Appendix 1: Population attributable fraction and probability of death.

Let d_i and pop_i be the death and population number, respectively, for the *i*th age group. The population proportion for the *i*th age group is $\pi_i = \mathrm{pop}_i/\mathrm{POP}$, where $\mathrm{POP} = \sum \mathrm{pop}_i$ is the total population number. Let the exposure prevalence be denoted by p_i for the *i*th age group. The exposed population is therefore $\mathrm{pop}_{1i} = p_i \times \mathrm{pop}_i$, and the unexposed population, $\mathrm{pop}_{0i} = (1-p_i) \times \mathrm{pop}_i$, for the *i*th age group. Let the relative risk for the exposure be denoted by RR (assumed to be constant across different age groups), and the background mortality rate (mortality rate for the unexposed subjects), by r_{0i}, for the *i*th age group. The mortality rate for the exposed subjects is therefore $r_{1i} = \mathrm{RR} \times r_{0i}$.

For all subjects (exposed and unexposed subjects taken together) in the *i*th age group, the mortality rate can be directly estimated from $r_i = \mathrm{d}_i/\mathrm{pop}_i$, but it is also a mixture of two mortality rates (for the exposed and the unexposed subjects, respectively), that is, $r_i = (1-p_i) \times r_{0i} + p_i \times \mathrm{RR} \times r_{0i}$. Given p_i's, r_i's and RR, we therefore have that $r_{0i} = \frac{r_i}{(1-p_i)+p_i \times \mathrm{RR}} = \frac{r_i}{1+p_i \times (\mathrm{RR}-1)}$.

The population attributable fraction (PAF) assuming a complete elimination of the exposure is,

$$\mathrm{PAF} = \frac{\begin{pmatrix}\text{factual mortality rate}\\ \text{for the total population}\end{pmatrix} - \begin{pmatrix}\text{counterfactual mortality rate}\\ \text{for the total population}\\ \text{when everyone is unexposed}\end{pmatrix}}{\begin{pmatrix}\text{factual mortality rate}\\ \text{for the total population}\end{pmatrix}}$$

$$= \frac{\sum \pi_i \times r_i - \sum \pi_i \times r_{0i}}{\sum \pi_i \times r_i}$$

$$= \frac{\sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i} - \sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i} \times \left[\frac{1}{1 + p_i \times (\text{RR} - 1)}\right]}{\sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i}}$$

$$= \frac{\sum \text{d}_i \times \left[\frac{p_i \times (\text{RR} - 1)}{1 + p_i \times (\text{RR} - 1)}\right]}{\sum \text{d}_i}$$

$$= \sum w_i \times \left[\frac{p_i \times (\text{RR} - 1)}{1 + p_i \times (\text{RR} - 1)}\right],$$

where $w_i = \frac{\text{d}_i}{\sum \text{d}_i}$ is the proportion of deaths in the *i*th age group. The PAF for a partial elimination $(\theta, 0 < \theta < 1)$ of the exposure is therefore

$$\text{PAF}^{\theta} = \frac{\begin{pmatrix}\text{factual mortality rate}\\ \text{for the total population}\end{pmatrix} - \begin{pmatrix}\text{counterfactual mortality rate}\\ \text{for the total population}\\ \text{when a fraction, } \theta,\\ \text{of the exposed people}\\ \text{is assumed unexposed}\end{pmatrix}}{\begin{pmatrix}\text{factual mortality rate}\\ \text{for the total population}\end{pmatrix}}$$

$$= \frac{\sum \pi_i \times r_i - \sum \pi_i \times [(1 - p_i + \theta \times p_i) \times r_{0i} + (p_i - \theta \times p_i) \times \text{RR} \times r_{0i}]}{\sum \pi_i \times r_i}$$

$$= \frac{\sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i} - \sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i} \times \left[\frac{1 - p_i + \theta \times p_i + (p_i - \theta \times p_i) \times \text{RR}}{1 + p_i \times (\text{RR} - 1)}\right]}{\sum \frac{\text{pop}_i}{\text{POP}} \times \frac{\text{d}_i}{\text{pop}_i}}$$

$$= \frac{\sum \text{d}_i \times \left[1 - \frac{1 + p_i \times (\text{RR} - 1) - \theta \times p_i \times (\text{RR} - 1)}{1 + p_i \times (\text{RR} - 1)}\right]}{\sum \text{d}_i}$$

$$= \sum w_i \times \frac{\theta \times p_i \times (\text{RR} - 1)}{1 + p_i \times (\text{RR} - 1)}$$

$$= \theta \times \text{PAF}.$$

To calculate the probability of death between 30-69 years old, let *i*=1, 2, …, 8 denote the age group of 30-34, 35-39, …, 65-69 years old, respectively. [1] The

probability of death who is alive at 30 years old will die between 30-69 years old in the absence of other causes of death is calculated by

$$Q = 1 - \prod_{i=1}^{8}(1 - q_i),$$

where $q_i = \frac{r_i \times 5}{1 + r_i \times 2.5}$. The same probability for a partial elimination (θ,0<θ<1) of the exposure is

$$Q^{\theta} = 1 - \prod_{i=1}^{8}\left(1 - q_i^{\theta}\right),$$

where $q_i^{\theta} = \frac{r_i^{\theta} \times 5}{1 + r_i^{\theta} \times 2.5}$ and the r_i^{θ} is the mortality rate for a partial elimination of the exposure which can be calculated by PAF method as following formula:

$$r_i^{\theta} = (1 - p_i + \theta \times p_i) \times r_{0i} + (p_i - \theta \times p_i) \times \mathrm{RR} \times r_{0i}.$$

Table S1. The proportion of four main risk factors by age groups and sex

Sex	Age groups	Smoking	Diabetes	Hypertension	Hyperlipidemia
Men	30-34	0.41	0.01	0.04	0.14
	35-39	0.43	0.02	0.08	0.20
	40-44	0.45	0.04	0.12	0.20
	45-49	0.42	0.06	0.18	0.25
	50-54	0.36	0.09	0.24	0.27
	55-59	0.30	0.14	0.29	0.25
	60-64	0.25	0.19	0.37	0.30
	65-69	0.22	0.18	0.45	0.22
Women	30-34	0.08	0.01	0.03	0.05
	35-39	0.06	0.02	0.03	0.09
	40-44	0.05	0.02	0.07	0.09
	45-49	0.03	0.03	0.11	0.15
	50-54	0.02	0.06	0.17	0.25
	55-59	0.02	0.10	0.26	0.27
	60-64	0.01	0.16	0.34	0.35
	65-69	0.01	0.21	0.46	0.34

Table S2. The relative risks of four main risk factors among the cerebrovascular disease and heart disease by age groups and sex

Risk factor	Age group	Cerebrovascular disease		Heart disease	
		Men	**Women**	**Men**	**Women**
Smoking	<55	3.65(1.94-6.86)	4.39 (3.01-6.40)	4.13(3.31-5.16)	5.61 (4.16-7.55)
	55-64	2.91(2.10-4.04)	3.38 (2.75-4.15)	2.63 (2.35-2.94)	3.18 (2.83-3.57)
	65-74	2.01(1.61-2.01)	2.85 (2.50-3.25)	1.84 (1.69-2.01)	2.60 (2.41-2.80)
High blood pressure	35-44	2.05(1.89-2.22)		1.68(1.29-2.20)	
	45-54	1.83(1.72-1.93)		1.56(1.29-1.89)	
	55-64	1.63(1.57-1.69)		1.45(1.29-1.62)	
	65-74	1.44(1.39-1.50)		1.33(1.29-1.38)	
High blood glucose	35-44	1.19(0.93-1.51)		1.21(1.02-1.43)	
	45-54	1.16(0.97-1.39)		1.19(1.05-1.36)	
	55-64	1.14(1.01-1.29)		1.18(1.08-1.29)	
	65-74	1.14(1.08-1.20)		1.16(1.11-1.21)	
High total cholesterol	35-44	1.71(1.46-1.99)		2.20(1.46-3.33)	
	45-54	1.41(1.35-1.48)		1.82(1.58-2.10)	
	55-64	1.20(1.15-1.25)		1.44(1.29-1.32)	
	65-74	1.08(1.03-1.13)		1.27(1.23-1.32)	

[a] The relative risk by sex is not available in the original paper

Figure S1

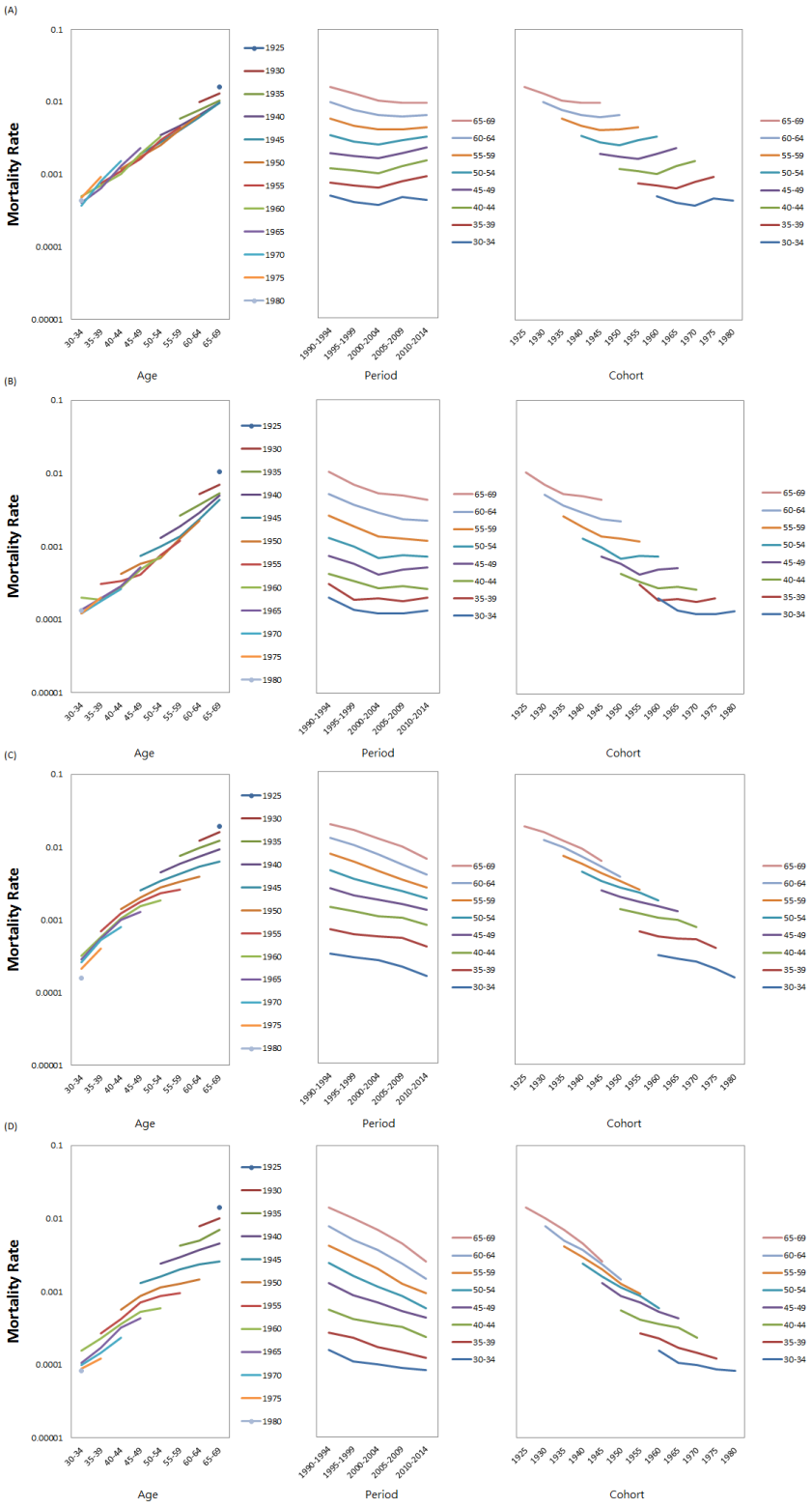

Figure S1. The basic mortality trend of heart disease in men (A) and women (B), and of cerebrovascular disease in men (C) and women (D) by age, period, and birth cohort.

Reference

1. WHO. Global Health Estimates: Deaths by Cause, Age, Sex and Country, 2000-2012. Geneva, World Health Organization, 2014.