

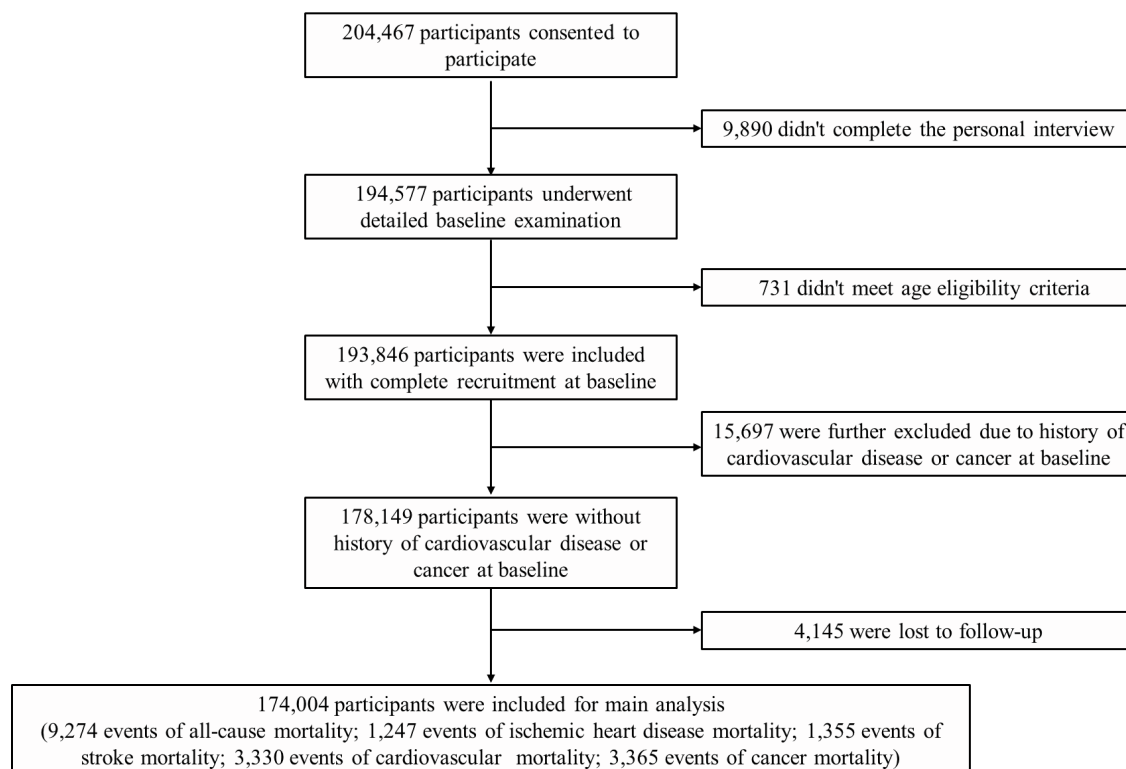
**Supplemental information**

**Association of social determinants, lifestyle, and  
metabolic factors with mortality in Chinese adults:**

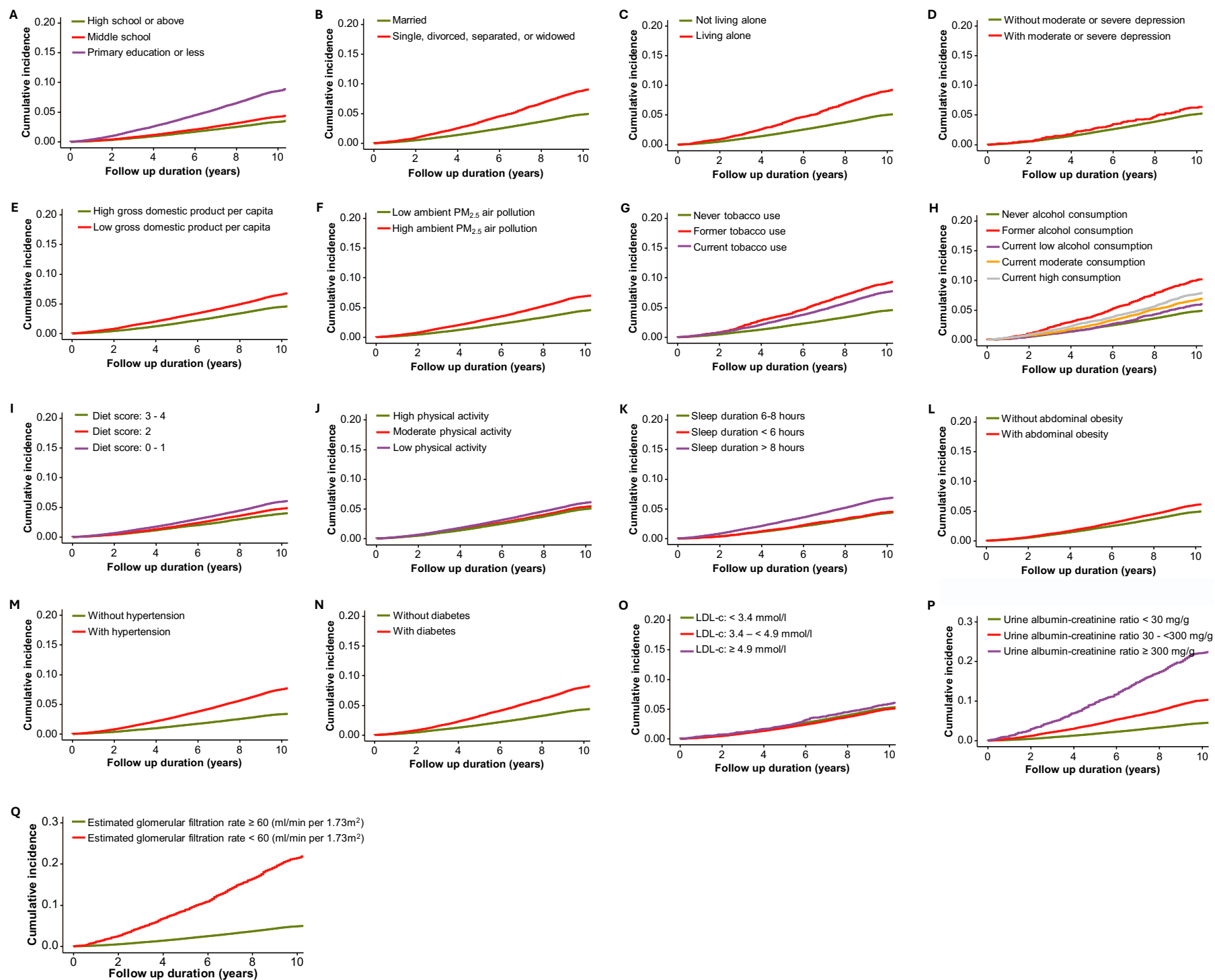
**A nationwide 10-year prospective cohort study**

**Jieli Lu, Mian Li, Jiang He, Yu Xu, Ruizhi Zheng, Jie Zheng, Guijun Qin, Yingfen Qin, Yuhong Chen, Xulei Tang, Zhen Ye, Min Xu, Tiange Wang, Lixin Shi, Qing Su, Xuefeng Yu, Li Yan, Zhiyun Zhao, Qin Wan, Gang Chen, Zhengnan Gao, Guixia Wang, Feixia Shen, Xuejiang Gu, Zuojie Luo, Li Chen, Xinguo Hou, Yanan Huo, Qiang Li, Hong Qiao, Yinfei Zhang, Tianshu Zeng, Chunyan Hu, Qiuyu Cao, Xiaojing Jia, Chao Liu, Youmin Wang, Shengli Wu, Tao Yang, Huacong Deng, Hongyan Qi, Xueyan Wu, Di Zhang, Meng Dai, Donghui Li, Shenghan Lai, Lulu Chen, Jiajun Zhao, Yiming Mu, Weiguo Hu, Guang Ning, Ruying Hu, Yufang Bi, Weiqing Wang, and for the 4C Study Group**

## Supplementary Figures

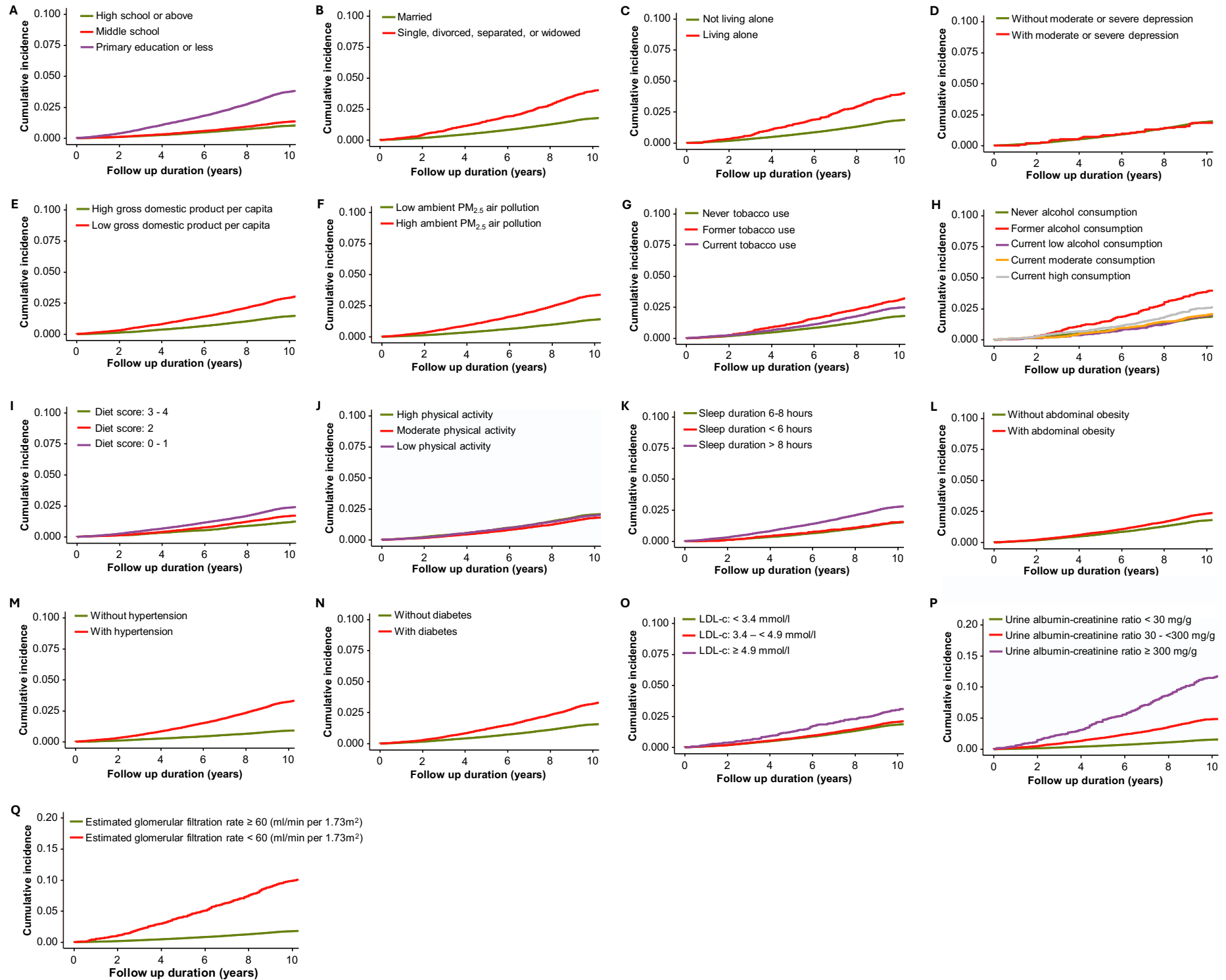


**Figure S1. Participant flow diagram of the China Cardiometabolic Disease and Cancer Cohort (4C) Study, related to Table 1.**



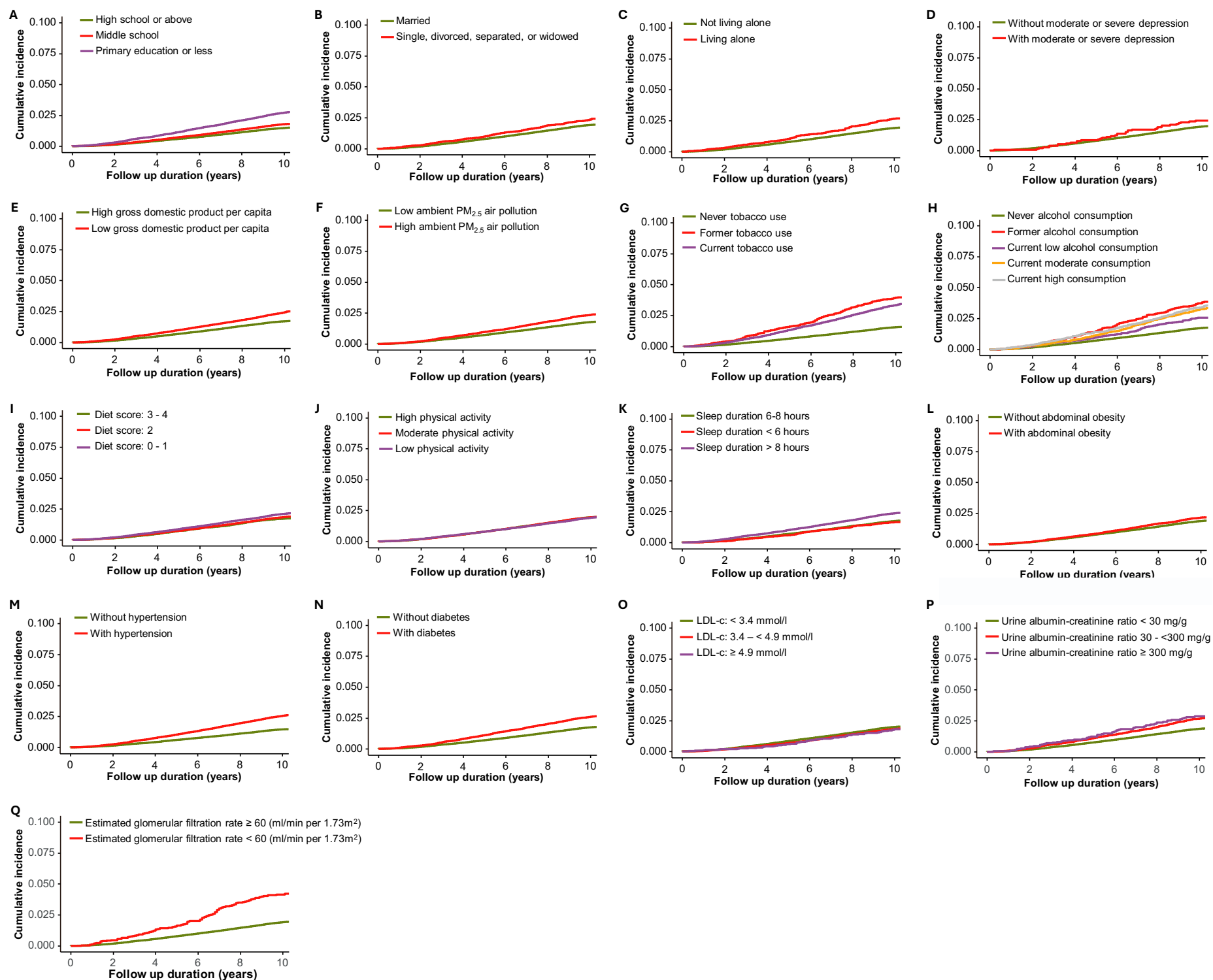
**Figure S2. Cumulative incidence of all-cause mortality with each risk factor using Kaplan-Meier analysis, related to Table 2.**

A, educational attainment; B, marital status; C, living status; D, depression status; E, gross domestic product per capita; F, ambient PM<sub>2.5</sub> air pollution; G, tobacco use; H, alcohol consumption; I, diet score; J, physical activity; K, sleep duration; L, abdominal obesity; M, hypertension; N, diabetes; O, low-density lipoprotein cholesterol; P, urine albumin-creatinine ratio; Q, estimated glomerular filtration rate



**Figure S3. Cumulative incidence of cardiovascular mortality with each risk factor using Kaplan-Meier analysis, related to Table 3.**

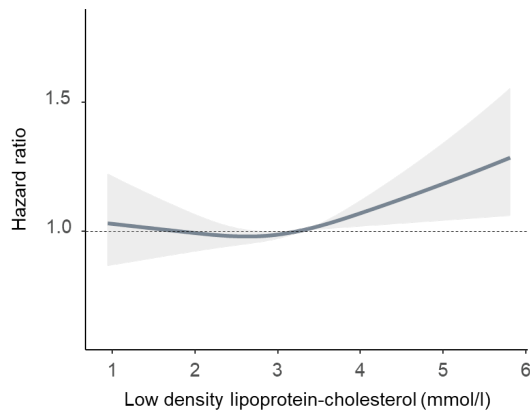
A, educational attainment; B, marital status; C, living status; D, depression status; E, gross domestic product per capita; F, ambient PM<sub>2.5</sub> air pollution; G, tobacco use; H, alcohol consumption; I, diet score; J, physical activity; K, sleep duration; L, abdominal obesity; M, hypertension; N, diabetes; O, low-density lipoprotein cholesterol; P, urine albumin-creatinine ratio; Q, estimated glomerular filtration rate



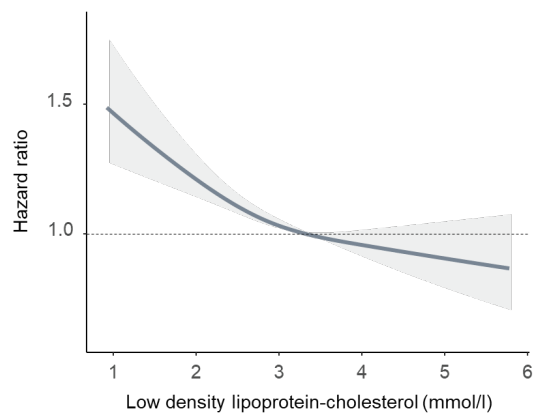
**Figure S4. Cumulative incidence of cancer mortality with each risk factor using Kaplan-Meier analysis, related to Table 4.**

A, educational attainment; B, marital status; C, living status; D, depression status; E, gross domestic product per capita; F, ambient PM<sub>2.5</sub> air pollution; G, tobacco use; H, alcohol consumption; I, diet score; J, physical activity; K, sleep duration; L, abdominal obesity; M, hypertension; N, diabetes; O, low-density lipoprotein cholesterol; P, urine albumin-creatinine ratio; Q, estimated glomerular filtration rate

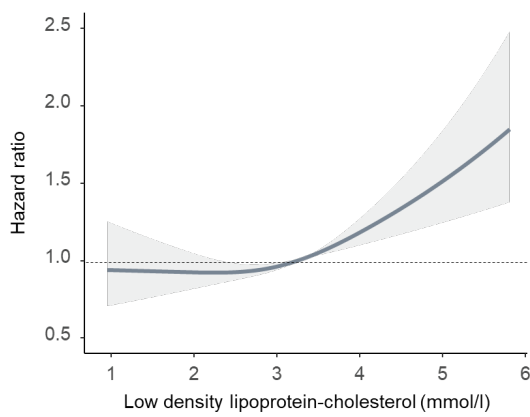
**A. Cardiovascular mortality**



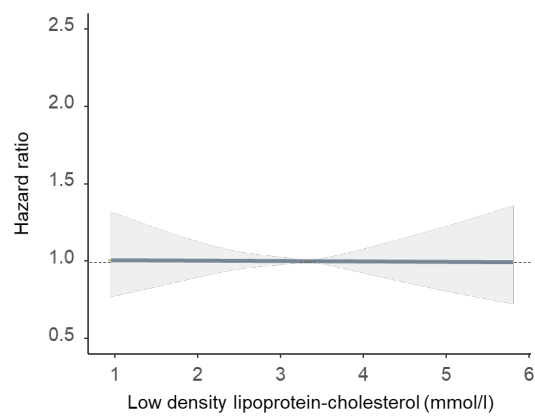
**B. Cancer mortality**



**C. Ischemic heart disease mortality**

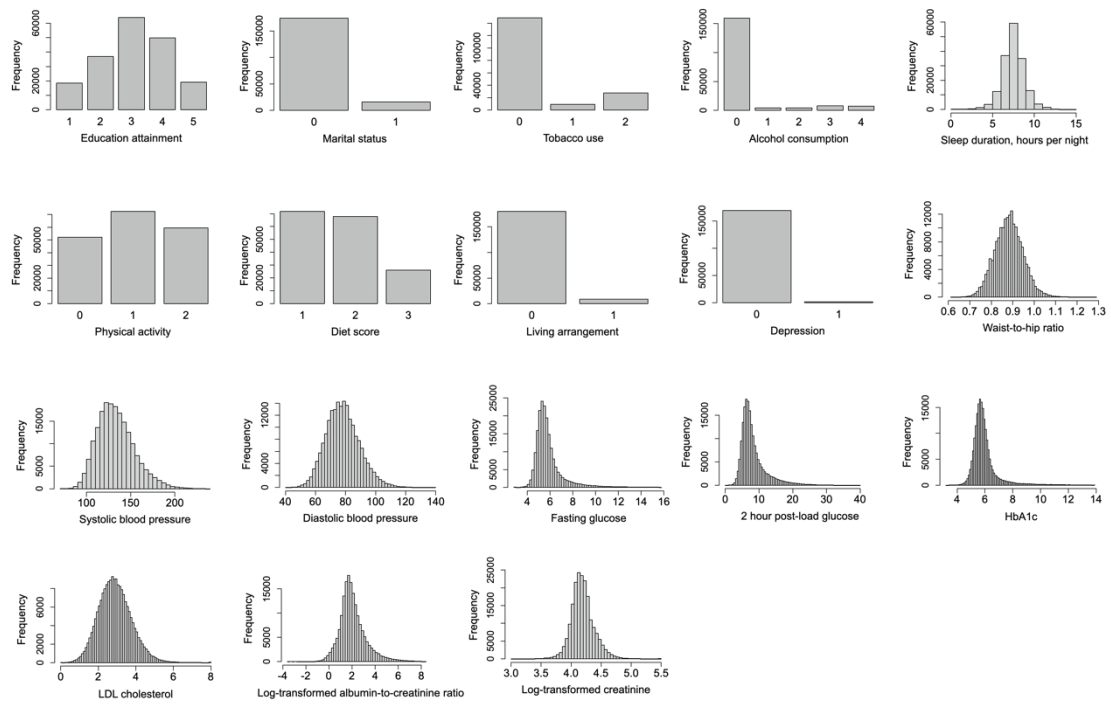


**D. Stroke mortality**

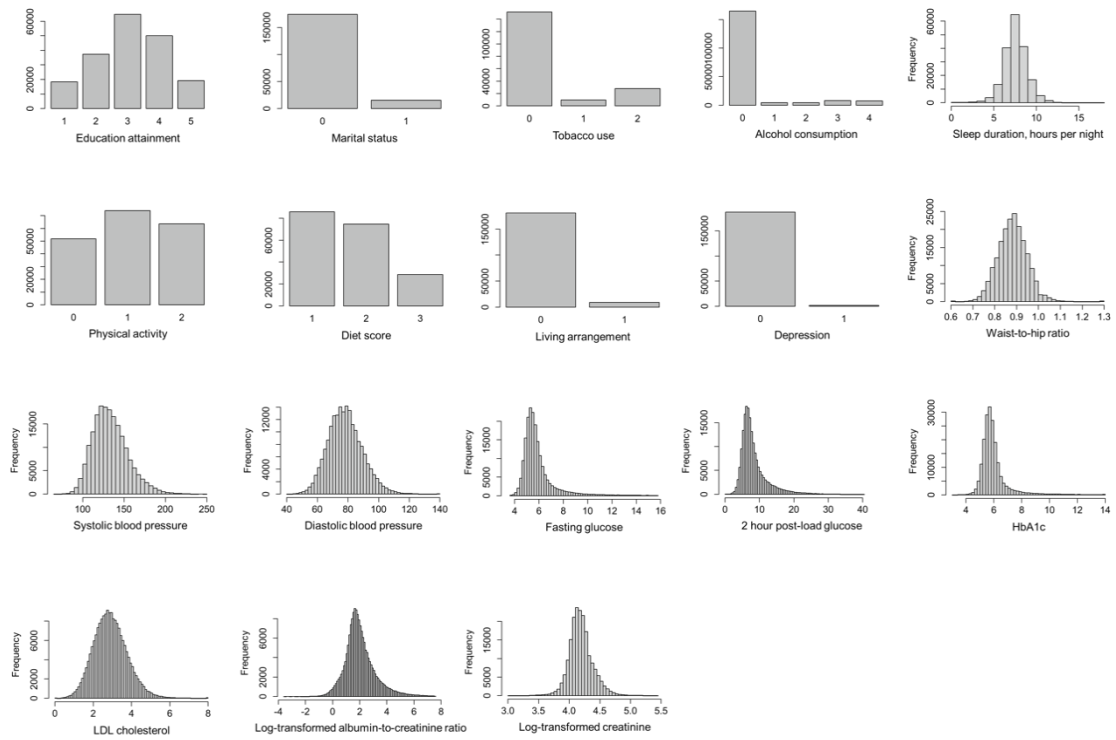


**Figure S5. Multivariable-adjusted hazard ratios for cause-specific mortalities according to levels of low-density lipoprotein cholesterol on a continuous scale, related to Table 2-4.**

Solid lines are multivariable adjusted hazard ratios, with shade showing 95% confidence intervals derived from restricted cubic spline regressions plotted with a reference value of 3.4 mmol/l for LDL-c using 3 knots at 5th, 50th, and 95th percentiles. Model was adjusted for age, sex, region and other individual risk factors. The highest and lowest 0.5% values of low-density lipoprotein cholesterol were trimmed.



**Figure S6. Distributions of variables used as predictors in multiple imputation, related to STAR Methods.**



**Figure S7. Distributions of predictors after multiple imputations, showing the first imputed data set, related to STAR Methods.**



**Table S1. Multivariable-adjusted hazard ratios and 95% CIs for ischemic heart disease mortality in overall population and by gender using competing risk regression model, related to Table 3**

	Overall		Women		Men		<i>P</i> interaction of women and men
	Case/N (%)	HR (95%CI)	Case/N (%)	HR (95%CI)	Case/N (%)	HR (95%CI)	
<b>Social determinants</b>							
<b>Educational attainment</b>							<.0001
High school or above	230/63519 (0.4)	1.00 (Reference)	51/38384 (0.1)	1.00 (Reference)	179/25135 (0.7)	1.00 (Reference)	
Middle school	271/59786 (0.5)	1.02 (0.84-1.23)	106/37742 (0.3)	1.53 (1.07-2.20)	164/22044 (0.8)	0.88 (0.70-1.10)	
Primary school or less	746/50699 (1.5)	1.43 (1.20-1.70)	478/37311 (1.3)	2.19 (1.57-3.05)	268/13388 (2.0)	1.16 (0.93-1.45)	
<b>Marital status</b>							0.508
Married	1042/160298 (0.7)	1.00 (Reference)	494/102038 (0.5)	1.00 (Reference)	549/58260 (0.9)	1.00 (Reference)	
Single, divorced, separated, or widowed	205/13706 (1.5)	1.11 (0.92-1.33)	142/11399 (1.3)	0.99 (0.79-1.24)	62/2307 (2.7)	1.32 (0.94-1.85)	
<b>Living alone</b>							0.595
No	1133/166267 (0.7)	1.00 (Reference)	563/107628 (0.5)	1.00 (Reference)	570/58639 (1.0)	1.00 (Reference)	
Yes	114/7737 (1.5)	1.14 (0.91-1.43)	73/5809 (1.3)	1.07 (0.81-1.41)	41/1928 (2.1)	1.22 (0.82-1.79)	
<b>Moderate or severe depression</b>							0.305
No	1237/172458 (0.7)	1.00 (Reference)	629/112266 (0.6)	1.00 (Reference)	609/60192 (1.0)	1.00 (Reference)	
Yes	10/1546 (0.6)	1.10 (0.56-2.19)	7/1171 (0.6)	1.54 (0.71-3.35)	2/375 (0.6)	0.55 (0.13-2.30)	
<b>Gross domestic product per capita (yuan)*</b>							0.008
≥ 36,262	584/117187 (0.5)	1.00 (Reference)	279/76795 (0.4)	1.00 (Reference)	305/40392 (0.8)	1.00 (Reference)	
< 36,262	663/56817 (1.2)	1.27 (1.10-1.46)	357/36642 (1.0)	1.43 (1.18-1.73)	306/20175 (1.5)	1.14 (0.93-1.38)	
<b>Ambient PM<sub>2.5</sub> air pollution (μg/m<sup>3</sup>)*</b>							0.742
< 59.11	519/124871 (0.4)	1.00 (Reference)	262/81659 (0.3)	1.00 (Reference)	257/43212 (0.6)	1.00 (Reference)	
≥ 59.11	728/49133 (1.5)	2.37 (2.09-2.70)	374/31778 (1.2)	2.13 (1.78-2.55)	354/17355 (2.0)	2.59 (2.16-3.11)	
<b>Lifestyle Risk Factors</b>							
<b>Tobacco use</b>							0.940
Never	915/139201 (0.7)	1.00 (Reference)	614/111225 (0.6)	1.00 (Reference)	301/27976 (1.1)	1.00 (Reference)	
Former	92/8192 (1.1)	1.15 (0.90-1.47)	8/495 (1.5)	1.42 (0.65-3.09)	84/7697 (1.1)	1.09 (0.84-1.41)	
Current	240/26611 (0.9)	1.31 (1.10-1.57)	14/1717 (0.8)	1.20 (0.70-2.06)	225/24894 (0.9)	1.29 (1.07-1.56)	
<b>Alcohol consumption</b>							0.344
Never	1051/150967 (0.7)	1.00 (Reference)	618/110977 (0.6)	1.00 (Reference)	433/39990 (1.1)	1.00 (Reference)	
Former	60/3832 (1.6)	1.36 (1.01-1.83)	6/484 (1.2)	1.57 (0.64-3.90)	54/3348 (1.6)	1.34 (0.99-1.82)	
Current: low	25/4223 (0.6)	0.63 (0.42-0.96)	7/1026 (0.6)	1.09 (0.48-2.47)	19/3197 (0.6)	0.54 (0.34-0.88)	
Current: moderate	51/7718 (0.7)	0.65 (0.48-0.89)	2/455 (0.6)	0.74 (0.19-2.91)	49/7263 (0.7)	0.64 (0.47-0.88)	
Current: high	60/7264 (0.8)	0.82 (0.61-1.09)	3/495 (0.7)	0.88 (0.29-2.66)	56/6769 (0.8)	0.83 (0.62-1.13)	
<b>Diet score</b>							0.781
3 - 4	110/26744 (0.4)	1.00 (Reference)	53/17060 (0.3)	1.00 (Reference)	57/9684 (0.6)	1.00 (Reference)	
2	392/68396 (0.6)	1.16 (0.93-1.46)	200/44931 (0.4)	1.10 (0.80-1.52)	192/23465 (0.8)	1.22 (0.87-1.70)	
0 - 1	745/78864 (1.0)	1.45 (1.17-1.81)	383/51446 (0.8)	1.29 (0.94-1.76)	362/27418 (1.3)	1.63 (1.21-2.19)	
<b>Physical activity</b>							0.498
High	370/47177 (0.8)	1.00 (Reference)	173/30718 (0.6)	1.00 (Reference)	197/16459 (1.2)	1.00 (Reference)	
Moderate	403/67064 (0.6)	0.84 (0.72-0.97)	216/44346 (0.5)	0.92 (0.74-1.13)	187/22718 (0.8)	0.76 (0.62-0.94)	
Low	474/59763 (0.8)	1.01 (0.87-1.17)	248/38373 (0.7)	1.03 (0.83-1.27)	227/21390 (1.1)	0.99 (0.81-1.22)	
<b>Sleep duration (hours per night)</b>							0.057
6 - 8	573/105943 (0.5)	1.00 (Reference)	277/69424 (0.4)	1.00 (Reference)	297/36519 (0.8)	1.00 (Reference)	
< 6	45/8945 (0.5)	0.79 (0.52-1.19)	23/5785 (0.4)	0.78 (0.45-1.35)	22/3160 (0.7)	0.80 (0.46-1.38)	
> 8	629/59116 (1.1)	1.14 (0.99-1.32)	336/38228 (0.9)	1.17 (0.97-1.40)	292/20888 (1.4)	1.12 (0.91-1.38)	
<b>Metabolic Risk Factors</b>							
<b>Abdominal obesity</b>							0.085
No	835/126976 (0.7)	1.00 (Reference)	376/78811 (0.5)	1.00 (Reference)	459/48165 (1.0)	1.00 (Reference)	
Yes	412/47028 (0.9)	1.05 (0.92-1.20)	260/34626 (0.8)	0.94 (0.79-1.11)	152/12402 (1.2)	1.18 (0.97-1.44)	
<b>Hypertension</b>							0.006
No	346/97980 (0.4)	1.00 (Reference)	156/66968 (0.2)	1.00 (Reference)	190/31012 (0.6)	1.00 (Reference)	
Yes	901/76024 (1.2)	1.46 (1.28-1.67)	480/46469 (1.0)	1.62 (1.32-1.97)	421/29555 (1.4)	1.30 (1.08-1.56)	
<b>Diabetes</b>							0.816
No	760/133871 (0.6)	1.00 (Reference)	385/88907 (0.4)	1.00 (Reference)	375/44964 (0.8)	1.00 (Reference)	
Yes	487/40133 (1.2)	1.40 (1.24-1.58)	251/24530 (1.0)	1.39 (1.17-1.64)	236/15603 (1.5)	1.39 (1.17-1.66)	
<b>Low-density lipoprotein cholesterol (mmol/l)</b>							0.353
< 3.4	842/127247 (0.7)	1.00 (Reference)	402/80717 (0.5)	1.00 (Reference)	440/46530 (0.9)	1.00 (Reference)	
3.4 - <4.9	362/43490 (0.8)	1.19 (1.05-1.35)	209/30230 (0.7)	1.19 (1.01-1.42)	153/13260 (1.2)	1.19 (0.98-1.44)	
≥ 4.9	43/3267 (1.3)	1.81 (1.32-2.48)	25/2490 (1.0)	1.50 (1.00-2.26)	18/777 (2.3)	2.52 (1.55-4.09)	
<b>Urine albumin-creatinine ratio (mg/g)</b>							0.045
< 30	826/155501 (0.5)	1.00 (Reference)	382/100742 (0.4)	1.00 (Reference)	444/54759 (0.8)	1.00 (Reference)	
30 - <300	322/16320 (2.0)	1.87 (1.62-2.15)	198/11288 (1.8)	2.00 (1.65-2.42)	124/5032 (2.5)	1.67 (1.34-2.08)	
≥ 300	99/2183 (4.5)	3.23 (2.55-4.08)	56/1407 (4.0)	3.32 (2.43-4.54)	43/776 (5.5)	3.05 (2.12-4.37)	
<b>Estimated glomerular filtration rate &lt; 60 (ml/min per 1.73m<sup>2</sup>)</b>							0.834
No	1125/170897 (0.7)	1.00 (Reference)	577/111600 (0.5)	1.00 (Reference)	549/59297 (0.9)	1.00 (Reference)	
Yes	122/3107 (3.9)	1.45 (1.17-1.79)	59/1837 (3.2)	1.38 (1.03-1.86)	62/1270 (4.9)	1.54 (1.14-2.08)	

For the 15 individual-level risk factors (excluding gross domestic product per capita and ambient PM<sub>2.5</sub> air pollution), each model was adjusted for age, sex, region (urban or rural), and all other individual-level risk factors. For the two community-level risk factors of gross domestic product per capita and ambient PM<sub>2.5</sub> air pollution, a separate model was employed with adjustment for age, sex, region (urban or rural) and the remaining 15 individual-level risk factors.

**Table S2. Multivariable-adjusted hazard ratios and 95% CIs for stroke mortality in overall population and by gender using competing risk regression model, related to Table 3**

	Case/N (%)	Overall	Case/N (%)	Women	Case/N (%)	Men	P interaction of women and men
		HR (95%CI)		HR (95%CI)		HR (95%CI)	
<b>Social determinants</b>							
<b>Educational attainment</b>							
High school or above	239/63519 (0.4)	1.00 (Reference)	76/38384 (0.2)	1.00 (Reference)	163/25135 (0.7)	1.00 (Reference)	0.330
Middle school	345/59786 (0.6)	1.28 (1.08-1.52)	127/37742 (0.3)	1.26 (0.94-1.68)	218/22044 (1.0)	1.31 (1.06-1.62)	
Primary school or less	771/50699 (1.5)	1.69 (1.43-2.00)	445/37311 (1.2)	1.67 (1.27-2.19)	326/13388 (2.4)	1.70 (1.36-2.11)	
<b>Marital status</b>							
Married	1159/160298 (0.7)	1.00 (Reference)	518/102038 (0.5)	1.00 (Reference)	641/58260 (1.1)	1.00 (Reference)	0.239
Single, divorced, separated, or widowed	196/13706 (1.4)	1.08 (0.90-1.30)	130/11399 (1.1)	0.99 (0.79-1.23)	66/2307 (2.9)	1.25 (0.89-1.76)	
<b>Living alone</b>							
No	1246/166267 (0.8)	1.00 (Reference)	584/107628 (0.5)	1.00 (Reference)	662/58639 (1.1)	1.00 (Reference)	0.291
Yes	109/7737 (1.4)	1.11 (0.88-1.39)	64/5809 (1.1)	1.01 (0.76-1.35)	45/1928 (2.4)	1.20 (0.80-1.79)	
<b>Moderate or severe depression</b>							
No	1345/172458 (0.8)	1.00 (Reference)	644/112266 (0.6)	1.00 (Reference)	701/60192 (1.2)	1.00 (Reference)	0.308
Yes	10/1546 (0.7)	1.12 (0.55-2.27)	4/1171 (0.4)	0.84 (0.31-2.26)	6/375 (1.5)	1.49 (0.58-3.83)	
<b>Gross domestic product per capita (yuan)*</b>							
≥ 36,262	708/117187 (0.6)	1.00 (Reference)	336/76795 (0.4)	1.00 (Reference)	372/40392 (0.9)	1.00 (Reference)	0.277
< 36,262	647/56817 (1.1)	1.29 (1.14-1.46)	312/36642 (0.9)	1.34 (1.13-1.59)	335/20175 (1.7)	1.25 (1.05-1.50)	
<b>Ambient PM<sub>2.5</sub> air pollution (µg/m<sup>3</sup>)*</b>							
< 59.11	746/124871 (0.6)	1.00 (Reference)	353/81659 (0.4)	1.00 (Reference)	393/43212 (0.9)	1.00 (Reference)	0.455
≥ 59.11	609/49133 (1.2)	1.34 (1.19-1.52)	295/31778 (0.9)	1.32 (1.11-1.56)	314/17355 (1.8)	1.36 (1.14-1.62)	
<b>Lifestyle Risk Factors</b>							
<b>Tobacco use</b>							
Never	1004/139201 (0.7)	1.00 (Reference)	624/111225 (0.6)	1.00 (Reference)	380/27976 (1.4)	1.00 (Reference)	0.037
Former	90/8192 (1.1)	0.86 (0.68-1.09)	5/495 (1.1)	1.10 (0.46-2.62)	85/7697 (1.1)	0.81 (0.63-1.03)	
Current	261/26611 (1.0)	1.04 (0.88-1.24)	19/1717 (1.1)	1.67 (1.04-2.68)	242/24894 (1.0)	0.96 (0.80-1.15)	
<b>Alcohol consumption</b>							
Never	1100/150967 (0.7)	1.00 (Reference)	633/110977 (0.6)	1.00 (Reference)	467/39990 (1.2)	1.00 (Reference)	0.533
Former	57/3832 (1.5)	1.28 (0.96-1.70)	2/484 (0.3)	0.43 (0.06-2.88)	56/3348 (1.7)	1.37 (1.03-1.83)	
Current: low	32/4223 (0.8)	0.78 (0.54-1.14)	4/1026 (0.4)	0.71 (0.27-1.87)	27/3197 (0.9)	0.81 (0.54-1.21)	
Current: moderate	73/7718 (0.9)	0.90 (0.69-1.17)	2/455 (0.5)	0.71 (0.18-2.84)	70/7263 (1.0)	0.92 (0.70-1.21)	
Current: high	93/7264 (1.3)	1.20 (0.94-1.53)	7/495 (1.4)	1.86 (0.86-3.99)	86/6769 (1.3)	1.20 (0.93-1.55)	
<b>Diet score</b>							
3 - 4	123/26744 (0.5)	1.00 (Reference)	54/17060 (0.3)	1.00 (Reference)	69/9684 (0.7)	1.00 (Reference)	0.702
2	457/68396 (0.7)	1.23 (0.99-1.52)	224/44931 (0.5)	1.26 (0.91-1.73)	234/23465 (1.0)	1.20 (0.90-1.60)	
0 - 1	775/78864 (1.0)	1.40 (1.14-1.71)	370/51446 (0.7)	1.36 (1.00-1.84)	404/27418 (1.5)	1.44 (1.08-1.91)	
<b>Physical activity</b>							
High	369/47177 (0.8)	1.00 (Reference)	172/30718 (0.6)	1.00 (Reference)	196/16459 (1.2)	1.00 (Reference)	0.255
Moderate	478/67064 (0.7)	1.01 (0.88-1.16)	241/44346 (0.5)	1.01 (0.83-1.24)	236/22718 (1.0)	1.00 (0.82-1.22)	
Low	508/59763 (0.9)	1.12 (0.96-1.30)	234/38373 (0.6)	1.02 (0.82-1.26)	274/21390 (1.3)	1.21 (0.99-1.49)	
<b>Sleep duration (hours per night)</b>							
6 - 8	623/105943 (0.6)	1.00 (Reference)	296/69424 (0.4)	1.00 (Reference)	327/36519 (0.9)	1.00 (Reference)	0.563
< 6	50/8945 (0.6)	0.78 (0.55-1.11)	22/5785 (0.4)	0.69 (0.39-1.20)	28/3160 (0.9)	0.87 (0.56-1.35)	
> 8	682/59116 (1.2)	1.24 (1.09-1.40)	330/38228 (0.9)	1.23 (1.03-1.47)	352/20888 (1.7)	1.24 (1.05-1.46)	
<b>Metabolic Risk Factors</b>							
<b>Abdominal obesity</b>							
No	919/126977 (0.7)	1.00 (Reference)	369/78811 (0.5)	1.00 (Reference)	550/48165 (1.1)	1.00 (Reference)	0.706
Yes	436/47027 (0.9)	1.04 (0.92-1.17)	279/34626 (0.8)	1.05 (0.89-1.24)	157/12402 (1.3)	1.00 (0.83-1.20)	
<b>Hypertension</b>							
No	333/97980 (0.3)	1.00 (Reference)	152/66968 (0.2)	1.00 (Reference)	180/31012 (0.6)	1.00 (Reference)	0.152
Yes	1022/76024 (1.3)	1.93 (1.69-2.21)	496/46469 (1.1)	2.02 (1.65-2.46)	527/29555 (1.8)	1.84 (1.53-2.21)	
<b>Diabetes</b>							
No	821/133871 (0.6)	1.00 (Reference)	384/88907 (0.4)	1.00 (Reference)	437/44964 (1.0)	1.00 (Reference)	0.758
Yes	534/40133 (1.3)	1.47 (1.31-1.65)	264/24530 (1.1)	1.48 (1.25-1.75)	270/15603 (1.7)	1.46 (1.24-1.71)	
<b>Low-density lipoprotein cholesterol (mmol/l)</b>							
< 3.4	984/127247 (0.8)	1.00 (Reference)	440/80717 (0.5)	1.00 (Reference)	545/46530 (1.2)	1.00 (Reference)	0.644
3.4 - <4.9	335/43490 (0.8)	0.94 (0.82-1.06)	188/30230 (0.6)	0.95 (0.80-1.13)	146/13260 (1.1)	0.91 (0.76-1.10)	
≥ 4.9	36/3267 (1.1)	1.30 (0.93-1.82)	20/2490 (0.8)	1.04 (0.67-1.63)	16/777 (2.1)	1.87 (1.12-3.13)	
<b>Urine albumin-creatinine ratio (mg/g)</b>							
< 30	972/155501 (0.6)	1.00 (Reference)	426/100742 (0.4)	1.00 (Reference)	546/54759 (1.0)	1.00 (Reference)	0.056
30 - <300	301/16320 (1.8)	1.51 (1.31-1.73)	177/11288 (1.6)	1.69 (1.39-2.06)	124/5032 (2.5)	1.30 (1.05-1.60)	
≥ 300	82/2183 (3.8)	2.34 (1.82-3.01)	45/1407 (3.2)	2.50 (1.77-3.51)	37/776 (4.8)	2.16 (1.48-3.15)	
<b>Estimated glomerular filtration rate &lt; 60 (ml/min per 1.73m<sup>2</sup>)</b>							
No	1247/170897 (0.7)	1.00 (Reference)	599/111600 (0.5)	1.00 (Reference)	648/59297 (1.1)	1.00 (Reference)	0.973
Yes	108/3107 (3.5)	1.33 (1.07-1.65)	49/1837 (2.7)	1.26 (0.92-1.72)	59/1270 (4.7)	1.41 (1.05-1.90)	

For the 15 individual-level risk factors (excluding gross domestic product per capita and ambient PM<sub>2.5</sub> air pollution), each model was adjusted for age, sex, region (urban or rural), and all other individual-level risk factors. For the two community-level risk factors of gross domestic product per capita and ambient PM<sub>2.5</sub> air pollution, a separate model was employed with adjustment for age, sex, region (urban or rural) and the remaining 15 individual-level risk factors.

**Table S3. Population attributable fractions for all-cause and cause-specific mortalities associated with low gross domestic product per capita and high ambient PM<sub>2.5</sub> air pollution, related to Figure 1-3.**

	All-cause mortality	Cardiovascular mortality	Ischemic heart disease mortality	Stroke mortality	Cancer mortality
Total population					
Low gross domestic product per capita	7.8% (6.1% - 9.7%)	13.3% (10.3% - 16.4%)	8.9% (3.8% - 14.1%)	9.2% (4.7% - 14.1%)	8.7% (5.8% - 11.6%)
High ambient PM <sub>2.5</sub> air pollution	4.3% (3.0% - 5.8%)	13.4% (10.8% - 16.1%)	28.3% (23.7% - 32.9%)	9.7% (5.6% - 13.6%)	2.2% (0.0% - 4.6%)
Women					
Low gross domestic product per capita	8.3% (5.8% - 10.9%)	16.2% (11.9% - 20.7%)	13.2% (6.1% - 20.5%)	10.4% (3.7% - 17.6%)	6.4% (2.2% - 10.7%)
High ambient PM <sub>2.5</sub> air pollution	3.5% (1.4% - 5.6%)	11.4% (7.7% - 15.2%)	24.5% (17.9% - 31.2%)	8.9% (3.3% - 14.8%)	-0.6% (-3.8% - 3.0%)
Men					
Low gross domestic product per capita	7.7% (5.1% - 10.2%)	10.2% (6.2% - 14.8%)	5.1% (-2.0% - 12.3%)	8.2% (1.6% - 15.0%)	10.7% (6.8% - 14.8%)
High ambient PM <sub>2.5</sub> air pollution	5.2% (3.1% - 7.2%)	15.3% (11.4% - 19.1%)	31.7% (25.1% - 38.3%)	10.3% (4.7% - 16.1%)	4.7% (1.4% - 7.9%)

Notes: The PAFs were calculated using the aforementioned formula:  $PAF = p(HR-1) / (1 + p(HR-1))$ , where p is the population prevalence of the risk factor.

**Table S4. Multivariable-adjusted hazard ratios and 95% confidence intervals of alcohol consumption with all-cause and cause-specific mortalities, related to Table 2-4.**

<b>Alcohol consumption category</b>	<b>All-cause mortality</b>	<b>Cardiovascular mortality</b>	<b>Ischemic heart disease mortality</b>	<b>Stroke mortality</b>	<b>Cancer mortality</b>
Never	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)	1.00 (Reference)
Former	1.16 (1.04 – 1.30)	1.25 (1.04 – 1.50)	1.34 (1.00 – 1.79)	1.27 (0.95 – 1.70)	1.11 (0.92 – 1.34)
Current: low	0.85 (0.74 – 0.96)	0.76 (0.61 – 0.96)	0.62 (0.41 – 0.93)	0.77 (0.53 – 1.11)	0.94 (0.77 – 1.15)
Current: moderate	0.87 (0.79 – 0.96)	0.72 (0.61 – 0.86)	0.65 (0.48 – 0.88)	0.89 (0.69 – 1.16)	1.07 (0.93 – 1.23)
Current: high but not binge drinking*	0.97 (0.86 – 1.10)	0.91 (0.73 – 1.13)	0.73 (0.50 – 1.06)	1.14 (0.85 – 1.54)	1.06 (0.88 – 1.28)
Current: high and binge drinking at least once a year*	1.21 (1.06 – 1.39)	1.09 (0.86 – 1.39)	0.96 (0.63 – 1.46)	1.32 (0.93 – 1.87)	1.40 (1.15 – 1.71)

Notes: \*At the baseline of our cohort, we had asked the participants “How many times have you experienced binge drinking in the past year?” Based on their responses to this item, we further categorized the subjects with current high alcohol consumption into two groups: current: high and not experiencing binge drinking, and current: high and experiencing binge drinking at least once a year.



**Table S5. Summary of Risk Factors: Definitions, Measurement Methods, and Categorizations for the Calculation of Population Attributable Fractions (PAFs), related to STAR Methods**

Risk Factor	Measurement and definition	Risk category	Reference category
<b>Social determinants</b>			
<b>Individual Level</b>			
Educational attainment	Education was self-reported, and classified into three groups: primary school or less, middle school education, or high school or above).	Low educational attainment (primary school or less, middle school education)	High school or above
Marital status	Marital status was self-reported and categorized as married or having a partner; single, divorced, separated, or widowed.	Single, divorced, separated, or widowed	Married or having a partner
Living arrangements	Living arrangements were self-reported and categorized as living with children and/or a spouse; or living alone.	Living alone	Living with children and/or a spouse
Depression	Depression was assessed with the self-reported Patient Health Questionnaire 9 (PHQ-9). The PHQ-9 consists of nine items based on the Diagnostic and Statistical Manual of Mental Disorders, 4 <sup>th</sup> edition (DSM-IV). Participants were asked how often they had been bothered by nine psychiatric symptoms over the past 2 weeks. Each of the nine items is scored as 0, 1, 2, or 3, which represents symptom severity of 'not at all', 'several days', 'more than half the days', or 'nearly every day', respectively. The nine items are summed to give the PHQ-9 total score. A score of $\geq 10$ represents moderate or severe depression. <sup>1</sup>	Moderate or severe depression (PHQ-9 score $\geq 10$ )	PHQ-9 score $< 10$
<b>Community level</b>			
Gross domestic product per capita	Gross domestic product per capita was retrieved from the Statistical Report on the National Economy and Social Development for each city in 2011. Participants were categorized into two groups using a cut-off value equal to the average gross domestic product per capita in China in 2011 (5614.4 US\$, 36,262 Chinese Yuan [CNY]) according to World Bank data. <sup>2</sup>	Low gross domestic product per capita ( $< 5614.4$ US\$)	$\geq 5614.4$ US\$
Ambient fine particulate matter (PM <sub>2.5</sub> ) air pollution	Data on the annual average residential PM <sub>2.5</sub> exposure in 2011 for each city were collected from the Global Annual PM <sub>2.5</sub> Grids, <sup>3</sup> which combines AOD retrievals from multiple satellite algorithms including the NASA MODerate resolution Imaging Spectroradiometer Collection 6.1 (MODIS C6.1), Multi-angle Imaging SpectroRadiometer Version 23 (MISRv23), MODIS Multi-Angle Implementation of Atmospheric Correction Collection 6 (MAIAC C6), and the Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) Deep Blue Version 4. Participants were categorized into two groups using a cut-off value equal to the upper quartile of PM <sub>2.5</sub> levels in our study (59.11 $\mu\text{g}/\text{m}^3$ ) according to World Health Organization [WHO] data. <sup>4</sup>	High PM <sub>2.5</sub> ( $> 59.11$ $\mu\text{g}/\text{m}^3$ )	$\leq 59.11$ $\mu\text{g}/\text{m}^3$
<b>Lifestyle factors</b>			
Tobacco use	Self-reported tobacco use using a standard tobacco use frequency questionnaire, categorized as never, former, or current. Never: never smoked or had not smoked cigarettes regularly ( $< 100$ cigarettes in a lifetime). Former: not currently smoking cigarettes but had smoked at least 7 cigarettes/week for at least 6 months in a lifetime. Current: smoke every day or almost every day, with at least 7 cigarettes/week for at least 6 months.	Current or former tobacco use	Never tobacco use
Alcohol consumption	Self-reported alcohol consumption using a standard alcohol consumption frequency questionnaire, categorized as never, former, or current. Never: never consumed alcohol. Former: not currently but had consumed alcohol once per week regularly for at least 6 months in a lifetime. Current: consumed alcohol once per week regularly during the past 6 months. Current drinkers' alcohol consumption was further classified as low ( $\leq 7$ drinks/week), moderate (8-21 drinks/week for men and 8-14 drinks/week for women), or high ( $> 21$ drinks/week for men and $> 14$ drinks/week for women).	Heavy alcohol consumption (Former, or high current consumption)	Never, or low or moderate current consumption
Diet score	Diet score was calculated according to recommendations from the American Heart Association, though whole grain consumption was replaced with bean consumption. <sup>5,6</sup> It was calculated as the sum of each of the following components: fruits and vegetables $\geq 4.5$ cups/day (1 point); fish $\geq 198$ g/week (1 point); sweets/sugar-sweetened beverages $\leq 450$ kcal/week (1 point); and soy protein $\geq 25$ g/day (1 point). Diet score was categorized into poor (0-1), intermediate (2), or healthy (3-4).	Unhealthy diet (Diet score: 0-2)	Diet score: 3-4
Physical activity	Physical activity was evaluated using the International Physical Activity Questionnaire, <sup>7</sup> and categorized as low ( $< 600$ metabolic equivalents [MET] $\times$ minutes per week or $< 150$ minutes per week of moderate intensity physical activity), moderate (600-3,000 MET $\times$ minutes or 150-750 minutes per week) or high ( $> 3000$ MET $\times$ minutes or $> 750$ minutes per week). <sup>8,9</sup>	Low physical activity	Moderate or high physical activity
Sleep duration	Sleep duration was self-reported with standardized questions and defined as the interval between evening bedtime and morning wake-up time. It was categorized into three groups ( $< 6$ hours/night, 6-8 hours/night, and $> 8$ hours/night). <sup>10-12</sup>	Long sleep duration ( $> 8$ hours/night)	Sleep duration $\leq 8$ hours/night
<b>Metabolic risk factors</b>			
Abdominal obesity	Waist and hip circumference were measured and used to calculate the waist-to-hip ratio (WHR). Abdominal obesity was defined as WHR $\geq 0.95$ for men and $\geq 0.90$ for women. <sup>13</sup>	Abdominal obesity (WHR $\geq 0.95$ in men and $\geq 0.90$ in women)	WHR $< 0.95$ in men and $< 0.90$ in women
Hypertension	Three blood pressure measurements were obtained with participants in a seated position after five minutes of quiet rest using an automated electronic device (OMRON Model HEM-752 FUZZY, Dalian, China). Hypertension was defined as a systolic blood pressure $\geq 140$ mmHg or diastolic blood pressure $\geq 90$ mmHg using the mean of three readings; or treatment with antihypertensive medications.	Definition of hypertension met	Definition of hypertension not met
Diabetes	Fasting and 2-hour postload glucose levels were measured using a glucose oxidase or hexokinase method. Hemoglobin A1c was measured using high-performance liquid chromatography (VARIANT II System, Bio-Rad Laboratories, CA, USA). Diabetes was defined as fasting glucose $\geq 7.0$ mmol/L or 2-hour postload glucose $\geq 11.1$ mmol/L; hemoglobin A1c $\geq 48$ mmol/mol (6.5%); self-reported history of diabetes. <sup>14</sup>	Definition of diabetes met	Definition of diabetes not met
Low-density lipoprotein cholesterol (LDL-C)	Serum fasting LDL-C was measured using an auto-analyzer (ARCHITECT ci16200 analyzer, Abbott Laboratories, Illinois, USA). LDL-C was divided into three subgroups: $< 3.4$ mmol/L ( $< 130$ mg/dL), $\geq 3.4$ and $< 4.9$ mmol/L (130-190 mg/dL), and $\geq 4.9$ mmol/L ( $\geq 190$ mg/dL). <sup>15-16</sup>	High LDL-C (LDL-C $\geq 3.4$ mmol/L [130 mg/dL])	LDL-C $< 3.4$ mmol/L (130 mg/dL)
Albuminuria	Urinary albumin concentration was measured by immunonephelometry using Siemens BNII and BN ProSpec nephelometers (Siemens Healthcare Diagnostics, Marburg, Germany). Urinary creatinine was determined by an enzymatic method (ADVIA Chemistry XPT System; Siemens Healthcare, Erlangen, Germany). Urine albumin-creatinine ratio was calculated. Albuminuria was defined as microalbuminuria (urine albumin-creatinine ratio: 30-299 mg/g) or macroalbuminuria (urine albumin-creatinine ratio $\geq 300$ mg/g). <sup>17</sup>	Albuminuria (Urine albumin-creatinine ratio $\geq 30$ mg/g)	Urine albumin-creatinine ratio $< 30$ mg/g
Low estimated glomerular filtration rate	Serum fasting creatinine was measured using an auto-analyzer (ARCHITECT ci16200 analyzer, Abbott Laboratories, Illinois, USA). Estimated glomerular filtration rate was calculated using the Chronic Kidney Disease-Epidemiology Collaboration equation. <sup>18</sup>	Low estimated glomerular filtration rate (estimated glomerular filtration rate $< 60$ ml/min per 1.73m <sup>2</sup> )	Estimated glomerular filtration rate $\geq 60$ ml/min per 1.73m <sup>2</sup>

**Table S6. Spearman correlation coefficients across risk factors, related to STAR Methods**

	Spearman correlation coefficients																
	RF1	RF2	RF3	RF4	RF5	RF6	RF7	RF8	RF9	RF10	RF11	RF12	RF13	RF14	RF15	RF16	RF17
RF1	1.00	0.32	-0.01	0.03	0.01	-0.06	0.02	0.02	-0.04	-0.01	<0.01	-0.02	-0.01	-0.06	-0.02	<0.01	-0.02
RF2	0.32	1.00	-0.01	0.03	0.01	-0.02	0.06	0.02	-0.02	0.01	<0.01	0.04	0.01	-0.03	-0.01	<0.01	<0.01
RF3	-0.01	-0.01	1.00	0.05	0.07	0.01	0.03	0.01	-0.01	0.04	0.01	-0.05	0.07	0.02	0.01	<0.01	0.11
RF4	0.03	0.03	0.05	1.00	0.11	-0.01	-0.02	-0.05	-0.03	0.02	-0.01	0.08	0.11	-0.03	-0.03	<0.01	-0.01
RF5	0.01	0.01	0.07	0.11	1.00	-0.01	0.05	-0.01	<0.01	0.07	0.02	0.09	0.16	-0.02	-0.01	-0.02	0.06
RF6	-0.06	-0.02	0.01	-0.01	-0.01	1.00	0.11	0.14	0.06	0.07	0.04	-0.01	0.07	0.05	0.02	0.01	0.02
RF7	0.02	0.06	0.03	-0.02	0.05	0.11	1.00	0.16	0.07	0.18	0.07	0.10	0.10	0.02	0.01	-0.01	0.07
RF8	0.02	0.02	0.01	-0.05	-0.01	0.14	0.16	1.00	0.06	0.12	0.06	<0.01	0.02	0.02	0.02	0.01	0.03
RF9	-0.04	-0.02	-0.01	-0.03	<0.01	0.06	0.07	0.06	1.00	0.03	0.02	0.03	-0.01	0.02	0.01	<0.01	0.07
RF10	-0.01	0.01	0.04	0.02	0.07	0.07	0.18	0.12	0.03	1.00	0.12	0.04	0.08	0.03	0.02	<0.01	0.06
RF11	<0.01	<0.01	0.01	-0.01	0.02	0.04	0.07	0.06	0.02	0.12	1.00	-0.02	0.02	0.04	0.02	<0.01	-0.03
RF12	-0.02	0.04	-0.05	0.08	0.09	-0.01	0.10	<0.01	0.03	0.04	-0.02	1.00	0.07	-0.04	-0.01	<0.01	0.28
RF13	-0.01	0.01	0.07	0.11	0.16	0.07	0.10	0.02	-0.01	0.08	0.02	0.07	1.00	0.03	0.01	-0.02	0.03
RF14	-0.06	-0.03	0.02	-0.03	-0.02	0.05	0.02	0.02	0.02	0.03	0.04	-0.04	0.03	1.00	0.50	0.03	-0.02
RF15	-0.02	-0.01	0.01	-0.03	-0.01	0.02	0.01	0.02	0.01	0.02	0.02	-0.01	0.01	0.50	1.00	0.04	-0.03
RF16	<0.01	<0.01	<0.01	<0.01	-0.02	0.01	-0.01	0.01	<0.01	<0.01	<0.01	<0.01	-0.02	0.03	0.04	1.00	-0.02
RF17	-0.02	<0.01	0.11	-0.01	0.06	0.02	0.07	0.03	0.07	0.06	-0.03	0.28	0.03	-0.02	-0.03	-0.02	1.00

Spearman correlation analysis is conducted based on 174,004 participants after imputation.

RF1 = Tobacco use; RF2 = Alcohol excess; RF3 = Unhealthy diet; RF4 = Low physical activity; RF5 = Long sleep duration; RF6 = Abdominal obesity; RF7 = Hypertension; RF8 = Diabetes; RF9 = High low-density lipoprotein cholesterol; RF10 = Albuminuria; RF11 = Low estimated glomerular filtration rate; RF12 = Low gross domestic product per capita; RF13 = Low education; RF14 = Single, divorced, separated, or widowed; RF15 = Living alone; RF16 = Depression; RF17 = High ambient PM<sub>2.5</sub> air pollution

**Table S7. Multicollinearity diagnostics of all the risk factors, related to STAR Methods**

	<b>Eigen Value</b>	<b>Condition Index</b>	<b>Tolerance</b>	<b>Variance Inflation</b>
<b>RF1</b>	1.43	2.09	0.89	1.13
<b>RF2</b>	1.15	2.33	0.89	1.12
<b>RF3</b>	1.06	2.42	0.97	1.03
<b>RF4</b>	0.99	2.51	0.97	1.04
<b>RF5</b>	0.86	2.70	0.95	1.05
<b>RF6</b>	0.81	2.78	0.96	1.04
<b>RF7</b>	0.78	2.83	0.92	1.09
<b>RF8</b>	0.69	3.01	0.94	1.06
<b>RF9</b>	0.64	3.12	0.98	1.02
<b>RF10</b>	0.59	3.26	0.94	1.07
<b>RF11</b>	0.58	3.28	0.98	1.02
<b>RF12</b>	0.52	3.48	0.89	1.12
<b>RF13</b>	0.49	3.55	0.94	1.06
<b>RF14</b>	0.45	3.71	0.74	1.35
<b>RF15</b>	0.40	3.95	0.75	1.34
<b>RF16</b>	0.26	4.92	1.00	1.00
<b>RF17</b>	0.07	9.56	0.90	1.11

Regression analysis is conducted based on 174,004 participants after imputation with all-cause mortality as dependent variables and 17 individual risk factors as independent variables.

RF1 = Tobacco use; RF2 = Alcohol excess; RF3 = Unhealthy diet; RF4 = Low physical activity; RF5 = Long sleep duration; RF6 = Abdominal obesity; RF7 = Hypertension; RF8 = Diabetes; RF9 = High low-density lipoprotein cholesterol; RF10 = Albuminuria; RF11 = Low estimated glomerular filtration rate; RF12 = Low gross domestic product per capita; RF13 = Low education; RF14 = Single, divorced, separated, or widowed; RF15 = Living alone; RF16 = Depression; RF17 = High ambient PM<sub>2.5</sub> air pollution

**Table S8. ICD-10 Codes used in the 4C study for causes of death, related to STAR Methods**

<b>Causes of death</b>	<b>ICD-10 codes</b>
Cardiovascular disease	I00-I99
Fatal ischemic heart disease	I20-I25
Fatal stroke	I60-I64, I69
Fatal congestive heart failure	I50
Other cardiovascular deaths	I00-I99 (not including I20-I25, I50, I60-I64, I69)
Cancer	C00-C97, D00-D09
Renal disease	N17-N19
Diabetes mellitus	E10-E14
Respiratory disease (exclude pneumonia)	J20-J99
Pneumonia	J12-J18
Other infectious disease	A00-A99, B00-B09, B20-B99
Liver disease	B15-B19, K70-K77
Alzheimer's and related conditions	F00-F03, G30-G32
Injury and external causes	S00-W99, X00-X59, X85-X99, Y00-Y09, Y85-Y86
Intentional self-harm	X60-X84, Y87.0
All other causes combined	



**Table S9. Variables used in the imputation algorithm, related to STAR Methods**

Demographic factors	age, sex, study center
Lifestyle factors	tobacco use, alcohol consumption, sleep duration, physical activity, and diet score
Social determinants factors	educational attainment, marital status, living arrangements, urban/rural region, depression, and PM <sub>2.5</sub> air pollution
Family medical history	family history of cancer, family history of diabetes, family history of coronary heart disease, and family history of stroke
Health status	previous diagnosis of diabetes, current oral antidiabetic medication use, current insulin treatment, history of cardiovascular disease, current antihypertensive medication use, current lipid-lowering medication use, history of cancer, and previous diagnosis of hypertension
Physical examination	body mass index, waist-to-hip ratio, systolic blood pressure, and diastolic blood pressure
Biochemical measures	fasting glucose, 2-hour post-load glucose, hemoglobin A1c, fasting insulin, high-density lipoprotein cholesterol, low-density lipoprotein cholesterol, triglycerides, total cholesterol, alanine transaminase, aspartate transaminase, glutamyl-transpeptidase, urinary albumin-creatinine ratio, and creatinine
Outcome at follow-up	all-cause mortality, ischemic heart disease mortality, stroke mortality, cancer mortality and the time to death or the last follow-up.

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