SPECIAL ARTICLE

Mortality Attributable to Smoking in China

Dongfeng Gu, M.D., Ph.D., Tanika N. Kelly, M.P.H., Xigui Wu, M.D., Jing Chen, M.D., M.Sc., Jonathan M. Samet, M.D., M.S., Jian-feng Huang, M.D., Manlu Zhu, M.D., Ji-chun Chen, M.D., Chung-Shiuan Chen, M.S., Xiufang Duan, M.D., Michael J. Klag, M.D., M.P.H., and Jiang He, M.D., Ph.D.

ABSTRACT

BACKGROUND
Smoking is a risk factor for many diseases and has been increasingly prevalent in economically developing regions of the world. We aimed to estimate the number of deaths attributable to smoking in China.

METHODS
We conducted a large, prospective cohort study in a nationally representative sample of 169,871 Chinese adults who were 40 years of age or older. Investigators for the China National Hypertension Survey collected data on smoking and other risk factors at a baseline examination in 1991 using a standard protocol. Follow-up evaluation was conducted in 1999 and 2000, with a response rate of 93.4%. We used multivariable-adjusted relative risk, prevalence of smoking, mortality, and population size in each age group, stratified according to sex, to calculate the number of deaths attributable to smoking in 2005.

RESULTS
There was a significant, dose–response association between pack-years smoked and death from any cause in both men and women after adjustment for multiple risk factors (P<0.001 for trend). We estimated that in 2005, a total of 673,000 deaths (95% confidence interval [CI], 564,700 to 781,400) were attributable to smoking in China: 538,200 (95% CI, 455,800 to 620,600) among men and 134,800 (95% CI, 108,900 to 160,800) among women. The leading causes of smoking-related deaths were as follows: cancer, 268,200 (95% CI, 214,500 to 321,900); cardiovascular disease, 146,200 (95% CI, 79,200 to 213,100); and respiratory disease, 66,800 (95% CI, 20,300 to 113,300).

CONCLUSIONS
Our study documents that smoking is a major risk factor for mortality in China. Continued strengthening of national programs and initiatives for smoking prevention and cessation is needed to reduce smoking-related deaths in China.

From the Department of Evidence Based Medicine, Cardiovascular Institute and Fu Wai Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, and the National Center for Cardiovascular Disease, Beijing (D.G., X.W., J. Huang, M.Z., Ji-chun Chen, X.D.); the Department of Epidemiology, Tulane University School of Public Health and Tropical Medicine (T.N.K., C.-S.C., J. He), and the Department of Medicine, Tulane University School of Medicine (Jing Chen, J. He) — both in New Orleans; and the Department of Epidemiology, Johns Hopkins University Bloomberg School of Public Health, Baltimore (J.M.S., M.J.K.). Address reprint requests to Dr. Gu at the Department of Evidence Based Medicine, Fu Wai Hospital, 167 Beilishi Rd., Beijing, 100037, China, or at gudf@yahoo.com.

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Cigarette smoking has been identified as the second leading risk factor for death from any cause worldwide.[1,2] In 2000, an estimated 4.83 million deaths were attributed to cigarette smoking globally, with nearly half occurring in the developing world.[1,3] Because many low- and middle-income countries are still in early stages of the tobacco epidemic, the number of smoking-related deaths in these nations will probably increase during the next decades.[3-5]

With a population of 1.3 billion, China is the world's largest producer and consumer of tobacco and bears a large proportion of deaths attributable to smoking worldwide.[6,7] Even though several prospective cohort studies have examined the relationship between tobacco smoking and mortality in the Chinese population,[8-11] the number of deaths attributable to smoking in China is still uncertain. Most previous prospective cohort studies in China were conducted in regional or occupational groups with a relatively small sample size[9-11] or did not have an active follow-up procedure for mortality.[8]

We used data from a large, prospective cohort study in a nationally representative sample of Chinese adults to examine the effect of tobacco smoking on deaths from any cause and from certain specific causes, as well as to estimate the population attributable risk and the number of deaths attributable to smoking in men and women in 2005. We offer these estimates as China moves forward with tobacco-control initiatives, reflecting its commitments through its ratification of the World Health Organization (WHO) Framework Convention on Tobacco Control.[12]

METHODS

STUDY POPULATION

In 1991, the China National Hypertension Survey was carried out in all 30 provinces, autonomous regions, and municipalities of mainland China with the use of a multistage design of random cluster sampling to select a nationally representative sample of the Chinese general population who were 15 years of age or older.[13] The overall response rate was 89.5%. In 1999 and 2000, investigators from each province were invited to participate in the China National Hypertension Survey Epidemiology Follow-up Study. Of the 30 provinces, 13 were not included in the follow-up study because contact information was not available for study subjects. However, the sampling process was conducted independently within each province in 1991, and the 17 provinces that were included in the follow-up study were evenly distributed in different geographic regions representing various levels of economic development in China. From the 17 provinces, 169,871 study subjects (83,533 men and 86,338 women) who were 40 years of age or older at their baseline examination were eligible to participate in the follow-up study.

For this report, we excluded 14,740 subjects who had missing information regarding tobacco-smoking status, since data on smoking were not collected in two provinces. The baseline characteristics of subjects from the remaining 15 provinces that were included in this analysis were similar to those in the 15 excluded provinces. In the two groups, respectively, the mean baseline ages were 55.9 and 55.3 years; the percentages of subjects who had a high-school education were 24.0% and 23.4%; who consumed alcohol, 19.8% and 18.7%; who were physically inactive, 37.0% and 36.6%; and who had ever smoked cigarettes, 37.9% and 36.7%. Of 155,131 eligible subjects (76,134 men and 78,997 women) from the 15 provinces that were included in this analysis, a total of 144,088 (92.9%) underwent successful follow-up.

BASELINE EXAMINATION

Baseline data were collected at a single clinic visit by specially trained physicians and nurses with the use of standardized methods with stringent levels of quality control.[13] Data on demographic characteristics, medical history, and lifestyle risk factors were obtained with the use of a standard questionnaire administered by trained staff. Tobacco smoking was defined as having smoked at least one cigarette per day for 1 year or more, and one cigarette was considered to be equivalent to 1 g of tobacco.[14] For subjects who reported past or current tobacco smoking, information on the number of cigarettes or grams of tobacco smoked per day, along with the duration of tobacco smoking, was also collected. Work-related physical activity was assessed, since leisure-time physical activity was uncommon at that time in China. Data on the amount and type of alcohol consumption during the past year were collected. Body weight and height were measured while subjects were wearing light indoor clothing without shoes, and the body-mass index was calculated. Three blood-pressure measurements were taken after the subject had been seated quietly for 5 minutes with the use of a standard mercury sphygmomanometer, according to a standard protocol.[15]

FOLLOW-UP DATA COLLECTION

The follow-up examination, which was conducted between 1999 and 2000, included tracking subjects or their proxies to a current address, performing in-depth interviews to ascertain disease status and vital information, and obtaining hospital records and death certificates. Of all deaths reported, vital information was provided by family members (75.0%), primary care physicians (12.6%), other health care providers (3.8%), and employers, relatives, or friends (8.5%). If a subject died while he or she was hospitalized, the subject's hospital record — including medical history, findings from physical examination, laboratory findings, autopsy findings, and discharge diagnosis — was abstracted by trained staff with the use of a standard form. Photocopies of selected sections of the subject's inpatient record, discharge summary, electrocardiogram, spirometry, chest radiograph, and pathology reports were also obtained. If death occurred outside the hospital, a detailed medical history was obtained from a family member or health care provider. Subjects' previous medical records were also obtained, if available. The majority of deaths (98.6%) that were reported during follow-up were verified by death certificates, medical records, or both.

An end-point assessment committee at the Chinese Academy of Medical Sciences in Beijing reviewed medical history information and death certificates and determined the final underlying cause of death with the use of prespecified criteria.[16] Two committee members independently verified the diagnosis, and discrepancies were adjudicated by discussion involving additional committee members. All committee members were unaware of the subjects' baseline risk factors. Causes of death were coded according to the *International Classification of Diseases, Ninth Revision*.

This study was approved by the institutional review board at Tulane University Health Sciences Center in New Orleans and the ethics committee at the Cardiovascular Institute and Fu Wai Hospital in Beijing. Written informed consent was obtained from all study subjects or their proxies at the follow-up visit. The study's steering committee had the final responsibility for the decision to submit the manuscript for publication.

STATISTICAL ANALYSIS

Person-years of follow-up were calculated from the date of baseline examination until the date of death or follow-up interview for each subject. Age-standardized mortality was calculated with the use of the 5-year age-specific mortality and age distribution of the Chinese population from year 2000 census data. Relative risks were calculated for subjects who had ever smoked with the use of lifelong nonsmokers as the reference category because current and former smokers had similar rates of death from any cause. Only a small number of subjects (3533 in total, including 2965 men and 568 women) reported being former smokers. Cox proportional-hazards models were used to adjust for prespecified covariates, including baseline age, level of education, alcohol consumption, level of physical activity, and the presence or absence of hypertension, overweight status, and self-reported diabetes, as well as geographic region (north vs. south) and urbanization (rural vs. urban), since the prevalence of cigarette smoking and mortality vary according to geographic region and level of urbanization in China. To examine the dose–response relationship between tobacco smoking and mortality in men and women, subjects who had ever smoked were divided into three groups, according to the number of pack-years smoked (<16.1, 16.1 to 30.3, and ≥30.3).

The multivariable-adjusted relative risks of death associated with smoking were obtained for each subgroup according to the level of urbanization (urban vs. rural), sex, and age group (40 to 54, 55 to 64, and ≥65 years). These estimates, along with the subgroup-specific proportion of smokers from a national survey,[7] were used to calculate the population attributable risk and 95% confidence intervals for each subgroup.[17] The population attributable risk was calculated with the use of the following equation (in which PAR denotes the population attributable risk, P the proportion of smokers, and RR relative risk):

$$PAR = (P \times [RR-1]) \div (P \times [RR-1]+1).$$

The overall relative risks or population attributable risks of death associated with smoking were calculated for men and women by pooling the subgroup-specific estimates of the natural logarithms of relative risks or population attributable risks for subjects of each sex and were weighted according to the size of the population in China in 2005 for each subgroup. The numbers of deaths attributable to smoking in each subgroup were then calculated by multiplying the population attributable risks according to the subgroup-specific rates of death from the study and population size in China in 2005. The total numbers of deaths attributable to smoking in men and women in urban and rural areas were calculated by summing these estimates among appropriate subgroups.

Methods to estimate variances that take into account sample clustering were used in Cox proportional-hazards models.[18] All analyses were conducted with the use of SAS statistical software, version 9.1 (SAS Institute). All reported P values are two-sided and have not been adjusted for multiple testing.

RESULTS

STUDY SUBJECTS

Baseline characteristics of study subjects according to smoking status are presented in Table 1. Both female and male smokers were more likely to consume alcohol and less likely to have a high-school education and to be overweight or obese than their counterparts who had never smoked. On average, male smokers were younger and less likely to be physically inactive or to have hypertension or diabetes than were male nonsmokers. In contrast, female smokers tended to be older and were more likely to be physically inactive and to have hypertension or diabetes than female nonsmokers.

During an average of 8.3 years of follow-up (1,115,417 person-years), a total of 17,863 subjects (10,140 men and 7723 women) died. There was a significant, dose–response association between pack-years smoked and death from any cause in both men and women after adjustment for multiple risk factors ($P<0.001$ for trend) (Table 2).

The multivariable-adjusted relative risk of death from any cause was significantly higher in smokers than in nonsmokers for men and women in all age groups (Table 3). There was some evidence that the relative risk of death from any cause that was associated with tobacco smoking was higher in women than in men ($P=0.02$ for interaction). However, the prevalence of smoking and the population attributable risk were higher for men than for women, with cigarette smoking accounting for 12.9% of deaths among men and 3.1% of

Table 1. Baseline Characteristics of the Subjects, According to Smoking Status.*

Variable†	Men		Women	
	Lifelong Nonsmoker	Former or Current Smoker	Lifelong Nonsmoker	Former or Current Smoker
No. of subjects‡	28,191	47,943	68,198	10,799
Age (yr)	57.3±11.1	54.6±10.0	55.7±11.0	59.5±9.6
High-school education (%)	38.8	26.6	18.5	9.5
Alcohol consumption (%)	19.1	48.2	1.8	9.1
Physical inactivity (%)	46.9	34.8	34.2	39.1
Overweight status or obesity (%)	27.2	17.6	26.3	25.1
Hypertension (%)	32.2	25.9	27.9	32.7
Self-reported diabetes (%)	2.7	1.7	2.1	2.6

* Plus–minus values are means ±SD. P values for comparisons between current or former smokers and lifelong nonsmokers were calculated by chi-square tests or t-tests. $P<0.001$ for all comparisons between the two groups, with the exception of $P=0.01$ for the comparison between the two groups of women with respect to overweight status or obesity.

† High-school education was defined as having 9 or more years of schooling. Alcohol consumption was defined as drinking alcohol on at least 12 occasions during the past 12 months. Work-related physical activity was assessed on the basis of subjects' occupation; office work was defined as physical inactivity. Overweight status or obesity was defined as a body-mass index (the weight in kilograms divided by the square of the height in meters) of 25 or more. Hypertension was defined as a mean systolic blood pressure of 140 mm Hg or more, a diastolic blood pressure of 90 mm Hg or more, or the use of an antihypertensive medication.

‡ The numbers of subjects were 153,507 for the analysis of educational status, 155,126 for the analysis of overweight status or obesity, and 155,117 for the analysis of hypertension.

Table 2. Relative Risk of Death from Any Cause among Former or Current Smokers, as Compared with Lifelong Nonsmokers, According to the Number of Pack-Years.*

Variable	Pack-Years				P Value for Trend
	0	0.1–<16.1	16.1–<30.3	≥30.3	
Men					
No. of deaths	3841	1297	1785	3108	
Person-yr of follow-up	198,936	96,420	113,587	115,382	
Age-standardized rate per 100,000 person-yr	1278.8	1487.8	1607.2	1740.0	<0.001
Age-adjusted relative risk (95% CI)†	1.00	1.10 (1.03–1.17)	1.20 (1.13–1.27)	1.29 (1.23–1.35)	<0.001
Multivariable-adjusted relative risk (95% CI)†‡	1.00	1.10 (1.03–1.17)	1.18 (1.12–1.23)	1.26 (1.20–1.33)	<0.001
Women					
No. of deaths	6195	644	457	418	
Person-yr of follow-up	493,303	39,221	21,206	15,661	
Age-standardized rate per 100,000 person-yr	1121.5	1380.5	1553.1	1585.7	<0.001
Age-adjusted relative risk (95% CI)†	1.00	1.22 (1.13–1.33)	1.33 (1.21–1.46)	1.42 (1.28–1.57)	<0.001
Multivariable-adjusted relative risk (95% CI)†‡	1.00	1.22 (1.13–1.33)	1.29 (1.17–1.42)	1.38 (1.25–1.53)	<0.001

* Data for 2706 subjects (21,701 person-years and 118 deaths) were excluded because of missing pack-year data.
† Relative risk was estimated from Cox proportional-hazards models.
‡ Variables included age at baseline, level of education, geographic region (north vs. south), urbanization (rural vs. urban), and the presence or absence of hypertension, overweight status or obesity, alcohol consumption, and physical inactivity; the presence or absence of diabetes was considered as a time-dependent covariate.

deaths among women. Population attributable risks were similar for subjects in all three age groups (40 to 54, 55 to 64, and ≥65 years), but the number of deaths attributable to smoking increased with age in both men and women because of the higher rates of death in the elderly.

It was estimated that a total of 673,000 deaths (95% confidence interval [CI], 564,700 to 781,400) were attributable to smoking in Chinese adults who were 40 years of age or older in 2005: 538,200 (95% CI, 455,800 to 620,600) in men and 134,800 (95% CI, 108,900 to 160,800) in women. The estimated numbers of smoking-related deaths were 327,500 (95% CI, 193,600 to 461,400) in rural areas and 345,500 (95% CI, 296,700 to 394,400) in urban areas (Fig. 1).

Cause-specific mortality from cancer, cardiovascular disease, and respiratory disease was significantly associated with cigarette smoking (Table 4). The estimated numbers of deaths attributable to smoking were as follows: cancer, 268,200 (95% CI, 214,500 to 321,900), including 240,400 (95% CI, 198,800 to 282,000) in men and 27,800 (95% CI, 15,800 to 39,900) in women; cardiovascular disease, 146,200 (95% CI, 79,200 to 213,100), including 126,600 (95% CI, 75,600 to 177,700) in men and 19,600 (95% CI, 3600 to 35,500) in women; and respiratory disease, 66,800 (95% CI, 20,300 to 113,300), including 48,600 (95% CI, 13,700 to 83,500) in men and 18,200 (95% CI, 6600 to 29,900) in women.

Lung cancer had the highest population attributable risk associated with cigarette smoking: 50.6% in men and 14.8% in women. The three leading diseases associated with deaths attributable to smoking were lung cancer, stroke, and chronic obstructive pulmonary disease in men and chronic obstructive pulmonary disease, lung cancer, and stroke in women. Together, these diseases accounted for approximately 45.1% of deaths attributable to smoking in men and 31.8% of those in women.

DISCUSSION

The results of our study involving a nationally representative sample of Chinese adults indicate that tobacco smoking is a major preventable cause of death in China. On the basis of observed risks, we estimate that tobacco smoking was responsible for about 673,000 premature deaths in Chinese adults who were 40 years of age or older in

Table 3. Relative Risk, Prevalence of Smoking, Population Attributable Risk, and the Absolute Number of Deaths Attributable to Smoking in China in 2005.

Age Group	Relative Risk (95% CI)		Prevalence of Smoking*	Population Attributable Risk	Absolute No. of Deaths Attributable to Smoking (95% CI)
	Age-Adjusted	Multivariable-Adjusted†			
			percent		*thousands*
Men					
40–54 yr	1.33 (1.20–1.48)	1.20 (1.07–1.34)	72.1	12.7	55.6 (17.3–93.8)
55–64 yr	1.26 (1.16–1.36)	1.25 (1.15–1.36)	70.6	15.0	82.4 (51.3–113.6)
≥65 yr	1.17 (1.11–1.23)	1.19 (1.12–1.26)	67.8	11.2	400.2 (315.8–484.6)
Total	1.28 (1.23–1.33)	1.21 (1.16–1.26)	71.1	12.9	538.2 (455.8–620.6)
Women					
40–54 yr	1.50 (1.26–1.80)	1.36 (1.13–1.63)	7.8	2.7	7.6 (0–15.7)
55–64 yr	1.33 (1.19–1.49)	1.31 (1.17–1.47)	11.4	3.4	12.7 (3.3–22.1)
≥65 yr	1.28 (1.18–1.37)	1.27 (1.18–1.37)	15.3	4.0	114.6 (79.4–149.8)
Total	1.41 (1.33–1.49)	1.33 (1.25–1.41)	9.9	3.1	134.8 (108.9–160.8)

* Data regarding prevalence are from the International Collaborative Study of Cardiovascular Disease in Asia, 2000–2001.[7]
† Data were adjusted for the age at baseline, educational level, geographic region (north vs. south), urbanization (rural vs. urban), and the presence or absence of hypertension, overweight status or obesity, alcohol consumption, and physical inactivity; the presence or absence of diabetes was considered as a time-dependent covariate.

2005. The number of deaths attributable to smoking was much greater among men than among women. Lung cancer was the leading cause of deaths attributable to smoking in men, and chronic obstructive pulmonary disease was the leading cause of such deaths in women.

These findings have important public health implications. Tobacco smoking is highly prevalent and is associated with substantially increased morbidity and mortality as well as health expenditures in China.[6,7,19] More troublesome, the prevalence of tobacco smoking has been continuously high in adult men, and the average age of smoking initiation has been dropping during recent decades.[20,21] Data from our study and others provide strong evidence that tobacco smoking causes an increased risk of cancer, vascular disease, and respiratory disease in China and elsewhere.[5,8-11,22-25] These data are a reminder of the urgent need for continued strengthening of national programs in China on smoking prevention and cessation. These efforts should include the full set of strategies recommended by the 2008 WHO report on the global tobacco epidemic.[26]

Unlike studies in Western populations, our study showed that the numbers of death from any cause were similar among former and current smokers. Smoking cessation has been relatively uncommon in China, and most smokers quit cigarette smoking because of chronic illness. The median age of smoking cessation was 61.0 years in men and 60.0 years in women among former smokers who died during follow-up. Our study reported a lower relative risk associated with smoking than did studies in Western populations,[25] but our results were similar to those of other studies conducted in the Chinese population.[5] The magnitude of the relative risks probably reflects the lower numbers of cigarettes smoked in the past and the later age of smoking initiation in subjects currently dying from smoking-related diseases.[27] Further investigations are warranted to explain the observed lower relative risk.

Other studies have estimated the smoking-related burden of disease in China. Liu and colleagues compared the smoking habits of 700,000 adults who died from cancer or from respiratory or vascular causes with those of 200,000 adults who died from other causes.[5] The underlying cause of death was obtained from local administrative records, and smoking information was recalled by family members. A validation study suggested that local administrative records on the underlying cause of death might not be reli-

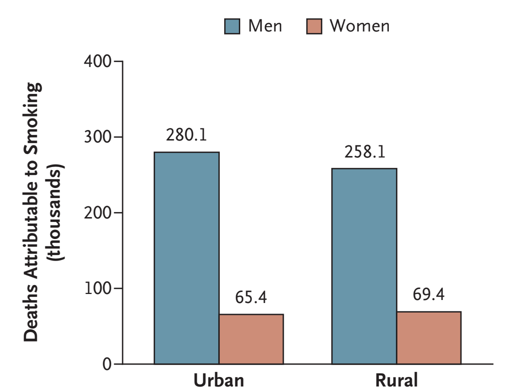

Figure 1. Number of Deaths Attributable to Smoking in 2005 in China, According to Sex and Urbanization.

The absolute numbers of deaths attributable to smoking in 2005 in China in urban areas were 280,100 (95% CI, 245,700 to 314,600) among men and 65,400 (95% CI, 51,000 to 79,800) among women; in rural areas, the numbers were 258,100 (95% CI, 146,200 to 370,000) among men and 69,400 (95% CI, 47,400 to 91,500) among women.

able for some diseases in China.[28] In addition, several potential confounding factors (e.g., lifestyle risk factors in the medical history) were not considered in their study. In our study, data on baseline tobacco smoking and other variables were carefully collected with the use of stringent quality-control procedures. In addition, the follow-up rate was high, and almost all deaths were confirmed. Potential confounding factors, including lifestyle risk factors, were considered in the analysis.[29] Despite the differences in the two studies, the estimate by Liu et al. that 600,000 deaths were attributable to smoking in 1990 is reasonably close to our estimate of 670,000 in 2005. Neither study estimated the effect of passive smoking on mortality. In addition, exposure to tobacco smoke was assessed by questionnaire in both studies. Although validation of smoking histories against biochemical markers would have been useful, smoking information was collected during an era when smoking was accepted, and a bias to deny or minimize smoking would have been unlikely.

Our study was limited by the availability of hospital records for only 71.0% of subjects who died. The classification of cause of death may be less accurate for subjects without hospital records. In addition, the mortality follow-up was conducted during the 1990s in our study, which reflects the patterns of health care and disease burden at that time. Smoking-related diseases, such as cancer and cardiovascular disease, are now more common causes of death in China. Our study might underestimate current deaths attributable to smoking in China. Furthermore, despite the adjustment for several potentially confounding factors in the multivariable analyses, smokers and nonsmokers may still differ with respect to other factors that contribute to disease risk. Finally, we estimated the number of deaths attributable to smoking that would have been prevented if the entire population in China had never been exposed to smoking; we could not estimate the number of deaths that were avoidable by smoking cessation.

Ezzati and Lopez estimated that the leading causes of deaths from smoking worldwide in 2000 were cardiovascular disease (753 million in men and 269 million in women), cancer (664 million in men and 160 million in women), and respiratory disease (310 million in men and 138 million in women).[3] On the basis of a case–control study, it has been predicted that smoking will cause about 930,000 adult deaths in India by 2010, mainly from tuberculosis and respiratory disease in men and women and heart disease and cancer in men.[22,23] The three leading causes of death attributable to smoking in the United States were cancer, cardiovascular disease, and respiratory disease in men and cardiovascular disease, cancer, and respiratory disease in women.[24] Respiratory disease was the leading cause of death attributable to smoking in South Africa.[30] Our findings for China are similar with regard to the leading causes of death attributable to smoking: cancer, cardiovascular disease, and respiratory disease.

These new estimates of the number of deaths attributable to smoking speak to the urgency of an agenda for a strong national tobacco-control program in China. Fortunately, there is far more tobacco-control activity than there was previously. The government is moving forward with implementation of tobacco-control measures and has strengthened its tobacco-control capacity within the Chinese Center for Disease Control. However, the government's role in tobacco control is in conflict with the selling of tobacco through its state-owned company and reliance on tobacco revenues.[31,32] In addition, mortality and morbidity will not be reduced in the short term without the adoption of measures to increase smoking

Table 4. Relative Risk, Population Attributable Risk, and Absolute Number of Deaths Attributable to Smoking in China, According to Sex and Cause of Death.*

Cause of Death	Men			Women		
	Multivariable-Adjusted Relative Risk (95% CI)†	Population Attributable Risk	Absolute No. of Deaths Attributable to Smoking (95% CI)	Multivariable-Adjusted Relative Risk (95% CI)†	Population Attributable Risk	Absolute No. of Deaths Attributable to Smoking (95% CI)
		%	*thousands*		%	*thousands*
Cancer						
Any	1.55 (1.41–1.70)	28.0	240.4 (198.8–282.0)	1.62 (1.42–1.85)	5.7	27.8 (15.8–39.9)
Lung	2.44 (2.01–2.96)	50.6	113.0 (93.6–132.5)	2.76 (2.18–3.49)	14.8	16.0 (9.6–22.5)
Liver	1.36 (1.11–1.66)	20.3	37.2 (17.2–57.3)	1.44 (0.99–2.11)	NA	NA
Stomach	1.52 (1.23–1.89)	27.0	40.6 (23.3–58.0)	1.05 (0.71–1.56)	NA	NA
Esophageal	1.34 (1.03–1.75)	19.4	19.2 (5.2–33.3)	1.24 (0.75–2.05)	NA	NA
Colon and rectal	1.02 (0.71–1.48)	NA	NA	1.21 (0.73–1.99)	NA	NA
Other	1.26 (1.03–1.55)	15.6	24.5 (5.3–43.7)	1.42 (1.12–1.80)	4.0	6.3 (0–13.0)
Respiratory disease						
Any	1.14 (1.02–1.26)	8.8	48.6 (13.7–83.5)	1.43 (1.25–1.65)	4.1	18.2 (6.6–29.9)
Chronic obstructive pulmonary disease	1.19 (1.05–1.35)	12.1	47.3 (18.0–76.5)	1.61 (1.37–1.89)	5.6	17.1 (7.1–27.1)
Cardiovascular disease						
Any	1.17 (1.09–1.26)	10.7	126.6 (75.6–177.7)	1.21 (1.10–1.34)	2.1	19.6 (3.6–35.5)
Stroke	1.17 (1.07–1.28)	10.8	82.5 (41.7–123.4)	1.18 (1.03–1.34)	1.7	9.8 (0–22.1)
Coronary heart disease	1.21 (1.03–1.42)	12.9	30.4 (6.7–54.1)	1.41 (1.15–1.71)	3.8	7.3 (0–15.2)

* Causes of death were coded according to the *International Classification of Diseases, Ninth Revision*. NA denotes not applicable.

† Data were adjusted for the age at baseline, educational level, geographic region (north vs. south), urbanization (rural vs. urban), and the presence or absence of hypertension, overweight status or obesity, alcohol consumption, and physical inactivity; the presence or absence of diabetes was considered as a time-dependent covariate.

cessation among the approximately 300 million current smokers in the country. These new estimates on mortality attributable to smoking document the potential human toll of inaction.

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APPENDIX

The following investigators participated in this study: **Steering Committee:** J. He (coprincipal investigator), D. Gu (coprincipal investigator), J. Chen, R. Hui, M.J. Klag, L. Kong, S. Tao, J. Wang, P.K. Whelton, X. Wu, and C. Yao. The following institutions and principal investigators participated in the study: **United States:** *Tulane University Health Sciences Center, New Orleans:* C.-S. Chen, J. Chen, J. He, T.N. Kelly, K. Reynolds, P.K. Whelton, R.P. Wildman; *Johns Hopkins Bloomberg School of Public Health, Baltimore:* M.J. Klag. **China:** *Fuwai Hospital and Cardiovascular Institute, Chinese Academy of Medical Sciences, and Peking Union Medical College, Beijing:* J. Chen, X. Duan, W. Gan, D. Gu, G. Huang, J. Huang, S. Tao, X. Wu, W. Yang, J. Zhao, M. Zhu; *Chinese Ministry of Health, Beijing:* L. Kong; *Tianjin City Bureau of Public Health, Tianjin:* G. Zheng; *Tianjin City Center of Disease Control and Prevention, Tianjin:* G. Song; *Guangdong Provincial People's Hospital and Cardiovascular Institute, Guangdong:* X. Liu, J. Mai; *Anzhen Hospital, Capital University of Medical Sciences, and Beijing Institute of Heart, Lung, and Blood Vessel Diseases, Beijing:* C. Yao; *Capital Iron and Steel Company's Hospital, Beijing:* X. Yu; *Fangshan District Hospital, Beijing:* X. Xu; *Zhejiang Provincial Center for Cardiovascular Disease Prevention and Research, Zhejiang:* H. Jin, X. Tang; *Fujian Provincial People's Hospital, Fujian:* X. Pu, L. Yu; *Shandong Provincial Academy of Medical Sciences, Shandong:* S. Zhang; *Guangxi Medical University, Guangxi:* L. Zhu; *Xi'an Jiaotong University Medical School, Shanxi:* J. Mo; *Henan Provincial Academy of Medical Sciences, Henan:* J. Guo; *Tongji Medical College and School of Public Health, Huazhong University of Science and Technology, Hubei:* Y. Hu, Y. Yu; *Sichuan Provincial Center of Disease Control and Prevention, Sichuan:* X. Wu; *West China College of Medicine, Sichuan University, Sichuan:* J. Wang; *Nanjing Medical University, Jiangsu:* H. Shen, C. Yao; *Beihua University Medical School, Jilin:* L. Xu, G. Zhao; *Inner Mongolia Hospital, Inner Mongolia:* X. Gao, J. Zhou; *First Clinical College of Harbin Medical University, Heilongjiang:* Y. Li; *Daqing City Center of Disease Control and Prevention, Heilongjiang:* Z. Li; *Hebei Provincial Academy of Medical Sciences, Hebei:* H. Zhang; *Zhongshan Hospital and Institute of Cardiovascular Diseases, Fudan University, Shanghai:* X. Pan.

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