table S13. Associations between 4 groups of change in cardiovascular health as defined in the Framingham study and incident cardiovascular disease and all-cause mortality.

Change in CVH status [a]	Elderly (60~74 years)		Very-elderly (≥ 75 years)	
Incident cardiovascular disease	**No./Total No.**	**Adjusted sHR (95% CI) [b]**	**No./Total No.**	**Adjusted sHR (95% CI) [b]**
Low-low	1764/39326	1.97 (1.84-2.10)	569/7091	1.69 (1.50-1.90)
Low-high	524/7344	1.42 (1.33-1.51)	176/1546	1.12 (0.99-1.27)
High-low	1803/25893	1.55 (1.40-1.71)	464/4519	1.36 (1.15-1.61)
High-high	1889/19907	1 [Reference]	556/3805	1 [Reference]
All-cause mortality	**No./Total No.**	**Adjusted HR (95% CI) [c]**	**No./Total No.**	**Adjusted HR (95% CI) [c]**
Low-low	1997/39326	1.62 (1.52-1.73)	975/7091	1.46 (1.33-1.60)
Low-high	563/7344	1.11 (1.04-1.19)	320/1546	0.99 (0.90-1.09)
High-low	1658/25893	1.39 (1.27-1.53)	702/4519	1.39 (1.22-1.57)
High-high	1881/19907	1 [Reference]	834/3805	1 [Reference]

Abbreviations: CI, confidence interval; CVH, cardiovascular health; HR, hazard ratio; sHR, subhazard ratio.

a. The 4 groups of change in CVH were defined as high-high (those with CVH score ≥8 at baseline and last score of ≥8, reference category), high-low (≥8 baseline and ≤7 last), low-high (≤7 baseline and ≥8 last) and low-low (≤7 baseline and ≤7 last) as used in the Framingham Offspring Study.

b. sHRs were adjusted for sex, age, economic status, Hospital Frailty Score, living in metropolitan cities, and competing risk of death.

c. HRs were adjusted for sex, age, economic status, Hospital Frailty Score, and living in metropolitan cities.

Figure S1. Summary of the statistical analysis design. Gray lines represent the enrollment of patients in this study cohort. Red line represent analysis according to the changes in CVH categories between the first and the second visit. CVD, cardiovascular disease; CVH, cardiovascular health.
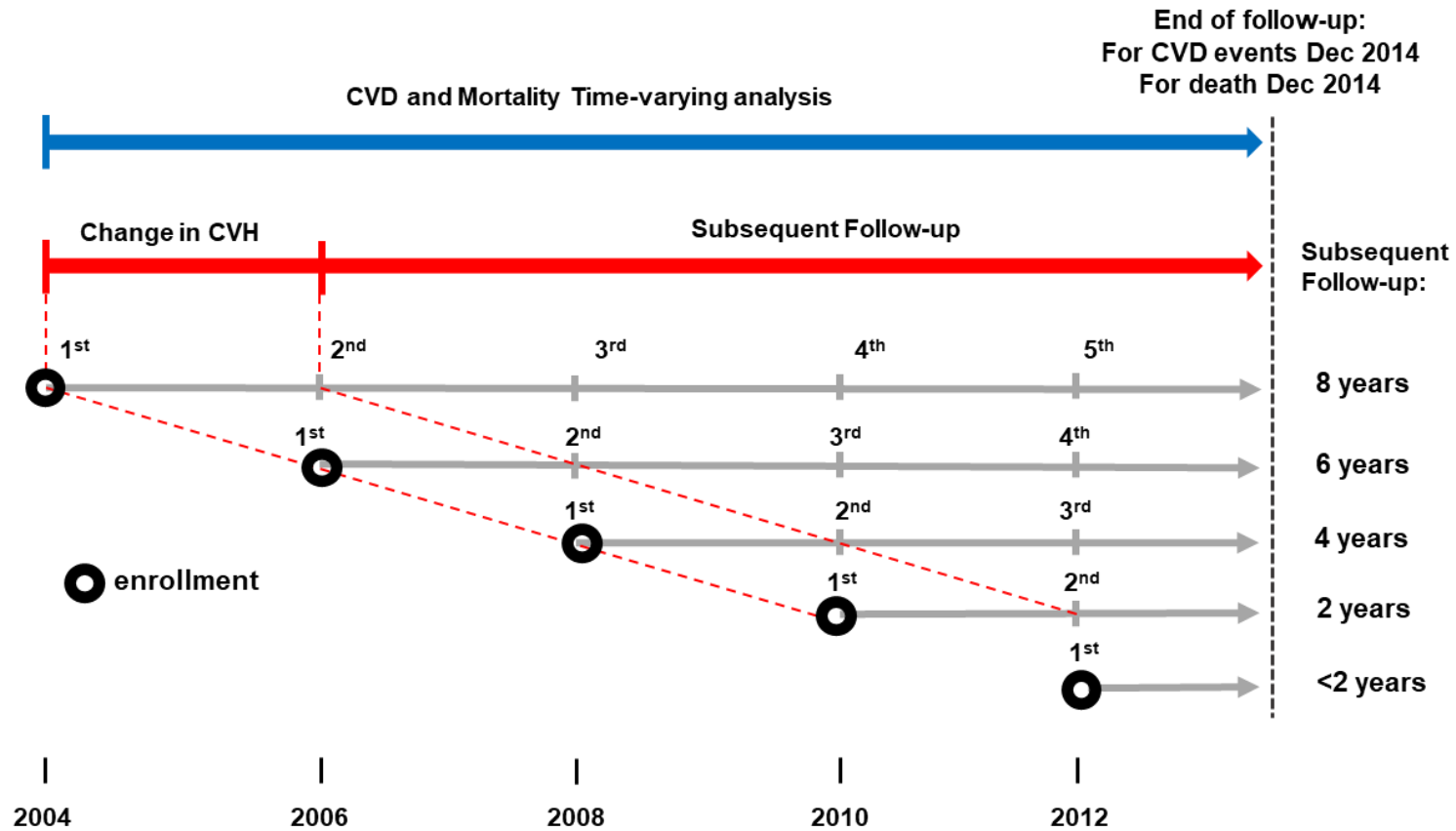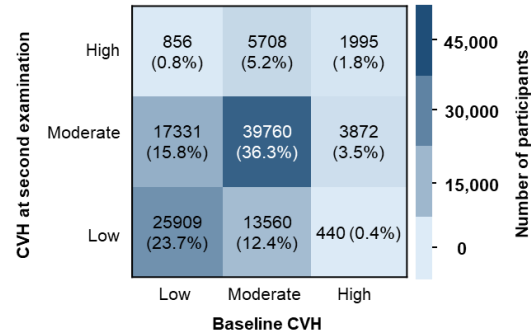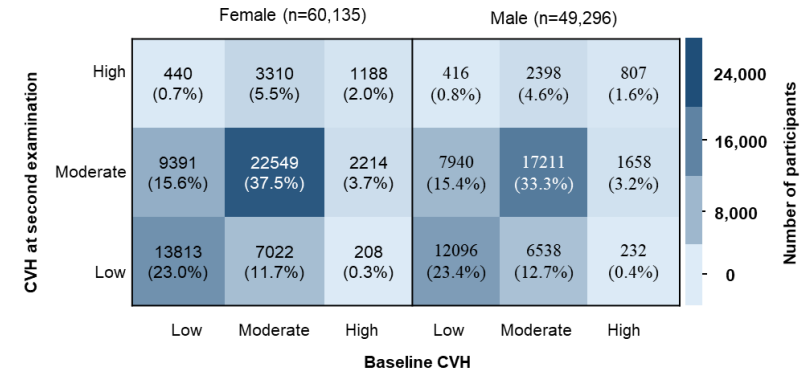
Figure S2. Distribution of the change in cardiovascular health between 1st and 2nd examination in the total study population (n=109,769) (A), in individuals aged <75 (n=92,490) and ≥70 years (n=16,961) (B), in women (n=60,135) and men (n=49,296) (C), and in high (n=50,330) and non-high (n=59,101) economic status (D). CVH, cardiovascular health.
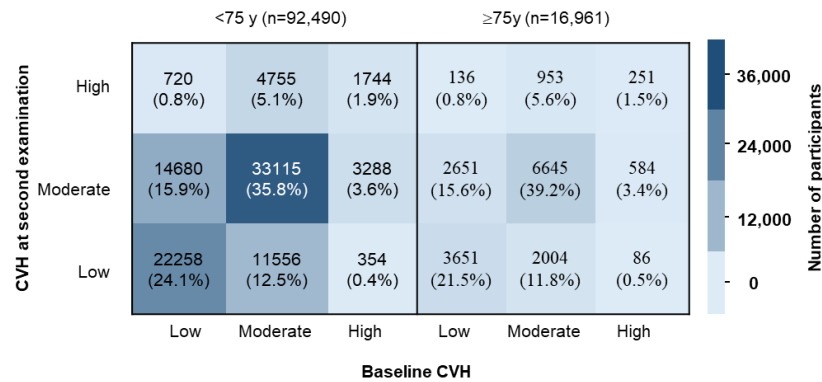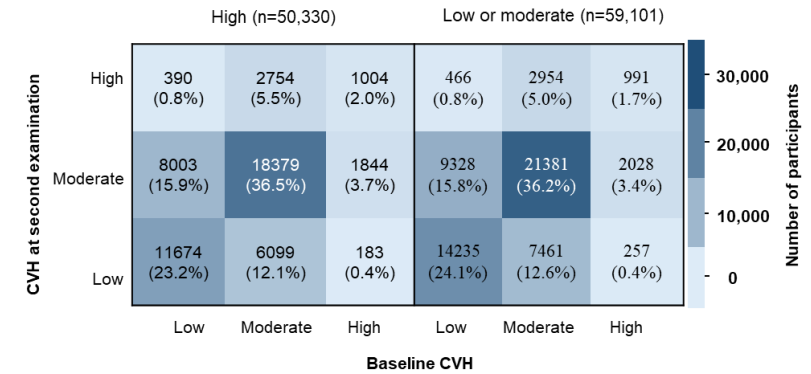
Figure S3. Kaplan–Meier curves of incident cardiovascular disease and all-cause mortality according to the patterns of change in cardiovascular health between the first and second health examinations.