

Cigar Smoking in Men and Risk of Death From Tobacco-Related Cancers

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Background: Cigar consumption in the United States has increased dramatically since 1993, yet there are limited prospective data on the risk of cancer associated with cigar smoking. We examined the association between cigar smoking and death from tobacco-related cancers in a large, prospective cohort of U. S. men. **Methods:** We used Cox proportional hazards models to analyze the relationship between cigar smoking at baseline in 1982 and mortality from cancers of the lung, oral cavity/pharynx, larynx, esophagus, bladder, and pancreas over 12 years of follow-up of the American Cancer Society's Cancer Prevention Study II cohort. A total of 137 243 men were included in the final analysis. Women were not included because we had no data on their cigar use. We excluded men who ever smoked cigarettes or pipes and adjusted all rate ratio (RR) estimates for age, alcohol use, and use of snuff or chewing tobacco. **Results:** Current cigar smoking at baseline, as compared with never smoking, was associated with an increased risk of death from cancers of the lung (RR = 5.1; 95% confidence interval [CI] = 4.0–6.6), oral cavity/pharynx (RR = 4.0 [95% CI = 1.5–10.3]), larynx (RR = 10.3 [95% CI = 2.6–41.0]), and esophagus (RR = 1.8; 95% CI = 0.9–3.7). Although current cigar smokers overall did not appear to be at an increased risk of death from cancer of the pancreas (RR = 1.3; 95% CI = 0.9–1.9) or bladder (RR = 1.0; 95% CI = 0.4–2.3), there was an increased risk for current cigar smokers who reported that they inhaled the smoke (for pancreas, RR = 2.7; 95% CI = 1.5–4.8; for bladder, RR = 3.6; 95% CI = 1.3–9.9). **Conclusions:** Results from this large prospective study support a strong association between cigar smoking and mortality from several types of cancer. [J Natl Cancer Inst 2000;92:333–7]

The number of cigars consumed in the United States increased by approximately 50% between 1993 and 1998 (1,2). This rapid increase is particularly striking because it followed a 66% decline from 1964 through 1993 (1). While cigarette smoking is an important and well-established cause of many cancers, less is known about the relationship between cigar smoking and the risk of cancer (3). Cigars may not be perceived as a substantial health hazard, possibly because cigars are not required to carry a health warning from the Surgeon General (4) or because of endorsements from celebrities associated with health and fitness, several of whom have been featured on the cover of *Cigar Aficionado*, a periodical that promotes the use of cigars (5). To clarify the potential health hazards of cigar smoking, we examined the association of cigar smoking with risk of death from six tobacco-related cancers in a large, prospective study of U.S. men.

METHODS

Study Population and Design

Men in this analysis were a subset of the 508 353 male participants in Cancer Prevention Study II (CPS-II), a prospective mortality study of 1.2 million men and women enrolled in 1982 by American Cancer Society volunteers in all 50 U.S. states, the District of Columbia, and Puerto Rico (6). Participants completed a baseline self-administered questionnaire in 1982 that included information on demographic characteristics and various behavioral, environmental, occupational, and dietary factors. Women could not be included in this analysis because they were not asked if they smoked cigars. The median age of male participants in 1982 was 57 years; none were younger than 30 years of age.

The vital status of study participants was determined for 12 years, through December 31, 1994. Two approaches were used to ascertain vital status. Volunteers made personal inquiries in September 1984, 1986, and 1988 to determine whether the participants whom they had enrolled were alive or dead and to record the date and place of all deaths. Automated linkage to the National Death Index extended follow-up through December 31, 1994, and identified deaths among the 8485 men lost to follow-up between 1982 and 1988 (7). At the completion of follow-up in December 1994, 400 290 men (78.7%) were alive, 107 248 (21.1%) had died, and 815 (0.2%) had follow-up truncated in September 1988 because of insufficient data for National Death Index linkage. Death certificates were obtained for 98.5% of all men known to have died. The underlying cause of death was coded from death certificates according to the International Classification of Disease, 9th Revision (ICD-9) (8). The ICD-9 codes used to define the tobacco-related cancer outcomes were as follows: lung (162.0–162.9), larynx (161.0–161.9), oral cavity/pharynx (140.0–141.9 and 143.0–149.9, which excludes salivary gland cancer),

esophagus (150.0–150.9), bladder (188.0–188.9), and pancreas (157.0–157.9).

Information on cigar smoking was based entirely on the smoking history reported in 1982. Men who reported ever smoking "cigarettes, cigars, or pipes, at least one a day for 1 year's time" were instructed to complete more detailed questions about smoking status (current or former), duration (in years), amount (number smoked per day), and depth of inhalation (none, slight, moderate, or deep). Each of these questions was asked separately for cigarettes, cigars, and pipes. Men who reported that they were current cigar smokers on the baseline questionnaire are considered "current" cigar smokers, although no information was available about smoking status later during follow-up. Men who reported they had never "smoked cigarettes, cigars, or pipes, at least one a day for 1 year's time" were considered to be "never smokers."

Analyses excluded men who reported a history of cancer other than nonmelanoma skin cancer (n = 6119), who reported that they had ever regularly smoked cigarettes or pipes (n = 364 561), or who had unclear or contradictory responses to smoking questions (n = 118). A total of 137 555 men remained for analysis.

Statistical Analysis

We used Cox proportional hazards modeling to examine the association of cigar smoking and cancer mortality while adjusting for other potential risk factors (9). We adjusted all rate ratio (RR) estimates for age, alcohol use, and use of snuff or chewing tobacco. The time axis used was follow-up time since enrollment in 1982. Age adjustment was accomplished by stratifying on exact year of age at enrollment within each Cox model. All Cox models were also adjusted for alcohol use (no regular use, less than one drink per day, one to two drinks per day, three drinks per day, four or more drinks per day) and use of snuff or chewing tobacco (never, former, or current). A small number of men whose level of alcohol consumption could not be determined (n = 312) were not included in the models. Race, educational level, body mass index, diabetes, vitamin supplement use, exercise level, and vegetable/citrus fruit intake were also examined as potential confounders. However, adjustment for these factors had little effect on the risk estimates. Vegetable and citrus fruit intake was estimated from the frequency of consumption of 28 common foods reported on the 1982 questionnaire, as has been described previously (10).

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RESULTS

Table 1 shows the distribution of potential risk factors for tobacco-related cancers according to cigar-smoking status at baseline. Most men in this analysis were white and middle-aged or elderly. Former cigar smokers tended to be somewhat older than both current cigar smokers and never smokers. Compared with never smokers, current cigar smokers were slightly less likely to report a college education and slightly more likely to report regular alcohol consumption. Both former and current cigar smokers were more likely than never smokers to be users of smokeless tobacco (snuff or chewing tobacco).

Table 2 shows mortality RRs for six tobacco-related cancers (lung, oral cavity/pharynx, larynx, esophagus, pancreas, and bladder) comparing current cigar smokers (at baseline) and former cigar smokers with never smokers. Current cigar smokers experienced greatly increased risk of mortality from cancers of the lung, oral cavity/pharynx, and larynx (RR ≥ 4) and moderately increased risk of mortality from cancer of the esophagus (RR = 1.8). Former cigar smokers had smaller increases in risk of mortality from these same cancers. There was no clear overall association between either current or former cigar smoking and pancreatic or bladder cancer mortality.

Table 3 shows mortality RRs for current cigar smokers compared with never smokers by the number of cigars smoked per day, self-reported cigar inhalation, and duration of cigar smoking. Current cigar smokers who smoked three or more cigars per day, who reported inhaling ci-

Table 1. Potential risk factors for tobacco-related cancers among men who never smoked or who smoked only cigars, American Cancer Society's Cancer Prevention Study II (1982 through 1994)

Risk factor	Never smokers (n = 121 799), %	Former cigar smokers (n = 7868), %	Current cigar smokers (n = 7888), %
Age at baseline, y			
30–39	5.9	0.9	2.4
40–49	20.1	12.8	18.4
50–59	34.9	34.3	40.6
60–69	26.6	31.5	27.1
70–79	10.5	15.9	9.6
≥ 80	2.0	4.6	1.9
Race			
White	93.4	95.1	93.1
Black	3.6	3.5	5.0
Hispanic*	1.1	0.5	0.8
Asian	1.0	0.3	0.3
Other	0.4	0.2	0.3
Unknown	0.5	0.5	0.5
Educational level			
Not high school graduate	12.1	17.5	14.6
High school graduate	18.6	21.3	22.2
Some college/technical school	23.3	26.5	25.6
College graduate	44.7	33.4	36.0
Unknown	1.3	1.4	1.5
Alcohol use, drinks/day			
No regular use	59.7	47.8	39.8
<1	11.2	12.3	12.3
1–2	21.1	26.7	29.5
3	2.9	4.6	6.4
≥ 4	4.8	8.3	11.6
Unknown	0.2	0.3	0.3
Smokeless tobacco†			
Never user	96.9	81.1	89.0
Former user	0.7	7.0	3.6
Current user	2.4	11.9	7.5

*Hispanic category includes black and white Hispanics.

†Snuff or chewing tobacco.

gar smoke, or who had smoked cigars for 25 or more years experienced substantially greater risk of mortality from lung cancer than men with less exposure to cigars. Risk of lung cancer mortality was, however, increased even for cigar smokers who reported not inhaling (RR = 3.3;

95% confidence interval [CI] = 2.3–4.7) or who had smoked for less than 25 years at baseline (RR = 2.1; 95% CI = 1.0–4.2). Risk of mortality from cancers of the oral cavity/pharynx and larynx also increased among current smokers with increasing numbers of cigars smoked per

Table 2. Mortality rate ratios and 95% confidence intervals (CIs) for tobacco-related cancers comparing men who smoked only cigars with men who never smoked, American Cancer Society's Cancer Prevention Study II (1982 through 1994)*

Cigar smoking status at baseline	Cancer					
	Lung	Oral cavity/pharynx	Larynx	Esophagus	Pancreas	Bladder
Never smokers†						
Rate ratio (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
No. of deaths	269	20	5	67	327	94
Former smokers‡						
Rate ratio (95% CI)	1.6 (1.2–2.4)	2.4 (0.8–7.3)	6.7 (1.5–30.0)	1.3 (0.6–2.8)	1.1 (0.7–1.6)	1.3 (0.7–2.5)
No. of deaths	36	4	3	8	30	10
Current smokers§						
Rate ratio (95% CI)	5.1 (4.0–6.6)	4.0 (1.5–10.3)	10.3 (2.6–41.0)	1.8 (0.9–3.7)	1.3 (0.9–1.9)	1.0 (0.4–2.3)
No. of deaths	88	6	4	9	28	6

*All rate ratios adjusted for age, alcohol use, and smokeless tobacco use.

†Category included 121 529 men.

‡Category included 7848 men.

§Category included 7866 men.

Table 3. Mortality rate ratios and 95% confidence intervals for tobacco-related cancers comparing men who smoked only cigars with men who never smoked, by cigars per day, inhalation, and duration, American Cancer Society's Cancer Prevention Study II (1982 through 1994)*

Cigar smoking status at baseline	Cancer					
	Lung	Oral cavity/pharynx	Larynx	Esophagus	Pancreas	Bladder
Never smokers†						
Rate ratio (95% CI)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)	1.0 (referent)
No. of deaths	269	20	5	67	327	94
Current smokers						
Cigars/day						
1–2 cigars/day‡	1.3 (0.7–2.4)	0	6.0 (0.7–53.5)	1.8 (0.6–5.0)	0.6 (0.3–1.4)	0
No. of deaths	10	0	1	4	6	0
≥3 cigars/day§	7.8 (5.9–10.3)	7.6 (2.9–19.6)	15.0 (3.4–65.9)	1.9 (0.8–4.9)	1.6 (1.0–2.5)	1.9 (0.8–4.4)
No. of deaths	68	6	3	5	18	6
Inhalation						
No inhalation¶	3.3 (2.3–4.7)	3.2 (0.9–11.0)	4.2 (0.5–37.1)	1.6 (0.7–4.1)	0.9 (0.5–1.5)	0.5 (0.1–2.1)
No. of deaths	36	3	1	5	12	2
Inhalation#	11.3 (7.9–16.1)	6.5 (1.4–29.2)	39.0 (8.4–180.1)	1.0 (0.1–7.2)	2.7 (1.5–4.8)	3.6 (1.3–9.9)
No. of deaths	37	2	3	1	12	4
Duration						
<25 y**	2.1 (1.0–4.2)	0	0	0.9 (0.1–6.4)	1.5 (0.7–3.3)	0
No. of deaths	8	0	0	1	7	0
≥25 y††	5.9 (4.5–7.7)	4.6 (1.6–13.0)	13.7 (3.4–54.5)	2.2 (1.0–4.7)	1.1 (0.7–1.8)	1.1 (0.4–2.7)
No. of deaths	75	5	4	8	19	5

*All rate ratios adjusted for age, alcohol use, and smokeless tobacco use.

†Category included 121 529 men.

‡Category included 3541 men.

§Category included 3945 men.

||Men who reported they “do not inhale” were categorized as “no inhalation.” Men who reported inhaling “slightly,” “moderately,” or “deeply” were categorized as “inhalation.”

¶Category included 5063 men.

#Category included 1723 men.

**Category included 2594 men.

††Category included 4959 men.

day, self-reported inhalation, and longer duration of use, although statistical power was limited and CIs were quite wide for specific exposure categories because of the small numbers of deaths from these cancers. Risk of mortality from esophageal cancer appeared stronger for long-duration smokers than for short-duration smokers but showed no clear trend with number of cigars smoked per day or inhalation. Risk of mortality from cancers of the pancreas and bladder was increased for current cigar smokers who reported inhaling cigar smoke (for pancreas, RR = 2.7 [95% CI = 1.5–4.8]; for bladder, RR = 3.6 [95% CI = 1.3–9.9]), with no evidence of increased risk for current smokers who reported not inhaling. The RR for current cigar smoking and the alcohol-related upper aerodigestive tract cancers (esophagus, oral cavity/pharynx, and larynx) was similar when stratified by alcohol use, although statistical power was limited (data not shown).

DISCUSSION

Results from this large, prospective study strongly support a causal relationship between cigar smoking and mortality

from cancers of the lung, oral cavity/pharynx, larynx, and esophagus; this increased risk appears to be independent of use of alcohol or other tobacco products. These findings are important because of the recent resurgence of cigar smoking in the United States and because prospective data on cigar smoking and cancer are limited. The epidemiologic literature on cigar smoking and cancer has recently been reviewed (11). However, this literature is often difficult to interpret for several reasons, including the combination of cigar and pipe smokers into a single category, failure to account for past or current cigarette smoking, the potential biases of hospital-based case-control studies, and limited study size. Only two other large, prospective studies (11,12), both based on data collected primarily in the 1950s and 1960s, have examined cancer mortality risk for cigar-only smokers, and neither of these studies adjusted for risk factors other than age.

In our study, risk of lung cancer mortality was increased approximately five-fold for men who were current cigar-only smokers at the start of the 12-year follow-up as compared with men who had never

smoked (RR = 5.1; 95% CI = 4.0–6.6; 88 deaths among cigar smokers). Results from previous cohort studies are summarized in Table 4. The increased risk of lung cancer in our study was substantially larger than the twofold increased risk reported in the three earlier U.S. cohort studies that compared cigar-only smokers with never smokers (11,13,14). In contrast, a small Swedish cohort study found an RR of 7.6 for lung cancer mortality (11 deaths among cigar smokers, no CI reported) (15), and a recent large, case-control study of incident lung cancer from Germany, Italy, and Sweden found an odds ratio for current cigar or cigarillo smokers of 10.6 (95% CI = 5.9–19.1) (16). In our study, risk was particularly increased for men who smoked three or more cigars per day, who reported inhaling, or who had smoked for 25 or more years. However, even cigar smokers who reported that they did not inhale were considerably more likely than never smokers to die from lung cancer (RR = 3.3; 95% CI = 2.3–4.7).

The reasons for the higher lung cancer mortality RR in our cohort (CPS-II) as compared with earlier U.S. studies are un-

Table 4. Cohort studies of cigar smoking and tobacco-related cancers*

Study population (follow-up years) (reference No.)	Cancer					
	Lung	Oropharynx	Larynx	Esophagus	Pancreas	Bladder
Cancer Prevention Study II (United States) (1982–1994) (current study)						
RR	5.1	4.0	10.3	1.8	1.3	1.0
(95% CI)	(4.0–6.6)	(1.5–10.3)	(2.6–41.0)	(0.9–3.7)	(0.9–1.9)	(0.4–2.3)
No. of deaths§	88	6	4	9	28	6
Swedish population-based cohort (1963–1979) (15)						
RR†	7.6					
No. of deaths§	11					
Kaiser Permanente (California) (1964–1996) (14)						
RR	2.1	2.6			1.2	1.1
(95% CI)	(1.1–4.1)	(1.2–5.8)			(0.5–2.9)	(0.6–2.0)
No. of cases§	11	8			6	10
Cancer Prevention Study I (United States) (1959–1972) (11)						
RR	2.1	7.9	10.0	3.6	1.6	1.4
(95% CI)	(1.6–2.7)	(5.1–11.7)	(4.0–20.6)	(2.2–5.6)	(1.2–2.1)	(0.9–2.0)
No. of deaths§	73	26	7	20	57	26
U.S. Veterans Study (1954–1969) (12,13)						
RR†	1.7	4.1‡	10.3	5.3	1.5	0.9
No. of deaths§	41	9	6	12	27	10

*Includes only results from cohort studies that had three or more cases or deaths among current cigar-only smokers. All results are for current cigar-only smokers (at baseline) compared with never smokers. All results are for mortality, except those from the Kaiser Permanente study, which are for incident cancer. RR = rate ratio; CI = confidence interval.

†CIs were not reported.

‡Results are for oral cancer mortality only.

§Number of deaths or cases among current cigar-only smokers.

clear. Differences in the background rate of lung cancer among never smokers do not explain the higher RR we observed, since lung cancer mortality rates among male never smokers in CPS-II were similar to those in CPS-I (17) and the U.S. Veterans Study (12). Variation in the number of cigars smoked per day also does not explain the difference because the distribution of cigars smoked per day was similar in CPS-II and in the two earlier large U.S. mortality cohorts (12,18). The importance of variation between the cohorts in the duration of cigar smoking is difficult to assess because no information on duration of cigar smoking is available from either CPS-I or the U.S. Veterans Study. However, important differences in duration of cigar smoking between the American Cancer Society's CPS-I cohort (started in 1959) and CPS-II cohort (started in 1982) appear unlikely. CPS-I men and CPS-II men had similar baseline age distributions, and data from the earliest CPS-II birth cohorts (which correspond to the largest birth cohorts in CPS-I) suggest that both CPS-I and CPS-II men began smoking cigars at similar ages.

One possible explanation for the greater increase in risk of lung cancer mortality observed in CPS-II is that there have been changes over time in the type of cigars smoked. Changes in the pH of

cigars may be particularly important with respect to lung cancer because of the potential effect of pH on inhalation patterns. While the pH of cigars is higher than cigarettes, pH varies greatly between cigar types, with some brands having low pH levels close to those of cigarettes (19). Low pH cigars may be particularly hazardous, since, like cigarettes, they may require some degree of inhalation to achieve substantial nicotine absorption (19), and their smoke may contain less free ammonia and, therefore, be easier to inhale than the smoke from high pH cigars (20). The role of changes in cigar pH or other cigar characteristics is, however, difficult to investigate because, to our knowledge, such historic data are not available. Chance variation may also have contributed to the differing results between our study and earlier studies.

Our results regarding increased risk of fatal cancers of the oral cavity/pharynx, larynx, and esophagus are generally similar to those from the limited number of prospective studies that have examined risk among current cigar-only smokers (see Table 4). The approximately twofold increased risk of mortality from esophageal cancer in our study is lower than the approximately fourfold to fivefold increased risk of mortality observed in CPS-I (11) and in the U.S. Veterans Study

(12), possibly as a result of chance. For all three of these cancers (oral cavity/pharynx, larynx, and esophagus), the increase in risk appeared strongest for men who had smoked for 25 or more years at the start of the 12-year follow-up. Conclusions about the precise risks of shorter-duration cigar smoking are limited by the small numbers of such short-duration smokers in this analysis. Risk also appeared to increase with the number of cigars smoked per day and inhalation for cancers of the oral cavity/pharynx and larynx but not for esophageal cancer. It is possible that variations in cigar consumption behavior that determine the amount of tobacco carcinogens swallowed (such as whether or not cigars are chewed or held in the mouth for long periods) may be more important for esophageal cancer than inhalation patterns or the number of cigars smoked per day.

While we found no clear overall increased risk of fatal pancreatic or bladder cancer, risk of mortality from both cancers was increased for cigar smokers who reported inhalation of cigar smoke. Inhalation of cigar smoke may be particularly relevant for these organs because (unlike the oral cavity/pharynx, larynx, and esophagus) they may have limited exposure to tobacco carcinogens except through inhalation into the lungs and sub-

sequent absorption into the bloodstream. Results from previous cohort studies are summarized in Table 4. Risk of pancreatic cancer mortality was increased in CPS-I (11) and in the U.S. Veterans Study (12), but incidence of pancreatic cancer was not clearly increased in the smaller Kaiser Permanente study (14). Mortality from bladder cancer was increased in CPS-I (11) but not in the U.S. Veterans Study (12), while there was no evidence of increased bladder cancer incidence in the Kaiser Permanente Study (14).

Strengths of this study include its large size and prospective design. The size of this study allowed us to examine risk among men who had never smoked cigarettes or pipes, isolating the effect of cigar smoking. In addition, we were able to examine the importance of number of cigars smoked per day, duration of cigar smoking, and self-reported inhalation, although small numbers for the less common cancers limited these analyses. We also were able to adjust (or determine that adjustment was unnecessary) for potential confounding factors, including alcohol and smokeless tobacco use.

A limitation of this study is that no information was available on smoking habits after completion of the baseline questionnaire. A considerable proportion of men classified as "current" cigar smokers at baseline may have quit smoking during the 12 years of follow-up. While the exact proportion of cigar smokers who quit during the 12 years of follow-up (1982 through 1994) is unknown, information on cigar smoking cessation in this cohort before baseline in 1982 suggests that the quit rate may have been quite high. We estimate that approximately 34% of cigar-only smokers in this cohort 12 years before baseline (1970) had quit by baseline (1982). To the extent that the risk of tobacco-related cancer decreases after quitting, we will have underestimated the effect of current cigar smoking. A second limitation is that we had no information on cigar size or type, which may be important determinants of cancer risk.

Current cigar smokers in this analysis had never regularly smoked cigarettes and had smoked cigars at least daily. Therefore, our results may not be generalizable to cigar smokers who have previously

smoked cigarettes or who smoke cigars only occasionally.

The importance of cigar smoking as a potential emerging public health hazard is illustrated by data from the 1997 Youth Risk Behavior Survey showing that 31% of U.S. high school boys and 11% of U.S. high school girls had reported smoking a cigar within the past 30 days (21). Our results, together with those from previous studies, indicate that, if these young people become regular cigar smokers, a sizable number will develop a smoking-related cancer later in life.

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NOTE

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