Supplementary Table 1: List of included and excluded Disease Surveillance Point sites.

Site	Sites in disease surveillance points system		
	Total	Included	Excluded
Beijing	7	7	0
Tianjin	7	7	0
Hebei	30	30	0
Shanxi	20	20	0
Inner Mongolia	20	20	0
Liaoning	22	22	0
Jilin	15	15	0
Heilongjiang	27	27	0
Shanghai	7	7	0
Jiangsu	27	27	0
Zhejiang	22	22	0
Anhui	24	24	0
Fujian	20	20	0
Jiangxi	20	20	0
Shandong	31	29	2
Henan	36	31	5
Hubei	22	22	0
Hunan	28	28	0
Guangdong	28	28	0
Guangxi	21	21	0
Hainan	8	7	1
Chongqing	11	11	0
Sichuan	31	31	0
Guizhou	20	20	0
Yunnan	25	25	0
Tibet	8	8	0
Shaanxi	13	12	1
Gansu	20	20	0
Qinghai	10	10	0
Ningxia	10	10	0
Xinjiang	15	14	1
Total	605	595	10

Supplementary Table 2: Grouping of CVD causes and mapping of ICD codes.

CVD cause	ICD-10 code
Total CVD	I00–I99
Heart disease	I05–I09, I10–I15, I20–I25, I30–I52
IHD	I20–I25
HHD*	I10–I15
RHD	I05–I09
Other heart disease	I30–I52
Cerebrovascular disease	I60–I69
HS	I60–I62
IS	I63
US	I64
Sequelae of stroke	I69.0–I69.4
Hypertensive encephalopathy	I67.4
Other cerebrovascular disease	I65–I69, except for I67.4, I69.0–I69.4
Other CVD	I00–I02, I26–I28, I70–I99

*The ICD-10 code ranges mapped to HHD included codes for essential hypertension (I10), secondary hypertension (I15), and hypertensive renal disease (I12). In line with the redistribution method of Global Health Estimates, 30% of HHD were redistributed to IHD and 10% were redistributed to other chronic kidney disease. CVD: Cardiovascular disease; HHD: Hypertensive heart disease; HS: Hemorrhagic stroke; ICD: International Classification of Disease; ICD-10, the 10th version of the ICD; IHD: International Classification of Disease; IHD: Ischemic heart disease; IS: Ischemic stroke; RHD: Rheumatic heart disease; US: Unspecific stroke.

Supplementary Table 3: List of ill-defined CVD causes of death.

Ill-defined CVD causes	ICD-10 Code
Chronic cardiopulmonary diseases	I27.9
Cardiac arrest	I46
Ventricular tachycardia	I47.2
Ventricular fibrillation and flutter	I49.0
Heart failure	I50
Myocarditis, unspecified	I51.4
Myocardial, degeneration	I51.5
CVD, unspecified	I51.6
Heart disease, unspecified	I51.9
Generalized and unspecified atherosclerosis	I70.9

CVD: Cardiovascular disease; ICD: International Classification of Disease; ICD-10, the 10th revision of the ICD.

Supplementary Table 4: Redistribution fractions for ill-defined CVD causes of death (ICD-10 codes: I46, I47.2, I49.0, I50, I51.4, I51.5, I51.6, I51.9, and I70.9).

Age (years)	Redistribution fractions of garbage causes to the target causes							
	Males, %				Females, %			
	IHD	Cardiomyopathy, myocarditis, endocarditis	COPD	Congenital heart anomalies	IHD	Cardiomyopathy, myocarditis, endocarditis	COPD	Congenital heart anomalies
0-	0	3	1	96	0	3	1	96
1-	1	9	4	85	1	10	3	86
5-	4	15	5	77	3	15	4	78
10-	8	23	5	63	7	22	5	67
15-	39	24	6	32	30	23	6	42
20-	59	21	5	15	44	23	6	26
25-	69	19	5	8	53	23	7	17
30-	75	16	5	4	65	19	7	9
35-	79	14	5	2	72	16	7	5
40-	82	12	6	1	77	12	9	2
45-	83	9	7	1	78	10	11	1
50-	90	0	10	0	85	0	15	0
55-	86	0	14	0	82	0	18	0
60-	82	0	18	0	79	0	21	0
65-	77	0	23	0	77	0	23	0
70-	72	0	28	0	75	0	25	0
75-	68	0	32	0	74	0	26	0
80-	66	0	34	0	73	0	27	0
85-	66	0	34	0	74	0	26	0

COPD: Chronic obstructive pulmonary diseases; CVD: Cardiovascular diseases; ICD: International Classification of Disease; IHD: Ischemic heart diseases.

Supplementary Table 5: Trends in age-standardized mortality rates of total and each subtype of CVD in sex-specific Chinese population, 2013–2018.

Parameters	Age-standardized mortality rate*, per 100,000 (95% CI)						APC (9
	In 2013	In 2014	In 2015	In 2016	In 2017	In 2018	CI),
Males							
Total CVD	341.55 (340.51, 342.59)	338.72 (337.73, 339.72)	334.12 (333.15, 335.11)	332.78 (331.83, 333.74)	329.02 (328.08, 329.96)	326.29 (325.37, 327.20)	−0.9 (−1.05, −
Heart disease	159.21 (158.5, 159.92)	159.39 (158.71, 160.07)	157.12 (156.45, 157.79)	157.45 (156.8, 158.11)	157.92 (157.27, 158.58)	159.29 (158.65, 159.93)	−0.0 (−0.54,
IHD	133.79 (133.14, 134.45)	135.86 (135.24, 136.5)	135.89 (135.27, 136.51)	137.73 (137.12, 138.34)	138.12 (137.51, 138.73)	139.84 (139.24, 140.44)	0.8 (0.57, 1
HHD	19.14 (18.9, 19.39)	16.98 (16.76, 17.2)	15.22 (15.01, 15.43)	14.14 (13.95, 14.34)	13.99 (13.79, 14.18)	13.76 (13.57, 13.94)	−6.5 (−9.94, −
RHD	3.25 (3.15, 3.36)	3.26 (3.16, 3.36)	2.83 (2.74, 2.92)	2.66 (2.58, 2.75)	2.79 (2.7, 2.88)	2.68 (2.6, 2.77)	−4.2 (−7.68, −
Other heart disease	3.02 (2.92, 3.12)	3.28 (3.18, 3.38)	3.18 (3.09, 3.28)	2.92 (2.83, 3.01)	3.03 (2.93, 3.12)	3.01 (2.92, 3.11)	−0.9 (−3.81,
Cerebrovascular disease	175.26 (174.52, 176.01)	172.57 (171.86, 173.28)	171.29 (170.59, 171.99)	169.87 (169.19, 170.56)	166.03 (165.37, 166.7)	161.87 (161.23, 162.52)	−1.4 (−1.98, −
HS	84.76 (84.24, 85.27)	82.25 (81.76, 82.74)	79 (78.52, 79.48)	74.99 (74.54, 75.45)	71.2 (70.77, 71.65)	66.94 (66.52, 67.36)	−4.7 (−5.51, −
IS	49.75 (49.36, 50.15)	51.66 (51.27, 52.05)	51.61 (51.23, 52)	50.99 (50.62, 51.36)	49.69 (49.33, 50.06)	49.36 (49.01, 49.72)	−0.4 (−1.84,
US	8.3 (8.14, 8.47)	7.61 (7.46, 7.76)	6.85 (6.71, 6.99)	6.76 (6.62, 6.9)	6.06 (5.93, 6.19)	5.89 (5.76, 6.01)	−6.8 (−8.66, −
Sequelae of stroke	21.13 (20.87, 21.39)	21.14 (20.9, 21.39)	24.69 (24.42, 24.96)	28.68 (28.4, 28.96)	31.43 (31.14, 31.72)	32.9 (32.61, 33.19)	10.1 (7.08, 1
Hypertensive encephalopathy	7.02 (6.87, 7.17)	6.2 (6.07, 6.34)	5.69 (5.56, 5.82)	5.32 (5.2, 5.44)	4.42 (4.31, 4.53)	3.85 (3.75, 3.95)	−11. (−14.08,
Other cerebrovascular	4.3 (4.18, 4.42)	3.72 (3.62, 3.83)	3.46 (3.36, 3.56)	3.13 (3.04, 3.22)	3.23 (3.13, 3.32)	2.94 (2.85, 3.03)	−6.9 (−10.16,

disease							
Other CVD	7.08 (6.93, 7.23)	6.77 (6.63, 6.91)	5.71 (5.59, 5.85)	5.45 (5.33, 5.58)	5.06 (4.94, 5.18)	5.12 (5.01, 5.24)	−7.2 (−10.53,
Females							
Total CVD	240.00 (239.18, 240.82)	236.06 (235.28, 236.84)	232.28 (231.53, 233.04)	229.95 (229.21, 230.68)	225.31 (224.6, 226.03)	220.93 (220.24, 221.62)	−1.6 (−1.81, −
Heart disease	118.17 (117.6, 118.74)	117.7 (117.16, 118.25)	115.41 (114.89, 115.94)	115.4 (114.88, 115.91)	114.63 (114.13, 115.14)	113.49 (113, 113.98)	−0.8 (−1.09, −
Ischemic heart disease	97.71 (97.19, 98.23)	98.51 (98.01, 99.01)	97.9 (97.41, 98.38)	99.07 (98.59, 99.55)	98.82 (98.35, 99.29)	97.77 (97.32, 98.23)	0.0 (−0.36,
Hypertensive heart disease	14.68 (14.48, 14.88)	13.04 (12.86, 13.22)	11.99 (11.82, 12.16)	11.22 (11.06, 11.38)	10.87 (10.71, 11.02)	10.7 (10.55,10.85)	−6.2 (−8.89, −
Rheumatic heart disease	3.91 (3.8, 4.02)	4.06 (3.95, 4.17)	3.62 (3.52, 3.72)	3.26 (3.17, 3.35)	3.16 (3.08, 3.25)	3.24 (3.15, 3.32)	−5.1 (−8.53, −
Other heart disease	1.87 (1.8, 1.95)	2.1 (2.02, 2.18)	1.91 (1.84, 1.98)	1.85 (1.78, 1.92)	1.79 (1.72, 1.86)	1.78 (1.71, 1.85)	−2.1 (−5.48,
Cerebrovascular disease	117.24 (116.66, 117.81)	113.9 (113.36, 114.45)	113.01 (112.48, 113.54)	111.12 (110.6, 111.63)	107.55 (107.06, 108.05)	104.36 (103.88, 104.84)	−2.2 (−2.76, −
Hemorrhagic stroke	53.68 (53.28, 54.07)	51.48 (51.11, 51.85)	49.27 (48.92, 49.63)	46.79 (46.45, 47.13)	43.77 (43.45, 44.1)	40.8 (40.49, 41.11)	−5.4 (−6.31,
Ischemic stroke	34.41 (34.1, 34.72)	35.31 (35.01, 35.61)	35.5 (35.2, 35.79)	34.67 (34.39, 34.95)	33.49 (33.22, 33.76)	33.28 (33.01, 33.55)	−1.0 (−2.41,
Unspecific stroke	6.32 (6.19, 6.45)	5.57 (5.46, 5.69)	4.99 (4.88, 5.1)	4.81 (4.71, 4.92)	4.52 (4.42, 4.62)	4.27 (4.18, 4.37)	−7.5 (−9.72, −
Sequelae of stroke	15.11 (14.91, 15.32)	15.12 (14.92, 15.31)	17.21 (17.01, 17.42)	19.52 (19.31, 19.74)	20.71 (20.5, 20.93)	21.53 (21.31, 21.74)	8.1 (5.52, 1
Hypertensive encephalopathy	4.74 (4.63, 4.86)	3.85 (3.75, 3.95)	3.64 (3.54, 3.73)	3.23 (3.14, 3.32)	2.84 (2.76, 2.93)	2.44 (2.37, 2.52)	−12. (−14.72, −
Other cerebrovascular disease	2.98 (2.89, 3.07)	2.58 (2.5, 2.66)	2.4 (2.32, 2.48)	2.09 (2.02, 2.16)	2.22 (2.15, 2.3)	2.03 (1.97, 2.1)	−7.1 (−11.08,
Other CVD	4.59 (4.48, 4.71)	4.45 (4.34, 4.56)	3.86 (3.77, 3.97)	3.44 (3.34, 3.53)	3.12 (3.04, 3.21)	3.08 (3, 3.17)	−9.0 (−11.70,

*Age-standardized mortality rate was computed with the direct method using the standard population structure from China's 2010 census conducted by the NBS. APC: Annual percentage change; CI: Confidence interval; CVD: Cardiovascular disease; HHD: Hypertensive heart disease; HS: Hemorrhagic stroke; IHD: Ischemic heart disease; IS: Ischemic stroke; NBS: National Bureau of Statistics; RHD: Rheumatic heart disease; US: Unspecific stroke.

Supplementary Table 6: Trends in LE at birth in overall and sex-specific Chinese population, 2013–2018.

Parameters	Life expectancy at birth (95% UI), years					
	In 2013	In 2014	In 2015	In 2016	In 2017	In 2018
Total population	75.66 (75.56, 75.77)	76.00 (75.93, 76.08)	76.29 (76.20, 76.39)	76.51 (76.42, 76.62)	76.76 (76.67, 76.84)	77.04 (76.96, 77.12)
Male	72.99 (72.90, 73.11)	73.29 (73.18, 73.39)	73.55 (73.44, 73.65)	73.80 (73.72, 73.89)	74.00 (73.91, 74.1)	74.29 (74.21, 74.39)
Female	78.69 (78.58, 78.79)	79.07 (78.98, 79.16)	79.36 (79.28, 79.45)	79.56 (79.47, 79.64)	79.86 (79.77, 79.94)	80.12 (80.03, 80.20)

LE: Life expectancy; UI: Uncertainty interval.

Supplementary Table 7: Age- and cause-specific contributions to gains in LE at birth in overall and sex-specific Chinese population, 2013–2018.

Parameters	Contributions to gains in life expectancy at birth from 2013 to 2018, years (%)			
	<15 years	15–64 years	≥65 years	Total
Total population				
All cause	0.35	0.45	0.58	1.38
Total CVD	0.007 (2.14)	0.09 (20.60)	0.19 (32.83)	0.29 (21.15)
Heart disease	0.001 (0.4)	0.01 (2.74)	0.03 (4.62)	0.04 (2.95)
IHD	0.002 (0.59)	−0.01 (−2.56)	−0.03 (−5.84)	−0.04 (−3.16)
HHD	0 (0.06)	0.02 (4.12)	0.05 (9.41)	0.07 (5.34)
RHD	0 (0)	0.01 (1.45)	0.004 (0.76)	0.01 (0.79)
Other heart disease	−0.001 (−0.37)	−0.001 (−0.27)	0.002 (0.3)	−0.001 (−0.06)

Cerebrovascular disease	0.006 (1.74)	0.08 (17.1)	0.14 (24.37)	0.22 (16.32)
HS	0.004 (1.12)	0.07 (15.97)	0.17 (29.9)	0.25 (18.14)
IS	0 (0)	0.01 (1.62)	0.01 (1.3)	0.01 (1.08)
US	0 (0)	0.004 (0.97)	0.03 (5.01)	0.03 (2.44)
Sequelae of stroke	0 (0)	−0.02 (−4.73)	−0.12 (−19.76)	−0.14 (−9.9)
Hypertensive encephalopathy	0 (0.01)	0.01 (2.29)	0.03 (5.59)	0.04 (3.11)
Other cerebrovascular disease	0 (0.09)	0.004 (0.99)	0.01 (2.32)	0.02 (1.33)
Other CVD	0 (0.01)	0.003 (0.76)	0.02 (3.85)	0.03 (1.88)
Males				
All cause	0.38	0.48	0.44	1.3
Total CVD	0.009 (2.25)	0.04 (7.51)	0.15 (35.09)	0.2 (15.27)
Heart disease	0.001 (0.33)	−0.03 (−5.39)	0.02 (4.53)	−0.005 (−0.37)
Ischemic heart disease	0.003 (0.67)	−0.05 (−9.68)	−0.03 (−7.78)	−0.08 (−6.01)
Hypertensive heart disease	0 (0.09)	0.02 (3.73)	0.05 (11.1)	0.07 (5.15)
Rheumatic heart disease	0 (0)	0.005 (0.99)	0.004 (0.85)	0.01 (0.65)
Other heart disease	−0.002 (−0.51)	−0.002 (−0.43)	0.002 (0.36)	−0.002 (−0.19)
Cerebrovascular disease	0.007 (1.84)	0.06 (12.63)	0.11 (25.99)	0.18 (13.97)
Hemorrhagic stroke	0.004 (1.1)	0.07 (14.33)	0.15 (35.07)	0.23 (17.44)
Ischemic stroke	0 (0.02)	0.002 (0.49)	0.005 (1.08)	0.01 (0.55)
Unspecific stroke	0 (0)	0.004 (0.76)	0.02 (5.37)	0.03 (2.09)
Sequelae of stroke	0 (0)	−0.03 (−6)	−0.11 (−24.84)	−0.14 (−10.59)
Hypertensive encephalopathy	0 (0)	0.01 (2.11)	0.03 (6.53)	0.04 (2.98)
Other cerebrovascular disease	0.001 (0.17)	0.004 (0.92)	0.01 (2.78)	0.02 (1.33)
Other CVD	0 (0.08)	0.001 (0.27)	0.02 (4.56)	0.02 (1.66)
Females				
All cause	0.3	0.39	0.74	1.43
Total CVD	0.006 (2.1)	0.15 (37.22)	0.23 (31.85)	0.39 (27.01)
Heart disease	0.001 (0.49)	0.05 (13.59)	0.04 (5.38)	0.094 (6.58)
Ischemic heart disease	0.002 (0.56)	0.03 (6.76)	−0.03 (−3.81)	0 (0)
Hypertensive heart disease	0 (0.02)	0.02 (4.58)	0.06 (8.22)	0.08 (5.49)
Rheumatic heart disease	0 (0)	0.009 (2.23)	0.005 (0.73)	0.01 (0.98)
Other heart disease	−0.001 (−0.29)	0 (−0.02)	0.002 (0.24)	0.001 (0.06)
Cerebrovascular disease	0.005 (1.72)	0.09 (22.2)	0.17 (23.19)	0.26 (18.37)

Hemorrhagic stroke	0.004 (1.25)	0.07 (17.48)	0.19 (25.77)	0.26 (18.32)
Ischemic stroke	0 (–0.03)	0.011 (2.86)	0.011 (1.48)	0.02 (1.54)
Unspecific stroke	0 (0)	0.005 (1.15)	0.04 (4.82)	0.04 (2.8)
Sequelae of stroke	0 (0)	–0.01 (–2.87)	–0.12 (–15.73)	–0.13 (–8.89)
Hypertensive encephalopathy	0 (0)	0.01 (2.5)	0.04 (4.88)	0.05 (3.2)
Other cerebrovascular disease	0 (0.04)	0.004 (1.07)	0.01 (1.97)	0.02 (1.32)
Other CVD	0 (–0.11)	0.006 (1.43)	0.02 (3.28)	0.03 (2.06)

US: Unspecific stroke.

Supplementary Table 8: Potential gains in LE in overall and sex-specific Chinese population, under different assumptions of the declining tendency in probability of premature CVD deaths.

Parameters	Total population		Males		Females	
	Scenario 1*	Scenario 2†	Scenario 1*	Scenario 2†	Scenario 1*	Scenario 2†
Total CVD	0.44	0.49	0.27	0.58	0.50	0.36
Heart disease	0.12	0.22	–0.01	0.27	0.20	0.16
IHD	0.01	0.19	–0.12	0.23	0.11	0.13
HHD	0.04	0.02	0.05	0.02	0.04	0.01
RHD	0.02	0.01	0.01	0.01	0.02	0.01
Other heart disease	0.01	0.01	0.004	0.01	0.01	0.004
Cerebrovascular disease	0.29	0.25	0.23	0.29	0.29	0.18
HS	0.26	0.15	0.27	0.17	0.21	0.11
IS	0.05	0.05	0.02	0.06	0.06	0.04
US	0.02	0.01	0.02	0.01	0.01	0.01
Sequelae of stroke	–0.26	0.02	–0.40	0.02	–0.13	0.02
Hypertensive encephalopathy	0.02	0.01	0.03	0.01	0.02	0.01
Other cerebrovascular disease	0.01	0.005	0.01	0.01	0.01	0.004
Other CVD	0.02	0.01	0.02	0.01	0.02	0.01

*Scenario 1: Assuming the probability of premature CVD deaths keeps the current declining tendency rather than remains the original levels in 2015.

†Scenario 2: Assuming the probability of premature CVD deaths decreased by 30% (target of The Health China 2030 Plan) rather than remaining the same as the original levels in 2015. CVD: Cardiovascular disease; HHD: Hypertensive heart disease; HS: Hemorrhagic stroke; IHD: Ischemic heart disease; IS: Ischemic stroke; LE: Life expectancy; RHD: Rheumatic heart disease; US: Unspecific stroke.

Details of Analytical Strategies

The probability of premature deaths

The probability of premature deaths, which reflected the unconditional probability of dying between exact ages 30 and 70 from a specific cause, was estimated with the standard life table method.[1]

First, we translated the mortality for cause *a* from age *x* to *x* + 5 into the 5-year probability of dying from cause a, assuming the mortality rates are constant in each 5-year age group:

$$q^{a}_{[x,x+5)} = 1 - e^{-M^{i,t}_{[x,x+5)}*5} \quad (1.1)$$

where $x = 30, 35, \ldots, 65$

Then, the survival probability for cause a between exact ages 30 and 70 could be estimated as:

$$p^{a}_{[30,70)} = \prod_{x=30}^{65} (1 - q^{a}_{[x,x+5)}) \quad (1.2)$$

And the unconditional probability of premature deaths for cause a in age 30–70 years was calculated as:

$$q^{a}_{[30,70)} = 1 - \prod_{x=30}^{65} (1 - q^{a}_{[x,x+5)}) \quad (1.3)$$

To further estimate the 95% confidence interval (CI) of $q^{a}_{[30,70)}$, we first calculated the variance of $q^{a}_{[x,x+5)}$:

$$S^2_{q^a_{[x,x+5)}} = \frac{1}{Death_{[x,x+5)}} \times {q^a_{[x,x+5)}}^2 \times (1 - q^a_{[x,x+5)}) \qquad (1.4)$$

where $Death_{[x,x+5)}$ represented the deaths counts between x and $x + 5$.

Then, the variance of $q^a_{[30,70)}$ was calculated as:

$$S^2_{p^a_{[30,70)}} = {p^a_{[30,70)}}^2 \sum_{x=30}^{65} (1 - q^a_{[x,x+5)})^{-2} \times S^2_{q^a_{[x,x+5)}} \quad (1.5)$$

Thus, the 95% CI of $q^a_{[30,70)}$ could be estimated as:

$$(q^a_{[30,70)} - 1.96 \times \sqrt{S^2_{p^a_{[30,70)}}},\ q^a_{[30,70)} + 1.96 \times \sqrt{S^2_{p^a_{[30,70)}}}) \qquad (1.6)$$

Life expectancy

We adopted the Chiang's method to estimate the LE based on period abridged life tables.[2]

First, the mortality from age x to $x + i$ was translated into the i-year probability of dying:

$$q_{[x,x+i)} = \frac{i \times M_{[x,x+i)}}{1 + (1 - a_x) \times i \times M_{[x,x+i)}} \qquad (2.1)$$

where a_x denoted the average number of years lived from age x to $x + i$.

For $x < 85$, the number of dying from age x to $x + i$ was calculated as:

$$d_{[x,x+i)} = q_{[x,x+i)} \times l_x \qquad (2.2)$$

where l_x denoted the number of survivors at age x and l_0 was defined as 100,000.

Then, for $x < 85$, the number of survivors at age $x + i$ could be represented as:

$$l_{x+i} = l_x - d_{[x,x+i)} \quad (2.3)$$

and the number of survival person-years for l_x survivors at age *x* was:

$$L_{[x,x+i)} = i \times (l_x - d_{[x,x+i)}) + i \times a_x \times d_{[x,x+i)} \quad (2.4)$$

In particular, the number of survival person-years for survivors at age 85 was calculated as:

$$L_{85+} = \frac{l_{85}}{M_{85+}} \quad (2.5)$$

Further, the total number of survival person-years for l_x survivors at age *x* was:

$$T_x = L_{[x,x+i)} + \dots + L_{85+} \quad (2.6)$$

Thus, the LE at age *x* was calculated as:

$$e_x = \frac{T_x}{l_x} \quad (2.7)$$

To calculate the 95% uncertainty interval (UI) (95% UI), the bootstrapping method was adopted, and the 95% UI was defined by the 2.5% and 97.5% quantiles of the forecast distribution.

Annual percentage change (APC, %)

To evaluate temporal trends in age-standardized mortality rates and probability of premature deaths, we estimated the APC and its 95% CI by fitting a regression line to the natural logarithm of the rate/probability, using calendar year as a regression variable.

$$Y^a = \beta_0 + \beta_1 lnX + \mu (3.1)$$

where Y^a denoted the mortality rate or probability of premature deaths from cause *a*, and *X* was the calendar year between 2013 and 2018.

Thus, the APC of Y^a was calculated as:

$$APC_{Y^a}, \% = \beta_0 \times 100$$

$$= \frac{dY^a/Y^a}{dX} \quad (3.2)$$

Decomposition of changes in LE

We applied the method of LE decomposition proposed by Arriaga to decompose changes in LE during 2013–2018 by age and cause of death.[3] In brief, effects of mortality changes on LE by age groups were decomposed into three parts: the direct effect, the indirect effect, and the interaction. For the last age group of ≥85 years, the indirect effect and interaction did not exist.

The direct effect reflected the change in life years within a certain age group due to the mortality change in that age group, which was calculated as:

$$DE_{[x,x+i)} = \frac{l_x^{t1}}{l_0^{t1}} \times \left(e_{[x,x+i)}^{t2} - e_{[x,x+i)}^{t1}\right) = \frac{l_x^{t1}}{l_0^{t1}} \times \left(\frac{T_x^{t2} - T_{x+i}^{t2}}{l_x^{t2}} - \frac{T_x^{t1} - T_{x+i}^{t1}}{l_x^{t1}}\right) \quad (4.1)$$

where $e_{[x,x+i)}$ denoted the temporary LE for the age interval $[x, x+i)$,

and $t1/t2$ was the initial/terminate year of the observation period.

The indirect effect was difference in life years at age above $x + i$ years due to mortality change within the age interval $[x, x+i)$ under the assumption that mortality after $x + i$ did not change, which was calculated as:

$$IE_{[x,x+i)} = \frac{T_{x+i}^{t1}}{l_0^{t1}} \times \left(\frac{l_x^{t1} l_{x+i}^{t2}}{l_{x+i}^{t1} l_x^{t2}} - 1\right) \quad (4.2)$$

The interaction was comprised of effects that could not be allocated to any particular age group, but to the change in mortality at all ages, which was calculated as:

$$I_{[x,x+i)} = OE_{[x,x+i)} - IE_{[x,x+i)} == \frac{T_{x+i}^{t2}}{l_0^{t1}} \times \left(\frac{l_x^{t1}}{l_x^{t2}} - \frac{l_{x+i}^{t1}}{l_{x+i}^{t2}}\right) - IE_{[x,x+i)} \quad (4.3)$$

Thus, the total contribution of mortality changes to LE within the age interval $[x, x + i)$ ($x = 0, 1, 5, \ldots, 80$) was calculated as:

$$TE_{[x,x+i)} = DE_{[x,x+i)} + IE_{[x,x+i)} + I_{[x,x+i)} \quad (4.4)$$

For the open-ended age group of ≥85 years, only direct effect existed:

$$TE_{85+} = DE_{85+} = \frac{l_{85}^{t1}}{l_0^{t1}} \times \left(e_{85}^{t2} - e_{85}^{t1}\right) = \frac{l_{85}^{t1}}{l_0^{t1}} \times \left(\frac{T_{85}^{t2}}{l_{85}^{t2}} - \frac{T_{85}^{t1}}{l_{85}^{t1}}\right) \quad (4.5)$$

Further, the effect of specific cause a within the age interval $[x, x + i)$ was calculated as:

$$TE_{[x,x+i)}^{a} = TE_{[x,x+i)} \times \left(\frac{M_{[x,x+i)}^{a,t1} - M_{[x,x+i)}^{a,t2}}{M_{[x,x+i)}^{t1} - M_{[x,x+i)}^{t2}}\right) \quad (4.6)$$

Potential gains in LE under different assumptions of the declining tendency in probability of premature CVD deaths [4]

Assumption 1: the probability of premature CVD deaths will maintain its current declining tendency until 2030. Then, the unconditional probability of premature deaths from cause a in 2030 can be approximatively estimated using the corresponding value in the baseline year 2015 and its APC during 2013–2018:

$$q_{[30,70)}^{a,2030} = q_{[30,70)}^{a,2015} \times (1 + APC_{q_{[30,70)}^{a}})^{15} \quad (5.1)$$

Assumption 2: the probability of premature CVD deaths in 2030 could decrease by 30% in comparison with 2015 levels. Then, the unconditional probability of premature deaths from cause a in 2030 can be estimated as:

$$q_{[30,70)}^{a,2030} = q_{[30,70)}^{a,2015} \times (1 - 0.3) \quad (5.2)$$

Then, we estimated the age-specific mortality rates of cause a in 2030 under assumption 1, which can be done by transforming and taking the logarithm of formula (1.3), and replacing $q^{a}_{[x,x+5)}$ with formula (1.1) as indicated below:

$$\log\left(1-q^{a,2030}_{[30,70)}\right)=\sum_{x=30}^{65}\log\left(1-q^{a,2030}_{[x,x+5)}\right)=-5\times\sum_{x=30}^{65}M^{a,2030}_{[x,x+5)} \quad (5.3)$$

Thus, the sum of 5-year age-specific mortality rates if cause a in ages 30–70 years is:

$$\sum_{x=30}^{65}M^{a,2030}_{[x,x+5)}=-\frac{1}{5}\log\left(1-q^{a,2030}_{[30,70)}\right) \quad (5.4)$$

The same proportional changes in mortality rates were assumed for all 5-year age groups; therefore, the mortality rate from cause a between exact age x and $x+5$ in 2030 can be estimated as:

$$M^{a,2030}_{[x,x+5)}=M^{a,2015}_{[x,x+5)}\times\frac{\log\left(1-q^{a,2030}_{[30,70)}\right)}{\log\left(1-q^{a,2015}_{[30,70)}\right)} (5.5)$$

Thus, we estimated the potential gains in LE due to the elimination of a certain proportion of deaths from cause a in ages 30–70 years between 2015 and 2030.

References

1. World Health Organisation. Global status report on noncommunicable diseases 2014. 2016.

2. Chiang CL. The life table and its applications. Malabar, FL: Robert E Krieger Publ Co, 1984.

3. Arriaga EE. Measuring and explaining the change in life expectancies. Demography 1984;21:83–96.

4. Cao B, Bray F, Ilbawi A, Soerjomataram I. Effect on longevity of one-third reduction in premature mortality from non-communicable diseases by 2030: A global analysis of the Sustainable Development Goal health target. Lancet Glob Health 2018;6:e1288–e1296. doi: 10.1016/s2214-109x(18)30411-x.