

Cancer Research
Vol 10, pp 532-542, 1950^N

Tobacco Smoking Habits and Cancer of the Mouth and Respiratory System

CLARENCE A. MILLS, M.D., AND MARJORIE MILLS PORTER, M.D.

(From the Laboratory of Experimental Medicine, University of Cincinnati, Cincinnati, Ohio)

Those concerned with the general aspects of disease trends have been much disturbed by the sharp rise in the frequency of lung cancer in recent decades. This concern seems fully justifiable, for this once rare disease now causes almost as many deaths as pneumonia or tuberculosis among white males in a city like Chicago (2). Of all neoplastic diseases in adult males, the incidence of lung cancer has shown the most rapid increase in recent years. Its incidence has been shown (2) to be greatest in the dirtier sections of industrial cities, where pneumonia and tuberculosis rates are also highest. That these high rates should involve the men so much more than the women of the same districts suggests that some factor or factors other than outdoor air pollution must be involved.

Carcinogenic compounds have been isolated from the tarry substances of both coal and tobacco smoke, as well as from the smoke of a great variety of other slowly burning organic substances. These tarry substances are otherwise irritating to the respiratory passages of laboratory animals inhaling tar-laden soot (3). The three serious respiratory diseases (cancer, pneumonia, and tuberculosis) show such similar variation in incidence with increasing density of air pollution in our industrial cities that one is led to suspect long-standing, chronic irritation as the responsible factor.

In searching for possible reasons why men should be so much more involved than women in the sharp rise of respiratory disease death rates in industrial districts, we deemed it wise to investigate the possible contributory role of tobacco smoking. We felt that milder stages of irritation from either tobacco smoke or coal smoke alone might reach dangerous degrees of damage when the two were summated. Having previously shown a significant relationship to exist between air pollution and the three respiratory disease death rates (2), we next investigated their connection with tobacco smoking habits. In the present report dealing with the smoking habits of some 368 white

men dying of buccal and respiratory tract cancer in Detroit and Cincinnati, we show a significantly higher incidence of pipe and cigar smoking among the buccal cancer victims than among controls of similar sex and age distribution and a significantly higher incidence of all forms of smoking among those dying of lung cancer.

METHODS

Smoking habits in a control population.—Columbus, Ohio, with a white population of 270,183 in the 1940 Census, was chosen as a representative American city of moderate size and industrialization. House-to-house visits were made (in 1947) in each of the city's 61 census tracts until 0.9 per cent of the calculated number of white males in each had been interviewed; smoking data were obtained only on residents 20 years of age or over. Although our original data contain detailed information on amount as well as type of smoking, Table 1 gives only three categories: (a) cigarettes, (b) pipe or cigars or any smoking combination containing either, and (c) nonsmokers.

In addition to the smoking habits by age, our survey also included a division of the whole city into clean, intermediate, and dirty districts. Of the 61 total census tracts, 1, 10, 25, 27, 37, and 54 were listed as the cleanest; tracts 11, 20, 44, 49, 55, 56, and 58-61 were called intermediate; and tracts 21, 24, 28-36, 38-43, 50, 53, and 57 comprised the areas dirtiest in air pollution.

From the data calculated on a percentage basis, it was found that cigarette smoking was heaviest among younger male adults and decreased with advancing age, while the reverse was true with cigar and pipe smoking. Cigarette smoking was also heaviest in the dirty (poorer) sections of the city and diminished toward the cleaner periphery, while the reverse was again true for pipe and cigar smoking. The higher cost of cigars may well have been a factor in explaining this smoking pattern that shifted with varying economic status, while the higher percentages of cigarette smokers in the younger age groups probably represented the

Received for publication January 23, 1950.

T C38501

TIMN 0088509

rapidly increasing adoption of this form of smoking since World War I.

Since objections might be raised against the use of Columbus smoking statistics as control data for comparison with various disease groups in other cities, we also ran an additional check on one category of persons in Cincinnati. Among 310 20-29-year-old white women scattered in all census tracts of Columbus, 39.68 per cent were cigarette

control groups. Names, addresses, and names of next-of-kin or informant specified on the death certificate were obtained for all people dying of cancer of the respiratory tract and of the buccal and pharyngeal tissue (Nos. 47 and 45, International List of Causes of Death) for the years 1940-45, inclusive, in Cincinnati, and 1942-46, inclusive, in Detroit. Positive information on smoking habits was obtained on 254 Cincinnati cases and on 503 in De-

TABLE 1
TOBACCO SMOKING HABITS (BY AGE) OF WHITE MEN IN COLUMBUS, OHIO (1947)

	20-29		30-39		40-49		50-59		60-69		70-79		80+	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Cigarettes	233	66 ± 2.5*	116	61 ± 3.5	131	61 ± 3.3	97	52 ± 3.7	41	34 ± 4.5	9	13 ± 4.2	1	5 ± 5.4
Pipe, cigars, or combination	38	11 ± 1.7	32	17 ± 2.7	42	19 ± 2.7	45	24 ± 3.1	37	31 ± 4.3	21	30 ± 5.7	9	47 ± 11.3
Non-smokers	80	23 ± 2.2	42	22 ± 3.0	43	20 ± 2.7	46	24 ± 3.3	42	35 ± 4.5	30	37 ± 6.1	9	47 ± 11.8
TOTALS:	351		190		216		188		120		69		19	

* Standard error, calculated according to the formula $s = \sqrt{pq/N}$, where p in this case represents the per cent smoking cigarettes, q the per cent not smoking cigarettes, and N the total number in that age group (smoking cigarettes and not smoking cigarettes) (3).

TABLE 2
TOBACCO SMOKING HABITS IN VICTIMS OF RESPIRATORY TRACT AND BUCCAL CANCER*

Group	TOTAL GROUP			CIGARETTES ONLY			PIPE, CIGARS, OR COMBINATIONS			NONSMOKERS				
	(No.)	(Mean age)	(Per cent)	(No.)	(Per cent)	(Standard error)	(No.)	(Per cent)	(Standard error)	(No.)	(Per cent)	(Standard error)		
Buccal (No. 45)	124	65.4	44	35	± 4.3	68	55	± 4.5	12	10	± 2.7			
Columbus controls	185	65.3	60	32	± 3.4	55	30	± 3.4	70	38	± 3.6			
Diff. standard error of diff.†				3.0	± 3.5	0.5		25	± 5.6	4.5		28	± 4.5	6.2
Respiratory (No. 47)	144	58.3	246	55	± 2.4	166	37	± 2.3	32	7	± 1.2			
Columbus controls	300	58.2	187	43	± 2.4	112	26	± 2.1	131	31	± 2.2			
Diff. standard error of diff.				12	± 3.4	3.5		11	± 3.1	3.6		24	± 2.5	0.6

* Detroit and Cincinnati white males.

† Standard error of the percentage difference (3) calculated thus: $s = \sqrt{pq/N} + (pq/N)$.

smokers, as compared to 41.35 per cent smokers among 520 white women of similar age and city-wide distribution over Cincinnati. This difference is insignificant.

In making a comparison of Columbus smoking habits with those of Detroit and Cincinnati respiratory and buccal cancer victims, it was considered wise to use the "whole city" statistics rather than those of any one economic or regional group in Columbus. Cancer victims of Cincinnati and Detroit were scattered throughout the city in all socio-economic groups. The only correction deemed necessary was one of age distribution (as indicated later).

Smoking habits of male victims of buccal and respiratory tract cancer as compared to those of con-

troit either by circular letter or by direct visitation to the next-of-kin or specified informant. This represented positive information in approximately 50 per cent of the deaths listed. Only with white males were numbers of cases adequate for statistical stability (175 in Cincinnati and 393 in Detroit).

Table 2 shows the smoking habits of the Cincinnati and Detroit white male respiratory tract and buccal cancer victims, as compared to Columbus controls of similar color, sex, and age distribution. The data on the Columbus control groups is obtained from Table 1 and is so presented that the percentage of the total for each decade is identical with the cancer group with which it is compared. Control groups were made as large as possible, the limiting factor usually being the number of cases

7 036502

TIMN 0088510

available in one of the more advanced age decades. Single control individuals were not selected to make up the total; this was accomplished by taking the required fractional part of the age decade's total of cigarette smokers, pipe or cigar users, and nonsmokers. Percentage age distribution of the two groups of cancer victims is presented in Table 3.

TABLE 3
AGE DISTRIBUTION OF THE DETROIT AND
CINCINNATI CANCER VICTIMS

Age group (years)	Resp. tract cancers (No. 47)		Buccal cancers (No. 45)	
	No.	Per cent	No.	Per cent
30-39	1	0.2	0	0.0
40-49	2	0.4	2	1.6
50-59	16	3.6	1	0.8
60-69	72	16.2	10	8.1
70-79	165	37.2	21	16.9
80-89	127	28.6	18	13.7
90+	51	11.5	29	23.1
Total	444	100.0	124	100.0

Table 2 illustrates that Cincinnati and Detroit white males dying of buccal cancer show no significant difference in cigarette smoking habits from the Columbus control group. There is a decided and highly significant increase in pipe and/or cigar usage among buccal cancer victims, however.

Cincinnati and Detroit victims of cancers of the respiratory tract (No. 47), on the other hand, exhibit highly significant elevations above normal in both cigarette and pipe and/or cigar usage. With both the buccal cancer group and respiratory tract cancer group, the incidence of non-smokers is only one-fourth as great as among the proper Columbus controls. These differences in percentages of non-smokers are highly significant.

While our data on smoking habits were fairly specific as to the amount of tobacco smoked daily, they were not satisfactorily complete as to duration in years. Comparison was made between Columbus controls and one cancer group (respiratory tract cancer victims in Detroit) as to the percentage of "heavy" smokers among the cigarette users.

PERCENTAGE OF "HEAVY" SMOKERS AMONG CIGARETTE USERS

	30-39	40-49	50-59	60-69	70-79
	yrs.	yrs.	yrs.	yrs.	yrs.
	(Per cent)				
Detroit cancer victims	86	79	87	73	67
Columbus controls	87	88	86	82	67

Here no significant difference is seen in the percentage of cigarette users who smoke one pack or more a day ("heavy" smokers).

DISCUSSION

From the findings here presented, it is evident that buccal cancer victims are significantly more addicted to pipe and/or cigar smoking than are the proper control population groups. Buccal cancer and control groups show no significant difference in cigarette smoking habits. This association of pipe and/or cigar usage with cancers of the buccal tissues has often been noted in medical literature and has been attributed to the more sluggish combustion and greater production of irritating tarry materials in these forms of smoking.

With cancers of the respiratory tract from the larynx downward, an abnormally high percentage of cigarette smokers, as well as of pipe and/or cigar users, is found. This group of cancer victims exhibits significantly increased percentages in all forms of smoking.

Roffa (3) found that 95 per cent of all respiratory tract cancers occurred in smokers. In our series, 93 per cent of all lower tract cancer victims, but only 90 per cent of upper tract cancer victims, were smokers. Many other investigators have reported 90-95 per cent incidence of tobacco smoking among respiratory tract cancer victims, with rather direct indictment of cigar and pipe smoking for cancers of the lip and tongue. Ours is the first study to indicate an indictment of all forms of smoking for cancers of the lower respiratory tract.

Schrek *et al.* in their recent paper (4) claim to have found a significant correlation between heavy cigarette smoking and respiratory tract cancers (from the pharynx down) and a negative correlation with cigar and pipe smoking, except for cancers of the lip. Their conclusions may be doubtful, however, because of their use of hospitalized tumor patients as their control group instead of a normal population cross-section, and because their data fail to indicate in any way the classification of the large percentage of both control and respiratory tract cancer individuals who were "combination" smokers—smoking cigarettes and pipe or cigars. Since Schrek *et al.* frankly stated that their interest centered on cigarette smoking, it might perhaps be assumed that any such "combination" smokers were listed only as cigarette users.

In these investigations we made correlation studies both ways, with "combination" smokers in control and cancer groups listed first as cigar and pipe smokers and then as cigarette smokers. In both cases the correlation values were similar. Almost 40 per cent of the Columbus men we interviewed were such "combination" smokers, these constituting almost half of the pipe and cigar smokers.

J C36503

TIMN 0088511

CONCLUSIONS

1. The percentage of cigar and pipe smokers is almost twice as high among white male victims of buccal cancer as among appropriately selected controls; all forms of smoking are significantly higher among victims of respiratory tract cancer than among the controls.

2. The percentage of nonsmokers among white male respiratory tract and buccal cancer victims is only one-fourth as high as among properly selected control groups.

3. Cigarette smoking seems to bear a highly significant relation to cancers of the respiratory tract

but no significant relation to the incidence of buccal cancer.

REFERENCES

1. HILL, B. *Principles of Medical Statistics*. 4th ed., London: Lancet, Inc., 1949.
2. MILLS, C. A., and PORTER, M. M. Health Costs of Urban Air Pollution. *Occ. Med.*, **5**:614-33, 1948.
3. ROFFO, A. H. Correlación del valor cancerígeno del alquitrán de tabaco con el de hulla. *Prensa med. Argent.*, **28**:1003, 1941.
4. SCHREK, R.; BAKER, L. A.; BALLARD, G. P.; and DOLGOFF, S. Tobacco Smoking as an Etiologic Factor in Disease. I. Cancer. *Cancer Research*, **10**:49-58, 1950.
5. SEELIG, M. G., and BENIGNI, E. L. Lung Tumor Development in a Resistant Strain of Mice Subjected to Inhalation of Soot. *Am. J. Cancer*, **34**:391, 1938.

DrFarrahCancerCenter.com

T 036504

TIMN 0088512