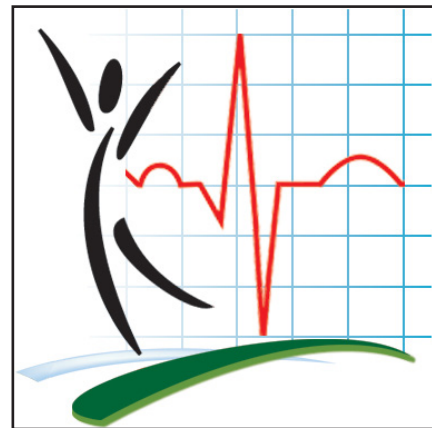


Health at a Glance

Childhood cancer incidence and mortality in Canada

by Lawrence Ellison and Teresa Janz

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- .. not available for a specific reference period
- ... not applicable
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- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^P preliminary
- ^r revised
- X suppressed to meet the confidentiality requirements of the *Statistics Act*
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- F too unreliable to be published
- * significantly different from reference category ($p < 0.05$)

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Health *at a Glance*

Childhood cancer incidence and mortality in Canada

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Highlights

- During the 2006-2010 period, children under age 15 were diagnosed with cancer at a rate of 161 new cases per million children, per year, and cancer caused 23 deaths per million, per year.
- The most commonly diagnosed childhood cancer groups in 2006-2010 were leukemias (32%), central nervous system tumours (19%) and lymphomas (11%).
- The rate of cancer diagnosis was 10% higher in boys than girls.
- In 2006-2010, the rate at which cancer was diagnosed before the age of 5 was almost twice the rate it was diagnosed between the ages of 5 and 14.
- Between 1992 and 2010, the rate of newly diagnosed cases of childhood cancer increased by an average of 0.4% per year, while the rate of cancer deaths in childhood decreased by an average of 2.0% per year.
- For leukemias, there was a 0.6% average increase per year in the rate of new cases from 1992 to 2010, and a 3.5% average decrease per year in the rate of deaths.

Cancer is the second leading cause of death in Canadian children¹ (after accidents), and it is the leading cause of death when just considering diseases.^{2,3}

Although childhood cancer is relatively rare compared with cancer in adults, for many children the effects can last a lifetime as a result of the cancer itself and/or from the treatment.^{4,5} Additionally, childhood cancer can cause emotional and financial strain on the entire family.^{6,7}

Another distinction is that the types of cancers that tend to develop in children differ from the types common to adults.⁸ Adults are more likely to be diagnosed with breast, lung, prostate and colorectal cancer, but these are very rare in children. Children are more likely to be diagnosed

with cancers of the blood and lymphatic system, such as leukemia. Because of the differences, analyses of childhood cancer typically use cancer groups that differ from the ones relevant to adults.

This article presents national data on the number of newly diagnosed cases of childhood cancer (incidence) and the number of deaths attributed to cancer (mortality) in children under the age of 15. Incidence data are explored by age, sex and the five most commonly diagnosed groups⁹ of childhood cancer. Due to the low number of cancer cases, five years of data, between 2006 and 2010, were combined to report the most recent results.¹⁰ These most recent statistics will be reported in this article as rates for the 2006-2010 time period.

The second main contribution of this paper is that it explores trends over time with almost 20 years of data (1992 to 2010) on both incidence and mortality.

The data sources include the [Canadian Cancer Registry](#) (1992 to 2010) and the [Canadian Vital Statistics – Death Database](#) (1992 to 2010) (see [Data sources, methods and definitions text box](#)).

All childhood cancers combined

During 2006–2010, childhood cancer was diagnosed at a rate of 161 new cases per million children, per year (Table 1).¹¹ This rate corresponds to an average of 905 new cases of childhood cancer per year during this time period—about 0.5% of the total number of cancers diagnosed yearly in Canada.

Table 1
Cancer incidence among children aged 0 to 14, by cancer group, Canada, 2006–2010

Cancer group	Average number of cases per year	Annual incidence rate (per million children)	Percent (%) of childhood cancer cases
All cancers	905	161	100
Leukemias	292	52	32
CNS ¹ tumours	173	31	19
Lymphomas	100	18	11
Neuroblastomas	71	13	8
Soft tissue sarcomas	59	10	6

1. CNS stands for central nervous system.

Source: Statistics Canada, Canadian Cancer Registry.

Leukemias are the most commonly diagnosed childhood cancer group

Leukemias were the most commonly diagnosed cancer, accounting for 32% of all childhood cancers. Leukemias are cancers of the blood cells that do not behave normally and grow uncontrollably. There are many different types of leukemia that are classified depending on the type of blood they develop from, and how fast they grow.¹²

Cancers of the **central nervous system (CNS)** were the second most commonly diagnosed childhood cancer group (19%). CNS tumours begin when normal cells in the brain or the spinal cord change and grow uncontrollably, forming a mass.

The third most commonly diagnosed group of childhood cancers were lymphomas (11%). Lymphomas begin when cells in the lymphatic system (a system of the body responsible for fighting infection or other diseases) change and grow uncontrollably. As lymph tissue is found in many parts of the body, including lymph nodes, skin, stomach, intestines and other organs, lymphomas can originate almost anywhere.

Neuroblastomas (8%) were the fourth most common group. A neuroblastoma is a solid cancerous tumour that begins in the nerve cells. It most often begins in the adrenal glands, but it can also develop in other areas of the abdomen and in the chest, in the neck, and near the spine.

Soft tissue sarcomas, the fifth most common childhood cancer group, represented 6% of the cancer cases. These are cancers that develop in the tissues that support and connect the body (for example, muscles, nerves and tendons).

Together, the five most commonly diagnosed cancer groups represent almost three-quarters of all new childhood cancers cases.

Incidence rates higher in boys and younger children

For all newly diagnosed childhood cancers combined during 2006–2010, the rate among boys was 10% higher than the corresponding rate among girls (Chart 1).^{13,14}

During the same time period, cancer was diagnosed at almost twice the rate among children younger than age 5 (238 per million, per year), than among those between 5 and 14 years old (124 per million, per year).

Lymphomas and leukemias are diagnosed more often in boys than girls

Considering specific cancer groups, the rate of diagnosis for lymphoma was 80% higher in boys than girls; for leukemias it was 18% higher in boys (Chart 2). There were no significant differences between boys and girls in the rate of diagnosis of: CNS tumours, neuroblastomas and soft tissue sarcomas.

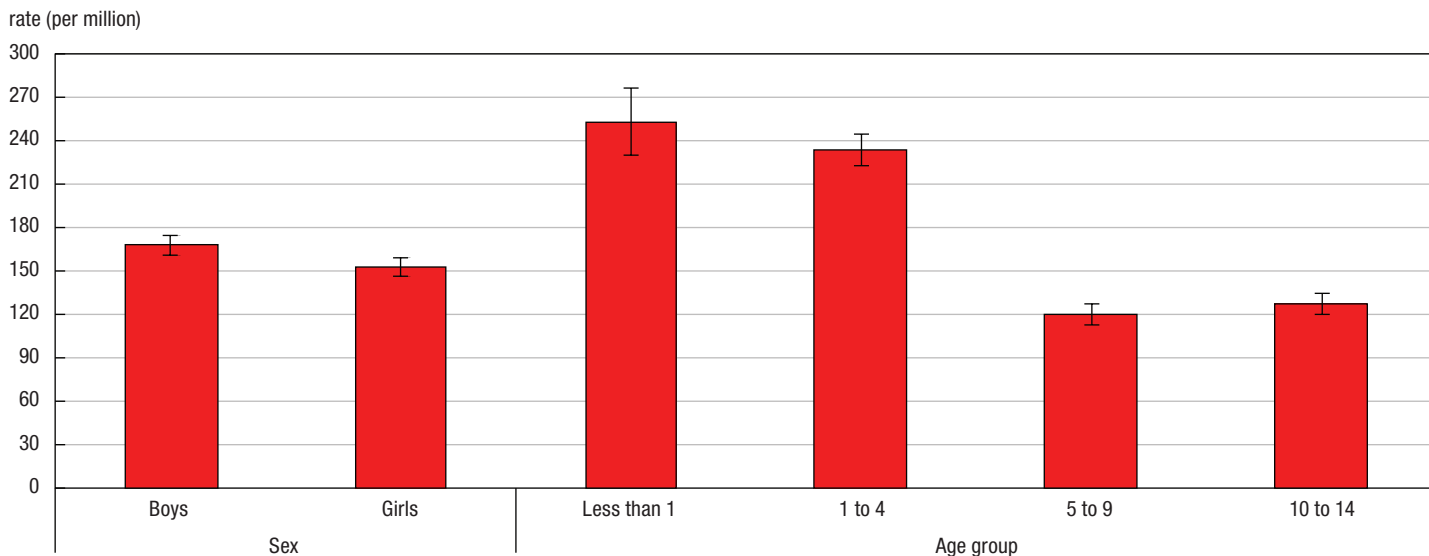
Patterns in the age at diagnosis vary by type of childhood cancer

Patterns in the age at diagnosis varied among the childhood cancer groups (Chart 3). For both leukemias and CNS tumours, incidence rates in the 2006–2010 time period were highest in the 1 to 4 year-old age group and lowest among those aged 10 to 14. The annual rate of leukemias in the 1 to 4 year-old age group (99 per million) was double the rate in any other age group.

Incidence rates of lymphomas increased with age. The rate among children aged 10 to 14 (27 new cases per million, per year) was approximately 5 times the rate for those under the age of 1.

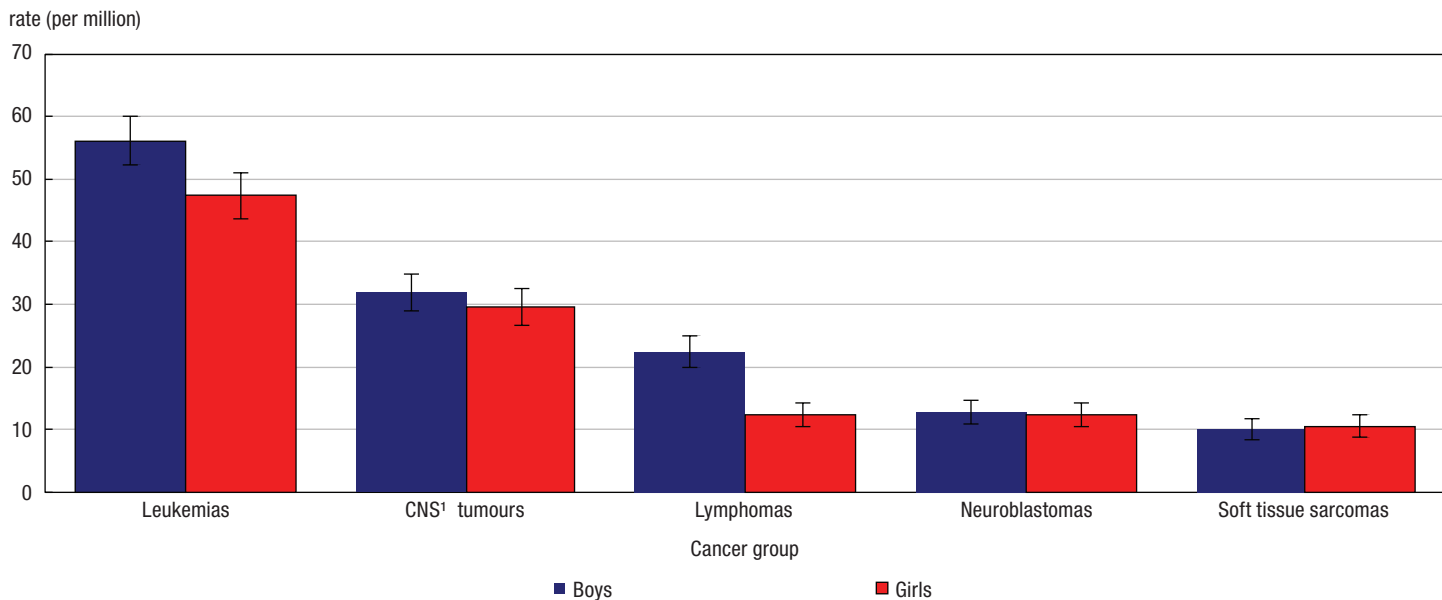
The annual rate of new cases of neuroblastomas declined with age from 68 per million in the first year of life to 24 per million among those aged 1 to 4 and, ultimately, to 1 per million for those aged 10 to 14.

Chart 1
Sex- and age-specific incidence rates for all cancers combined, among children aged 0 to 14, Canada, 2006–2010



Note: The lines overlaid on the bars in this chart indicate the 95% confidence interval. Confidence intervals indicate the degree of variability in the estimates.
Source: Statistics Canada, Canadian Cancer Registry.

Chart 2
Cancer incidence rates among children aged 0 to 14, by cancer group and sex, Canada, 2006–2010

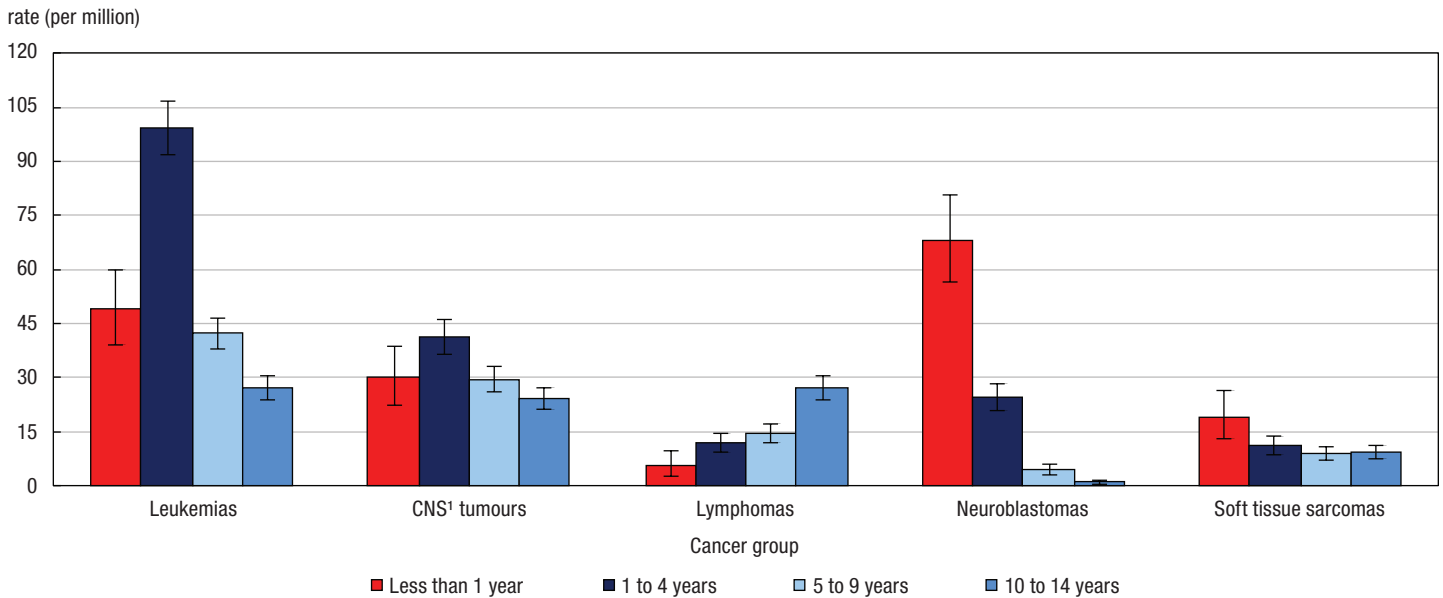


1. CNS stands for central nervous system.

Note: The lines overlaid on the bars in this chart indicate the 95% confidence interval. Confidence intervals indicate the degree of variability in the estimates.
Source: Statistics Canada, Canadian Cancer Registry.

Chart 3

Age-specific cancer incidence rates among children aged 0 to 14, by cancer group, Canada, 2006–2010



1. CNS stands for central nervous system.

Note: The lines overlaid on the bars in this chart indicate the 95% confidence interval. Confidence intervals indicate the degree of variability in the estimates.

Source: Statistics Canada, Canadian Cancer Registry.

The rate of incidence of soft tissue sarcomas was also highest before the age of 1 (19 per million per year). The rate of diagnosis in the first year of life was about twice the rate for ages 1 to 14 combined.

Central nervous system (CNS) tumours are the most common cancer-related cause of death in children

During the 2006–2010 period, one in three deaths due to cancer in children was from a CNS tumour, and almost one in four was from leukemia (data not shown). Overall, an average of 129 children under the age of 15 died each year from cancer. This figure corresponds to an annual mortality rate of 23 per million children.

Childhood cancer mortality decreasing over time from 1992 to 2010; incidence slowly increasing

In order to assess the change over time, data between 1992 and 2010 were examined. It was noted that the childhood cancer mortality rate decreased by an average of 2.0% per year (Chart 4), while the incidence rate increased by an average of 0.4% annually (Chart 4 and Table 2).¹⁵⁻¹⁷

The overall pattern of increasing incidence rates differed somewhat between boys and girls. Among boys, the rate increased by an average of 0.5% per year. Among girls, a 3.1% average annual increase was observed between 2004 and 2010, whereas from 1992 to 2004 there was no significant change in the rate.

Table 2
Trends in age-standardized incidence rates of childhood cancers among children aged 0 to 14, annual percent change (APC), by cancer group and sex, Canada, 1992 to 2010

Cancer group	Sex		
	Both	Males	Females
All cancers	0.4*	0.5*	0.5 [†]
Leukemias	0.6*	0.8*	0.4
Lymphomas	0.5	0.5	0.3
CNS¹ tumours	0.1	0.1	-0.1
Neuroblastomas	0.7	1.4*	0.0
Soft tissue sarcomas	-0.1	-1.0	0.9

* The APC was significantly different from 0, indicating the presence of a statistically significant trend

[†] A further refinement revealed two distinct trends during this period: for the period from 1992 to 2004, the APC was -0.8; for 2004 to 2010 it was 3.1*. The number shown is a weighted average of these two APCs

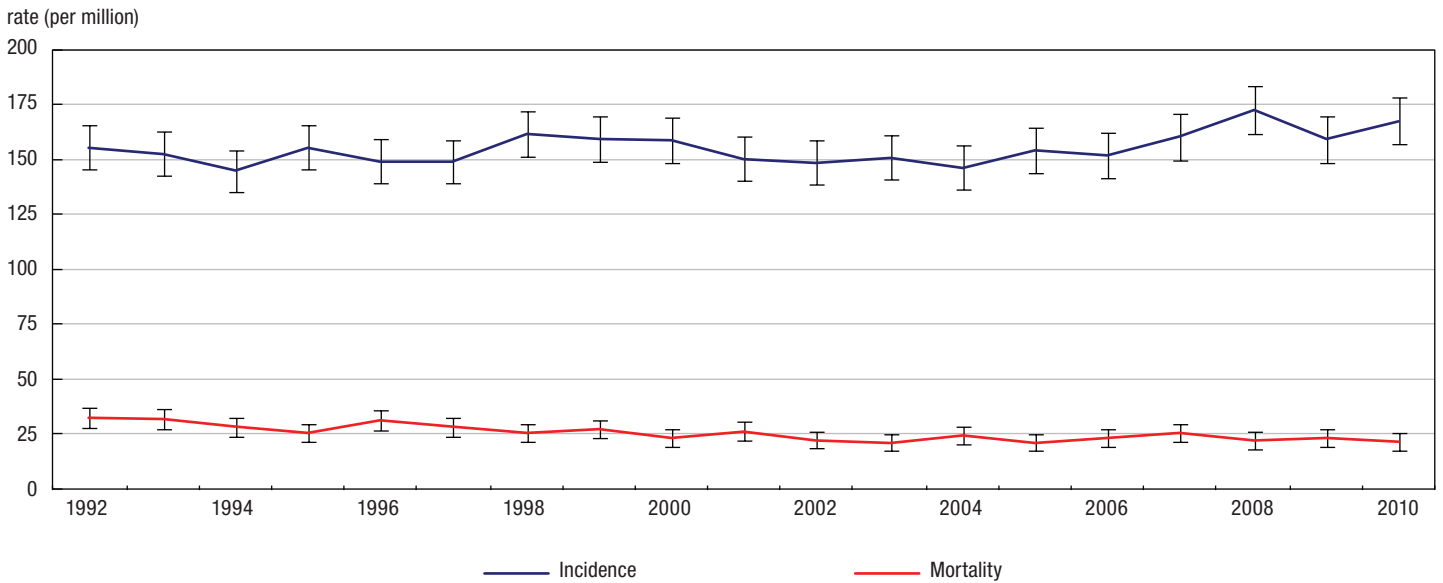
1. CNS stands for central nervous system.

Note: The annual percent change (APC) represents the average percent change in age-standardized incidence rates between 1992 and 2010. A positive APC indicates that the rate for that cancer is generally increasing over time, while a negative rate indicates it is generally decreasing. In some cases, the trend is more appropriately described by multiple APCs.

Source: Statistics Canada, Canadian Cancer Registry.

Chart 4

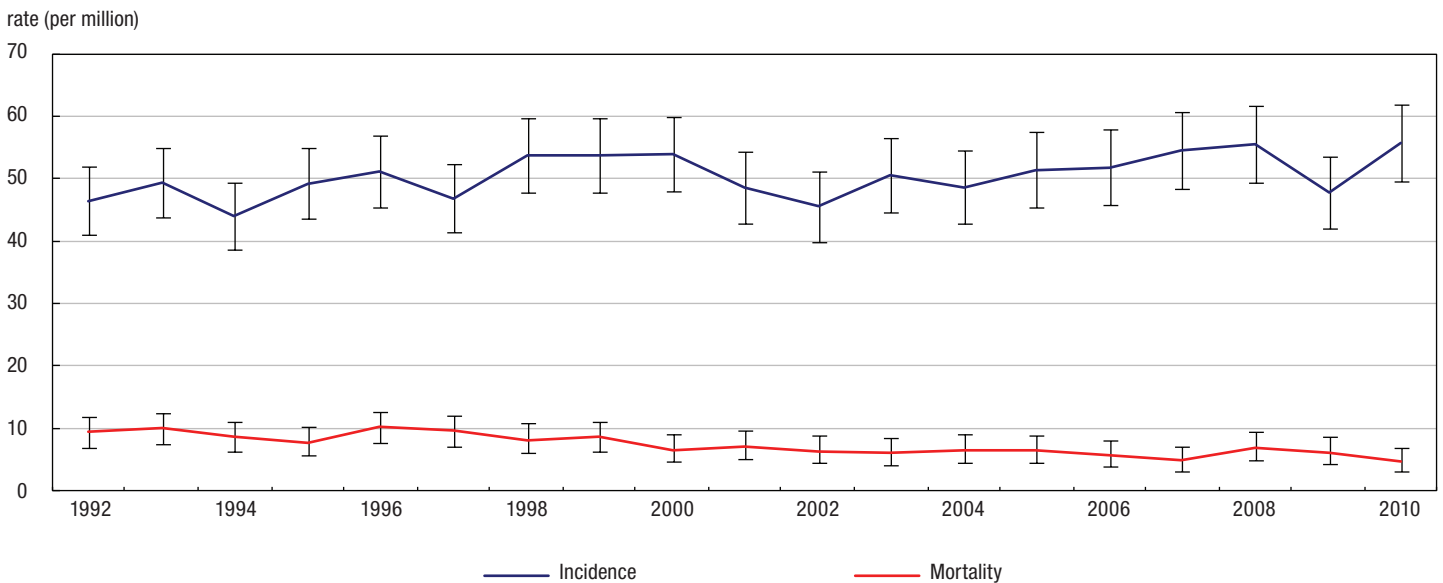
Age-standardized cancer incidence and mortality rates among children aged 0 to 14, by year, Canada, 1992 to 2010



Note: The vertical error bars overlaid on the trend lines indicate 95% confidence intervals. Confidence intervals indicate the degree of variability in the estimates.
Source: Statistics Canada, Canadian Cancer Registry and Canadian Vital Statistics – Death Database.

Chart 5

Age-standardized leukemia incidence and mortality rates among children aged 0 to 14, by year, Canada, 1992 to 2010



Note: The vertical error bars overlaid on the trend lines indicate 95% confidence intervals. Confidence intervals indicate the degree of variability in the estimates.
Source: Statistics Canada, Canadian Cancer Registry and Canadian Vital Statistics – Death Database.

Childhood leukemia mortality decreasing over time; incidence slowly increasing

Between 1992 and 2010, the mortality rate for leukemia decreased by an average of 3.5% per year (Chart 5), while the incidence rate for this cancer increased by an average of 0.6% annually (Chart 5 and Table 2). The rate of diagnosis of new cases of leukemia increased among boys (0.8% per year). However, there was no significant change in the rate among girls (Table 2).

Childhood lymphoma mortality decreasing

While there was no significant change in the incidence rate of lymphomas between 1992 and 2010 (Chart 6 and Table 2), the mortality rate for this group of cancers decreased by an average of 4.5% per year during this period (Chart 6). It is important to consider, however, that lymphoma deaths during childhood were already exceedingly rare in the early 1990s.

There were no significant changes over time in the incidence rates of CNS tumours, neuroblastomas or soft tissue sarcomas between 1992 and 2010¹⁸ with one exception: the incidence rate of neuroblastomas, among boys, increased by an average of 1.4% per year.

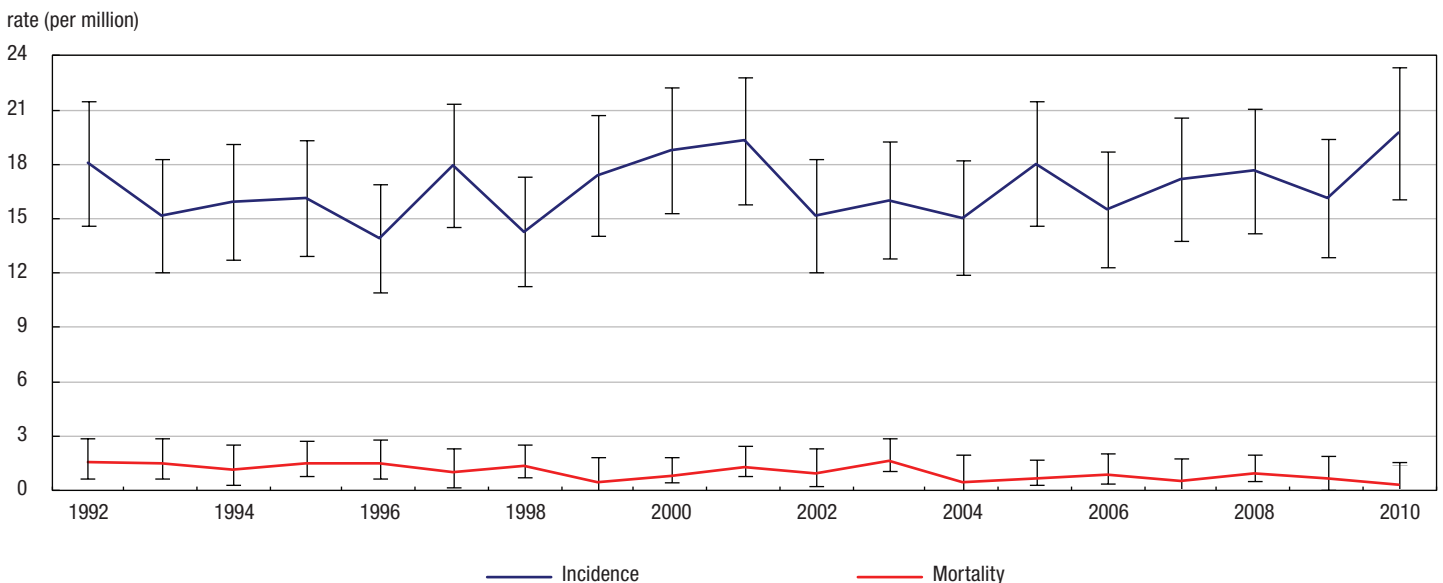
Summary

During the 2006–2010 period, cancer in children was diagnosed at an annual rate of 161 cases per million children. The annual mortality rate was 23 deaths per million children. Leukemias were the most commonly diagnosed childhood cancer group, accounting for 32% of all cancer cases in children. The rate of diagnosis for all cancers combined was 10% higher in boys than girls, overall, and 80% higher specifically for lymphoma. The rate at which cancer was diagnosed before the age of 5 was almost twice the rate it was diagnosed between the ages of 5 and 14.

Between 1992 and 2010, the rate of newly diagnosed cases of childhood cancer increased by an average of 0.4% per year, while the rate of cancer deaths in childhood decreased by an average of 2.0% per year.

Lawrence Ellison and Teresa Janz are analysts with the Health Statistics Division.

Chart 6
Age-standardized lymphoma incidence and mortality rates by year, among children aged 0 to 14, Canada, 1992 to 2010



Note: The vertical error bars overlaid on the trend lines indicate 95% confidence intervals. Confidence intervals indicate the degree of variability in the estimates.
Source: Statistics Canada, Canadian Cancer Registry and Canadian Vital Statistics – Death Database.

Data sources, methods and definitions

Data sources

Canadian Cancer Registry is a dynamic, person-oriented, population-based database maintained by Statistics Canada. It contains information on cases diagnosed from 1992 onward, compiled from reports from every provincial and territorial cancer registry in Canada. Cancer incidence data in this report are from the final tabulation master file released February 3, 2014.¹⁹ The analysis file was created using the multiple primary coding rules of the International Agency for Research on Cancer.²⁰ Cases were defined based on the International Classification of Diseases for Oncology, Third Edition.²¹

Canadian Vital Statistics – Death Database includes demographic and cause of death information for all deaths from all provincial and territorial vital statistics registries in Canada. Prior to 2010, some data were collected on Canadian residents who died in some American states; these deaths were excluded from this analysis. Starting with the 2010 reference year, data on Canadian residents who died in American states are no longer collected.

Methods: Classification of cases and deaths

Cancer cases were classified using an updated version of the third edition of the International Classification of Childhood Cancer (ICCC-3).²²⁻²⁵ This system groups similar cancers into 12 major diagnostic groups and subgroups for additional refinement. For simplicity, only the five most frequently diagnosed groups were included in this report.

Deaths were classified using the World Health Organization's *International Statistical Classification of Diseases and Related Health Problems—10th Revision (ICD-10)*²⁶ for deaths from the year 2000 onward, and the *9th Revision (ICD-9)*²⁷ for deaths from previous years.²⁸ The definitions of specific cancer types differ between ICCC-3 and ICD-9/ICD-10. The categories are similar for the leukemias and lymphomas, but, for solid tumours, the categories can be quite different.

Definitions

For ease of communication, abbreviated names have been used throughout the text to represent the following childhood cancer groups:

Leukemias	Leukemias, myeloproliferative diseases, and myelodysplastic diseases
Lymphomas	Lymphomas and reticuloendothelial neoplasms
Central nervous system (CNS) tumours	Central nervous system and miscellaneous intracranial and intraspinal neoplasms
Neuroblastomas	Neuroblastoma and other peripheral nervous cell tumours
Soft tissue sarcomas	Soft tissue and other extrasosseous sarcomas

References and notes

1. A child is defined in this report as being under 15 years of age.
2. The analysis excluded deaths in the first month of life.
3. Statistics Canada. 2014. Custom tabulation, based on 2011 Canadian Vital Statistics Death Database.
4. Ellison, L.F., P De, L.S. Mery., and P.E. Grundy. 2009. "Canadian cancer statistics at a glance: cancer in children." *Canadian Medical Association Journal* 180:422-424.
5. Hudson, M.M., K.K. Ness, J.G. Gurney, et al., 2013. "Clinical ascertainment of health outcomes among adults treated for childhood cancer: A report from the St. Jude lifetime cohort study." *Journal of the American Medical Association* 309 (22):2371-2381.
6. Canadian Cancer Society/National Cancer Institute of Canada: Canadian Cancer Statistics 2008, Toronto, Canada, 2008.
7. Barr, R.D., and A. Sala. 2003. "Hidden financial costs in the treatment for childhood cancer." *Journal of Pediatric Hematology and Oncology* 25 (11): 842-844.
8. Marsden, H.B. 1988. "The classification of childhood tumours." *IARC Scientific Publication* 87: 9-16.
9. For simplicity, childhood cancer diagnostic groups are referred to by abbreviated names throughout the text. The corresponding non-abbreviated diagnostic group names are provided in the [Data sources, methods and definitions](#) section.
10. Childhood cancer rates may be unstable from one year to the next because the diagnosis of cancer is rare in children. To decrease the variability of the rates provided, five years of data have been combined.
11. Incidence and mortality counts presented in this paper were randomly rounded to a base of five to help ensure the confidentiality of the underlying individual cases. The crude (unadjusted) rates presented were derived from rounded counts.
12. Canadian Cancer Society. 2015. [What is childhood leukemia?](#) (accessed May 4, 2015).
13. Male-to-female ratios were calculated using incidence rates based on actual counts.
14. Rothman, K.J., and S. Greenland, eds. 1998. *Modern Epidemiology*. 2nd edition. Philadelphia: Lippincott-Raven Publishers, 238.
15. All trend analyses were performed using incidence and mortality rates that were age-standardized to the 1991 Canadian population.
16. National Cancer Institute. 2013. *Joinpoint Regression Program*. Version 4.0.4. Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute.
17. Unless otherwise noted, the annual changes in age-standardized incidence and mortality rates reported in this article are the annual percent changes (APC). If statistically significant changes in trends were detected in the study period, then multiple annual percent changes (APC) were reported. The minimum time span on which to report a trend was set at five years. Thus, the most recent possible trend period in this study was 2006 to 2010. The critical level used to determine whether a given trend was significantly increasing or decreasing was set at 0.05.
18. Mortality rate trends for CNS tumours, soft tissue sarcomas and neuroblastomas were not examined.
19. Statistics Canada. 2014. "Cancer incidence in Canada, 1992 to 2010 (final)." *The Daily*. February 3. Available at <http://www.statcan.gc.ca/daily-quotidien/140203/dq140203d-eng.htm>.
20. International Association of Cancer Registries. 2004. *International Rules for Multiple Primary Cancers (ICD-O Third Edition)*. Internal Report no. 2004/02. Lyon: International Association for Research on Cancer.
21. Fritz, A., C. Percy, A. Jack, et al., eds. 2013. *International Classification of Diseases for Oncology*. 3rd edition, 1st revision. Geneva: World Health Organization.
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23. Swerdlow, S.H., E. Campo, N.L. Harris, et al., eds. 2004. *WHO Classification of Tumours of Haematopoietic and Lymphoid Tissues*. 4th edition. Geneva: World Health Organization.
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25. Non-malignant intracranial and intraspinal tumours were excluded, as they were not consistently reported. A total of 38 cases from 1992 to 2010 did not initially map to a diagnostic group. However, upon manual review, 21 of these cases were considered to be atypical teratoid rhabdoid tumours that could be included under diagnostic group III, central nervous system tumours. The corresponding figures from 2006 to 2010 were 16 and 6.
26. World Health Organization. 2004. *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)*. 2nd edition. Geneva: World Health Organization.
27. World Health Organization. 1975. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death, Ninth Revision (ICD-9)*. Vol. 1. Geneva: World Health Organization.
28. Leukemia deaths were defined as codes C91.0 to C95.9, and C90.1 in ICD-10; and 204.0 to 208.9, and 203.1 in ICD-9. Lymphoma deaths were defined as codes C81.0 to C85.9, C90.0, C90.2, and C96.3 in ICD-10; and 200.0 to 200.2, 200.8, 202.0 to 202.2, and 202.8 in ICD-9. CNS tumour deaths were defined as codes C70.0 to C72.9 in ICD-10; and 191.0 to 192.9 in ICD-9.