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Smoking Cessation and Mortality Trends Among Two United States Populations

James E. Enstrom

SCHOOL OF PUBLIC HEALTH AND JONSSON COMPREHENSIVE CANCER CENTER,
UNIVERSITY OF CALIFORNIA, LOS ANGELES, CALIFORNIA

ABSTRACT. The long-term impact of smoking cessation on mortality is assessed among two U.S. populations: a large cohort of U.S. veterans aged 55–64 at entry and followed from 1954 through 1979 and the NHANES I Epidemiologic Followup Study (NHEFS) cohort of a national sample of U.S. adults aged 55–74 at entry and followed from 1971 through 1992. Direct and indirect survey data indicate that 50–70% of those who were current cigarette smokers at entry had quit smoking during the 19- to 26-year follow-up periods. The impact of smoking cessation on mortality among the cigarette smokers as a whole has been assessed by determining the time trend of the relative risk (RR) of death and 95% confidence interval (CI) for the cigarette smokers compared with never-smokers over the entire follow-up period in both cohorts. The total death rates for the 1954⁄57 U.S. veteran smokers as a whole (63,159 males) have converged only slightly toward those of never-smokers, from RR = 1.65 (1.58–1.72) during 1954–1959 to RR = 1.61 (1.58–1.63) during 1954–1979. The lung cancer death rates for 1954⁄57 smokers as a whole have not converged toward those of never-smokers, with RR = 10.89 (7.70–15.41) during 1954–1959 and RR = 11.10 (9.78–12.61) during 1954–1979. The total death rates for the 1971–1975 NHEFS smokers as a whole (694 males and 1116 females) have not converged toward those of never-smokers. For males, RR = 1.92 (1.46–2.52) during 1971–1982 and RR = 1.96 (1.63–2.36) during 1971–1992; for females, RR = 1.79 (1.31–2.46) during 1971–1982 and RR = 1.79 (1.47–2.17) during 1971–1992. The lung cancer death rates have diverged, based on small numbers of deaths. For males, RR = 15.76 (2.06–120.61) during 1971–1982 and RR = 22.20 (5.31–92.92) during 1971–1992; for females, RR = 2.92 (0.57–15.06) during 1971–1982 and RR = 4.74 (1.94–11.59) during 1971–1992. These trends are contrary to the substantial convergence predicted by the death rate trends among U.S. veterans who were former smokers at the beginning of follow-up. While these results confirm that those former smokers who survive for at least 5 years experience death rates that converge toward those of never-smokers, they also indicate that a cohort of cigarette smokers that undergoes substantial cessation experiences a death rate that does not converge toward the death rate of never-smokers. The fact that there has been no convergence for lung cancer is quite surprising, as this is the disease most strongly linked to smoking and smoking cessation and less likely to be influenced by other lifestyle factors. Further investigation is needed for a complete understanding of the impact of smoking cessation. J CLIN EPIDEMIOL 52;9:813–825, 1999. © 1999 Elsevier Science Inc.

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INTRODUCTION

It has been estimated by the Surgeon General and others that cigarette smoking causes about 19% of all U.S. deaths [1]. This represents more than 400,000 deaths per year, mainly from coronary heart disease, lung cancer, and other respiratory diseases, that in principle can be eliminated by smoking cessation. However, in spite of a substantial degree of cigarette smoking cessation and a large reduction in tar-and-nicotine levels in cigarettes during the past 35 years in the general U.S. population [2], the lung cancer death rate remains persistently high [3]. Indeed, among U.S. adults since 1966, the percentage of current cigarette smokers has declined from 43% to 25% and the percentage of former smokers has increased from 13% to 25%, and yet the lung cancer death rate has increased by about 100%. Thus, it is important to evaluate the impact of smoking cessation from a perspective that may explain these trends.

The value of smoking cessation comes primarily from observational epidemiological studies, which consistently indicate that the death rates of former cigarette smokers are lower than those of current cigarette smokers, and that the former smoker death rates converge toward those of never-

Address correspondence to: James E. Enstrom, Ph.D., M.P.H., School of Public Health, University of California, Los Angeles, CA 90095-1772.

smokers the longer the former smokers have not smoked [4]. Among former smokers, whose smoking status was determined at the time they entered an epidemiological study, the decline in risk of death compared with never-smokers begins during the first 5 years after quitting and continues for at least 10–15 years. After 15 years, the risk of all-cause mortality returns nearly to that of never-smokers and the risk of lung cancer mortality drops to about twice that of never-smokers.

The observational studies have the limitation that the reported benefits of cessation are based on mortality patterns among persons who were already former smokers at the time they enrolled and were classified by the number of years since they last smoked at time of enrollment. The self-selected former smokers who enrolled in these studies are those who were alive at the time the study began. A former smoker who stopped 15 years before the study began is by definition one who remained alive those 15 years. Former smokers who died before the study began would obviously not be included and might be different than the self-selected former smokers who were included.

The most rigorous way to evaluate cessation is to randomly assign smokers to either a cessation intervention or no intervention in a randomized controlled trial (RCT). There has been just one completed RCT designed to evaluate smoking cessation alone: the Whitehall Civil Servants Study of 1445 middle-aged white men in London [5]. There has been one RCT in which smoking cessation was the major risk factor change during 6 years of intervention: the Multiple Risk Factor Intervention Trial (MRFIT) of 12,866 middle-aged white men in the United States [6]. Initially, both studies showed substantially more smoking cessation in the intervention group relative to the control group (about 45% versus 20% in MRFIT averaged over 6 years and about 60% versus 25% in Whitehall averaged over 9 years), but the cessation differences diminished substantially over time. For the intervention groups relative to their respective control groups, the total mortality during 16–20 years of follow-up was 6% less in the MRFIT and 7% less in Whitehall; lung cancer mortality was 15% more in MRFIT and 10% less in Whitehall. None of these differences are statistically significant. The ongoing Lung Health Study, designed to evaluate smoking cessation among 3,702 men and 2,185 women, shows no differences in lung cancer or total mortality during the first 5 years [7]. So the RCTs have not definitively confirmed the value of smoking cessation, but they are limited by the fact that they were not able to sustain a large difference in smoking cessation between intervention and control groups.

We provide additional insight into this issue by evaluating natural experiments of smoking cessation among two U.S. cohorts, whereby the smokers as a whole largely quit, and consequently their smoking-related death rates should converge toward the corresponding death rates among those who have never smoked. A natural experiment approximates a controlled experiment, and inferences about etiological factors derived from such situations are considerably stronger than inferences derived solely from an observational study, but they are not as strong as those drawn from an RCT [8]. The study of British physicians is a prime example of a natural experiment [9]. The British study involved 34,440 physicians who substantially reduced their cigarette smoking from 1951 to 1971 and whose lung cancer death rate declined relative to the general population rate and converged toward that of nonsmokers during these 20 years. The major mortality benefits of cessation were among smoking-related causes in physicians less than age 65 at death, with no overall benefits for ages 65 and older [9].

1954–79 U.S. VETERANS STUDY

METHODS

This is a study of U.S. veterans who held Government Life Insurance Policies, primarily white men who served in World War I (WW I) [10–13]. A questionnaire requesting information about the use of tobacco, residence, usual occupation, and industry of employment was mailed to about 295,000 eligible subjects in January 1954. After a second mailing in January 1957, a total of 248,046 (84%) policy holders, aged 30–84 years, responded. There were 200,428 veterans who ever or never smoked cigarettes regularly. Of these, 136,802 (68%) were born during 1890–1899, essentially all of whom were WW I veterans.

They were followed up for survival from January 1, 1954 through September 30, 1980, using Veterans Administration (VA) records, as described elsewhere [10–13]. Causes of death were obtained from VA claims folders or from state vital records. The underlying cause of death was coded from the death certificates for 97% of all deaths by trained nosologists according to the International Classification of Diseases, Seventh Revision (ICD7). These veteran cohort data are on a publically available data file maintained by the National Cancer Institute [13].

Current cigarette smokers have been defined as all veterans currently smoking cigarettes at time of enrollment in 1954 or 1957, regardless of whether they also smoked cigars and/or pipes. Veterans who never smoked regularly are those who, at time of enrollment, had never smoked cigarettes, cigars, or pipes or had smoked them only occasionally. Former cigarette smokers include all cigarette smokers who had quit smoking cigarettes at time of enrollment, regardless of their cigar and/or pipe smoking history. These definitions are consistent with those used in most previous analyses [10–12] but are slightly different than those used recently [13].

We have analyzed the U.S. Veterans cohort using Cox proportional hazards regression to determine the relative risk (RR) of death and 95% confidence interval (CI) over time for persons who smoked cigarettes at enrollment com-

TABLE 1. Cigarette smoking prevalence among World War I veterans and all males in the United States born during 1890–1899 (aged 55–64 years as of 1955)

Subjects	1955	1967	1976	1985
Percentage of current cigarette smokers by year				
WW I veterans [refs. 13–16]	48	32	15	9
All males [refs. 13–16]	46	30	14	9
All males [ref. 18]	49	30	15	
Percentage of current cigarette smokers relative to 1955				
WW I veterans [refs. 13–16]	100	67	31	19
All males [refs.13–16]	100	65	30	20
All males [ref. 18]	100	61	31	
Percentage of former smokers among those who ever smoked cigarettes				
WW I veterans [13–16]	27	49	76	84
All males [13–16]	25	49	76	83

pared with persons who never smoked regularly [14]. The follow-up period for the U.S. veterans cohort has been defined to be from January 1, 1954, through December 31, 1979, because follow-up for 1980 may have been somewhat incomplete [12]. Relative risks have been determined by decade (1954–1959, 1960–1969, and 1970–1979) and for the entire 26-year follow-up period (1954–1979). The analysis has been restricted to veterans born during 1890–1899 (those aged 55–64 years as of January 1, 1955) in order to relate more precisely mortality trends to imputed smoking trends described later here. The results are limited to deaths from lung cancer (ICD7 162–163), the cause of death most strongly related to smoking, and all causes.

Because smoking habits were determined only at time of enrollment in 1954 or 1957 for this cohort, we have estimated smoking prevalence over time among WW I veterans born during 1890–1899 from four national surveys that provide data for U.S. male veterans and U.S. males by year

of birth: the Current Population Survey (CPS) for 1955 [15], 1967 [16], and 1985 [17], and the 1976 National Health Interview Survey (NHIS) [18]. Similar analyses of smoking trends by birth cohort among all U.S. males have been done recently using NHIS [19,20].

RESULTS

Table 1 shows cigarette smoking prevalence during 1955–1985 and degree of cessation since 1955 for all males and WW I veterans born during 1890–1899 based on national surveys. The cigarette smoking prevalence among WW I veterans declined from 48% in 1955 to 9% in 1985 among the 1890–1899 birth cohort. These data show that veterans had smoking patterns similar to those of all men. This high degree of smoking cessation is generally seen among all persons over 55 years of age in national surveys [19,20].

Table 2 presents data on the mortality patterns among those veterans who were already former cigarette smokers at the beginning of the study. The relative risk of death during 1954–1959 by length of time quit as of entry date (1954/57) is shown for all former cigarette smokers ($n = 31,162$) compared with those who never smoked regularly ($n = 42,481$) among U.S. veteran males. The RR for all causes declines from 1.61 (1.50–1.72) for <5 years to 1.05 (0.97–1.14) for 15+ years and the RR for lung cancer declines from 10.18 (6.83–15.18) for <5 years to 1.73 (0.93–3.22) for 15+ years. Reduced RRs occur only among those former smokers who have survived for at least 5 years after stopping. These data are used here to predict the expected impact of smoking cessation on the smokers in this cohort. Findings similar to these were published more than 30 years ago and helped establish the relationship between smoking cessation and mortality [10].

Table 3 shows the relative risk of death by decade among 1954/57 current cigarette smokers ($n = 63,159$) compared with those who never smoked regularly ($n = 42,481$). The

TABLE 2. Relative risk of death (RR and 95% CI) during 1954–1959 by length of time quit as of entry date (1954/57) for all former cigarette smokers ($n = 31,162$) compared with those who never smoked regularly ($n = 42,481$) for all causes and lung cancer. The number of deaths shown is for current and never smokers combined

Cause of death	RR by length of time quit in years			
	<5	5–9	10–14	≥15
Number of former smokers	10,689	6303	4012	10,158
All causes of death				
RR	1.61	1.39	1.28	1.05
95% CI	1.50–1.72	1.28–1.52	1.15–1.43	0.97–1.14
Number of deaths	4205	3652	3403	3803
Lung cancer				
RR	10.18	6.79	2.89	1.73
95% CI	6.83–15.18	4.20–10.96	1.38–6.02	0.93–3.22
Number of deaths	117	67	43	48

TABLE 3. Observed relative risk of death (RR and 95% CI) by decade among 1954/57 current cigarette smokers (*n* = 63,159) compared with those who never smoked regularly (*n* = 42,481) among U.S. veteran males for all causes and lung cancer. Shown for comparison is expected relative risk of death based on estimated cigarette smoking prevalence for veterans in Table 1, former/never ratios in Table 2, and 1954–1959 current/never ratios by age in Appendix Table 1. Percentage changes in RRs are relative to 1954–1959 RRs. The number of deaths shown is for current and never smokers combined

Cause of death	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
All causes				
Observed RR	1.65	1.72	1.51	1.61
95% CI	1.58–1.72	1.67–1.76	1.48–1.55	1.58–1.63
Number of deaths	10,111	30,420	35,068	75,599
Expected RR	1.65	1.53	1.13	1.39
Observed change	0.0%	+4.2%	–8.5%	–2.4%
95% CI		+1.2%, +6.7%	–10.3%, –6.1%	–4.2%, +1.2%
Expected change	0.0%	–7.3%	–31.5%	–15.8%
Lung cancer				
Observed RR	10.89	11.57	10.65	11.10
95% CI	7.70–15.41	9.51–14.09	8.81–12.89	9.78–12.61
Number of deaths	558	1713	1401	3672
Expected RR	10.89	7.45	5.64	7.41
Observed change	0.0%	+6.2%	–2.2%	+1.9%
95% CI		–12.7%, +29.4%	–19.1%, +18.4%	–10.2%, +15.8%
Expected change	0.0%	–31.6%	–48.2%	–32.0%

TABLE 4. Relative risk of death (RR and 95% CI) from all causes by decade among 1954/57 current cigarette smokers by number of cigarettes per day compared with those who never smoked regularly among U.S. veteran males. Adjusted total is a weighted average based on the smoking distribution as of 1954–1959. The number of smokers is shown in parentheses, and number of deaths is shown for current and never-smokers combined

Amount of smoking	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
Total (*n* = 63,159)				
Adjusted RR	1.65	1.73	1.55	1.63
95% CI	1.58–1.72	1.68–1.77	1.52–1.59	1.58–1.65
Number of deaths	10,111	30,420	35,068	75,599
1 cigarette/day (*n* = 2,814)				
RR	1.11	1.15	1.12	1.13
95% CI	0.97–1.28	1.06–1.24	1.05–1.20	1.08–1.18
Number of deaths	3265	10,168	14,863	28,296
1-9 cigarettes/day (*n* = 9,272)				
RR	1.23	1.29	1.19	1.23
95% CI	1.14–1.33	1.24–1.35	1.14–1.24	1.20–1.27
Number of deaths	3850	12,032	17,035	32,917
10-20 cigarettes/day (*n* = 29,561)				
RR	1.63	1.68	1.51	1.59
95% CI	1.55–1.71	1.63–1.73	1.47–1.55	1.56–1.62
Number of deaths	6332	19,190	23,882	49,404
21–39 cigarettes/day (*n* = 18,090)				
RR	1.92	2.03	1.83	1.92
95% CI	1.81–2.02	1.97–2.09	1.78–1.89	1.88–1.96
Number of deaths	5332	16,064	19,958	41,354
≥40 cigarettes/day (*n* = 3,422)				
RR	2.15	2.39	1.95	2.17
95% CI	1.95–2.37	2.26–2.53	1.83–2.08	2.09–2.25
Number of deaths	3516	10,854	14,962	29,332

1954–1959 RR is 1.65 (1.58–1.72) for all causes and 10.89 (7.70–15.41) for lung cancer, and these RRs are similar to the corresponding RRs for former smokers who had quit for <5 years. Comparing 1954–1959 with the entire follow-up period of 1954–1979, the RR declined by only 2% (1.65 to 1.61) for all causes of death and increased by 2% (from 10.89 to 11.10) for lung cancer. The 1954–1979 RRs represent the cumulative impact of smoking cessation on this cohort, as they cover all smokers for the entire follow-up period. The results show only a slight convergence of the RR for veterans who smoked cigarettes at enrollment compared with veterans who never smoked regularly in spite of fact that about two thirds of all the current cigarette smokers at enrollment were estimated to have quit 20 years later, based on Table 1.

Table 3 also compares the observed convergence with the convergence that is expected based on the conventional results for former smokers. The expected RRs are based on the estimated cigarette smoking prevalence over time for veterans in Table 1, the former/never ratios in Table 2, and the 1954–1959 age-specific current/never ratios (1.65 for ages 55–64, 1.57 for ages 65–74, and 1.19 for ages 75–84). Sample calculations of the expected RRs for 1960–1969 and 1970–1979 are shown in Appendix Table 1. Percentage changes in RRs are shown relative to RRs for 1954–1959. The observed and expected changes for 1954–1979 were −2.4% versus −15.8% for all causes and +1.9%

versus −32.0% for lung cancer. The observed RR changes do not come close to the predicted impact of cessation.

When the RR over time is examined by number of cigarettes smoked per day in 1954/57, a pattern similar to that in Table 3 is seen in Table 4 for all causes of death and in Table 5 for lung cancer. There is no reduction in RR at any level of smoking, even for light smokers, who probably experienced an even higher degree of cessation than the heavier smokers. Indeed, the adjusted RR based on the smoking distribution at entry decreased by only 1% for all causes (1.65 for 1954–1959 versus 1.63 for 1954–1979) and increased by 5% for lung cancer (from 10.9 to 11.5).

1971–92 NHANES I EPIDEMIOLOGIC FOLLOWUP STUDY

METHODS

The NHANES I Epidemiologic Followup Study (NHEFS) is a prospective cohort study based on the National Health and Nutrition Examination Survey (NHANES I) conducted by the National Center for Health Statistics (NCHS) on a representative sample of the civilian noninstitutionalized population of the United States aged 25–74 years [21–23]. Persons estimated to be at risk of malnutrition (children, the elderly, women of child-bearing age, and the poor) were oversampled. The subject of this report is the

TABLE 5. Relative risk of death (RR and 95% CI) from lung cancer by decade among 1954/57 current cigarette smokers by number of cigarettes per day compared with those who never smoked regularly among U.S. veteran males. Adjusted total is a weighted average based on the smoking distribution as of 1954–1959

Amount of smoking	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
Total				
Adjusted RR	10.9	11.6	11.4	11.5
95% CI	7.7–15.4	9.5–14.1	9.4–13.8	10.1–13.1
Number of deaths	558	1713	1401	3672
<1 cigarette/day				
RR	3.18	4.37	3.41	3.78
95% CI	1.41–7.17	2.91–6.56	2.20–5.29	2.86–5.00
Number of deaths	41	136	140	317
1–9 cigarettes/day				
RR	4.41	3.69	3.76	3.80
95% CI	2.72–7.14	2.77–4.93	2.83–4.99	3.16–4.58
Number of deaths	66	188	198	452
10–20 cigarettes/day				
RR	8.90	10.47	10.30	10.20
95% CI	6.19–12.80	8.54–12.85	8.43–12.58	8.93–11.66
Number of deaths	235	789	697	1721
21–39 cigarettes/day				
RR	16.99	17.27	17.49	17.41
95% CI	11.83–24.39	14.05–21.22	14.26–21.45	15.22–19.92
Number of deaths	260	752	616	1628
≥40 cigarettes/day				
RR	23.93	24.89	20.32	23.01
95% CI	15.60–36.69	19.45–31.86	15.45–26.73	19.45–27.20
Number of deaths	92	272	214	578

cohort of 3168 males and 3737 females on whom smoking data were collected during 1971–1975. We created one master file for this cohort of NHEFS subjects by linking together 1971–1975 interview data with follow-up interview data from 1982–1984, 1987, and 1992, and follow-up death data through 1992 [23]. Follow-up through 1992 has been completed on 97% of the men and on 95% of the women, and there were 1109 male deaths and 838 female deaths. Follow-up of some individuals has been done through July 1993 and a few deaths occurred in 1993 and are included in the totals shown here. These NHEFS data are on publically available data files maintained by NCHS [23].

To determine the impact of smoking cessation, statistical analysis using the Cox proportional hazards model has evaluated the relative risk (RR and 95% CI) from death as a function of initial smoking status and time period of follow-up for the NHEFS cohort in a manner similar to that used for the U.S. veterans cohort [14]. The follow-up period is from time of entry into the study (1971–1975) until death, withdrawal (date last known alive) or end of follow-up (1992–1993), a median of 19 years. The sample weights associated with the oversampling of certain NHEFS subjects have not been used in our analysis. Our results are limited to deaths from lung cancer (ICD9 162) and all causes. Smoking was measured directly among survivors at four different times: 1971–1975, 1982–1984, 1987, and 1992.

RESULTS

Data on smoking habits of cigarette smokers in NHEFS cohort during 1971–1975 has been compared with follow-up smoking data from 1982–1984, 1987, and 1992 in Table 6.

Of those who smoked cigarettes in 1971–1975, only 45% of the men and 50% of the women still smoked in 1992. Of those aged 55–74 at entry who smoked cigarettes in 1971–1975, only about 30% of the men and 40% of the women still smoked in 1992. These data demonstrate the large degree of smoking cessation among this cohort, especially for those aged 55–74 at entry. These results are consistent with other national surveys that show a similar degree of cessation among persons aged 55 years and older [18]. Also, the four surveys in NHEFS show that there is good agreement between smoking status reported in 1971–1975 and 1992 for never and former smokers. Of the former smokers in 1971–1975, 100% were former smokers in 1992. Of the never-smokers in 1971–1975, 95% were never-smokers in 1992.

Table 7 shows the relative risk of death (RR and 95% CI) during 1971–1982, 1983–1992, and 1971–1992 for current cigarette smokers aged 55–74 years at entry as of 1971–1975 compared with never-smokers for death from all causes and lung cancer. There has been no measurable change in RR from all causes for males, females, or both genders over a 20-year period. For lung cancer, the RR increased for males and remained the same for females, based on small numbers of deaths.

Table 8 shows the baseline characteristics of 1971–1975 current cigarette smokers aged 55–74 years at entry as a function of 1982–1984 cigarette smoking status. Compared with the 1982–1984 respondents, (current and former smokers), the 1982–1984 nonrespondents have somewhat poorer health status and less education and other differences, but none of the differences are large. The 1982–1984 current and former smokers have fairly similar initial characteristics. Ideally, it would be useful to know the trends in

TABLE 6. Cigarette smoking trends among NHEFS males and females. Percentage of current cigarette smokers among all the respondents to the original 1971–1975 questionnaire are shown by age at entry, along with percentage among the surviving respondents to the follow-up questionnaires in 1982–1984, 1987, and 1992. Number of respondents are shown in parentheses

Age at entry	Percentage of current smokers by year			
	1971–1975	1982–1984	1987	1992
Males				
25–35	100 (360)	79	62	54
35–44	100 (251)	76	58	47
45–54	100 (353)	75	53	41
55–64	100 (229)	69	44	32
65–74	100 (165)	70	47	31
25–74	100 (1358)	74	56	45
Total respondents	(1358)	(1109)	(857)	(780)
Females				
25–35	100 (370)	81	66	59
35–44	100 (269)	81	64	50
45–54	100 (328)	80	58	46
55–64	100 (180)	69	44	32
65–74	100 (82)	70	47	31
25–74	100 (1229)	77	59	50
Total respondents	(1229)	(998)	(893)	(820)

characteristics for all subjects since 1971–1975, but such data are not available. Based on the existing data, it is reasonable to assume that the mortality patterns observed are primarily related to smoking cessation, although other factors may have played some role.

DISCUSSION

This study provides valuable new evidence regarding the long-term relationship of smoking cessation to the prevention of smoking-related diseases in two U.S. populations. First, we confirmed among the U.S. veterans cohort the well-established decrease in relative risk of death among self-selected former smokers compared with never-smokers, when classified by the number of years quit as of the start of the study [4,10,11].

We then showed that there has been relatively little decline in relative risk over time among all veterans who smoked cigarettes at the start of the study compared with never-smokers, in spite of a large portion of the smokers having quit by 1979. In particular, there has been no decline in the lung cancer death rate of the cigarette smokers relative to never-smokers, even though lung cancer is the disease most strongly linked with cigarette smoking and is the one that should be most impacted by cessation over a

long follow-up period. Our lung cancer trend for the U.S. veterans cohort agrees with the trend recently published using a slightly different definition of cigarette smokers [13]. These results are supported by a national sample, the NHEFS cohort, which also shows no decline in relative risk of death among cigarette smokers as a whole in spite of substantial smoking cessation.

The smoking patterns among the NHEFS cohort were measured four times, and the resultant cessation trend agrees fairly well with the imputed cessation trend for U.S. veterans. Both studies indicate that about 70% of current male smokers aged 55–64 quit after 20 years. Obviously, the U.S. veterans study has the major weakness that smoking status was not measured after initial enrollment in 1954/57. However, several national surveys have shown that since 1955, a high degree of smoking cessation occurred in U.S. veterans as a whole, as well as in the general population. Thus, it is highly unlikely the veterans in the cohort have not also experienced a similar degree of cessation. In any case, the differences between the observed and expected trends in relative risks in Table 3 are so large that they would still be substantial even if cohort veterans had a smaller degree of cessation than that estimated.

These findings are further supported by our new results among the Cancer Prevention Study (CPS) I cohort in

TABLE 7. Relative risk of death (RR and 95% CI) by decade among 1971–1975 current cigarette smokers (390 males and 259 females) compared with never-smokers (304 males and 857 females) based for all causes and lung cancer for ages 55–74 years at entry

	RR by decade of follow-up		
	1971–1982	1983–1992	1971–1992
All causes			
Males (n = 694)			
RR	1.92	2.08	1.96
95% CI	1.46–2.52	1.60–2.70	1.63–2.36
Number of deaths	236	253	489
Females (n = 1116)			
RR	1.79	1.82	1.79
95 % CI	1.31–2.46	1.42–2.34	1.47–2.17
Number of deaths	208	349	557
Both males and females (n = 1810)			
RR	1.86	1.93	1.88
95% CI	1.52–2.28	1.62–2.31	1.65–2.15
Number of deaths	444	602	1046
Lung cancer			
Males			
RR	15.76	30.23	22.20
95% CI	2.06–120.61	4.00–228.58	5.31–92.92
Number of deaths	15	23	38
Females			
RR	2.92	6.08	4.74
95% CI	0.57–15.06	2.08–17.79	1.94–11.59
Number of deaths	6	15	21
Both males and females			
Lung cancer	7.78	10.39	9.21
95% CI	2.46–24.57	4.36–24.73	4.61–18.40
Number of deaths	21	38	59

TABLE 8. Key 1971–1975 characteristics for NHEFS subjects who smoked cigarettes and were aged 55–74 years as of 1971–1975 by their 1982–1984 cigarette smoking status. No response includes five males and six females who stated they never smoked

1971–1975 characteristic	1982–1984 cigarette smoking status			
	Current	Former	No response	Total
Males				
Number of subjects	124	80	185	394
Race (% white)	81	93	78	82
Marital status (% married)	81	89	75	79
Education (% ≥ 12 years)	41	36	31	36
Height (mean in inches)	69	68	67	68
Weight (mean in pounds)	164	168	160	161
Health status (% fair/poor)	30	35	42	37
Alcohol consumption (% never)	17	20	24	21
Recreational exercise (% much/moderate)	62	52	49	54
Other physical activity (% very active)	40	35	32	35
Females				
Number of subjects	108	63	85	262
Race (% white)	86	90	82	86
Marital status (% married)	60	57	53	58
Education (% ≥ 12 years)	39	46	34	39
Height (mean in inches)	63	62	61	62
Weight (mean in pounds)	147	150	140	142
Health status (% fair/poor)	32	29	35	32
Alcohol consumption (% never)	23	27	34	28
Recreational exercise (% much/moderate)	47	37	45	44
Other physical activity (% very active)	32	35	28	32

California (19,899 male cigarette smokers and 21,137 female cigarette smokers). Over a 38-year follow-up period (1960–1997), about 93% of the 1959 male smokers stopped smoking, and yet the RR of the 1959 smokers as a whole versus never-smokers declined by only 11% for all causes (from 1.95 to 1.74) and by only 5% for lung cancer (from 12.63 to 11.96) [24]. Over the 38-year follow-up period,

about 93% of the female smokers stopped smoking and yet the RR of the smokers versus never-smokers increased by 4% for all causes (1.47 to 1.53) and by 146% for lung cancer (2.49 to 6.12) [24].

These mortality trends do not agree well with predictions of disease prevention due to smoking cessation that are based on the widely accepted results for self-selected former

TABLE 9. Cigarette smoking prevalence and lung cancer death rates during 1966–1968 and 1986 among U.S. whites aged 45–64 years as of 1966–1968 based on NMS

Subjects	White males		White females	
	1966–1968	1986	1966–1968	1986
Percentage of current cigarette smokers	52	15	33	13
Percentage of current cigarette smokers relative to 1966–1968	100	29	100	39
Percentage of former smokers among those who ever smoked cigarettes	31	79	19	65
Estimated lung cancer death rates (annual deaths per 100,000) and ratio [number of sample deaths shown]				
Total population	118.5 [706]	412.3 [213]	20.4 [150]	172.5 [125]
Never smokers	18.5 [27]	70.0 [10]	6.9 [30]	37.5 [13]
Total/Never ratio	6.4	5.9	3.0	4.6

smokers. Thus, the impact of smoking cessation on smokers as a whole appears to be substantially less than that universally stated by the Surgeon General and other official agencies. It appears that the risk of death associated with cigarette smoking status at enrollment is more fixed than previously believed.

These findings can be applied in an approximate way to smoking cessation and lung cancer trends in the general U.S. population. Table 9 shows the cigarette smoking patterns and lung cancer death rate during 1966–1968 and 1986 for the birth cohort of U.S. whites aged 45–64 as of 1966, based on the National Mortality Survey (NMS) [16,25]. In addition, the lung cancer death rate is presented for those in this birth cohort who never smoked cigarettes, based on a small number of sample deaths. The smoking data indicate that about 70% of the male smokers and 60% of the female smokers in this birth cohort quit from 1966 to 1986. However, the lung cancer mortality rate ratio of total population to never-smokers shows only slight convergence for males (from 6.4 to 5.9) and divergence for females (from 3.0 to 4.6). Although this analysis is admittedly crude, it suggests that smoking cessation has had little impact on the lung cancer death rate in this general population birth cohort as a whole.

The results for all causes of death could be affected by lifestyle changes other than cessation among smokers that might have negated the benefits of smoking cessation, but it is not clear what these changes might have been. Other than Table 8, data to address this issue are not available. If it is eventually determined that other lifestyle changes negate the impact of cessation, then this would become an important consideration when evaluating the overall impact of cessation. It is much less likely that other lifestyle changes would have affected the results for lung cancer, as cigarette smoking is by far the strongest risk factor for this disease.

It is possible that while the RR for long-term quitters declines over time, the RR for continuing smokers increases over time, thereby resulting in a relatively constant RR trend for the original cohort of smokers as a whole. This notion is supported by the unexplained increase in the RR for current smokers versus never-smokers since the 1960s [25,26]. Another factor that may have affected the RR trends for all causes is the unexplained decline in age-specific death rates from all causes (but not from lung cancer) that has occurred among never-smokers in the general population since the 1960s [25,26]. Regardless of these considerations, the fact remains that there is a lack of convergence in RR in spite of substantial cessation. Although these findings are subject to limitations, they raise an important issue about the value of smoking cessation. Additional research is needed to understand fully the impact of smoking cessation.

APPENDIX

The results for U.S. veterans aged 30–84 at entry are similar to the ones presented in this article for those aged 55–64 years at entry and are presented in Appendix Tables 2–7. Results for several smoking-related causes of death are also presented. The NHEFS results for those aged 25–74 at entry are similar to the ones presented above for those aged 55–74 years at entry and are presented in Appendix Tables 8 and 9.

APPENDIX TABLE 1. Expected relative risk [RRe] for veterans born during 1890–1899. RRe is based on the age-specific RR for current smokers, RRc (age), RR for former smokers (RR[F<5], RR [F5–9], RR [F10–14], and RR [F15+]) in Table 2. The calculation is a weighted average of the excess risk in current and former smoking categories for each decade, assuming a linear amount of cessation since 1955 based on the smoking data in Table 1: 15% by 1960–1964, 30% by 1965–1969, 45% by 1970–1974, and 60% by 1975–1979. The calculation details are shown for all causes of death and lung cancer for 1960–1969 and 1970–1979

All causes

$$RRe\ (1960–1969) = 1 + [RRc(65–74) − 1] \times [0.70 \times [RRc − 1] + 0.15 \times [RR(F{<}5) − 1] + 0.15 \times [RR(F5{-}9) − 1]] / [RRc − 1]$$
$$= 1 + [1.57 − 1] \times [0.70 \times [1.65 − 1] + 0.15 \times [1.61 − 1] + 0.15 \times [1.39 − 1]] / [1.65 − 1] = 1.53$$
$$RRe(1970–1979) = 1 + [RRc(75 − 84) − 1] \times [0.40 \times [RRc − 1] + 0.15 \times [RR(F{<}5) − 1] + 0.15 \times [RR\ (F5 − 9) − 1] + 0.15 \times$$
$$[RR(F10 − 14) − 1] + 0.15 \times [RR(F15+) − 1]] / [RRc − 1]$$
$$= 1 + [1.19 − 1] \times [0.40 \times [1.65 − 1] + 0.15 \times [1.61 − 1] + 0.15 \times [1.39 − 1] + 0.15 \times [1.28 − 1] + 0.15 \times$$
$$[1.05 − 1]] / [1.65 − 1] = 1.13$$

Lung cancer

$$RRe\ (1960–1969) = 1 + [RRc(65 − 74) − 1] \times [0.70 \times [RRc − 1] + 0.15 \times [RR(F{<}5) − 1] + 0.15 \times [RR(F5 − 9) − 1]] / [RRc − 1]$$
$$= 1 + [7.96 − 1] \times [0.70 \times [10.89 − 1] + 0.15 \times [10.18 − 1] + 0.15 \times [6.79 − 1]] / [10.89 − 1] = 7.45$$
$$RRe\ (1970–1979) = 1 + [RRc(75 − 84) − 1] \times [0.40 \times [RRc − 1] + 0.15 \times [RR(F{<}5) − 1] + 0.15 \times [RR(F5 − 9) − 1] + 0.15 \times$$
$$[RR(F10 − 14) − 1] + 0.15 \times [RR(F15+) − 1]] / [RRc − 1]$$
$$= 1 + [7.96 − 1] \times [0.40 \times [10.89 − 1] + 0.15 \times [10.18 − 1] + 0.15 \times [6.79 − 1] + 0.15 \times$$
$$[2.89 − 1] + 0.15 \times [1.73 − 1]] / [10.89 − 1] = 5.64$$

APPENDIX TABLE 2. Relative risk of death (RR and 95% CI) by length of time quit as of entry date (1954/57) for all former cigarette smokers (*n* = 31,162) compared with those who never smoked regularly (*n* = 42,481) among U.S. veteran males born during 1890–1899 for selected causes of death[a]

Cause of death	RR by length of time quit in years			
	<5	5–9	10–14	≥15
All former smokers	*n* = 10,689	*n* = 6303	*n* = 4012	*n* = 10,158
All causes	1.61 (1.50–1.72) [4205]	1.39 (1.28–1.52) [3652]	1.28 (1.15–1.43) [3403]	1.05 (0.97–1.14) [3803]
All cancer	1.82 (1.57–2.12) [805]	1.65 (1.36–1.99) [694]	1.36 (1.06–1.74) [632]	1.21 (1.02–1.44) [723]
BC, eso, or ca	4.19 (2.00–8.79) [28]	2.01 (0.66–6.10) [18]	0.78 (0.10–5.96) [15]	0.88 (0.25–3.07) [17]
Lung cancer	10.18 (6.83–15.18) [117]	6.79 (4.20–10.96) [67]	2.89 (1.38–6.02) [43]	1.73 (0.93–3.22) [48]
Other cancer	1.20 (1.00–1.44) [660]	1.30 (1.04–1.61) [609]	1.27 (0.97–1.66) [574]	1.19 (0.99–1.43) [658]
All CVD	1.54 (1.41–1.67) [2747]	1.40 (1.26–1.56) [2418]	1.30 (1.14–1.49) [2255]	1.00 (0.91–1.11) [2494]
Coronary HD	1.50 (1.36–1.66) [1922]	1.40 (1.23–1.59) [1699]	1.42 (1.22–1.65) [1601]	0.98 (0.87–1.10) [1745]
Stroke	1.35 (1.03–1.78) [282]	1.05 (0.73–1.53) [247]	0.92 (0.57–1.50) [233]	1.10 (0.82–1.47) [272]
Bron, emp, asthma	14.97 (8.07–27.76) [58]	7.13 (3.31–15.38) [26]	4.29 (1.53–12.04) [18]	3.15 (1.38–7.20) [23]

[a]All cancer (ICD7 140–207); lung cancer (ICD7 162–163); buccal cavity, esophagus, and other respiratory cancer (ICD7 140–150, 160–161); all cardiovascular diseases (CVD) (ICD7 330–334, 400–468), as well as coronary heart disease (CHD) (ICD7 420) and stroke (ICD7 330–334); and bronchitis, emphysema, and asthma (ICD7 241, 500–502, 527.1).

APPENDIX TABLE 3. Relative risk of death (RR and 95% CI) by decade among all 1954/57 current cigarette smokers (*n* = 63,159) compared with those who never smoked regularly (*n* = 42,481) among U.S. veteran males born during 1890–1899 for selected causes of death

Cause of death	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
All causes	1.65 (1.58–1.72) [10,111]	1.72 (1.67–1.76) [30,420]	1.51 (1.48–1.55) [35,068]	1.61 (1.58–1.63) [75,599]
All cancer	1.99 (1.80–2.19) [2136]	2.15 (2.03–2.28) [6073]	1.87 (1.78–1.97) [6313]	2.00 (1.93–2.07) [14,522]
BC, eso, or ca	5.30 (3.03–9.26) [119]	8.81 (5.80–13.37) [302]	3.96 (2.95–5.32) [284]	5.47 (4.40–6.81) [705]
Lung cancer	10.89 (7.70–15.41) [558]	11.57 (9.51–14.09) [1713]	10.65 (8.81–12.89) [1401]	11.10 (9.78–12.61) [3672]
Other cancer	1.31 (1.17–1.45) [1459]	1.36 (1.28–1.45) [4058]	1.30 (1.23–1.38) [4628]	1.33 (1.27–1.38) [10,145]
All CVD	1.58 (1.50–1.66) [6474]	1.52 (148–1.57) [18,313]	1.34 (1.30–1.38) [20,454]	1.44 (1.41–1.46) [45,241]
Coronary HD	1.57 (1.48–1.68) [4559]	1.50 (1.45–1.56) [11,926]	1.29 (1.24–1.34) [11,947]	1.41 (1.38–1.45) [28,432]
Stroke	1.35 (1.15–1.60) [619]	1.32 (1.22–1.43) [2661]	1.22 (1.14–1.29) [4169]	1.26 (1.21–1.32) [7449]
Bron, emp, asthma	7.45 (4.21–13.18) [144]	10.03 (7.92–12.71) [1019]	11.29 (8.76–14.55) [826]	10.37 (8.79–12.24) [1989]

APPENDIX TABLE 4. Cigarette smoking prevalence among veterans and all males in the United States aged 35–44, 45–54, and 55–64 years as of January 1, 1955

Subjects by age as of 1955	Percentage of current cigarette smokers			
	1955 [ref. 13]	1967 [ref. 14]	1976 [ref. 16]	1985 [ref. 15]
35–44 years (born during 1910–1919)				
Veterans	64	55	40	24
All males	62	53	38	23
45–54 years (born during 1900–1909)				
Veterans	61	49	29	15
All males	58	45	27	14
55–64 years (born during 1890–1899)				
Veterans	48	32	15	9
All males	46	30	14	9

APPENDIX TABLE 5. Relative risk of death (RR and 95% CI) by length of time quit as of entry date (1954/1957) for all former cigarette smokers (n = 43,559) compared with those who never smoked regularly (n = 59,351) among U.S. veteran males of all ages for selected causes of death

Cause of death	RR by length of time quit in years			
	<5	5–9	10–14	≥15+
All former smokers	n = 15,196	n = 9,348	n = 5,735	n = 13,280
All causes	1.61 (1.52–1.71) [5931]	1.38 (1.28–1.48) [5377]	1.33 (1.22–1.45) [5047]	1.05 (0.99–1.12) [5636]
All cancer	1.76 (1.54–2.25) [1100]	1.62 (1.38–1.89) [1000]	1.42 (1.16–1.73) [919]	1.20 (1.04–1.39) [1047]
BC, eso, or ca	3.47 (1.84–6.56) [40]	2.08 (0.89–4.86) [30]	0.45 (0.06–3.31) [24]	1.33 (0.59–2.99) [31]
Lung cancer	10.16 (7.19–14.36) [152]	6.36 (4.27–9.47) [97]	3.28 (1.86–5.75) [66]	1.77 (1.07–2.92) [72]
Other cancer	1.15 (0.97–1.36) [908]	1.28 (1.06–1.53) [873]	1.32 (1.07–1.64) [829]	1.16 (1.00–1.35) [944]
All CVD	1.57 (1.46–1.69) [3893]	1.35 (1.24–1.48) [3557]	1.31 (1.18–1.46) [3348]	1.01 (0.93–1.10) [3718]
Coronary HD	1.56 (1.42–1.70) [2664]	1.35 (1.21–1.50) [2425]	1.39 (1.23–1.58) [2296]	0.99 (0.90–1.09) [2516]
Stroke	1.36 (1.07–1.73) [440]	1.15 (0.87–1.51) [412]	1.19 (0.87–1.64) [396]	0.99 (0.78–1.24) [445]
Bron, emp, asthma	14.67 (8.87–24.27) [82]	7.55 (4.25–13.43) [47]	3.49 (1.56–7.80) [31]	2.35 (1.21–4.58) [37]

APPENDIX TABLE 6. Relative risk of death (RR and 95% CI) by decade among all 1954–1957 current cigarette smokers (n = 97,518) compared with those who never smoked regularly (n = 59,351) among U.S. veteran males of all ages for selected cause of death

Cause of death	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
All causes	1.63 (1.57–1.69) [14,231]	1.69 (1.65–1.72) [41,254]	1.52 (1.49–1.55) [45,086]	1.60 (1.58–1.62) [100,571]
All cancer	1.97 (1.82–2.14) [2943]	2.11 (2.01–2.22) [7978]	1.90 (1.82–2.00) [8206]	2.00 (1.94–2.06) [19,127]
BC, eso, or ca	4.92 (3.17–7.65) [171]	6.10 (4.48–8.30) [400]	4.00 (3.09–5.19) [388]	4.88 (4.07–5.84) [959]
Lung cancer	10.29 (7.72–13.71) [736]	10.95 (9.24–12.98) [2147]	10.85 (9.17–12.84) [1946]	10.86 (9.73–12.13) [4829]
Other cancer	1.32 (1.20–1.44) [2036]	1.38 (1.30–1.46) [5431]	1.30 (1.24–1.37) [5872]	1.34 (1.29–1.38) [13,339]
All CVD	1.55 (1.49–1.62) [9095]	1.51 (1.47–1.55) [24,877]	1.33 (1.30–1.37) [26,059]	1.43 (1.41–1.46) [60,031]
Coronary HD	1.55 (1.47–1.63) [6250]	1.51 (1.46–1.56) [5918]	1.31 (1.27–1.36) [15,238]	1.43 (1.40–1.46) [37,406]
Stroke	1.27 (1.12–1.46) [932]	1.29 (1.21–1.38) [3771]	1.20 (1.13–1.27) [5266]	1.24 (1.19–1.29) [9969]
Bron, emp, asthma	6.24 (4.04–9.63) [205]	10.11 (8.24–12.40) [1313]	11.72 (9.30–14.78) [998]	10.28 (8.90–11.88) [2516]

APPENDIX TABLE 7. Relative risk of death (RR and 95% CI) by decade among all 1954/57 current cigarette smokers by number of cigarette per day compared with those who never smoked regularly among U.S. veteran males of all ages for all causes and lung cancer. Adjusted total is a weighted average based on the smoking distribution as of 1954/57

Cause of death	RR by decade of follow-up			
	1954–1959	1960–1969	1970–1979	1954–1979
All causes				
Adjusted total	1.63 (1.57–1.69)	1.70 (1.66–1.73)	1.55 (1.52–1.58)	1.62 (1.60–1.64)
<1 cig/day (n = 4,115)	1.14 (1.02–1.28) [4791]	1.16 (1.09–1.24) [14,268]	1.12 (1.06–1.19) [18,804]	1.14 (1.09–1.19) [37,863]
1–9 cigs/day (n = 13,147)	1.23 (1.16–1.31) [5674]	1.30 (1.25–1.35) [16,914]	1.19 (1.15–1.23) [21,549]	1.24 (1.21–1.27) [44,137]
10–20 cigs/day (n = 45,492)	1.61 (1.54–1.68) [9046]	1.66 (1.62–1.70) [26,334]	1.51 (1.48–1.55) [30,556]	1.58 (1.56–1.61) [65,936]
21–39 cigs/day (n=28,832)	1.92 (1.84–2.02) [7509]	2.01 (1.96–2.07) [21,883]	1.86 (1.81–1.91) [25,661]	1.93 (1.90–1.97) [55,053]
≥40 cigs/day (n = 4,932)	2.19 (2.01–2.38) [5095]	2.39 (2.28–2.51) [15,079]	2.03 (1.92–2.15) [18,992]	2.21 (2.14–2.29) [39,166]
Lung cancer				
Adjusted total	10.3 (7.7–13.7)	10.9 (9.2–12.9)	11.1 (9.5–13.2)	11.0 (9.8–12.2)
<1 cig/day	3.53 (1.84–6.77) [61]	3.60 (2.47–5.26) [176]	3.44 (2.34–5.05) [180]	3.54 (2.76–4.55) [417]
1–9 cigs/day	4.39 (2.96–6.53) [98]	3.77 (2.95–4.83) [256]	4.12 (3.23–5.26) [263]	4.02 (3.43–4.71) [617]
10–20 cigs/day	8.28 (6.11–11.21) [311]	10.03 (8.40–11.98) [1009]	10.26 (8.59–12.24) [941]	9.92 (8.84–11.14) [2261]
21–39 cigs/day	16.85 (12.44–22.82) [338]	16.82 (14.05–20.14) [939]	17.50 (14.61–20.96) [867]	17.19 (15.28–19.33) [2144]
≥40 cigs/day	25.10 (17.47–36.07) [128]	23.47 (18.83–29.25) [339]	21.03 (16.56–26.71) [287]	22.75 (19.63–26.37) [754]

APPENDIX TABLE 8. Relative risk of death (RR and 95% CI) by decade of follow-up and age when enrolled during 1971–1992 among 1971-1975 current cigarette smokers compared never-smokers based on proportional hazards model of NHEFS males and females for all causes of death

Age when enrolled	Number of subjects	RR by decade of follow-up		
		1971–1982	1983–1992	1971–1992
Males				
25–74	2131	2.15 (1.69–2.74) [330]	2.09 (1.68–2.59) [389]	2.08 (1.77–2.44) [719]
25–34	551	5.94 (0.76–46.46) [11]	4.43 (1.00–19.54) [16]	4.96 (1.77–2.44) [27]
35–44	383	2.11 (0.70–6.36) [19]	2.13 (0.92–4.94) [32]	2.08 (1.08–4.12) [51]
45–54	499	3.93 (1.79–8.62) [64]	2.11 (1.27–3.51) [88]	2.57 (1.68–3.93) [152]
55–64	373	2.05 (1.26–3.34) [83]	1.89 (1.31–2.72) [132]	1.88 (1.40–2.52) [215]
65–74	321	1.90 (1.37–2.63) [153]	2.25 (1.56–3.24) [121]	2.00 (1.57–2.55) [274]
Females				
25–74	3181	1.68 (1.29–2.19) [271]	1.94 (1.59–2.38) [469]	1.83 (1.56–2.15) [740]
25–34	736	2.19 (0.40–11.97) [6]	1.91 (0.62–5.84) [13]	2.02 (0.80–5.15) [19]
35–44	572	0.76 (0.29–1.95) [18]	1.96 (0.90–4.29) [27]	1.34 (0.75–2.41) [45]
45–54	757	2.07 (1.10–3.93) [39]	2.52 (1.61–3.96) [80]	2.41 (1.67–3.48) [119]
55–64	574	2.06 (1.17–3.63) [49]	2.23 (1.59–3.12) [141]	2.15 (1.61–2.86) [190]
65–74	542	1.71 (1.16–2.51) [159]	1.40 (0.94–2.08) [208]	1.54 (1.17–2.03) [367]

APPENDIX TABLE 9. Relative risk of death (RR and 95% CI) by decade among 1971–1975 current cigarette smokers (1329 males and 1193 females) compared with never smokers (802 males and 1988 females) based for all causes and lung cancer for ages at entry

	RR by decade of follow-up		
	1971–1982	1983–1992	1971–1992
All causes			
Males (n = 2131)			
RR	2.15	2.09	2.08
95% CI	1.69–2.74	1.68–2.59	1.77–2.44
Number of deaths	330	389	719
Females (n = 3181)			
RR	1.68	1.94	1.83
95% CI	1.29–2.19	1.59–2.38	1.56–2.15
Number of deaths	271	469	740
Both males and females (n = 5312)			
RR	1.91	2.01	1.95
95% CI	1.61–2.25	1.74–2.33	1.75–2.18
Number of deaths	601	858	1459
Lung cancer			
Males			
RR	20.67	39.89	28.71
95% CI	2.78–153.78	5.41–294.24	6.98–118.16
Number of deaths	24	35	59
Females			
RR	5.78	5.06	5.20
95% CI	1.36–24.60	1.99–12.84	2.38–11.35
Number of deaths	9	21	30
Both males and females			
Lung cancer	10.63	10.07	10.01
95% CI	3.59–31.47	4.75–21.32	5.41–18.53
Number of deaths	33	56	89

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