

Cancer Incidence Registration and Trends in Ontario

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The Ontario Cancer Registry (OCR) contains information on the incidence, mortality and survival of cancer in Ontario. The OCR refers to the population of Ontario, which is currently more than 9 million people. Cancer registration is accomplished by the computerised linkage of records collected routinely for other purposes. Incidence data are available from the OCR beginning in 1964. Incidence rates, age-standardised to the World Standard Population, are presented for Ontario in two recent 5-year periods (1979–1983 and 1984–1988). Age-specific rates are also presented for selected sites. The most common cancer sites, in terms of Ontario incidence rates, were similar to those reported from other registries. In males, these were cancers of the lung, prostate, colon, bladder and rectum. In females, these were cancers of the breast, lung, colon, body of the uterus and ovary. The potential effects of changes in medical services, screening practices and risk factor prevalence on the incidence rates and trends are discussed.

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INTRODUCTION

INFORMATION ABOUT cancer incidence in Ontario is maintained by the Ontario Cancer Registry (OCR), operated by the Ontario Cancer Treatment and Research Foundation. The OCR now has 25 years of incidence data and comprises information on 645 000 incident cases of cancer diagnosed between 1964 and 1988 among residents of Ontario. Ontario is Canada's most populous province with a population of 9.1 million at the time of the 1986 census. This population is distributed unevenly over a large area (1.1 million square kilometres), with the majority living in the southern region of the province and 82% of the population inhabiting urban areas. 80% of Ontario residents were born in Canada but nevertheless represent a wide variety of ethnic groups; 60% are of British, 8% of French, 6% of Italian and 5% of German origin.

The OCR employs a unique system of registration, based on computerised linkage of cancer records collected routinely for other purposes. The four principal sources of data for the OCR are: reports of hospitalisations with a mention of cancer; pathology reports with a mention of cancer; reports on patients referred to the facilities in Ontario that specialise in cancer care (clinics or hospital); and death certificates. Since Ontario does not have a unique number in the health or political system that identifies an individual throughout life, records pertaining to a single individual are linked together on the basis of several identifying variables, including name, date of birth, sex, health insurance number and hospital or clinic chart number. The linkage of these records is accomplished by a computerised, probabilistic record linkage system based on the generalised iterative record linkage system [1]. A set of computerised decision rules (case resolution) is applied to the linked records to determine site of disease, histology, and date and method of

diagnosis. The OCR serves as a source of information regarding cancer incidence [2], mortality [3] and survival in Ontario. Details of the design and operation of the OCR have been described [2].

Cancer incidence rates for the province of Ontario are examined in this paper for two recent 5-year periods (1979–1983 and 1984–1988). Age-standardised incidence rates are presented for all sites of cancer combined and for specific sites. Age-specific rates also are presented for several major sites, and demonstrate the pattern of the incidence trends across age groups. To facilitate the comparison of cancer incidence between populations, the definitions and methods we use are similar to those presented in the report of cancer incidence in Vaud, Switzerland [4].

METHODS

Cancers were classified according to the ninth revision of the International Classification of Diseases (ICD-9) [5]. "All sites combined" refers to ICD-9 codes 140–208, but excludes skin cancer other than melanoma (ICD-9 173), a site not reported by the OCR. For site-specific analyses, site groupings were defined according to ICD-9 codes. Incidence rates were age-adjusted to the World Standard Population [6].

RESULTS

Figure 1 presents age-adjusted incidence rates and the number of incident cases for Ontario during 1984–1988. For males, on the basis of incidence rates, the five most common sites of cancer were lung (ICD-9 162 also includes a small number of cancers of the trachea and bronchus), prostate, colon, bladder and rectum. For females, the five leading sites were breast, lung, colon, body of the uterus and ovary.

Tables 1 and 2 present age-adjusted incidence rates for two 5-year intervals (1979–1983 and 1984–1988). They indicate that the most common cancer sites for each sex were the same in both periods, although lung cancer moved from the third most frequent form of cancer in women in 1979–1983 to second place in 1984–1988. For both males and females, the incidence rates for all sites combined (excluding skin cancers other than melanoma) increased by more than 5% between the two periods.

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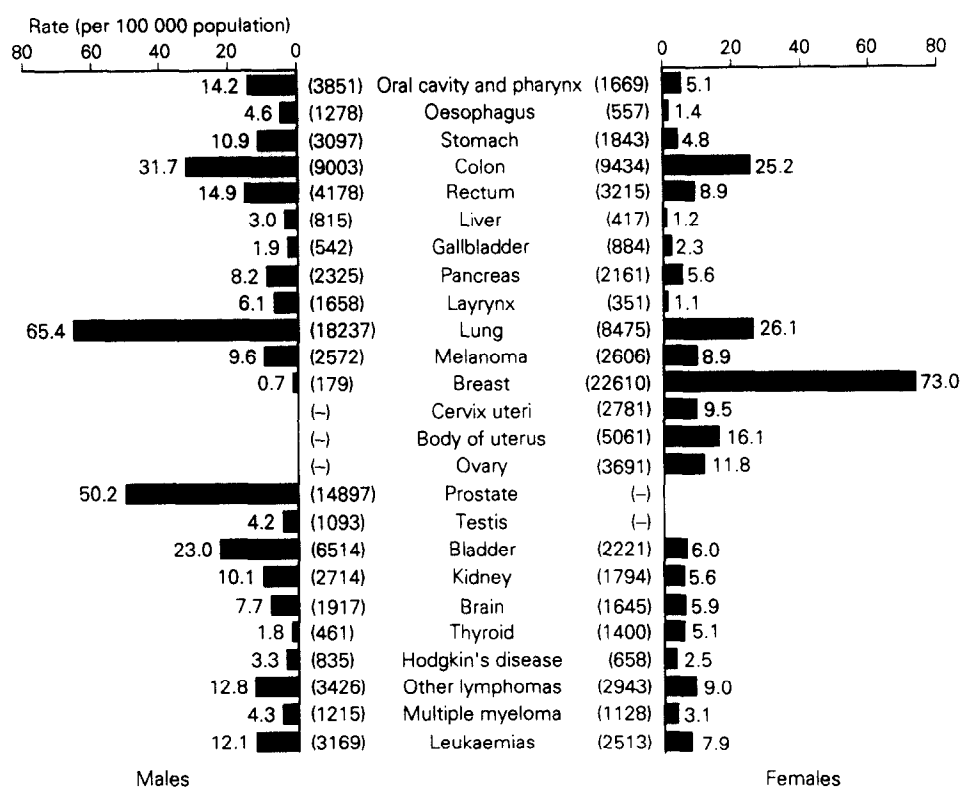


Fig. 1. Age-adjusted (World Standard Population [6]) incidence rates for selected cancers, Ontario, 1984-1988. No. of cases are given in parentheses.

In males (Table 1 and Fig. 2), age-adjusted incidence rates increased by 16.3% for prostate cancer and by 9.9% for colon cancer, whereas the other leading sites showed little change (less than a 2% difference for lung, bladder and rectum). Other large increases in incidence rates (greater than 15% change) in men occurred for liver cancer, malignant melanoma of the skin, cancer of the testes, thyroid cancer, and non-Hodgkin lymphoma. All of these cancers, except melanoma and the lymphomas, are quite rare, with annual rates of less than 5 per 100 000. For the remaining cancers with an incidence greater than 5 per 100 000, slight reductions in incidence were observed for those of the oral cavity and pharynx, stomach, pancreas, larynx, brain and nervous system and the leukaemias. In contrast, the incidence of cancer of the kidney increased.

Among females (Table 2 and Fig. 2), age-adjusted incidence rates for the most common sites increased by 26.9% for cancer of the lung and 9% for breast cancer, changed only slightly for colon cancer, and declined for cancers of the body of the uterus (-10.2%) and the ovaries (-2.7%).

Large increases in incidence in females (over 15% change) occurred for cancers of the liver, larynx, kidney and thyroid. An 11% increase occurred in malignant melanoma of the skin for females, which was less than the increase observed for males (25.3%). Except for kidney cancer, thyroid cancer and malignant melanoma, the sites exhibiting substantial change were quite rare, with annual incidence rates of less than 5 per 100 000. Among the sites that showed a decrease between the two periods, stomach cancer changed the most, declining by 14.7%.

Trends in age-specific incidence rates were examined for selected sites in Table 3. For each specific site, except for Hodgkin's disease, incidence rates increased with increasing age. Between the two periods, there was an increase in the incidence of cancer of the colon for males who were 50 years

and older, whereas for younger males and for all females there was no change in incidence. Lung cancer rates have changed little for males, whereas for females they increased in all age groups, especially in those greater than 65 years of age. Incidence rates increased in each age group for malignant melanoma and thyroid cancer, in both sexes, and for breast cancer in females. There was a large increase in the incidence of prostate cancer among males greater than 65 years of age and a small increase in the 50-64 year age group. For Hodgkin's disease, there was a slight decline in the rates at older ages (50+) but a slight increase in females in the 0-49 age group.

DISCUSSION

The most common cancer sites in Ontario are similar to those reported in many developed countries [6, 7]. Compared with the Vaud Cancer Registry, the ranking of cancer sites for Ontario is the same except that female lung cancer ranked second in Ontario but fourth in Vaud [4].

Lung cancer is the most common cancer in Ontario (excluding skin cancers other than melanoma), accounting for more than 15% of all cancers diagnosed in 1984-1988, in both sexes combined. It has been at an epidemic peak for many years among males, with only a small increase (1%) from 1979-1983 to 1984-1988. In females, the rate of lung cancer is increasing rapidly, with a 27% increase from the earlier to the later period. The sex ratio still favours males (2.5:1), but this ratio can be expected to fall over the next few decades as the incidence in females continues to rise. There is now evidence of a falling rate in young males, probably reflecting a major decline in prevalence of cigarette smoking in males since the early 1960s. Compared with rates in the rest of the world, Ontario rates are in the middle of the range [6]. Compared with annual incidence rates recently reported from the Vaud Cancer Registry, female lung

Table 1. Age-adjusted* incidence rates per 100 000 population, 1979–1983, 1984–1988; and percent rate of change for selected cancers, Ontario (males)

Site	ICD-9	Age-adjusted rate*		% Change†
		1979–1983	1984–1988	
Oral cavity and pharynx	140–9	14.6	14.2	–2.9
Oesophagus	150	4.2	4.6	9.0
Stomach	151	11.7	10.9	–6.7
Colon	153	28.9	31.7	9.9
Rectum	154	14.7	14.9	1.8
Liver	155	2.2	3.0	35.3
Gallbladder	156	2.1	1.9	–7.3
Pancreas	157	8.7	8.2	–5.3
Larynx	161	6.6	6.1	–6.7
Trachea, bronchus and lung	162	64.8	65.4	0.9
Melanoma	172	7.7	9.6	25.3
Male breast	175	0.6	0.7	18.6
Cervix uteri	180	–	–	–
Body of uterus	182	–	–	–
Ovary	183	–	–	–
Prostate	185	43.2	50.2	16.3
Testis	186	3.6	4.2	16.1
Bladder	188	22.6	23.0	1.7
Kidney	189	8.8	10.1	14.8
Brain and other nervous system	191–2	7.8	7.7	–1.3
Thyroid	193	1.5	1.8	16.6
Hodgkin's disease	201	3.5	3.3	–5.2
Other lymphomas	200, 202	11.1	12.8	15.6
Multiple myeloma	203	4.1	4.3	4.9
Leukaemias	204–8	12.4	12.1	–2.3
All sites (except skin non-melanoma)	140–208 (excl 173)	306.2	323.4	5.6

ICD-9 = International Classification of Disease, 9th revision [5].

* Age-adjusted to the world standard population [6].

†% Change = [(1984–1988 rate) – (1979–1983 rate)/(1979–1983 rate)] × 100.

cancer is more common in Ontario (26.1 per 100 000) than in Vaud (10.8 per 100 000) [4].

Ontario breast cancer rates are among the highest in the world [6]. Breast cancer is the most common female cancer in Ontario, accounting for over 26% of all cancers (excluding skin cancers other than melanoma) in women. Since the early 1980s, the rate of breast cancer has been increasing steadily, with increases being observed at all ages. While some of this effect may be due to screening mammography, most of the increase, particularly in the elderly, probably represents a true increase in risk [8]. Since the mid-1980s, a small increase in breast cancer mortality also has been noted (data not shown).

Both the incidence of prostate cancer and its rate of increase over time have been much greater in Ontario than in Vaud [4]. However, similar increases in incidence, but not mortality, have been reported for prostate cancer in many other developed countries. This suggests that increased diagnostic surveillance in more recent years may play a role in the apparent increase in incidence. It is known that physicians examine the prostate in older men even if no symptoms are present, although the extent

of this practice is unknown. The large absolute increase in incidence in men over the age of 65 supports this explanation; however, the substantial increase even in the younger males suggests that additional factors may also be operating.

It is noteworthy that the incidence of testicular cancer, which is the most common form of cancer in men aged 20–34, has increased by a percentage that is similar to that for prostate cancer (16%). Such an increase in testicular cancer incidence has been reported from other developed countries, although the explanation is unknown. In contrast, mortality rates due to cancer of the testis have declined, in part due to improvements in treatment.

Colorectal cancer rates in Ontario are among the highest in the world, particularly for males [6]. Compared with the report from Vaud [4], the incidence of colon cancer is much higher in Ontario, whereas the rates of rectal cancer are similar. Colorectal cancer rates have been high in Ontario for many years and account for nearly 15% of all cancers diagnosed in both sexes combined in 1984–1988. A male preponderance exists (1.4:1 male:female), which is higher for rectal cancer (1.7:1), than for colon cancer (1.3:1).

The rate of cervical cancer in Ontario is among the lowest in the world [4], in large measure due to the success of community-based cervical cancer screening implemented in Ontario during the mid-1960s. While this rate does not take into account

Table 2. Age-adjusted* incidence rates per 100 000 population, 1979–1983, 1984–1988; and percent rate of change for selected cancers, Ontario (females)

Site	ICD-9	Age-adjusted rate		% Change†
		1979–1983	1984–1988	
Oral cavity and pharynx	140–9	4.9	5.1	4.3
Oesophagus	150	1.6	1.4	–8.4
Stomach	151	5.7	4.8	–14.7
Colon	153	25.2	25.2	0.3
Rectum	154	9.2	8.9	–2.9
Liver	155	1.0	1.2	21.9
Gallbladder	156	2.4	2.3	–3.0
Pancreas	157	5.8	5.6	–3.6
Larynx	161	1.0	1.1	20.0
Trachea, bronchus and lung	162	20.5	26.1	26.9
Melanoma	172	8.0	8.9	11.0
Breast	174	66.9	73.0	9.0
Cervix uteri	180	10.8	9.5	–11.7
Body of uterus	182	18.0	16.1	–10.2
Ovary	183	12.2	11.8	–2.7
Prostate	185	–	–	–
Testis	186	–	–	–
Bladder	188	6.1	6.0	–1.5
Kidney	189	4.4	5.6	29.4
Brain and other nervous system	191–2	5.7	5.9	2.1
Thyroid	193	4.1	5.1	22.3
Hodgkin's disease	201	2.3	2.5	10.5
Other lymphomas	200, 202	8.2	9.0	9.5
Multiple myeloma	203	2.8	3.1	8.8
Leukaemias	204–8	7.9	7.9	0.3
All sites (except skin non-melanoma)	140–208 (excl 173)	250.9	263.5	5.0

Table 3. Age-adjusted incidence rates per 100 000 population, 1979–1983 and 1984–1988, for selected cancers by age group and sex, Ontario

Site	ICD-9	Age group (years)	Males		Females	
			1979–83	1984–88	1979–83	1984–88
Colon	153	0–49	3.0	3.0	3.3	3.4
		50–64	70.0	81.7	65.3	65.5
		65+	247.2	267.9	201.0	200.5
Rectum	154	0–49	1.6	1.6	1.6	1.4
		50–64	40.9	43.5	26.5	24.0
		65+	115.1	113.7	64.7	66.7
Lung	162	0–49	5.6	5.2	3.8	4.4
		50–64	197.4	197.1	73.3	87.8
		65+	494.7	508.3	113.8	158.8
Melanoma	172	0–49	4.0	4.9	5.8	6.1
		50–64	19.4	25.3	16.7	18.4
		65+	27.7	34.8	17.8	23.0
Breast	175/174	0–49	0.1	0.1	25.4	27.6
		50–64	1.7	1.6	201.1	220.2
		65+	4.5	5.2	292.6	318.4
Prostate	185	0–49	0.4	0.5	–	–
		50–64	67.2	80.0	–	–
		65+	488.1	563.4	–	–
Kidney	189	0–49	1.9	2.3	1.3	1.8
		50–64	26.6	29.5	12.2	16.3
		65+	54.4	62.5	24.5	29.9
Hodgkin's disease	201	0–49	3.0	3.0	2.1	2.5
		50–64	4.3	3.9	2.5	2.0
		65+	8.0	6.1	4.6	3.5

the substantial proportion of hysterectomies among Ontario females, adjustment for hysterectomy would not be expected to have much effect on the rate of change over time [9]. While the cervical cancer rate has fallen appreciably since the start of cancer registration in Ontario (59% decline from 1964 to 1988), it is believed that much of the residual risk could still be prevented through an organised, centralised screening programme [10].

For cancer of the kidney, the ICD coding system is problematic, as ICD-9 category 189 includes cancers of the ureter, urethra and other urinary organs (apart from the bladder), as well as cancers in the kidney pelvis (which are histologically and aetiologically similar to cancers of the bladder) and renal parenchyma. Since parenchymal tumours constitute about 80% of cancers in this category, it is likely but not certain that the observed trend reflects the pattern for these tumours. The increase in incidence between the two periods has occurred within each of the age and sex groups, although this tumour is more common in males than in females. Similar increases have been noted in the USA and elsewhere [11], despite smaller changes in mortality. There is no obvious explanation for the increasing incidence, although it has been postulated that the use of ultrasonography has made earlier diagnosis possible. Cancers of the kidney have historically been difficult to diagnose except by invasive techniques because of the non-specificity of the usual presenting symptoms. Thus it is possible that the advent of a non-invasive and more certain diagnostic technique

is responsible in part for recent increases in the incidence of this disease.

The incidence of cutaneous malignant melanoma has been increasing rapidly over the entire period of the Ontario Cancer Registry (i.e. since 1964) in both sexes [2]. A similar trend has been observed in other areas of the world populated largely by whites [12–14]. In fact melanoma is currently the most rapidly increasing cancer after female lung cancer. The increase does not appear to be confined to any specific age or sex group and is generally believed to be real rather than artefactual. While there may have been some improvement in registration of this cancer, which is often treated on an outpatient basis, this cannot account for the large increase observed. Melanoma is becoming an important cancer in young adults. In Ontario, melanoma currently ranks first or second in terms of cancer incidence among males in five year age groups between 25 and 44, and second or third among females in the same age groups.

A substantial decline in stomach cancer for both sexes has been observed in Ontario since 1964, which was when incidence statistics first became available. Similar decreases have been observed in stomach cancer mortality in Ontario since the 1930s. In fact, this cancer was the most common cancer cause of death among males in the 1930s, but is now ranked fourth, due to its steady downward trend and to the rise in lung cancer. Although cancer of the stomach is a more common site of cancer in some



Fig. 2. Percent change in incidence, between 1979–1983 and 1984–1988, for selected cancers, Ontario.

Asian countries than it is in Ontario [6], declining rates have been noted in many different parts of the world [15].

Although cancer of the thyroid is rare (accounting for about 1% of new diagnoses of cancer), the increase in incidence shown for both sexes is probably real, since it has also been reported elsewhere [16]. It is believed that the increase may be due to use of radiation to treat benign head and neck conditions. Thyroid cancer is one of the few tumours common to both sexes which shows a strong female predominance (1:3 male:female).

The observed trends in cancer incidence in Ontario may be due to several factors. For some sites, such as prostate and perhaps breast and kidney, the increased rates may be in part due to enhancements in case detection. For other sites, such as malignant melanoma of the skin, the incidence trends may be partly attributable to more complete registration. The incidence trends may also reflect true variation in underlying risk factors, as has occurred with lung cancer. In summary, the patterns of cancer incidence in Ontario parallel much of what is seen in other developed countries. Still, the site-specific trends since 1979 are unique reflections of the health care system, the implementation of medical technologies, and the constellation of risk factors in the Ontario population.

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