The Epidemiology of Cancer

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ABSTRACT

The epidemiology of cancer has been described as the study of cancer's distribution by age, sex, economic status, etc. and of those factors which determine its prevalence. Twenty-five years ago the mortality rate in Canada for all sites of malignancy was approximately identical for both males and females, but since that time there has been a constant and significant increase in cancer among males; a slight, yet significant, decrease among females.

In the past few years mortality from cancer of the respiratory system has shifted from a minor to a major component of cancer mortality. In addition, migration from one country to another changes the cancer risk; patterns of disease among migrants shift substantially to those found in the country to which they have migrated. Cigarette smokers have a higher risk of bladder cancer than non-smokers.

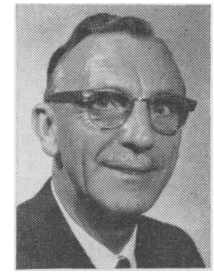
The study of occupational exposure to specific chemical and physical agents is potentially one of the most important ways in which analytical epidemiologic methods can contribute to the knowledge of cancer etiology. One of the basic requirements for successful epidemiology programs is the organization of population-based cancer registries which provide the necessary descriptive information on the population.

AT THE INTERNATIONAL CANCER CONGRESS held in Tokyo in 1966, Sir Alexander Haddow, the Director of the Chester Beatty Research Institute in London and the President of the International Union Against Cancer, made the following statement: "We are impressed by the probability that a much higher proportion of human cancer than we had ever recently suspected—perhaps amounting to as much as 80 percent—may be due to environmental causes".

This challenging statement made by one of the world's renowned cancer researchers has prompted detailed studies of cancer incidence and mortality in various countries to assess the reliability of the 80 percent figure given by Sir Alexander and secondly, it has stimulated epidemiological studies in cancer prevention.

Variations Of Cancer

The epidemiology of cancer has been described as the study of cancer's distribution by age, sex, economic status, etc. and of those factors which determine its prevalence. This definition suggests that cancer epidemiology must be considered in terms of descriptive epidemiology dealing with the distribution of the disease and analytic epidemiology concerned with the search for causative factors. It is unfortunate, however, that much of cancer epidemiology has been confined to the descriptive phase and little attention given to interpretation of the distribution of the disease in terms of possible causal factors. Nevertheless, descriptive epidemiology has revealed some remarkable variations in the major forms of cancer between countries. In Canada, for example, the lung is the most prevalent cancer site in men but in Japan it is relatively insignificant; cancer of the stomach is the major problem—four times more prevalent than in Canada. Skin cancer offers another example of variation between countries. In South Africa and Australia this site of cancer in both males and females is the highest in the world, two to three times higher than in Canada. Among females cancers of the breast and uterus show wide variation from country to country. The Netherlands, Scotland, Denmark and Canada, for instance, have four to six times the incidence found in Finland, Portugal, Chile and



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Japan. The actual death rate in Canada for cancer of the breast is approximately 24 per 100,000 population. In Japan it is four per 100,000 compared with a figure for Chile of approximately 22 per 100,000. There are other parts of the world where cancer of the liver or oesophagus are the most prevalent forms of the disease.

In Canada, mortality data show highly significant differences in the distribution of cancer sites. Twenty-five years ago the mortality rate in Canada[1] for all sites of malignancy was approximately identical for both males and females, but since that time there has been a constant and significant increase in cancer among males; a slight, yet significant, decrease among females. The age adjusted death rate for males has increased nearly 25 percent while that for females has decreased approximately seven percent. Before 1944 the cancer death rate in Canada was always greater for females than for males. Among the major sites of cancer in Canadians the most striking decline has occurred in cancer of the stomach for both sexes. The male death rate has dropped approximately 35 percent and the female rate approximately 45 percent. Similar declines have been reported from other countries but to date there is no satisfactory explanation of this. Cancer of the intestine appears to be quite different in terms of its male-female distribution from any other cancer site. Without exception the female rate exceeds the male rate in each province. Twenty-five years ago the male mortality rate was 15 per 100,000 whereas the female rate was 20 per 100,000. Today the rates for the two sexes are approximately equal.

Cancer Of The Lung

In the past few years mortality from cancer of the respiratory system has shifted from a minor to a major component of cancer mortality. Twenty-five years ago it accounted for five percent of all cancer deaths. It now accounts for nearly 15 percent. For males the percentages have increased from seven to approximately 20 and the actual death rate has increased more than three times during this period. In Canada, the level of mortality from cancer of the respiratory system is matched by a number of western countries, and exceeded by several. In an international study by Segi[2] Canada ranks 16th in an analysis of 24 countries. There has been much speculation as to whether the increased lung cancer rate was real or an artifact attributable to improved diagnosis and case reporting but the sustained rise continuing to the present day leaves little doubt that this type of cancer is really increasing. To check reliability of diagnosis of primary lung cancer in Canada a study[3] undertaken in 1959 investigated some 2,235 deaths through the doctors who had signed the death certificates. It revealed that 95.2 percent were based solely on clinical evidence.

Although cancer of the breast was a classic example of a stable mortality rate for many years there is evidence in Canada of a slight but significant increase. Since this observation is based on mortality data it should be mentioned that morbidity data indicate a substantial rise in the incidence of female breast cancer. For example, in Saskatchewan the incidence rate per 100,000 females increased from approximately 38 to 60—a rise of more than 50 percent[4] since 1944. If this experience is true elsewhere in Canada then it undoubtedly accounts for the improved survival experience reported by the Canadian provinces in recent years.

International List

The distinction between cancer of the cervix uteri and of the corpus uteri was not introduced until 1939 with the fifth revision of the International List. In addition there has recently been increasing emphasis on greater specificity of diagnosis within the uterus, due mainly to the development of cytological screening programs. It becomes impossible, therefore, to describe changes over time in cancer of the cervix as distinct from cancer of the corpus. But if these are combined, a significant decrease of nearly 40 percent in the age adjusted death rate has occurred.

These variations in some of the major sites of cancer in Canadians require more extensive study for it has been shown elsewhere that within a country peculiarities in cancer distribution often point to environmental factors. Notable among these are variations found with socio-economic status, for example, cancers of the cervix and stomach show three to four times higher rates in unskilled workers and their wives than in professional people. In direct contrast cancers of the breast are more common in higher income groups.

Genetic differences between populations or segments of the same population may also contribute to these site variations but existing evidence makes it unlikely that they could account for such large differences. In addition, migration from one country to another changes the cancer risk; patterns of disease among migrants shift substantially to those found in the country to which they have migrated. For example, stomach cancer among the Japanese[5] varies between those in Japan and those who have migrated to Canada or the United States. There is significantly less stomach cancer among the immigrants and less again in those born in North America of Japanese parents. It would appear that for some forms of cancer in one or two generations the migrant group attains the risk characteristic of the host country indicating that the cancer pattern is probably environmental rather than related to the genetic composition of the population.

In addition to these examples of descriptive findings there are other epidemiologic aspects of malignant disease which have attracted attention. There is, for example, considerable evidence of the significance of viruses in the etiology of cancer both in domestic and laboratory animals and this has led to interest in the question of whether or not human cancers tend to cluster in time and/or space. There are long-standing impressions of "cancer houses" and these have been reinforced by recent "outbreaks" of leukemia. However, where leukemia clustering has been statistically evaluated negative or equivocal results

have been found and it seems quite clear that most leukemia cases do not cluster and therefore do not conform to the spread of the classical infectious diseases. However, rare clusters do occur, particularly in the case of acute lymphoblastic leukemia in children. A study by Goldenberg[6] in Manitoba indicated a suspicion of clustering in the city of Winnipeg. Interpretation of these rare clusters is difficult in view of the negative evidence we have about communicability of the great majority of leukemia cases. Perhaps the only human tumor for which there is reasonably reliable evidence of clustering is Burkitt's Lymphoma[7] which has been shown to cluster in particular districts of the Uganda in Africa and also to vary between districts in different years.

Analytic Epidemiology

This brief account indicates the contribution of descriptive epidemiology to our knowledge of cancer. It is now appropriate to discuss analytic epidemiology and its contribution. Analytic epidemiology can be described as the testing of hypotheses which seek to identify causal factors sufficient to explain the distribution of the disease in question. The most satisfactory evidence is that needed to test arguments such as "if the difference between two populations in disease frequency is dependent on differences with respect to a specific factor, then, within each population this factor should be found more frequently in people with the disease than in those without." Unfortunately the data required to test such inferences are rarely available and special studies to obtain them are usually required. The following studies of this nature have been undertaken in Canada.

Cigarette smokers have a higher risk of bladder cancer than non-smokers and Dr. W. K. Kerr[8] is one of those who has reported on this phenomenon. Although the strength of this relationship is considerably less than that for cancer of the lung heavy cigarette smokers appear to have a bladder cancer rate about five times that of non-smokers. This is because a number of end products of inhaled smoke are excreted in the urine and biochemical mechanisms which would reasonably explain the relationship to cancer have been identified.

In special studies of two population groups, Dr. P. E. Enterline[9] of McGill University investigated factors responsible for the high incidence of lung cancer in Jewesses and conducted a detailed study in the city of Montreal. His report will include analyses of diet, social habits and smoking history. Dr. Louis Dionne of Quebec City has conducted a similar study among nuns. It has already been reported[10] that cancer of the cervix does not occur among nuns.

Occupational Hazards

The study of occupation exposure to specific chemical and physical agents is potentially one of the most important ways in which analytical epidemiologic methods can contribute to the knowledge of cancer etiology. The demonstration of a specific occupational hazard is important to workers in that particular occupation but in addition such hazards give an opportunity to study the effect of *high* doses of substances to which the population at large may be exposed in *lower* doses. An example is Quebec's asbestos industry where workers occupationally exposed to asbestos fibres have high rate of carcinoma of the lung and develop plural mesotheliomas. However, the increasing prevalence of such fibres in the general environment and the increasing frequency of asbestos fibres found in the lungs of persons without occupational exposure has led to concern about this hazard to the population at large.

Dr. J. C. McDonald, Head of the Department of Epidemiology and Health at McGill University has undertaken a complete study of all cases of mesothelioma in Canada over the past ten years. Another occupational cancer which has attracted considerable interest is that of the increased incidence of lung cancer in a fluorspar mining community. A complete investigation of the respiratory symptoms, lung function and chest radiography among the fluorspar miners of St. Lawrence, Newfoundland was undertaken by the Federal Department of Occupational Health.[11] The incidence of carcinoma of the lung in this occupational group was found to be 25 times greater than in the rest of the Province and the study indicated that a high level of radon gas in the mine was a significant factor.

Registries

One of the basic requirements for successful epidemiology programs is the organization of operation of population-based cancer registries which provide the necessary descriptive information on the population. In many provinces such registries have been in operation for ten or more years and beginning on January 1, 1969 these data were transmitted to the Dominion Bureau of Statistics for its national cancer reporting system. This will permit epidemiology studies to be done on a national basis and will undoubtedly reveal factors related to cancer control in Canada that require investigation. To take the maximum advantage of this opportunity to develop cancer epidemiology in Canada, the National Cancer Institute of Canada has recently appointed a full time epidemiologist to its senior staff. When one considers that perhaps the greatest contribution of epidemiology to the fight against cancer has been the demonstration that many of the disease's prevalent forms are preventable, continuing epidemiological studies hold great promise for the future control and ultimate elimination of cancer. ◄

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