Environment and health: 4. Cancer

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Review

Synthèse

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One of the urgent environmental health issues of the past 25 years has been workplace and community exposures and the risk of cancer. In the United States, much of the concern has focused on toxic chemicals and radiation, both ionizing and nonionizing, and their relation to clusters of cancer in communities, factories and sometimes schools. Citizens' and workers' organizations have focused on some dramatic examples, such as Times Beach, Missouri,[1] and Love Canal, New York,[2] the residents of both locations having been evacuated because of community exposure to carcinogenic chemicals such as dioxin, and the Oak Ridge National Laboratory, in Tennessee,[3] where excess radiation has increased the risk of death from leukemia in the workforce. In Europe, widespread concern followed the chemical plant explosion in Seveso, Italy,[4] and the nuclear plant disaster in Chernobyl, Ukraine.[5] However, numerous, less publicized examples have occurred in communities throughout North America, and health care providers have been asked to evaluate the causes and implications of many such local concerns. In this article I address 3 aspects of the problem: the background of cancer incidence and mortality against which local clusters or excess cases are assessed, the types of exposures that are known or suspected causes of such clusters, and the implications for health care providers who wish to provide guidance for concerned patients and communities.

Understanding cancer trends

Over the past 30 years the incidence of cancer in Canada has risen, from an age-adjusted rate for all cancer types of 276.0 (females) and 334.7 (males) per 100 000 in 1971 to an estimated 345.4 and 446.4 per 100 000, respectively, in 2000 (Fig. 1).[6] Similarly in the United States the incidence rate has risen steadily, from an age-adjusted rate for all cancer types of 320.0 per 100 000 in 1973 to 392.0 per 100 000 in 1995.[7] The age-adjusted cancer mortality rates in the 2 countries have risen and recently fallen during this period. Because of improved treatments for some cancers and declining lung cancer mortality among men in both countries, the cancer mortality rate rose and then declined since 1975. However, there are some important trends in specific types of cancer that are revealing.

Fig. 2 shows the main types of cancer for which there have been significant trends in incidence or mortality, or both, in Canada. The trends in the United States are similar except for a few cancer types. For example, over the past 25 years in the United States, thyroid cancer mortality has declined and incidence has increased, and bladder cancer incidence has increased and mortality has declined. Some of these trends, such as the decreasing incidence and mortality from stomach cancer, are not new and have been associated with improvements in food quality and safety over the past century. Likewise, the decreasing incidence and mortality from cervical cancer are most likely the result of intensive screening efforts and therapeutic efficacy. The most worrisome trends, however, are the cancer types in which both incidence and mortality have been increasing for the past 2 decades or more. These include lung cancer in women, non-Hodgkin's lymphoma and melanoma. Some, for example non-Hodgkin's lymphoma, have been associated with environmental and occupational exposures to carcinogens.

Recently, attention in the United States has focused on the decline in mortality for some of the more common cancer types, including breast and gynecologic cancers, prostate cancer, lung cancer in men and colorectal cancer in both sexes. This trend has been especially evident during 1991–1995. The age-adjusted cancer mortality declined 0.5% per year on average during this period, which some observers attributed to reduced smoking among men and better treatment of the more common cancers other than lung cancer.[8] Although any reversal in the long-term up-

ward trend in cancer mortality is welcome, the recent decline is really quite modest. Considering the decrease in mortality from heart disease and stroke over the past 25 years, and the enormous resources devoted toward reducing mortality from cancer during the same period, it is surprising that more progress has not been made.

Another measure of the national burden of cancer is the estimated lifetime risk of having an invasive malignant disease. The most recent published data from the National Cancer Institute of Canada calculate this risk to be 40% for men and 35% for women.[6] The corresponding lifetime risks in the United States are 44% and 38%.[7] These figures are higher than the often quoted "1 in 3" and partly reflect the overall aging of the North American population. However, these lifetime risks carry with them a prospect of much suffering and distress for cancer patients and their families. This is the motivation to look for avoidable causes of cancer, along with the continued effort to improve treatment.

Occupational and environmental causes of cancer

Several authors have attempted to quantify the avoidable causes of cancer. In 1981 a widely cited report by Doll and Peto[9] identified tobacco products and diet as the largest contributors to cancer mortality among white people under age 65 in the United States, with a relatively small contribution by occupation and industrial pollution. More recently, a group at the Harvard Center for Cancer Prevention[10] revised these estimates slightly and suggested that 30% of total cancer deaths were due to tobacco and another 30% were due to adult diet and obesity. This group estimated that 5% of cancer deaths are due to occupational factors and 2% to environmental pollution and the remainder due to a variety of other factors. The accuracy of these estimates is open to question, but it is not productive to play one cancer cause off against another or to trivialize an avoidable cause that does not equal the large impact of tobacco on the overall cancer burden. Clearly, some factors interact and magnify the effect of each acting separately; asbestos and tobacco smoke in workplaces, or tobacco smoke and radon in homes are 2 examples of such synergistic exposures. The point is to take action wherever it is possible to reduce cancer risk.

Two of the cancer types that have been increasing rapidly in recent years are melanoma and non-Hodgkin's lymphoma. The causes of these 2 cancers include environmental and occupational exposures to ultraviolet light[11] as well as genetic factors and, in the case of non-Hodgkin's lymphoma, exposure to phenoxyacetic acid herbicides, solvents and viruses.[12] Table 1 lists other occupational and environmental substances that are considered by the International Agency for Research on Cancer (IARC) to cause cancer in humans (group 1 in the IARC classification system).[14,15]

The list of established human carcinogens has grown substantially over the past 25 years. This is due in part to the accumulation of knowledge about the human health effects of various chemicals, drugs and other substances during this period. Other substances that are currently being evaluated include electric and magnetic fields and environmental estrogens; these potential sources are of particular concern because of the size of the population that may be exposed to them in industrialized countries.

Implications for cancer prevention

Most of the concerns about environmental causes of cancer have arisen because of widely publicized events such as toxic pollution of communities around industrial sites or nuclear facilities. Many of these events are localized, and the exposed population may be limited to the workers in the industries or the communities immediately around the facilities. Typically, the exposures to workers are greater than to residents of surrounding communities, but there are unusual events in which community exposures have been substantial. Community exposures are also of concern because residents include infants, children and elderly people, in addition to working adults. Exposure of newborns to radioactive iodine, for example, may lead to a greater sub-

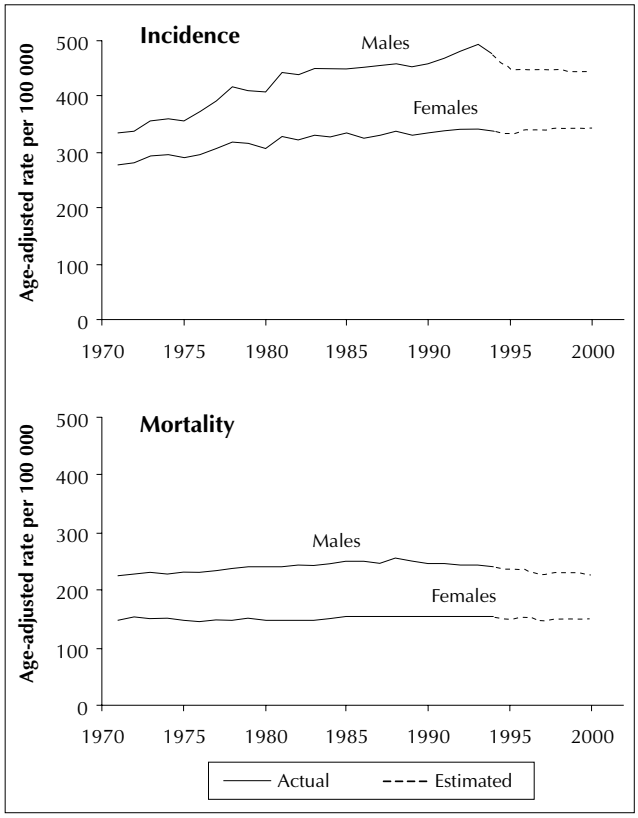

Fig. 1: Age-adjusted incidence and mortality rates for all cancers in Canada, 1971–2000. Incidence rates for 1996–2000 and mortality rates for 1998–2000 are estimated. [Source: *Canadian Cancer Statistics 2000*. National Cancer Institute of Canada, Toronto.]

sequent risk of thyroid cancer than an equivalent exposure in adults.[16] This is the reason that environmental regulations are more stringent than workplace regulations for the same substance.

Although recent downward trends in cancer mortality are welcome, there are still environmental and occupational exposures in many communities and workplaces that could be avoided. Indeed, despite the phasing out of substances that deplete stratospheric ozone over the past decade, the amount of ultraviolet radiation reaching the earth's surface will continue to increase into the next century.[17] This result of ozone depletion represents an environmental problem that has direct implications for cancer in humans and that should be a concern for all health care providers. Rather than attempting to diminish the seriousness of environmental and occupational exposures, or rank them below other causes of cancer, it is in everyone's interest to take them seriously and seek opportunities to prevent further exposure.

The usual recommendations for cancer prevention, such as those offered by the Canadian Cancer Society[18] and the American Cancer Society,[19] include smoking cessation, eating a diet high in plant foods and low in meat and dairy products, increasing physical activity and having periodic health examinations and screening tests. Although these are rational recommendations, they are necessarily general and not focused on particular circumstances that exposed workers or community residents may be concerned about. Health care providers who wish to provide additional advice and help for such patients or communities need to enquire about what the exposures have been. Public databases such as the US Environmental Protection Agency Toxic Release Inventory (www.rtk.net), the Canadian National Pollutant Release Inventory (www.ec.gc.ca/pdb/npri) or local agency records can provide some insight into preventable exposures. A careful exposure history[20] or an understanding of toxic releases from industrial facilities will provide the basis for targeted cancer prevention that will be helpful to a broader population.

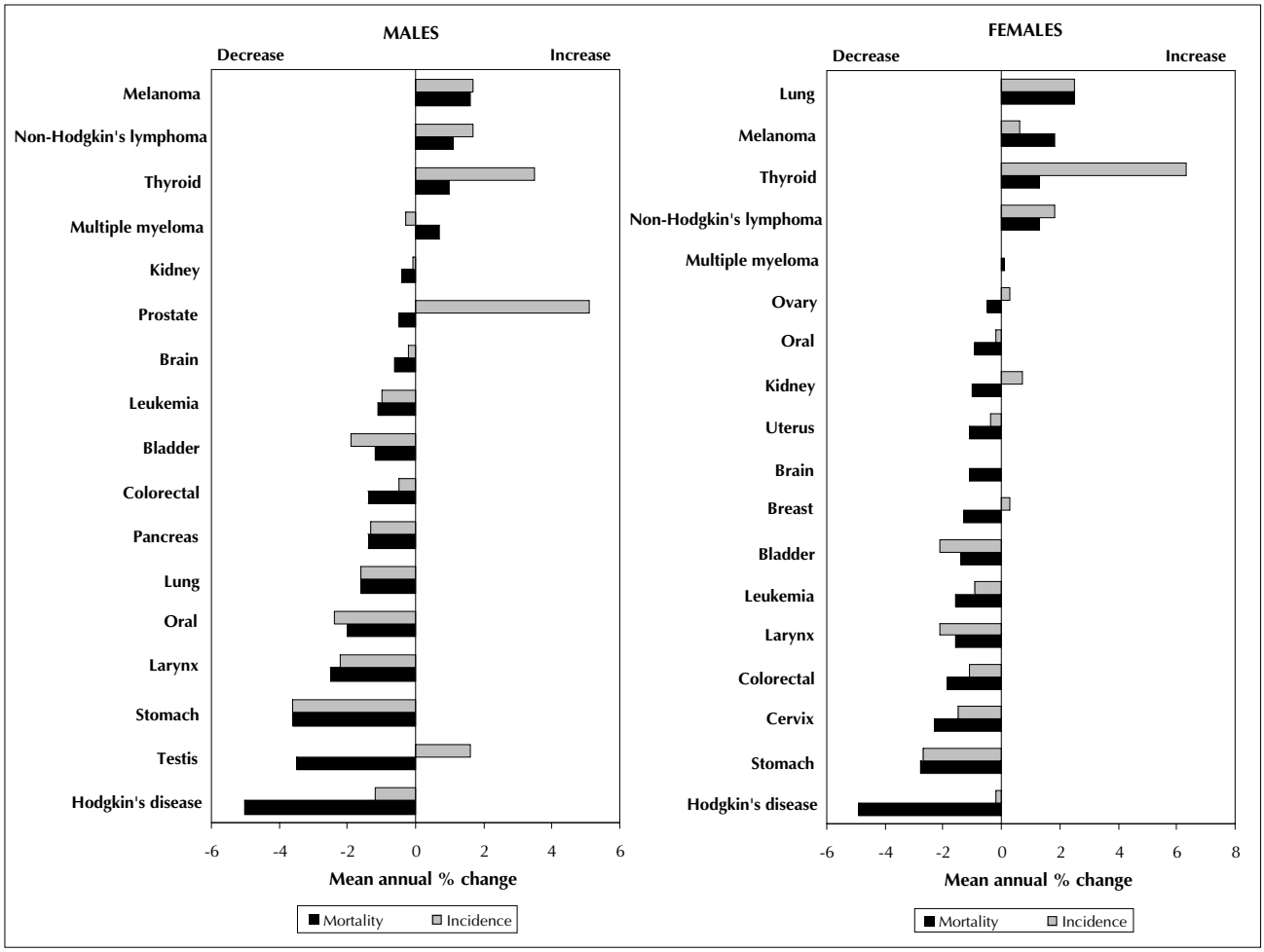

Fig. 2: Mean annual percent change in age-adjusted incidence (1988–1995) and mortality (1988–1997) rates for selected cancer sites among males and females in Canada. [Source: *Canadian Cancer Statistics 2000*. National Cancer Institute of Canada, Toronto.]

Table 1: Some established occupational and environmental carcinogens

Carcinogen	Target organ in humans
Aflatoxins	Liver
4-Aminobiphenyl	Bladder
Arsenic	Lung, skin
Asbestos	Lung, pleura, peritoneum
Benzene	Hematopoietic system
Benzidine	Bladder
Beryllium	Lung
Bis(chloromethyl) ether	Lung
Cadmium	Lung
Coal-tar pitches	Skin, lung, bladder
Erionite	Pleura
Mineral oils	Skin
Mustard gas	Pharynx, lung
2-Naphthylamine	Bladder
Nickel compounds	Nasal cavity, lung
Radon	Lung
Shale oils	Skin
Silica	Lung
Solar radiation	Skin
Soots	Skin, lung
Talc containing asbestiform fibres	Lung
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	Lung, soft tissue
Tobacco smoke	Lung, bladder, oral cavity, pharynx, larynx, esophagus
Vinyl chloride	Liver, lung, blood vessels

Source: References 13, 14 and 15.

Environmental exposure assessment

People may be exposed to hazardous materials in the home, workplace, school or other settings (e.g., while travelling or during recreational activities). An assessment should consider all potential, not just occupational, exposures. In many cases people may have significant exposures without symptoms or recognition of the hazard. An exposure history has several components, including a description of the patient's past and present jobs, a listing of materials used in the home, yard, garden, garage or shop, and any exposure at school or during travel or play. Does the patient live with a person exposed to chemicals or radiation in the workplace? Has the patient ever lived in proximity to industrial plants or used contaminated drinking water? If an exposure is identified, then information about its duration and the nature and name of the materials is appropriate, including the timing of any symptoms in relation to exposure. A diet history may suggest exposure, for example to mercury or polychlorinated biphenyl (PCB) in sports or subsistence fish eaters. The determination of smoking status, alcohol use and use of recreational and prescription drugs is also important in this assessment. As in most clinical matters, the more a physician knows about the life experience of the "whole" patient, the more likely that he or she will identify relevant hazardous exposures.

Competing interests: None declared.

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