Cancer Mortality in Chinese Immigrants to New York City

Comparison with Chinese in Tianjin and with United States-Born Whites

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Background. **Cancer rates in immigrant populations are frequently found to be intermediate between the country of origin and the adopted country. Such observations play an important role in establishing the environmental origin of cancer. Chinese now constitute the third largest group immigrating to New York City.**

Methods. **Cancer deaths in New York City (1986–90) among 706 male and 412 female foreign-born Chinese were compared using proportional cancer mortality ratios (PCMR) with Chinese who died of cancer in Tianjin, China (19,461 deaths, 1983–87), and with United States-born whites in New York City (32,293 deaths).**

Results. **Cancer sites were divided into those for which the age-adjusted PCMR were significantly higher in Tianjin Chinese (TC) compared with New York City whites (NYW), and those for which PCMR were significantly lower in TC compared with NYW. PCMR for Chinese immigrants usually fell between those of TC and NYW, but some were closer to those of TC (e.g., liver, gallbladder, female lung) whereas other sites were closer to those of NYW (e.g., esophagus, colon, rectum).**

Conclusions. **These data provide additional support for the concept that much cancer originates with and can be modified by environmental factors. *Cancer* 1994; 73:1270–5.**

Key words: immigrant studies, proportional mortality, Chinese, New York City, Tianjin.

Cancer incidence and mortality rates in immigrant populations are frequently observed to be intermediate in comparison with rates in their home country and for natives of their adopted country. Such observations play an important role in establishing environmental (in contrast to genetic) links to cancer.[1]

In a recent publication, Yu et al. compared the incidence rates of cancers of the colon, rectum, prostate, and breast among native Chinese in Shanghai, Chinese Americans, with white Americans.[2] Data for the former group were derived from the Shanghai Tumor Registry, whereas United States data were taken from the Surveillance, Epidemiology, and End Results program (San Francisco Bay area used for Chinese Americans and Connecticut for white Americans). White Americans had age-adjusted rates of colon cancer four times as high and rates of rectal cancer twice as high as Shanghai Chinese, whereas in Chinese Americans the rates were almost equal to the rates of white Americans. Rates of prostate cancer and postmenopausal breast cancer were 26-fold and 10-fold higher, respectively, in whites compared with rates of Shanghai Chinese; Chinese American rates were intermediate.

These findings have important implications in environmental epidemiology, and Yu et al. drew a number of inferences concerning the influence of dietary fat on these four cancer sites.[2] However, as Yu et al. emphasized, ecologic studies have fundamental limitations because they depend on population parameters rather than individual measurements. On the other hand, analytic studies require substantially more resources. Although more flexible, case-control studies, the most popular of these, generally focus on a single cause rather than on multiple causes.

Intermediate between ecologic and analytic studies are those derived from official records, such as death certificates, using indirect standardization to make comparisons between two or more populations. In this report, we use death certificates from the cities of New York and Tianjin to compare the relative frequency of various types of cancer in Chinese immigrants to New

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York relative to residents of Tianjin as well as with United States-born New York City whites (NYW). Detailed mortality data were readily available for both cities. Our aim was to test specifically the hypothesis that the relative frequency of certain cancers in the immigrant group is intermediate between that in the country of origin and the adopted country.

Materials and Methods

This study uses data recorded on death certificates for all deaths that occurred within New York City from 1986 to 1990, and for Tianjin from 1983 to 1987. New York is the largest city in the United States, with a 1990 population of 7.2 million. It is also a traditional port of entry for immigrants, many of whom choose to live there permanently. The 1990 Census listed 238,919 persons of Chinese ancestry who resided in New York City, making Chinese the most populous group of Asian origin in New York.

New York City constitutes an independent registration area for births and deaths, equivalent to all other states. The New York City death certificate contains information on race, ancestry (formerly called descent or origin), and birthplace of decedent, which is recorded in the computer file either as state, if born in the United States, or country of birth. Sex, dates of birth and death, and other demographic data are coded as well, and underlying cause of death is coded to the Ninth Revision of the International Classification of Diseases. All of the above items are coded by trained nosologists, and special attention is given to the accurate assignment of over 270 possible ancestry and birthplace codes.

Tianjin, the third largest city in China, is located approximately 70 miles Southeast of Beijing and 570 miles Northwest of Shanghai, China's only other larger cities. Tianjin is an important industrial, rail, shipping, and commercial center with a population of about 8.7 million. All death certificates for permanent residents are filed with local police stations, and copies are forwarded to the Statistics Bureau, where the underlying cause of death is coded using the International Classification of Diseases-9. All death certificates of cancer cases are sent to the Tianjin Cancer Registry as part of the Tianjin Chronic Disease Control Program.

For men and women considered separately, three study groups were constructed: (1) all United States-born whites who died of any type of cancer in New York City during the 5-year period from 1986 to 1990; (2) all persons of Chinese ancestry born outside of the United States and who died of any type of cancer in New York City during the same period; (3) all persons who died of cancer in Tianjin and who were permanent residents of the central urban area (population approximately 3.3 million) during 1983 to 1987. The time periods chosen represent the 2 most recent 5-year periods for which mortality data were available in both cities.

Reliable population figures were not available for Chinese immigrants to New York City. Therefore, a statistical method was used that requires only numerator data. Proportional cancer mortality ratios (PCMR) were formed according to the method described by Breslow and Day.[3] In this method, all cancer deaths are classified by sex, age, and cause. We used the following six age strata: 1–29 years, 30–44 years, 45–54 years, 55–64 years, 65–74 years, and 75 or more years. We eliminated all deaths occurring under one year of age, because these are subject to ascertainment biases that do not affect other age groups and contain few cancers. For each cancer site in the reference population, the ratio within a given age stratum for the specified cause of death to the total population was multiplied by the total number of cancer deaths in that age stratum for the ancestry group under investigation, to produce an expected number of deaths in that stratum. The total observed deaths divided by the sum of the expected deaths for all six age groups yielded the age-adjusted PCMR for the cause of death in question. The Poisson statistic is used to compare observed with expected deaths.

In this analysis, the Tianjin population was chosen as the reference standard. This was an arbitrary choice; NYW could have been chosen equally, resulting in most PCMR being roughly the reciprocals of those shown. The large number of deaths in the two anchor groups, coupled with the large number of comparisons increases the likelihood that some statistically significant results may have occurred by chance. Therefore, emphasis should be placed on the interpretation of overall patterns, and not on the outcome of individual significance tests, which may be misleading.

Results

During the 5-year period from 1986 to 1990, a total of 15,937 white United States-born men and 16,356 white United States-born women died of cancer in New York City, representing 24.4 and 26.0% of total deaths in those groups, respectively. Also, 706 Chinese men and 412 Chinese women born outside the United States died in New York City. This represents 95.0% of all decedents whose death certificates listed Chinese ancestry. A total of 11,091 male and 8370 female cancer deaths were registered in Tianjin during the comparison period of 1983–1987.

Table 1 shows the five leading fatal cancers in each of the three study populations according to sex. Lung cancer appeared as the overwhelming leading cause, (25–31% of all cancers) except in United States-born

Table 1. Five Most Common Causes of Cancer Fatalities: Tianjin, 1983–1987, and New York City Native-born Whites and Foreign-born Chinese, 1986–1990

	Men			Women	
Type of cancer	*No. of deaths*	*Percent of all cancers*	Type of cancer	*No. of deaths*	*Percent of all cancers*
		Tianjin Chinese			
Lung	2887	26.0	Lung	2331	27.8
Stomach	2121	19.1	Stomach	861	10.3
Liver	1815	16.4	Liver	676	8.1
Esophagus	1073	9.7	Breast	616	7.4
Pancreas	362	3.3	Esophagus	582	7.0
		NYC Chinese			
Lung	217	30.7	Lung	101	24.5
Liver	103	14.6	Breast	44	10.7
Colon	61	8.6	Colon	44	10.7
Stomach	60	8.5	Stomach	27	6.6
Nasopharynx	36	5.1	Pancreas	24	5.8
		NY Whites			
Lung	4827	30.3	Breast	3362	20.6
Colon	1810	11.4	Lung	3254	19.9
Prostate	1454	9.1	Colon	1827	11.2
Lymphatic	836	5.2	Ovary	950	5.8
Pancreas	749	4.7	Pancreas	907	5.5

NYW women, in whom the number of breast cancers was slightly higher. Tianjin Chinese (TC) and NYW differed in that besides lung cancer, the leading cancers in TC were stomach and liver, whereas in NYW they were colon and prostate in men, and colon and breast in women. What is remarkable about Chinese immigrants to New York City is that their list of leading cancers includes both stomach and liver cancer (sixth for immigrant women, after pancreatic cancer), similar to Tianjin, but also colon and breast cancer, similar to NYW.

Cancer sites were divided into two distinct classes: those sites for which the age-adjusted PCMR were significantly higher in TC compared with United States-born NYW (Table 2), and those for which the rates were significantly lower in TC (Table 3). The tables have been further arranged according to whether immigrant PCMR were significantly different from either TC, NYW, or both.

In comparing NYW with TC, men and women usually fell into the same higher or lower classifications with the two exceptions of lung and skin cancer. The lung cancer PCMR for NYW women was 0.73, whereas for NYW men it was 1.16, significantly different from TC in both instances.

Most PCMR for foreign-born Chinese in New York City were intermediate between TC and NYW, with two important exceptions; cancer of the nasopharynx (NPC) was substantially higher in immigrant Chinese than in TC (PCMR = 7 for men, 6 for women), who in turn had rates approximately three-fold and two-fold higher than NYW men and women, respectively. The other exception was for cancers of the lymphatic system in women, in which Chinese immigrants had one-tenth the expected number of deaths based on Tianjin rates, compared with NY whites who had 1.66 times the expected number of deaths. Cancer sites for which the PCMR in TC exceeded significantly those in NYW included the stomach, cervix, liver, gallbladder, and esophagus. Immigrant Chinese had PCMR closer to TC for cancers of the liver and gallbladder, but closer to NYW for cancers of the esophagus and rectum. The PCMR of the immigrant Chinese for stomach and cervix cancer fell between the two larger groups and were significantly different from both.

The proportional mortality ratios were significantly greater in NYW compared with TC for more cancer sites than the reverse. These sites included the colon, pancreas, and lung in men and malignant melanoma, breast, and uterus in women.

Chinese immigrants to New York City experienced PCMR that were for the most part between those of Tianjin and NYW. They were closer to TC with respect to malignant melanoma, kidney cancer, and hematopoietic cancers (all in men only); for women, the PCMR for

Table 2. Standardized Proportional Cancer Mortality Ratios (PCMRs) for Deaths Among Foreign-born Chinese in New York City: Cancer Sites for Which PCMRs Are Significantly Higher in Tianjin Chinese Compared With New York Whites

		Proportional cancer mortality ratio			Number of deaths		
Cancer site	Sex	*Tianjin Chinese (reference)*	*New York City Chinese*	*NY Whites*	*Tianjin Chinese*	*New York City Chinese*	*NY Whites*
Nasopharynx*	Male	1.00	7.08#‡‡	0.33#	85	36	34
	Female	1.00	6.06#‡‡	0.59¶	32	8	28
Stomach†	Male	1.00	0.44#‡‡	0.16#	2121	60	512
	Female	1.00	0.60¶‡‡	0.21#	861	27	369
Cervix†	Female	1.00	0.41#**	0.16#	490	11	177
Liver‡	Male	1.00	0.93‡‡	0.16#	1815	103	372
	Female	1.00	0.68‡‡	0.21#	676	23	282
Gallbladder‡	Male	1.00	1.17**	0.50#	118	9	90
	Female	1.00	1.84**	0.75#	98	9	146
Lung‡	Female	1.00	0.93**	0.73#	2331	101	3254
Esophagus§	Male	1.00	0.31‡‡	0.22#	1073	23	390
	Female	1.00	0.15‡‡	0.13#	582	5	180
Rectum§	Male	1.00	0.54‖	0.60#	307	11	269
	Female	1.00	0.52‖	0.41#	319	9	276

* PCMR for NY Chinese is significantly higher than both TC and NYW.
† PCMR for NY Chinese is significantly lower than TC and significantly higher than NYW.
‡ PCMR for NY Chinese is significantly different from NYW, but not from TC.
§ PCMR for NY Chinese is significantly different from TC, but not from NYW.
‖ Comparisons with Tianjin Chinese (the reference group), $P < 0.05$.
¶ Comparisons with Tianjin Chinese (the reference group), $P < 0.01$
# Comparisons with Tianjin Chinese (the reference group), $P < 0.001$.
** Comparisons with NY Whites, $P < 0.05$.
†† Comparisons with NY Whites, $P < 0.01$.
‡‡ Comparisons with NY Whites, $P < 0.001$.

these cancers were not statistically different from rates of either of the larger groups. They were closer to NYW for colon cancer, lung cancer in men, and cancer of the uterus, ovary, and multiple myeloma in women. For most other cancers, the PCMR for immigrant Chinese were not statistically different from those of either larger group.

Discussion

Most PCMR in NY Chinese were intermediate between TC and NYW. The only important instances in which the ethnic patterns differed between men and women were for cancers of the larynx and lung (higher in Chinese women and in NYW men). Although the PCMR for lung cancer in NY Chinese men was higher than that of Tianjin men, it was similar in NY Chinese women and in Tianjin women. The incidence of female lung cancer in Tianjin is nearly twice as great as the incidence in Shanghai, a known high-risk region within China.[4] The only important cancer site that did not differ between TC and NYW was the bladder.

Thus, this study supports the hypothesis that many cancers are influenced by environmental factors that include nutrition and lifestyle and that an individual's risk is subject to change as one's environment changes. It is important, however, to recognize the limitations of this study in methodology as well as data, to avoid overinterpretation.

The fundamental weakness of a proportional method is that rates are constrained to a total of 100 percent. A proportional rate for a particular illness may, therefore, appear to be high only because another common rate is low, and vice versa. The use of PCMR rather than overall proportional mortality rates attenuates this problem somewhat by eliminating several major causes of death, including coronary heart disease and stroke, mortality rates for which differ substantially in the populations studied.

A second study weakness is a lack of information on the area of origin within China. During 1982 to 1989, approximately 52,700 people of Chinese ancestry emigrated to New York City from the People's Republic of China, whereas another 10,000 came from Hong Kong, and 9200 came from Taiwan.[5] Many of the latter group had family origins on the mainland, especially the southeastern coastal province of Fukien. In addi-

Table 3. Standardized Proportional Cancer Mortality Ratios (PCMRs) for Deaths Among Foreign-born Chinese in New York City: Cancer Sites for Which Proportional Rates Are Significantly Lower in Tianjin Chinese Compared with New York Whites

		Proportional cancer mortality ratio			Number of deaths		
Cancer site	*Sex*	*Tianjin Chinese (reference)*	*New York City Chinese*	*New York Whites*	*Tianjin Chinese*	*New York City Chinese*	*New York Whites*
Lymphatic* system	F	1.00	0.10#‡‡	1.66#	223	1	644
Prostate†	M	1.00	5.19#‡‡	13.63#	57	22	1454
Breast†	F	1.00	1.43‖‡‡	2.89#	616	44	3362
Malignant melanoma‡	M	1.00	1.90‡‡	14.68#	16	2	302
Kidney‡	M	1.00	1.30††	2.91#	89	7	377
Lymphatic system‡	M	1.00	0.80‡‡	2.33#	278	13	836
Leukemia‡	M	1.00	0.90††	1.98#	296	14	671
Colon§	M	1.00	4.35¶	6.00#	213	61	1810
	F	1.00	3.49#	3.68#	241	44	1827
Pancreas§	F	1.00	2.15¶	2.01#	226	24	907
Lung§	M	1.00	1.18‖	1.16#	2887	217	4827
Uterus§	F	1.00	7.04¶	4.61#	19	7	186
Ovary§	F	1.00	1.76‖	2.70#	207	17	950
Multiple myeloma§	F	1.00	9.05#	7.63#	17	6	193

* Standardized Proportional Cancer Mortality Ratios (PCMRs) for NY Chinese is significantly lower than both TC and NYW.

† PCMR for NY Chinese is significantly higher than TC and significantly lower than NYW.

‡ PCMR is significantly different from NYW, but not from TC.

§ PCMR is significantly different from TC, but not from NYW.

‖ Comparisons with Tianjin Chinese (the reference group), $P < 0.05$.

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** Comparisons with NY Whites, $P < 0.05$.

†† Comparisons with New York Whites, (the reference group), $P < 0.01$.

‡‡ Comparison with NY Whites, $P < 0.001$.

tion, much of the current illegal immigration has been traced to the Fukien province. Although Tianjin mortality data were used as a reference group because of their availability, many cancer deaths in New York undoubtedly involved earlier immigrants, who came predominantly from Guangdong, China.

No one city or region can be said to represent the entire country. Incidence rates, as reported by the International Agency for Research on Cancer[6] and mortality rates for many cancers vary throughout China, and the use of different Chinese cities or provinces as reference populations might have possibly changed some of the PCMR.

Nevertheless, our overall findings are consistent with other studies that compare cancer in Chinese with American populations, including those of King and colleagues,[7,8] as well as those of Yu et al.[2] Although our data our purely descriptive, they are consistent with hypotheses linking many of these sites—especially the colon, breast, and prostate—with western dietary patterns, notably the consumption of dietary fat.[9] These data do not, of course, take the place of analytic findings based upon dietary observations.

Our data also provide insight into the experience of Chinese immigrants to New York City, whose patterns of cancer mortality were broadly similar to those in China for some sites and to those in United States-born NYW for others. Considering the major cancer sites that are generally regarded as related to nutrition, including the stomach, colon, breast, and prostate, it is noteworthy that the New York City Chinese mortality pattern is closer to the NYW pattern for cancer of the colon, but intermediate for the other three sites. New York Chinese rates of esophageal and rectal cancer, two other cancer sites considered nutritionally related, were closer to those of NYW. For other rare cancer sites, the New York Chinese rates were found to be intermediate when there were sufficient observations to make valid comparisons.

The low PCMR for rectal cancer (0.5 for men and women) would appear to be anomalous, because IARC puts the standardized incidence ratios at 2.8 and 1.9, respectively,[6] for the United States Surveillance, Epidemiology, and End Results program (white) compared with Tianjin. However, the corresponding mortality ratios are 0.7 and 0.5, which are consistent with the data

presented here. The possibility that this apparent anomaly might be due to inconsistent classification of rectal cancer on death certificates bears further investigation.

For NPC, New York Chinese had a proportional rate of 6–7 times that of the TC and 12–20 times the NYW rate). This is most likely because NY Chinese, until recently, have come most commonly from Guangdong and other places in South China, where the incidence of NPC is high compared with the rest of China.[10]

Within China, Tianjin is known to be a low-risk area for NPC.[7] Even so, case-control studies have shown that in Tianjin, dietary factors—especially consumption of salted fish—are strongly related to NPC risk.[11] Similarly, although the absolute incidence of breast cancer in Tianjin is low compared with the United States, traditional risk factors such as reproduction and family history exist within the population as they do in Shanghai and in the United States.[12] Consequently, one would expect that the differences in risk between Chinese immigrants to New York City and the local white population will tend to diminish over time as the immigrant lifestyle begins to resemble that of the host city, unless it is offset by continued immigration. These changes and the attendant changes in cancer risk need to be monitored by the appropriate analytic studies.

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