Continued Increases in the Relative Risk of Death From Smoking

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Objectives. We examined changes in the relative risk of death among current and former smokers over recent decades in the United States.

Methods. Data from the National Health Interview Survey (NHIS) and National Health and Nutrition Examination Survey (NHANES) were linked to subsequent deaths. We calculated age-standardized death rates by gender and smoking status, and estimated multivariate discrete time logit regression models.

Results. The risk of death for a smoker compared with that for a never-smoker increased by 25.4% from 1987 to 2006 based on NHIS data. Analysis of NHANES data from 1971 to 2006 showed an even faster annual increase in the relative risk of death for current smokers. Former smokers also showed an increasing relative risk of death, although the increase was slower than that among current smokers and not always statistically significant. These trends were not related to increasing educational selectivity of smokers or increased smoking intensity or duration among current smokers. Smokers may have become more adversely selected on other health-related variables.

Conclusions. A continuing increase in the relative risk of death for current and former smokers suggests that the contribution of smoking to national mortality patterns is not decreasing as rapidly as would be implied by the decreasing prevalence of smoking among Americans. (*Am J Public Health.* 2012;102: 2181–2186. doi:10.2105/AJPH.2011.300489)

Many prospective cohort studies have documented an excess mortality among smokers relative to that among nonsmokers. However, the magnitude of the relative risk of death from smoking has varied from study to study. The size of the risk has obvious implications for the behavioral choices of individuals. It is also directly relevant to the interpretation of population-level variation in mortality. For example, smoking has been identified as a major contributor to the poor ranking of the United States in international comparisons of longevity,[1] to the worsening position of womens' life expectancy relative to that of men in the United States,[2] and to the higher mortality of poorly educated relative to well-educated individuals in several countries.[3] An accurate identification of the relative risks of smoking, and trends therein, helps to clarify its role in population health.

The largest studies of the excess mortality risks of smokers have been conducted by the American Cancer Society. In Cancer Prevention Study I (CPS-I), approximately 1.05 million volunteers were recruited in 1959 from 25 states. Cancer Prevention Study II (CPS-II) recruited a similar number of volunteers in 1982 from all 50 states. Participants in both studies were older, more educated, and more likely to be married than was the general US population. Whites made up 97% of CPS-I and 93% of CPS-II.[4]

Comparisons of the risk of death among smokers and nonsmokers between these 2 studies showed that the ratio of mortality among smokers to that of nonsmokers rose between 1959 and 1965 and 1982 and 1986.[4–6] For example, the ratio of age-standardized death rates of current cigarette smokers to never-smokers over this interval rose from 1.7 to 2.3 among men and from 1.2 to 1.9 among women.[4] A similar increase in the relative risk of death for smokers was recorded in a study of British doctors begun in 1951. At age 60 years and older, the relative risk of death among smokers increased from 1.46 for those born in the 19th century to 2.19 for those born in the 20th century.[7] Rosenbaum et al.[8] demonstrated a similar increase over the period from 1966 and 1968 to 1987 using data from National Mortality Follow-back Surveys.

We used data from the National Health Interview Survey (NHIS) to investigate (1) whether similar trends are observed in nationally representative cohort studies; (2) whether such trends extend beyond the period 1986 to 1987, the last period included in previous studies of trends in risk; (3) whether similar trends are observed among former smokers, who now outnumber current smokers older than 45 years[9] (former smokers were not included in the CPS analysis); and (4) whether an increase in the relative risk of death among smokers is attributable to increasing educational selectivity of smokers compared with nonsmokers or to changes in the intensity and duration of smoking among current smokers.

Although we relied primarily on data from NHIS in this investigation, we also used data from the National Health and Nutrition Examination Survey (NHANES), another nationally representative data set. NHANES data extend over a longer period than those from NHIS but contain a much smaller number of observations.

METHODS

The NHIS is an annual cross-sectional survey of the noninstitutionalized US population conducted by the National Center for Health Statistics (NCHS). The 1986–2004 annual surveys are linked to the National Death Index (NDI) by NCHS. To date, mortality follow-up is available through December 31, 2006, in the publicly available NHIS Linked Mortality File. We pooled 1987–2003 annual survey results but excluded 1989 and 1996 surveys because they do not contain questions on cigarette smoking. We also excluded the 2004 survey because there were insufficient data for the timing of entry into the study. Before 1997, questions on cigarette smoking were included in various supplemental questionnaires administered to a subset of all adults. The 1997–2003 surveys contained questions on smoking in the

sample adult questionnaire, which is given to 1 adult in each family surveyed. NHIS data are obtained through the Integrated Health Interview Series (IHIS),[10] which is a publicly available set of harmonized NHIS variables. For variables not included in the IHIS, we obtained data from publicly available NHIS files provided by NCHS. To examine trends over a longer period, we provide additional results from NHANES. We used data from NHANES I (1971–1975), II (1976–1980), and III (1988–1994), and the NHANES continuous series (1999–2004). Similar to the NHIS, the NHANES is nationally representative of the noninstitutionalized US population.

Our focus was adults aged 50 to 74 years at baseline. In the combined 1987–2003 NHIS, there were 138 338 respondents in this age range who were included in the subsamples that were asked questions about smoking. More than 99% of the respondents had sufficient information to check mortality status in NDI (99.4%; n = 137 570). Among them, information on smoking was missing in approximately 1% of the sample, and an additional 1% had missing data on at least 1 other covariate used in the analysis. The final analytic sample includes 134 382 respondents who were followed for a total of 1.3 million person-years. The number of deaths recorded was 32 973. We also used additional models for deaths from 3 major underlying causes of death: cardiovascular disease, lung cancer, and respiratory diseases. The mortality period we analyzed falls under both *International Classification of Diseases, Ninth edition* (*ICD-9* [1979–1998]) and *ICD-10* (since 1999) guidelines for cause of death coding for all US deaths. We used a consistent set of 113 underlying cause-of-death recodes provided in the NHIS Linked Mortality File.[11] Deaths occurring prior to 1999 were classified in comparable *ICD-10* groupings by NCHS. Cardiovascular mortality (*ICD-10* code I00-I78) includes deaths from heart disease, cerebrovascular diseases, and diseases of the circulatory system. Lung cancer mortality (*ICD-10* code C33-C34) includes deaths from neoplasms of the lung, trachea, and bronchus. Respiratory mortality (*ICD-10* code A16, J00-J98) includes deaths from chronic obstructive pulmonary disease, respiratory infections, asthma, and other respiratory diseases excluding neoplasms.

A strength of the NHIS is that it contains a fairly consistent set of measures of cigarette smoking behavior across annual surveys. Respondents are consistently defined as never-smokers if they report having smoked less than 100 cigarettes in their entire lives. Former smokers are defined as those who report smoking at least 100 cigarettes in their entire lives but report that they do not currently smoke. Current smokers are those who report having smoked at least 100 cigarettes and report that they currently smoke.

We used discrete-time logit regressions to model mortality. We used this approach, rather than a model that assumes a continuous-time process, because the timing of deaths in the public-use NHIS files is given in quarter-year intervals. We estimated trends in the relative risks of smoking by including an interaction term between smoking status and calendar year at baseline in our models. This approach allowed us to estimate an annual change in the relative risks associated with former and current smoking. Furthermore, we included 2-way interaction terms between smoking status and age and smoking status and gender because the risks of smoking have been previously shown to vary by both age and gender.[4] To control for the changing educational selectivity of smokers over time, we also controlled for educational attainment categorized as less than 12 years, 12 years, 1 to 3 years of college, 4 years of college or bachelor's degree, and 5 or more years of college. Risks of smoking may be confounded by body mass index, and therefore, we also included standard body mass index categories (< 18.5, 18.5–24.9, 25.0–29.9, 30.0–34.9, and ≥35.0 kg/m^2) in all regressions.

All analyses included sample weights and accounted for the complex survey design of the surveys. Because we pooled multiple years of the NHIS that span 2 distinct design periods, we adjusted sample weights according to recommended guidelines and used appropriate primary sampling units and strata recodes.[10] Analyses were conducted using Stata version 11.0 software (StataCorp LP, College Station, TX).

RESULTS

We began by showing age-adjusted mortality and relative risks of smoking by gender (Table 1). To assess changes over time in the mortality risks associated with smoking, we

TABLE 1—Age-Standardized Death Rates and Relative Risks of Dying From All Causes by Gender and Period: National Health Interview Survey, 1987–2006

Characteristic	Men		Women	
	1987–1996	1997–2006	1987–1996	1997–2006
All: death rate per 1000 (95% CI)	23.2 (22.3, 24.0)	19.9 (19.0, 20.7)	13.4 (12.8, 14.0)	12.7 (12.2, 13.3)
Never-smokers				
Death rate per 1000 (95% CI)	14.7 (13.3, 16.0)	12.1 (11.0, 13.2)	9.8 (9.0, 10.6)	9.1 (8.5, 9.7)
Relative risk	Ref	Ref	Ref	Ref
Current smokers				
Death rate per 1000 (95% CI)	38.6 (36.1, 41.1)	37.7 (35.0, 40.4)	22.8 (21.0, 24.6)	23.0 (16.6, 20.2)
Relative risk (95% CI)	2.63 (2.34, 2.92)	3.12 (2.75, 3.48)	2.33 (2.06, 2.61)	2.53 (2.24, 2.81)
Former smokers				
Death rate per 1000 (95% CI)	21.0 (19.8, 22.2)	18.9 (17.8, 20.0)	14.8 (13.5, 16.0)	14.4 (13.2, 15.5)
Relative risk (95% CI)	1.43 (1.26, 1.59)	1.56 (1.39, 1.73)	1.51 (1.32, 1.70)	1.58 (1.41, 1.75)
Sample size, no.	25 121	23 792	35 735	30 675
Deaths, no.	3976	2916	3660	2599
Person-years, no.	154 318	139 332	227 355	184 006

Note: CI = confidence interval. Participants were aged 50–74 years at study entry. Entry years were 1987–1993 (excluding 1989) for the earlier period and 1997–2003 (excluding 1999) for the later period. Deaths were followed through December 31, 1996, for the earlier period and December 31, 2006, for the later period. Death rates and relative risks are weighted. Sample size, number of deaths, and person-years are unweighted.
Source: National Health Interview Survey (NHIS).

divided data into 2 periods of observation. In the first period, we included cohorts aged 50 to 74 years who entered observation between January 1, 1987, and December 31, 1993. They were followed in death data until December 31, 1996. In the second period, we included cohorts aged 50 to 74 years at entry between January 1, 1997, and December 31, 2003; they are followed in death data until December 31, 2006. Smoking data were not available for the 1989 entry cohort; therefore, we excluded the 1999 entry cohort so that the 2 periods of observation were identically constituted with respect to length of entry and follow-up.

When all smoking status categories were combined (Table 1), death rates declined for both men and women. In absolute and percentage terms, the decline was larger for men: 23.2 to 19.9 among men compared with 13.4 to 12.7 among women (measured by deaths per 1000 person-years). The male advantage in rates of mortality change replicates that in national life tables over this period.[12] Table 1 shows that mortality declines have also occurred within all smoking statuses for both genders with the exception of female current smokers, who suffered a slight and statistically insignificant increase in death rates. For both genders, the largest proportionate declines in death rates occurred among never-smokers, so that the relative risks of former and current smokers increased for both genders. Among men, the relative risks of current smokers increased from 2.63 to 3.12 across the 2 periods, whereas the relative risks of former smokers increased from 1.43 to 1.56. Among women, the relative risks of current smokers increased from 2.33 to 2.53, and the relative risks of former smokers rose from 1.51 to 1.58. The 95% confidence intervals for relative risks overlapped for both genders between the 1987 to 1996 period and the 1997 to 2006 period.

The values presented in Table 1 do not adjust for many other factors affecting mortality, nor do they explicitly test for the significance of trends in the mortality risk from smoking. To address these issues, Table 2 introduces multivariate regression models predicting deaths from all causes combined. Model 1 (Table 2) relates mortality to a variety of relevant biological and biosocial variables in addition to smoking status, including age, gender, race/ethnicity, and body mass index. Model 2 adds educational attainment to that set of variables. The risks (in the form of odds ratios) of current and former smokers were allowed to vary linearly by age and year of entry into the data set. Age was centered on 65.0 years, and the counting of calendar years began with 1987 as year zero. We additionally allowed risks of smoking to vary by gender. In models not shown, we included a variable that interacts gender with trends in the mortality risk of being a current or former smoker. These interactions were insignificant and hence were dropped in our basic model.

For both genders, both current and former smokers have much higher death rates than never smokers. According to Model 1, for someone entering at age 65 years in 1987, the odds of death for a male current smoker were

TABLE 2—Models Predicting Death from All Causes: NHIS, 1987–2006, and NHANES, 1971–2006

Characteristic	Model 1 NHIS (n = 134 382), OR (95% CI)	Model 2 NHIS (n = 134 382), OR (95% CI)	Model 2 NHANES (n = 19 145), OR (95% CI)
Calendar year	0.986*** (0.980, 0.992)	0.991*** (0.984, 0.997)	0.983*** (0.975, 0.991)
Age, y	1.113*** (1.108, 1.117)	1.109*** (1.104, 1.113)	1.123*** (1.113, 1.333)
Female	0.724*** (0.687, 0.762)	0.686*** (0.651, 0.723)	0.648*** (0.578, 0.727)
Current smoker	2.878*** (2.649, 3.126)	2.660*** (2.449, 2.889)	3.220*** (2.791, 3.714)
Current X female	0.880*** (0.819, 0.946)	0.929* (0.864, 0.999)	0.921 (0.779, 1.088)
Current X age	0.984*** (0.979, 0.990)	0.985*** (0.980, 0.991)	0.980*** (0.969, 0.991)
Current X year	1.012** (1.004, 1.020)	1.011** (1.003, 1.019)	1.019*** (1.009, 1.029)
Former smoker	1.427*** (1.312, 1.552)	1.388*** (1.275, 1.510)	1.578*** (1.356, 1.837)
Former X female	0.996 (0.929, 1.069)	1.037 (0.966, 1.113)	1.067 (0.902, 1.263)
Former X age	0.996 (0.991, 1.001)	0.996 (0.991, 1.001)	0.987* (0.977, 0.999)
Former X year	1.008* (1.000, 1.016)	1.008 (1.000, 1.016)	1.013* (1.003, 1.024)
Educational attainment			
Grade 12	....	0.809*** (0.780, 0.838)	0.872** (0.804, 0.949)
1–3 y of college	....	0.759*** (0.725, 0.794)	0.834*** (0.755, 0.922)
4 y of college/Bachelor's degree	....	0.626*** (0.592, 0.663)	0.640*** (0.549, 0.745)
≥ 5 y of college	....	0.586*** (0.549, 0.625)	....

Note: CI = confidence interval; NHANES = National Health and Nutrition Examination Survey; NHIS = National Health Interview Survey; OR = odds ratio. Participants were aged 50–74 years at study entry. Never smoker is the omitted category for smoking status and < 12 y is the omitted category for educational attainment. Calendar year indicates year of entry in study. Age is centered on 65.0 years and the year is centered on 1987. For NHIS, entry years were 1987–2003 (excluding 1989 and 1996), and deaths were followed through December 31, 2006. For NHANES, entry years were 1971–1975 (NHANES I), 1976–1980 (NHANES II), 1988–1994 (NHANES III), and 1999–2004 (NHANES continuous). Deaths were followed through December 31, 1992, for the 2 earlier NHANES cohorts and through December 31, 2006, for the 2 later NHANES cohorts. The 2 highest educational categories were combined in the NHANES because of availability of data. All models control for race/ethnicity, body mass index, and time in study. Estimates are weighted.

* $P < .05$; ** $P < .01$; *** $P < .001$.

elevated by the factor 2.88 and for women by 2.53 (i.e., 2.88×0.88). With respect to our central concern, trends in the mortality risk of smoking, the odds of death for current smokers have been increasing rapidly and significantly at a rate of 1.2% per year (OR = 1.012; $P < .01$). Based on the estimated trend, the relative odds for current smokers rose by 25.4% between 1987 and 2006 (i.e., $[1.012^{19} - 1.000] \times 100$).

At age 65 years in 1987, both male and female former smokers had approximately 43% increased odds of dying relative to never-smokers ($P < .001$). The relative odds of death for former smokers also grew over this period at a significant rate ($P = .05$).

Model 2 in Table 2 introduces educational attainment into the equation predicting mortality. This variable is introduced to address the question of whether smokers are an increasingly selective group, an issue raised by many, including Thun and Heath.[5] A readily measured element of social selectivity is educational attainment. It is well known that the largest declines in smoking have occurred among better-educated people. For example, the age-adjusted prevalence of current smoking among persons aged 25 years and older decreased by 67% among college graduates between 1974 and 2007 but only by 24% among high school graduates.[13] Table 2 shows that, although greater schooling is associated with sharply reduced mortality, the direction and magnitude of the trends in smoking risks remain essentially unchanged when educational attainment is introduced. To explore this issue further, we added to Model 2 an interaction term between a linear variable for educational attainment and time. The interaction term was insignificant, and the estimated trend in the mortality risk for current smokers remained essentially unchanged at 1.011 ($P < .01$). This trend, therefore, appears to be independent of any changes in the association between educational attainment and smoking.

It is possible that forms of selectivity beyond educational attainment have influenced the relative risks of smokers. For example, smokers in more recent periods may be more adversely distributed on other domains of health. To investigate this possibility, we examined relative changes in 3 variables over the periods 1997 to 1999 and 2007 to 2009, the longest periods for which comparable data for these variables were available from NHIS. Table 3 shows that smokers were less likely to exercise vigorously, more likely to engage in binge drinking, and were at higher risk for serious mental illness. Furthermore, the changes among smokers were more adverse over the period than were changes among never-smokers. However, differences in the amount of change by smoking status were small. Using a logit model controlling for age at the individual level (not presented), we found that only differences between current smokers and never-smokers in terms of change in physical activity were significant at $P < .05$, and it is widely recognized that results using this variable are likely to be contaminated by reverse causation.

To test the robustness of our findings based on NHIS data, Model 2 was also applied to completely independent data derived from NHANES. As in the model applied to NHIS, individuals were aged 50 to 74 years at baseline, the reference age group was aged 65 years, and the reference year was 1987. A longer period of observation is available in NHANES, 1971–2006, but there are many fewer overall observations (n = 19 145 in NHANES).

A comparison of the coefficients of the regressions applied to the 2 data sets in Table 2 shows substantial agreement. Mortality risks of current and former smokers were higher in NHANES than in NHIS. More central to our concerns, the relative odds of death among smokers grew faster in NHANES. Such differences may partly reflect differences in the coverage period. In NHANES, the trend of increasing odds of death for current smokers was significant at $P < .001$, and the increasing trend in the odds of death for former smokers was significant at $P < .05$. When estimated for the 2 data sets, the 95% confidence intervals for coefficients of trends in mortality risks overlapped. Thus, risk trends were consistent in the 2 data sources. The implication of a rising relative risk of death for smokers was bolstered by the appearance of similar trends in both data sources.

We demonstrated that the increasing educational selectivity of smokers was not playing an important role in the rising relative mortality risk of smokers. We then investigated whether changes in smoking patterns among current smokers might be responsible for the trend. Our investigation focused on NHIS, whose larger sample size supported more intensive analysis. We next used a subset of NHIS data that included only baseline years in which questions were asked about the timing of initiation, from which we derived a measure of

TABLE 3—Age-Standardized Percentage of Vigorous Physical Activity, High Risk for Serious Mental Illness, and Binge Drinking in the Prior Year by Smoking Status and Period: National Health Interview Survey, 1997–1999 and 2007–2009

	1997–1999, % (95% CI)	2007–2009, % (95% CI)	Δ (95% CI)
Vigorous physical activity (≥ 20 min, ≥ 3x/wk)			
Never-smoker	16.61 (15.71, 17.51)	20.96 (19.97, 21.95)	4.35 (3.01, 6.69)
Current smoker	10.45 (9.40, 11.50)	10.98 (9.91, 12.05)	0.53 (–0.96, 2.03)
Former smoker	20.80 (19.70, 21.91)	22.90 (21.67, 24.13)	2.10 (0.44, 3.75)
At high risk for serious mental illness (≥ 13 score on K6 scale)			
Never-smoker	2.18 (1.87, 2.48)	2.20 (1.89, 2.50)	0.02 (–0.41, 0.45)
Current smoker	5.35 (4.68, 6.03)	6.34 (5.33, 7.35)	0.99 (–0.23, 2.20)
Former smoker	2.33 (1.95, 2.72)	2.69 (2.23, 3.15)	0.36 (–0.24, 0.96)
Binge drinking at least once in prior y (≥ 5 alcoholic drinks on any 1 d)			
Never-smoker	5.26 (4.71, 5.80)	7.59 (6.91, 8.27)	2.33 (1.46, 3.20)
Current smoker	18.07 (16.87, 19.26)	21.13 (19.52, 22.73)	3.06 (1.06, 5.07)
Former smoker	13.51 (12.55, 14.48)	16.93 (15.77, 18.09)	3.42 (1.91, 4.93)

Note: CI = confidence interval. Participants were aged 50–74 years. The sample size was = 47 055. The K6 scale consists of 6 questions measuring nonspecific psychological distress.[14] Estimates are weighted.

smoking duration. This restriction reduced the sample size from 134 382 to 93 072 participants. We constructed the smoking duration variable by subtracting age at smoking initiation from current age (for current smokers) or from age at quitting (for former smokers).

In their comparison of changes in smokers' mortality risks between 1959 and 1965 and 1982 and1986, Thun et al.[4] concluded that smokers were smoking more cigarettes per day during the later period, which may have been a factor in the rising risk of death among smokers. To test whether such a change in smoking intensity continued, we disaggregated the category of current smoker into numbers of cigarettes smoked per day: < 1 pack, 1 to < 2 packs, and ≥ 2 packs. Table 4 shows that the intensity of smoking reported by smokers at baseline dropped considerably between cohorts entering between 1987 and 1992 and 1997 and 2003. The duration of smoking tells a somewhat different story. For male current smokers, the mean duration of smoking was virtually constant, and for female current smokers, it increased by 1.00 years over this period. The mean duration of smoking among former smokers declined for both genders.

To be sure that changes in intensity and duration were not responsible for the rise in mortality risks of current smokers, we reestimated Model 2 in Table 2 on this subset of data that included smoking duration (not shown). Only current and never-smokers were included. The coefficient of the trend in mortality risk among current smokers in this subset was 1.009 ($P < .05$) compared with 1.011 ($P < .01$) when the full data set was used. Thus, the basic trend was preserved. When both duration and intensity of smoking were added to the model, each set of variables was powerfully related to the odds of dying. However, the trend in relative odds of death among current smokers declined only modestly from 1.009 to 1.007. By entering variables separately, it became clear that they partially offset one another because intensity decreased whereas duration increased; however, in combination they accounted for little of the increased odds of death for current smokers.

Other changes in smoking patterns that we were unable to measure may be related to the increasing odds of death for smokers. There are indications that smokers may have started inhaling more deeply,[8] perhaps to compensate for reductions in the tar and nicotine content of cigarettes.[15] An additional possibility is that, while duration of smoking has increased only slightly, the years of lifetime smoking may be distributed in a more damaging fashion among more recent cohorts.[6] We controlled current intensity of smoking but not past intensity, which may have increased among cohorts born later. Finally, it is possible that regulations restricting smoking to small areas have exposed smokers to more secondhand smoke.

The models used for all causes of death can also be applied to mortality from specific causes. Of course, as the number of observed deaths declines through such disaggregation, sampling errors increase. In the NHIS, the trend in odds ratios for current smokers was positive and significant at $P < .05$ for mortality from cardiovascular disease (1.015) and positive and statistically insignificant for mortality from lung cancer (1.009). These rates of increase were similar to that for all causes. For respiratory disease, the risk trend was nearly flat (0.996).

DISCUSSION

A continuing rise in the relative risk of death for current and former smokers suggests that the contribution of smoking to national mortality patterns is not declining as rapidly as implied by the declining prevalence of smoking among Americans. This observation is consistent with evidence based on lung cancer trends that smoking is largely responsible for shortfalls in US longevity relative to that of other Organisation for Economic Co-operation and Development (OECD) countries, despite the United States having one of the lower proportions of current smokers.[1]

The increasing relative risk of death among smokers raises the question of whether prominent estimates of the number of deaths attributable to smoking are accurate. A study by the Centers for Disease Control and Prevention (2008) estimates that an average of 443 000 annual deaths in the United States were attributable to smoking during the period 2000 to 2004.[16] This estimate was made by combining the prevalence of current and former smokers estimated in NHIS with a set of mortality risks for current and former smokers. These relative risks were derived from the American Cancer

TABLE 4—Age-Standardized Smoking Duration and Intensity by Gender and Period at Study Entry: National Health Interview Survey, 1987–1992 and 1997–2003

	Men		Women	
Characteristic	1987–1992, Mean (95% CI)	1997–2003, Mean (95% CI)	1987–1992, Mean (95% CI)	1997–2003, Mean (95% CI)
Smoking intensity (current smokers), %				
< 1 pack/d	31.01 (29.00, 33.04)	41.16 (39.58, 42.73)	43.16 (41.23, 45.09)	53.94 (52.36, 55.52)
1 to < 2 packs/d	51.50 (49.35, 53.66)	46.55 (44.94, 48.16)	47.42 (45.42, 49.41)	40.45 (38.89, 42.02)
≥ 2 packs/d	17.48 (15.88, 19.09)	12.29 (11.29, 13.29)	9.43 (8.19, 10.66)	5.61 (4.90, 6.32)
Smoking duration, y				
Current smokers	43.31 (43.07, 43.55)	43.37 (43.21, 43.54)	39.23 (38.94, 39.53)	40.23 (40.01, 40.45)
Former smokers	27.07 (26.62, 27.53)	24.73 (24.46, 25.01)	26.62 (26.08, 27.17)	24.45 (24.15, 24.76)

Note: CI = confidence interval. Participants were aged 50–74 years. The sample size was 93 072. Entry cohorts were from 1987–1988 and 1992 for the earlier period and from 1997–2003 for the later period. Estimates are weighted.

Society's CPS-II mortality estimates for the period 1982 to 1988. As we have seen, the relative risk of death from smoking has increased in national data since that period. Accordingly, it is possible that the number of deaths attributable to smoking is underestimated by CDC. A new analysis of deaths attributable to smoking by Rostron[17] uses NHIS data for mortality risks for 1997 to 2006 and estimates that an average of 520 000 annual deaths were attributable to smoking during this period. This rise in estimated smoking-attributable deaths is clearly consistent with increasing relative risks of death for smokers. ■

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Both authors contributed to all aspects of this research, including conceptualization, data analysis, and writing.

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Human Participant Protection

These analyses were based entirely on secondary data analysis of publicly available data. No approval was necessary.

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