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Association of Cancer Sites With Tobacco and Alcohol Consumption and Socioeconomic Status of patients: interview Study From the Third National Cancer Survey[1]

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ABSTRACT—From personal interviews obtalned for **7,518** incident cases of invasive cancer from the population-based Third National Cancer Survey, the quantitative lifetime use of **cigarettes**, cigars, pipes, unsmoked tobacco, **wine**, beer, hard liquor, and combined alcohol were recorded, as well as educatlon and family **income** level. In an initial screening analysis of these data, Mantel-Haenszel 2x2 **contingency tabulations** ,and **multiple** regression analyses were used to compare each **specific** cancer site with controls from other **sites** to test for **associations** with the "exposure varlables." Significant **positive** assoclations with cigarette smoking were found for cancers of the lung, larynx, oral cavity, esophagus, stomach, pancreas, bladder, kidney, and uterine cervix. Other ***forms*** of tobacco were associated with cancers of the oral cavity, larynx, lung, and cervix. Consumption of wine. beer, hard liquor, and all combined showed positive **associations** with neoplasms of the oral cavity, larynx, esophagus, colon, rectum, breast, and thyroid gland. College education and high income both showed positive associations with cancers of the breast, thyroid gland, uterine corpus, and melanomas In males. These same indicators of **high** socioeconomic status showed Inverse associations with invasive neoplasms of the uterine cervix, lung, lip–tongue, and colon In females. College attendance (but not income) showed an inverse **association** with stomach cancer and positive association with pancreatic cancer in males. **Still** other tumor sites showed "suggestive" associations with each of these exposure variables. In the analyses producing these results, age, race, sex, smoking, drinking, education, income, parity, **foreign birth**, marital status, and geographic bcation were used as Stratification variables separately or **In** combination when appropriate to assess and control for their potentially confounding affects and to examine results in different strata to assess **interaction.**—J Natl Cancer **Inst 58: 525–547, 1977.**

When the TNCS patient interview study was being designed in the late 1960's, prior mortality and case-control studies had already suggested that some cancer sites were associated with exposure to tobacco and alcohol. SES had also been mentioned as an important factor in cancer epidemiology. These three variables were included in the TNCS interview for three main reasons: 1) to see if the results from prior studies would be verified in this population-based cross-sectional study of incident cancers, **2)** to examine the large sample of cancer cases for possible associations of the variables with other sites not yet implicated in prior studies with fewer cases (especially some of the less common ones), and **3)** to obtain sufficient information about these variables to be able to correct for their effect in the analysis of other variables such as industry and occupation. This report considers the first two reasons; subsequent reports will consider the third.

The association of cancer with tobacco, alcohol, and SES were all included in this single report, since the proper analysis and discussion of the results for any of them singly could not be done without involving the other two. Two approaches were considered: 1) an in-depth analysis of single cancer sites versus a few relevant exposures, or 2) an overview screening analysis of all sites versus all measures of tobacco, alcohol, and SES. This report, which presents the screening analysis of all sites, was done first with the hope of indicating which, associations would deserve the most emphasis in future in-depth analyses.

METHODS

Interview data.—The overall methodology **for** the TNCS has been explained in previous reports ***(1-3).*** Personal interviews were obtained from 7,518 patients (57% of those randomly selected for an interview). The accompanying report ***(4)*** introduced the general methodology and variables obtained for the TNCS interview study while discussing nonresponse and analytic a p proaches ***to*** these data. The "intercancer comparison" of one cancer site with controls from other sites was used with caution in this analysis after considering the hazards of this approach already discussed ***(4).***

For most of the quantitative analyses used in this report, ***both*** amount ***and*** duration were needed for each form of alcohol or tobacco used by the patient. If either were not known, the exposure status for that patient had to be counted as unknown. The lifetime history of tobacco was quantified for anyone known to smoke more than a few cigarettes, pipes **or** cigars, or to use snuff or chewing tobacco. The basic units of exposure (cigarette-years, pipe-years, and cigar-years) were calculated **as** the product of number per day times years used. Snuff and chewing tobacco were recorded together as cans and plugs per week times years used.

The quantitated lifetime drinking history was obtained only for persons using at least one form of alcohol (wine, beer, or hard liquor) at least once a week for 1 whole year. Persons who never drank this often were counted with nondrinkers. For each form used, standardized units (e.g., wine glasses or jiggers) consumed each week were multiplied by duration used (years) to derive jigger-years, glass-years, and can-years. **A** total

ABBREVIATIONS USED: TNCS = Third **National Cancer Survey; SES** = **socioeconomic status; cgt-yr = cigarette years: oz-yr = ounce-years; BM** = **black males; WM** = **white males: BF = black females; WF = white females.**

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"ounce-years" of absolute alcohol consumption was calculated with the use of a formula cited by the Framingham study *(5)* (combined alcohol=liquor+0.3 beer+0.17 wine) adapted for the standardized volumes recorded in the TNCS interview. If either amount or duration were not known for any of the three forms of alcohol consumption, the total ounce-year consumption of all alcohol was counted as unknown, the same as if none of the information on drinking were known. For the analysis, a value of zero ounce-year consumption was assigned to each specific form and to the total ounce-year for all nondrinkers (which included all persons who never drank weekly for a whole year).

Educational level was simply coded as years of formal education from 1 to 18 (12=high school graduate, 16=college graduate, 18=master's degree or higher). Total family income (1 year before any cancer diagnosis) included salaries before taxes of both husband and wife and were recorded as one of seven intervals (in thousands of dollars per year: <2, 2–3, 4–5, 6–7, 8–9, 10–15, >15).

Statistical procedures.—As an initial computerized screen of 35 cancer sites versus several measures of tobacco, alcohol, and SES, this analysis was designed to identify major associations. Some deserve more in-depth analysis on an individual basis with the use of more sophisticated analytic tools not feasible for the large number of associations tested in this overview. In the main screening analyses, the Mantel-Haenszel method (6) was used to calculate summary chi-squares and relative odds by application of the "intercancer comparison approach" explained in *(4)*. With this approach, since patients with cancers of one site are compared to patients with cancers at other sites, care must be taken to eliminate exposure-biased patients from the control group.. This is particularly true for the analysis of cigarettes and alcohol. First, sites known from other studies to be strongly associated with tobacco and alcohol were compared individually with all remaining "nonrelated' sites as controls (tables 4–5, 8–9). Next, each site of the nonrelated set was compared with all other nonrelated sites combined, to search for associations among these sites (tables 6–7, 10–11). For tobacco and alcohol, calculations were done with several mutually exclusive ranges as the "exposed' to illustrate increasing relative odds with increasing levels of exposure for any variables that might suggest a dose-response relationship. Exposed persons within successive specified ranges or intervals of exposure were compared with the nonexposed. For cigarette smoking, three intervals of quantitated consumption were successively compared to nonsmokers (tables 4–7). The three intervals of increasing cigarette usage represent 1–400 cigarette-years (up to 20 pack-years), 401–800 cigarette-years (over 20 but less than 40 pack-years), and more than 800. The total number of smokers with quantified consumption (3,425) were divided fairly evenly into these three groups (1,183, 924, 1,318) from the first three columns in row "All exposed" in tables 4B and 5B. For cigars, two exposure groups with approximately equal numbers of exposed subjects were divided as 1–50 cigar-years and all over that amount. The users of pipe and chewing or snuff tobacco were divided the same way, also resulting in approximately equal numbers in each group. Similarly, all patients using some form of alcohol were divided into two fairly equal exposure groups with 51 glass-years, can-years, jigger-years, and total ounce-years as the level of division. The Mantel-Haenszel extension procedure (7) was also applied to these groups to calculate a chi-square as a test of dose-response trends.

For the analysis of a specific type of alcohol consumption such as wine, wine-drinkers were compared only with nondrinkers. Persons who drank beer or hard liquor but not wine were excluded the same as were the "unknown" for that specific tabulation. For tables 8–11 the influence of cigarette smoking was controlled by stratification for a clearer analysis of other forms of tobacco and alcohol use.

Stratification or control variables were used according to the Mantel-Haenszel method to investigate and control for the effects of potential confounding variables. Five-year age groups and race (white, black, other) were used as stratification variables in all analyses. All results were obtained for each sex separately as well as for both sex strata combined. Additional stratification variables added separately or in combinations with others included marital status and geographic location. Education level, cigarette-years (nonsmokers and three smoker intervals) and total ounce-years of alcohol (nondrinkers and three drinking intervals) were also used as stratification variables when appropriate (e.g., drinking as exposure variable, controlling for smoking and educational level). The headings of tables 4–11 clearly indicate which control variables were used in each instance. Specific results were also obtained for each control stratum to assess uniformity of associations between strata and to screen for interactions between exposure and control variables within a stratum. Only 8 of the 141 tables of relative odds produced for these analyses could be printed with this report (tables 4–11). However, the results for all 141 were carefully reviewed and reflected in the text of this report. The tables not printed contained the results (both stratum-specific and combined strata) for all of the stratification variables mentioned in the text.

For sites showing association in the Mantel–Haenszel relative odds and extension chi-square calculations, standard step-up multiple regression analysis was also performed with the SPSS computer program system *(8)*. Categoric variables including cancer were entered as 0–1 variables, with a specific cancer site as the dependent variable and age, race, tobacco and alcohol consumption, education, income, foreign or native birth, and number of children (females only) as the independent variables. Analogous to the contingency analyses, control subjects were limited in these analyses to avoid exposure bias.

RESULTS

Proportion of Persons Smoking, Drinking, and Attending College

Table 1 shows the percentage of cigarette smokers by

TABLE 1.—Comparisonofpercent cigarette smokers *from* life-histoy questionnaires'

Sex and age	TNCS interview, 1969–71		Hammond, 1[illegible] lion volunteers[c]
	All cancer patients	Excluding cigarette-related[b]	
Males			
35–44	79	74	
45–54	a5	75	74
55–64	a3	75	73
65–74	75	68	66
75–84	56	49	52
a5+	35	31	34
Females			
35–44	60	61	
45–54	56	59	48
55–64	46	43	40
65–74	25	22	23
75–84	14	13	12
85+	5	6	6

[a] For comparisons of persons born at the same time, TNCS subjects in a given age group in 1970 correspond to subjects from the Hammond study who were 10 years younger in 1960.

[b] Excluding cancer sites reported by other studies to be strongly associated with smoking cigarettes: lung, larynx, oral, esophagus, and bladder.

[c] Calculated from appendix tables 2a and 2b from Hammond's report (*8*).

age and sex for the TNCS patient interviews and for subjects from Hammond's study of one million persons from the general U.S. population (*9*). For both studies. the numbers indicate the percentage of persons in specific age–sex groups who ever smoked regularly sometime during their lifetimes. The decreasing proportion of smokers with increasing age in both studies probably reflects the increasing popularity of smoking over the years and the increased mortality among smokers. Because of these time trends in smoking, comparisons of the age-specific smoking rate between the two studies had to be made for persons born at the same time. Since the ages listed are from studies 10 years apart, the TNCS patients from 1969–71were compared with Hammond subjects who were 10 years younger in 1960. This comparison showed that the TNCS cancer patients (first column, table 1) included a larger proportion of smokers than did the general population 'sample in Hammond's study. However, after patients from smoking-associated cancer sites (known from other studies) were excluded, the remaining TNCS subjects contained approximately the same percentage of smokers in each age group as the Hammond subjects. Among the TNCS subjects, younger females still included more smokers.

Table 2 shows the percentage of persons in each age group who attended college among TNCS patients (first three columns) and within the census base population (*10*) for the interview study. Comparison of the first three columns with the last shows strikingly that a consistently higher proportion of the cancer patients attended college than did the general population. After exclusion of cancer sites shown by other studies to be strongly related to education (second column), and even after all persons with unknown educational status were counted as not attending college (third cdumn), the greater proportion of college attendees among the cancer patients was still evident in every age group. Based on the age-adjusted totals, the percentage of male cancer patients attending college was 1.2 times that of the base population, whereas the percentage of female TNCS patients attending college was 1.3 times that of the general population. In individual comparisons made separately for each of the eight geographic'areas, the same general relationship was observed.

For alcohol consumption, the detailed comparison of TNCS patients to a general population is not possible due to differences in the definition of drinkers and nondrinkers. In the TNCS interview, the first question pertaining to alcohol was whether the cancer patient had ever drunk any alcoholic beverage at least once a week every week for at least 1 year. If the response was "no," that patient was counted as a nondrinker. In response to that question, 11% were uncertain whereas 60% of those remaining said "no." In the Harris survey (*11*), which used a national cross-section of persons 18 and older in 1972–74, current abstainers and infrequent drinkers were defined as those who drink less than *once a month* or not at all. Using this definition, they found that 42% were abstainers and infrequent drinkers. A larger proportion of women were abstainers or light drinkers in both the TNCS (78% female, 47% male) and the Harris survey (51% female, 31% male).

TABLE 2.—*Percent* ofpersons attending college *for TNCS*, 1969–71 *and* 1970 *census of* base population

Sex and age	TNCS interview patients[a]			Census base population
	All cancer excluding unknown	Excluding education-related[b]		
		Excluding unknown	Unknown as non	
Males				
25–34	56	58	57	40
35–44	34	40	39	31
45–54	26	29	28	27
55–64	24	26	24	20
65–74	20	22	20	15
75+	19	19	16	12
Age adjusted total[c]	23	25	23	19
Females				
25–34	33	38	38	31
35–44	27	30	29	23
45–54	30	34	33	19
55–64	26	26	25	17
65–74	18	18	15	15
75+	15	17	14	12
Age adjusted total[c]	22	24	22	16

[a] Persons of "unknown educational level" were excluded from the first two TNCS columns. In the third column they were included as persons not attending college.

[b] Tumor sites were excluded if they showed strong positive or negative associations in previous studies discussed later in this report (breast, cervix, colon, rectum, stomach, mouth, and lung). The census base population figures were derived by combining the 1970 census data for the eight geographical areas included in the interview.

[c] Age adjustments were based on the age distributionof the TNCS patients.

Orientation to Tables

Table 3 summarizes the associations found in the TNCS interview study for tobacco, alcohol, and SES with specific cancer sites. All associations listed in table 3 had a Mantel-Haenszel chi-square, relative odds, or extension chi-square of sufficient strength to meet the objective criteria specified at the bottom of the table. Multiple regression analyses were performed for all associations listed in table 3 to further test for linear dose-reponse relationships and to allow simultaneous inclusion of many covariates (as control and exposure variables). The covariates are listed in the "Methods" section. The regression slopes showed generally the same trends as the relative odds. The sites showing a statistically significant dose-response regression slope with respective exposure variables are indicated by a footnote in table 3. Another footnote denotes a strong dose-response relationship evident by striking elevation in the relative odds at successively increasing exposure levels as well as by significant regression slopes. Sites listed in double parentheses were associated with respective exposures in the tabulations controlling only age and race but were considered suspect or spurious on the basis of subsequent tabulations in which additional exclusions or control variables were used. The specific details upon which table 3 is based are given in tables 4–11 and the remaining text.

Exposures tested in tables 4–11 include college attendance (designated by ED13+), family income over $10,000 (FI>10), and consumption levels of various forms of alcohol and tobacco as previously defined. Tables 4B–11B list the numbers of exposed patients from each cancer site at each exposure level. The total number of patients for each site appears in the far right column labeled "Total," and the total number of c

TABLE 3.—*Summary of associations: TNCS interview study* [a]

"Exposure" variables	Positive associations		Inverse associations	
	Significant	Suggestive	Significant	Suggestive
Cigarettes	Lip-tongue Larynx [b] Lung [b] Pharynx [b] Esophagus [b] Bladder [b] Cervix (F) [b] Gum-mouth Stomach Pancreas Kidney	Vulva (F) Acute granulocytic leukemia Chronic granulocytic leukemia Other lymphomas (M)	((Colon))	((Gall bladder-duct)) ((Melanoma)) ((Nervous system))
Other tobacco (cigar, pipe, chew-snuff)	Gum-mouth [b] Cervix (F) Larynx (M) Lung (only in males not using cigarettes)	Lip-tongue (M) Multiple myeloma (M) Testis (M) Corpus (F) Other lymphomas (M)	Lung (only in males using cigarettes)	
Alcohol (wine, beer, hard, all)	Pharynx [b] Gum-mouth [b] Larynx Lip-tongue [c] Breast [b] Esophagus. Colon [c] Rectum (F) Thyroid ((Lung))	Salivary Liver Stomach Melanoma Pancreas [c] (see text) Chronic lymphocytic leukemia Acute granulocytic leukemia Chronic granulocytic leukemia	((Prostate)) ((Bladder))	((Corpus)) ((Ovary)) Connective tissue Lymphoreticular sarcoma (M) Hodgkin's disease (M)
College and/or high income	Breast [c] corpus (F) Melanoma (M) Thyroid	Hodgkin's disease (F) Other lymphomas Pharynx (F) Acute lymphocytic leukemia chronic granulocytic leukemia Salivary gland	Cervix [c] Stomach [c] Lung Lip-tongue Colon (F)	Salivary (see text and tables: Education positive, income inverse)

[a] Significant=$P<0.05$ for regular or extension M-H chi-square in any contingency tables for male, female, or both sexes; suggestive=relative odds >2.0 or <0.5 based on 5 or more "exposed"patients of that cancer site. (M) or (F) indicates associations observed only in one sex; ((site)) designates sites whose association was likely spurious, since it weakened considerably or disappeared in analyses employing appropriate exclusions or control variables as explained in text.

[b] Strong dose-response gradient evident in increasing relative odds and multiple regression, both "significant" (see tables 4–11).

[c] Significant linear slope in multiple regression analysis (*see* text).

posed patients appears in the next to last row labeled "All exposed." The ICDA[6] codes defining the cancer sites are given in (4).

Tables 4 and 5 present the results for known smoking-associated sites for males and females stratifying on age and race; tables 6 and 7 present the results for the remaining sites. Tables 8–11 give the analogous results after stratifying on cigarette use. Results from other computer tabulations and multiple regression analyses will be given in the text only.

Associations Found

Cigarette smoking was positively associated with large and consistent dose–response increases in risk for invasive cancers of the oral cavity, larynx, and lung in both sexes; relative odds were higher in women than in men (tables 4, 5). Bladder and esophageal cancer showed moderate dose-dependent positive associations. Among the remaining sites (tables 6, 7), an association with smoking was suggested for cancer of the stomach, pancreas, uterine cervix (invasive), vulva, and kidney, as well as for lymphomas, multiple myeloma, and granulocytic leukemias (tables 6, 7). The inverse associations suggested for colon, bile system, melanoma, and nervous system can be eliminated by excluding from controls the sites still associated with smoking in tables 6 and 7.

The use of other forms of tobacco suggested positive associations with several of the same sites related to smoking cigarettes. These associations were most clearly defined after controlling for cigarette smoking status (tables 8–11). Use of cigar, pipe, and chewing (or snuff) tobacco were all positively related to cancer of the oral cavity and larynx, and a relationship was suggested for bladder and lymphomas. Other positive associations with one or more of these forms of tobacco were suggested for cancer of the stomach, colon, testis, and uterus (cervix and corpus), and for multiple myeloma.

Considerably fewer persons used these forms of tobacco than cigarettes; this resulted in less power for defining reliable associations. Thus for these exposure variables, it is especially important to correlate the relative odds listed in the "A tables" with the "B-table" listings of the number of exposed persons upon which calculations were based. Several other elevated odds ratios in tables 8–11 were based on very few patients.

An inverse association between all three other tobacco categories and lung cancer was suggested to exist only among cigarette smokers; a positive association was found in noncigarette smokers (as will be discussed later).

The intake of alcoholic beverages was positively associated with large and consistent dose–response increases in risk for invasive cancers of the oral cavity and larynx (tables 8, 9). Less strikingly positive associations were found for cancers of the esophagus, stomach, colon, liver, breast, and thyroid gland, and for malignant melanoma. For most of these associations, elevated relative odds were consistently observed for each of the three forms of alcohol independently as well as for the combined ounce-year consumption. As with cigarette smoking, the relative odds were usually higher in females. Females also exhibited a positive association of alcohol with rectal cancer, whereas males did not. Considerable confounding by smoking was indicated by the dramatic changes in relative odds for alcohol associations that resulted from controlling smoking (compare tables 4–7 with tables 8–11). A strong factitious association of alcohol with lung cancer disappeared, but for colon and breast cancer it changed from borderline to strongly positive. As indicated in table 3, several sites showed inverse associations with alcohol but lost this relationship in subsequent tabulations that excluded the major sites reported by other studies to be related to alcohol (mouth, esophagus, colon, rectum, larynx, and breast).

College attendance and high family income were found to have both positive and inverse associations with several cancer sites even after correction for cigarette smoking status (tables 8–11). Strong positive associations with both variables were observed for cancers of the breast and thyroid gland and for melanomas in males. The same dual positive trends were observed for the uterine corpus, but statistical significance was achieved only after correction for alcohol consumption. Lung cancer showed a strong inverse association with education in males and with both education and income in females. This association remained strong even after stratifying on cigarette use. Inverse associations with both variables of high socioeconomic class were also observed in females for cancers of the colon and uterine cervix and for lip cancer in both sexes combined. It is interesting that the strong inverse association with education was less striking with in situ cervical cancer (odds ratio 0.6) than the invasive type (0.3). An inverse association between income and invasive cervical cancer (0.5) was not found for the in situ cervical cancer (1.0). A strong inverse association between stomach cancer and college attendance was consistently observed; however, family income showed no association.

In other tabulations, addition of control variables and stratification on education, marital status, and geographic location resulted in little or no change in the odds ratios for the associations listed in table 3. Stratification on alcohol consumption resulted in a mild decrease in the summary relative odds for the associations of cigarette smoking with cancer sites also related to alcohol consumption (mouth, larynx, and esophagus).

In tabulations by age-specific groups (<30, 30–49, 50–69, 75+ years), the associations listed in table 3 were generally apparent in each age group having a reasonable number of cases for the specific cancer site considered. Some exceptions included thyroid cancer, for which the association with higher education and income was evident mainly in the two younger groups (<50). Males with Hodgkin's disease showed a consistent positive association with both high family income and college attendance in the youngest age group (odds ratios: 1.88 and 1.89); for all ages combined, only education showed the association. Females with Hodgkin's disease

[6] Eighth Revision International Classification of Diseases, Adapted for use in the United States. Public Health Service, National Center for Health Statistics, 1968.

TABLE 4A.—*Relative odds in males, controlling for age and race: Each known tobacco-related site versus nonrelated group*

Cancer sites	Exposure variables[a]																		
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI≥10
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Lip-tongue	0.42	1.12	2.36*	0.77	0.74	1.54	1.86	0.59	2.04*	0.85	1.59	0.51	1.35	0.5	0.79	0.27	1.03	0.65	0.53*
Salivary	1.15	0.58	0.26	—	1.03	1.32	1.37	1.26	0.89	1.2	0.82	0.63	—	0.8	0.62	—	—	—	1.74
Gum-mouth	1.94	1.03	2.62*	2.22	2.34	2.34	4.94***	0.84	3.62**	1.5	3.75**	0.92	0.66	2.3	1.92	5.64***	3.9	0.96	0.78
Pharynx	1.82	3.21*	4.77**	2.23	10.93***	2.69	9.93***	1.01	7.21***	1.9	6.97**	0.62	.16	0.8	0.40	0.65	—	0.65	0.63
Esophagus	0.45	1.54	2.70*	1.10	1.62	0.78	2.11	1.47	1.82	0.89	1.91	1.12	0.8	0.26	1.26	0.82	0.73	0.59	1.23
Larynx	2.90	3.31*	17.66***	2.66	2.40	3.52**	3.49***	2.45*	2.82***	2.24	2.73**	1.94	1.3	1.76	1.42	2.01	1.70	0.73	0.88
Lung	2.74***	5.52***	9.93***	0.85	1.38	1.30	1.74***	1.24	1.60***	1.15	1.56**	0.85	0.6	0.77	0.70	0.73	0.51	0.62***	0.89
Bladder	0.87	1.96**	2.34***	0.83	0.64	1.03	1.37	1.23	0.85	0.96	0.97	1.35	0.8	1.37	1.31	1.61	1.15	0.82	1.03

[a] Labels for exposure variables indicate which group of exposed patients was compared with nonexposed patients for: three increasing levels of cigarette use, two levels for beer, wine, hard liquor, combined oz-yr of alcohol, cigars, pipes, chewing or snuff tobacco, and single-exposure groups for persons attending college or having family income greater than $10,000/yr. No calculation of relative odds was possible if zero persons appeared in one or more cells in the summary table. This is indicated by a dash. The numbers in bold type were "significant" (Mantel-Haenszel chi square >3.84 after continuity correction). *P* values are indicated: *<0.05, **<0.01, and ***<0.001. Absence of an asterisk indicates no *P* value is listed due to less than 5 persons in one cell.

TABLE 4B.—*Number of exposed males, controlling for age and race: Each known tobacco-related site versus nonrelated group*

Cancer sites	Exposure variables[a]																			
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Lip-tongue	5	12	38	3	4	9	19	5	27	10	29	6	10	7	5	1	2	16	17	85
Salivary	5	2	1	0	1	2	4	3	3	4	4	1	0	1	1	0	0	1	7	18
Gum-mouth	12	8	24	4	5	5	22	3	19	8	27	4	6	8	6	8	3	15	14	57
Pharynx	7	11	24	2	11	4	20	2	19	5	25	3	5	2	2	2	0	10	12	53
Esophagus	2	8	19	2	3	2	10	5	12	4	16	5	4	1	5	2	1	6	10	49
Larynx	9	15	68	7	9	11	30	14	31	19	39	17	11	16	11	11	5	20	27	106
Lung	63	125	339	20	45	44	133	69	160	89	203	48	30	45	34	27	11	118	184	737
Bladder	24	45	89	10	11	16	49	29	41	32	60	27	19	26	25	19	10	48	54	229
All related cancers	127	226	602	48	89	93	287	130	312	171	403	111	85	106	89	70	32	234	325	1,334
Controls[b]	359	293	464	96	128	143	275	208	368	296	475	160	168	156	157	98	71	493	509	2,102
All exposed	486	519	1,066	144	217	236	562	338	680	467	878	271	253	262	246	168	103	727	834	3,436
Exposed + nonexposed	1,245	1,278	1,825	1,328	1,401	1,420	1,746	1,522	1,864	1,652	2,063	2,510	2,492	2,408	2,392	1,489	1,424	3,114	2,820	3,436

[a] *See* footnote, table 4A. Numbers involved in "significant" associations appear in bold type.
[b] Controls included a group of all cancer patients from sites "not related" to tobacco, as explained in text.

TABLE 5A.—*Relative odds in females, controlling for age and race: Each known tobacco-related site versus no related group*

Cancer site	Exposure variables[a]																	
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
		2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Lip-tongue	4.3[*]	4.70	5.21	2.27	3.01	5.31	14.15	2.73	5.61	0.86	7.19***	—	—	—	—	—	—	0.63	1.31
Salivary	0.3	0.43	2.09	1.02	—	—	—	1.11	1.26	0.74	1.03	—	—	—	—	5.03	—	1.89	1.13
Gum-mouth	0.8	2.22	9.17***	—	2.66	5.20	2.33	2.10	3.69	1.87	3.24	—	—	—	—	—	—	1.38	0.82
Pharynx	1.4	2.79	11.12***	6.14	6.08	12.13	3.09	1.20	16.87***	1.67	14.42***	—	—	—	—	—	—	1.23	0.51
Esophagus	2.2	9.52**	7.88	6.44	3.99	—	16.54	1.55	6.75	1.82	8.46***	—	—	—	—	28.17	—	1.56	0.77
Larynx	5.9	—	22.32	2.21	3.99	3.45	8.29	0.98	1.64	0.71	1.40	—	—	—	—	1.49	—	0.60*	0.60*
Lung	3.4 ***	11.46***	16.41***	0.90	1.77	1.57	2.30*	1.71*	1.33	1.53	1.52	—	—	—	—	—	1.78	0.95	0.88
Bladder	1.9	4.90***	2.53	0.97	0.47	1.80	—	0.66	0.66	1.14	0.56	—	—	—	—	—	—	—	—

[a] *See* footnote, table A.

TABLE 5B.—*Number of exposed females, controlling for age and race: Each known tobacco-related site versus nonrelated group*

Cancer site	Exposure variables[a]																			
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Lip-tongue	6	3	3	1	1	1	4	2	4	1	6	0	0	0	0	0	0	0	2	21
Salivary	2	1	2	1	0	0	0	2	1	2	1	0	0	0	0	0	0	3	5	17
Gum-mouth	2	3	8	0	1	2	1	3	4	4	4	0	0	0	0	2	0	8	5	27
Pharynx	3	3	7	2	1	4	1	1	8	2	8	0	0	0	0	0	0	6	4	20
Esophagus	3	5	4	2	1	0	4	1	4	2	6	0	0	0	0	0	0	5	2	23
Larynx	4	0	5	1	1	1	2	1	1	1	1	0	0	0	0	1	0	4	3	13
Lung	27	47	42	6	6	7	9	23	11	9	15	0	0	0	0	1	0	30	34	194
Bladder	13	14	6	3	1	3	0	4	3	0	3	0	0	0	0	0	1	15	10	77
All related cancers	60	76	77	16	12	18	21	37	36	51	44	0	0	0	0	4	1	71	65	392
Controls[b]	637	329	175	154	77	108	86	303	184	436	212	3	0	2	0	2	1	773	807	3,464
All exposed	697	405	252	170	89	126	107	340	220	487	256	3	0	2	0	6	2	844	872	3,856
Exposed + nonexposed	2,805	2,513	2,360	2,759	2,678	2,71	2,696	2,929	2,809	3,078	2,847	3,436	3	2	3	2	2	3,588	3,197	3,856

[a,b] *See* footnotes, tables 4A and 4B.

TABLE 6A.—*Relative odds in males, controlling for age and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, oral, esophagus, and bladder)*

Cancer sites	Exposure variables [a]																			
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>0
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Stomach	1.71	2.06*	1.56	0.90	1.63	1.33	1.04	1.59	1.06	1.42	1.30	0.81	0.80	1.25	1.04	1.06	1.40	0.42*	1.06
Small intestine	0.84	0.52	0.89	—	—	—	—	—	0.61	—	0.51	—	1.18	—	—	1.77	2.81	0.58	0.13
Colon	0.65*	0.73	0.79	1.12	2.19***	0.99	1.42	1.21	1.35	1.19	1.29	1.00	1.44	0.99	1.12	0.93	1.51	1.08	0.98
Rectum	1.63*	1.53	0.78	1.04	0.62	1.45	0.91	0.84	0.99	0.98	0.83	1.84*	1.06	1.34	0.70	0.95	0.73	1.06	0.81
Liver	0.64	2.29	3.08	—	5.34	0.60	1.35	—	2.07	0.27	1.97	—	0.60	—	0.78	0.89	—	0.59	0.71
Gallbladder-bile ducts	1.18	0.33	0.61	0.73	0.55	—	0.98	0.32	0.63	0.66	0.91	0.99	1.53	0.81	0.58	—	1.20	0.88	1.49
Pancreas	0.60	1.89	1.40	0.71	0.74	0.84	1.39	0.60	1.41	0.87	1.41	0.72	0.73	0.92	[illegible]	0	0.26	1.41	0.81
Breast	2.14	0.90	1.26	—	3.85	5.71	6.33	11.82	5.85	8.37	4.23	2.87	—	0.90				1.19	2.31
Cervix, invasive	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Uterine corpus	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ovary	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vulva		—		—		—	—	—	—	—	—	—	—	—	—	—	—	—	—
Prostate	0.74	0.74	0.90	1.39	0.43 *	0.83	0.85	0.81	0.82	0.98	0.84	1.10	0.92	1.17	1.25	1.54	1.17	1.00	0.86
Male genitalia	0.44	2.33	1.01	2.53	0.90	1.39	1.16	1.56	0.83	1.73	1.01	0.63	0.77	1.57	1.89	2.27	—	1.35	1.17
Kidney	2.74*	0.84	1.57	0.87	0.63	1.02	0.73	0.92	0.69	1.02	0.76	1.20	0.82	0.88	0.84	0.91	—	0.75	1.15
Connective tissue	0.61	0.84	0.59	—	0.71	0.42	0.51	1.02	0.76	0.50	0.63	1.39	0.41	0.85	0.44	0.51	—	0.56	0.96
Melanoma	1.05	0.37	0.52	1.09	—	1.87	0.70	1.56	1.74	2.06	1.45	2.35	0.53	0.91	1.44	0.61	—	2.27*	1.88
Nervous system	0.72	0.81	0.53	1.08	0.80	0.65	0.59	1.29	0.14	0.38	0.38*	0.55	0.26	0.53	1.18	—	0.91	1.49	1.39
Thyroid gland	0.95	0.61	1.57	2.27	4.56	1.20	0.94	1.36	0.97	1.13	1.71	0.41	—	0.81	—	0.78	—	1.66	1.52
Lymphosarcoma	1.52	1.15	1.35	0.59	0.53	0.95	0.61	0.58	0.57	0.46	0.62	0.73	0.66	0.50	1.53	0.42	0.90	0.63	0.91
Hodgkin's disease	1.27	0.72	0.83	0.40	0.50	0.52	0.86	0.97	0.99	0.51	0.90	0.61	3.94	0.54	0.72	1.31	3.05	0.71	1.30
Other lymphomas	3.33	3.29	1.65	—	—	1.17	0.24	0.62	0.63	0.77	0.35	—	0.81	2.18	2.30	1.10	2.94	0.53	1.90
Multiple myeloma	0.97	0.37	1.01	0.42	0.36	—	0.46	0.55	1.07	0.11	0.95	1.65	1.57	1.16	1.14	0.36	1.59	1.61	0.82
Acute lymphocytic leukemia	0.40	1.48	0.35	2.53	—	—	0.62	—	0.57	—	0.88	—	8.81	2.03	2.77	5.44	—	1.64	1.31
Chronic lymphocytic leukemia	1.36	0.86	0.78	1.53	2.38	1.18	2.22	0.86	0.58	1.75	0.94	1.32	1.00	1.13	0.74	0.42	1.66	0.43	0.56
Acute granulocytic leukemia	1.61	1.35	1.44	1.35	1.39	1.35	1.52	1.17	1.05	2.56	1.08	0.81	3.19	0.61	0.93	1.96	—	0.49	0.96
Chronic granulocytic leukemia	1.80	—	3.22	3.93	—	4.00	—	—	2.13	3.26	0.94	—	0.88	—	2.38	—	—	2.82	—
Other primaries	1.05	1.08	1.23	0.29	1.49	1.61	1.11	1.30	1.17	1.69	1.13	0.68	0.75	1.36	1.71	2.05	0.90	1.05	1.23
Unknown primaries	1.59	1.41	2.14*	1.38	2.35	1.62	1.55	1.63	1.93	1.37	1.58	0.63	0.90	0.89	0.34	0.90	0.51	1.44	0.81

[a] *See* footnote, table 4A.

TABLE 6B.—*Number of exposed males, controlling for age and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, oral, esophagus, and bladder)* [a]

Cancer sites	Exposure variables [b]																		
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Stomach	23	22	39	35	45	36	22	17	25	22	38	10	10	13	10	7	6	16	33	158
Small intestine	3	1	2	0	0	0	0	0	2	0	2	0	1	0	0	1	1	2	1	12
Colon	50	46	85	38	39	22	57	38	77	52	97	28	40	29	31	15	15	87	75	333
Rectum	42	37	38	10	9	19	27	18	40	29	43	23	15	19	11	9	5	44	41	185
Liver	4	4	7	0	4	1	4	0	7	1	7	0	1	0	1	1	0	5	5	31
Gallbladder-bile ducts	7	2	6	1	1	0	4	1	4	3	7	2	3	2	1	0	1	7	10	34
Pancreas	8	24	33	13	5	5	17	11	24	19	32	6	6	5	4	2	1	31	23	113
Breast	3	1	3	0	1	1	2	2	3	3	3	2	0	1	0	0	0	3	3	10
Cervix, invasive	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uterine corpus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ovary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vulva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostate	67	59	131	29	25	0	68	45	102	63	129	46	55	2	56	38	32	102	68	531
Male genitalia	11	14	4	5	2	8	6	10	3	14	6	2	1	4	2	2	0	26	24	53
Kidney	18	7	18	3	3	5	9	7	10	11	14	6	4	5	4	3	0	13	21	73
Connective tissue	8	8	7	0	2	2	4	7	6	5	7	4	1	3	1	1	0	11	17	45
Melanoma	13	4	5	3	0	6	4	7	8	12	10	6	1	3	3	1	0	22	23	40
Nervous system	14	11	10	5	3	4	7	10	2	12	7	3	1	3	4	0	0	24	33	75
Thyroid gland	8	4	8	3	4	3	3	5	4	5	9	1	0	2	0	1	0	13	14	30
Lymphosarcoma	13	9	10	2	2	5	6	4	6	5	9	3	2	2	4	1	1	13	21	57
Hodgkin's disease	21	5	5	2	1	4	6	9	5	7	7	2	4	2	1	2	1	19	23	54
Other lymphomas	6	5	4	0	0	3	1	2	3	4	2	0	1	3	2	1	1	4	11	22
Multiple myeloma	8	3	11	1	1	0	3	3	10	1	11	6	6	4	4	1	3	11	8	40
Acute lymphocytic leukemia	1	2	1	1	0	0	1	0	1	0	2	0	2	1	1	1	0	4	10	22
Chronic lymphocytic leukemia	5	5	6	2	5	3	5	3	4	5	8	4	4	4	3	1	3	5	6	36
Acute granulocytic leukemia	5	3	4	1	1	2	3	2	3	6	3	1	3	1	1	1	0	3	9	27
Chronic granulocytic leukemia	2	0	5	1	0	1	0	0	2	2	1	0	1	0	2	0	0	5	0	10
Other primaries	15	12	22	1	7	9	12	11	17	13	21	5	6	8	11	9	3	23	30	111
Unknown primaries	11	10	25	3	8	5	11	8	19	10	20	4	5	5	2	3	1	25	19	85
All exposed	320	303	489	99	136	118	386	226	387	305	495	164	173	116	159	101	27	518	528	2,187
Exposed + nonexposed	996	929	1,115	571	969	830	1,552	1,219	1,739	1,328	1,562	1,571	1,552	1,510	940	991		1,963	1,811	2,187

[a] Control group for this comparison was practically the same group used in tables 4 and 5, except that patients with cancers at the site being tested were removed from the control group before each site was successively compared with all others combined (*see* text).

[b] *See* footnote, table 4A.

TABLE 7A.—*Relative odds in females, controlling for age and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, mouth, esophagus, and bladder)*

Cancer sites	Exposure variables[a]																	
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Stomach	0.65	1.67	1.98	1.48	1.35	1.82	1.72	1.52	0.73	1.58	0.81	–	–	–	–	–	1.05	0.60	0.88
Small intestine	5.55	11.07	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	4.07
Colon	1.18	0.94	0.66	0.87	1.50	0.99	1.22	1.00	1.15	1.17	0.32	–	–	–	–	0.40	1.96	0.73*	0.78
Rectum	0.84	0.67	0.91	0.69	0.45	0.53	1.64	0.95	1.24	0.63	1.57	–	–	–	–	1.05	0.80	1.13	0.98
Liver	0.30	–	1.57	3.55	–	–	5.50	2.19	–	2.43	–	–	–	–	–	–	–	0.71	2.85
Gallbladder-bile ducts	0.95	0.74	–	0.77	0.85	1.20	1.01	0.37	0.91	0.98	0.84	–	–	–	–	–	–	0.98	0.47
Pancreas	1.38	2.06	2.76*	0.67	0.85	1.41	–	0.82	1.09	0.74	0.98	–	–	–	–	–	–	0.86	0.94
Breast	0.96	0.88	0.77	1.62**	0.90	1.10	1.06	1.27	1.30	1.15	1.31	0.82	–	1.97	–	0.26	0.64	1.44**	1.30**
Cervix, invasive	1.15	1.60*	1.81	0.61	1.40	1.29	1.29	0.61	0.79	0.88	0.81	–	–	9.09	–	3.08	2.29	0.30**	0.45**
Uterine corpus	0.89	0.79	0.74	0.77	0.60	0.23	0.42	0.91	0.79	0.72	0.65	11.82	–	–	–	2.66	0.66	1.24	1.23
Ovary	0.70	1.10	0.79	0.62	1.00	0.54	0.88	0.61	0.93	0.88	0.87	–	–	–	–	–	2.32	1.12	1.10
Vulva	2.85	2.08	1.73	0.92	–	2.56	1.41	1.97	0.69	1.52	0.58	–	–	–	–	–	4.06	0.25	0.19
Prostate	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Male genitalia	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Kidney	1.31	1.18	1.59	1.25	–	1.30	0.80	0.60	0.99	0.84	0.85	–	–	–	–	2.97	–	0.76	1.08
Connective tissue	0.83	1.82	0.78	1.40	–	0.76	–	0.42	0.77	0.76	0.70	–	–	–	–	–	–	0.65	1.96
Melanoma	1.08	0.44	0.89	0.31	2.44	1.09	0.64	0.85	1.44	0.97	1.18	–	–	–	–	–	–	0.79	0.94
Nervous system	1.00	1.07	0.38	1.30	1.22	0.64	1.65	0.45	1.37	0.65	1.13	–	–	–	–	28.16	–	1.22	0.87
Thyroid gland	0.67	0.62	1.07	1.39	–	2.28	1.00	1.36	0.78	1.59	0.61	–	–	–	–	–	2.49	1.86*	1.86*
Lymphosarcoma	1.69	–	1.52	1.49	1.23	1.16	0.67	1.33	1.17	1.04	0.97	–	–	–	–	–	–	0.80	0.88
Hodgkin's disease	2.37	1.21	1.04	1.08	–	0.59	–	0.70	–	0.96	–	–	–	–	–	–	–	1.98	0.89
Other lymphomas	0.40	–	1.43	–	–	2.59	–	–	–	0.71	–	–	–	–	–	–	–	1.76	3.05
Multiple myeloma	1.59	1.25	2.26	0.65	2.24	1.76	2.15	0.63	1.41	0.46	1.61	–	–	–	–	2.36	–	1.17	1.44
Acute lymphocytic leukemia	1.14	–	–	–	40.54	–	–	–	–	3.50	–	–	–	–	–	–	–	–	0.67
Chronic lymphocytic leukemia	0.80	0.34	0.53	0.83	1.02	1.30	1.50	0.88	0.55	0.86	0.98	–	–	–	–	8.77	3.44	1.10	0.21
Acute granulocytic leukemia	1.53	8.76	2.59	–	–	–	–	3.46	–	2.34	–	–	–	–	–	–	–	0.60	0.13
Chronic granulocytic leukemia	0.75	3.27	2.59	–	–	–	9.19	1.60	3.35	0.95	–	–	–	–	–	–	–	1.71	3.39
Other primaries	0.82	0.91	0.65	0.89	0.42	0.65	–	0.99	0.18	0.82	0.15	–	–	–	–	1.58	2.63	0.76	0.69
Unknown primaries	1.38	4.66**	6.74***	0.39	2.72	1.86	2.05	1.45	0.30	1.37	1.07	–	–	–	–	1.24	–	0.75	0.71

[a] *See* footnote, table 4A.

TABLE 7B.—*Number of exposed females, controlling for age and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, mouth, esophagus, and bladder)*[a]

Cancer sites	Exposure variables[b]																				
	Cigarette level			Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	3	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Stomach	7	8	7	4	4	3	3	8	3	12	4	0	0	0	0	0	2	11	11	108
Small intestine	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7
Colon	63	28	13	13	14	9	10	29	23	48	30	0	0	0	0	1	7	63	56	389
Rectum	19	7	7	4	2	2	5	11	10	11	14	0	0	0	0	1	1	33	20	154
Liver	1	0	1	1	0	0	1	2	0	3	0	0	0	0	0	0	0	2	5	14
Gallbladder-bile ducts	5	2	0	1	1	1	1	1	2	4	2	0	0	0	0	0	0	8	3	47
Pancreas	13	10	8	2	2	3	0	5	5	7	5	0	0	0	0	0	0	17	14	111
Breast	237	128	62	71	26	41	34	132	77	176	90	1	0	0	0	3	8	327	336	1,167
Cervix, invasive	70	39	17	10	7	7	10	19	11	38	13	0	0	0	0	6	4	26	46	266
Uterine corpus	64	36	19	14	6	3	5	35	19	39	19	1	0	0	0	5	2	98	100	358
Ovary	24	22	9	5	4	3	4	10	9	20	10	0	0	0	0	0	2	44	48	180
Vulva	9	3	2	1	0	2	1	4	1	5	1	1	0	0	0	0	1	2	2	31
Prostate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Male genitalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kidney	10	5	4	3	0	2	1	3	3	6	3	0	0	0	0	1	0	10	12	53
Connective tissue	5	4	1	2	0	1	0	1	1	3	1	0	0	0	0	0	0	5	14	39
Melanoma	17	3	3	1	3	2	1	5	4	8	4	0	0	0	0	0	0	13	16	59
Nervous system	10	6	1	3	1	1	2	2	3	4	3	0	0	0	0	2	0	14	18	61
Thyroid gland	23	7	5	7	0	9	2	10	2	18	2	0	0	0	0	0	1	34	40	86
Lymphosarcoma	16	0	5	4	2	2	1	7	4	8	4	0	0	0	0	0	0	12	15	64
Hodgkin's disease	11	2	1	2	0	1	0	2	0	4	0	0	0	0	0	0	0	11	10	30
Other lymphomas	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	3	11
Multiple myeloma	7	3	3	1	2	2	2	2	3	2	4	0	0	0	0	1	0	10	7	46
Acute lymphocytic leukemia	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	3	8
Chronic lymphocytic leukemia	4	1	1	1	1	1	1	2	1	3	2	0	0	0	0	1	1	6	2	34
Acute granulocytic leukemia	2	4	1	0	0	0	0	4	0	4	0	0	0	0	0	0	0	3	1	23
Chronic granulocytic leukemia	1	2	1	0	0	0	1	1	2	1	0	0	0	0	0	0	0	3	1	12
Other primaries	15	8	0	4	1	1	0	8	1	10	1	0	0	0	0	1	2	18	19	106
Unknown primaries	8	10	1	1	4	1	1	7	1	10	4	0	0	0	0	1	0	11	8	83
All exposed	645	339	81	155	81	11	9	310	151	446	216	3	0	2	0	23	31	84	815	3,547
Exposed+nonexposed	2,664	2,358	1,046	2,574	1,650	1,153	1,563	729	1,644	2,866	2,636	3,157	154	1,281	101	1,568	1,576	1,068	1,946	3,547

[a,b] *See* footnotes, table 6B.

TABLE 8A.—*Relative odds in males, controlling for smoking, age, and race: Each known tobacco-related site versus nonrelated group*

Cancer sites	Exposure variables[a]															
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Lip-tongue	0.78	0.70	1.70	15 6	0.60	1.64	1.00	1.3	1.06	Z[illegible]	1.05	1.00	0[illegible]6	1.86	0.66	0.52
Salivary	—	2.08	1.89	19 2	2.01	0.95	1.77	1.0	0.72	—	0.27	0.50	—	—	—	2.91
Gum-mouth	2.79	2.30	2.67	40 5***	0.90	3.84**	1.95	3.7**	1.07	1.89	2.27	2.24	[illegible]88 *	6.65	1.05	0.66
Pharynx	1.90	17.70**	3.06	102 8***	1.24	5.90**	1.85	6.2**	0.60	1.25	0.33	0.53	c.45	—	0.72	0.65
Esophagus	1.27	4.55	0.99	16 4	1.27	1.16	0.88	1.3	0.54	1.41	0.30	1.91	0.90	—	0.61	1.39
Larynx	2.13	2.16	3.66 *	30 3**	2.22	2.23*	2.23	2.2	2.41*	1.73	1.66	1.39	1.75	2.6[illegible]	0.74	0.97
Lung	0.64	1.07	1.23	11 4	0.94	1.05	0.94	1.0	0.90	0.96	0.69	0.89	0.65	0.7[illegible]	0.68**	0.95
Bladder	0.77	0.54	0.9[illegible]	11 2	1.07	0.64	0.80	0.8	0.36	1.02	1.44	1.61	1.61	0.7[illegible]	0.83	1.03

[a] *See* footnote, table 4A. By controlling for cigarette smoking, the *independent* associations of cancer with other forms of tobacco and alcohol can be observed. Note, for example, that lung cancer is *not* associated with alcohol in this table, but is in table 4A. This implicates cigarette smoking as a confounding variable responsible for a spurious association of lung cancer with alcohol in table 4A.

TABLE 8B.—*Number of exposed males, controlling for smoking, age, and race: Each known tobacco-related site versus nonrelated group*

Cancer sites	Exposure variables[a]																
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Lip-tongue	3	4	9	19	5	[illegible]7	10	29	6	9	7	5	1	2	16	17	74
Salivary	0	1	2	4	3	3	4	4	1	0	1	1	0	0	1	7	16
Gum-mouth	4	5	5	22	3	[illegible]9	8	27	4	6	8	6	8	3	15	12	53
Pharynx	2	9	4	20	2	[illegible]7	4	24	3	4	2	2	2	0	9	12	47
Esophagus	2	[illegible]	2	9	5	11	4	15	5	4	1	4	2	0	6	8	[illegible]8
Larynx	7	[illegible]	11	30	13	31	18	39	17	11	16	10	11	5	19	27	[illegible]9
Lung	20	4[illegible]	44	130	66	[illegible]54	87	195	47	30	44	32	26	10	104	152	5[illegible]8
Bladder	9	1[illegible]	16	46	28	39	29	58	25	18	26	25	19	10	46	52	2[illegible]6
All related cancers	47	8[illegible]	9[illegible]	280	125	[illegible]01	164	391	1 0[illegible]	[illegible]2	105	85	69	3 0	216	287	1,101
Controls[b]	99	13[illegible]	14[illegible]	278	212	[illegible]73	299	482	1 5[illegible]	162	156	150	98	6 6	460	462	1,788
All exposed	146	21[illegible]	23[illegible]	558	337	[illegible]74	463	873	2 6[illegible]	244	261	235	167	9 6	676	749	2,889
Exposed + nonexposed	1,280	1,35[illegible]	1,37[illegible]	1,692	1,471	1[illegible]08	1,598	2,008	2,4[illegible]	2,411	2,331	2,305	1,435	1 6 4	2,700	2,438	2,889

[a, b] *See* footnotes, table 4B.

TABLE 9A.—*Relative odds in females, controlling for smoking, age, and race: Each known tobacco-related site versus nonrelated group*

Cancer site	Exposure variables[a]															
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Lip-tongue	.87	3.60	8.38	16.92	2.07	9.40	0.72	9.66**	—	—	—			—	—	0.28
Salivary	.45	—	—	—	1.88	3.77	1.07	2.76	—	—	—	—	—	—	0.66	1.41
Gum-mouth	—	0.67	1.55	0.21	1.55	1.61	1.17	1.52	—	—	—	—	4.92	—	1.41	1.17
Pharynx	0	4.74	7.61	7.83	1.10	24.61**	1.68	16.97**	—	—	—	—	—	—	2.11	1.26
Esophagus	6.59	3.69	—	14.41	0.91	6.56	0.88	8.14*	—	—	—	—	—	—	1.10	0.75
Larynx	1.63	1.62	—	4.35	0.52	1.00	0.31	0.81	—	—	—	—	—	—	1.36	1.06
Lung	0.70	1.05	0.83	1.09	1.17	0.60	1.05	0.70	—	—	—	—	—	—	0.56*	0.52**
Bladder	0.95	—	0.85	—	0.47	0.40	0.68	0.35	—	—	—	—		2.43	0.90	0.94

[a] *See* footnote, table 8A.

TABLE 9B.—*Number exposed females, controlling for smoking, age, and race: Each known tobacco-related site versus nonrelated group*

Cancer sites	Exposure variables[a]																
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr Level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Lip-tongue	1	1	1	4	2	4	1	6	0	0	0	0	0	0	0	2	20
Salivary	1	0	0	0	2	1	2	1	0	0	0	0	0	0	3	5	16
Gum-mouth	0	1	2	1	3	4	4	4	0	0	0	0	2	0	7	5	25
Pharynx	2	1	4	1	1	8	2	8	0	0	0	0	0	0	6	4	18
Esophagus	2	1	0	4	1	4	2	6	0	0	0	0	0	0	4	2	1
Larynx	1	1	0	2	1	1	1	1	0	0	0	0	0	0	4	3	1
Lung	6	6	7	9	23	11	29	15	0	0	0	0	1	0	4	2	4
Bladder	3	1	2	0	4	3	9	3	0	0	0	0	0	—	5	0	7
All related cancers	16	12	16	21	37	36	50	44	0	0	0	0	3		63	58	337
Controls[b]	150	76	108	86	304	181	439	209	3	0	2	0	23	0	734	746	3,188
All exposed	166	88	124	107	341	217	489	253	3	0	2	0	26	1	797	804	3,525
Exposed+nonexposed	2,739	2,661	2,697	2,680	2,914	2,790	3,064	2,828	21	418	006	006	785	30	327	944	3,525

[a, b] *See* footnotes, table 4B.

TABLE 10A.—*Relative odds in males, controlling for smoking, age, and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, oral, esophagus, and bladder)*

Cancer sites	Exposure variables[a]															
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
	1	2	1	2	1	2	1	2	1	2	1	2	1	2		
Stomach	1.06	1.8≥	1.30	1 Z2	1Z≥	0.92	1Z2	1.18	0≥5	0.95	1.07	1.3	1.00	1.73	0.48*	1.0
Small intestine	–	–	–	–	–	0.59	–	0.49	–	0.92	–	–	1.72	5.64	0.76	0.0
Colon	0.11	2.14 •	1.17	1.68*	1.46	1.61*	1.38	1.54*	1.06	1.31	0.99	0.5	1.11	1.70	1.12	0.8
Rectum	0.95	0.52	1.20	0.84	0.83	0.93	0.84	0.74	1.59	1.18	1.22	0.6	0.76	0.73	1.14	0.9
Liver	–	4.53	1.90	2.39	–	3.90	0.52	2.75	–	1.22	–	⊾.0	1.59	–	0.92	0.0
Gallbladder-bile ducts	0-Q2	0.77	–	1.71	0.47	0.66	1.02	1.07	1.24	1.48	1.13	0.6	–	4.18	1.09	1.9
Pancreas	0.63	0.70	0.6	1.10	0.6	1.5	0.72	1.34	0.74	0.92	0.5	0.47	0.31	0.25	1.52	0.5
Breast	–	5.53	1–.0	6.25	15.9	6.6	≥.09	3.58	2.81	–	0.8	–	–	–	1.75	3.7
Cervix, invasive	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Uterine corpus	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Ovary	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Vulva	–						–	–	–	–	–	–	–	–	–	–
Prostate	1.41	0.49*	0.89	0.86	0.83	0.82	0.78	0.87	1.05	0.84	1.33	1.18	1.47	1.13	0.95	0.87
Male genitalia	2.85	0.26	1.21	0.99	1.29	0.75	1.29	0.70	0.84	⊾.46	2.11	3.55	5.00	–	0.74	1.21
Kidney	0.95	0.66	0.96	0.71	0.98	0.70	1.07	0.76	1.03	0.89	0.75	0.65	1.08	–	0.73	1.01
Connective tissue	–	0.57	0.40	0.47	1.06	0.77	0.54	0.55	1.69	0.36	0.91	0.46	0.92	–	0.60	1.16
Melanoma	2.0≥	–	2.03	0.99	1.54	1.88	2.64	1.71	2.32	0.56	0.81	1.42	1.06	–	2.36*	1.59
Nervous system	1.5≥	0.9≥	0.84	0.65	1.54	0.17	1.14	0.50	0.53	–	0.53	1.22	–	0.80	1.05	1.11
Thyroid gland	1.85	4.69	2.69	1.27	1.52	0.95	1.5≥	1.45	0.52	–	0.99	–	0.65	–	1.71	1.63
Lymphosarcoma	0.37	0.44	0.78	0.56	0.45	0.44	0.4≥	0.53	0.72	0.33	0.53	1.61	0.44	–	0.68	1.02
Hodgkin's disease	0.23	0.44	0.40	0.65	0.85	0.65	0.4≥	0.82	0.63	3.45	0.51	0.75	1.96	–	0.53	1.27
Other lymphomas	–	–	0.94	0.22	0.40	0.34	0.5≥	017	–	1.19	2.35	2.36	0.70	3.58	0.77	1.78
Multiple myeloma	0.53	0.36	–	0.44	0.61	0.92	0.1≥	0.78	1≥9	2.26	1.38	1.46	0.26	1.84	1.48	0.57
Acute lymphocytic leukemia	4.76	–	–	0.78	–	0.59	–	0.97	–	10.72	2.55	2.62	9.16	–	2.26	3.81
Chronic lymphocytic leukemia	1 17	2.63	1 21	2.14	1 3	0.4	2.8	⊥.40	1.01	1 5	0 6≥	0. 6	0 4	1.0	0 4	0.40
Acute granulocytic leukemia	1.0	1 0	1.3≥	1.5	1.0	1 10	2 56	0.8≥	0.77	3.9Z	0.64	⊥.44	3.0≥	–	0.75	1.7≥
Chronic granulocytic leukemia	3.9	–	4.40	–	–	1 60	≥56	0.7	–	1 5	–	2.88	–	–	≥ 2	–
Other primaries	0.41	1.54	2.49	1.29	1.43	1.28	2.27*	1.41	0.89	0.74	1.50	1.56	2.12	0.89	1.04	1.39
Unknown primaries	0.79	1.37	0.87	1.04	1.42	1.37	0.88	1.11	0.57	0.70	0.88	0.22	0.78	0.45	1.70	0.77

[a] *See* footnote, table 4A.

TABLE 10B.—*Number of exposed males, controlling for smoking, age, and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, mouth, esophagus, and bladder)*[a]

Cancer sites	Exposure variables[a]																
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Stomach	5	13	9	22	16	24	22	37	9	16	12	16	2	2	15	29	120
Small intestine	0	0	0	0	0	2	0	2	0	1	0	0	1	1	2	1	10
Colon	18	39	22	56	38	75	52	96	28	38	27	31	15	15	81	70	294
Rectum	10	7	18	25	18	40	27	42	22	15	18	10	9	4	41	39	165
Liver	0	4	1	4	0	7	1	7	0	1	0	1	1	0	4	5	18
Gallbladder-bile ducts	1	1	0	4	1	3	3	6	2	3	2	1	0	1	7	9	25
Pancreas	3	5	5	17	6	24	11	≥2	6	3	5	4	2	1	27	21	3
Breast	0	1	1	2	3	3	3	3	2	0	1	0	0	0	3	3	3
Cervix, invasive	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uterine corpus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ovary	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Vulva	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prostate	29	25	30	65	44	100	62	127	43	51	52	52	27	28	88	64	465
Male genitalia	5	2	8	5	10	2	14	4	2	1	4	2	2	0	21	23	44
Kidney	3	3	5	9	7	10	11	14	6	3	5	3	3	0	12	17	53
Connective tissue	0	2	2	4	7	6	5	7	4	1	3	1	1	0	10	16	38
Melanoma	3	0	5	4	6	8	11	10	6	1	3	3	1	0	19	19	34
Nervous system	5	3	4	7	10	2	12	7	3	0	3	4	0	1	20	24	54
Thyroid gland	3	4	3	3	5	4	5	9	1	0	2	0	1	0	13	13	28
Lymphosarcoma	2	2	5	6	4	5	5	8	3	1	2	4	1	0	11	18	42
Hodgkin's disease	2	1	4	5	9	4	7	7	2	4	2	1	2	0	17	21	46
Other lymphomas	0	0	3	1	2	2	4	1	0	1	3	2	1	1	4	8	17
Multiple myeloma	1	1	0	3	3	9	1	10	6	6	4	4	1	2	11	7	37
Acute lymphocytic leukemia	1	0	0	1	0	1	0	2	0	2	1	1	1	0	4	5	7
Chronic lymphocytic leukemia	2	5	≥	9	≥	9	9	≥	≥	3	3	2	1	2	6	5	8
Acute granulocytic leukemia	1	1	2	3	2	≥	6	≥	0	3	1	1	1	0	≥	7	16
Chronic granulocyti leukemia	1	0	1	0	0	2	2	1	0	1	0	2	0	0	4	0	≥
Other primaries	1	7	8	12	10	16	17	21	5	5	8	10	8	3	18	22	74
Unknown primaries	3	7	4	11	8	17	9	18	4	4	5	1	3	1	20	16	59
All exposed	99	133	143	278	212	373	29	482	158	162	156	150	98	66	460	462	1,788
Exposed+nonexposed	886	920	930	1,065	999	1,160	1,[illegible]	1,270	1,495	1,499	1,444	1,438	≥97	≥65	1,662	1,524	1,788

[a,b] *See* footnotes, table 6B.

TABLE 11A.—*Relative odds in females, controlling for smoking, age, and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, mouth, esophagus, and bladder)*

Cancer sites	Exposure variables[a]															
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10
			1	2	1	2	1	2	1	2	1	2	0	2		
Stomach	1.73	2.20	1.96	0.30	1.32	0.78	1.51	0.82	–	–	–	–	–	1.09	0.51	0.93
Small intestine	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	3.31
Colon	0.85	1.52	1.03	1.25	1.04	1.23	1.19	1.44	–	–	–	–	0.33	1.69	0.68*	0.80
Rectum	0.69	0.70	0.36	2.15	1.10	1.50	0.75	1.96*	–	–	–	–	0.94	0.81	1.23	1.27
Liver	8.18	–	–	11.99	4.86	–	5.05	–	–	–	–	–	–	–	0.97	3.60
Gallbladder-bile ducts	0.77	1.11	1.50	1.09	0.41	1.05	1.04	0.86	–	–	–	–	–	–	0.77	0.59
Pancreas	0.50	0.69	1.26	–	0.65	0.68	0.58	0.59	–	–	–	–	–	–	0.82	0.73
Breast	1.67**	1.08	1.18	0.35	1.43**	1.44*	1.28*	1.55**	0.65	–	3.33	–	0.26	0.67	1.50***	1.29*
Cervix, invasive	0.62	1.53	1.22	0.20	0.54*	0.76	0.82	0.73	–	–	6.55	–	4.71*	3.60	0.29***	0.43***
Uterine corpus	0.78	0.49	0.23	0.31	0.95	0.77	0.69	0.63	12.40	–	–	–	3.07	0.72	1.21	1.23
Ovary	0.49	0.85	0.51	0.81	0.52	0.94	0.74	0.85	–	–	–	–	–	1.88	1.03	1.20
Vulva	0.63	–	1.61	0.84	1.67	0.43	1.20	0.39	–	–	–	–	–	3.40	0.26	0.26
Prostate	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Male genitalia	–		–	–	–	–	–	–	–	–	–	–	–	–	–	–
Kidney	1.19	–	1.17	0.75	0.55	0.92	0.80	0.76	–	–	–	–	2.98	–	0.81	0.96
Connective tissue	1.31	–	0.58	–	0.28	0.59	0.63	0.50	–	–	–	–	–	–	0.77	3.34
Melanoma	0.33	2.03	1.42	0.66	1.06	0.95	1.04	0.85	–	–	–	–	–	–	0.72	0.73
Nervous system	1.17	1.20	0.57	2.05	0.46	1.70	0.59	1.39	–	–	–	–	29.32	–	1.15	0.53
Thyroid gland	1.33	–	2.45	1.02	1.66	1.31	1.73	90	–	–	–	–	–	2.35	1.86*	1.74
Lymphosarcoma	1.73	0.42	1.17	0.59	1.17	0.92	0.94	75	–	–	–	–	–	–	0.79	0.83
Hodgkin's disease	1.56	–	0.71	–	0.53	–	0.87	–	–	–	–	–	–	–	1.74	0.67
Other lymphomas	–	–	2.10	–	–	–	0.50	–	–	–	–	–	–	–	1.45	2.21
Multiple myeloma	0.56	0.55	0.79	1.64	0.28	1.15	0.42	0.93	–	–	–	–	2.22	–	1.36	0.79
Acute lymphocytic leukemia	–	–	–	–	–	–	5.64	–	–	–	–	–	–	–	–	1.03
Chronic lymphocytic leukemia	0.97	1.27	2.05	2.73	0.55	0.75	0.71	1.20	–	–	–	–	–	3.07	1.27	0.27
Acute granulocytic leukemia	–	–	–	–	1.96	–	1.43	–	–	–	–	–	–	–	0.62	–
Chronic granulocytic leukemia	–	–	–	7.59	1.47	3.17	0.90	–	–	–	–	–	–	–	2.35	3.41
Other primaries	1.07	0.44	1.01	–	1.04	0.16	1.00	0.12	–	–	–	–	2.94	3.60	0.86	0.71
Unknown primaries	0.34	2.30	1.29	0.56	0.80	0.21	0.93	0.42	–	–	–	–	2.65	–	0.67	1.01

[a] *See* footnote, table 4A.

TABLE 11B.—*Number of exposed females, controlling for smoking, age, and race: Each site of the nonrelated group versus all other sites of that group (excluding lung, larynx, mouth, esophagus, and bladder)*[a]

Cancer sites	Exposure variables[a]																
	Wine level		Beer level		Hard liquor level		Total alcohol oz-yr level		Cigar level		Pipe level		Chewing or snuff tobacco level		ED13+	FI>10	Total
	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Stomach	4	4	3	3	8	3	12	4	0	0	0	0	0	2	9	10	82
Small intestine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7
Colon	13	13	9	9	8	23	17	29	0	0	0	0	1	6	57	54	359
Rectum	4	2	1	5	1	10	11	11	0	0	0	0	1	1	32	20	138
Liver	1	0	0	1	2	0	3	0	0	0	0	0	0	0	2	4	10
Gallbladder-bile ducts	1	1	1	1	1	2	4	2	0	0	0	0	0	0	5	3	35
*Pancreas	2	2	3	0	5	5	7	5	0	0	0	0	0	0	14	10	85
Breast	68	76	40	54	29	76	175	89	1	0	1	0	3	8	≥17	≥23	1,118
Cervix, invasive	10	7	17	0	19	11	38	13	0	0	1	0	6	4	25	43	249
Uterine corpus	13	5	3	4	34	18	36	18	1	0	0	0	5	2	95	97	≥45
Ovary	4	3	3	4	10	9	18	10	0	0	0	0	0	2	38	43	153
Vulva	1	0	2	1	4	1	5	1	1	0	0	0	0	1	2	2	30
Prostate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Male genitalia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kidney	3	0	2	1	3	3	6	3	0	0	0	0	1	0	10	11	48
Connective tissue	2	0	1	0	1	1	3	1	0	0	0	0	0	0	5	9	26
Melanoma	1	3	2	1	5	3	8	3	0	0	0	0	0	0	12	13	55
Nervous system	3	1	1	2	2	3	4	3	0	0	0	0	2	0	11	9	39
Thyroid gland	7	0	9	2	0	2	18	2	0	0	0	0	0	1	34	≥8	81
Lymphosarcoma	4	1	2	0	7	3	8	3	0	0	0	0	0	0	10	≥2	54
Hodgkin's disease	2	0	1	0	2	0	4	0	0	0	0	0	0	0	9	6	23
Other lymphomas	0	0	1	0	0	0	1	0	0	0	0	0	0	0	3	2	10
Multiple myeloma	1	1	1	2	1	3	2	3	0	0	0	0	≥	0	9	4	34
Acute lymphocytic leukemia	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	2
Chronic lymphocytic leukemia	1	1	1	1	2	1	≥	2	0	0	0	0	1	1	6	2	≥
Acute granulocytic leukemia	0	0	0	0	4	0	4	0	0	0	0	0	0	0	2	0	15
Chronic granulocytic leukemia	0	0	0	2	1	2	1	0	0	0	0	0	0	0	≥	4	11
Other primaries	4	1	2	0	8	1	10	1	0	0	0	0	1	2	16	16	87
Unknown primaries	1	4	≥	2	7	1	10	3	0	0	0	0	1	0	8	8	63
All exposed	16	76	19	6	34	181	89	29	3	0	2	0	3	≥0	34	46	≥188
Exposed+nonexposed	2,52	2,438	2,47	2,9	2,66	2,543	2,82	2,672	3,092	3,089	3,080	3,078	2,517	2,524	3,018	2,669	3,188

[a, b] *See* footnotes, table 6B.

showed only the association with education, but it was also present in the older age groups (odds ratios: **4.67, 1.32, 1.25,** 1.86).

In tabulations by cigarette smoking levels (nonsmokers, up to 20, 20–40, and over **40** pack-years),, the associations listed in table **3** for alcohol, education, income, and other tobacco use were generally found in nonsmokers and each level of smokers with a few prominent exceptions. The inverse association between lung cancer and use of pipes and cigars was evident in all three categories of cigarette smokers (odds ratios generally about 0.6). However, in men not smoking cigarettes, use of cigars and pipes was positively associated with lung cancer for those whose level of consumption of pipe or cigar tobacco was in the upper half. Odds ratios were **2.1** for both cigar and pipe levels **2,** based on 11 cases of lung cancer among **186** cigar smokers and **9** cases of lung cancer among **138** pipe smokers, none of whom used cigarettes. The positive association of alcohol drinking with stomach cancer was found only in the 111 stomach cancer patients who smoked, while the **91** patients who were nonsmokers did not show any association with alcohol.

In tabulations by drinking levels (nondrinkers and three levels of drinkers by combined ounce-year intake), almost all associations with tobacco and SES were present in each level with sufficient numbers of exposed patients to test for an association. As a notable exception, only drinkers consistently showed the positive association between smoking and stomach cancer (odds ratios generally from **2** to **5).** Among nondrinkers, none of the groups of male cigarette smokers showed an association with stomach cancer. In females, a positive odds ratio (1.88) was observed only in the heaviest smokers (upper third).

Review of the results by race categories indicated that essentially all of the associations found in the TNCS interview data were based on the white patients. Blacks accounted for only 0.8% of the subjects, and other races for only **1.7%.** Consequently, their contribution to the overall relative odds was too small to have much effect even if their trends differed from those in whites. For most cancer sites, the number of cases in blacks was too small to achieve a significant chi-square even for odds ratios of **4** and greater. In general, the associations seen for whites were also suggested for blacks. The most prominent differences in odds ratios for blacks and whites were found for the following suggestive associations: stomach–cigarettes (1.7, BM; 1.1, WM), rectum–cigarettes **(2.6,** BM; 0.8, WM), uterine cervix–cigarettes **(0.9,** BF; **1.3, WF),** and breast–college education (1.0, BF; **1.5, WF).** Although at least **10** exposed patients of the specific cancer site were involved in each association mentioned, the confidence intervals for the odds ratio in blacks would likely include the value listed for the whites in each case.

Review of the tabulations by martial status (ever married, never married) and geographic location (eight TNCS interview areas) verified within each of these subcategories the Presence of the major associations in table 3. Associations that were weak or suggestive frequently involved sites or exposures with insufficient numbers of exposed cases to allow reliable evaluation of odds ratios at these subcategory levels.

Because of the strong inverse association between education and stomach cancer, foreign birth was considered a possible confounding variable. Foreign birth was strongly associated with stomach cancer (odds ratios: males, **2.70;** females, **4.17** at $P<0.001$) and inversely associated with education. However, in tabulations stratified by native or foreign birth, the significant inverse association between stomach cancer'end education was present in both groups. In males, foreign birth was also associated positively with cancer of the larynx (1.69, $P<0.05$) and inversely with cancer of the prostate (0.74, $P<0.05$), whereas in females it associated inversely with breast cancer **(0.78,** $P<0.05$).

Because of the suggested association of several cancer sites with alcohol, the results of tabulations for cirrhosis of the liver are worth brief mention. These data are based on 127 affirmative responses to an interview question of whether they had even had cirrhosis of the liver (no verification of diagnoses attempted). Among nondrinkers in the TNCS interview, 1% claimed to have had that diagnosis; however, among the three increasing levels of alcohol drinkers, the proportion with cirrhosis increased to 2, 4, and 10%. The last figure was based on 36 patients claiming to have had cirrhosis among 353 persons listed with over 500 ounce-years of total alcohol consumption. In tests for associations between cirrhosis and individual cancer sites stratifying on cigarette use, odds ratios were as follows for both sexes combined: pharynx: **4.77, P < 0.001;** esophagus: 3.57; stomach: **1.01;** colon: **1.41;** rectum: 0.82; liver: **3.67,** $P < 0.001$; pancreas: **2.32,** $P < 0.05$; lung: 0.57, $P < 0.05$; breast: **0.46;** melanoma: 1.98; and thyroid gland: 2.33. Each of these was based on at least three patients with cancer at that site who claimed cirrhosis. Age, race, and smoking were used as stratification variables.

Simple Correlation and Multiple Regression Analyses

Simple correlation analyses were performed to define associations among covariates. In males, years of education correlated inversely with cigarette smoking ($r=-0.035$) and total alcohol consumption ($r=-0.045$); in females strong positive correlations were found ($r=0.108$ and 0.079). In females family income showed a significant positive association with drinking and smoking, but in males family income was not significantly related to either. Strong positive correlations were observed between the use of cigarettes and alcohol (males, $r=0.243$; females, $r=0.259$) and between education and family income **(0.440, 0.393).** The use of cigars, pipes, and unsmoked tobacco (in males) correlated inversely with cigarette-years (−0.053 for all three), education (−0.111, −0.036, −0.165), and income (−0.124, −0.095, −0.176). The use of pipes correlated strongly with cigars (0.396) as did also the use of either pipes or cigars with unsmoked tobacco (0.110). Alcohol use correlated positively with cigars (0.063) and unsmoked tobacco **(0.069)** but not with pipe use **(−0.008).** Among the TNCS patients, black race correlated inversely with cigarette con-

sumption (−0.084), but alcohol consumption was not strongly related (0.004). Foreign birth correlated inversely with education and family income in both males (−0.121, −0.110) and females (−0.132, −0.084).

Multiple regression analyses were used to determine which measures of tobacco and alcohol exposure (dose, duration, or product of dosexduration) showed the strongest association with related cancer sites. Comparability of units was achieved with the use of β, the regression coefficient based on standard deviation units. Separate analyses were done for males and females including age and race as covariates. For lung cancer in males, cigarette-years correlated best (β=0.321); however, good correlation was also found for average number of cigarettes per day (β=0.306) and years of cigarette use (β=0.295). In females the trends were identical. For cancer of the larynx, the same pattern was found for cigarettes and hard liquor (total consumption was strongest: daily consumption and years correlated almost as well). However, for beer and wine total years consumed correlated better with cancer of the larynx than did daily consumption or even total consumption. A similar analysis for cigars, pipes, and unsmoked tobacco with cancer of the gum and mouth revealed the best correlation with years of use for cigars and unsmoked tobacco, but daily consumption correlated much better for pipes.

Inasmuch as several sites were associated significantly with both cigarettes (cgt-yr) and alcohol (oz-yr), the relative strength of each exposure after controlling for the other was evaluated by multiple regression. The standardized regression slope (based on standard deviation units) in males (versus the cancer site) for alcohol and cigarettes after controlling for age, race, education, and cigarettes or alcohol is given: pharynx (oz-yr=0.104, cgt-yr=0.084), gum-mouth (oz-yr=0.081, cgt-yr=0.018), lip-tongue (oz-yr=0.057, cgt-yr=0.043), esophagus (oz-yr=0.037, cgt-yr=0.044), and larynx (oz-yr=0.038, cgt-yr=0.167). In females, the analogous results were: oral cavity (oz-yr=0.049, cgt-yr=0.046), esophagus (oz-yr=0.026, cgt-yr=0.033) and larynx (oz-yr=0.002, cgt-yr=0.082). Hence in males, oral and esophageal cancers were related more to drinking than smoking, whereas the reverse was true for laryngeal cancer. In females, for these sites the strength of association of alcohol was somewhat less than in males. (Other sites strongly associated with cigarettes and alcohol were excluded before performing the regression in each case.) The values of relative odds for the analogous tests in which the Mantel-Haenszel tabulations were used showed similar relationships between alcohol, smoking, and these cancer sites.

For cancers of the breast and uterus (corpus and cervix), multiple regression analyses were done to allow simultaneous inclusion of several covariates (age, race, education, income, smoking, drinking, number of children, and foreign birth). With breast cancer, positive correlations were observed for education (β=0.048), income (β=0.041), and alcohol consumption (β=0.042), but number of children correlated inversely (β=−0.022). With cancer of the uterine cervix, strong positive correlations were found. for black race (β=0.149) and number of children (β=0.102), inverse correlation with education (β=−0.100), income (β=−0.84), and foreign birth (β=−0.031); a mild positive association was found with smoking (β=0.017). For cancer of the uterine corpus, family income correlated positively (β=0.061), but inverse correlations were found for number of children (β=−0.059), alcohol consumption (β=−0.046), black race (β=−0.035), and foreign birth (β=−0.018). The multiple regression analyses for these three sites were done after excluding the major smoking-related sites but not the alcohol-related ones. In each of these cases, the standardized regression slope listed (β) represents the independent contribution of specific covariates after adjusting for all other covariates. Thus education and income both correlated independently with breast cancer after adjusting for each other.

DISCUSSION

Sources of Error

The sources of error in the basic interview data from the TNCS have been considered, and many have been discussed in *(4)*. The large number of unobtained interviews (43%) produced no major bias for most variables known for them (age, race, sex, marital status, country of birth, number of primary cancers, and site distribution). Geographic location was biased by nonreponse, but controlling for this variable (by stratification) in the analyses did not alter the results reported.

The intercancer comparison approach required for the analysis of these data is one of the most likely sources for possible misinterpretations. The relative odds reported in the tables only reflect a comparison of cases from one specific cancer site versus other cancer cases. This approach can produce factitious inverse (or even positive) associations as explained in *(4)*. Without an understanding of this potential problem, it is not possible to assess the validity and importance of the various findings of this study. To deal with this exposure bias, exclusions were employed in an effort to limit the control group to cases hoped to be unbiased with respect to the exposure being tested.

Some critics may well debate the reliability of the results that depended on exclusions of cancer sites strongly associated with smoking cigarettes or drinking alcohol. However, the use of these exclusions was justified not only by findings in this study but more importantly by other previous studies that reported these associations. Even when these exclusions are used, some of the remaining cancer sites included as controls were associated with the exposure variables and could have biased the control group sufficiently to prevent the detection of still other low-level associations.

The most accurate information was for diagnosis and classification of cancer because this was obtained from medical records (including a report of the histology for 95% of those interviewed). The lifetime history for exposure variables was only as accurate as the memories and communicating abilities of the patients, spouses,

and others who were interviewed. Perhaps because of the fine degree of qualitative and quantitative information requested, many of the respondents did not know the specific information needed for some questions about exposure variables [see table 4 in (4)]. The possible effects of excluding these unknown responses from tabulations involving specific variables must also be considered.

The strong suspicion that tobacco, alcohol, and SES interrelate sufficiently to act as confounding variables prompted the approach used to analyze and report them "as a single package." The statistical tools employed, the information available on each patient, and the relatively large sample size allowed for the identification and control of many such confounding effects. This would be considered by the investigators as one of the major strengths of this study.

The large number of multiple comparisons performed in the analyses of these data poses the problem of possible overinterpretation of P-values and statistical significance. With the many comparisons in this study, some totally spurious associations would be expected to achieve even a "$P<0.001$" purely by chance alone. These multiple comparisons were not independent, because the same set of patients were used in the analyses of several exposure variables. When comparisons were made for two or three groups by level of exposure, the exposed patients were completely different in each comparison, but the nonexposed controls were the same for each comparison of that exposure. As carefully pointed out in (4), P-value calculations should be interpreted only as an index of relative strength for comparing the associations reported in this study and *should not be construed as actual probabilities*.

When this problem of multiple comparisons is viewed in proper perspective, it becomes evident that for each association suggested, two questions should be asked: What evidence is there that this association is "real" rather than spurious either by chance, statistical artifact, or confounding? Even if it were real, what evidence would support or reject a hypothesis of causal relationship? In answer to both questions, the criteria for causality cited in the first report on smoking to the Surgeon General *(12)* and expanded by Hill *(13)* can be useful in considering the likelihood that a particular association is real or possibly even causal: strength, consistency, specificity, temporality, biologic gradient (dose–response), plausibility, coherence with knowledge of the disease, outcome of experimental intervention, and analogy with similar situations in other known data. The data in this TNCS interview study provide some indicators of strength (relative odds and chi-square), consistency (variation or lack of it within age, race, sex, geographic, socioeconomic, and exposure groups), and biologic gradients (regression slopes, Mantel extension chi-square, and especially dose–response changes in relative odds). Perhaps one of the most important criteria to stress is consistency between studies of different types. Consequently, a major portion of the remaining discussion is devoted to a comparison of the findings of this study with those of other incidence, mortality, case-control, and geographic correlation studies.

Cigarettes

The findings of numerous studies on smoking and cancer have been comprehensively reviewed in the well-known Reports to the Surgeon General (*12, 14–18*). Several large mortality studies in the United States, Great Britain, and Canada have agreed on the major findings in these reviews (*9, 19–22*). More recent studies in Sweden (*23*) and Japan (*24*) have generally concurred. Tabular summaries in the 1971 Report to the Surgeon General (*15*) give solid support to the association of cigarette smoking with cancers of the lung, larynx, oral cavity, esophagus, bladder, kidney, and pancreas. The objective "rediscovery" of *all* these associations in the TNCS interview smdy (at significant *P*-values) justifies some confidence in the ability of this study to detect "true associations" despite the inherent complications of this intercancer comparison approach. The two remaining sites found in TNCS data to be significantly related to cigarettes also have some support in other studies. An association with stomach cancer has been mentioned by investigators of the large prospective Japanese study (*24*), while cancer of the cervix was found related in the recent large population-based Swedish study (*23*) as well as in a prior retrospective study (25). The TNCS data indicate that this association was present in both invasive and in situ cervical cancer. The suggestive associations of cigarette smoking with cancer of the vulva, granulocytic leukemias, and lymphomas pose hypotheses for future studies to test. Several tumor sites inversely associated with cigarettes in the analysis (table 3) probably reflect the kind of statistical artifact that can result from the intercancer approach inasmuch as several smoking-associated sites including stomach; pancreas, kidney, and cervix remained in the controls.

Other Tobacco

The **TNCS** findings of an association of pipe and cigar use with cancers of the oral cavity, larynx, and esophagus agree with several major studies (*15*). The concomitant association of unsmoked tobacco use with these same three sites in TNCS tabulations could represent either separate associations or possibly a reflection of the strong correlation of cigar and pipe smoking with the use of chewing and snuff tobacco. The number of users of unsmoked tobacco was too small to allow an analysis stratifying on pipe and cigar use. At least for cancers of the gum and mouth, chewing and snuff tobacco seem to play a primary role because they show the strongest association (more than for pipes, cigars, or cigarettes). This seems reasonable since both forms of unsmoked tobacco are often held in prolonged contact with gum and mouth during use; this allows ample opportunity for exposure to carcinogens. After controlling for cigarette use, the strong and significant association of invasive cervical cancer (and suggestive for cancer of the corpus) with unsmoked tobacco (based on 10 of 57 "users" found with cancer of the cervix) was unex-

pected. However, a plausible mechanism based on absorption of carcinogens could be postulated equally well for females who "chew" and "dip snuff' as for those who smoke cigarettes and get cervical cancer. Of course, both forms of tobacco could be factitiously related to cervical cancer through common association with some other risk factor such as early age of coitus (26) or venerally transmitted viral infections (26–27). Such possibilities will have to be evaluated by studies with data on all of the factors for the same subjects. The preservation of both significance and elevated relative odds in a contingency tabulation stratifying on 18 I-year education levels speaks against a spurious association via socioeconomic status as confounder. The remaining suggestive associations of pipes, cigars and/or unsmoked *to*bacco with cancer of the colon, rectum, stomach, and testis and lymphoma and myeloma are useful as hypotheses to test. No major change in any of these associations occurred when alcohol was used as a stratification variable. The consistent ***inverse*** association between lung cancer and all three forms of "other tobacco use" was observed only in cigarette smokers as mentioned. It is plausible that these cigarette smokers who also used other forms of tobacco could have been diverted by their use of these other forms into a pattern of lower exposure to cigarette smoke, either by decreased inhalation or by a tendency at times to smoke cigarettes somewhat less than their average reported in the interview. The TNCS finding of *positive* association with lung cancer in heavy ***pure*** pipe and cigar smokers compared to nonsmokers is supported by findings in a study by Wynder and Mabuchi *(28)*.

Alcohol

The association of alcohol with cancer sites has not been studied as extensively as the association of smoking, but the studies that have been done are reviewed and compared in the second report to Congress on alcohol and health *(29)*. Strong associations with tumors of the oral cavity, larynx, and esophagus from the TNCS agree with the findings of Rothman and Keller (*30*) and Wynder and associates ***(31–32).*** In both these studies and the TNCS data there is evidence for a cooperative role between tobacco and alcohol. However, each "exposure" was associated separately with all three sites (smoking in nondrinkers and drinking in nonsmokers). Future studies of these data should include in-depth analyses of synergism. Three additional sites associated with alcohol in the TNCS find some support in other studies of individuals: pancreas (*33*), liver (*34*), and stomach ***(35).*** In a geographic study correlating cancer mortality with per capita consumption of alcoholic beverages, cancers of the colon, rectum, breast, and thyroid-gland were associated with beer consumption ***(36).*** For these latter sites, the TNCS data indicate an association with wine, beer, hard liquor, and all three combined rather than with just beer. This could indicate that alcohol itself is the major factor rather than other substances in these beverages. Malignant melanoma and chronic lymphocytic leukemia also showed suggestive associations with alcohol in the TNCS data. No other reported studies could be found which specifically tested these two. Cancers of the kidney and bladder were associated with alcohol in Breslow and Enstrom's geographic correlation study ***(36)*** but not in the TNCS data.

An excellent example of the value of using control variables was illustrated by the factitious association of lung cancer with alcohol (tables **4, 5)**. As observed in these tables, when only age and race were controlled, a significant dose–response positive association was observed. This, of course, was simply an illustration of the confounding role played by smoking that was strongly related to both lung cancer and alcohol use. In tabulations controlling for smoking (tables 8, 9), this spurious association disappeared entirely.

It is interesting to consider the possible mechanisms for the positive alcohol associations. With few exceptions, these alcohol-associated sites are seen to share a common potential for exposure to ingested alcohol in relatively high concentrations as it passes through the aerodigestive system and portal circulation. Adding to this interest is the observation in TNCS data that the decreasing relative odds for association with alcohol a p proximately parallel the expected successive dilutions of alcohol in the alimentary tract and portal circulation: highest in the oral cavity; lower in larynx, esophagus, and liver; and lowest in stomach, pancreas, colon, and rectum.

The findings with regard to cirrhosis of the liver are also pertinent to this consideration. It has been well documented *(29)* that hepatomas occur predominantly in livers already diseased with cirrhosis (both alcohol and nonalcoholic cirrhosis). In these studies, "cancer seems to occur in livers with marked regenerative activity, regardless of the cause" (29). A similar mechanism of enhanced repair processes for injured bronchial epithelium has been hypothesized from histologic studies as a means by which smoking induces bronchial carcinoma *(19)*. The ability of alcohol to irritate or injure tissues is no secret. A repetition of this process of tissue injury and repair (even at a subclinical level) may be a part of alcohol's role in association with these cancer sites. Exposure to tobacco carcinogens is probably important also. The supportive association of cirrhosis (considered an index of heavy alcohol consumption) with most alcohol-related sites in the TNCS could be viewed as further evidence that direct toxic effects of alcohol contribute to carcinogenesis in those sites. However, it could also be viewed as a suggestion that alcohol only causes the cirrhosis and that the deranged metabolic and immunologic states associated with cirrhosis play the primary role in the development of cancer. In this regard, it is interesting that the **43** persons classified as nondrinkers with cirrhosis also were distributed more frequently than expected among several "alcohol-associated" sites (liver, esophagus, colon, rectum, pancreas, and thyroid gland). Of course, this could also be explained by a possible false declaration of nondrinking status by persons with alcoholic cirrhosis.

The associations of alcohol with cancers of the breast and thyroid gland, malignant melanoma, and chronic lymphocytic leukemia do not readily fit the mechanisms discussed. However, especially for breast cancer, the association is of such strength and consistency as to demand further consideration. One reported hypothesis arising from these data suggests a pituitary-mediated mechanism for the associations of alcohol with breast and thyroid cancer and malignant melanoma **(37).** Associations with even more sites could be explained by a carcinogenic effect of propanol, methyl butanol, and other trace alcohols detected in many alcoholic beverages *(38).* These alcohols were also found to induce leukemia; cancer of the stomach, esophagus, and liver; and fibroadenoma of the breast in rats when given either orally or sc (up to 1 ml/kg twice a week) *(38)*.

SES

Table 2 indicated a higher educational level among the TNCS cancer patients combined than among their base populations. Ascertainment bias could be playing a role because persons who had attended college would probably be more likely to have their cancers reported and to allow an interview. However, a similar slight excess in overall cancer (mortality) was observed in counties with higher median educational levels in the study by Hoover et al. *(39).* Of course, the apparent mild association of college education with cancer in general only reflects a net balance of all sites, some of which are associated with low SES. The positive association of high SES with breast cancer and inversely with cancers of the lung, lip, stomach, and cervix agreed generally with findings from Buffalo, New Haven, Denmark, and Great Britain *(40)* as well as from the previous national cancer survey *(41)*. The TNCS data sustain these findings in analyses controlling for cigarettes and alcohol. The SES associations for breast and cervical cancers remained strong in multiple regression analyses that also included parity, foreign birth, and exposure to tobacco or alcohol, most of which were also associated with these tumors. The strong inverse association with income seen for ***invasive*** cervical cancer was *not* found for *in situ* cases. This could well be due to ascertainment bias in the more wealthy women who would be more apt to visit a physician for "pap" smears.

Although income and education correlate well, they each reflect some characteristics of an individual not shared by the other variable. This was indicated by the TNCS analyses (both Mantel-Haenszel and multiple regression), which indicated that education and income can both exhibit significant independent associations with a cancer site after controlling for the other. This was true for both cervix and breast. It would thus appear wise for future epidemiologic studies to classify individuals by both education and income. Other insight into SES and cancer has been provided by TNCS data that correct for smoking and still show a significant inverse association between both measures of SES and lung cancer. Such associations will possibly find plausible explanations in the further analysis of the TNCS interview study with respect to industries and occupations.

This report highlights the most pertinent results of a screening analysis of TNCS interview data relating to tobacco, alcohol, and SES. However, it should not be considered an exhaustive representation of the data. As already stated, many tabulations have been done that could not be included here, and even the tabulations in this report contain details too numerous to discuss completely. Our main intent was to present major findings with respect to smoking, drinking, and SES, and to give insight into the kinds of information that can be obtained from further scrutiny of the data. Topics such as possible relationships of industry and occupation to socioeconomic associations and characterization of histologic types for site-specific associations were beyond the scope of this report but are planned for future ones.

The numerous findings presented here should provide stimulus for further detailed analysis and interpretation of the TNCS data as well as some insight into the kinds of hypotheses that should be tested in future epidemiologic studies. Persons with further interest in the TNCS data should direct inquiries to the Demography Section, Biometry Branch, NCI, Bethesda, Maryland 20014.

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