RETROSPECTIVE COHORT STUDY OF REFINERY WORKERS

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Several epidemiological studies have examined the association of cancer risk and employment in oil refineries. Results from these studies, especially the positive findings, have been inconsistent with each other and different conclusions have been made based on relatively small samples of workers, on limited lengths of observation and on different methodologies. This study is undertaken to examine the mortality experience of workers from a single refinery for a period of over 40 years with a total of 402,554 person-years of observation. The sample size of this study should be capable of providing sufficient statistical power to detect a moderate increase (or decrease) of mortality risk associated with work exposure.

Methodology

The study cohort includes employees at this Texas refinery who were ever employed between January 1, 1937 and January 1, 1978. The inception and operation of the social security system, which began in 1937, was taken into consideration for determining the starting date of this study. Demographic and work history information of each cohort member were reconstructed from review of personnel records and verified by other company records, such as annuitant records, insurance benefit records, seniority lists, medical records and mortality records. The

pay status of each study subject was determined from the work history and then classified according to the duration of employment (expressed as percentage of total employment) that was spent on an hourly or salaried basis. Two subgroups, 100% hourly (blue collar workers) and 75% or more salaried (white collar workers) are subjects for further analysis in this study. The vital status of the cohort as of January 1, 1978 was determined from company records, the Social Security Administration, motor vehicle bureaus and local follow-up sources.

Death certificates were collected and the underlying cause of death was classified by a trained nosologist according to the rules of the ICD revision in effect at the time of death and then recoded to the ICDA 8th revision.

Person years were calculated for each cohort member during the observation period. For those lost to follow-up, person-years were calculated up to the last known date, usually the date of separation from employment. Utilizing the computer program developed by Monson, standardized mortality ratios (SMRs) were calculated by comparing age-sex-race-year-cause specific mortality rates with comparable U.S. general population rates. Mortality rates that were not available from Monson's program were generated from NCHS and NIOSH data. Confidence intervals for each SMR were calculated and significance testing was based on the assumption of a Poisson distribution for the observed deaths, using a two-sided test of significance.

Results

The characteristics of the cohort are described in Table 1. A total of 16,710 workers were included in the study, with 74% white male, 15% nonwhite male and 11% female. A grand total of 402,554 person-years were observed and 77% of these were contributed by white males. The average age a study subject entered into the cohort (not necessarily the age at hire) was 28.9 years, and subjects were followed for an average of 24 years. The vital status was ascertained for 93.8%, of the male cohort and 6.2% (923) of them were lost to follow-up. Death certificates were unavailable for 7.2% of the male deaths (304). These deaths were included in the analysis of overall statistics and in the SMR for all causes but not in the cause-specific analysis.

The follow-up of the females in the cohort was less successful, with vital status identified for 68%. More women were lost to follow-up, probably because they usually changed their last name after marriage. Furthermore, 54% of the females left work between 1942 and 1947 and nearly half (45%) of all females worked less than one year. In view of these characteristics of the females in the cohort and the relatively small sample size (females only contributed 91 deaths and 8% of the total person-years), the following results and discussion will be limited only to the males in the cohort.

Tables 2-6 show additional characteristics of the cohort. Approximately one-third (33%) of the cohort was hired before 1940 and another

one-third (37%) hired between 1940-1949. On the other hand, 80% of those with vital status unknown were hired before 1950. Over one-half (55%) were hired before age 25. One-quarter each of the cohort had either worked less than 1 year or more than 30 years. According to pay status, 84% of the cohort were hourly workers and 11.5% were salaried workers with 75% or more of their time being salaried. It is interesting to note that the percent lost to follow-up is highest among those born between 1910-1929 and whose employment status might have been interrupted and affected by World War II (i.e. the highest concentration of short timers and turnovers).

Tables 7-9 show the SMRs and their confidence intervals for hourly, 75%+ salaried, and total males from the cohort. The SMRs for white males and nonwhite males are calculated separately and then combined as total male in each table. Among the hourly, 706 cancer deaths were observed and 743.30 expected with a resultant SMR of 0.95. Of some 50 causes of death examined, only bone cancer showed statistically significant increase, with 12 cases observed and 4.51 expected (SMR = 2.66). A significant deficit was observed in all causes, cancer of digestive organs and peritoneum, cancer of esophagus, cancer of rectum, cancer of bladder, lymphosarcoma and reticulosarcoma, nonmalignant respiratory diseases, cirrhosis of liver, arteriosclerotic heart diseases, cerebrovascular diseases, accidents and suicide.

Several cancer sites showed a nonsignificant increase of SMR.

Notable among them were Hodgkin's disease (SMR = 1.42), kidney cancer (SMR = 1.21), leukemia (SMR = 1.15) and skin cancer (SMR = 1.11). (Note that observed cancer cases less than 5 or SMR less than 1.10 and $p > 0.20$ were not mentioned in the increased SMR.) No increase was seen in lung cancer (SMR = 0.99) and brain cancer (SMR = 0.97).

Among the salaried, 62 cases of cancer were observed and 76.88 expected with an SMR of 0.81. Of those causes of death examined, none showed significant increase while several causes showed significant decrease. These included all causes, circulatory system diseases, nonmalignant respiratory diseases, tuberculosis and other infectious diseases, cirrhosis of liver, accidents and suicide.

Several cancer sites, including pancreas and lymphatic and hematopoietic tissue, showed nonsignificant excesses (SMR = 2.14 and 1.48 respectively).

Among the total male population, 4,239 deaths were observed with a significantly decreased SMR of 0.84. The SMR for all cancer was 0.94 with 818 cases observed. Examination of the cause-specific SMRs showed that the pattern was very similar to that of the hourly male. The only significant increase was bone cancer. Those showing the significant decreases were the same as those seen in the hourly male. This is not unexpected because the latter contributed 84% of the study subjects to the total.

Discussion

There have been several published papers studying the mortality experiences of refinery workers. Blot et al. surveyed the cancer mortality from 1950 to 1969 in U.S. counties with petroleum industries. Significant increases were found for cancers of the lung, stomach, rectum, testis, nasal cavity and sinuses and skin, while brain cancer showed a significant decrease. From the same data, Hoover and Fraumeni described an increased pattern of bladder, lung and liver cancer among U.S. counties with a concentration of chemical industries.

Tabershaw/Cooper found in a study of workers at 17 oil refineries in the United States that these workers experienced significantly less overall and cancer mortality than a comparable U.S. male population. Although mortality from lymphomas was greater than expected (24 observed vs 19.26 expected), the SMR (1.25) was not statistically signigicant. Hanis et al. found that employees exposed on a daily basis to crude petroleum or its by-products had a three fold risk of esophageal and stomach cancer (28 cases observed) and about a two fold risk of lung cancer (69 cases observed). A study by Theriault and Goulet of employees at a Canadian oil refinery showed a significant increase in brain tumor mortality for those workers employed less than 20 years (3 cases observed), yet lung cancer mortality was less than expected (3 cases observed). Thomas et al. found increased PMR of cancer of the brain, stomach, pancreas, liver, lung, leukemia and multiple myeloma, in the Texas Gulf

coast regions, and yet a study by Rushton and Alderson of eight oil refineries in the United Kingdom reported a deficit of lymphoma, lung, brain, and genital cancer mortality. Wen et al. reported no increased brain cancer risk among workers in a Texas refinery. In regard to the possibilities of increased cancer risk, no definite conclusion can be made because these mortality results have been inconsistent and sometimes contradictory among refinery workers. Methodological differences such as SMR vs PMR, differing sample sizes and lengths of observation as well as lack of control of confounding variables, may account for most of the discrepancies. The data presented in this study represent the largest and longest study of refinery workers ever reported in North America.

Of some 50 causes of death examined, bone cancer is the only site showing a statistically significant increase. None of the literature has reported such an increase. These bone cancer cases are currently under review to verify their diagnostic validity. There are, however, some indications that not all of these bone cancers are bonafide primary bone cancer. Two out of the three cases in this study were reviewed previously and this review reflected that the cause of these deaths was misclassified due to either inaccurate entry on the death certificate or coding artifacts of the 8th revision of ICDA classification. This has occurred in previous cancer surveys as well as in the present study. Percy et al. reviewed a large set of cancer deaths collected from the

Third National Cancer Survey. Of 252 bone cancers stated on death certificates as the underlying cause of death, more than half (127) were not confirmed in the hospital records. Bone was actually a secondary site of these cases and the authors concluded that bone cancer was prone to be misclassified and overreported. Nevertheless, further efforts including clinico-pathological verification of these cases are in progress.

Of great interest is the lack of a significant increase of lung cancer which is the number one cause of cancer and which has been implicated in many study reports as increased among petrochemical workers. The negative finding in this study is also augmented by a statistically significant decrease in nonmalignant respiratory diseases (200 cases observed and 295.29 expected with SMR = 0.68).

It is also of interest to note from this study significant decreases of SMR in several cancer sites. Significant decreases are seen in cancer of esophagus, rectum, bladder, lymphosarcoma and reticulosarcoma, and digestive organs and peritoneum in contrast to some previous reports. These findings could be interpreted to mean that being a refinery worker is associated with decreased risk of dying from these cancers. Further study is needed, however, to elucidate the validity of such an association.

This study also failed to show a significantly increased cancer risk of brain, lung, leukemia, stomach and pancreas as reported in other studies. Varying amounts of nonsignificant cancer excesses, have been observed in this study in Hodgkin's disease, leukemia, skin, pancreas,

and kidney. However, given the TYpe I error (α) = 0.05 and Type II error (β) = 0.2 the sample size of this study is sufficiently large to detect at least a two fold risk of each of these cancers, if such a risk did indeed exist. It is worth noting that salaried workers accounted for more of such excesses than hourly workers in the cases of pancreas, skin cancer and Hodgkin's disease. This may not be consistent with the proposition that these excesses are work exposure related. Further refinement of the data and their implications are underway, and are being prepared for publication.

In summary, a 41 year follow-up study of employees from a large Texas refinery revealed no significant increase of cancer risk, except for bone cancer. Significant decreases were found in bladder, rectal and esophageal cancer. Implications of these findings have been discussed.

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TABLE 1
COHORT STATISTICS
1937-1978

	Male				
	White *	Nonwhite	Total	Female	TOTAL
Number studied	12,397	2,547	14,944	1,766	16,710
(%)	(74.2%)	(15.2%)	(89.4%)	(10.6%)	
Person-years observed	310,037	59,260	369,297	33,257	402,554
(%)	(77.0%)	(14.7%)	(91.7%)	(8.3%)	
Average years of follow-up	25.0	23.3	24.7	18.8	24.0
Average age of entry	29.2	30.4	29.4	24.2	28.9
Number alive	8,288	1,494	9,782	1,112	9,894
Number dead	3,417	822	4,239	91	4,330
Cause known	3,176	759	3,935	81	4,016
Cause unknown	241	63	304	10	314
(%)	(7.0%)	(7.7%)	(7.2%)	(11.0%)	(7.2%)
Number lost to follow-up	692	231	923	563	1,486
(%)	(5.6%)	(9.1%)	(6.2%)	(31.9%)	(8.9%)

* Male employees whose race is unknown (1.8%) are included in the "white" category

TABLE 2

VITAL STATUS OF THE MALE COHORT BY YEARS OF SERVICE

1937-1978

Years of service	Alive		Dead		Unknown		TOTAL	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)
Less than 1	2432	(24.9)	708	(16.7)	447	(48.4)	3587	(24.0)
1-4	1922	(19.6)	433	(10.2)	258	(28.0)	2613	(17.5)
5-9	1007	(10.3)	217	(5.1)	98	(10.6)	1322	(8.8)
10-14	400	(4.1)	243	(5.7)	52	(5.6)	695	(4.6)
15-19	278	(2.8)	302	(7.1)	29	(3.1)	609	(4.1)
20-24	563	(5.8)	423	(10.0)	22	(2.4)	1008	(6.8)
25-29	851	(8.7)	450	(10.6)	7	(0.8)	1308	(8.8)
30 or more	2329	(23.8)	1463	(34.5)	10	(1.0)	3802	(25.4)
TOTAL	9782	(100.0)	4239	(99.9)	923	(99.9)	14,944	(100.0)

TABLE 3

DISTRIBUTION OF THE MALE COHORT BY VITAL STATUS AND YEAR OF HIRE

1937-1978

Year of Hire	Alive		Dead		Unknown		TOTAL		
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	
1900-1919	132	(1.3)	754	(17.7)	27	(2.9)	913	(6.1)	
1920-1929	917	(9.4)	1493	(35.2)	70	(7.6)	2480	(16.6)	80%
1930-1939	915	(9.4)	492	(11.6)	138	(15.0)	1545	(10.3)	
1940-1949	3619	(37.0)	1332	(31.4)	503	(54.5)	5454	(36.5)	
1950-1959	2061	(21.1)	160	(3.8)	120	(13.0)	2341	(15.7)	
1960-1969	601	(6.1)	2	(0.0)	28	(3.0)	631	(4.2)	
1970-1978	1537	(15.7)	6	(0.1)	37	(4.0)	1580	(10.6)	
TOTAL	9782	(100.0)	4239	(99.8)	923	(100.0)	14,944	(100.0)	

TABLE 4

DISTRIBUTION OF THE MALE COHORT BY VITAL STATUS AND AGE AT HIRE

1937-1978

Age at Hire (Years)	Alive No. (%)	Dead No. (%)	Unknown No. (%)	TOTAL No. (%)
≤ 24	6147 (62.8)	1584 (37.4)	561 (60.8)	8292 (55.5)
25-29	2166 (22.1)	938 (22.1)	204 (22.1)	3308 (22.1)
30-34	927 (9.5)	711 (16.8)	70 (7.6)	1708 (11.4)
35-39	328 (3.4)	431 (10.2)	50 (5.4)	809 (5.4)
40-44	131 (1.3)	280 (6.6)	20 (2.2)	431 (2.9)
45+	83 (0.8)	295 (7.0)	18 (1.9)	534 (3.6)
TOTAL	9782 (100.0)	4239 (100.0)	923 (100.0)	14,944 (100.0)

TABLE 5

DISTRIBUTION OF THE MALE COHORT BY PAY STATUS AND RACE

1937-1978

Percentage of Employment*		White		Nonwhite		TOTAL	
Salaried	Hourly	No.	(%)	No.	(%)	No.	(%)
0%	100%	10,089	(81.4)	2482	(97.4)	12,571	(84.1)
25%	75%	294	(2.4)	7	(0.3)	301	(2.0)
50%	50%	279	(2.2)	7	(0.3)	286	(1.9)
75%	25%	196	(1.6)	3	(0.1)	199	(1.3)
90%	10%	254	(2.0)	3	(0.1)	257	(1.7)
100%	0%	1,235	(10.0)	33	(1.3)	1,268	(8.5)
Unknown		50	(0.4)	12	(0.5)	62	(0.4)
TOTAL		12,397	(100.0)	2547	(100.0)	14,944	(99.9)

* Based on the percentage of employment rounded to the nearest percentage category.

TABLE 6

VITAL STATUS BY YEAR OF BIRTH FOR MALE COHORT

Year of Birth	Alive		Deceased		Unknown	
	No.	(%)	No.	(%)	No.	(%)
< 1890	39	(5)	727	(92)	24	(3)
1890-1899	370	(22)	1231	(75)	44	(3)
1900-1909	1227	(50)	1094	(42)	143	(6)
1910-1919	2290	(69)	772	(23)	269	(8)
1920-1929	2627	(80)	354	(11)	307	(9)
1930-1939	1291	(91)	54	(4)	75	(5)
1940-1959	1938	(97)	7	(0)	61	(3)
TOTAL	9782	(65)	4239	(28)	923	(6)

TABLE 7

STANDARDIZED MORTALITY RATIOS FOR SELECTED CAUSES OF DEATH
HOURLY MALES†

1937-1978

Cause of Death (ICDA 8th Revision)	Observed	Expected	SMR	95% C.I. Lower Limit	95% C.I. Upper Limit
All Causes (000-999)	3748	4305.15	0.87**	0.84	0.89
All Malignant Neoplasms (140-209)	706	743.30	0.95	0.88	1.02
Cancer of Buccal Cavity & Pharynx (140-149)	17	25.03	0.68	0.40	1.08
Cancer of Digestive Organs and Peritoneum (140-159)	199	240.44	0.83**	0.72	0.95
Cancer of Esophagus (150)	11	23.67	0.46**	0.23	0.83
Cancer of Stomach (151)	63	59.81	1.05	0.81	1.34
Cancer of Large Intestine (153)	56	64.59	0.87	0.65	1.12
Cancer of Rectum (154)	12	26.46	0.45**	0.23	0.79
Cancer of Liver (155-156)	10	19.33	0.52*	0.25	0.95
Cancer of Pancreas (157)	42	41.14	1.02	0.74	1.38
Cancer of Respiratory System (160-163)	212	219.27	0.97	0.84	1.11
Cancer of Lung (162-163)	203	204.86	0.99	0.86	1.13
Cancer of Bone (170)	12	4.51	2.66**	1.37	4.65
Cancer of Skin (172-173)	12	10.78	1.11	0.57	1.94
Cancer of Prostate (185)	63	61.99	1.02	0.78	1.30
Cancer of Testis (186)	5	4.84	1.03	0.33	2.41
Cancer of Bladder (188)	11	23.44	0.47**	0.23	0.84
Cancer of Kidney (189)	20	16.51	1.21	0.74	1.87
Cancer of Eye (190)	1	0.58	1.72	0.02	9.59
Cancer of Brain & other CNS (191-192,225,238)	25	25.68	0.97	0.63	1.44
Cancer of Thyroid (193)	1	1.43	0.70	0.01	3.89
Lymphatic and Hematopoietic Cancer (200-209)	63	65.96	0.96	0.73	1.22
Lymphosarcoma & Reticulosarcoma (200)	2	13.66	0.15**	0.02	0.53
Hodgkin's Disease (201)	13	9.17	1.42	0.75	2.42
Leukemia & Aleukemia (204-207)	32	27.76	1.15	0.79	1.63
Cancer of other Lymphatic Tissue (209)	14	14.86	0.94	0.51	1.58
Diabetes Mellitus (250)	54	62.18	0.87	0.65	1.13
Infective & Parasitic Diseases	51	152.20	0.34**	0.25	0.44
Tuberculosis	29	95.02	0.30**	0.20	0.44
Arteriosclerotic Heart Disease (410-413)	1145	1326.91	0.86**	0.81	0.91
Cerebrovascular Disease (430-438)	267	360.05	0.74**	0.65	0.84
Nonmalignant Respiratory Diseases (460-519)	185	252.39	0.73**	0.63	0.85
Emphysema (492)	46	49.79	0.92	0.67	1.23
Gastric & Duodenal Ulcer (531-534)	13	35.43	0.37**	0.20	0.63
Cirrhosis of Liver (571)	37	86.16	0.43**	0.30	0.59
Diseases of Genito-Urinary System (580-629)	67	100.02	0.61**	0.47	0.77
Accidents (800-949)	234	287.31	0.81**	0.71	0.92
Suicide (950-959)	60	74.05	0.81	0.62	1.04

* $p < 0.05$

** $p < 0.01$

† white and nonwhite combined

TABLE 8

STANDARDIZED MORTALITY RATIOS FOR SELECTED CAUSES OF DEATH

SALARIED MALES[†]

1937-1978

Cause of Death (ICDA 8th Revision)	Observed	Expected	SMR	95% C.I. Lower Limit	95% C.I. Upper Limit
All Causes (000-999)	300	444.79	0.67**	0.60	0.76
All Malignant Neoplasms (140-209)	62	76.88	0.81	0.62	1.03
Cancer of Buccal Cavity and Pharynx (140-149)	1	2.88	0.35	0.00	1.93
Cancer of Digestive Organs & Peritoneum (150-159)	16	24.46	0.65	0.37	1.06
Cancer of Stomach (151)	1	5.79	0.17*	0.00	0.96
Cancer of Large Intestine (153)	3	7.20	0.42	0.08	1.22
Cancer of Rectum (154)	3	2.97	1.01	0.20	2.95
Cancer of Pancreas (157)	9	4.19	2.14	0.98	4.08
Cancer of Respiratory System (160-163)	19	22.08	0.86	0.52	1.34
Cancer of Lung (162-163)	17	20.64	0.82	0.48	1.32
Cancer of Bone (170)	0	0.50	0.00	0.00	0.00
Cancer of Skin (172-173)	2	1.42	1.41	0.16	5.09
Cancer of Prostate (185)	4	6.01	0.67	0.18	1.70
Lymphatic & Hematopoietic Cancer (200-209)	11	7.43	1.48	0.74	2.65
Lymphosarcoma & Reticulosarcoma (200)	2	1.57	1.27	0.14	4.60
Hodgkin's Disease (201)	3	1.13	2.65	0.53	7.76
Leukemia & Aleukemia (204-207)	3	3.23	0.93	0.19	2.71
Cancer of other Lymphatic Tissue (208)	3	1.45	2.07	0.42	6.04
Diabetes Mellitus (250)	3	6.41	0.47	0.09	1.37
Infective & Parasitic Diseases	5	10.72	0.47	0.15	1.09
All Diseases of Circulatory System (390-458)	165	231.80	0.71**	0.61	0.83
Arteriosclerotic Heart Disease (410-413)	125	147.62	0.85	0.70	1.00
Cerebrovascular Disease (430-438)	23	35.22	0.65*	0.41	0.98
Nonmalignant Respiratory Diseases (460-519)	6	25.20	0.24**	0.09	0.52
Emphysema (492)	1	5.49	0.18	0.00	1.01
Gastric & Duodenal Ulcer (531-534)	1	3.76	0.27	0.00	1.48
Cirrhosis of Liver (571)	1	9.33	0.11**	0.00	0.60
Diseases of Genito-Urinary System (580-629)	5	9.79	0.51	0.16	1.19
Accidents (800-949)	14	32.86	0.43**	0.23	0.71
Suicide (950-959)	3	9.96	0.30*	0.06	0.88

* $p < 0.05$

** $p < 0.01$

† white and nonwhite combined.

TABLE 9

STANDARDIZED MORTALITY RATIOS FOR SELECTED CAUSES OF DEATH
TOTAL MALES†
1937-1978

Cause of Death (ICDA 8th Revision)	Observed	Expected	SMR	95% C.I. Lower Limit	95% C.I. Upper Limit
All Causes (000-999)	4239	5046.15	0.84**	0.81	0.87
All Malignant Neoplasms (140-209)	818	872.75	0.94	0.87	1.00
Cancer of Buccal Cavity & Pharynx (140-149)	18	29.36	0.61*	0.36	0.97
Cancer of Digestive Organs and Peritoneum (140-159)	229	281.80	0.81**	0.71	0.92
Cancer of Esophagus (150)	12	26.84	0.45**	0.23	0.78
Cancer of Stomach (151)	66	69.52	0.95	0.73	1.20
Cancer of Large Intestine (153)	65	76.77	0.85	0.65	1.08
Cancer of Rectum (154)	18	31.45	0.57*	0.34	0.90
Cancer of Liver (155-156)	10	22.54	0.44**	0.21	0.81
Cancer of Pancreas (157)	52	48.28	1.08	0.80	1.41
Cancer of Respiratory System (160-163)	244	257.24	0.95	0.83	1.07
Cancer of Lung (162-163)	233	240.40	0.97	0.84	1.10
Cancer of Bone (170)	12	5.32	2.26*	1.16	3.94
Cancer of Skin (172-173)	15	13.01	1.15	0.64	1.90
Cancer of Prostate (185)	76	72.11	1.05	0.83	1.31
Cancer of Testis (186)	5	5.75	0.87	0.28	2.03
Cancer of Bladder (188)	12	27.84	0.43**	0.22	0.75
Cancer of Kidney (189)	22	19.59	1.12	0.70	1.70
Cancer of Eye (190)	2	.69	2.90	0.33	10.47
Cancer of Brain & other CNS (191-192,225,238)	28	30.43	0.92	0.61	1.33
Cancer of Thyroid (193)	1	1.68	0.60	0.01	3.31
Lymphatic and Hematopoietic Cancer (200-209)	76	78.26	0.97	0.77	1.21
Lymphosarcoma & Reticulosarcoma (200)	4	16.27	0.25**	0.07	0.63
Hodgkin's Disease (201)	16	10.94	1.46	0.83	2.38
Leukemia & Aleukemia (204-207)	36	33.09	1.09	0.76	1.51
Cancer of other Lymphatic Tissue (208)	18	17.34	1.04	0.61	1.64
Diabetes Mellitus (250)	59	72.93	0.81	0.61	1.04
Infective & Parasitic Diseases	57	170.89	0.33**	0.25	0.43
Tuberculosis	29	106.75	0.27**	0.18	0.39
Arteriosclerotic Heart Disease (410-413)	1328	1576.33	0.84**	0.80	0.89
Cerebrovascular Disease (430-438)	306	418.67	0.73**	0.65	0.82
Nonmalignant Respiratory Diseases (460-519)	200	295.29	0.68**	0.59	0.78
Emphysema (492)	49	59.42	0.82	0.61	1.09
Gastric & Duodenal Ulcer (531-534)	17	41.80	0.41**	0.23	0.65
Cirrhosis of Liver (571)	40	101.45	0.39**	0.28	0.54
Diseases of Genito-Urinary System (580-629)	75	126.11	0.60**	0.47	0.75
Accidents (800-949)	256	338.30	0.76**	0.67	0.86
Suicide (950-959)	64	89.59	0.71**	0.55	0.91

* $p < 0.05$

** $p < 0.01$

† white and nonwhite combined