Cigarette Smoking and Lung Cancer Trends*

A Light at the End of the Tunnel?

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Objective: To update the epidemic curves for lung cancer in the United States by gender in relation to the temporal trends in adult current cigarette smoking prevalence.

Methods: The design of the study was ecologic, based on population figures. Available data on the prevalence of current cigarette smoking from 1920 to 1990 were plotted in conjunction with age-adjusted lung cancer mortality rates from 1930 to 1992 for each sex.

Results: There was a strong temporal relationship between the curves for cigarette smoking prevalence and lung cancer mortality rate with approximately a 30-year population latency period in both men and women. The curves occurred later in women than in men. The lung cancer rate in men peaked in 1990 and then began to decline while the rate in women continued to rise.

Conclusion: The temporal association between cigarette smoking prevalence and lung cancer mortality provides additional support for the causal relationship between smoking and lung cancer.

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Key words: cigarette smoking, lung cancer, trends

The causal association between cigarette smoking and lung cancer has been well established over the past 4½ decades. The relationship meets all the criteria except one for judging an association to be causal as enumerated by an advisory committee to the Surgeon General of the Public Health Service in 1964:1 consistency, strength of the association and a dose-response relationship, temporal relationship, and coherence. The exception is specificity, but the lack of specificity can be explained by the fact that cigarette smoke is a product containing thousands of chemicals, many having different effects on the human body.

In 1965, Hill2 added another important criterion: the cessation of exposure leads to a decline in risk. This requirement has been thoroughly satisfied by studies based on individual data. Since this is true and the prevalence of cigarette smoking fell substantially and progressively from the 1960s on, one would expect a peaking of the lung cancer epidemic after an appropriate latency period. The purpose of this study is to document the peaking of US lung cancer mortality rates in 1990 among men and the beginning of the decline by 1992. Similar data for women will be shown for contrast.

Materials and Methods

Cigarette smoking prevalence for US men and women aged 18 years and older in percent were obtained from two survey sources: (1) data published by Burbank3 for 1920 to 1960, and (2) data published by Giovino et al4 for 1965 to 1990. The percentages were plotted at 5-year intervals up to 1990.

Curves for annual lung cancer age-adjusted mortality rates (per 100,000) by sex from 1930 to 1992 were recently published by Parker et al5. The exact rates were obtained (S. Parker, personal communication, February 29, 1996). Age adjustment was based on the US 1970 population. The rates were plotted at 5-year intervals from 1930 to 1990 and for 1992.

Results

The curves for men are shown in Figure 1. The prevalence of current cigarette smokers was estimated to be 46% in 1920 and rose steadily to 65% in 1940, plateaued until 1955, and then began to decline progressively, reaching 28% in 1990.

The male lung cancer mortality rate was only 4.9/100,000/yr in 1930, rose slowly at first, and then more rapidly until 1980. Thereafter it slowed and peaked at 75.6 in 1990. The rate then fell to 74.6 in 1991 (not shown) and 73.1 in 1992. The population
Figure 1. Trends in prevalence of cigarette smoking among US men aged 18 years or older and age-adjusted lung cancer mortality rate.

Cigarette smoking prevalence estimates from 1955 on were based on national probability samples. The data prior to 1955 may not be as reliable. Estimates for men were based on annual marketing surveys by the Milwaukee Journal in its metropolitan area. Therefore the sample may not be representative of all US men. However, Burbank found that there was good agreement with national surveys beginning in 1955 and therefore used a straight line approximation for the early data. Milwaukee estimates for women were 33% higher than the national estimates. Burbank calculated the early female prevalences from cohort analysis in the 1955 national survey. The

Discussion

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early prevalence trends in both sexes are not likely to be in gross error because of these weaknesses.

Since the case fatality rate for lung cancer remains about 90%, the mortality rate is a good index for the incidence rate. Changes in International Classification of Diseases coding may have affected trends in the mortality rate but were unlikely to alter substantially the shape of the epidemic curve, particularly since the last revision in 1977.

Among cigarette smokers, almost all start daily use before the age of 25 years and the mean age at initiation is 17.7 years.\(^6\) The peak age for the development of incident lung cancer has been in the seventh decade of life, usually in the age stratum of 65 to 69 years.\(^7\) These figures suggest an average latency interval between onset of smoking and lung cancer diagnosis of close to 50 years. However, substantial numbers of lung cancer begin to appear in the fifth decade of life\(^7\) so one would expect to see a decline in risk within 30 years of the decline in smoking for the US population as noted in this analysis.

Devesa et al\(^7\) reported a small decline in lung cancer incidence among men between 1981 to 1982 and 1983 to 1984 based on cancer registry data in five geographic areas of the United States, but no decline in US male lung cancer mortality at that time.

Gilliland and Samet\(^8\) recently made similar observations for the period 1983 to 1987 but showed in their Figure 2 that lung cancer mortality began to fall among US men aged 45 to 54 years in the late 1970s and early 1980s. In contrast, the mortality rate for men older than 75 years showed no decline up to 1987 when their curve ended. The impact of decline in cigarette smoking on lung cancer mortality would be expected to show up first in younger men as a cohort effect seen in Figure 1 of the report by Giovino et al.\(^6\)

Other evidence of a decline in the male lung cancer rates in the late 1980s has been reported recently by Zheng et al\(^9\) for incidence in Connecticut. In California in the same period, Schenker et al\(^10\) showed a small decline in male lung cancer mortality (their Fig 4).

Tolley et al\(^11\) used a model to predict future lung cancer age-adjusted mortality rates for ages 55 to 84 years by race and gender. The model was based primarily on trends in smoking behavior. The results indicated a decline in white men by 1995 while the decline in the other gender-race groups would be delayed until 2005. Since white men are a majority of all men in the United States and men are at highest risk for lung cancer in the age stratum of 55 to 84 years, the model is consistent with the observations in Figures 1 and 2 herein.

Although there are factors other than the prevalence of cigarette smoking that may influence the lung cancer mortality rate, they are of much less importance, eg, occupational and environmental exposures. Changes in cigarette characteristics in recent decades have had only a minor impact. The increase in the proportion of ex-smokers as current smoking has declined would be expected to slow the decline in lung cancer mortality. However, data on the risk in relation to the number of years since smoking cessation have shown a marked decrease in risk after 16 or more years of abstinence, reaching 16 to 20% of the risk in current smokers.\(^12\)

The trends in lung cancer mortality reviewed herein are encouraging. They indicate that we are approaching the height of the lung cancer epidemic in this country provided the trends in cigarette smoking prevalence continue to fall.

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12. US Department of Human Services. The health benefits of smoking cessation. Public Health Service, Centers for Disease Control, Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health. DHHS publication No. (CDC) 90-8416. 1990; 130 (Table 7)