THE UNIVERSITY OF CALGARY

CANCER MORTALITY OF CHINESE POPULATION IN CANADA 1980-1984

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF MEDICAL SCIENCE

CALGARY, ALBERTA

June, 1987

ISBN 0-315-38091-8

THE UNIVERSITY OF CALGARY

FACULTY OF GRADUATE STUDIES

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ABSTRACT

A number of epidemiologic studies on cancer mortality in Chinese emigrants to foreign countries have been reported. However, in Canada there are no studies which focus on this specific problem. Such studies in Canadian populations would be useful because Chinese immigrants in Canada comprise the fourth largest ethnic immigrant group in the country. Also, reported studies have shown that the cancer site profile in Chinese immigrants presents some unique characteristics that make comparative studies of cancer between Chinese immigrants and the native-born populations informative with respect to risk factors for cancer.

For these reasons, a comparison of cancer mortality in Chinese immigrants with that of the Canadian-born population was carried out to assess whether there are differences in the distribution and risk of various cancers between the two groups. The Chinese immigrants studied were those who were born in the People's Republic of China, Hong Kong or Taiwan.

The study population of Chinese comprised a total of 763 deaths among 81,740 males and 592 deaths among 83,965 females over the period 1980-1984. Results showed that the overall cancer mortality rates in the Chinese population were significantly higher than in the Canadian-born. The standardized mortality ratio for the Chinese population, based on mortality rates among the Canadian-born during 1980-1984, was 141 in males and 116 in females for cancer at all sites.

Compared with the Canadian-born, Chinese males had high standardized mortality ratios for cancers of the nasopharynx, stomach, intestines, colon, liver and lung, and Chinese females had high ratios for cancers of the nasopharynx, liver, lung and uterus or uterine cervix. Chinese males had low ratios for cancers of the skin and prostate and females had low ratios for cancers of the pancreas, skin, breast and ovary.

Another interesting finding was that the relative risk decreases significantly with age for cancer of the nasopharynx and liver in Chinese males, while the relative risk decreases significantly with age for cancer of the nasopharynx, stomach, intestines and liver in Chinese females.

Cancer mortality rates in males compared with females, however, showed a high degree of inter-country uniformity relative to most of the cancer sites. Comparison by sex of cancer mortality rates revealed that male to female sex ratios tended to be higher in both the Chinese- and Canadian-born populations. Among the Chinese, the male-to-female sex ratio of mortality rates for persons under 35 years of age was less than one. After age 35, the sex ratio increases with age, reaching a peak of 2.15 at 75 years and over.

Even though the Canadian data cannot provide etiologic explanations for the observed differences in risks between the two population groups, they do serve to confirm results that have come out of similar comparisons in the U.S.A. and Australia. The results of this study thus emphasize the need for further detailed epidemiologic investigations into the possible risk factors for cancer in Chinese immigrants in Canada compared to the Canadian-born.

ACKNOWLEDGEMENTS

I would like to dedicate this thesis to Chinese-Canadian friendship.

I wish to acknowledge my gratitude to the following individuals and groups for their assistance during the various stages of my research program and thesis writing:

Dr. S. Ramcharan, my thesis supervisor, for her able supervision and guidance.

Dr. E.J. Love, Professor and Head of the Department of Community Health Sciences, The University of Calgary, who supported this project throughout the conduct of this study.

Dr. G. Hill, for his great help. He provided me with many ideas for this thesis.

Dr. J.S. Beck, for his guidance, patience, and constant encouragement which made working in his laboratory most pleasant.

Ms. Elaine Scott, for her help, particularly with use of the computer terminal and the SPSS system.

Mr. John Silins, *Ms. Joan Lindsay* and *Ms. Joan Coulter* of Statistics Canada, who provided the data for this project.

My *colleagues* and my *students* of Sun-Yat-Sen medical university in China deserve special mention for their constant encouragement.

Deep appreciation is given to my family: *my husband, Pai An*, who offered me encouragement; *my children, Mai and Tong*, who, by their independence, allowed me to study in Canada.

I would like to thank all the people in the *Department of Community Health Sciences*, The University of Calgary.

Thanks to *Mr. A. Rix* and *Mr. G.R. Bourrier*, Directors of Fellowships and Awards Division of the International Development Research Centre (I.D.R.C.), for their approval of this study.

This project was supported by a fellowship from the International Development Research Centre, Canada.

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CHAPTER 1

INTRODUCTION AND SIGNIFICANCE OF THE PROBLEM

PURPOSE OF THE STUDY

Cancer is a very frequent disease throughout the world, but the causes of most types of cancer are still not determined. Research on cancer mortality rates within countries is, therefore, useful since it may yield valuable insights as to possible etiologic factors. Different countries have different cancer mortality rates which may be related to differences in climate, geology, air quality, occupations, diets, socio-economic conditions, ethnicity, genetic background, etc. Comparative studies of cancer rates among countries could, therefore, be used to identify factors that may be causally related to certain types of cancer. However, comparisons of such data on a world scale must be considered with caution because they may contain many artifacts. For example: differences in data collection procedures, availability of data, access and utilization of medical care, diagnostic techniques, treatment regimens which result in increases in survival, methods for certification of cause of death, completeness of death registration, and accuracy of the population census can make the results of cancer mortality in different countries appear to look different when they are not.

Many epidemiologists have recognized that the migration of populations forms one of nature's unplanned experiments, providing an unusual opportunity to compare different types and levels of disease

risk between migrants and population groups in their country of origin or in the country of settlement. The Chinese have migrated to many countries throughout the world and thus they represent a special resource for epidemiologic investigations of many kinds of diseases including cancers. This study will compare the cancer mortality patterns of people living in Canada who were born in China with those of Canadians who were born in Canada. No information on this topic has been published to date. Therefore, one objective of this investigation is that it would serve to point out the need for future epidemiologic studies of the Chinese immigrant population in Canada and to encourage others to investigate this group. Another general aim is to draw a comparison between cancer mortality of those born in China and those born in Canada, in order to provide information that would help towards the understanding of measures for reducing cancer mortality in both populations.

The specific purposes of this study are: (1) to describe cancer mortality in 1980-1984 among Canadians born in China; (2) to discuss some methodological problems involved in studying cancer mortality patterns; (3) to compare cancer risks in the groups born in China and born in Canada in order to elucidate the pattern of cancer mortality in both groups; (4) to illustrate the distribution of cancer mortality in males and females of both populations; (5) to note some of the interesting findings from the study, focusing on the most common cancers in both populations; and (6) to suggest some areas of useful future research regarding cancer epidemiology in the Chinese immigrant population in Canada.

LITERATURE REVIEW

Few studies have been done to compare mortality in white populations and immigrant Chinese groups. The principal ones were those carried out by investigators at the National Cancer Institute, National Institutes of Health, in the United States (1,2,3). One other study compared mortality of Chinese in New South Wales and the residents of New South Wales who were born in Australia (4).

The first report in the U.S. was by Smith who examined cancer mortality among Chinese in Hawaii and the continental U.S. for the years 1949-1952 (1). There were 32,647 Chinese residing in Hawaii and 120,113 residing in the Continental U.S. Because of the small sizes of these groups, particularly that in Hawaii, the author combined them for purposes of analysis after noting that there was little difference between them with respect to mortality rates for specific cancer sites. The total number of deaths from cancer at all sites was 643 among Chinese males and 168 among females. Chinese males were found to have a higher overall cancer mortality than white males, but no significant difference for females was observed. Among the Chinese, both sexes experienced relative to whites markedly excessive mortality from cancer of the pharynx. There was also excess mortality for cancer of the liver and biliary passages and stomach, but a marked deficit in mortality due to cancer of the prostate in Chinese males compared to white males. Chinese females had significantly more deaths attributed to cancer of the lung and to leukemia than would be expected, compared to white females. This study did not differentiate between Chinese born in the United States and those that were foreign born.

The second report that appeared in the U.S. was by Kind and Haenszel who studied nativity differences in cancer mortality among the Chinese in the U.S. for 1959-1962 (2). There were 887 deaths from cancer at all sites among a total of 93,288 foreign-born Chinese, and 367 deaths from cancer at all sites among a total of 142,796 native-born (born in the U.S.) Chinese. The authors found that Chinese males (foreign-born and native-born combined) continued to show, as they did ten years earlier (1), a higher (25%) mortality ratio for all cancer sites combined compared to white males. They concluded that the relatively stable cancer mortality ratios for the Chinese meant that their experience had followed the prevailing trend for U.S. whites during the same time interval. However, they described a distinctive site profile of cancer risks in U.S. Chinese compared to U.S. whites, the most striking differences being the elevated risks for nasopharyngeal carcinoma in both sexes, the low risk for prostate and high risks for liver and esophagus among males, and the low risk for breast and high risk for lung cancer among females. Foreign-born Chinese males had a significantly higher mortality for all cancers combined compared to white males, but there was no difference in the overall risk between U.S.-born Chinese females and white females.

No clear-cut differentials between foreign-born and U.S.-born Chinese by cancer site could be demonstrated. They attributed this partly to the small numbers of deaths observed, but noted that other factors should be taken into account: there was evidence of regional variation in cancer risks by site within China, nativity might be confounded with place of origin in continental China and, with respect

to nasopharyngeal cancer, genetic differences among populations within China have not been ruled out as possible.

They also reported on 172 deaths from cancer, all sites, in males and 23 in females based on data provided by the British Columbia Department of Health Services and Hospital Insurance. The small numbers made the results subject to sampling variation, but they observed that the pattern of cancer risks by site was consistent with the U.S. data.

King and Locke studied a total of 1,824 cancer deaths in 1968-1972 among the Chinese in California, Hawaii and New York City (3). The data showed that the overall cancer mortality ratio for Chinese males was similar to that for U.S. white males, whereas Chinese females had a lower ratio than did U.S. white females. However, the distinctive profile of cancer risks among Chinese generally resembled that seen in the 1959-1962 data (2). Also, differences in mortality by nativity generally followed the pattern seen ten years before. For Chinese males, a higher mortality among the foreign-born than among the U.S.-born was observed for all cancers combined. In contrast, the overall cancer risk among Chinese females was similar for the two nativity groups. Foreign-born Chinese males also showed an excess risk for cancers of practically all specific sites, including lung and colon. However, among females, the difference was not as great except for cancers of the nasopharynx, liver and pancreas, which was apparently due to the small numbers of deaths.

Zhang et al. found in 1969-1978 that, compared to the Australians resident in New South Wales, Chinese males born in China had significantly higher rates for cancers of the nasopharynx, lung, intestines and rectum, and stomach and liver, whereas females had a

significantly higher risk for cancers of the lung and stomach (4). They examined 378 cancer deaths among 2,295 Chinese males and 165 cancer deaths among 1,721 Chinese females. They concluded that mortality patterns among the Chinese in New South Wales were similar to those for united States Chinese.

CHAPTER 2

MATERIALS AND METHODS

POPULATIONS DATA

Populations by place of birth, sex and age were derived from the 1982 census data of Statistics Canada. The breakdown was listed as follows:

Place of Birth:

1. Total place of birth
2. Born in Canada
3. Born in Hong Kong
4. Born in People's Republic of China
5. Born in Taiwan
6. Subtotal of Hong Kong, P.R. of China and Taiwan
7. Other places of birth
8. Subtotal born outside Canada

Sex:

1. Total Sex
2. Male
3. Female

Age in Years, by 5-year age groups:

1. Total of all ages
2. 0-4
3. 5-9
4. 10-14
5. 15-19
6. 20-24
7. 25-29
8. 30-34
9. 35-39
10. 40-44
11. 45-49
12. 50-54
13. 55-59
14. 60-64
15. 65-69
16. 70-74
17. 75-79
18. 80-84
19. 85+

DEFINITION OF NATIVITY GROUPS

Two population subgroups were selected from the 1981 census for this study: (1) born in People's Republic of China, Hong Kong and Taiwan; and (2) born in Canada of whatever ethnic origin.

For purposes of this study, born in China or Chinese refers to persons who were born in People's Republic of China, Hong Kong or Taiwan. It is assumed, and no doubt correctly so, that the vast majority of such persons will be ethnic Chinese. Canadian-born refers to all persons born in Canada regardless of ethnic origin. Among the Canadian-born will be a relatively small number of ethnic Chinese.

MORTALITY DATA

In order to have sufficient cancer mortality data for a meaningful analysis, it was decided to select for review all cancer deaths that occurred during the five-year period 1980-1984, the years for which place of birth is recorded in the mortality statistics. All cancer deaths for which the place of birth recorded was either Mainland China, Hong Kong or Taiwan provided the numerators for the mortality rates among the population with Chinese nativity. Deaths for which the place of birth recorded was Canada formed the numerators for mortality rates among the population born in Canada. Deaths occurring in persons born in places other than those listed above were excluded. Deaths were classified by sex and five-year age groups.

Cancer deaths were grouped according to site as categorized in the International Classification of Diseases (ICD), 9th Revision. The ICD is a system for the classification of morbidity and mortality, based mainly on the anatomical site affected, and is revised periodically by expert groups meeting under the auspices of the World Health Organization. The categories of cancer sites used in the analysis of deaths are as follows:

Cancer Site	ICD Code
Cancer (all sites)	140-208
Nasopharynx, Hypopharynx	147-149
Esophagus	150
Stomach	151
Intestines, Colon	152,153
Rectum	154
Liver, Gallbladder	155,156
Pancreas, Other Sites	157-160
Larynx	161
Lung, Bronchus	162
Skin	172,173
Breast	174
Uterus, Cervix uteri	179-182
Ovary	183
Prostate	185
Bladder, Kidney	188,189
Brain, Nervous System	191,192
Lymphosarcoma	200,202
Hodgkin's Disease	201
Leukemias	204-208

STATISTICAL ANALYSIS

The following statistical measures were used to compare cancer death rates in the Chinese and the Canadian-born populations:

(1) Age-specific death rates

(2) Two kinds of summary indices: (a) standardized death rates among the Chinese using the Canadian-born group as standard; and (b) standard mortality ratios (SMR) which are generated during the calculation of the standardized death rates

(3) Relative risks: (a) age-specific; and (b) summed over all age groups as the SMR which is equivalent to the relative risk.

(1) Age-specific death rate:

Age-specific mortality is the proportion of individuals of a certain age who die during the particular period of time under

consideration. Calculating the mortality at different ages provides a useful method for comparing mortality patterns (5,6).

Age-specific cancer mortality rate is defined as:

$$\frac{\text{Total no. of cancer deaths occurring in a specific age group of the population of a defined area during a defined period}}{\text{Estimated total population of the same age group of the population of the same area during the same period}} \times 100{,}000$$

Age-specific mortality rates were calculated by dividing the number of deaths in a given category defined by place of birth, kind of cancer, sex and age by the number of person-years in a similarly defined category. The age groups included 0-14, 15-34, 35-54, 55-74, and 75 years and over.

For this analysis, the total population comprised the person-years of experience over the five-year period covering 1980-1984. It was calculated by multiplying the number of persons in the 1981 census by five.

Age-specific mortality rates are simple to calculate. They can be used to compare the mortality in specific age groups of two populations when the age and sex compositions of these populations are different. However, there is often the need for a single summary mortality rate in order to avoid having to examine numerous rates when comparing the mortality experience in different populations. The simple summation of the overall death rate, called the crude death rate (CDR), can be used, but since it is affected considerably by the age and sex constitution of a population, it can produce misleading results. For this reason, the standardized death rate is generally used instead.

(2) Standardized death rate (SDR) and Standard mortality rate (SMR):

The standardized death rate was calculated by the indirect method. This procedure requires only that the age structure of the study population and its crude death rate are known (5,7,8). Since age- and sex-specific death rates were available, the direct method could have been used instead. However, the indirect method also yields the standard mortality ratio which is a useful summary measure of mortality.

The indirect standardization procedure starts with the selection of a series of standard death rates at different ages. For this, the rates in the Canadian-born in 1980-1984 were chosen. These rates were then applied to the corresponding age groups in the Chinese population for which the standardized rate was sought. The aim of the procedure is to determine the total number of deaths that would have been expected in that group if it had had the age-specific death rates of the standard population (5,6,7,8,9).

An illustrative example of the procedure for calculating the standardized death rate is given in Table 1. Column 2 shows that in the Chinese population, there were 173 thousand males at ages 15-34. The death rate of males at these ages among the Canadian-born in 1980-1984 was 5.99 per 100,000. Therefore, at this rate, there would have been (173,000 x 5.99) / 100,000 = 10.36 deaths among Chinese males. A similar calculation is carried out for each age-group separately for each sex, and the deaths expected at the standard rates are totalled. The standardized mortality ratio (SMR) is then derived. This is the ratio of the observed number of deaths in the study population to the number of deaths that would be expected if the population had the same rates as the standard population, expressed as a percentage.

If the SMR is greater than 100%, this means that there is an excess risk in the study population relative to the standard population.

If the SMR is less than 100%, this means that there is a reduced risk in the study population relative to the standard population.

If the SMR equals 100%, this means that there is neither an excess nor a deficit of risk in the study population relative to the standard population.

The standardized death rate (indirect method) can then be calculated by multiplying the crude mortality rate in the standard population by the SMR, as is illustrated in Table 1.

(3) Relative risk (RR):

This is the ratio of the death rate in the study population to that in the standard population. It is a satisfactory measure when applied to age-specific rates but not to crude rates. To obtain an adequate summary relative risk, it is necessary to use the ratio of the standardized rate for the study group to the rate in the standard population. Since the SMR is equivalent to the standardized RR, it can be used instead.

To assess the significance of differences in the comparisons of relative risks across the age groups, chi-square tests of homogeneity were applied. Confidence intervals of the SMR were obtained using the method described by Symons and Taulbee (10). This makes the assumption of a Poisson model, and the 5% and 1% confidence levels were determined on the basis of tabular values provided by Bailar and Ederer (11). A confidence interval of the SMR that does not include 100 indicates that the observed difference in risk is unlikely to be due to chance.

CHAPTER 3

RESULTS

POPULATIONS BORN IN CHINA AND BORN IN CANADA

As shown in Table 2, the population born in China consisted of 81,740 males and 83,965 females. The population born in Canada consisted of 10,047,225 males and 10,169,100 females. The sex ratio (males/females) of 0.97 in the Chinese population differed from that in the Canadian population, which was 0.99. The age distribution also differed with 7.8% of the Chinese males and 6.9% of the females being under 15 years of age compared with 26.5% among the Canadian males and 24.9% among the Canadian females. At the other end of the age spectrum, among the Chinese males, 3.1% were 75 years old and over, while among the Canadian-born males, 1.8% were 75 years old and over. The equivalent data among females were 4.2% and 2.7%, respectively. The differences in the age distributions were statistically significant at $\alpha = .01$.

MORTALITY FROM CANCER, ALL SITES

The total number of deaths from cancer in the Chinese population available for analysis for the five-year study was 763 among males and 592 among females (Tables 3 and 4). The number of deaths in the population born in Canada was 51,583 among males and 44,983 among females (Tables 5 and 6). From Table 7, it can be seen that cancer mortality varies strikingly with age. The cancer mortality rates

increase with age in both sexes and in both populations. For every sex and age subgroup, except for males under 15 years of age, the rate in the Chinese was higher than in the corresponding Canadian-born group. The excess risk was apparent in the total mortality for cancer at all sites (crude rate), in males and in females, and persisted even when the rates among the Chinese were standardized for age. In males, the ratio of the overall rate in the Chinese to that in the Canadian-born was 1.41, while in females, the corresponding ratio was 1.16.

SEX DIFFERENTIALS IN MORTALITY FROM CANCER

Tables 8 and 9 present sex- and age-specific mortality rates from cancers at all sites, and sex differentials for the Chinese and Canadian-born populations in 1980-1984. The sex differential in cancer mortality has generally been measured by the ratio or difference of male and female mortality rates (M/F, M-F). The use of ratios or differences provides different information: ratios assess the relative differential in male and female mortality; differences assess the magnitude of the differential. Comparison of both differences and ratios allows the fullest assessment of the sex differential in cancer mortality.

When using differences or ratios to examine the sex differential in mortality, age differences in the population must also be considered. The sex mortality ratio demonstrates that relative to women, men had higher mortality rates between the ages of 55-74 and 75 and over in both populations. The sex differential is also of greatest magnitude at the older ages. Among the Chinese, men had lower rates than women at ages less than 35 years, while among the Canadian-born only, men in the age group 35-54 years had a lower rate than females.

Age-standardized mortality rates and sex differentials for various cancer sites are shown in Tables 10 and 11 for the Chinese and the Canadian-born populations. Among the Canadian-born, the age-adjusted mortality rate for each of the cancer sites common to males and females was higher for men than for women, except for cancer of intestines or colon and liver or gallbladder. In the Chinese population, males also showed higher death rates than females for all specific cancer sites except Hodgkin's Disease and leukemia. Skin cancer was excluded from the comparison because it is extremely rare in Chinese. The lung cancer sex mortality ratio among the Canadian-born was higher than that among the Chinese (2.68 and 1.91, respectively).

MORTALITY FROM CANCER AT SPECIFIC SITES

Tables 12 and 13 show comparisons of cancer mortality rates in the Chinese and Canadian-born populations for males and females for specific cancer sites. Generally, mortality rates for most cancers among Chinese males were higher than those of the Canadian-born except for cancer of the larynx, skin, prostate and Hodgkin's Disease. Among Chinese females, the rates for cancer of the stomach, intestines or colon, breast, ovary, brain or nervous system and skin were lower than in the Canadian-born.

Tables 14 and 15 show the ranking of mortality rates for ten leading cancer sites by nativity for males and females. In males of both populations, the commonest site was lung cancer, while among females, the commonest site was breast cancer in the Canadian-born and lung cancer in the Chinese. Cancer of the liver or gallbladder and nasopharynx or hypopharynx were represented among the Chinese males but

were absent among the Canadian-born males, while leukemias and cancers of the nervous system appeared among the Canadian-born males but not among the Chinese. Cancers of the liver or gallbladder and nasopharynx or hypopharynx were among the ten leading sites in Chinese females but not in Canadian-born females, while cancers of the ovary and bladder or kidney appeared in the list for the Canadian-born females but not for the Chinese females.

The observed and expected numbers of deaths and the SMR for specific cancer sites are presented in Table 16. Confidence intervals for the SMR are also included. The higher overall cancer mortality in Chinese males, SMR 141, and in females, SMR 116, compared to the Canadian-born is seen to be statistically significant. The sites associated with significantly higher risks among Chinese males compared to Canadian-born males are the nasopharynx or hypopharynx, stomach, intestines or colon, rectum, liver or gallbladder and lung. Among Chinese females, a significantly elevated ratio compared to Canadian-born females exists for nasopharynx or hypopharynx, liver or gallbladder, lung, uterus and leukemias. The category including cancer of the pancreas is a heterogeneous one and thus comparisons are not meaningful.

Since cancer risks vary with age, and because of the possibility that the summarization procedure of the SMR might obscure varying patterns of age-specific risks, relative risks by cancer site and age were examined. These are shown in Tables 17 and 18 for males and females. Chi-square tests for homogeneity of risks across the age groups for each cancer site in males and females are also given in Table 19. The high risks seen at the youngest ages, 15-34, are most likely

due to sampling variation as a result of very small numbers of deaths in this group (see Tables 3 and 4). More specific comments follow on the findings at selected cancer sites.

Cancer of the Nasopharynx or Hypopharynx:

As with the homeland population, the population born in China showed a high mortality ratio for cancer of the nasopharynx, compared with the Canadian-born population, the SMR being 774 for males and 1,414 for females. These differences were statistically significant. The M/F ratios for cancer of the nasopharynx showed an excess of deaths among males. The M/F ratio is 3.23 in the Canadian-born and 1.78 in those born in China. One interesting aspect of this cancer is that the relative risk shows a significant decrease with age among both Chinese males and females (Tables 17-19).

Cancer of the Digestive System:

(a) Cancer of the Esophagus: The risk in Chinese males and in females was higher relative to that in the Canadian-born (SMR: males 147, females 110), but these differences were not statistically significant. Mortality among males, both Chinese and Canadian-born, was much higher than in their female counterparts.

(b) Cancer of the Stomach: The risk of stomach cancer among Chinese males was significantly higher than in Canadian-born males (SMR 188). In contrast, the risk among Chinese females was lower than that of the Canadian-born females (SMR 80). But this difference was not statistically significant.

(c) Cancer of the Intestines, Colon: The risk of intestinal or colon cancer among Chinese males was much higher than among Canadian-born males (SMR 159). This difference was statistically significant. On the other hand, Chinese females showed a lower ratio compared to Canadian-born females (SMR 87). This difference was not statistically significant. The relative risk decreases significantly with age for cancer of the intestines or colon among Chinese females. Among Chinese males, relative risks also showed a significant association with age, but no clear trend with age was present.

(d) Cancer of the Rectum: The mortality risks for cancer of the rectum among Chinese males was significantly higher than in Canadian-born males (SMR 174). Mortality risks among Chinese females was, however, not significantly different from that in Canadian-born females (SMR 116).

(e) Cancer of the Liver or Gallbladder: Mortality was relatively quite high among the Chinese population, particularly in males (SMR: males 1,046, females 302). These differences were statistically significant. The relative risk of cancer of the liver or gallbladder decreases significantly with age in Chinese males (Table 17). Among Chinese females, a decline of the relative risk with age is also present, but this was not statistically significant (Table 18).

Cancer of the Larynx:

Chinese males showed a lower risk of this cancer relative to Canadian-born males (SMR 81). Chinese females, on the other hand, showed a higher risk relative to Canadian-born females (SMR 136), But these differences were not statistically significant.

Cancer of the Lung or Bronchus:

Significantly higher mortality ratios were noted in the Chinese compared to the Canadian-born (SMR: males 126, females 176). These ratios were significantly greater than 100. The relative risks were significantly associated with age in both Chinese males and females. There was no definite trend with age among Chinese males, but in Chinese females, the relative risks increased with age from age 35 years (Table 18).

Cancer of the Prostate Gland:

The risk among Chinese males was significantly lower than that for Canadian-born males (SMR 47). No trend in the relative risks with age was discernible.

Cancer of the Breast (Female):

Mortality from breast cancer was significantly lower among Chinese females compared to Canadian-born females (SMR 63). There was a significant decreasing trend in the relative risk with age.

Cancer of the Reproductive Organs:

Mortality from cancer of the uterus or cervix was higher in Chinese females compared to Canadian-born females (SMR 144), but this difference was not statistically significant.

The ratio for ovarian cancer was significantly lower in Chinese females compared to Canadian-born females (SMR 68). The relative risks showed no association with age.

Cancer of the Bladder or Kidney:

The ratios in the Chinese population were increased compared to the Canadian-born, but the differences were not significant (SMR: males 117, females 125).

Cancer of the Brain or Nervous System:

Mortality risks among the Chinese were lower compared to the Canadian-born, but these differences were not statistically significant (SMR: males 88, females 65).

Lymphosarcoma:

There was a non-significant increased risk of this cancer among the Chinese (SMR: males 129, females 157).

Leukemias:

Mortality risk among Chinese males was not different from that in the Canadian-born males. A higher ratio was present among Chinese females, but this difference was not significant (SMR 157).

CHAPTER 4

DISCUSSION

COMPARISON OF FINDINGS WITH THOSE OF OTHER STUDIES

The results of this study in Canada are similar to those reported by King and Haenszel, and King and Locke on Chinese in the U.S. in 1959-1962 and 1968-1972 (2,3). Data from both countries show that foreign-born Chinese males, but not females, have a higher risk of overall cancer mortality relative to native-born males. The U.S. data compared the Chinese with the white U.S. population; in this Canadian study, the comparison group consisted of the Canadian-born population in which the large majority would be white.

The foreign-born Chinese population in both countries, males and females, have, relative to the comparison populations, a similar pattern of cancer mortality risks by site which is characterized by: (1) a strikingly elevated risk of cancer of the nasopharynx and a very high risk of cancer of the liver or gallbladder in both sexes; (2) excess risks for cancer of the esophagus and stomach and a low risk of cancer of the prostate in males; and (3) a high risk of lung cancer and a low risk of cancer of the breast and cancer of the ovary in females (Table 20).

A large proportion of the Chinese migrants into Canada and the U.S. came from Guangdong (or Kwangtung) province in China, comprising the so-called "Cantonese" group of immigrants (12). It would, therefore, be of interest to compare the cancer mortality experience of the Canadian

population born in China with that of the residents of Guangzhou, the capital city of Guangdong, for whom some data were available (13). Tables 21 and 22 show the cancer patterns in terms of the ranking of the five highest cancer death rates by cancer site among the three groups: Canadians born in Canada, Canadians born in China, and residents of Guangzhou. Among males, cancer of the lung and cancer of the intestines or colon were common to the three groups, but the Canadian males who were born in China had high risks for cancer of the liver or gallbladder and for cancer of the nasopharynx as did the residents of Guangzhou. Cancer of the lung ranked highest as a site of cancer mortality among both the Canadian females born in China and the residents of Guangzhou. In both groups of Chinese females, but not in the Canadian-born, cancer of the liver or gallbladder was among the five leading cancer sites; while unlike in the Canadian-born females, cancer of the ovary was not among the leading cancer sites in either group of Chinese females.

COMMENTS ON THE PROBABLE CAUSES OF SOME CANCERS; SUGGESTED FUTURE STUDIES

The descriptive profile of cancer risks observed in Canadians who were born in China enables some suggestions to be made about possible risk factors that might partly explain some of the differences in mortality by cancer site. Most cancers have multiple causes, many of which may interact in unknown ways, and the complex etiological mechanisms remain unclear. Risk factors include natural environmental factors, racial-genetic characteristics and traditional living habits. Since no information was obtained in this study about specific characteristics that may be associated with cancer in the study's populations, interpretation of the findings are necessarily exploratory

rather than explanatory in nature. The fact that the results from this study are consistent with those of studies on foreign-born Chinese population groups in the U.S. and Australia support the notion that there may be common underlying etiologic features related to these cancer types in the Chinese. Consideration of some of these factors may, therefore, help to emphasize potentially useful hypotheses about etiologic factors for certain cancer types that could form the basis for future detailed studies specially designed to investigate such hypothetical relationships.

Cancer of the Nasopharynx:

This cancer occupies a prominent and unique position in cancer risks among the Chinese in China and in Chinese migrant populations worldwide (12). In recent years, a number of epidemiologic studies on nasopharyngeal cancer in Chinese immigrants to foreign countries have been reported (14-19). These studies show that both the incidence and mortality rates in Chinese migrants are higher than in the local inhabitants. Another name for nasopharyngeal cancer is "Guangdong cancer" because Guangdong province has the highest risk for this type of cancer in China (12). A study by Huang and Wang in Guangzhou, the capital city of Guangdong, of nasopharyngeal cancer mortality over the period 1970-1976, shows a lower risk among migrants who came from outside the province of Guangdong compared with local residents of Guangzhou even though the former had resided in Guangzhou for many years (20). Parallel results were obtained for the period 1965-1975 in Shanghai where the risk of nasopharyngeal cancer among the migrants from Guangdong was higher than that in the indigenous Shanghai residents

despite the migrants' long residence in Shanghai. The authors commented on the possible relationship of environmental, racial-genetic and life-style factors to the observed differential risks of nasopharyngeal cancer in these subpopulations in China and noted that a genetic explanation of the susceptibility could not be entirely ruled out.

In the Canadian study, both Chinese males and females had extremely higher risks of death from nasopharyngeal cancer compared to Canadian-born males and females (Table 16). One possible explanation of this observation is that the case-fatality rate in Chinese is higher than in the Canadian-born group. However, the findings are also compatible with the hypothesis of a genetic predisposition in some groups of Chinese for cancer of the nasopharynx. But, in the Canadian study, the relative risk for this cancer type decreased significantly with age in both Chinese males and females (Tables 17-19). This finding is suggestive of an environmental effect in the etiology of nasopharyngeal cancer, and argues against the genetic hypothesis. On the other hand, the age trend could reflect a cohort or survivorship effect which manifests itself as a lower risk in the group remaining after those at risk of nasopharyngeal cancer have died.

Special studies would be required to investigate the various etiologic hypotheses mentioned. Such studies could be epidemiologic case-control studies which would obtain information from Chinese migrants about region of origin in China, age at entry into Canada, length of stay in Canada, and their lifestyle habits in China and Canada. If the case group consists of cancer deaths, then information about the decedents would have to be obtained from relatives and friends. If cases could be identified from cancer registries when they

first become notified, that is, while the patients are still alive, information could then be obtained directly from the patients. Studies based on cancer registries would necessarily have to be carried out in Vancouver or Toronto where there are greater aggregations of Chinese immigrants. Such studies are expected to be feasible as well as useful since, according to the 1981 census of Canada, Chinese immigrants comprise the fourth largest ethnic immigrant group in the country (21).

Cancer of the Lung:

Males and females born in China were shown to have a higher mortality rate from cancer of the lung than did the Canadian-born. The difference in risk was particularly noteworthy in Chinese females (Table 16). Also noteworthy was the lower sex ratio for lung cancer mortality among the Chinese compared to that among the Canadian-born (Tables 10 and 11). Although the relative risks were significantly associated with age in both males and females, only in females aged 35 and over was there an apparent trend of increasing risk with age (Table 18).

Higher rates among female Chinese immigrants have been reported in several countries, and it is thought that smoking does not explain most of the risk in Chinese women (12). Smoking is not as common in Chinese women as it is in Chinese men (12). A recent report has found an association between exposure to indoor burning of "smoky" coal as opposed to wood or "smokeless" coal in women in certain parts of China to be stronger than the association with tobacco smoking (22).

The increasing risk among older Chinese females in the Canadian data is difficult to interpret. Further investigation of possible risk factors for lung cancer in Chinese women other than tobacco smoking

appears to be needed. The data required for such a study would have to include a detailed history covering length of stay in Canada, environmental exposures and personal habits.

Cancers of the Digestive System:

In the Canadian study, there was a general tendency towards a higher risk of most major cancers of the digestive system in the Chinese males compared with Canadian-born males (Table 16). The sites involved were esophagus, stomach, intestines, colon, rectum, liver and gallbladder. The risk was outstandingly high for cancer of the liver or gallbladder, which also showed a very high risk in Chinese females. All of these cancer sites are of major importance as high risk cancer sites in China (12). Much study has been devoted to the numerous environmental factors which have been causally associated with these cancers: diet, carcinogens in food products, lifestyle, geographical region, socio-economic level, viral agents, etc. (12).

The notable finding in the Canadian data is evidence of a decreasing relative risk of liver cancer with age, which was statistically significant among males but not among females (17-19). This finding is consistent with the hypothesis of an environmental factor or factors being causally related to liver cancer among the Chinese in their country of origin. Studies in China have implicated a wide variety of environmental contaminants as etiologic agents in liver cancer. The more generally accepted hypothesis now is that liver cancer in the south-east of China is due to an interaction between hepatitis B virus and an environmental carcinogen, probably an aflatoxin contaminant in food (12). As in the case of cancer of the nasopharynx, further

detailed studies (preferably case-control in design), would be needed to elucidate the role of the numerous possible factors that must be taken into account in any investigation of the etiology of liver cancer.

Cancer of the Prostate:

The low risk of cancer of the prostate in Chinese men is worthy of further investigation because this might help to elucidate some of the possible etiologic factors. Numerous environmental agents have been implicated (23), and there is some evidence that sexual factors may have a causal role (24).

Cancer of the Breast (Female):

The Canadian data provide additional evidence documenting the low risk of breast cancer in Chinese (and oriental women) (3). The age-specific relative risks show a declining trend with age (that is, younger women have a higher risk) which was statistically significant. This observation may be interpreted as suggesting that younger Chinese women may be acquiring a breast cancer risk more like the Canadian-born women.

However, studies on the etiology of breast cancer have been legion and numerous hypotheses including genetic, familial, hormonal, reproductive, viral, dietary and physical factors have been tested in different populations in many parts of the world (23). Because of the myriad endogenous and exogenous factors which may or may not have etiologic importance with respect to the development of breast cancer, the findings of this study cannot throw much light on the etiology.

LIMITATIONS OF THE DATA

1. Use of the 1981 census to estimate the person-years of observation for the five-year period 1980-1984: No allowance was made for changes in the size of the population over this period of time, in particular for in- or out-migration. Because of the large discrepancy in size between the group composed of the Chinese immigrants who were born either in Mainland China, Hong Kong or Taiwan and that comprising the Canadian-born, the assumption of a constant population size over the five-year period could have seriously misrepresented the actual size of the Chinese population. Even though out-migration in either group could be assumed to be of about the same degree or at least to be relatively small in magnitude compared to the size of the corresponding population, there was the possibility that in-migration of Chinese into Canada might be relatively large during that time and would lead to an underestimate of the population at risk. This would have the effect of spuriously increasing the cancer death rates in the Chinese group since deaths in the 1980-1984 period among new immigrants would get counted in the numerator of the rates.

In order to obtain an estimate of the possible error that could have resulted from this underestimate of the Chinese population, data on Chinese immigration into Canada were obtained from the publication on Immigration Statistics from Employment and Immigration Canada for the years 1980-1982 and 1984 (25). The 1983 publication was not available at the time the search was made. The total number of Chinese immigrants coming into Canada for the four-year period ranged between 11,202 (1984) and 14,541 (1981), averaging about 7.6% of the Chinese population each year. An average number for the five-year period was calculated by sex

and age categories and a new set of death rates were computed for cancer at all sites in males and in females and in selected age- and sex-groups and for nasopharyngeal cancer in males and females in the 15-34 age group. Tests of significance showed no differences between the old and the revised rates. The conclusion was that failure to take into account new Chinese immigrants did not seriously affect the death rates that were used in the comparisons.

2. Statistics Canada has reported the results of their 20% sample of the 1981 census in which they estimated the extent of the bias due to undercoverage of the population to be of the order of 2% (26). They indicated that undercoverage was higher in certain segments of the population, e.g. young male adults and recent immigrants. If we assume that this percentage applied to Chinese immigrants, the numbers underestimated would be unlikely to affect the mortality rates significantly.

3. It is possible that the diagnosis of cancer in Chinese immigrants because of language difficulties or differences in the availability or use of medical care services might not be as adequate as in the Canadian-born. There was no way of making an estimate of the occurrence or magnitude of this form of bias. The possibility of such a bias would have to be taken into account in any detailed special studies that are carried out and procedures set up to avoid or to measure it.

CONCLUSIONS

The Canadian data show that the overall cancer mortality rates in the group of Canadians who were born in China were higher than in the Canadian-born during the period 1980-1984.

These findings are generally in agreement with the results of similar studies carried out in the U.S.A. and in Australia.

The Canadian data serve to emphasize the importance of the strikingly high, increased risk of nasopharyngeal and liver cancer in Chinese males and females compared to Western populations such as the Canadian-born. They also confirm the reported significantly lower risks for prostatic cancer in males, and for breast and ovarian cancer in Chinese females relative to such comparison populations.

These results cannot offer any explanations as to specific etiologic factors that produced the observed differences in risks, but do provide additional information that suggest potentially useful approaches to future investigations into the etiology of these types of cancer.

Table 1

Calculation of Standardized Death Rate by the Indirect Method: Cancer Mortality (all sites) for Chinese Males, Canada, 1980-1984 (the age specific cancer death rates for males born in Canada being chosen as the standard)

(1) Age in Years	(2) Population Distribution of Chinese Males in Thousands (p_j)	(3) Age Specific Cancer Death Rates in Standard Population (Males Born in Canada) per 100,000 (R_j)
15-34	173	5.99
35-54	137	60.99
55-74	54	482.22
75 +	13	1473.92
Total	377 (p)	139.79 = Crude death rate in standard population (R)

Total number of deaths observed in Chinese males = 763.

Number of deaths expected at rate in standard population:

$$\Sigma R_j p_j = \frac{1,000}{100,000}\left[(5.99 \times 173) + (60.99 \times 137) + (482.22 \times 54) + (1473.92 \times 13)\right] = 545.9$$

$$\text{Standard mortality ratio (SMR)} = \frac{\text{Observed number of deaths}}{\text{Expected number}} \times 100$$

$$= \frac{763}{545.9} \times 100 = 139.8$$

$$\text{Standardized cancer death rate} = \frac{\text{SMR}}{100} \times \text{crude death rate in standard population}$$

$$= \frac{139.8}{100} \times 139.79 = 195.4$$

Table 2

Percent Distribution of Canadian Population Born in China and Born in Canada, by Age and Sex (1981 Census)

Age	Born in China				Born in Canada			
	Males		Females		Males		Females	
	Population	%	Population	%	Population	%	Population	%
Under 15	6,350	7.77	5,765	6.87	2,667,375	26.50	2,535,090	24.93
15-34	34,695	42.44	34,600	41.21	3,866,030	38.48	3,818,575	37.55
35-54	27,345	33.45	24,585	29.58	2,065,045	20.55	2,081,105	20.46
55-75	10,820	13.24	15,510	18.47	1,273,250	12.67	1,461,735	14.38
75 and over	2,530	3.10	3,505	4.17	175,525	1.75	272,595	2.68
Total	81,740	100.00	83,965	100.00	10,047,225	100.00	10,169,100	100.00

Table 3

Number of Deaths in 1980-1984 From Cancer in Canadian Males Born in China, by Age

Kinds of Cancer	Total (%)	< 15	15-34	35-54	55-74	75 +	Not Stated
Nasopharynx, Hypopharynx	38 (4.99)	0	5	13	17	3	0
Esophagus	20 (2.62)	0	0	2	11	7	0
Stomach	50 (6.55)	0	0	7	24	19	0
Intestines, Colon	77 (10.09)	0	3	6	39	29	0
Rectum	32 (4.19)	0	0	3	10	19	0
Liver, Gallbladder	104 (13.63)	0	4	31	55	14	0
Pancreas, Other Sites	39 (5.11)	0	0	7	19	13	0
Larynx	6 (0.79)	0	0	1	2	3	0
Lung, Bronchus	212 (27.79)	0	1	28	96	87	0
Skin	2 (0.26)	0	0	0	0	2	0
Prostate	26 (3.41)	0	0	0	6	20	0
Bladder, Kidney	35 (4.59)	0	0	3	10	22	0
Brain, Nervous System	10 (1.31)	0	0	4	6	0	0
Lymphosarcoma	21 (2.75)	0	5	1	9	6	0
Hodgkin's Disease	2 (0.26)	0	0	0	0	2	0
Leukemias	22 (2.88)	0	2	5	9	6	0
Others	67 (8.78)	0	1	7	32	27	0
Total	763 (100.00)	0	21	118	345	279	0

Table 4

Number of Deaths in 1980-1984 From Cancer in Canadian Females Born in China, by Age

Kinds of Cancer	Total (%)	< 15	15-34	35-54	55-74	75 +	Not Stated
Nasopharynx, Hypopharynx	24 (4.05)	0	2	16	5	1	0
Esophagus	6 (1.01)	0	0	0	4	2	0
Stomach	21 (3.55)	0	2	3	9	7	0
Intestines, Colon	52 (8.78)	0	3	7	31	11	0
Rectum	17 (2.87)	0	1	1	6	9	0
Liver, Gallbladder	38 (6.42)	0	1	6	21	10	0
Pancreas, Other Sites	27 (4.56)	0	1	4	16	6	0
Larynx	2 (0.34)	0	0	0	1	1	0
Lung, Bronchus	123 (20.78)	0	2	6	78	37	0
Skin	0	0	0	0	0	0	0
Breast	65 (10.98)	0	4	20	29	12	0
Uterus, Cervix Uteri	39 (6.59)	0	1	9	21	8	0
Ovary	20 (3.38)	0	0	4	11	5	0
Bladder, Kidney	21 (3.55)	0	1	1	9	10	0
Brain, Nervous System	8 (1.35)	0	1	2	3	2	0
Lymphosarcoma	23 (3.88)	0	1	5	9	8	0
Hodgkin's Disease	2 (0.34)	0	0	1	1	0	0
Leukemias	27 (4.56)	3	3	3	6	12	0
Others	77 (13.01)	0	1	11	26	39	0
Total	592 (100.00)	3	24	99	286	180	0

Table 5

Number of Deaths in 1980-1984 From Cancer in Canadian Males Born in Canada, by Age

Kinds of Cancer	Total (%)	< 15	15-34	35-54	55-74	75 +	Not Stated
Nasopharynx, Hypopharynx	489 (0.95)	5	5	94	326	59	0
Esophagus	1,319 (2.56)	0	3	180	874	262	0
Stomach	2,477 (4.80)	1	18	285	1,448	725	0
Intestines, Colon	4,496 (8.71)	0	43	485	2,627	1,341	0
Rectum	1,731 (3.35)	0	10	197	1,049	475	0
Liver, Gallbladder	958 (1.86)	9	14	116	597	222	0
Pancreas, Other Sites	3,761 (7.29)	5	31	445	2,322	958	0
Larynx	728 (1.41)	0	1	106	497	124	0
Lung, Bronchus	16,505 (32.00)	1	36	2,049	11,428	2,991	0
Skin	760 (1.47)	0	89	219	318	134	0
Prostate	4,797 (9.30)	3	0	71	2,203	2,519	1
Bladder, Kidney	2,740 (5.31)	10	10	310	1,523	887	0
Brain, Nervous System	1,523 (2.95)	100	157	375	755	136	0
Lymphosarcoma	1,571 (3.05)	38	113	243	830	347	0
Hodgkin's Disease	307 (0.60)	1	91	71	101	43	0
Leukemias	2,089 (4.05)	181	220	283	920	485	0
Others	5,332 (10.34)	133	317	768	2,880	1,233	1
Total	51,583 (100.00)	487	1,158	6,297	30,698	12,941	2

Table 6

Number of Deaths in 1980-1984 From Cancer in Canadian Females Born in Canada, by Age

Kinds of Cancer	Total (%)	< 15	15-34	35-54	55-74	75 +	Not Stated
Nasopharynx, Hypopharynx	152 (0.34)	1	3	23	93	32	0
Esophagus	513 (1.14)	0	2	39	276	196	0
Stomach	2,316 (5.15)	0	22	159	1,440	695	0
Intestines, Colon	5,121 (11.38)	1	39	519	2,518	2,044	0
Rectum	1,263 (2.81)	1	11	136	606	509	0
Liver, Gallbladder	1,098 (2.44)	7	16	80	576	419	0
Pancreas, Other Sites	3,585 (7.97)	2	15	327	1,893	1,348	0
Larynx	157 (0.35)	0	0	24	107	26	0
Lung, Bronchus	6,236 (13.86)	1	40	1,216	3,976	1,003	0
Skin	572 (1.27)	4	60	191	193	124	0
Breast	9,098 (20.23)	0	147	2,151	4,939	1,861	0
Uterus, Cervix Uteri	2,394 (5.32)	0	109	442	1,280	563	0
Ovary	2,669 (5.93)	5	53	496	1,587	528	0
Bladder, Kidney	1,455 (3.23)	9	19	139	704	584	0
Brain, Nervous System	1,200 (2.67)	84	106	253	621	135	1
Lymphosarcoma	1,299 (2.89)	16	54	173	649	407	0
Hodgkin's Disease	180 (0.40)	2	48	46	53	31	0
Leukemias	1,619 (3.60)	137	140	222	618	502	0
Others	4,056 (9.02)	113	148	559	1,576	1,660	0
Total	44,983 (100.00)	383	1,032	7,195	23,705	12,667	1

Table 7

Cancer Mortality Rates (Per 100,000) 1980-1984, and Sex Differentials, in Canadians Born in China and Born in Canada, by Age

Age Groups (Yrs)	Males		Females		Ratio Chinese/Canadian	
	Born in China	Born in Canada	Born in China	Born in Canada	Males	Females
Under 15	0	3.65	10.40	3.02	---	3.44
15-34	12.11	5.99	13.87	5.41	2.02	2.56
35-54	86.30	60.99	80.54	69.15	1.41	1.16
55 - 74	637.71	482.20	368.79	324.34	1.32	1.14
75 and over	2205.53	1474.55	1027.10	929.36	1.50	1.11
Total: Crude Rate	186.69	102.68	141.01	88.47	1.82	1.59
Standardized Rate	144.77	-	102.62	-	1.41	1.16

Table 8

Cancer Mortality Rates (Per 100,000) 1980-1984, and Sex Differentials, in Canadians Born in China, by Age

Age Groups (Yrs)	Mortality Rate Per 100,000		Sex Ratio (M/F)	Sex Difference (M-F)
	Males	Females		
Under 15	0	10.40	0	-10.40
15-34	12.11	13.87	0.87	-1.76
35-54	86.30	80.54	1.07	5.76
55-74	637.71	368.79	1.73	268.92
75 and over	2205.53	1027.10	2.15	1178.43
Total: Crude Rate	186.69	141.01	1.32	45.68
Standardized Rate	144.77	102.62	1.41	42.15

Table 9

Cancer Mortality Rates (Per 100,000) 1980-1984, and Sex Differentials, in Canadians Born in Canada, by Age

Age Groups (Yrs)	Mortality Rate Per 100,000		Sex Ratio (M/F)	Sex Difference (M-F)
	Males	Females		
Under 15	3.65	3.02	1.21	0.63
15-34	5.99	5.41	1.11	0.58
35-54	60.99	69.15	0.88	-8.16
55-74	482.20	324.34	1.49	157.86
75 and over	1474.55	929.36	1.59	545.19
Total Rate	102.68	88.47	1.16	14.21

Table 10

Cancer Standardized Mortality Rates (Per 100,000) 1980-1984, and Sex Differentials, for Specific Cancer Sites, in Canadians Born in China

Kinds of Cancer	Males	Females	Sex Ratio (M/F)	Sex Difference (M-F)
Nasopharynx, Hypopharynx	7.53	4.23	1.78	3.30
Esophagus	3.86	1.43	2.70	2.43
Stomach	9.29	3.64	2.55	5.65
Intestines, Colon	14.22	8.80	1.62	5.42
Rectum	6.00	2.88	2.08	3.12
Liver, Gallbladder	19.96	6.52	3.06	13.44
Pancreas, Other Sites	7.40	4.60	1.61	2.80
Larynx	1.17	0.42	2.79	0.75
Lung, Bronchus	41.33	21.61	1.91	19.72
Bladder, Kidney	6.39	3.58	1.78	2.81
Brain, Nervous System	2.66	1.54	1.73	1.12
Lymphosarcoma	5.76	4.01	1.44	1.75
Hodgkin's Disease	0.28	0.64	0.44	-0.36
Leukemias	4.46	4.99	0.89	-0.53
Others	12.86	13.35	0.96	-0.49
Total	144.77	102.62	1.41	42.15

Table 11

Cancer Mortality Rates (Per 100,000) 1980-1984, and Sex Differentials, for Specific Cancer Sites, in Canadians Born in Canada

Kinds of Cancer	Males	Females	Sex Ratio (M/F)	Sex Difference (M-F)
Nasopharynx, Hypopharynx	0.97	0.30	3.23	0.67
Esophagus	2.63	1.01	2.60	1.62
Stomach	4.93	4.55	1.08	0.38
Intestines, Colon	8.95	10.07	0.89	-1.12
Rectum	3.45	2.48	1.39	0.97
Liver, Gallbladder	1.91	2.16	0.88	-0.25
Pancreas, Other Sites	7.49	7.05	1.06	0.44
Larynx	1.45	0.31	4.68	1.14
Lung, Bronchus	32.85	12.26	2.68	20.59
Skin	1.51	1.13	1.34	0.38
Bladder, Kidney	5.45	2.86	1.91	2.59
Brain, Nervous System	3.03	2.36	1.28	0.67
Lymphosarcoma	3.13	2.55	1.23	0.58
Hodgkin's Disease	0.61	0.35	1.74	0.26
Leukemias	4.16	3.18	1.31	0.98
Others	10.61	7.98	1.33	2.63
Total	102.68	88.47	1.16	14.21

Table 12

Cancer Mortality Rates (Per 100,000) 1980-1984, in Canadians Born in Canada and Born in China (Males)

Kinds of Cancer	Born in Canada	Born in China	
	Crude (Standard)	Crude	Standardized
Nasopharynx, Hypopharynx	0.97	9.30	7.53
Esophagus	2.63	4.89	3.86
Stomach	4.93	12.23	9.29
Intestines, Colon	8.95	18.84	14.22
Rectum	3.45	7.83	6.00
Liver, Gallbladder	1.91	25.45	19.96
Pancreas, Other Sites	7.49	9.54	7.40
Larynx	1.45	1.47	1.17
Lung, Bronchus	32.85	51.87	41.33
Skin	1.51	0.49	0.36
Prostate	9.55	6.36	4.51
Bladder, Kidney	5.45	8.56	6.39
Brain, Nervous System	3.03	2.45	2.66
Lymphosarcoma	3.13	5.14	5.76
Hodgkin's Disease	0.61	0.49	0.28
Leukemias	4.16	5.38	4.46
Others	10.61	16.39	12.86
Total	102.68	186.69	144.77

Table 13

Cancer Mortality Rates (Per 100,000) 1980-1984, in Canadians Born in Canada and Born in China (Females)

Kinds of Cancer	Born in Canada	Born in China	
	Crude (Standard)	Crude	Standardized
Nasopharynx, Hypopharynx	0.30	5.72	4.23
Esophagus	1.01	1.11	1.43
Stomach	4.55	5.00	3.64
Intestines, Colon	10.07	12.39	8.80
Rectum	2.48	4.05	2.88
Liver, Gallbladder	2.16	9.05	6.52
Pancreas, Other Sites	7.05	6.43	4.60
Larynx	0.31	0.48	0.42
Lung, Bronchus	12.26	29.30	21.61
Skin	1.13	0	0
Breast	17.89	15.48	11.29
Uterus, Cervix uteri	4.71	9.29	6.79
Ovary	5.25	4.76	3.56
Bladder, Kidney	2.86	5.00	3.58
Brain, Nervous System	2.36	1.91	1.54
Lymphosarcoma	2.55	5.48	4.01
Hodgkin's Disease	0.35	0.48	0.64
Leukemias	3.18	6.43	4.99
Others	7.98	18.34	13.35
Total	88.47	141.01	102.62

Table 14

Mortality Rates (Per 100,000) 1980-1984, for
Ten Leading Cancer Sites in Canadians
Born in Canada and Born in China
(Males)

Rank	Born in Canada		Born in China	
	Cancer Site	Rate per 100,000	Cancer Site	Standardized Rate per 100,000
1	Lung, Bronchus	32.85	Lung, Bronchus	41.33
2	Prostate	9.55	Liver, Gallbladder	19.96
3	Intestines, Colon	8.95	Intestines, Colon	14.22
4	Pancreas, Other Sites	7.49	Stomach	9.29
5	Bladder, Kidney	5.45	Nasopharynx, Hypopharynx	7.53
6	Stomach	4.93	Pancreas, Other Sites	7.40
7	Leukemias	4.16	Bladder, Kidney	6.39
8	Rectum	3.45	Rectum	6.00
9	Lymphosarcoma	3.13	Lymphosarcoma	5.76
10	Brain, Nervous System	3.03	Prostate	4.51

Table 15

Mortality Rates (Per 100,000) 1980-1984, for
Ten Leading Cancer Sites in Canadians
Born in Canada and Born in China
(Females)

Rank	Born in Canada		Born in China	
	Cancer Site	Rate per 100,000	Cancer Site	Standardized Rate per 100,000
1	Breast	17.89	Lung, Bronchus	21.61
2	Lung, Bronchus	12.26	Breast	11.29
3	Intestines, Colon	10.07	Intestines, Colon	8.80
4	Pancreas, Other Sites	7.05	Uterus, Cervix uteri	6.79
5	Ovary	5.25	Liver, Gallbladder	6.52
6	Uterus, Cervix uteri	4.71	Leukemias	4.99
7	Stomach	4.55	Pancreas, Other Sites	4.60
8	Leukemias	3.18	Nasopharynx, Hypopharynx	4.23
9	Bladder, Kidney	2.86	Lymphosarcoma	4.01
10	Lymphosarcoma	2.55	Stomach	3.64

Table 16

Observed (Obs) and Expected (Exp) Numbers and SMR for Cancer Deaths by Site Occurring among Canadian Males and Females Born in China: Canada 1980-1984

Kinds of Cancer	Males			Females		
	Obs	Exp	SMR (95% CL)	Obs	Exp	SMR (95% CL)
Nasopharynx, Hypopharynx	38	4.91	774 (528;1020)*	24	1.70	1414 (848;1980)*
Esophagus	20	13.59	147 (83;211)	6	5.45	110 (22;198)
Stomach	50	26.53	188 (136;241)*	21	26.29	80 (46;114)
Intestines, Colon	77	48.46	159 (123;194)*	52	59.48	87 (64;111)
Rectum	32	18.37	174 (114;235)*	17	14.68	116 (61;171)
Liver, Gallbladder	36	18.50	1046 (846;1248)*	38	12.59	302 (206;398)*
Pancreas, Other Sites	39	39.43	99 (68;130)	27	41.42	65 (41;90)*
Larynx	6	7.41	81 (16;146)	2	1.47	136 (-53;324)
Lung, Bronchus	212	168.44	126 (109;143)*	123	69.81	176 (145;207)*
Prostate	26	55.03	47 (29;65)*	-	-	-
Breast	-	-	-	65	103.08	63 (48;78)*
Uterus, Cervix uteri	-	-	-	39	27.03	144 (99;190)
Ovary	-	-	-	20	19.49	68 (38;98)*
Bladder, Kidney	35	29.83	117 (78;156)	21	16.79	125 (72;179)
Brain, Nervous System	10	11.38	88 (33;142)	8	12.27	65 (20;110)
Lymphosarcoma	21	16.29	129 (74;184)	23	14.65	157 (93;221)
Leukemias	22	20.53	107 (62;152)	27	17.21	157 (97;216)
Others	67	55.26	121 (92;150)	77	46.01	167 (130;205)*
Total	763	540.18	141 (131;151)*	592	509.53	116 (107;126)*

* Risks were significantly different from 100 at the 5% level.

Table 17

Relative Risks for Cancer Deaths by Site Occurring Among Canadian Males Born in China, by Age: Canada 1980-1984

Kinds of Cancer	Age Groups (Yrs)				
	15-34	35-54	55-74	75 +	Total
Nasopharynx, Hypopharynx	110.9	10.4	6.1	3.5	7.7
Esophagus	0	0.84	1.5	1.8	1.5
Stomach	0	1.8	2.0	1.8	1.9
Intestines, Colon	7.8	0.93	1.8	1.5	1.6
Rectum	0	1.2	1.1	2.8	1.7
Liver, Gallbladder	31.8	20.2	10.8	4.4	10.5
Pancreas, Other Sites	0	1.2	0.96	0.94	0.99
Larynx	0	0.71	0.47	1.7	0.81
Lung, Bronchus	3.1	1.0	0.99	2.0	1.3
Prostate	0	0	0.32	0.55	0.47
Bladder, Kidney	0	0.73	0.77	1.7	1.2
Brain, Nervous System	0	0.81	0.94	0	0.88
Lymphosarcoma	4.9	0.31	1.3	1.2	1.3
Leukemias	1.0	1.3	1.2	0.86	1.1
Others	0.35	0.68	1.3	1.5	1.2
Total	2.0	1.4	1.3	1.5	1.4

Table 18

Relative Risks for Cancer Deaths by Site Occurring Among Canadian Females Born in China, by Age: Canada 1980-1984

Kinds of Cancer	Age Groups (Yrs)				
	15-34	35-54	55-74	75 +	Total
Nasopharynx, Hypopharynx	73.6	58.9	5.1	2.4	14.1
Esophagus	0	0	1.4	0.79	1.1
Stomach	10.0	1.6	0.59	0.78	0.80
Intestines, Colon	8.5	1.1	1.2	0.42	0.87
Rectum	10.0	0.62	0.93	1.4	1.2
Liver, Gallbladder	6.9	6.4	3.4	1.9	3.0
Pancreas, Other Sites	7.4	1.0	0.80	0.35	0.65
Larynx	0	0	0.88	3.0	1.4
Lung, Bronchus	5.5	0.42	1.8	2.9	1.8
Breast	3.0	0.79	0.55	0.50	0.63
Uterus, Cervix uteri	1.0	1.7	1.6	1.1	1.4
Ovary	0	0.68	0.65	0.74	0.68
Bladder, Kidney	5.8	0.61	1.2	1.3	1.2
Brain, Nervous System	1.0	0.67	0.46	1.2	0.65
Lymphosarcoma	2.0	2.4	1.3	1.5	1.6
Hodgkin's Disease	0	0	1.8	1.8	1.8
Leukemias	2.4	1.1	0.92	1.9	1.6
Others	0.75	1.7	1.6	1.8	1.7
Total	2.6	1.2	1.1	1.1	1.2

Table 19

The Results of Tests of Homogeneity of Relative Risks of Cancer Deaths at Different Ages by Site Occurring Among Canadian Males and Females Born in China: Canada 1980-1984

Kinds of Cancer	Males			Females		
	d.f.	χ^2	P Value	d.f.	χ^2	P Value
Nasopharynx, Hypopharynx	3	66.0	< 0.01	2	55.0	< 0.01
Esophagus	2	1.0	> 0.05	1	0.4	> 0.05
Stomach	2	0.1	> 0.05	3	23.6	< 0.01
Intestines, Colon	3	11.5	< 0.01	3	32.7	< 0.01
Rectum	2	6.7	< 0.05	3	7.7	> 0.05
Liver, Gallbladder	3	64.1	< 0.01	3	6.9	> 0.05
Pancreas, Other Sites	2	0.3	> 0.05	3	13.4	< 0.01
Larynx	2	2.3	> 0.05	1	0.8	> 0.05
Lung, Bronchus	3	25.9	< 0.01	3	26.8	< 0.01
Prostate	1	1.4	> 0.05	-	-	-
Breast	-	-	-	3	14.0	< 0.01
Uterus, Cervix uteri	-	-	-	3	1.1	> 0.05
Ovary	-	-	-	2	0.1	> 0.05
Bladder, Kidney	2	5.7	> 0.05	3	3.5	> 0.05
Brain, Nervous System	1	0.1	> 0.05	3	1.3	> 0.05
Lymphosarcoma	3	12.9	< 0.01	3	1.4	> 0.05
Leukemias	3	0.6	> 0.05	4	1.1	> 0.05
Others	3	5.6	> 0.05	3	1.1	> 0.05
Total	3	5.1	> 0.05	4	76.3	< 0.01

χ^2 value Critical Standard:

d.f. = 1	5% = 3.84	1% = 6.63
d.f. = 2	5% = 5.99	1% = 9.21
d.f. = 3	5% = 7.81	1% = 11.34
d.f. = 4	5% = 9.49	1% = 13.28

Table 20

SMR for Cancers by Site Occurring Among Idai (Foreign-born) in Hawaii, California, and New York City (1968-1972) and Among Foreign-born Chinese in Canada (1980-1984), by Sex

Kinds of Cancer	Males		Females	
	Idai in U.S.A.[1]	Foreign-born Chinese in Canada	Idai in U.S.A.[1]	Foreign-born Chinese in Canada
Nasopharynx	3059*	774*	2600*	1414*
Esophagus	245*	147	56	110
Stomach	193*	188*	174*	80
Intestines, Colon	126*	159*	48*	87
Rectum	153*	174	83	116
Liver, Gallbladder	1089*,327	1046*	522*	302*
Lung, Bronchus	122*	126*	142*	176*
Prostate	34*	47*	-	-
Breast	-	-	52*	63*
Uterus, Cervix uteri	-	-	75,79	144
Ovary	-	-	58*	68*
Bladder, Kidney	73,57	117	61,100	129
Brain, Nervous System	93	89	71	65
Leukemias	72	107	102	157*

[1] Data from JNCI 65: 1141-1148, 1980 (Ref. No. 3).

* Risks were significantly different from 100 at the 5% level.

Table 21

Five Leading Sites of Cancer Mortality Among Males Born in Canada and Born in China: Canada 1980-1984; and Among Male Residents in Guangzhou: China 1980*

Rank	Kinds of Cancer		
	Born in Canada	Born in China	Guangzhou Residents
1	Lung, Bronchus	Lung, Bronchus	Liver, Gallbladder
2	Prostate	Liver, Gallbladder	Lung, Bronchus
3	Intestines, Colon	Intestines, Colon	Nasopharynx
4	Bladder, Kidney	Stomach	Intestines, Colon
5	Stomach	Nasopharynx	Esophagus

* Cancer mortality data from Guangzhou were taken from Wang, Z.J. et al. Acta Academiae Med. Zhongshan 2: 837, 1982 (Ref. No. 13).

Table 22

Five Leading Sites of Cancer Mortality Among Females Born in Canada and Born in China: Canada 1980-1984; and Among Female Residents in Guangzhou: China 1980*

Rank	Kinds of Cancer		
	Born in Canada	Born in China	Guangzhou Residents
1	Breast	Lung, Bronchus	Lung, Bronchus
2	Lung, Bronchus	Breast	Liver, Gallbladder
3	Intestines, Colon	Intestines, Colon	Intestines, Colon
4	Ovary	Uterus, Cervix uteri	Uterus and Breast
5	Uterus, Cervix uteri	Liver, Gallbladder	Stomach

* Cancer mortality data from Guangzhou were taken from Wang, Z.J. et al. Acta Academiae Med. Zhongshan 2: 837, 1982 (Ref. No. 13).

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