SPECIAL ARTICLE

A Nationally Representative Case–Control Study of Smoking and Death in India

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ABSTRACT

BACKGROUND

The nationwide effects of smoking on mortality in India have not been assessed reliably.

METHODS

In a nationally representative sample of 1.1 million homes, we compared the prevalence of smoking among 33,000 deceased women and 41,000 deceased men (case subjects) with the prevalence of smoking among 35,000 living women and 43,000 living men (unmatched control subjects). Mortality risk ratios comparing smokers with nonsmokers were adjusted for age, educational level, and use of alcohol.

RESULTS

About 5% of female control subjects and 37% of male control subjects between the ages of 30 and 69 years were smokers. In this age group, smoking was associated with an increased risk of death from any medical cause among both women (risk ratio, 2.0; 99% confidence interval [CI], 1.8 to 2.3) and men (risk ratio, 1.7; 99% CI, 1.6 to 1.8). Daily smoking of even a small amount of tobacco was associated with increased mortality. Excess deaths among smokers, as compared with nonsmokers, were chiefly from tuberculosis among both women (risk ratio, 3.0; 99% CI, 2.4 to 3.9) and men (risk ratio, 2.3; 99% CI, 2.1 to 2.6) and from respiratory, vascular, or neoplastic disease. Smoking was associated with a reduction in median survival of 8 years for women (99% CI, 5 to 11) and 6 years for men (99% CI, 5 to 7). If these associations are mainly causal, smoking in persons between the ages of 30 and 69 years is responsible for about 1 in 20 deaths of women and 1 in 5 deaths of men. In 2010, smoking will cause about 930,000 adult deaths in India; of the dead, about 70% (90,000 women and 580,000 men) will be between the ages of 30 and 69 years. Because of population growth, the absolute number of deaths in this age group is rising by about 3% per year.

CONCLUSIONS

Smoking causes a large and growing number of premature deaths in India.

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India is a diverse country, with marked regional variation in lifestyles and in the main causes of death.[1] Among adults, most deaths are from respiratory, vascular, or neoplastic disease or from tuberculosis; the death rates from these diseases can be increased by smoking.[2] In recent years, large household surveys have shown that in middle age, more than one third of men and a few percent of women smoke tobacco and that there are about 120 million smokers in India.[3,4] Tobacco is commonly consumed in the form of bidis, which are smaller than cigarettes and typically contain only about a quarter as much tobacco, wrapped in the leaf of another plant. Anecdotal evidence suggests that many of those who smoke have been doing so for decades, so the hazards may already be substantial. However, smoking starts at somewhat older ages in India than it does in Europe and North America,[3] and the average daily consumption per smoker is lower.[5,6]

The effects of prolonged smoking of bidis or cigarettes on mortality in India have been assessed reliably in only two specific localities[5-9] in which the numbers of female smokers were too small to study. To assess the hazards of smoking in India nationwide among both women and men, we have conducted a case–control study that collected information on all adult deaths from 2001 to 2003 in a nationally representative sample of 1.1 million homes.

Methods

Study Design

Details of the study sample, case and control definitions, assessment of exposures, assignment of the underlying causes of death, and statistical methods are in the Supplementary Appendix (available with the full text of this article at www.nejm.org). In brief, the study was conducted in 1.1 million homes in 6671 small areas chosen randomly from all parts of India (about 1000 persons per area); the Sample Registration System was established by the Registrar General of India to monitor all births and deaths in these areas.[10,11] Each home in which a death had been recorded between 2001 and 2003 was visited by 1 of 900 nonmedical field-workers to collect information about the cause of death, the history of tobacco and alcohol use, and educational status. The underlying causes of all deaths were sought by verbal autopsy (a structured investigation of events leading to the death).[6,12-14] Two trained physicians independently assigned codes to the causes of death on the basis of the nonmedical field-worker's written narrative of the death. If the two physicians did not agree on the assigned three-digit code from the *International Classification of Diseases, 10th Revision*,[15] a senior physician adjudicated. A random sample of about 10% of the areas was resurveyed independently, generally with consistent results. Details of the methods, quality-control checks, and validation results have been reported previously.[12-14,16,17]

The field teams asked respondents (typically, household members) whether the deceased person had been a smoker within the previous 5 years and, if so, the usual number of bidis or cigarettes the person had smoked per day. Since smoking cessation is uncommon in India,[5,18] the key comparisons were between persons who had smoked in the past 5 years and those who had not. Questions were also asked about other tobacco smoking, quid chewing, alcohol consumption, and years of education. Adult respondents were asked similar questions about themselves.

Subjects

Potential case subjects were adults 20 years of age or older who had died between 2001 and 2003 and whose deaths had been recorded in the earlier fieldwork of the Sample Registration System. Among case subjects, data were available for 33,069 women and 41,054 men after the exclusion of deaths for nonmedical or maternal causes and of deaths for which data regarding smoking status were missing (3%). Adults who provided information about someone who had died were also asked about their own smoking status, and 97% of them provided a response (34,857 women and 43,078 men). This population of respondents served as the control group. The analyses do not match particular case subjects with particular control subjects; therefore, the study design does not adjust for household.

Women and men were analyzed separately. In the major analyses, we used logistic regression to adjust for age, educational level, and use or nonuse of alcohol.

Calculation of Absolute Risk

In the calculation of absolute risk, we used the World Health Organization (WHO) age-specific death rates for India to correct for any slight undercounts in the Sample Registration System.[19,20] Deaths of persons between the ages of 30 and 69

years are presented separately because deaths at these ages involve substantially more years of life lost than do deaths at older ages. In addition, the assignment of underlying causes of death is substantially more reliable for persons between the ages of 30 and 69 years than for older persons,[12,14,16,17] and the main effects of smoking on mortality occur after the age of 25 years (the approximate median age at which smoking begins among men in India[4]).

RESULTS

CHARACTERISTICS OF THE SUBJECTS

Persons who died were older and less educated and had a higher prevalence of smoking, tobacco chewing, and alcohol use than did living control subjects (Table 1, and Table 1 of the Supplementary Appendix). In the group of control subjects, the prevalence of smoking among men rose with age, from 8% among those between 15 and 19 years to 27% among those between 30 and 34 years. The prevalence then remained approximately constant at 35 to 40% for subjects between the ages of 35 and 69 years (Fig. 1, and Table 2 of the Supplementary Appendix). Between the ages of 40 and 59 years, smoking was more common among men without primary education (44%) than among other men (35%). The age-specific prevalence of smoking among female control subjects between 30 and 69 years of age rose fairly steadily from 3 to 6%. Between the ages of 40 and 59 years, the prevalence of smoking was 6% for women without primary education and 2% for other women.

SMOKING AND MORTALITY

For women between the ages of 30 and 69 years, 9% of those who died from medical causes were smokers; 5% of control subjects were smokers (Table 2). The mortality risk ratio comparing smokers with nonsmokers was 2.0 (99% confidence interval [CI], 1.8 to 2.3), after adjustment for age, educational level, and use or nonuse of alcohol. This mortality risk ratio corresponds to an excess of 783 deaths among female smokers between the ages of 30 and 69 years, constituting 5% (99% CI, 4 to 6) of deaths from any medical cause in the study. Since further adjustment for status with respect to tobacco chewing, residence (urban or rural), and religion did not substantially alter the risk ratios, all subsequent analyses were adjusted only for age, educational level, and use or nonuse of alcohol (see the Supplementary Appendix). For women 70 years of age or older, the risk ratio was lower than that for women between the ages of 30 and 69 years, and the difference was not significant (risk ratio, 1.3; 99% CI, 0.9 to 1.7).

Among men between the ages of 30 and 69 years, 55% of those who died from any medical cause were smokers, as compared with only 37% of control subjects of similar ages (risk ratio, 1.7; 99% CI, 1.6 to 1.8). This risk ratio corresponds to an excess of 5751 deaths among male smokers between the ages of 30 and 69 years, constituting 23% (99% CI, 21 to 24) of deaths from any medical cause in the study. The risk ratio was slightly lower among older men (1.6; 99% CI, 1.4 to 1.9).

UNDERLYING CAUSES OF DEATH

Among women between the ages of 30 and 69 years, smokers accounted for 13% of those who died from tuberculosis (risk ratio, 3.0, 99% CI, 2.4 to 3.9) and 14% of those who died from respiratory disease (risk ratio, 3.1; 99% CI, 2.5 to 3.8). Among the 783 excess deaths of women that were associated with smoking, tuberculosis accounted for 127 (16%) and respiratory disease accounted for 221 (28%); the proportions were lower for stroke (6%) and heart disease (10%).

Among men in this age group, smokers accounted for 66% of those who died from tuberculosis (risk ratio, 2.3; 99% CI, 2.1 to 2.6) and 60% of those who died from respiratory disease (risk ratio, 2.1; 99% CI, 1.9 to 2.3). Thus, of the 5751 smoking-related excess deaths from medical causes among men between the ages of 30 and 69 years, 1174 (20%) were from tuberculosis and 1078 (19%) were from respiratory disease. The risk ratio for death from stroke among men was 1.6 (99% CI, 1.4 to 1.8) and that for death from heart disease was also 1.6 (99% CI, 1.5 to 1.8), with deaths from heart disease accounting for 1102 of the smoking-associated excess deaths (19%) in men in this age group. Women and men who had smoked also had an increased risk of death from neoplastic disease and peptic ulcer.

RELATIVE RISK IN SUBGROUPS

Among women, the absolute number of deaths associated with smoking was too small to be statistically reliable after stratification for location of residence (urban or rural), educational level, use or nonuse of alcohol, and level of tobacco use, even though no anomalies were apparent

Table 1. Demographic Characteristics of the Subjects, According to Sex.*

Characteristic	Women		Men	
	Case Subjects (N=33,069)	Control Subjects (N=34,857)	Case Subjects (N=41,054)	Control Subjects (N=43,078)
	percent			
Age				
20–29 yr	6	18	5	21
30–39 yr	6	25	7	25
40–49 yr	7	23	11	23
50–59 yr	13	17	18	16
60–69 yr	24	12	26	9
≥70 yr	44	5	34	6
Residence				
Rural	82	78	81	84
Urban	18	22	19	16
Educational level†				
None completed	83	56	56	31
Primary or middle school	10	18	22	23
Secondary school or higher	6	25	21	45
Unknown	1	1	1	2
Religion				
Hindu	82	82	82	83
Muslim	10	10	10	10
Other	7	8	7	6
Unknown	1	1	1	1
Chewing tobacco				
Yes	15	8	25	21
No	83	90	71	76
Unknown	2	3	4	3
Alcohol consumption				
Yes	4	3	27	16
No	94	95	70	82
Unknown	3	2	4	3
Smoking tobacco				
Yes	9	4	51	32
No	91	96	49	68

* Among both men and women, all differences between case subjects and control subjects were significant (P<0.001), except for religion. Percentages may not total 100 because of rounding.

† "None completed" denotes either no formal education or no completion of primary school. Primary education was defined as the completion of grade 6, middle-school education as the completion of grade 9, and secondary-school education as the completion of grade 10.

(Fig. 2, and Fig. 1A and 1B of the Supplementary Appendix). Thus, the results for these subgroups are described here only for men.

For men between the ages of 30 and 69 years, the risk ratio for death from any medical cause was slightly higher in urban areas (1.9) than in rural areas (1.6) (Fig. 2). The risk ratio for death from tuberculosis was also higher in urban areas (2.7) than in rural areas (2.3), but the difference was not significant (Fig. 1B of the Supplemen-

tary Appendix). However, since the proportion of deaths from tuberculosis was lower in urban areas than in rural areas, tuberculosis accounted for only about 15% of the smoking-associated excess deaths in urban areas, as compared with 22% in rural areas. Conversely, heart disease (chiefly acute heart attack) accounted for about 24% of smoking-associated excess deaths in urban areas, as compared with only about 18% in rural areas.

In a comparison of smokers and nonsmokers, the relative risk of death from any medical cause in men between the ages of 30 and 69 years was similar among those without primary education (1.6), those with primary or middle school education (1.7), and those with secondary or postsecondary education (1.7); the relative risk was the same among users of alcohol and nonusers of alcohol (1.6).

Most male subjects smoked only bidis, but some smoked only cigarettes, and there was a dose–response relationship between smoking and mortality among men who smoked only bidis (risk ratio for one to seven bidis per day, 1.3; risk ratio for eight or more, 2.2) and among those who smoked only cigarettes (risk ratio for one to seven cigarettes per day, 1.8; risk ratio for eight or more, 2.9; P<0.001 for both trends) (Table 3 of the Supplementary Appendix). Even among those who smoked only one to seven bidis per day (mean, four per day), the smoking-associated excess deaths accounted for a quarter of all deaths from any medical cause (risk ratio, 1.3). Among those who smoked only one to seven cigarettes per day (mean, four per day), smoking-associated excess deaths accounted for almost half of deaths from any medical cause (risk ratio, 1.8).

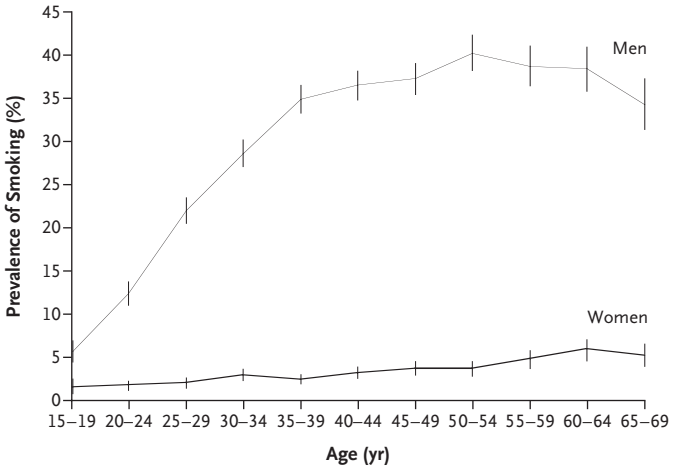

Figure 1. Prevalence of Smoking in India, According to Age and Sex.
The I bars represent 99% confidence intervals.

ABSOLUTE RISK

To help estimate absolute hazards, we used WHO estimates of Indian national death rates and annual numbers of deaths, subdivided according to 5-year age groups. Within each age group, our study provides the proportion of deaths from any medical cause; the relative risk of death from any medical cause among smokers, as compared with nonsmokers; and the prevalence of smoking among control subjects. The combination of these data with the WHO data yields for each age group the death rates for smokers and nonsmokers (adjusted for any differences in educational level, alcohol use, or death from nonmedical causes) and the number of deaths that would have been avoided if smokers had had the same death rates as nonsmokers of similar age, education, and use or nonuse of alcohol.

From these age-specific death rates among smokers and nonsmokers, we calculated the cumulative rate of death among subjects between the ages of 30 and 69 years (Fig. 3). These rates suggest that about 62% of female smokers who were 30 years of age will die before the age of 70, as compared with only 38% of otherwise similar nonsmokers (absolute difference, 24 percentage points) (Fig. 3A). A substantial hazard was evident even before the age of 50 years: 15% of female smokers will die between the ages of 30 and 49 years, as compared with only 7% of nonsmokers. The median ages at death suggested that female smokers will die an average of approximately 8 years (99% CI, 5 to 11) earlier than their nonsmoking counterparts. Likewise, about 61% of male smokers who were 30 years of age will die before the age of 70 years, as compared with 41% of otherwise similar male nonsmokers (absolute difference, 20%) (Fig. 3B). The median ages at death suggested that male smokers will die an average of approximately 6 years (99% CI, 5 to 7) earlier than their nonsmoking counterparts. Again, a substantial hazard was evident before the age of 50 years: 15% of male smokers, as compared with 9% of male nonsmokers, will die between the ages of 30 and 49 years. Figure 2 of the Supplementary Appendix

Table 2. Death from Any Medical Cause and Rate of Smoking among Women and Men, Stratified According to Particular Underlying Cause of Death for Subjects between the Ages of 30 and 69 Years.*

Age Group and Underlying Cause of Death	No. of Deaths	Proportion Who Smoked	Risk Ratio (99% CI)†	Smoking-Associated Excess Deaths
		%		*no. (%)*
Women				
Age 20–29 yr, any medical cause	2,070	3	1.5 (1.0–2.4)	20 (1)
Age 30–69 yr				
Tuberculosis	1,363	13	3.0 (2.4–3.9)	127 (9)
Respiratory disease	2,288	14	3.1 (2.5–3.8)	221 (10)
Stroke	1,597	8	1.6 (1.2–2.1)	47 (3)
Heart disease	2,473	7	1.7 (1.3–2.1)	77 (3)
Neoplastic disease	2,153	8	2.1 (1.6–2.6)	90 (4)
Peptic ulcer	239	13	2.8 (1.6–4.8)	20 (8)
Liver disease and alcohol	511	11	1.5 (1.1–2.3)	20 (4)
Infection	2,420	8	1.5 (1.2–1.9)	63 (3)
Other or unspecified disease	3,342	8	1.7 (1.4–2.1)	118 (4)
Age 30–69 yr, any medical cause	16,386	9	2.0 (1.8–2.3)	783 (5)
Age ≥70 yr, any medical cause	14,613	8	1.3 (0.9–1.7)	281 (2)
Men				
Age 20–29 yr, any medical cause	1,841	29	1.2 (1.0–1.5)	88 (5)
Age 30–69 yr				
Tuberculosis	3,119	66	2.3 (2.1–2.6)	1174 (38)
Respiratory disease	3,487	60	2.1 (1.9–2.3)	1078 (31)
Stroke	2,200	53	1.6 (1.4–1.8)	423 (19)
Heart disease	5,409	52	1.6 (1.5–1.8)	1102 (20)
Neoplastic disease	2,248	59	2.1 (1.9–2.4)	709 (32)
Peptic ulcer	397	61	1.9 (1.4–2.5)	111 (28)
Liver disease and alcohol	1,596	63	1.6 (1.4–1.9)	389 (24)
Infection	2,842	51	1.3 (1.2–1.5)	366 (13)
Other or unspecified disease	3,992	48	1.3 (1.1–1.4)	399 (10)
Age 30–69 yr, any medical cause	25,290	55	1.7 (1.6–1.8)	5751 (23)
Age ≥70 yr, any medical cause	13,923	45	1.6 (1.4–1.9)	2328 (17)

* Causes of death were defined according to the following codes from the *International Classification of Diseases, 10th Revision* (with the exclusion of codes related to deaths from maternal causes or injury): tuberculosis (A15-19, B90) includes respiratory and other tuberculosis; respiratory disease (J00-99) is chiefly chronic obstructive pulmonary disease, asthma, and pneumonia; stroke (I60-69, G81-83) includes subarachnoid hemorrhage; heart disease (I00-59, I70-99, R96) includes all vascular disease and sudden death except stroke and is mostly directly or indirectly due to ischemic heart disease; neoplastic disease (C00-D48) includes malignant and benign neoplasms; peptic ulcer (K25-31) includes gastric and duodenal ulcer and gastritis; liver disease and alcohol (K70-77, B15-19, F10, R17-18, X45, X65, Y15, Y90-91) includes cirrhosis, hepatitis, jaundice, ascites, alcoholism, and alcohol poisoning; infection (rest of A and B, G00-09, R50) includes fever of unknown origin (R50, 18% of this subgroup) and inflammatory central nervous system disease but excludes other respiratory infection, tuberculosis, and hepatitis; other or unspecified disease (all of codes A–N and P–R except for the abovementioned disorders) includes completely ill-defined disorders (R99, 19% of this subgroup) and diabetes but excludes maternal deaths (O) and all deaths from injury (codes V–Y). Percentages may not total 100 because of rounding.

† Risk ratios comparing smokers with nonsmokers were adjusted for age, educational level, and use or nonuse of alcohol.

Category	No. of Deaths	Proportion of Smokers %	Risk Ratio (99% CI)	Smoking-Associated Excess Deaths no.	%
Women					
Residence					
Rural	13,536	9.8	2.0 (1.8–2.3)	704	5
Urban	2,850	6.8	1.9 (1.4–2.7)	79	3
Education					
None completed	13,236	10.2	2.0 (1.7–2.3)	678	5
Primary or middle school	1,837	5.8	2.2 (1.5–3.4)	58	3
Secondary school or higher	1,145	4.9	1.8 (1.1–2.9)	25	2
Unknown	168	8.9	2.4 (0.8–7.2)	9	5
Alcohol use					
No	15,202	7.5	2.2 (1.9–2.5)	621	4
Yes	767	41.6	1.5 (1.1–2.0)	106	14
Unknown	417	16.6	1.2 (0.7–2.0)	12	3
Total	**16,386**	**9.3**	**2.0 (1.8–2.3)**	**783**	**5**
Men					
Residence					
Rural	20,150	56.4	1.6 (1.6–1.8)	4574	23
Urban	5,140	51.3	1.9 (1.6–2.1)	1177	23
Education					
None completed	13,359	58.2	1.6 (1.5–1.7)	2945	22
Primary or middle school	5,836	56.8	1.7 (1.5–1.8)	1318	23
Secondary school or higher	5,781	47.8	1.7 (1.6–1.9)	1147	20
Unknown	314	47.8	1.2 (0.8–1.9)	23	7
Alcohol use					
No	16,047	44.0	1.6 (1.5–1.7)	2731	17
Yes	8,345	75.7	1.6 (1.5–1.8)	2466	30
Unknown	898	68.5	2.2 (1.7–2.9)	335	37
Total	**25,290**	**55.4**	**1.7 (1.6–1.8)**	**5751**	**23**

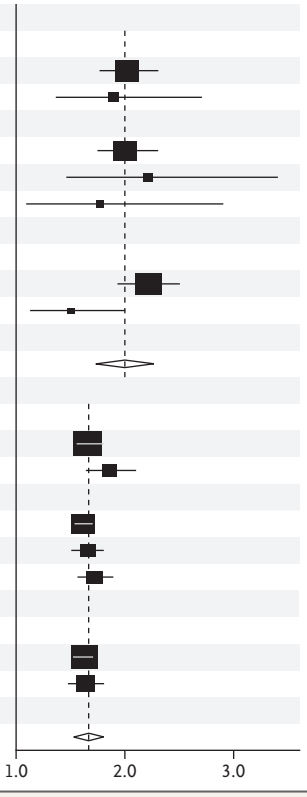

Figure 2. Risk of Death from Any Medical Cause among Smokers, as Compared with Nonsmokers, between the Ages of 30 and 69 Years.

Risk ratios for residence (urban or rural) were adjusted for age, educational level, and use or nonuse of alcohol; those for educational level were adjusted for age and use or nonuse of alcohol; those for alcohol use or nonuse were adjusted for age and educational level. Subjects for whom data were missing were excluded from the analysis. Horizontal bars represent 99% confidence intervals, and vertical dashed lines and diamonds indicate the overall mortality risk ratios. The area of each square is inversely proportional to the variance of the logarithm of the risk ratio, so a large square corresponds to a short confidence interval.

provides estimates of absolute risks of death for smokers and nonsmokers for three major causes of death: respiratory disease, heart disease, and tuberculosis.

ESTIMATED NATIONAL MORTALITY IN 2010

Table 3 provides estimates of the numbers of adult deaths in India for 2010 and the numbers that would be avoided if smokers had the same rate of death as otherwise similar nonsmokers. These 2010 projections assume that as the population grows, the age-specific distributions of the underlying causes of death and of the proportions associated with smoking will be similar over the next few years to those suggested by this study. Among women between the ages of 30 and 69 years, the excess number of deaths associated with smoking will be approximately 5% (99% CI, 4 to 6) of all deaths. Among men in this age group, the excess will be 20% (99% CI, 19 to 22) of all deaths. This proportion differs from the 23% shown in Table 2 and Figure 2, since deaths from injuries were excluded from those denominators. The excess number of deaths among adult smokers in 2010 will be about 930,000, including 580,000 deaths among men and 90,000 deaths among women between the ages of 30 and 69 years. Because of population growth, the annual number of smoking-associated deaths among adults will be about 1 million during the 2010s.

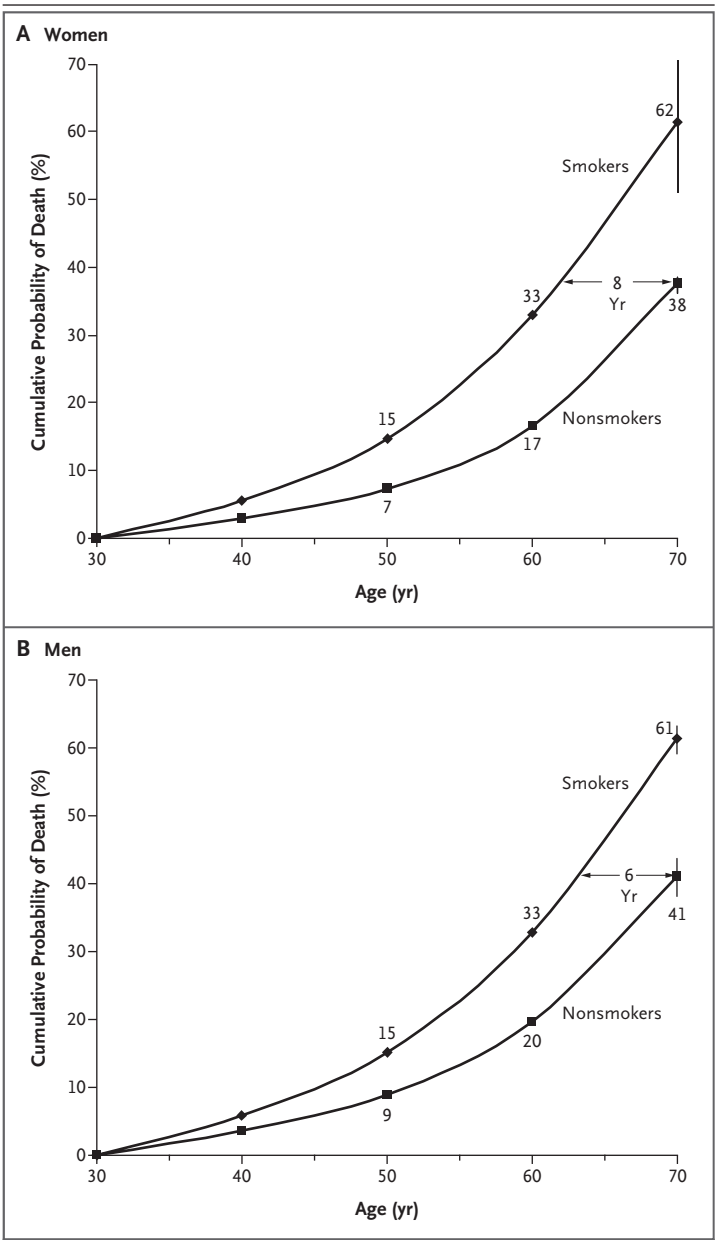

Figure 3. Cumulative Probability of Death from Any Cause among Smokers and Nonsmokers between the Ages of 30 and 69 Years.

All values have been adjusted for age, educational level, and use or nonuse of alcohol in estimates for women (Panel A) and men (Panel B).

DISCUSSION

In this large, nationally representative case–control study, we found that in both rural and urban India, among men between the ages of 30 and 69 years, the rate of death from any medical cause in smokers was 1.7 times that in nonsmokers of similar age, educational level, and alcohol status (use or nonuse). Among female smokers, mortality from any medical cause was double that among their nonsmoking counterparts. Most of the excess mortality was from tuberculosis or from respiratory, vascular, or neoplastic disease.

Although the hazard associated with any smoking (even only a few bidis a day) was substantial, the hazard of cigarette smoking (risk ratio, 2.2) was even higher and corresponded to more than a doubling of the risk of death in middle-aged men, suggesting about a 10-year gap in median survival between cigarette smokers and nonsmokers. Such risks are similar to those seen in a study in the United Kingdom in which most of the male smokers had been smoking substantial numbers of cigarettes since about 18 years of age.[21] We could not study smoking cessation, since quitting is uncommon in India[18] and often occurs only after a smoker becomes ill. However, studies elsewhere have shown that cessation can substantially reduce a smoker's risk.[21,22]

Although the assessment of smoking-associated risks for women is subject to more uncertainty, the risk of smoking among women appears to be at least as large as that for men. For both sexes, such extreme risks in India are surprising,[7] since the age at which persons generally start smoking is older[23] and the amount that is smoked per person is lower[5] than in Europe or North America; India also appears to have a relatively low rate of lung cancer.[9] Indeed, in our study, the number of smoking-associated deaths from tuberculosis was more than 10 times the number of smoking-associated deaths from lung cancer. These high overall risks reflect the high background rates of death from tuberculosis, respiratory disease, and heart disease among nonsmokers in India.

Our study has some limitations. First, differences between case subjects and control subjects, in factors other than the few variables that we measured, may have affected the relative risks. Second, tobacco use and alcohol use are strongly correlated, so residual confounding by the use of alcohol could explain some of the excess mortality among smokers. However, the relative risk of death from any medical cause among smokers, as compared with nonsmokers, was similar when analyses were restricted to those who did not drink alcohol. Third, verbal-autopsy methods misclassify the underlying causes of some

Table 3. Estimate of the Excess Number of Deaths Associated with Smoking among Indian Adults in 2010, According to Age, Sex, and Underlying Cause of Death.*

Age Group and Underlying Cause of Death	Excess Deaths Associated with Smoking (in thousands)			
	Women		Men	
	no./total no.	%	*no./total no.*	%
Age 20–29 yr, any cause	2/280	1	9/319	3
Age 30–69 yr†				
Tuberculosis	14/155	9	120/315	38
Respiratory disease	26/259	10	109/353	31
Stroke	5/182	3	42/223	19
Heart disease	8/281	3	110/548	20
Neoplastic disease	9/228	4	67/211	32
Peptic ulcer	2/27	8	11/40	28
Other medical cause‡	29/729	4	120/851	14
Injury§	0/141	0	0/341	0
Any cause	93/2002	5	579/2882	20
Age ≥70 yr, any cause	33/1735	2	219/1628	13
Total (age ≥20 yr), any cause	128/4017	3	807/4829	17

* Data regarding cause-specific total numbers of deaths have been adjusted according to the total number of deaths from any cause on the basis of predictions by the World Health Organization for 2010.[2] Some percentages reflect the use of rounded numerators and denominators.
† Codes from the *International Classification of Diseases, 10th Revision,*[15] are listed in Table 2.
‡ Maternal deaths were included but none were attributed to smoking.
§ Deaths from fires or accidents were included, but none were attributed to smoking.

deaths.[12-14,16,17] Although a more precise classification of the underlying disease responsible for each death would probably sharpen the findings by increasing the risk ratios for some conditions and decreasing it for others, it would have little effect on the risk ratio for the aggregate of all diseases. Fourth, we did not have information on the smoking status of people who were homeless or living alone when they died; overall, we obtained information on smoking for only 88% of all enumerated deaths. However, persons who were homeless or living alone were also excluded from the control subjects. Finally, the tendency of smokers to live with other smokers could have inflated the rates of smoking among control subjects. In addition, control subjects were self-selected by their willingness to be interviewed. However, we had few refusals, and the age-specific prevalence of smoking among control subjects was reasonably similar to that in recent independent, nationally representative surveys.[18,24] Differential reporting of the daily amount smoked between case subjects and control subjects could have distorted the dose–response relationships, but the overall hazards associated with smoking should not be increased, since it is unlikely that many deceased nonsmokers were misreported as having been smokers.

Previous studies of men in India[6-9,25-27] and of men and women elsewhere[21,28-31] have provided reasonably robust evidence that smoking can actually cause various types of respiratory, vascular, and neoplastic disease — in other words, that smoking increases the risk of developing such diseases in the near future among otherwise similar people of a given age. Hence, it is reasonable to conclude that the observed association between excess mortality and such diseases after adjustment for age and use or nonuse of alcohol was mostly causal, especially since the relative risks were not materially altered by adjustment for educational level or by restriction of the analyses to persons who did not consume alcohol. In contrast, the association between smoking and death from liver disease (which is greatly reduced after adjustment for use or nonuse of alcohol) is probably largely or wholly due to the tendency of habitual drinkers to smoke tobacco.

Tuberculosis is a special case because the tubercle bacillus is obviously a cause of all deaths from tuberculosis. Nevertheless, smoking could also be a cause of many of the deaths from tuberculosis. Subclinical infection is widespread,[32,33] and smoking could facilitate progression to clinical disease.[6] If so, smoking might also contribute to the spread of tuberculosis to others.

If the associations we observed in our study were mostly causal, we estimate that smoking will cause about 930,000 deaths in 2010 in India. Of these deaths, about 580,000 among men and 90,000 among women will occur between the ages of 30 and 69 years (about 1 in 20 deaths from any cause among women and 1 in 5 deaths from any cause among men in this age group). The excess mortality among smokers in India will account for much of the gap between male and female mortality in middle age.

Because of population growth, the absolute numbers of deaths are rising by about 3% per year among persons between the ages of 30 and 69 years and by a higher rate among persons who are older.[2] During the 2010s, therefore, the annual number of deaths from smoking in India will be about 1 million, which is similar to the annual number in China.[34] Of the million annual deaths from smoking in India, approximately 70% (100,000 among women and 600,000 among men) will occur in middle age, rather than old age.

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