



Centre for Cancer Control Research
South Australia cancer statistics

Monograph No 10

Cancer among young South Australians

April 2008

Preface to

Cancer among young South Australians

This monograph documents patterns of cancer among young South Australians under the age of 25 years. While cancer is a rare disease in young people, it evokes strong emotions in the community and generally causes many years of life to be lost by those who die as a consequence.

The results of this monograph present a mixed picture in terms of cancer trends over the past 28 years. Cancer incidence has been increasing among young South Australians, particularly adolescents and young adults. This is due mainly to increases in lymphoma and thyroid cancer (as seen in other developed countries) and melanoma. Despite the increasing incidence, mortality rates have declined over the same period. Significant improvements have been observed in survival outcomes, particularly for children, which are likely to be due to advances in treatment.

Unfortunately little is known about the causes of most cancers in young people, although sun protection is advocated to prevent melanoma. Further research is required to determine how best to reduce cancer risk more generally in this age group.

Associate Professor Brenda Wilson
chief executive
The Cancer Council South Australia

Acknowledgements

South Australian data in this monograph were compiled from data collected by the South Australian Cancer Registry within the South Australian Department of Health for the period 1977-2004. Staff of the Epidemiology Branch of the Department of Health are acknowledged for providing ongoing data support and associated data analyses. The Cancer Council also acknowledges the Australian Institute of Health and Welfare for the provision of data for Australia as a whole and the International Agency for Research on Cancer for cancer data from other countries and regions of the world.

Principal authors: Kerri Beckmann and David Roder, Centre for Cancer Control Research, Cancer Council South Australia

Table of contents

Preface	i
Acknowledgements	ii
Table of contents	iii
Summary	1
Methodology	7
Overview – All cancers	11
Leukaemias	21
Lymphomas	29
Malignant tumours of the brain and central nervous system	37
Sympathetic nervous system tumours	45
Retinoblastomas	51
Renal tumours	55
Hepatic tumours (cancers of the liver)	61
Malignant bone tumours	65
Soft tissue sarcomas	71
Germ cell, trophoblastic and other gonadal neoplasms (GCTOG tumours)	77
Carcinomas (epithelial neoplasms)	83
a) Melanoma	85
b) Thyroid cancer	88
Resources	93
Bibliography	95
Glossary	97

Summary

Summary

Cancer is a rare disease among young people in South Australia, with approximately 100 new cases occurring each year among those under 25 years of age. The average annual cancer incidence rate among 0–24 year olds, during 1977 to 2004, was 19.8 per 100,000. The incidence rate among adolescents and young adults aged 15–24 years (27.4 per 100,000) was approximately twice as high as that among children under 15 years (14.3 per 100,000). Even though cancer is the second most frequent cause of death in young people after injury and poisoning, cancer mortality rates were relatively low, with an average of 24 young South Australians dying from cancer each year (annual average mortality rate = 4.6 per 100,000).

Specific cancers with the highest annual incidence rates among young people aged 0–24 years in South Australia in 1990–2004 include: leukaemia (3.9/100,000), lymphoma (3.1/100,000), central nervous system tumours (2.6/100,000), and melanoma (3.7/100,000).

Children under 15 years of age have a higher incidence of leukaemia, tumours of the central nervous system (CNS) and sympathetic nervous system (SNS), renal and hepatic tumours, and retinoblastoma than young people aged 15–24 years. Adolescents and young adults, on the other hand, have a higher incidence of lymphoma, bone and soft tissue tumours, germ cell tumours, melanoma and thyroid cancer than children.

Incidence rates have increased over the past 28 years in young South Australians for all cancers combined, and for lymphoma, melanoma and thyroid cancer. Trends in the incidence of bone cancers suggest a decline in incidence (borderline significance), the reasons for which are unclear.

Overall, the increase in cancer incidence was more prominent among adolescents and young adults (1.6% per year) than among children under 15 years of age (0.45% per year). Much of the increase among the older age group can be attributed to increases for lymphoma, thyroid cancer and melanoma. Among children, the increase in incidence is most likely due to increases for leukaemia, although, this increase is not statistically significant. Reasons for increasing incidence rates are unclear. Improved diagnostic methods and/or earlier diagnosis may in part explain the increase in melanoma and thyroid cancers among the older age group, but these factors are unlikely to account for the increases for leukaemias and lymphomas.

Despite rising incidence rates, cancer mortality rates have declined over the period 1977–2004 among young South Australians. This decline is primarily due to a decrease in cancer mortality rates among children (particularly those under 10 years), with no significant decrease evident for adolescents and young adults (15–24 years).

There are some differences in cancer incidence rates according to gender among young South Australians. Overall, young

males are slightly more likely to be diagnosed with cancer than females (IRR 1.06, 95%CI 0.99–1.15). Compared with females, males have a higher incidence of leukaemia — particularly acute lymphoid leukaemia (ALL), lymphoma and germ cell tumours (mostly testicular). Females, on the other hand, have a higher incidence of thyroid cancer and melanoma.

There were no statistically significant differences in the incidence of cancer in young people under 25 years according to socio-economic status or place of residence (rural or metropolitan). However, there is a non-significant trend among adolescents and young adults (15–24 yrs) toward lower incidence rates among the least socially advantaged young people. This trend is reversed in the case of mortality rates, with the least advantaged having the highest cancer mortality rates. These differences are not statistically significant and may reflect random variation. The only specific cancer to exhibit an association with socio-economic status was melanoma, where the incidence increased with increasing level of social advantage.

Overall, 70% of young South Australians survived five years after diagnosis of their cancer. Survival outcomes were significantly better for those aged 15–24 years than for children under 15 years. To a large extent, this difference in survival outcome reflects differences in cancer types across age groups.

Five-year survivals were highest for thyroid cancer (100%), melanoma (95%), retinoblastoma (91%), germ cell tumours (90%) and lymphomas (81%). Cancers with least favourable outcomes include SNS (50%), bone (59%), brain/CNS tumours (61%) and leukaemias (65%).

Statistically significant improvements in survival among young patients were evident over time for all cancers combined, leukaemias (particularly acute myeloid leukaemia), lymphomas, germ cell tumours and melanoma, but not for other types. Improvements were far more prominent for children diagnosed with cancer than for adolescents and young adults aged 15–24 years. (Five-year survival increased from 61% to 77% for children compared with 76% to 82% for 15–24 year olds).

Conclusion

The incidence of cancer among young South Australians is low when compared with rates among older adults. Leukaemia, melanoma, lymphoma and brain/CNS tumours are the most common cancers among those under 25 years of age, with leukaemia being the most common in children under 15 years and melanoma being the most common in those aged 15–24 years. Young males are at a slightly higher risk of developing cancer than females.

Cancer incidence among young people has been increasing gradually since cancer registration began in South Australia. The increase is more prominent in the older age group, and has been greatest for cancers that have better prognoses, such as melanoma, thyroid cancer and lymphoma. At the same time cancer mortality rates are declining among young South

Australians. This decline reflects a change in death rates for children under 15 years of age, with no significant change being evident among older adolescents and young adults aged 15–24 years. The increasing incidence rate among adolescents and young adults partly explains why mortality rates have not declined, despite improvements in survival.

Outcomes for young people with cancer have improved significantly over time but, as with mortality trends, improvements have mainly been among children under 15 years of age at diagnosis, with only a comparatively small improvement in survival for adolescents and young adults. While overall survival is better for adolescents and young adults than for children, the difference relates to the types of cancer affecting the two age groups.

Highlights

Rates of cancer are higher for young people aged 15–24 than for children under 15 years of age. However, the older age group tends to have more cancers that have a better prognosis (eg. lymphoma, thyroid cancer and germ cell tumours).

Cancer rates have increased among young people in SA, most prominently among 15–24 year olds. Specific cancers that show an increasing incidence include leukaemia, lymphoma, melanoma, and thyroid cancer. By comparison bone cancer incidence may have decreased.

Cancer mortality has decreased among children but not among adolescents and young adults. Significant decreases in mortality are seen for leukaemia and lymphoma.

Cancers are slightly more common in young males than young females. Males have higher rates of leukaemia, lymphoma and germ cell tumours. Females have higher rates of melanoma and thyroid cancer.

Improvements in survival outcomes are more prominent for children under 15 years than for young people aged 15–24 years.

Table i.

Summary of cancer incidence in young South Australians (1977–2004)
– Age standardised annual incidence rates per 100,000

Cancer type (ICCC classification)	0-14yrs		15-24yrs		0-24yrs		Incidence rate ratio	
	1977-1990	1991-2004	1977-1990	1991-2004	1977-1990	1991-2004	1991-2004 / 1977-1990	male/ female
All cancers	13.9 (12.8-15.0)	14.5 (13.3-15.6)	24.1 (22.4-25.8)	28.7 (26.8-30.5)	18.0 (17.1-19.0)	20.2 (19.2-21.2)	1.13 (1.04-1.20)	1.06 (0.99-1.15)
I. Leukaemias	4.6 (3.9-5.2)	4.9 (4.2-5.6)	1.8 (1.3-2.2)	2.4 (1.8-2.9)	3.4 (3.0-3.9)	3.9 (3.4-4.3)	1.13 (0.95-1.35)	1.17 (0.99-1.39)
Acute lymphoid leukaemia (ALL)	3.9 (3.3-4.5)	4.1 (3.5-4.7)	0.9 (0.6-1.2)	1.2 (0.8-1.6)	2.7 (2.3-3.1)	2.9 (2.5-3.3)	1.08 (0.89-1.32)	1.29 (1.06-1.57)
Acute myeloid leukaemia (AML)	0.6 (0.3-0.8)	0.7 (0.4-0.9)	0.6 (0.3-0.8)	1.0 (0.6-1.3)	0.6 (0.4-0.7)	0.8 (0.6-1.0)	1.45 (0.97-2.14)	0.80 (0.53-1.20)
II. Lymphomas	1.7 (1.3-4.4)	1.6 (1.3-2.0)	3.7 (3.1-4.4)	5.3 (4.5-6.1)	2.5 (2.2-2.9)	3.1 (2.7-3.5)	1.23 (1.02-1.49)	1.58 (1.30-1.92)
III. Brain/ CNS	2.8 (2.3-3.3)	2.9 (2.4-3.5)	1.9 (1.4-2.4)	2.0 (1.5-2.6)	2.4 (2.1-2.8)	2.6 (2.2-3.0)	1.06 0.86-1.30	1.09 (0.89-1.34)
IV. Neuroblastoma / sympathetic nervous system tumours	0.9 0.6-1.1	0.8 0.6-1.1	0.1 0.0-0.2	0.1 0.0-0.2	0.5 (0.4-0.7)	0.5 (0.4-0.7)	0.97 (0.62-1.51)	1.30 (0.82-2.03)
V. Retinoblastoma*	0.3 (0.1-0.5)	0.3 (0.1-0.4)	0	0	0.2 (0.1-0.3)	0.2 (0.1-0.2)	0.86 (0.39-1.92)	1.33 (0.59-3.00)
VI. Renal tumours	0.7 (0.5-1.0)	0.8 (0.6-1.1)	0.2 (0.0-0.3)	0.1 (0.0-0.2)	0.5 (0.3-0.7)	0.5 (0.4-0.7)	1.08 (0.68-1.70)	0.90 (0.57-1.42)
VII. Hepatic tumours*	0.2 (0.0-0.3)	0.1 (0.0-0.2)	0.1 0.0-0.1	0	0.1 (0.0-0.2)	0.1 (0.0-0.1)	0.45 (0.10-1.62)	1.11 (0.37-3.31)
VIII. Bone cancers	0.7 0.5-1.0	0.6 0.4-0.9	1.2 1.0-1.8	0.7 0.9-1.7	0.9 (0.7-1.2)	0.7 (0.5-0.8)	0.70 (0.49-1.01)	1.15 (0.80-1.64)
IX. Soft tissue sarcomas	0.9 (0.6-1.2)	0.8 (0.5-1.1)	1.4 (1.0-1.8)	1.3 (0.9-1.7)	1.1 (0.9-1.3)	1.0 (0.8-1.2)	0.91 (0.67-1.26)	0.87 (0.64-1.19)
X. Germ cell, trophoblastic and gonadal tumours	0.4 0.2-0.6	0.6 (0.4-0.8)	2.3 (1.8-2.9)	2.8 (2.2-3.3)	1.2 (0.9-1.4)	1.5 (1.2-1.7)	1.24 (0.94-1.64)	4.34 (3.04-6.19)
XI. Malignant epithelial tumours: - Thyroid	0.1 (0.0-0.2)	0.1 (0.0-0.2)	1.4 (1.0-1.8)	2.2 (1.7-2.7)	0.6 (0.4-0.8)	0.9 (0.7-1.2)	1.54 (1.07-2.22)	0.17 (0.10-0.27)
- Melanoma	0.5 (0.2-0.5)	0.3 (0.2-0.5)	6.2 (5.3-7.0)	8.9 (7.7-9.7)	2.7 (2.3-3.1)	3.7 (3.3-4.2)	1.38 (1.15-1.64)	0.72 (0.61-0.86)

*small numbers

Table ii.

Summary of survival outcomes in young South Australians with cancer

Cancer type (ICCC classification)	5 year survivals (95% CI)		LR test (p-value)
	1977-1990	1991-2004	
All cancers	73% (71-76)	80% (78-82)	25.14 (<0.0001)
I. Leukaemias	59% (52-64)	70% (64-76)	9.78 (0.0018)
Acute lymphoid leukaemia (ALL)	67% (60-73)	74% (67-80)	3.72 (0.0538)
Acute myeloid leukaemia (AML)	24% (12-38)	58% (44-70)	11.43 (0.0007)
II. Lymphomas	76% (70-82)	86% (81-90)	7.66 (0.0057)
III. Brain/CNS	63% (56-70)	60% (52-67)	0.06 (0.8088)
IV. Neuroblastomas /sympathetic nervous system tumours	48% (32-62)	51% (33-66)	0.14 (0.7107)
V. Retinoblastoma*	92% (48-96)	100%	1.64 (0.2004)
VI. Renal tumours	69% (50-81)	83% (65-92)	2.20 (0.1384)
VII. Hepatic tumours*	63% (22-86)	100%	2.16 (0.1418)
VIII. Bone cancers	62% (50-73)	56% (39-70)	1.05 (0.3063)
IX. Soft tissue sarcomas	68% (57-77)	69% (56-79)	0.26 (0.6090)
X. Germ cell, trophoblastic tumours and other neoplasms of the gonads	83% (73-89)	96% (90-99)	8.79 (0.0030)
XI. Malignant epithelial tumours: -Thyroid carcinomas	100%	100%	---
-Melanoma	92% (88-95)	98% (95-99)	10.31 (0.0013)

* small numbers of cases

Methodology

Methodology

Data sources

This monograph reports on 2,888 cases of invasive cancer diagnosed in young South Australians from the period 1977 to 2004, and 673 deaths from cancer occurring during the same period. Young people are defined as those under the age of 25 years.

Data on all new invasive cases of cancer among individuals under 25 years of age, recorded in the South Australian Central Cancer Registry were analysed. The Registry has collected data on all invasive cancers (with the exception of non-melanocytic skin cancer) occurring in South Australia since 1977, under a mandatory reporting requirement. Data were complete and verified to the end of 2004. Data on all deaths from cancer among individuals aged under 25 years at the time of death were also extracted from the SA Cancer Registry for the period 1977-2004. Descriptors obtained from the Registry included date of diagnosis, date of death, age at diagnosis, gender, cancer site (ICD9), morphology (SNOMED/ICD-0), postcode at diagnosis and cause of death (ICD-9).

Classification of cancers

Unlike adult cancers which are normally classified by primary site, childhood cancers are more often classified by histological type rather than site. In this monograph, data on cancers have been classified according to the International Classification of Childhood Cancers v3 (ICCC). Conversion from ICD 9 to ICC3 were undertaken and double checked independently. In some cases, information on morphology was not adequate to classify into subcategories (eg germ cell tumours). The ICC3 system has been used internationally to report cancers in adolescents and young adults and is used throughout this monograph to classify cancers across the whole age spectrum (i.e. 0-24 years). See table iii for an outline of the ICC3.

Socio-economic status and place of residence

Socio-economic status (SES) and place of residence were derived from postcode information at the time of diagnosis. SES was categorised into quartiles based on the 1996 SEIFA index of disadvantage developed by the Australian Bureau of Statistics. Postcodes for which SEIFA scores were not available were assigned the ranking of neighbouring postcodes (taking the lowest quartile if adjacent postcodes differed in SES values).

In this document, comparisons are made across the four quartile ranges (labelled low SES, low-med SES, mid-high SES and high SES) or, where numbers are small, between the lower 50% (low SES) and higher 50% (high SES) ranges.

Place of residence was coded as rural or metropolitan according to 1996 South Australian statistical sub-divisions. Denominator

populations were determined via interpolation of the census figures for each census year from 1981 to 2001 for males and females separately in five year age groups for each postcode. Adjustment was made for census under-enumeration.

Analysis

All analyses were undertaken using STATA v8.

Incidence and mortality rates

The cancer Incidence Rate is defined as the number of new cases of cancer in a specified time period (usually one year) divided by the number of people at risk in the specified population group of interest. The cancer Mortality Rate is defined as the number of deaths from cancer occurring during a specified time period divided by the number of people in the population at risk. Throughout this report the incidence and mortality rates are expressed as the number of cases/deaths per 100,000 children /young people per year.

Crude incidence/mortality rates are presented when referring to each individual year of age or five-year age groups. Age-standardised incidence rates are generally presented when referring to broader age groupings (eg, 0-14yrs, 15-24yr and 0-24yrs).

Age standardised rates present summary incidence and mortality rates across several age groups by applying age-specific rates to a standard population age profile using the direct standardisation method.

$$\begin{aligned} \text{Age Standardised Rate (0-24yrs)} = & \\ & \text{Age-specific rate (0-4yrs)} \times \text{population proportion (0-4 yrs)} + \\ & \text{age-specific rate (5-9yrs)} \times \text{population proportion (5-9 yrs)} + \\ & \text{age-specific rate (10-14yrs)} \times \text{population proportion (10-14 yrs)} + \\ & \text{age-specific rate (15-19yrs)} \times \text{population proportion (15-19yrs)} + \\ & \text{age-specific rate (20-24yrs)} \times \text{population proportion (20-24 yrs)}. \end{aligned}$$

The standard population used throughout this monograph is the Australia standard population 2001. The following proportions were used:

Table iv.

Proportions used for standardisation using the Australian standard population 2001

	0-14 years	15-24 years	0-24 years
0-4 yrs	0.314	-	0.187
5-9 yrs	0.341	-	0.203
10-14 yrs	0.345	-	0.205
15-19 yrs	-	0.520	0.211
20-24 yrs	-	0.480	0.194
	1.000	1.000	1.000

Table iii

International Classification of Childhood Cancer (ICCC)

Cancer type (ICCC classification)	
I. Leukaemias	VIII. Bone tumours
a) Acute lymphoid leukaemia	a) Osteosarcoma
b) Acute myeloid leukaemia	b) Chondrosarcoma
c) Chronic myeloid leukaemia	c) Ewing's tumour and related sarcomas
d) Other specified leukaemia	d) Other specified bone tumours
e) Unspecified leukaemia	e) Unspecified bone tumours
II. Lymphomas	IX. Soft tissue sarcomas
a) Hodgkin lymphoma	a) Rhabdomyosarcoma
b) Non-Hodgkin lymphoma	b) Fibrosarcoma, peripheral nerve sheath tumours & other fibrous neoplasms
c) Burkitt's lymphoma	c) Kaposi sarcoma
d) Other misc lymphoreticular neoplasms	d) Other specified soft tissue sarcomas
	e) Other unspecified soft tissue sarcomas
III. CNS & misc intracranial/intraspinal tumours	X. Germ cell, trophoblastic & gonadal neoplasms
a) Ependymoma	a) Intracranial and intraspinal germ cell tumours
b) Astrocytoma	b) Extracranial & extragonadal germ cell tumours
c) Intracranial/intraspinal embryonal tumours (includes PNETs)	c) Gonadal germ cell tumours
d) Other gliomas	d) Other unspecified gonadal tumours
e) Other specified intracranial/intraspinal	
	XI. Malignant epithelial tumours
IV. Neuroblastomas & sympathetic nervous cell tumours	a) Adrenocortical carcinomas
a) Neuroblastoma and ganglioneuroblastoma	b) Thyroid carcinomas
b) Other peripheral nervous cell tumours	c) Nasopharyngeal
	d) Melanoma
V. Retinoblastoma	e) Skin carcinomas
	f) Unspecified carcinomas
VI. Renal tumours	
a) Nephroblastoma & non-epithelial renal tumours	XII. Other & unspecified neoplasms
b) Renal carcinomas	a) Other specified malignant tumours
c) Unspecified renal tumours	b) Other unspecified malignant tumours
VII. Hepatic tumours	
a) Hepatoblastoma	
b) Hepatic carcinomas	
c) Unspecified hepatic tumours	

The only exception were global comparisons derived through Globocan, which were adjusted using the World Standard Population.

Male to female rate ratios

Incidence rate ratios (IRRs) comparing rates for males relative to females are presented in the summary tables. The rate ratios presented represent the combined Mantel–Haenszel estimates for the male compared with females across the relevant age groups, based on age-specific rates.

Time trends

Estimates of the annual increments in incidence and mortality rates, along with 95% confidence intervals, were calculated using the Poisson regression function in STATA for two age categories (0–14 and 15–25 yrs), or all ages (0–24yrs) when the number of cases was small. These estimates are based on crude rates.

Incidence rate ratios (IRRs) comparing rates for the period 1977–1990 with those for 1991 to 2004 are presented in the summary tables. These rate ratios represent the combined Mantel–Haenszel estimates for the relevant age group, based on age-specific rates for the relevant 5-year age groups.

Survival outcomes

Survival outcomes presented in this monograph are based on Kaplan–Meier product limit method and are plotted for one year, two years, three years, four years and five years post-diagnosis. The five-year survival fractions (i.e. the percentage who survived their cancer for five years or more) are presented for comparisons between subgroups of the population/time periods, with assessment of statistical differences using the log-rank test. In all instances, the date of censorship was 31 December 2004.

Chapter 1

Overview – All cancers

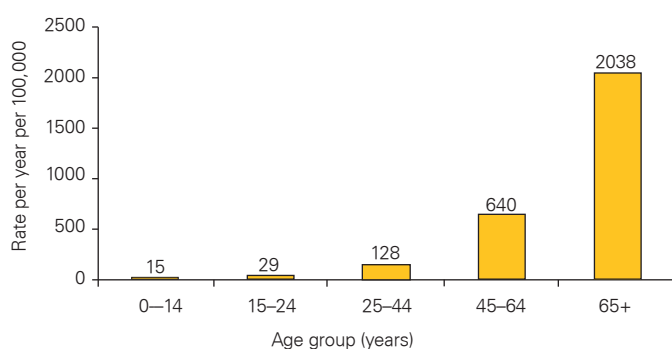
Overview – All cancers (excluding non-melanocytic skin cancer)

Cancers in children and young people are extremely rare. Less than 3% of all cancers in South Australia occur in people aged under 25 years of age. Between 1977 and 2004, 2888 young people under 25 years of age were diagnosed with cancer in South Australia (approximately 100 cases per year). Of these cases, 1214 were among children under 15 years of age (approximately 43 cases per year).

Cancer incidence increases with age. The average annual incidence of cancer in South Australian children under 15 years (1991–2004) was 15 cases per 100,000. Among adolescents and young adults 15–24 years of age, the annual incidence rate was 29 cases per 100,000, about twice the rate for those under 15 years of age. The incidence rate of cancer among young people under 25 years of age (20/100,000) is considerably lower than for older age groups. The annual cancer incidence rate among South Australians aged 25–44 was 128/100,000, approximately six times that for young people under 25 years of age. The rates among those aged 45–64 years and 65 years and over were approximately 30 and 100 times those of people under 25 years of age (respectively). (Figure 1.1)

Figure 1.1

Age specific incidence rate: all cancers
(South Australia 1991–2004)



Despite the low cancer incidence rates among young people, cancer is the second most common cause of death in children (0–14yrs) and in adolescents and young people (12–24yrs), after injury and poisoning in Australia (AIHW). In 2003, 18% of deaths in children were due to cancer, with a mortality rate of approximately 2.7 deaths per 100,000 children. Among adolescents and young adults, the mortality rate from cancer in 2001 was 4.2 per 100,000.

Overall patterns and trends

Leukaemia was the most common cancer among young people in South Australia during 1977–2004, accounting for 18.5% of cancers in those under 25 years of age. Melanoma was the next most common cancer (16.4%), followed by lymphomas (14.9%) and cancers of the central nervous system (12.8%). (Table 1.1)

The profile of cancer types varies considerably between children (<15 years) and adolescents and young adults (15–24 years). Leukaemia accounted for 33.3% of cancers in children while cancers of the Central Nervous System (CNS) accounted for 20% of childhood cancers (1977–2004). (Figure 1.2) The most common cancer in young people aged 15–24 years was melanoma, comprising 28.3% of cancers in this age group. The next most common cancers in young people were lymphomas (25.7%), followed by cancers of the CNS (22.0%). (Figure 1.3) Melanoma, thyroid cancer and germ cell cancers (which include testicular cancer) were more common in the older than younger age group. Conversely renal tumours and tumours of the sympathetic nervous system were more common among children than among adolescents and young adults.

Table 1.1

Numbers of cases diagnosed by cancer type and age at diagnosis (South Australia 1977–2004)

Cancer type	0–14 yrs	15–24 yrs	0–24 yrs
Leukaemia	404	130	534
Lymphoma	145	285	430
Central nervous system tumours	244	125	369
Sympathetic nervous system tumours	73	5	78
Retinoblastoma	24	0	24
Renal tumours	66	8	74
Hepatic tumours	11	2	13
Malignant bone tumours	58	61	119
Soft tissue sarcomas	73	84	157
Germ cell tumours	42	163	205
Melanomas	31	474	505
Thyroid cancers	8	114	122
Other carcinomas and other tumours	35	223	258
All cancers combined	1214	1674	2888

Figure 1.2

Cancers in children 0–14 years (South Australia 1977–2004)

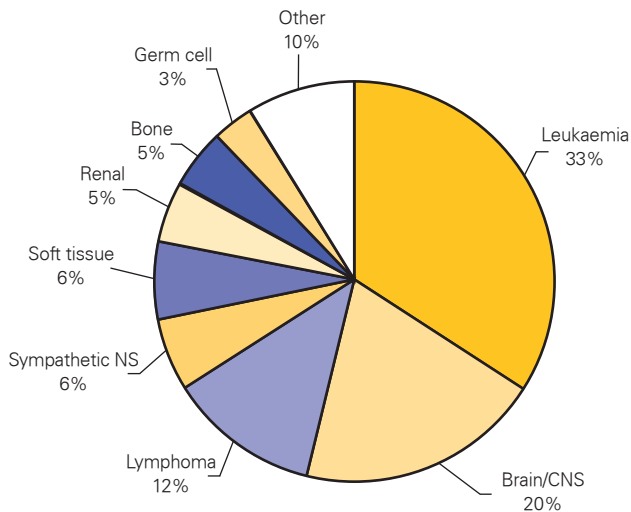
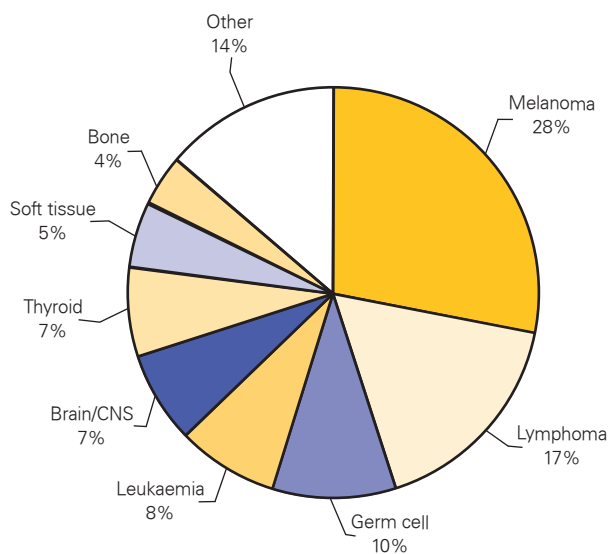


Figure 1.3

Cancers in young people 15–24 years (South Australia 1977–2004)



In the period between 1977 and 2004, 673 people under the age of 25 years lost their lives to cancer. This is equivalent to approximately 24 young people each year. There were 343 deaths among those under 15 years of age and 330 among those aged 15–24 years. (Table 1.2)

Leukaemia was responsible for the highest number of cancer deaths, both among children under 15 years and among young people 15–24 years of age. Tumours of the central nervous system were the next most common cancers leading to deaths in both age groups. Other cancers for which there were

relatively large numbers of deaths among children included cancers of the sympathetic nervous system, lymphomas, renal cancers and soft tissue sarcomas. Among adolescents and young adults, lymphomas, bone cancers, soft tissue sarcomas and melanomas were the next most common cancers causing deaths in this age group after leukaemia and tumours of the central nervous system. (Figure 1.4, Figure 1.5)

Deaths due to leukaemia, cancers of the central nervous system, cancers of the sympathetic nervous system and renal tumours were more prominent in children, whereas deaths due to lymphoma, bone cancers, soft-tissue sarcomas, germ cells tumours and melanomas were more prominent among older adolescents and young adults.

Table 1.2

Numbers of deaths by cancer type and age at diagnosis (South Australia 1977–2004)

Cancer type	0–14 yrs	15–24 yrs	0–24 yrs
Leukaemia	128	82	210
Lymphoma	27	50	77
Central nervous system tumours	87	53	140
Sympathetic nervous system tumours	36	5	41
Retinoblastoma	4	0	4
Renal tumours	16	4	20
Hepatic tumours	6	1	7
Malignant bone tumours	12	38	50
Soft tissue sarcomas	16	28	44
Germ cell tumours	5	16	21
Melanomas	1	19	20
Other carcinomas and epithelial tumours	5	34	38
All cancers combined	343	330	673

Figure 1.4

Cancer deaths in children 0–14 years (South Australia 1977–2004)

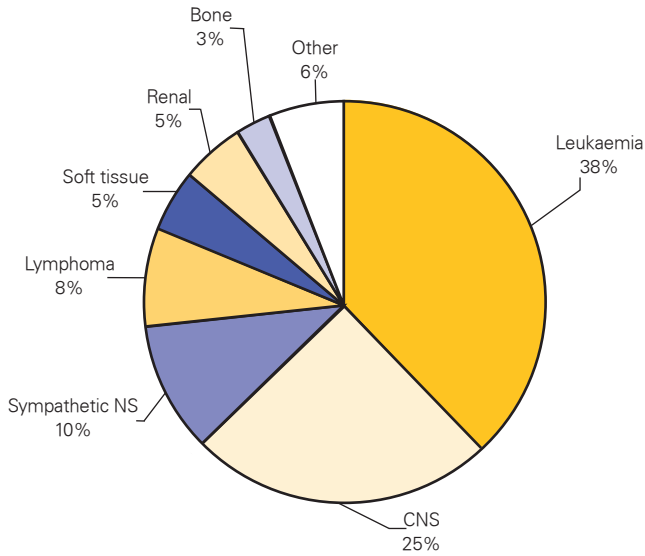
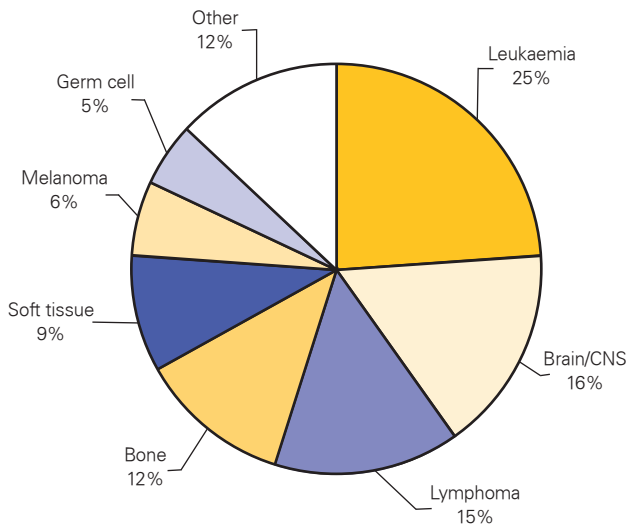


Figure 1.5

Cancers deaths in young people 15–24 years (South Australia 1977–2004)



Age differences

Childhood cancers are most common in the first few years of life. Among South Australian children under 15 years, cancer incidence is highest between one and two years of age. Incidence rates decline between the ages of three to six years and remain relatively low until puberty. From the early teens, rates of cancer increase with increasing age. The incidence of cancer in the late teens and early twenties is greater than the incidence in the early years of life. (Figure 1.6)

Because cancer deaths are rare, the pattern of deaths by age is somewhat erratic. There appears to be a general trend towards increasing mortality with increasing age. (Figure 1.7) Poisson regression shows a statistically significant increment with age in years (Incidence rate ratio = 1.018, 95%CI 1.01–1.03). Among children under 15 years, the peak in deaths occurs at two years of age.

Figure 1.6

Age specific incidence rate: all cancers (South Australia 1977–2004)

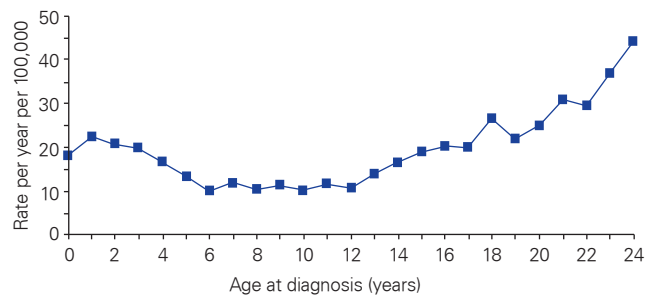
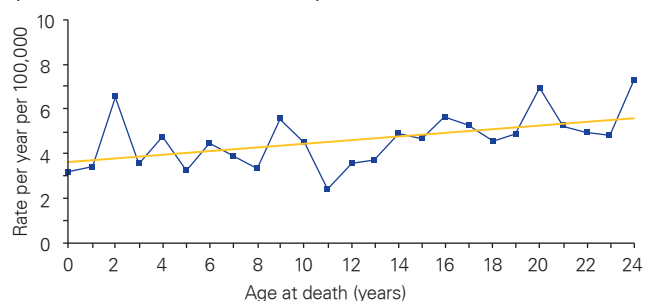


Figure 1.7

Age specific mortality rate: all cancers (South Australia 1977–2004)



Differences by gender

Young males tend to have more cancers than young females. Although this trend is not statistically significant for the South Australian population, it is consistent with international trends in relation to childhood cancers for all sites combined and some specific cancers. (Figure 1.8, Table 1.3) There is a statistically significant difference in South Australia in relation to mortality, with males under 25 years of age having higher cancer mortality rates than females. The difference is most notable in the 15–19 year age group. (Figure 1.9, Table 1.3)

Figure 1.8

Age specific incidence rate by gender: All cancers (South Australia 1977–2004)

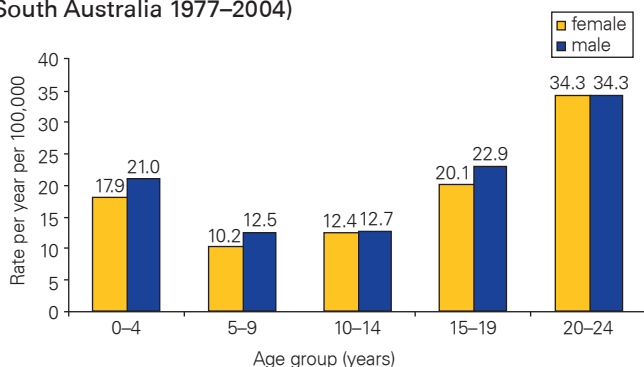


Figure 1.9

Age specific mortality rate by gender: All cancers (South Australia 1977–2004)

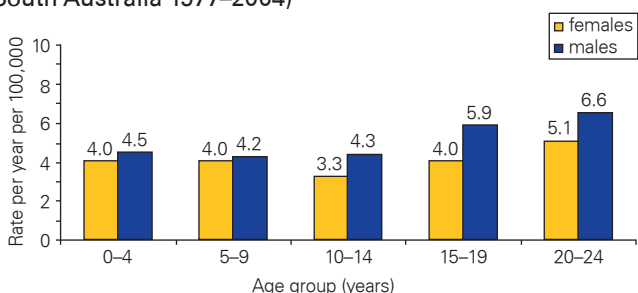


Table 1.3

Male to female incidence and mortality rate ratios for all cancers combined, by age group (South Australia 1977–2004)

age group	Incidence		Mortality	
	rate ratio male : female	95% CI RR	rate ratio male : female	95% CI RR
0-4yrs	1.17	0.98–1.40	1.11	0.76–1.64
5-9yrs	1.23	0.98–1.54	1.05	0.72–1.54
10-14yrs	1.02	0.83–1.26	1.31	0.89–1.95
15-19yrs	1.14	0.97–1.33	1.47	1.05–2.07
20-24yrs	0.94	0.83–1.06	1.29	0.95–1.76
M-H* 0-24yrs	1.06	0.99–1.14	1.25	1.07–1.46

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by residence and socio-economic status

Among children under 15 years of age, the incidence of cancer did not vary between rural South Australians and those living in metropolitan Adelaide. Nor did incidence rates vary according to socio-economic groupings (based on SEIFA scores for residential postcodes at the time of diagnosis). Among 15–24 year olds, there was a trend toward higher incidence rates among young people from areas of higher socio-economic status and among young people living in metropolitan Adelaide at the time of diagnosis. (Figure 1.10) Neither of these trends was statistically significant ($p>0.05$) and hence could possibly represent random variations across these groups.

The rate of death from cancer tended to decrease with increasing socio-economic status, among both children (0–14yrs) and adolescents and young adults (15–24yrs). A slightly higher death rate was noted among children from rural areas but death rates were similar for young people (15–24yrs) living in rural and metropolitan areas at diagnosis. (Figure 1.11) None of the observed differences in death rates for either age group was statistically significant.

Figure 1.10

Age standardised incidence rate by place of residence and SES: All cancers (South Australia 1977–2004)

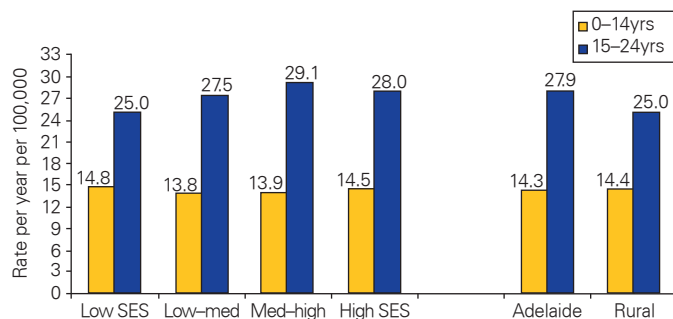
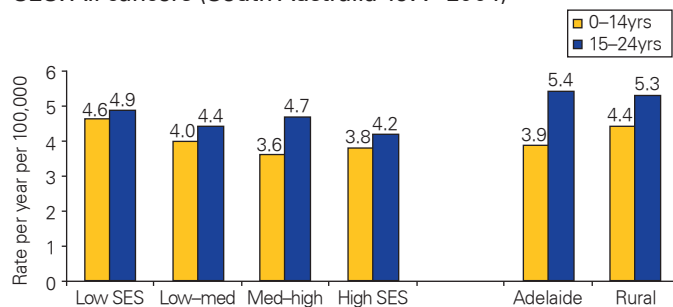


Figure 1.11

Age standardised mortality rate by place of residence and SES: All cancers (South Australia 1977–2004)



Trends in cancer incidence and mortality

Incidence rates have increased for all cancers combined in both the younger (0–14yrs) and older (15–24yrs) age groups. (Figure 1.12, Figure 1.13) The increase is more pronounced among 15–24 year olds. Rates have increased among children by 0.45% per year and in young people aged 15–24 years by 1.6% per year. (Table 1.4) While the increase among 15–24 year olds is statistically significant, the increase among children is not. However, given the observed increases in cancer incidence in other western countries it is likely that trends among South Australian children represent an actual increase rather than a chance variation.

Overall, cancer mortality has decreased since 1977 among young South Australians (0–24yrs). This decline is due mostly to a significant decrease in mortality among children (0–14yrs) of around 2.5% per year, with little change in mortality rates occurring among the older age group over this period. (Table 1.4)

Figure 1.12

Trends in cancer incidence and mortality among 0–14 year olds: All cancers
(Age standardised rate, South Australia 1977–2004)

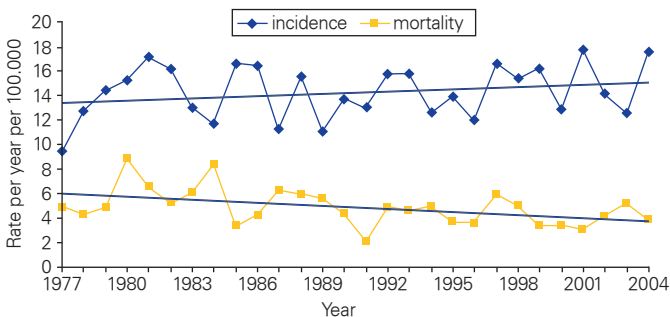


Figure 1.13

Trends in cancer incidence and mortality among 15–24 year olds: all cancers
(Age standardised rate, South Australia 1977–2004)

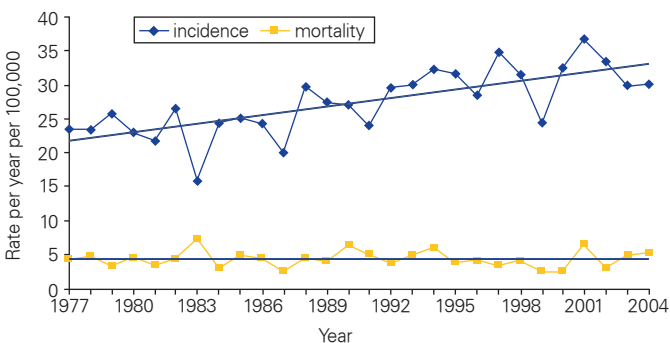


Table 1.4

Rate ratios showing annual change in cancer incidence and mortality by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	change per annum	95% CI	change per annum	95% CI
0–4yrs	1.0026	0.992–1.013	0.968	0.946–0.991
5–9yrs	1.0034	0.990–1.017	0.976	0.954–0.999
10–14yrs	1.0075	0.995–1.020	0.979	0.957–1.001
15–19yrs	1.0178	1.008–1.027	1.011	0.991–1.031
20–24yrs	1.0144	1.007–1.022	0.995	0.977–1.014
M-H* 0–14yrs	1.0045	0.998–1.012	0.975	0.962–0.988
M-H* 15–24yrs	1.0158	1.010–1.022	1.002	0.989–1.016

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Regional comparisons

Global comparisons

Childhood cancers tend to be more common in developed than developing countries. (Figure 1.14) International comparisons indicate that Australia has one of the highest rates of childhood cancers (0–14yrs), just below rates for New Zealand and above those of North America. Mortality rates, however, are relatively low in comparison to other regions of the world. (Figure 1.15) Cancer death rates in Australia are higher than in North America, Northern and Western Europe, Eastern Asia and some African regions. Lower mortality in these regions could be the result of a lower incidence of childhood cancers, different profiles of cancer types, and in some instances, better survival rates due to effective treatments or a mixture of these factors.

Figure 1.14

Comparison of cancer incidence rates by country/region among 0–14 year olds: all cancers (Globocan estimates for 2000)

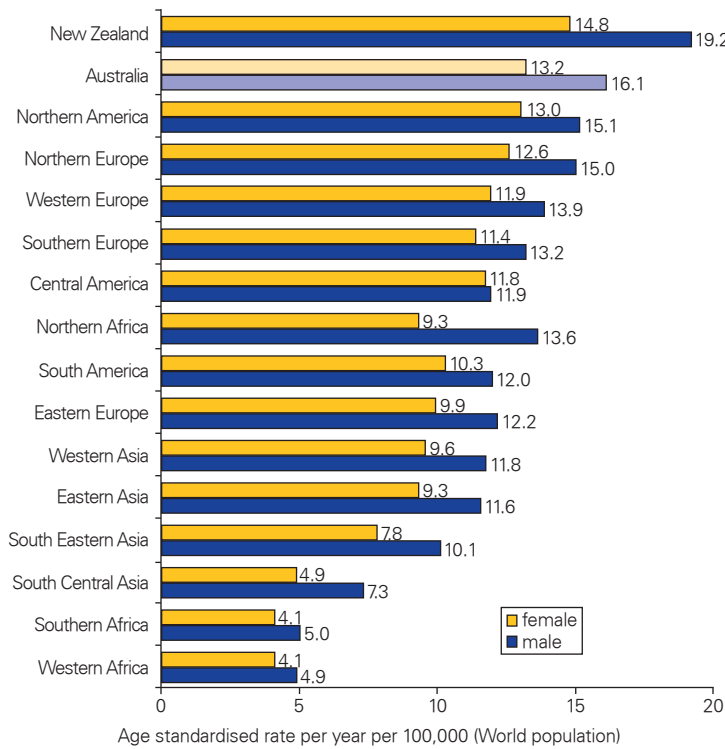
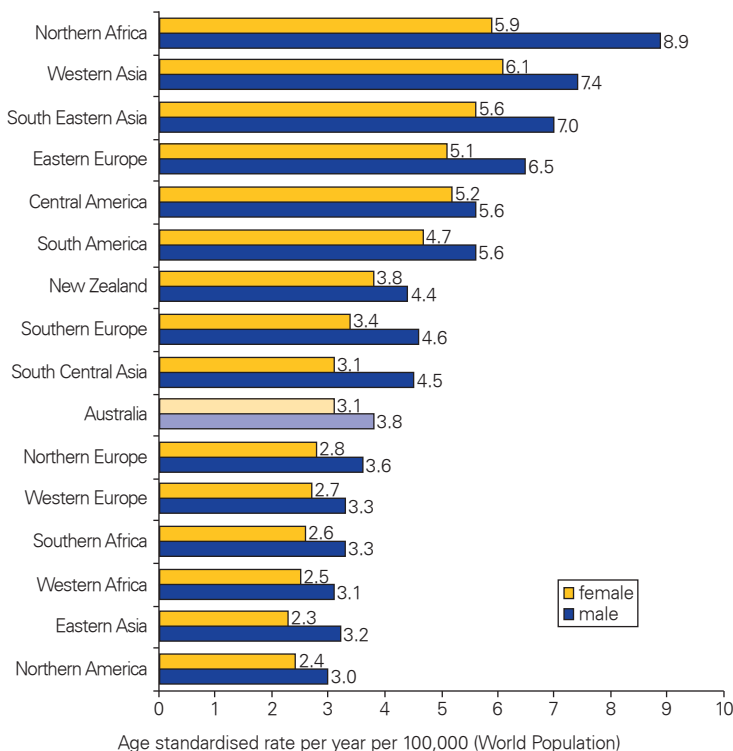


Figure 1.15

Comparison of cancer mortality rates by country/region among 0-14 year olds (Globocan estimates for 2000)



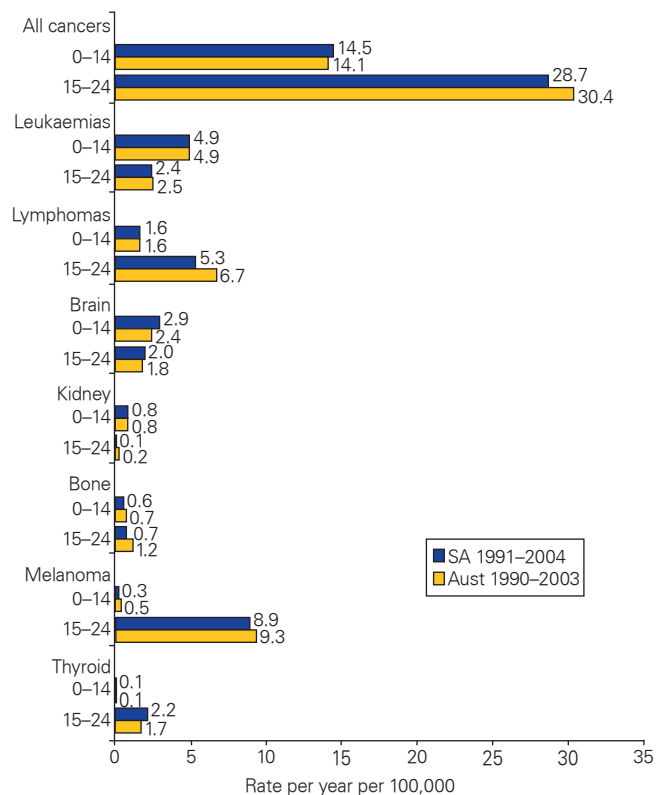
National comparisons

The incidence of cancer among young people in South Australia is very similar to rates observed for all of Australia. For the period 1991–2004, the annual incidence rate among South Australian children was 14.5/100,000, compared with 14.1/100,000 for Australian children (1990–2003). The annual incidence rate among South Australian adolescents and young adults (15–24yrs) was slightly lower than the national rate (28.7 compared with 30.4/100,000), but this difference is not statistically significant.

Generally incidence rates for specific cancers were also comparable across both the younger and older age group. The only statistically significant difference between rates for South Australians and national rates was for lymphoma among 15–24 year olds, where the annual incidence was lower for South Australia [5.3/100,000 (CI: 4.5–6.1) compared with 6.7/100,000 (CI: 6.5–7.0)]. (Figure 1.16)

Figure 1.16

Age standardised incidence rate by cancer type and age group for South Australia and Australia



Survival

Survival outcomes for invasive cancers in young people are relatively favourable, with 80% of young South Australians surviving their cancers at least five years after diagnosis during the period 1991–2004. Survival among children under 15 years of age is significantly worse than for adolescents and young adults 15–24 years of age. (Figure 1.17) This is most likely a function of the higher incidence of cancers that have better survival outcomes, such as melanoma, lymphoma and thyroid cancer, among the older age group.

While there is no observable difference in survival outcomes between males and females under 15 years of age, survival was significantly worse among males than females aged 15–24 years.

Similarly, no differences in survival are evident by socio-economic status (SES) (based on SEIFA scores for postcode of residence) among children but survival outcomes do differ significantly by SES among adolescents and young adults 15–24 years of age at diagnosis. Those from the lowest SES areas had the poorest outcomes while those from areas of higher SES had the most favourable outcomes. However the patterns observed do not suggest a consistent gradient by SES level. (Figure 1.18, Figure 1.19)

Survival outcomes appear to have improved over the period since records were collected, for both children and young people 15–24 years of age. Among children under 15 years, five-year survivals have improved considerably, from 61% during the period 1977–1983 to 77% during 1998–2004. The improvement among 15–24 year olds is more modest, with an increase from 76% survival at five years for those diagnosed between 1977 and 1983 to 82% survival for those diagnosed between 1998 and 2004. (Figure 1.20)

Figure 1.17

Survival by age group: all cancers (South Australia 1977–2004)

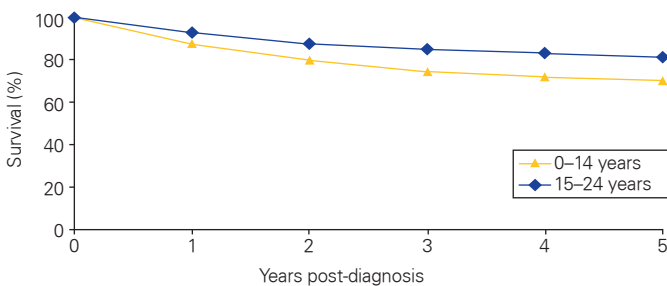


Figure 1.18

Five-year survival from cancer for 0–14 year olds, by age group, gender, residence and SES (South Australia 1977–2004)

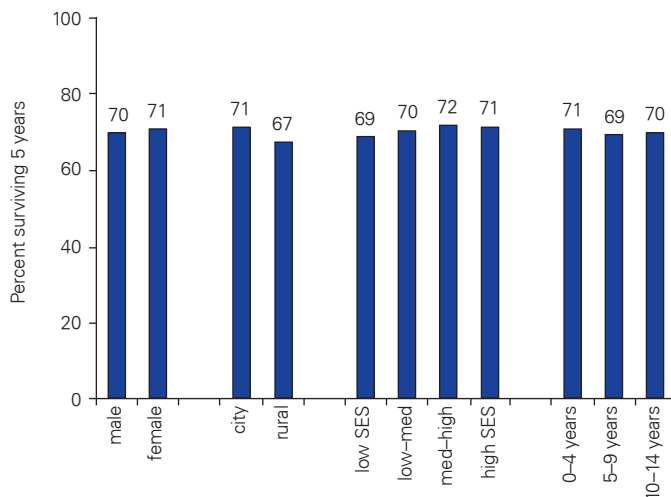


Figure 1.19

Five-year survival from cancer for 15–24 year olds, by age group, gender, residence and SES (South Australia 1977–2004)

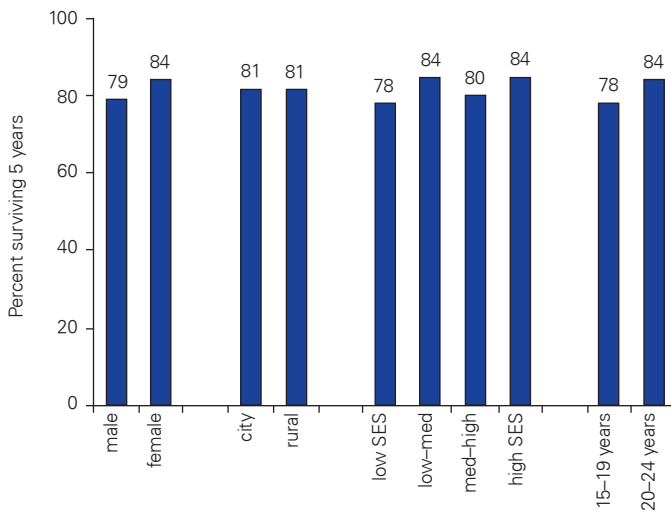
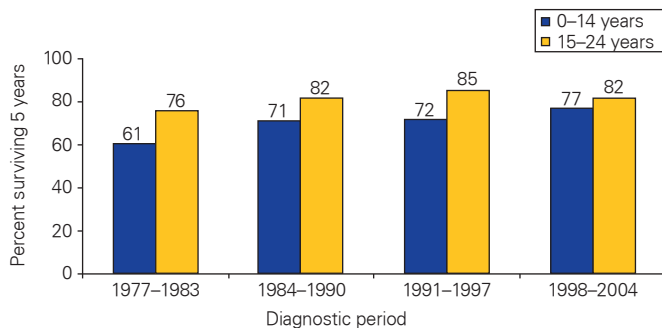


Figure 1.20
Five-year survival from cancer by diagnostic period
(South Australia 1977–2004)



Differences in survival outcomes by age group were statistically significant ($p < 0.0001$). Survival outcomes were significantly different for males and females ($p = 0.01$) and across SES groups ($p = 0.04$) in the 15–24 year old age group but not in the 0–14 year old age group. While statistically significant differences were observed in relation to survival by socio-economic status among 15–24 year olds, patterns of difference did not show a consistent gradient effect. Differences across time periods were also statistically significant in both age groups (0–14yrs: $p < 0.0001$; 15–24yrs: $p = 0.0002$).

All cancers combined

Cancer is rare in young people. From 1977–2004 there have been 2888 cases of cancer diagnosed among young people under 25 years in South Australia (approximately 100 cases per year).

A total of 673 young people died from cancer between 1977 and 2004 in South Australia (approximately 24 per year). Despite the low death rate, cancer is the second most common cause of death in young people after injury and poisoning.

Rates of cancer in young South Australians are similar to corresponding rates for the whole of Australia. Australia had a relatively high rate of childhood cancer compared to other regions of the world, although rates of cancer in children in Australia are lower than for New Zealand.

The most common childhood cancers in South Australia are leukaemia (33%), cancers of the brain/central nervous system (20%) and lymphomas (12%). Melanoma (28%), lymphomas (17%) and germ cell tumours (10%) are the most common cancers in adolescent and young adults in South Australia.

Leukaemia (38%) and brain cancers (25%) are responsible for the largest proportion of cancer deaths in children, followed by sympathetic nervous system tumours (10%) and lymphomas (8%). Leukaemia (25%), brain cancers (16%), lymphomas (15%) and bone cancers (12%) are the most common causes of cancer death in adolescents and young adults (15–24 years).

Cancer incidence rates are approximately twice as high among 15–24 year olds as in children under 15 years, with 29 cases per 100,000 people aged 15–24 per year and 15 cases per 100,000 children under 15 years per year. Cancer occurs more frequently in very young children than in older children, with incidence peaking during the second year of life. Rates increase with age from adolescence onwards.

Cancer death rates tend to increase with age but much more slightly than incidence rates. There is a slight peak around two years of age.

Young males have a slightly higher incidence of cancer than young females (rate ratio 1.06, borderline significance). Cancer death rates are also higher among young males (rate ratio 1.25, statistically significant).

Incidence rates among young people (15–24 years) tend to increase with higher socio-economic status. This trend is not evident among children (<15 years) nor in relation to death rates.

The incidence rate for all cancers has increased over the past three decades, significantly among adolescents and young adults (1.6% per year) but less prominently among children (0.45% per year, borderline significance).

Death rates among South Australian children have decreased significantly (2.5% per year) while no change in death rates is evident among young people aged 15–24 years.

Survival outcomes in South Australia are good, with 80% of young people diagnosed with cancer surviving for at least five years (1977–2004).

Outcomes are more favourable for adolescents and young adults (15–24 years) than for children under 15 years (five-year survival of 81% compared with 70%), which is due in part to the different mix of cancers occurring in these age groups.

While there is no difference by gender for children, male adolescents and young adults had poorer survival outcomes than females in this age group.

Survival outcomes have improved significantly over the period from 1977–1983 to 1998–2004. These improvements are more prominent among children than young people (15–24 years). [Five-year survivals: 61% to 77% among children compared with 76% to 82% for young people.]

Chapter 2

Leukaemias

Leukaemias

Introduction

Leukaemia is a cancer of the white blood cells. Different types of leukaemia are classified according to the type of cells in which they originate and how quickly they progress. Lymphatic leukaemia involves malignant transformation of immature lymphocytes, while myeloid leukaemia involves transformations of immature myelocytes. Acute forms of leukaemia develop rapidly whereas chronic forms develop and progress quite slowly. The majority of leukaemias in children and young people are acute forms. Acute lymphoid leukaemia (ALL) is the most common type of leukaemia in children and young adults. Acute myeloid leukaemia (AML) is rare in the early years of life but is a significant contributor to the cancer burden in adolescents and young adults.

When leukaemia occurs, immature stem cells in the blood develop uncontrollably within the bone marrow, eventually affecting the development of other blood cells. These immature cells are not able to fight infections and leave less room for healthy white cells, red blood cells and platelets to function.

Symptoms that may signal leukaemia in young people include:

- fatigue, weakness, paleness, dizziness
- joint pain, headache, trouble walking
- bruising, bleeding from the nose/gums
- repeated infections
- persistent fever
- loss of appetite, weight loss.

Leukaemia is usually treated by chemotherapy and sometimes radiotherapy. Advances in treatments have dramatically improved survival outcomes for children with leukaemia over the past three decades, with the vast majority now achieving remission and three quarters surviving five years or more after diagnosis.

Risk factors

Little is known about the causes of leukaemia in children and young adults.

Factors that are known to be associated with increased risk of ALL include:

- age (incidence peaks between two and five years of age)
- sex (30% more common in males)
- higher socio-economic status (this may be related to lack of or later exposure to certain infections)
- ionising radiation in utero (prenatal x-rays: unlikely to be a major cause in SA today due to protocols for protection of mothers pre-natally)

- ionising radiation post-natally (therapeutic radiation has been associated with increased risk of ALL)
- genetic predisposition (a 20-fold increased risk of leukaemia has been observed among children with Down syndrome).

Other risk factors have been suggested. However, evidence is inconclusive at this stage. These include:

- high birth weight (several studies have suggested a two-fold increased risk of leukaemia among infants with a birth weight greater than 4000 g)
- first born or only child (which may relate to exposure to infections)
- parents' occupational exposure to chemicals (isolated studies have suggested a link between childhood leukaemia and exposure to specific chemicals (e.g. petrochemicals, hydrocarbons, paints)
- electromagnetic fields (some studies report increased risk for children living in the vicinity of high voltage powerlines while other studies have not shown a link)
- vitamin K at birth (findings from early studies have not been confirmed in large studies undertaken more recently).

A different pattern of risk factors is emerging for AML in children and young people. Established risk factors for AML include:

- chemotherapy (there is an increased risk of AML among people previously exposed to particular chemotherapy drugs)
- ionising radiation in utero (AML has been linked to prenatal x-rays but this is not likely to be an important factor now due to protocols for limiting the x-raying of pregnant women)
- genetic predisposition (young people with Down syndrome have a 500-fold increased risk of developing AML; the risk is increased with other specific syndromes as well).

Other suggested risk factors for which evidence is inconclusive include:

- maternal alcohol consumption during pregnancy (relates particularly to AML in the first three years of life)
- parental exposure to benzene
- parental and child exposure to pesticides.

Occurrence

Leukaemia is the most common form of cancer in children under 15 years of age and the fourth most common cancer among 15 to 24 year olds.

Between 1977 and 2004, there were 543 cases of leukaemia diagnosed among young people in South Australia. Three quarters of those were among children under 15 years of age.

The rate of new cases of leukaemia in children is approximately five cases per 100,000 children per year. Among adolescents and young adults, the rate is approximately two cases per 100,000 per year.

There were 210 deaths due to leukaemia among young people in South Australia in the period from 1977 to 2004. Sixty percent of these deaths were among children under 15 years of age.

The most common type of leukaemia occurring in young people in South Australia was acute lymphatic leukaemia (ALL), accounting for 76% of cases. Acute myeloid leukaemia (AML) accounted for 19% of cases, while chronic myeloid leukaemia (CML) made up only 4% of cases. Other forms of leukaemia were rare (2%). (Figure 2.1)

The distribution of types of leukaemia differed between age groups. ALL was more common among children than adolescents and young adults, making up 84% of all leukaemia cases in those under 15 years. ALL made up only 50% of cases among those aged between 15 and 24 years of age, while AML made up a larger proportion of cases among 15–24 year olds (37%) than among those under 15 years (13%). (Table 2.1)

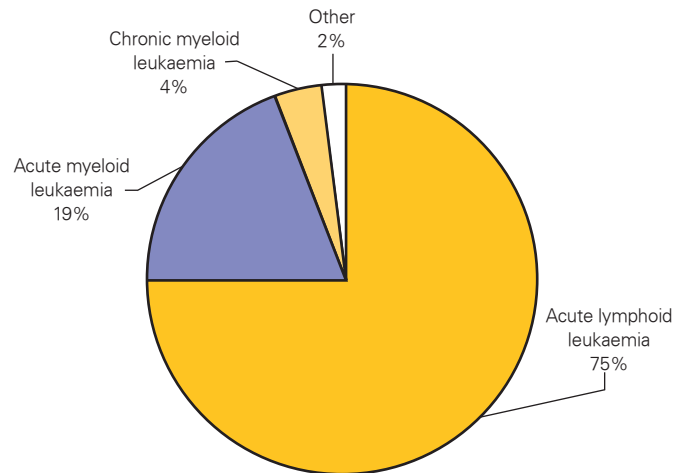
Table 2.1

Number of cases of leukaemia diagnosed in South Australia 1977–2004, by cancer subtype

leukaemia type	<15 yrs		15–24 yrs		0–24 yrs	
	n	%	n	%	n	%
Acute lymphoid leukaemia	340	84.2	65	50.0	405	75.9
Acute myeloid leukaemia	53	13.1	48	36.9	101	18.9
Chronic myeloid leukaemia	6	1.5	14	10.8	20	3.7
Other leukaemia	5	1.2	3	2.3	8	1.5
Total	404	100.0	130	100.0	534	100.0

Figure 2.1

Types of leukaemia diagnosed among young South Australians aged 0–24 years (1977–2004)



Differences by age

The incidence of leukaemia peaks in children between two and three years of age. Following this marked peak, the incidence declines rapidly to the age of seven and then more gradually through to 24 years. (Figure 2.2)

Mortality patterns among young South Australians are less clear and may fluctuate due to the relatively small numbers of cases. Mortality rates appear to peak at two years and nine years, but otherwise there is little variation across the age range to 24 years. (Figure 2.3)

Figure 2.2

Age specific incidence rate: leukaemia (South Australia 1977–2004)

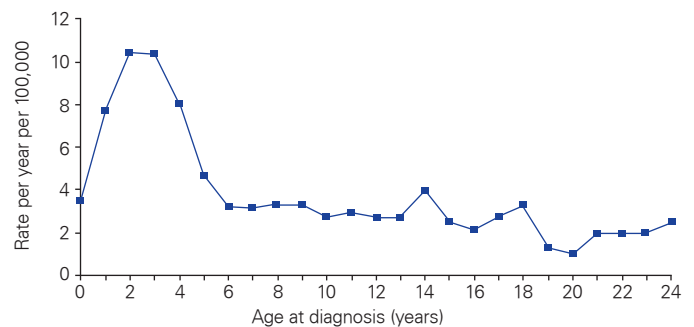
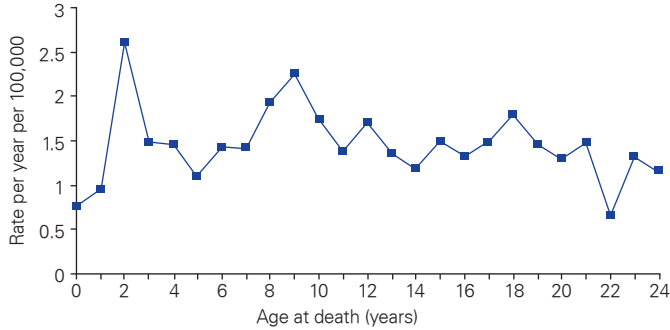


Figure 2.3

Age specific mortality rate: leukaemia (South Australia 1977–2004)



Differences by gender

Age-specific incidence rates of leukaemia are slightly higher among males than females in all age categories, with higher rate ratios occurring in older age groups. (Figure 2.4) None of the differences observed across these age categories is statistically significant. (Table 2.2) The overall rate ratio for males compared with females (1.17) is of borderline significance, but is likely to reflect a true elevation in young males rather than a chance event, given that such patterns have been observed nationally and internationally. This male preponderance only applies to cases of acute lymphoid leukaemia and was not observed in relation to acute myeloid leukaemia. (Detail is shown in Summary Table i.)

There is no consistent pattern in relation to mortality rates for leukaemia according to gender. (Figure 2.5)

Figure 2.4

Age specific incidence rate by gender: leukaemia (South Australia 1977–2004)

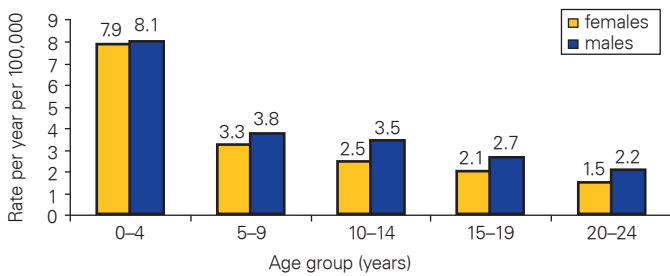


Figure 2.5

Age specific mortality rate by gender: leukaemia (South Australia 1977–2004)

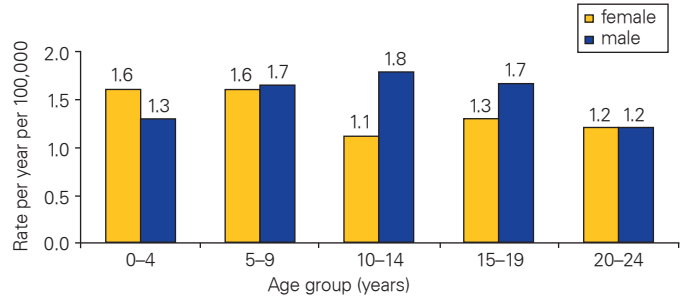


Table 2.2

Male to female incidence and mortality rate ratios for leukaemia, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate ratio male : female	95% CI RR	rate ratio male : female	95% CI RR
0–4yrs	1.02	0.77–1.34	0.82	0.41–1.61
5–9yrs	1.16	0.77–1.76	1.03	0.56–1.94
10–14yrs	1.39	0.90–2.19	1.6	0.83–1.17
15–19yrs	1.30	0.80–2.13	1.24	0.67–2.35
20–24yrs	1.42	0.81–2.52	0.96	0.47–1.96
M-H* 0–24yrs	1.17	0.99–1.39	1.11	0.85–1.46

* M-H=Mantel-Haenszel estimate for overall rate ratio

Differences by place of residence and socio-economic status.

There are no statistically significant differences in the incidence of leukaemia across socio-economic groupings or by place of residence among children, nor among adolescents and young adults. (Figure 2.6) Rates of death from leukaemia also vary very little by socio-economic status or place of residence. (Figure 2.7)

Figure 2.6

Age standardised incidence rate by place of residence and SES: leukaemia (South Australia 1977–2004)

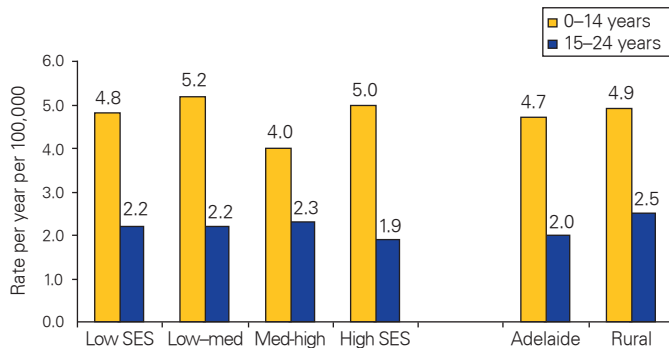
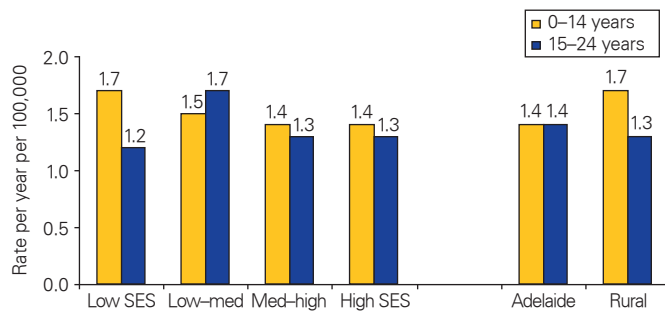


Figure 2.7

Age standardised mortality rate by place of residence and SES: leukaemia (South Australia 1977–2004)



Trends in incidence and mortality

The incidence of leukaemia in South Australia appears to have increased between 1977 and 2004. (Figure 2.8) The annual incidence among children under 15 years has increased by 0.5% per year and among 15–24 years olds by 2% per year. In both age groups, trends were bordering on being statistically significant. (Table 2.3) These increases are consistent with trends observed in the USA.

Mortality on the other hand has declined over the period 1977–2004. (Figure 2.8) This decline was observed in children under 15 years of age but was not evident among 15–24 year olds. The mortality decline among children is of the order of around 4% per year. (Table 2.3)

Figure 2.8

Trends in incidence and mortality among 0–24 year olds: leukaemia (Age standardised rate, South Australia 1977–2004)

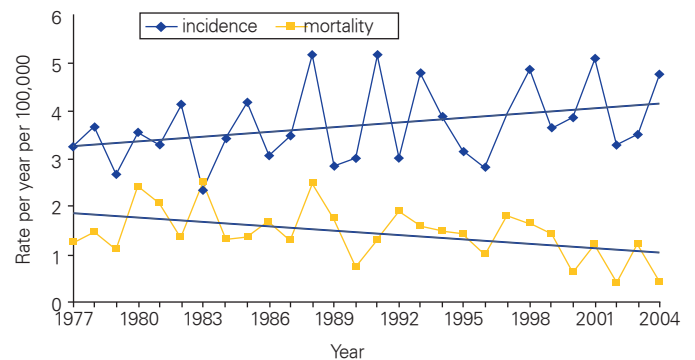


Table 2.3

Rate ratios showing annual change in incidence and mortality for leukaemia, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–4 yrs	1.007	0.990–1.024	0.946	0.908–0.986
5–9 yrs	1.012	0.988–1.037	0.958	0.923–0.995
10–14 yrs	0.993	0.968–1.018	0.966	0.930–1.003
15–19 yrs	1.022	0.993–1.051	1.004	0.969–1.040
20–24 yrs	1.019	0.986–1.053	1.027	0.985–1.070
M-H* 0–14 yrs	1.005	0.993–1.018	0.957	0.939–0.979
M-H* 15–24 yrs	1.021	0.999–1.043	1.013	0.987–1.041

*M-H = Mantel-Haenszel estimate for overall rate ratio.

World comparisons

Australia has relatively high rates of leukaemia by world standards. (Figure 2.9) Estimates made by IARC for the year 2000 (Globocan 2000) indicate that the incidence in children under 15 years in Australia is higher than in Northern America and Western Europe. However, New Zealand and Northern Europe have rates higher than Australia. Mortality rates for leukaemia are slightly higher for Australia than for Northern America, Northern Europe, Western Europe and Southern Africa. Mortality rates are lower than those for New Zealand and most other developing regions. (Figure 2.10)

Figure 2.9

Comparison of leukaemia incidence rates by country/region among 0–14 year olds (Globocan estimates for 2000)

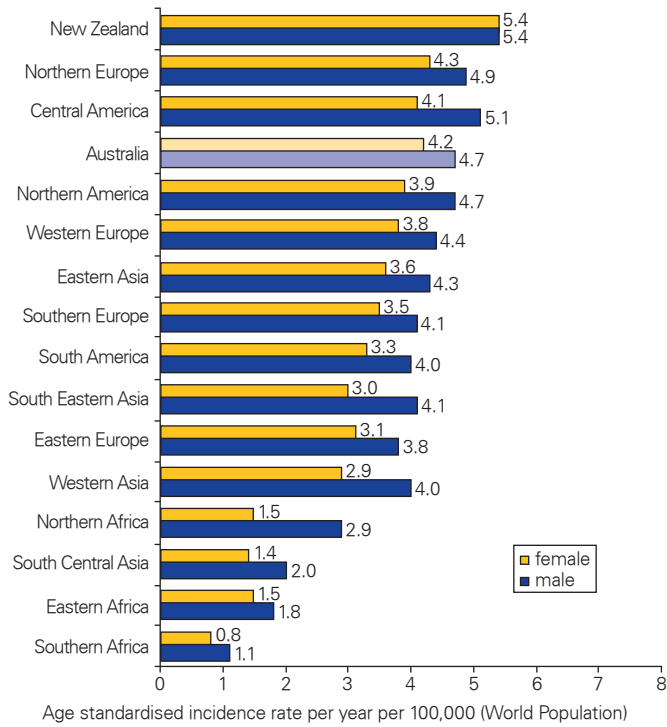
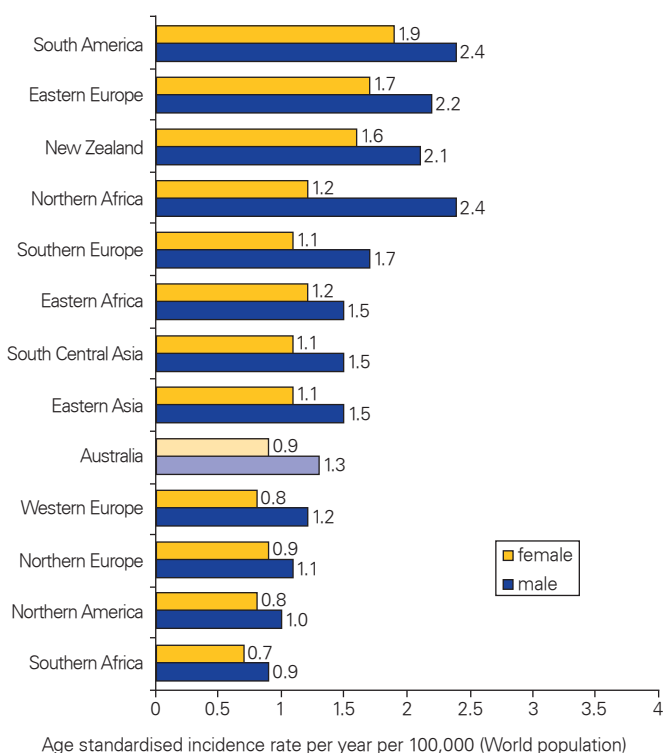


Figure 2.10

Comparison of leukaemia mortality rates by country/region among 0–14 year olds (Globocan estimates for 2000)



Survival

Two thirds of young people diagnosed with leukaemia in SA between 1977 and 2004 survived for at least five years after diagnosis. Survival outcomes are significantly better for children under 15 years of age than for young people aged 15–24 years (68% surviving five years compared with 55%). (Figure 2.11) There was no difference in survival outcomes according to gender, socio-economic status, and place of residence. Young people diagnosed with acute myeloid leukaemia had significantly worse survival outcomes than those diagnosed with acute lymphoid leukaemia (43% of those with AML survived to five years compared with 70% of those with ALL). (Figure 2.12)

Overall there has been a significant improvement in survival outcomes for young people diagnosed with leukaemia. The five-year survival for young people (0–24yrs) diagnosed between 1977 and 1983 was 55%, whereas the five-year survival for young people diagnosed between 1998 and 2004 was 79%. However, improvements are most notable among children diagnosed with leukaemia before the age of 15, with little change observed in survival outcomes among adolescents and young adults. Among those under 15 years of age, five-year survival improved from 55% to 88%, while for 15–24 year olds, improvement was negligible (52% to 54%). (Figure 2.13)

Figure 2.11

Survival from leukaemia by age group (South Australia 1977–2004)

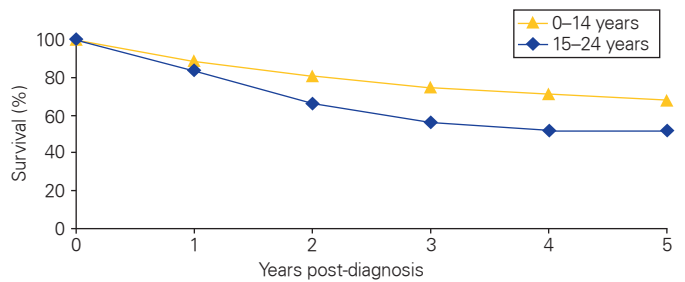
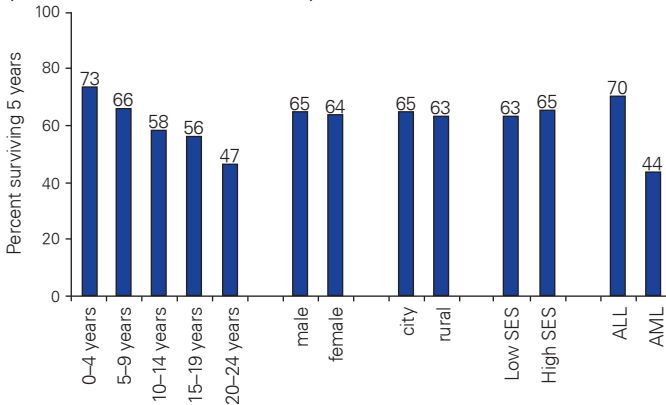


Figure 2.12

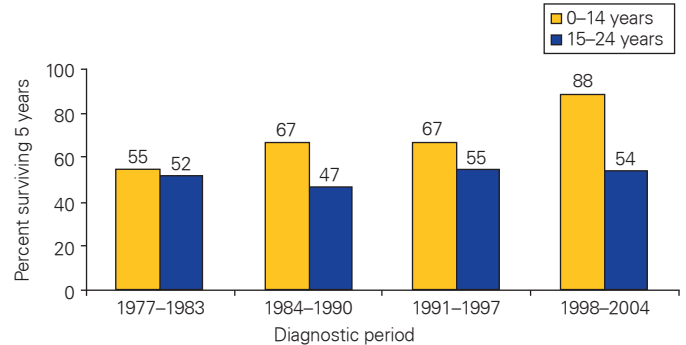
Five-year survival from leukaemia for 0–24 year olds, by age group, gender, residence, SES and time period (South Australia 1977–2004)



The difference in survival by age group was statistically significant ($p < 0.0001$), as was the difference in survival by cancer type ($p < 0.0001$). No other comparison showed statistically significant differences.

Figure 2.13

Five-year survival from leukaemia by diagnostic period (South Australia 1977–2004)



Improvements in survival over time were statistically significant among children 0–14 years of age ($p = 0.0007$). However among 15–24 year olds, there was no statistically significant difference in survival over time ($p = 0.3995$).

Leukaemias

Leukaemia is the most common childhood cancer and the fourth most common cancer affecting young people aged 15–24 years in South Australia.

A total of 543 cases of leukaemia were diagnosed in young people under 25 years of age in South Australia between 1977 and 2004 (approximately 20 cases per year). Two hundred and ten young people died from leukaemia during the same period.

Incidence rates in South Australia are similar to those for Australia as a whole. The incidence of leukaemia is generally higher in developed countries. Consequently, Australia's rate is relatively high compared with other regions in the world.

Acute lymphatic leukaemia (ALL) is the predominant type of leukaemia in children. Adolescents and young adults experience more acute myeloid leukaemia (AML) than children.

Leukaemia incidence peaks at around two to three years of age, and then declines with age. Death rates in South Australia peak at around two years and nine years of age, but are otherwise relatively constant.

Incidence rates in South Australia have varied slightly according to gender, with males being more likely to

develop leukaemia than females (rate ratio 1.17, borderline significance). No significant difference in deaths is apparent according to gender.

Incidence and death rates have been similar across socio-economic groups and for country and rural residents.

The incidence of leukaemia has increased over time, by 0.5% annually among children and 2% annually among young people 15–24 years of age (both of borderline significance). Mortality rates have decreased during the period among children (by 4% per year, statistically significant) but not in young people aged 15–24 years.

Two thirds of young people with leukaemia have survived five years or longer after diagnosis.

Survival outcomes vary with age, with higher survival fractions occurring among younger patients. Survival outcomes do not vary by gender, SES or place of residence. Outcomes are significantly better for those with ALL (70%) compared with AML (44%).

Survival outcomes improved quite markedly in children between 1977–1983 and 1998–2004 (from 55 to 88%) but not in adolescents and young adults (from 52 to 54%).

Little is known about the risk factors for leukaemia in children and young adults.

Chapter 3

Lymphomas

Lymphomas

Introduction

Lymphomas are cancers that originate in the lymphatic system, which is part of the immune system that fights infection and disease. There are two main types of lymphoma commonly referred to: Hodgkin lymphoma and non-Hodgkin lymphoma. Both types have various subcategories which are classified according to the main mix of cell types involved. Hodgkin lymphoma (HL) was the first of the lymphomas to be described on the basis of a distinctive cell type observed within these tumours. Other types of lymphoma identified since then have been referred to as non-Hodgkin lymphoma (NHL).

Lymphomas develop when a lymphatic cell undergoes a malignant change and starts dividing uncontrollably. Eventually these crowd out the healthy lymphatic cells and form tumours within the lymph glands or other parts of the lymphatic system. While most lymphomas start in the lymph glands, some occur in or spread to other parts of the body such as the chest, stomach and intestines, where there is a large amount of lymphatic tissue.

Symptoms associated with Hodgkin and non-Hodgkin lymphoma are similar. These include:

- swelling of lymph nodes (usually in the neck, under the arms or in the groin)
- fever, night sweats
- weight loss, loss of appetite.

Usually the swelling is painless. Occasionally glands in the chest are involved which cause difficulty breathing or coughing, while involvement of glands in the abdomen can cause bowel blockages.

Most childhood lymphomas are high grade which means that they are fairly aggressive and often quite extensive when diagnosed.

Treatments are different for different types of lymphoma but most involve chemotherapy. Occasionally radiation therapy is also used. In cases of NHL that recur, bone marrow transplants are sometimes required.

Survival prospects are generally good for most forms of lymphoma in young people.

Risk factors

The causes of lymphoma are not well understood. It is likely that there are different factors contributing to the various subtypes of lymphoma.

Factors that are known to be associated with an increased risk of Hodgkin lymphoma in young people include:

- a family history of HL (99-fold increase for identical twins and seven fold increase among siblings)
- Epstein-Barr virus infection (EBV is linked with 50% of HL but the association varies with age, gender and level of economic development of the region)
- socio-economic status (in children under 10 years of age, those of lower SES are at greater risk while among young people 15 yrs or older, the risk is greater among those of higher SES).

Potential risk factors for non-Hodgkin lymphoma include:

- immune suppression (immunotherapy, immune deficiency syndromes, HIV)
- infections (including EBV, helicobacter pylori)
- chemical exposures (pesticides, fertilisers and solvents)
- genetic predisposition (family clusters are known to occur although this could relate to environmental exposures rather than genetic factors).

NHL is more common in males than females and among Caucasians than other ethnic groups. In most Western countries, the incidence of NHL has approximately doubled in the last three decades despite the stabilisation of HIV rates and improved treatments for other potentially relevant infections.

Occurrence

Lymphoma is the third most common form of cancer affecting young people under 25 years of age in South Australia. It is surpassed in frequency only by leukaemia and melanoma. Between 1977 and 2004, 430 cases of lymphoma were diagnosed in those under 25 years of age, with two thirds of cases occurring in 15–24 year olds. This is equivalent to around five cases of lymphoma diagnosed in South Australians under 15 years of age and ten cases being diagnosed in the older age group per year.

Approximately three in 100,000 young people under 25 years of age develop lymphoma each year. The incidence is higher among adolescents and young adults; 5.3 per 100,000 young people aged 15–24 years (between 1991 and 2004), compared with a corresponding 1.6 per 100,000 children under 15 years of age.

Slightly over half of all lymphomas diagnosed were Hodgkin lymphomas, while most of the remaining were non-Hodgkin lymphomas (43%). (*Figure 3.1*) There was only a small number of Burkitt lymphomas recorded among young people, affecting almost exclusively children under 15 years of age. Hodgkin lymphoma was the more prominent form of lymphoma among 15–24 year olds, while non-Hodgkin lymphoma was more prominent in children under 15 years of age. (*Table 3.1*)

During the period 1977–2004, there were 77 deaths among young people due to lymphoma (less than three deaths per year). Two thirds occurred among young people aged 15–24 years.

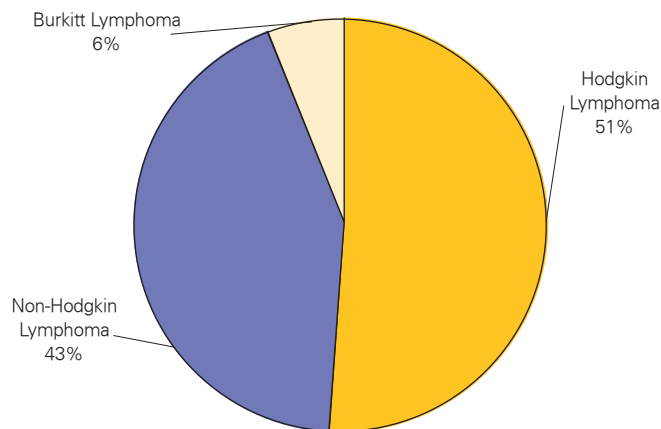
Table 3.1

Number of cases of lymphoma diagnosed in South Australia 1977-2004, by cancer subtype

type	<15yrs		15-24yrs		0-24yrs	
	n	%	n	%	n	%
Hodgkin lymphoma	42	29.0	179	62.8	221	51.4
Non-Hodgkin lymphoma	79	54.5	105	36.8	184	42.8
Burkitt lymphoma	24	16.6	1	0.4	25	5.8
Total	145	100.0	285	100.0	430	100.0

Figure 3.1

Types of lymphoma diagnosed among young South Australians 0-24 years old (1977-2004)



Age differences

The likelihood of developing lymphoma increases substantially with increasing age. (Figure 3.2) The age-specific incidence rate among young adults (20-24 year olds) in South Australia was over five times that found among children under five years of age. Death rates, while somewhat variable due to the relatively small number of deaths, are greater among adolescents and young adults than among children under 15 years. (Figure 3.3)

Figure 3.2

Age specific incidence rate: lymphoma (South Australia 1977-2004)

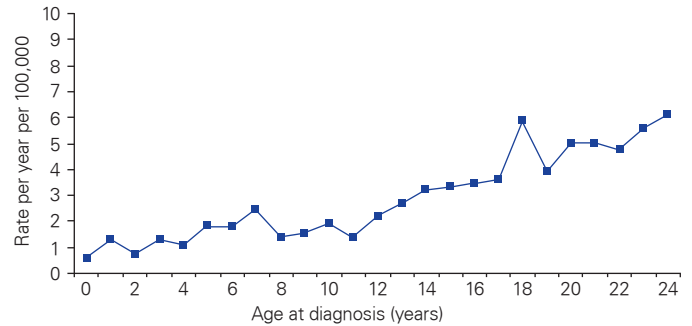
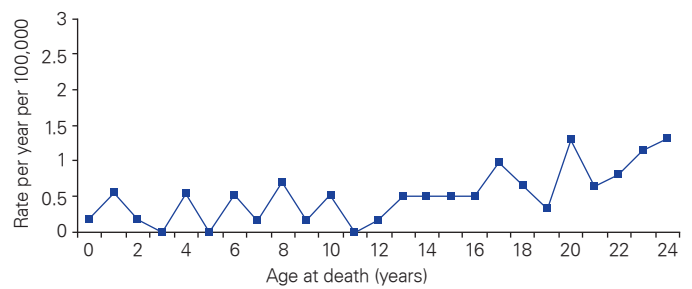


Figure 3.3

Age specific mortality rate: lymphoma (South Australia 1977-2004)



Gender differences

Across all age groups, males were more likely to develop lymphoma than females. (Figure 3.4) Gender differences were greatest among children under 10 years of age, with males being four times more likely to develop lymphoma than females. In the older age group, males were 1.4 times more likely than females to develop lymphoma. (Table 3.2) The same pattern relates to death rates, with males being twice as likely to die from lymphoma as females. (Figure 3.5, Table 3.2)

Figure 3.4

Age specific incidence rate by gender: lymphoma (South Australia 1977-2004)

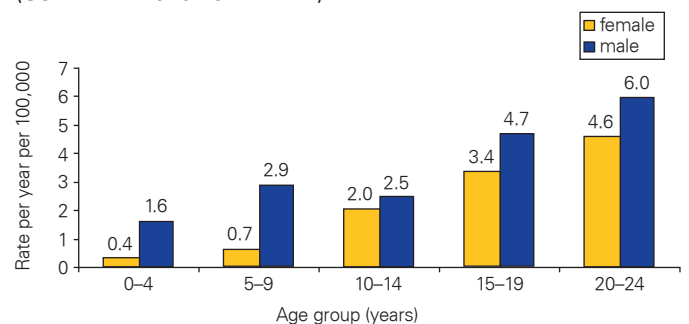


Figure 3.5

Age specific mortality rate by gender: lymphoma (South Australia 1977–2004)

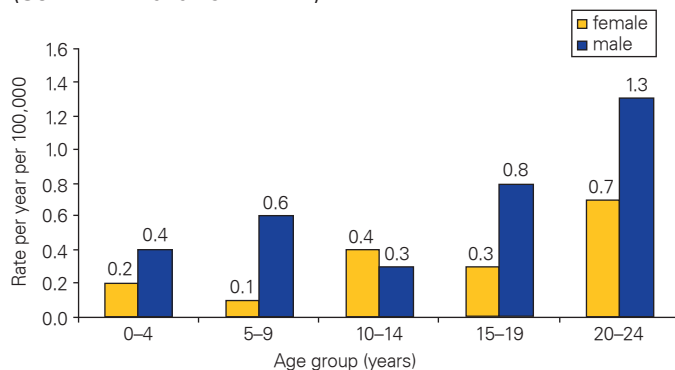


Figure 3.6

Age standardised incidence rate by place of residence and SES: lymphoma (South Australia 1977–2004)

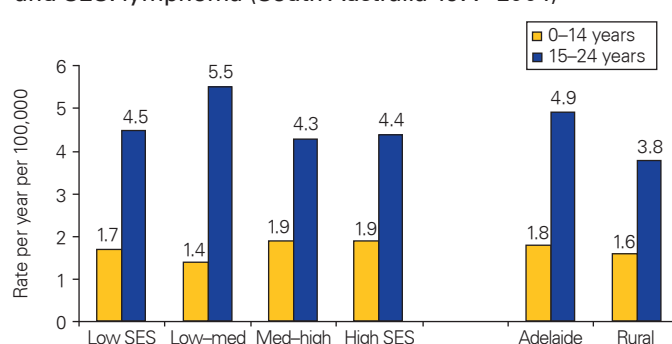


Table 3.2

Male to female incidence and mortality rate ratios for lymphoma, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	IR ratio male : female	95% CI IRR	IR ratio male : female	95% CI IRR
0–4yrs	4.18	1.55–14.15	2.85	0.51–28.9
5–9yrs	4.43	2.12–10.34	7.59	1.02–336.8
10–14yrs	1.24	0.76–2.09	0.95	0.22–4.11
15–19yrs	1.40	0.96–2.04	2.49	0.83–8.91
20–24yrs	1.30	0.94–1.80	1.84	0.85–4.22
M-H* 0–24yrs	1.58	1.30–1.92	2.11	1.31–3.42

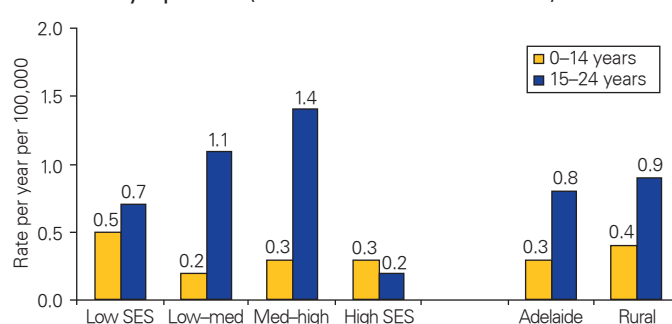
* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

Among both children and adolescents and young adults, there was very little difference in lymphoma incidence rates according to socio-economic status. Among 15–24 year olds, the incidence of lymphoma was higher among metropolitan residents, but this difference was not statistically significant. (Figure 3.6) Death rates were similar for children under 15 years across social class grouping and by place of residence. For young people aged 15–24 years, the death rates were also similar for rural and metropolitan residents. (Figure 3.7) Differences in death rates by socio-economic status among young people (15–24 years) were small and non-significant.

Figure 3.7

Age standardised mortality rate by place of residence and SES: lymphoma (South Australia 1977–2004)



Trends in incidence and mortality

The incidence of lymphoma has been increasing steadily among young people in South Australia during the period for which records are available. (Figure 3.8) The increase is quite pronounced, with incidence rates almost doubling in three decades. This increase has predominantly been among the older age groups, with no significant change noted in children under 15 years. The annual increment in South Australia among 15–24 year olds is in the order of 3% per year. (Table 3.3) The increased occurrence of lymphoma is entirely due to an increase in NHL. Similar trends have been observed nationally and in other western countries, and are not restricted to young adults but are observed in adults of all ages.

Mortality rates on the other hand have declined slightly over the past 28 years. (Figure 3.8) Death rates declined significantly among children under 15 years of age at a rate of about 8% per year, but have remained stable among young people 15–24 years of age. (Table 3.3)

Figure 3.8

Trends in incidence and mortality among young people 0–24 years: lymphoma (Age standardised rates, South Australia 1977–2004)

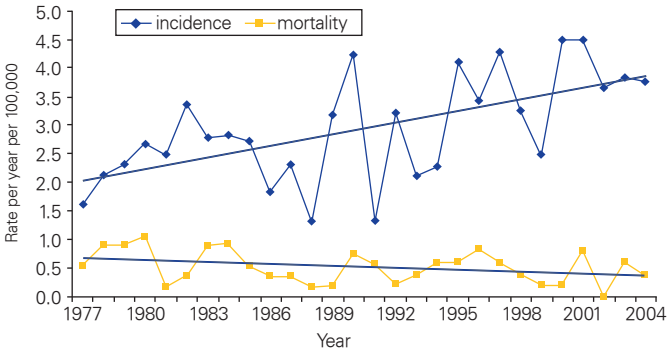


Table 3.3

Rate ratios showing annual change in incidence and mortality for lymphoma, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–4yrs	0.975	0.930–1.023	0.865	0.766–0.977
5–9yrs	0.998	0.964–1.033	0.995	0.915–1.081
10–14yrs	1.025	0.995–1.055	0.889	0.803–0.984
15–19yrs	1.036	1.013–1.059	1.020	0.963–1.081
20–24yrs	1.029	1.009–1.049	1.007	0.963–1.052
M-H* 0–14yrs	1.006	0.986–1.026	0.924	0.875–0.975
M-H* 15–24yrs	1.032	1.017–1.047	1.012	0.977–1.048

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Global comparisons

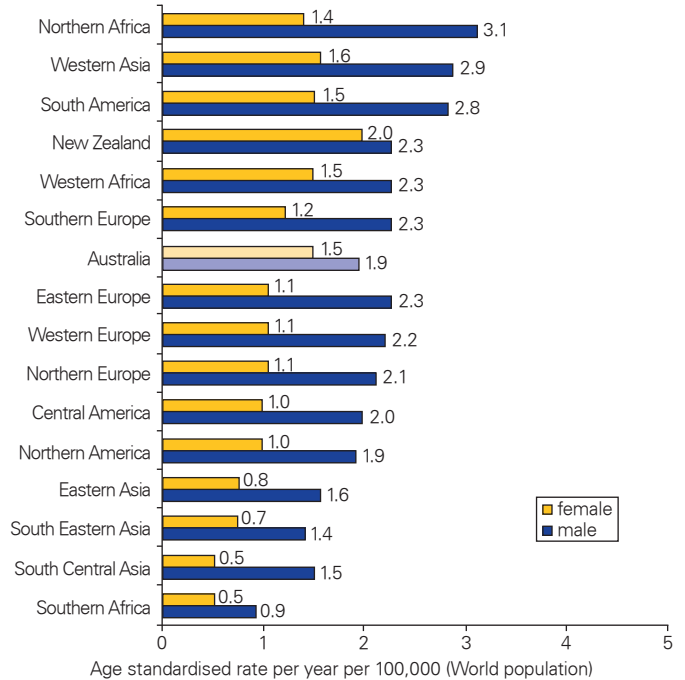
The incidence rate for lymphoma among children in Australia lies in the middle of the range of rates across various regions of the world, based on Globocan 2000 estimates. (Figure 3.9) Rates of childhood lymphoma are higher in New Zealand, Western Asia, parts of Africa and Southern America, and lower in other regions of Europe, Northern and Central America and most of Asia. The somewhat mixed pattern for childhood lymphomas observed globally may be due to different causal factors for different types of lymphoma.

Mortality rates for childhood lymphomas in Australia are among the lowest in the world. (Figure 3.10)

(Data for 15–24 year old age group are not available from Globocan.)

Figure 3.9

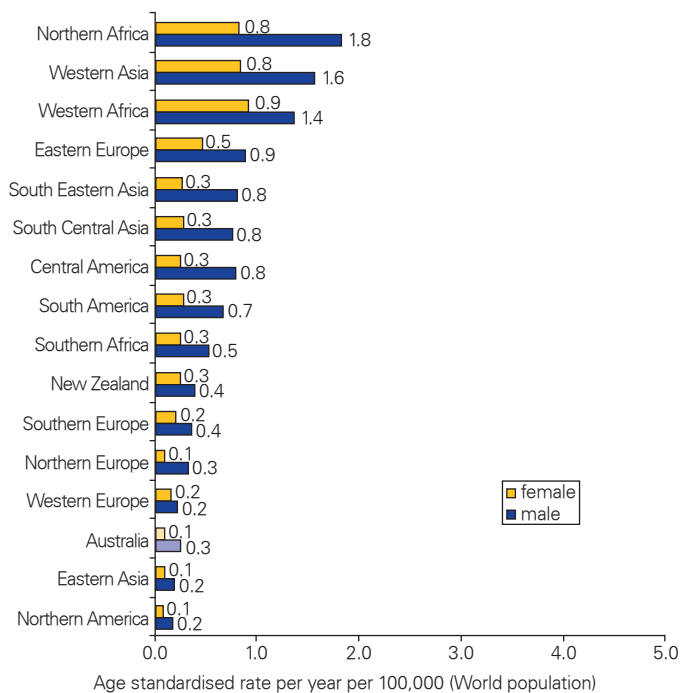
Comparison of lymphoma incidence rates by country/region among 0–14 year olds (Globocan estimate for 2000)



Combined incidence rates for HL and NHL from Globocan 2000

Figure 3.10

Comparison of lymphoma mortality rates by country/region among 0–14 year olds (Globocan estimates for 2000)



Combined mortality rates for HL and NHL from Globocan 2000

Survival

Survival prospects for young South Australians with lymphoma are relatively good. Over the entire period (1977–2004), 81% of people under the age of 25 years when diagnosed with lymphoma were alive five years after diagnosis. There were slight differences in survival outcomes according to age at diagnosis. (Figure 3.11) Children under five years of age had the poorest outcomes (70% surviving five years) while those aged 10–14 years had the best survival outcomes (86% surviving five years). However, neither differences between children (0–14 yrs) and adolescents and young adults (15–24 yrs), nor differences across 5-year age groups were statistically significant.

Five-year survival was higher among females than males (86% compared with 78%). However, the observed difference between male and female survival outcomes was not statistically significant (i.e. it may be due to random variation). Survival outcomes did not differ significantly by socio-economic status or place of residence. However survival outcomes did differ by type of lymphoma. Outcomes were significantly better for those diagnosed with Hodgkin lymphoma compared with non-Hodgkin lymphoma. The proportion surviving five years after a diagnosis of Hodgkin lymphoma was 89% compared with 73% among those diagnosed with non-Hodgkin lymphoma ($p=0.0001$). (Figure 3.12)

Survival outcomes were significantly better in the later period (1991–2004) compared with earlier years (1977–1990) ($p=0.0057$). (Figure 3.13)

Figure 3.12

Five-year survival from lymphoma for 0–24 year olds, by age group, gender, residence, SES and type (South Australia 1977–2004)

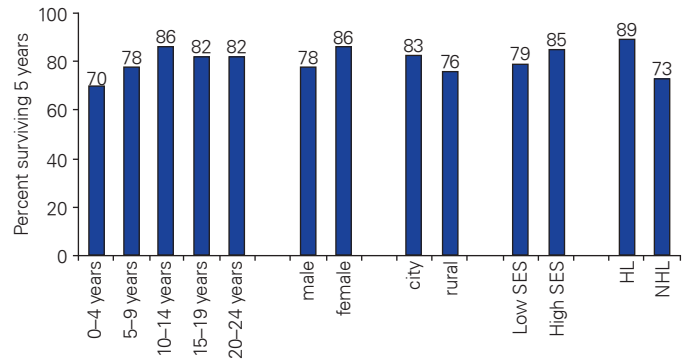
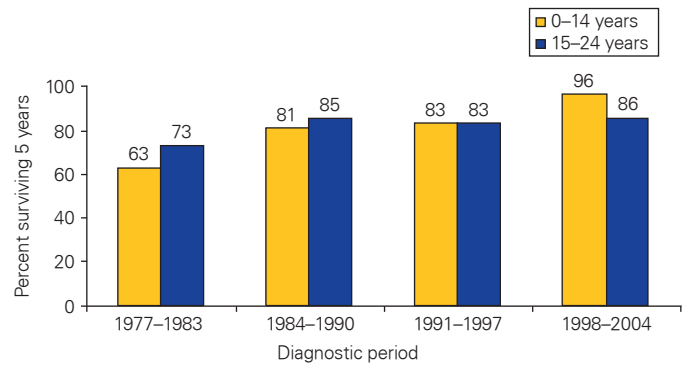


Figure 3.13

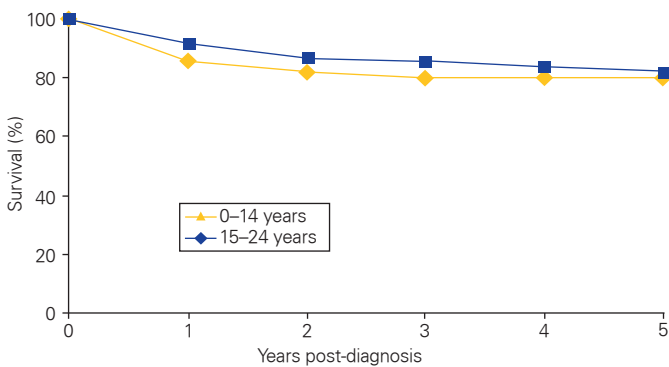
Five-year survival from lymphoma by diagnostic period (South Australia 1977–2004)



Log rank test (0-14y: $\chi^2=12.04$, $df=3$, $p=0.0073$; 15-24y: $\chi^2=7.98$, $df=3$, $p=0.0465$)

Figure 3.11

Survival from lymphoma by age group (South Australia 1977–2004)



Lymphomas

Lymphoma is the third most common cancer in children and the second most common cancer in young people 15–24 years of age in South Australia.

The incidence of lymphoma among young people in South Australia is comparable to that for all of Australia. The rate of childhood lymphoma in Australia is neither particularly high nor low in comparison with other regions of the world.

Between 1977 and 2004, there were 430 cases of lymphoma diagnosed among young people under 25 years of age in South Australia (15 cases per year) and 77 deaths from lymphoma (three deaths per year).

Hodgkin lymphoma is the most common form among young people (15–24) in South Australia, while non-Hodgkin lymphoma is the most common form in children.

Lymphoma is more common in adolescents and young adults than in children. The incidence of lymphoma increases gradually with age. Death rates follow a similar pattern.

Males are significantly more likely to develop lymphoma than females (rate ratio = 1.58) and to die from lymphoma (rate ratio = 2.11).

There were no statistically significant differences in incidence or mortality rates according to SES or place of residence.

There has been a pronounced increase in incidence of lymphoma among young South Australians over the past three decades. The increase has been largely among adolescents and young adults (significant increase of 3.2% per year) with only a slight increase occurring among children (non-significant increase of 0.6% per year).

Mortality rates have declined in children (significant decrease of 8% per year) but not in young people aged 15–24 years.

Overall survival outcomes are good for young people with lymphoma, with 81% surviving five years or more from diagnosis.

There were no significant differences in survival outcomes by age group, SES or place of residence. However females had better outcomes than males (five-year survival: 86% v 78%).

Outcomes were more favourable for those diagnosed with Hodgkin lymphoma compared with non-Hodgkin lymphoma (five-year survival: 89% v 73%).

Survival outcomes have improved significantly over time for both age groups (five-year survival among children: 63%–96%; among young people 15–24 years: 73%–86%).

Causes of lymphoma are unclear. Family history, SES status and infections with Epstein-Barr virus are associated with increased risk of Hodgkin lymphoma, while immune suppression, infections and chemical exposures have been associated with risk of non-Hodgkin lymphoma.

Chapter 4

Malignant tumours of the brain and central nervous system

Malignant tumours of the brain and central nervous system

Introduction

Tumours of the brain and central nervous system (CNS) can be malignant or benign. They may be primary tumours that start in the brain or CNS or they can be secondary tumours that spread from other parts of the body to the brain. This section deals only with primary malignant tumours of the brain and central nervous system.

Brain/CNS tumours are the second most common cancer in children after leukaemia and are one of the main cancer groups affecting adolescents and young adults. They are a diverse group of tumours that originate from cells in the brain, spinal cord or other parts of the CNS such as the pituitary gland. Ninety percent of CNS tumours in children occur in the brain. It is the histological type (cell type) rather than the site of the tumour that determines the behaviour of these cancers in young people.

The International Classification of Childhood Cancers includes five major types of tumours within the broader category of CNS tumours. These are ependymomas, astrocytomas, primitive neuroectermal tumours (PNET), other gliomas and other miscellaneous intracranial and intraspinal tumours. Tumours that originate from glial cells (supporting cells) are called gliomas. Gliomas include astrocytomas and ependymomas. Astrocytomas are the most common type of brain tumours found in young people.

Tumours of the brain cause problems when they spread to normal brain tissue and/or put pressure on surrounding tissue, interfering with normal brain function. Symptoms of brain tumours vary depending on the site of the cancer, but usually relate to a build up of pressure within the brain (via a blockage in the flow of cerebrospinal fluid). Symptoms can include:

- headaches
- irritability, drowsiness
- change in personality
- periods of unconsciousness
- weakness, clumsiness, balance problems
- vision problems
- fits/seizures
- persistent vomiting, nausea
- back pain
- excessive thirst or urination.

In infants there may be a bulge at the soft spot on the top of their head or the head may become enlarged.

Treatment may include surgery to remove the tumour. Radiotherapy and/or chemotherapy may also be necessary. Depending on the type of tumour and degree of spread, five-year survival can range from 40% to 80%.

Risk factors

The causes of brain and CNS tumours in children and young people are not well understood. Because brain/CNS tumours are such a diverse group of tumours, it is likely that there are many different risk factors for these cancers. The few factors that have been linked with tumours of the CNS explain only a small proportion of the brain cancers in young people. These factors include:

- genetic predispositions associated with a few rare syndromes
- previous exposure of the brain to ionising radiation.

Other factors for which evidence is still inconclusive include:

- maternal diet during pregnancy
- parents or siblings with brain tumours
- family history of other cancers (leukaemia, lymphoma or bone cancer).

Evidence is even more limited again for the following factors:

- electromagnetic fields/mobile phones
- pesticides
- father's occupation/chemical exposures
- head injuries
- family history of epilepsy/mental impairment.

Factors that **do not** appear to increase the risk of brain cancers in children, but which have attracted concern, include:

- exposure to passive cigarette smoke
- electric blankets
- ultrasound during pregnancy.

Occurrence

There were 369 cases of tumours of the brain/CNS diagnosed among young South Australians between 1977 and 2004. This is equivalent to approximately 13 cases per year.

The average annual incidence rate between 1991 and 2004 among South Australians under 25 years of age was 2.6 per 100,000. The annual incidence of CNS tumours was slightly higher for children under 15 than for young people aged 15–24 years (2.8/100,000 compared with 2.0/100,000).

Types of CNS tumours presenting in children (under 15 years) and young people (15–24 years) were similar. Astrocytomas were the most common type among both age groups (57%) followed by primitive neuroectodermal tumours (PNET) (19%) and other gliomas (14%). (Table 4.1, Figure 4.1)

During the period 1977–2004, 140 young people died from brain/CNS tumours (around 5 young people in South Australia per year). Forty five percent of these fatal tumours were astrocytomas. Nearly three quarters of deaths were in children under 15 years of age.

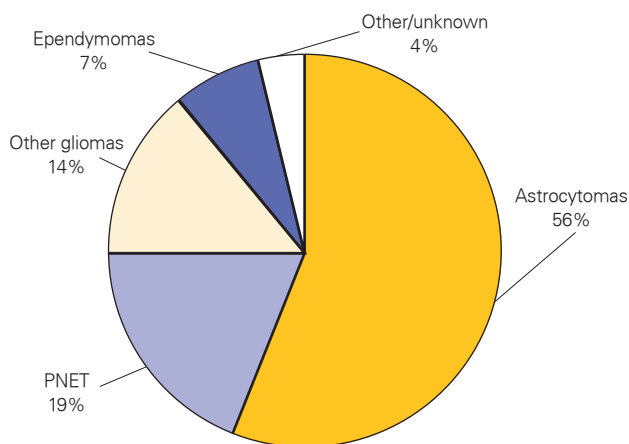
Table 4.1

Number of cases of brain/CNS tumours diagnosed in South Australia 1977-2004, by subtype

type	<15yrs		15–24yrs		0–24yrs	
	n	%	n	%	n	%
Astrocytomas	132	54.1	78	62.4	210	56.9
Ependymomas	16	6.6	10	8.0	26	7.0
Primitive neuroectodermal tumours (PNET)	57	23.4	13	10.4	70	19.0
Other gliomas	32	13.1	18	14.4	50	13.6
Other/unknown	7	2.9	6	4.8	13	3.5
Total	244	100.0	125	100.0	369	100.0

Figure 4.1

Types of brain/ CNS tumours among young South Australians aged 0–24 years, 1977–2004



Age differences

The incidence of tumours of the brain/CNS appears to decline with increasing age, although there is some indication of a bimodal distribution. (Figure 4.2) Infants and very young children had the highest incident rates peaking at 4.5 per 100,000 in the second year of life. From the age of nine years, the rate declines but increases again in the early teens. These fluctuations may be due to small numbers/random variation. Mortality rates appear to be reasonably consistent across all ages from 0 to 24 years. (Figure 4.3)

Figure 4.2

Age specific incidence rate: brain/CNS tumours (South Australia 1977–2004)

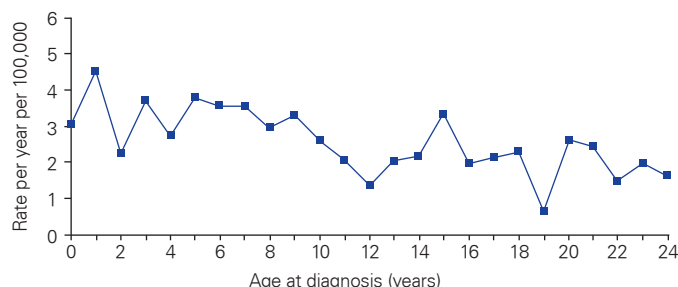
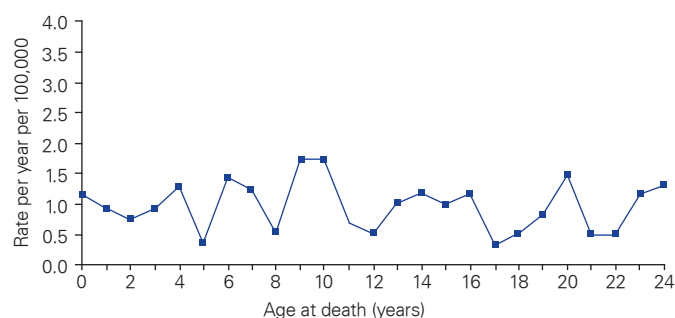


Figure 4.3

Age specific mortality rate: brain/CNS tumours (South Australia 1977–2004)



Gender differences

There is no consistent pattern of differences in incidence or mortality rates according to gender. (Figure 4.4, Figure 4.5) Although mortality rates are considerably higher for males than females in the age range 10–14 years, this difference is not statistically significant. International data do, however, suggest that young males are at greater risk than females of developing certain cancers of the CNS. (Table 4.2)

Figure 4.4

Age specific incidence rates by gender:
brain/CNS tumours (South Australia 1977–2004)

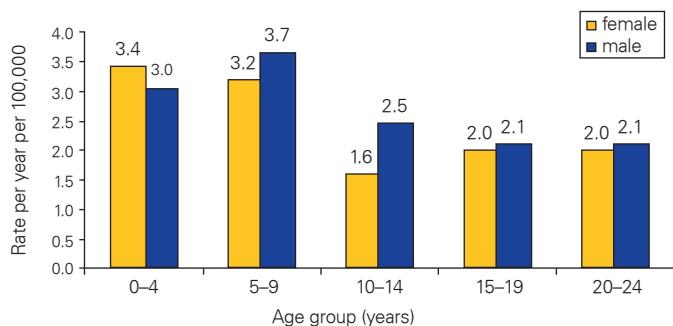


Figure 4.5

Age specific mortality rates by gender:
brain/CNS tumours (South Australia 1977–2004)

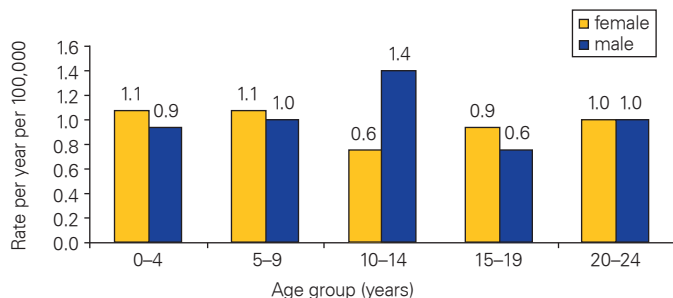


Table 4.2

Male to female incidence and mortality rate ratios for brain/
CNS tumours, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	IR ratio male : female	95% CI	IR ratio male : female	95% CI
0-4yrs	0.89	0.57–1.38	0.88	0.38–2.03
5-9yrs	1.14	0.75–1.74	0.95	0.43–2.08
10-14yrs	1.52	0.88–2.68	2.21	0.97–5.48
15-19yrs	1.05	0.62–1.79	0.66	0.25–1.68
20-24yrs	1.02	0.60–1.75	0.96	0.44–2.11
M-H* 0-24 yrs	1.09	0.89–1.34	1.05	0.76–1.47

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

There were no statistically significant differences in the incidence of brain/CNS tumours in relation to social class grouping or place of residence. (Figure 4.6) Nor did death rates differ according to SES or place of residence, either among children or among adolescents and young adults. (Figure 4.7)

Figure 4.6

Age standardised incidence rates by place of residence
and SES: brain/CNS tumours (South Australia 1977–2004)

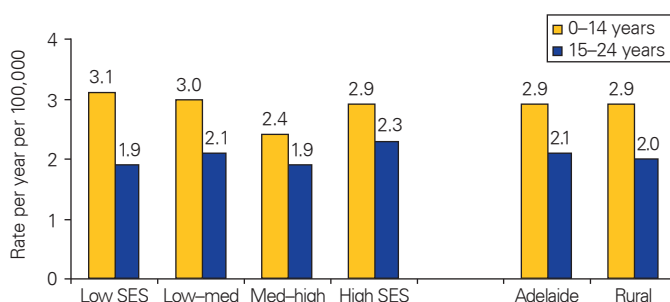
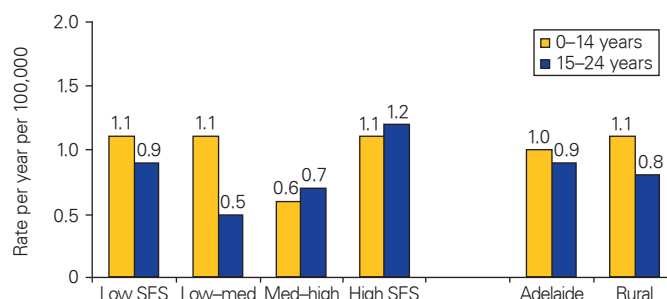


Figure 4.7

Age standardised mortality rates by residence and SES:
brain/CNS tumours (South Australia 1977–2004)



Time trends

Incidence and mortality rates for CNS tumours among young South Australians have remained relatively stable. (Figure 4.8)

Statistical tests showed no significant differences between rates in more recent years (1991–2004) and rates in earlier years (1977–1990). Nor did they show any statistically significant incremental, annual change in mortality or incidence rates. (Table 4.3)

Figure 4.8

Trends in incidence and mortality among 0–24 yr olds: brain/CNS tumours (Age standardised rate, South Australia 1977–2004)

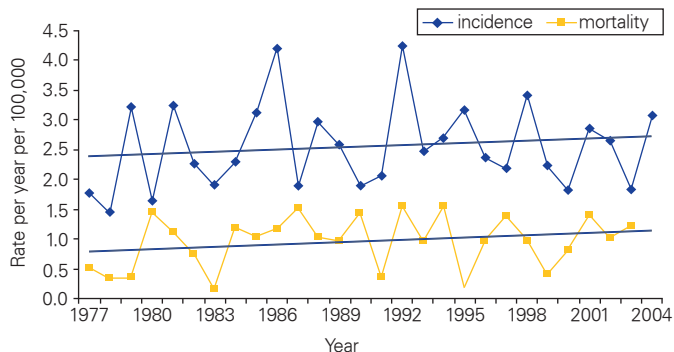


Table 4.3

Rate ratios showing annual change in incidence and mortality for brain and other CNS tumours, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–4yrs	0.990	0.965–1.017	1.000	0.9554–1.049
5–9yrs	1.017	0.992–1.043	1.004	0.960–1.050
10–14yrs	1.021	0.990–1.054	1.001	0.958–1.046
15–19yrs	1.005	0.975–1.036	1.053	0.998–1.110
20–24yrs	0.989	0.958–1.021	1.018	0.973–1.065
M-H*	1.009	0.993–1.025	1.002	0.976–1.028
0–14yrs				
M-H*	0.997	0.976–1.019	1.033	0.998–1.068
15–24yrs				

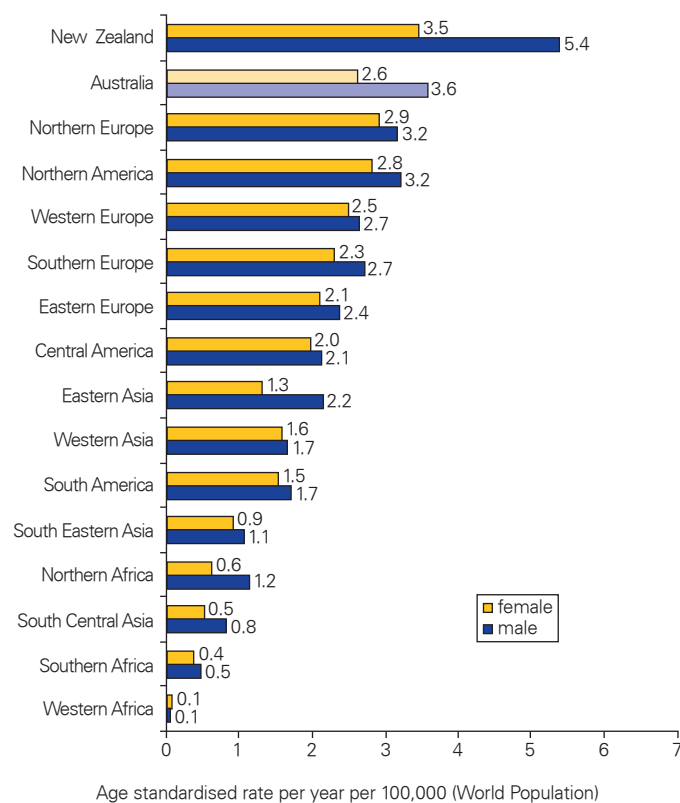
* M-H = Mantel-Haenszel estimate for overall rate ratio.

yet unknown) causal factors or may relate to differences in diagnosis and reporting of cancers of the nervous system.

Mortality rates for tumours of the CNS are also relatively high for Australia in comparison to other regions of the world. (Figure 4.10)

Figure 4.9

Comparison of incidence rates for brain and nervous system tumours by country/region among 0–14 year olds (Globocan estimates for 2000)



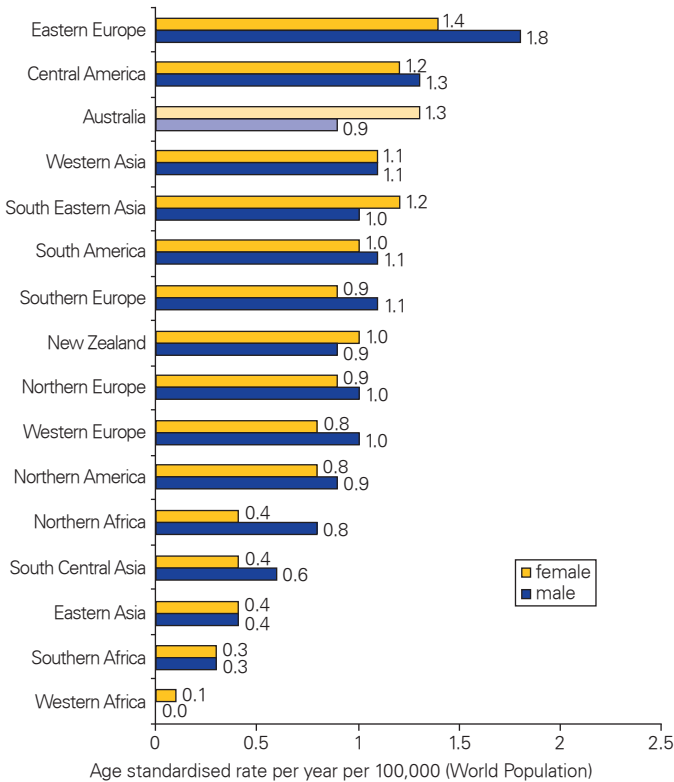
Global comparisons

(Brain and nervous system tumours combined in <15 year olds)

In Globocan 2000, which provides estimates of cancer incidence in countries across the world, data on tumours of the brain and CNS are grouped with data on tumours of the whole nervous system. Considering these two groups of cancers together, childhood incidence rates in Australia are higher than for most other regions of the world. (Figure 4.9) Generally, the incidence of brain and nervous system tumours are higher in more developed countries than in less developed regions. These differences may be due to differences in (as

Figure 4.10

Comparison of mortality rates for brain and nervous system tumours by country/region among 0–14 year olds (Globocan estimates for 2000)



Survival

Survival outcomes for brain/CNS tumours were less favourable than survival outcomes for many other cancers affecting young people. The proportion surviving five years or more from diagnosis (for all tumour types and all age groups together over the whole period) was 61%.

Outcomes were similar for children (0–14 years) and young people (15–24 years). (Figure 4.11) However, there was considerable variation within the older age group, with a five-year survival of 71% for 15–19 year olds compared with a 47% survival at 5 years for those aged 20–24 years. Log rank tests comparing the five year age groups did not indicate statistically significant differences.

Survival outcomes did vary depending on the type of cancer ($p=0.015$), with outcomes being significantly poorer for those diagnosed with primitive neuroectodermal tumours (PNET) compared with other types. Survival outcomes were most favourable for those diagnosed with astrocytomas, the most common cancer of the CNS in young people. (Figure 4.12)

No differences in outcomes were evident in relation to gender, socio-economic status or place of residence. Nor was there any evidence of improvement in survival outcomes over time. (Figure 4.13) Statistical tests comparing cases diagnosed between

1977 and 1990 and those diagnosed between 1991 and 2004 showed no significant difference in survival outcomes.

Figure 4.11

Survival from brain/CNS tumours by age group (South Australia 1977–2004)

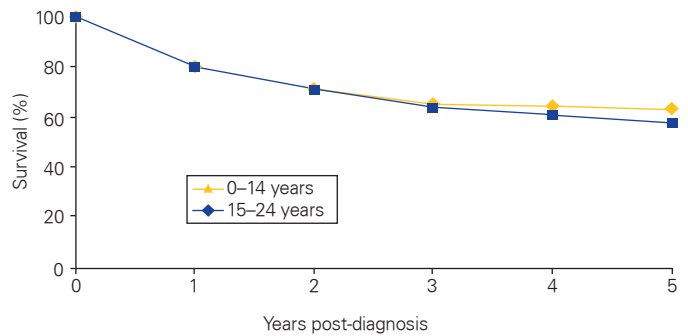
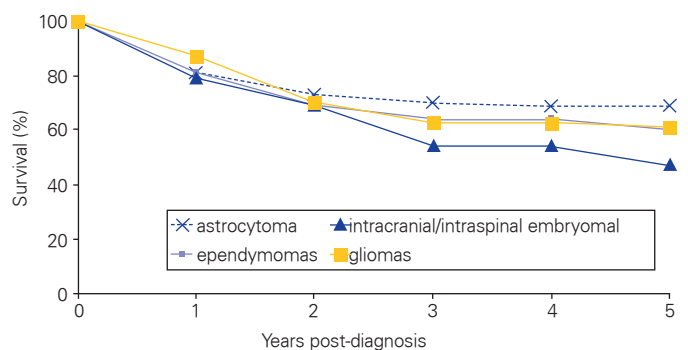


Figure 4.12

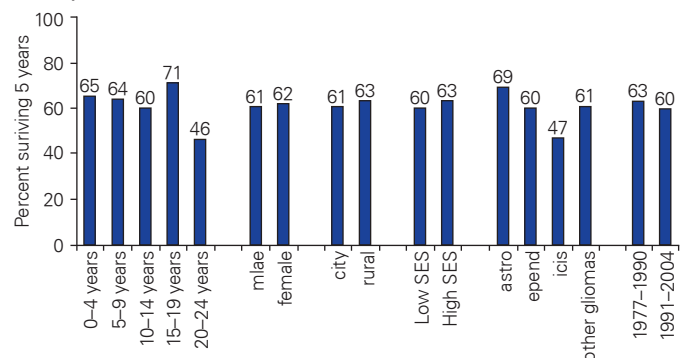
Survival from brain/CNS tumours by cancer types (South Australia 1977–2004)



Log rank test : $\chi^2=12.34$, $df=3$, $p=0.015$.

Figure 4.13

Five-year survival from brain/CNS tumours for 0–24 year olds, by age group, gender, residence, SES and time period (South Australia 1977–2004)



Cancers of the brain and central nervous system (CNS)

Cancers of the CNS (90% being brain cancers) are the second most common cancers in both children and young people (15–24 years old) in South Australia. They also account for the second highest proportion of cancer deaths in young people after leukaemia.

Brain cancers occur more frequently in developed countries. Even so, the incidence of brain cancers in Australia is relatively high by comparison with other regions of the world.

Between 1977 and 2004, 369 CNS cancers were diagnosed among young South Australians (13 per year) and 140 young people died from cancers of the CNS (5 per year).

There are a number of different types of cancer of the CNS affecting young South Australians, but the most common is astrocytoma.

Tumours of the brain and CNS are more common among SA children in their early years of life, with incidence declining with increasing age. Death from cancers of the CNS have occurred at a reasonably constant rate across all ages under 25 years.

There are no statistically significant differences in the incidence of CNS tumours by gender, SES or place of residence. Nor is there evidence of any such patterns in relation to rates of death from CNS tumours.

Trends in incidence and mortality have remained relatively constant over the past three decades among young people in South Australia.

Survival outcomes are lower for cancers of the CNS than for many other cancers affecting young people. During 1977–2004, 61% of young people with cancers of the CNS survived five years or more after diagnosis.

Survival outcomes did not differ significantly with age, gender, SES or place of residence.

Outcomes did differ according to the type of tumour, with most favourable outcomes occurring for those with astrocytomas (69%) and least favourable outcomes for those with primitive neuroectodermal tumours.

No improvement in survival over time is evident.

Apart from genetic predisposition and exposure to ionising radiation (which would account for only a small proportion of cases) causes of brain/CNS cancers have not been determined.

Chapter 5

Sympathetic nervous system tumours

Sympathetic nervous system tumours

Introduction

Tumours of the sympathetic nervous system (SNS) are malignancies of immature nerve cells that control bodily organs such as the heart, lungs and liver, in response to various stressors. These tumours account for around one in twelve cancers in children under 15 years of age but are rarely seen in adolescents and young adults.

The vast majority of SNS tumours are neuroblastomas. There are other SNS tumours that form from different cell types, although these are quite rare (e.g. paraganglioma, medulloepithelioma and olfactory neurogenic tumours). Neuroblastomas develop from immature cells (neuroblasts) from the neural crest which runs from the neck to the base of the spine. They usually begin in the nervous tissue near the adrenal glands. These glands are located on top of the kidneys and produce hormones that control heart rate, blood pressure and blood sugars. In a few cases, SNS tumours occur in other parts of the body including the chest, neck and near the spinal cord.

Neuroblastomas occur most often in very young children (under five years) and are the most common type of cancer in infants under 12 months. During the first few months after birth, clumps of neuroblasts can be detected in some infants but these immature cells will usually mature and the clumps dissolve. In some cases, these neuroblasts do not mature but continue to divide and grow causing a solid tumour to develop. The inability to mature and stop growing is due to an abnormality in the cellular DNA. It is likely that these tumours develop before birth but are only detected later when the tumour is large enough to cause symptoms. By the time neuroblastomas are detected, they have usually spread and metastasised to other parts of the body, for example, the liver, lymph nodes or bone marrow.

Symptoms usually result from the tumour placing pressure on surrounding tissue or from bone pain due to metastases. Common symptoms include:

- a lump in the abdomen, neck or chest (with or without pain)
- a swollen stomach
- trouble breathing (in infants)
- weakness or paralysis
- bulging eyes
- dark rings under the eyes.

Less common signs include:

- fever
- fatigue

- shortness of breath
- high blood pressure
- jerky muscle movements
- uncontrolled eye movements
- swelling in the feet, legs or scrotum.

Prognosis (chances of surviving) for children diagnosed with neuroblastoma depends on a number of different factors including the age at diagnosis, the site of the tumour, the degree of cell change and the stage of the cancer (degree of spread) at diagnosis. Survival outcomes are generally better for the younger ages at diagnosis.

Treatment options vary according to the risk profile of the patient. The three risk groups, defined as low, medium and high depending on age, stage, site and histology of the tumour, are treated differently. Surgery to remove the tumour may be effective in low risk patients where the tumour has not spread. A combination of chemotherapy and surgery is often used when treating medium risk patients. Radiation may be used in cases where the tumour is causing serious problems. For high risk patients, treatment may involve high-dose chemotherapy followed by surgery and/or radiation therapy. In addition, new methods are being trialled internationally including monoclonal antibody therapy, stem cell transplantation in conjunction with chemotherapy and radiotherapy, and other anticancer drug therapy.

Children treated for neuroblastoma have an increased risk of developing other cancers.

Risk factors

The causes of tumours of the sympathetic nervous system among children are unknown. Most research has been undertaken in relation to neuroblastoma. A very small proportion of neuroblastomas (1–2%) are likely to be hereditary. The familial form is suspected when tumours develop in two different places within the body (not as a result of metastases) or where neuroblastoma has occurred in several members of the family. Since the incidence of neuroblastoma is similar in different regions of the world, environmental factors are not likely to be strongly associated with their development.

Research findings on the causes of neuroblastoma are inconsistent or limited. Studies have suggested links with the following factors:

- medications taken during pregnancy (tranquillisers, amphetamines, diuretics, muscle relaxants)
- sex hormones (fertility drugs during or prior to pregnancy)
- low birth weight (however preterm birth appears to be protective)
- previous miscarriage or foetal death
- alcohol consumption during pregnancy

- tobacco use during pregnancy
- father's occupation (eg. involving exposure to pesticides, paint, rubber, hydrocarbons or electromagnetic radiation).

Occurrence

Between 1977 and 2004, there were 78 cases of sympathetic nervous system (SNS) tumours diagnosed in South Australia among young people. This is equivalent to approximately three cases per year. The incidence rate among South Australian children (under 15 years) is 0.8/100,000.

Ninety five percent of these tumours were classified as neuroblastomas. In the same period, there were 41 deaths among people under 25 years of age from SNS tumours. Neuroblastomas predominantly occurred during infancy and early childhood. Seventy eight percent of cases in South Australia were diagnosed in children under five years of age. (Table 5.1) Just over 80% of deaths occurred in children under 10 years.

Table 5.1

Number of cases of SNS tumours diagnosed by cancer subtype (South Australia 1977–2004)

type	0–14 yrs		15–24 yrs		0–24 yrs	
	n	%	n	%	n	%
Neuroblastoma	70	100.0	4	50.0	74	94.9
Other	0	0.0	4	50.0	4	5.1

Age differences

The vast majority of SNS tumours in young people in South Australia occurred in children under five years of age, with extremely low rates from five years onwards. The highest incidence was among infants under 12 months of age. (Figure 5.1)

The rate of death from tumours of the sympathetic nervous system in South Australia was highest among children under 10 years of age and relatively low among older children, teenagers and young adults. Unlike the pattern in relation to incidence, there was no sharp peak in death rate in the first few years of life. (Figure 5.2)

Figure 5.1

Age specific incidence rate: neuroblastoma/SNS tumours (South Australia 1977–2004)

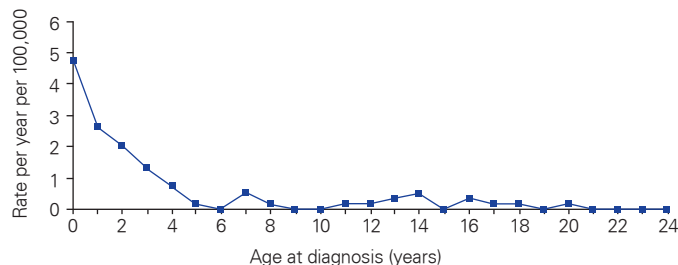
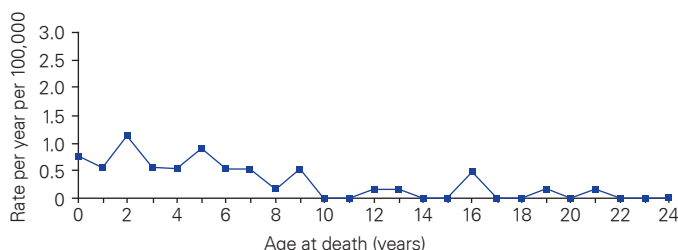


Figure 5.2

Age specific mortality rate: neuroblastoma/SNS tumours (South Australia 1977–2004)



Differences by gender

While the incidence of neuroblastomas/other SNS tumours was higher among young South Australian males (<5yrs), this difference was not statistically significant. (Figure 5.3, Table 5.2) International data indicate that males have a slightly higher risk of developing neuroblastomas than females. Mortality rates were similar for males and females in South Australia. (Figure 5.4)

Figure 5.3

Age specific incidence rate by gender: neuroblastoma/SNS tumours (South Australia 1977–2004)

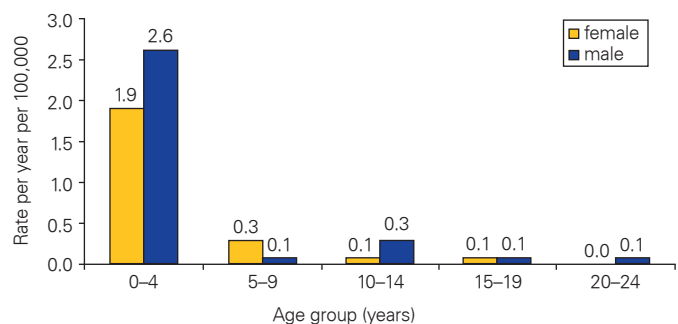


Figure 5.4

Age specific mortality rate by gender: neuroblastoma/SNS tumours (South Australia 1977–2004)

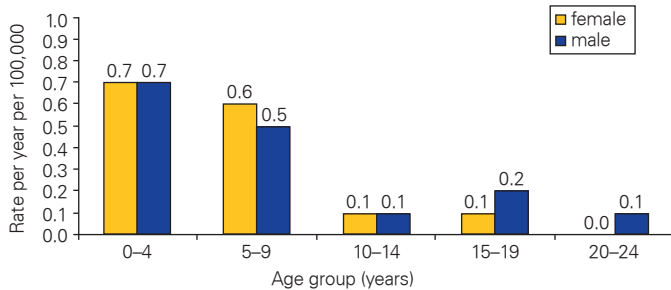


Table 5.2

Male to female incidence and mortality rate ratios for SNS tumours, by age group (South Australia 1977–2004)

age group	Incidence		Mortality	
	IR ratio male : female	95% CI	IR ratio male : female	95% CI
0-4yr	1.37	0.80–2.38	1.06	0.39–2.94
5-9yrs	0.24	0.01–2.40	0.83	0.26–2.62
10-14yrs	2.37	0.39–24.9	0.95	0.01–74.3
15-19yrs	0.96	0.07–13.2	2.87	0.23–150.7
20-24yrs	-	-	-	-
M-H* 0-24 yrs	1.30	0.81–2.10	1.10	0.60–2.03

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

There were no significant differences in the incidence rates among children under 15 years for tumours of the sympathetic nervous system across social class groupings and by place of residence. (Figure 5.5) Rates of death were also similar across these groupings. (Figure 5.6) The number of cases among 15–24 year olds was too small to make meaningful comparisons.

Figure 5.5

Age standardised incidence rate among 0–14 year olds by place of residence and SES: neuroblastoma/SNS tumours (South Australia 1977–2004)

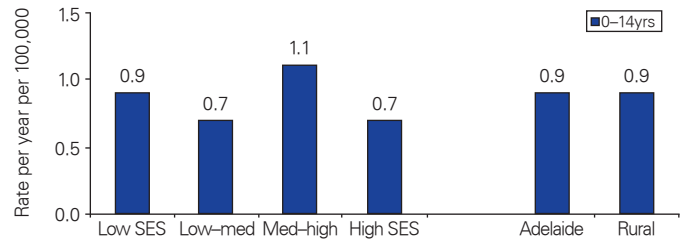
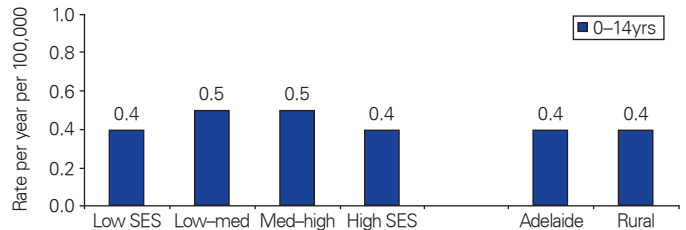


Figure 5.6

Age standardised mortality rate among 0–14 year olds by place of residence and SES: neuroblastoma/SNS tumours (South Australia 1977–2004)



Time trends

The incidence and mortality rates for SNS tumours among young South Australians have remained relatively stable over the past 28 years, with no significant differences being noted in relation to annual changes or differences between the earlier (1977–90) or later time periods (1991–2004). (Figure 5.7, Table 5.3)

Figure 5.7

Trends in incidence and mortality among 0–24 year olds: neuroblastoma/SNS tumours (Age Standardised rate, SA 1977–2004)

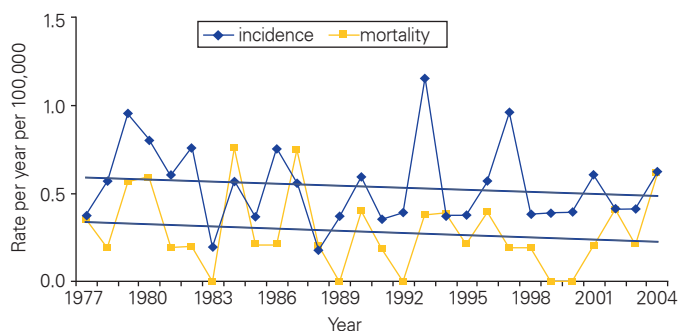


Table 5.3

Rate ratios showing annual change in incidence and mortality for neuroblastoma/SNS tumours, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–14yrs	0.995	0.967–1.024	0.990	0.951–1.030
15–24yrs	0.990	0.887–1.105	1.018	0.916–1.131

Survival

Overall, the survival outcomes for young people diagnosed with tumours of the SNS in South Australia are poorer than for many other childhood cancers. The proportion of young people surviving five years after diagnosis is approximately 50%. (Figure 5.8)

Survival outcomes were found to be significantly different for infants and very young children. The proportion of infants (under one year) surviving five years was 84%, compared with 51% for those in their second year of life when diagnosed, and 19% for those aged between two and four years of age when diagnosed. Five-year survival among those aged five years or older at diagnosis was 31%. (Figure 5.9)

No significant differences in survival outcomes have been noted by gender, SES or place of residence. There was no evidence of a significant change in survival over time, with five-year survival being roughly the same for those diagnosed between 1977 and 1990 (48%) and between 1991 and 2004 (51%). (Figure 5.10)

Figure 5.8

Survival from neuroblastomas/SNS tumours (South Australia 1977–2004)

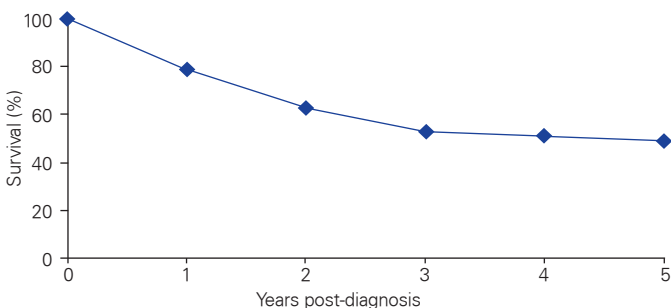


Figure 5.9

Survival from neuroblastomas/SNS tumours by age at diagnosis (South Australia 1977–2004)

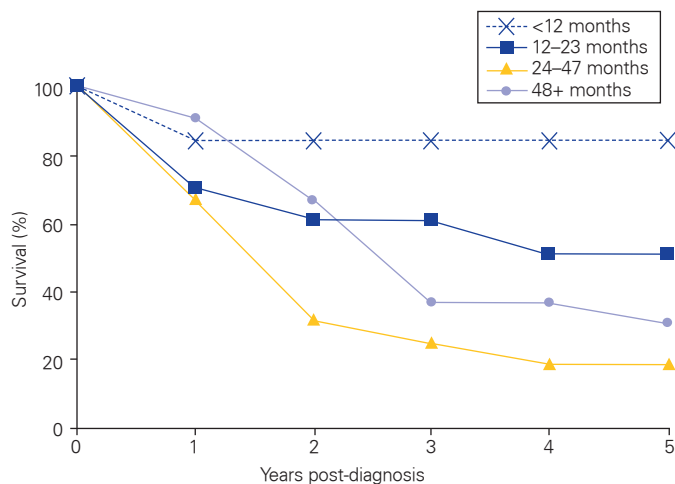
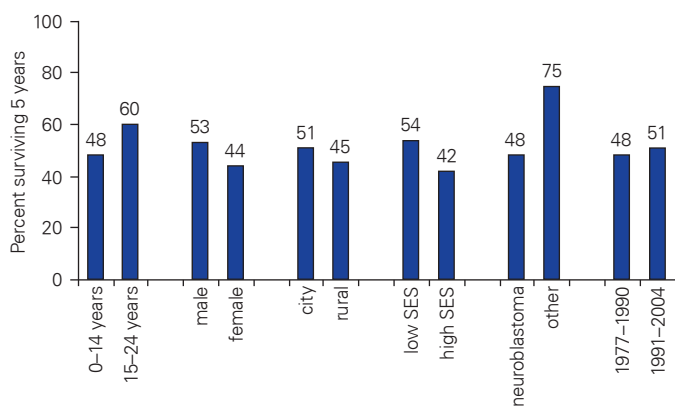


Figure 5.10

Five-year survival from neuroblastomas/SNS tumours by age group, gender, residence, SES and time period (South Australia 1977–2004)



Tumours of the sympathetic nervous system (SNS)

Between 1977 and 2004, there were 78 cases of SNS tumours diagnosed among young people in South Australia (about three cases per year). Ninety percent of these cases were neuroblastomas affecting children under 15 years of age.

During the same period, 41 young people died from tumours of the SNS (one to two deaths per year).

The peak incidence of SNS tumours occurs in the first year of life. Cases are very rare after the age of five years. Death rates are highest in the first ten years of life.

The incidence of SNS tumours is higher in males under five years than in females, but the difference is not statistically significant.

Incidence and mortality rates do not vary by SES or place of residence and have remained stable in South Australia over the past three decades.

Survival outcomes for SNS tumours are poorer than for most other cancers affecting young people, with only 50% living for five years after diagnosis.

Survival outcomes varied markedly in relation to age at diagnosis, with infants under one year having the highest five-year survival (84%) and young children between the ages of two and four years at diagnosis having the poorest survival (19%).

There is no difference in survival outcomes by gender, SES or place of residence, nor is there any evidence of changes in survival over time.

Chapter 6

Retinoblastomas

Retinoblastoma

Introduction

Retinoblastoma is a cancer of one or both eyes that develops in young children. Retinoblastoma occurs in the retina, the light sensitive layer at the back of the eye that enables sight. About three quarters of cases are unilateral (occur only in one eye) while one quarter are bilateral (occur in both eyes). Bilateral retinoblastoma is usually a sign of a hereditary form of the disease.

Specific genes are known to control the cell division of retinal cells. In retinoblastoma cases, a gene that suppresses cell growth is missing or damaged so cells of the retina continue to divide, developing into a tumour. This genetic defect can either be inherited (in which case the defect occurs in all cells throughout the body) or develop spontaneously (only appearing in cells of the eye).

Signs of retinoblastoma are varied. The most common sign is the white appearance of the pupil. Other signs include:

- crossing of the eyes
- one eye turned outwards or inwards
- red painful eyes
- inflammation of the tissue around the eye
- an enlarged or dilated pupil
- poor vision
- failure to thrive/not eating or drinking.

More than 95% of children with retinoblastoma are successfully cured. Ninety percent will retain vision in at least one eye and 80% are likely to retain perfect vision.

Treatment depends on the age of the child but will usually involve surgery to remove the eye. Children who have surgery are able to have a prosthetic (artificial) eye implanted after their surgery has healed. When both eyes are involved, the second eye (less affected eye) is treated with radiotherapy or by other methods such as laser therapy or cryotherapy in an attempt to retain some vision.

Children with bilateral (hereditary) retinoblastomas and children treated with radiotherapy are at increased risk of developing other tumours (unrelated to the eye) later in life, particularly bone and soft tissue sarcomas, and melanomas.

Risk factors

About 30% of retinoblastomas are thought to be familial. Genetic factors involved in hereditary retinoblastomas are well understood. Offspring of patients with bilateral retinoblastoma have a 50% risk of inheriting the gene mutation, and a 90% chance of developing the disease.

Reasons for the sporadic development of genetic mutations that lead to retinoblastoma are not known. One study has examined father's occupation and found an association with certain occupations that involve metal manufacturing, welding and employment in the military, but this evidence is limited.

Occurrence and survival

Between 1977 and 2004, 24 cases of retinoblastoma were diagnosed in South Australia, approximately one case per year. All cases were among children under five years of age. (Table 6.1) During the same period, there were four deaths from retinoblastoma among South Australian children. No deaths have occurred since 1993.

The highest incidence of retinoblastoma was among children under two years of age. (Figure 6.1) Rates were similar among male and females.

Survival in relation to retinoblastoma is high, with 91% of SA children surviving five years after diagnosis. (Figure 6.2)

Numbers are too small to determine trends in incidence or survival but evidence from other developed countries suggests rates of retinoblastoma have remained stable over the past two decades.

Table 6.1

Cases of retinoblastoma in South Australia 1977–2004

Age	Female	Male	Total
< 1yr	5	3	8
1 yr	2	6	8
2 yrs	2	2	4
3 yrs	1	2	3
4 yrs	0	1	1
Total	10	14	24

Figure 6.1

Age specific incidence rate: retinoblastoma (South Australia 1977–2004)

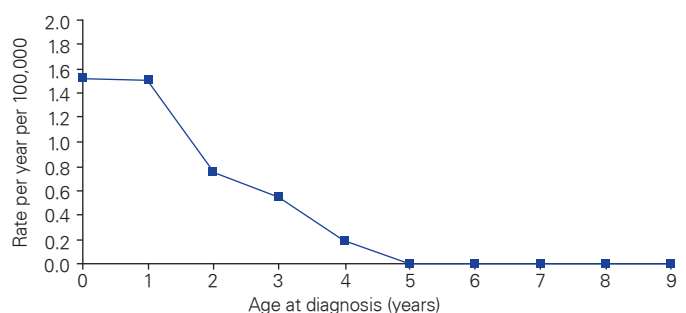
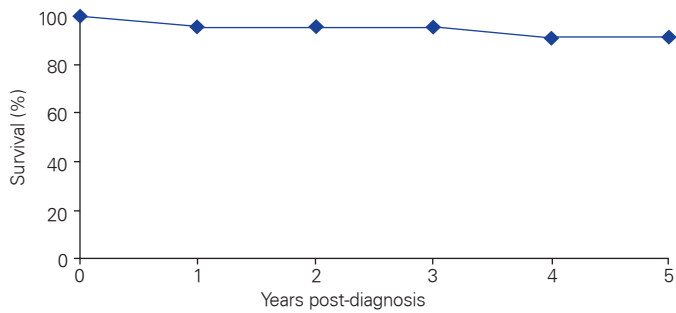


Figure 6.2

Survival from retinoblastoma
(South Australia 1977–2004)



Retinoblastoma

Between 1977 and 2004, there were 24 cases of retinoblastoma diagnosed in South Australia (about one per year). There were only four deaths from retinoblastoma in the same period.

All cases of retinoblastoma occurred in children under five years of age, the peak incidence occurring in infants under two years of age.

The vast majority of patients with retinoblastoma survive for five years or more (91%).

Chapter 7

Renal tumours

Renal tumours

Introduction

Renal tumours account for about 6% of the cancer burden in children (under 15 years) but only a small proportion of cancers in adolescents and young adults.

Renal tumours are cancers of the cells in the kidneys. Wilms tumour, named after the doctor who first described this type of tumour, is the most common type of renal tumour found in children. It occurs when immature cells of the kidney (nephroblasts) continue to divide in their immature form rather than develop into functioning cells, eventually forming a solid tumour that compresses normal tissue around it. This type of cancer accounts for around 90% of renal tumours in children. It usually occurs in children under the age of seven years and is most likely to be diagnosed in children around three years of age. Wilms tumours are related to particular defects in the DNA of one of two genes on chromosome 11, which affect the development and control of the genital and urinary systems.

Renal cell carcinoma, another form of kidney cancer, is very rare in children but does occasionally occur in adolescents and young adults. Other forms of renal cancer are extremely rare in children, adolescents and young adults.

Wilms tumour (also referred to as nephroblastoma) usually occurs in one kidney but can sometimes affect both kidneys. Often these tumours are not detected early because they can grow to be quite large without causing pain. The main sign of Wilms (and other renal tumours) is a mass in the abdomen. Other symptoms include:

- swelling or pain in the abdomen
- blood in the urine
- unexplained fever
- reduced appetite.

Prognosis is generally good for children diagnosed with Wilms tumour. Outcomes do vary, however, depending on age, grade (how much the cells in the tumour differ from normal healthy kidney cells) and stage (degree of spread). Even though in many cases tumours are quite large, it is unusual for the cancer to have metastasised (spread to other parts of the body) at the time of diagnosis.

Prognosis is less favourable for other types of renal cancers which have a greater tendency to spread outside the kidney.

Wilms tumour and other childhood renal cancers are usually treated by surgery to remove the affected kidney (nephrectomy). Standard treatment usually involves chemotherapy but radiotherapy may also be needed depending on characteristics of the tumour (stage and grade). If both kidneys are involved, only part of the kidney(s) is removed, with chemotherapy and radiotherapy being used to shrink the tumour to leave some kidney function.

Around 85% of children diagnosed with Wilms tumour will be disease free after treatment.

Risk factors

Most research on causes of renal cancers in young people has focused on Wilms tumour.

Wilms tumours are often associated with genetic syndromes (birth defects) involving abnormalities in urinary and genital tract development. Syndromes include WAGR, Beckwith-Wiedemann, Denys-Drash and Simpson-Golabi-Behme syndromes.

In addition, there appears to be a familial link in 1–3% of cases (inheritance abnormal gene). There are also differences in the likelihood of developing Wilms tumour according to race/ethnicity (e.g. lower incidence in Asian children), further supporting a genetic link.

Evidence is unclear in relation to environmental factors. Several have been suggested but evidence is limited to only one or two studies or measures of exposure that have not been reliable. Paternal occupation involving welding or mechanics has been suggested as a risk factor, but evidence is not yet conclusive.

Other factors where evidence is even more limited include:

- high birth weight
- parental exposure to pesticides
- exposure to X-rays in utero
- consumption of tea or coffee during pregnancy
- maternal use of hair dyes
- use of certain medications during pregnancy
- maternal occupation (electronics, clothes manufacturing, hair dressing, laboratory and dental assistants).

Occurrence

Between 1977 and 2004, 74 cases of renal tumours were recorded among young people under 25 years of age in South Australia. This is less than three cases per year. Among children (<15 years) renal cancers occurred at a rate of less than one per 100,000 per year.

The majority of renal tumours were Wilms tumours which occurred in children under 15 years of age. Eight cases of renal cell carcinoma have occurred in this period, all but one recorded in young people aged 15–24 years of age. (*Table 7.1*)

During the same period, there were 20 deaths among young South Australians due to renal cancers. Eighty percent of these were among children under 15 years of age.

Table 7.1

Number of cases of renal tumours diagnosed in South Australia 1977–2004, by cancer subtype

type	<15yrs		15–24yrs		0–24yrs	
	n	%	n	%	n	%
Nephroblastoma (Wilms)	65	98	1	13	66	89
Renal cell carcinoma	1	2	7	87	8	11

Age differences

The majority of cases of renal cancer occurred in children under seven years of age. The peak incidence occurred at two years of age (which is similar to observations internationally). (Figure 7.1)

Death rates from renal tumours were more even across the range of ages although rates were slightly higher among those under seven years. (Figure 7.2)

Gender differences

More renal tumours were reported among young females than young males in South Australia, with the largest difference occurring for within the 5–9 year age group (not statistically significant). (Figure 7.3) Overall, the difference was not statistically significant. (Table 7.2) International data have also suggested a slight predominance of Wilms tumours among girls.

Age and gender specific death rates are too small to draw meaningful conclusions about gender differences in relation to renal cancer mortality in young people. (Figure 7.4, Table 7.2)

Figure 7.3

Age specific incidence rate by gender: renal tumours (South Australia 1977–2004)

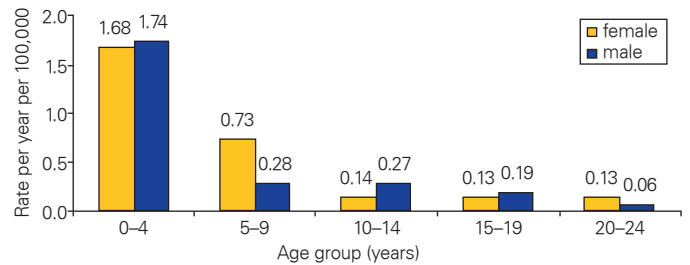


Figure 7.4

Age specific mortality rate by gender: renal tumours (South Australia 1977–2004)

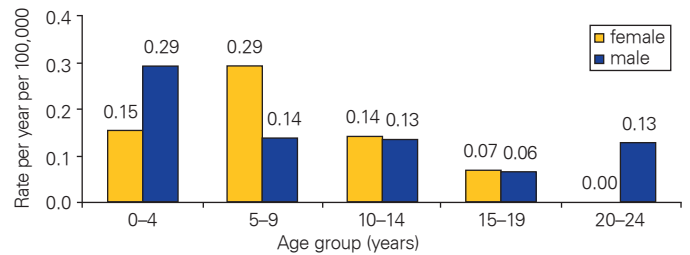


Figure 7.1

Age specific incidence rate: renal tumours (South Australia 1977–2004)

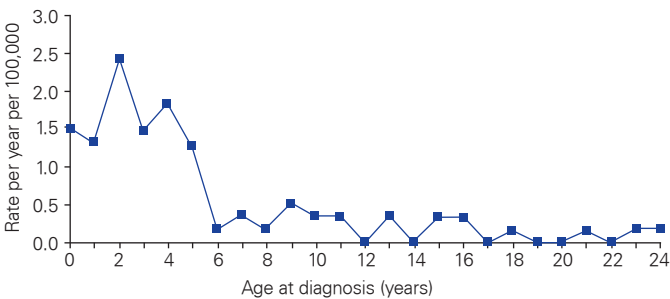


Figure 7.2

Age specific mortality rate: renal tumours (South Australia 1977–2004)

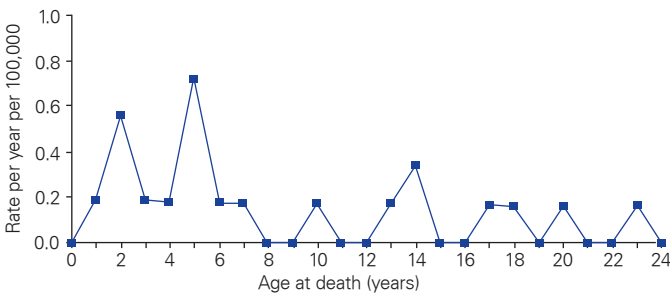


Table 7.2

Male to female incidence and mortality rate ratios for renal tumours combined, by age group (South Australia 1977–2004)

age group	Incidence	
	rate ratio male : female	95% CI RR
0–4yrs	1.11	0.60–2.07
5–9yrs	1.02	0.31–3.42
10–14yrs	2.02	0.29–22.3
15–19yrs	1.61	0.18–19.2
20–24yrs	-	-
M-H* 0–24yrs	1.08	0.68–1.70

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

There were no significant differences in the incidence of renal tumours among children in relation to social class grouping or by place of residence. (Figure 7.5) Nor did rates of death vary by SES or place of residence. (Figure 7.6)

Figure 7.5

Age standardised incidence rates among 0–14 year olds by place of residence and SES: renal tumours (South Australia 1977–2004)

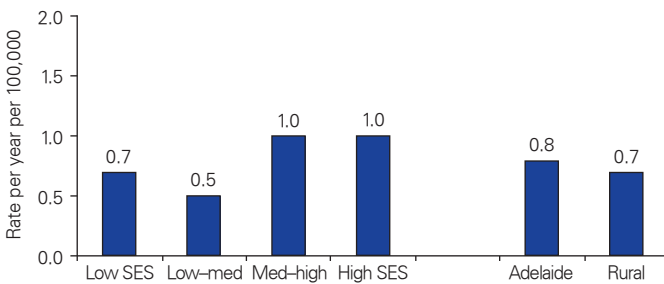
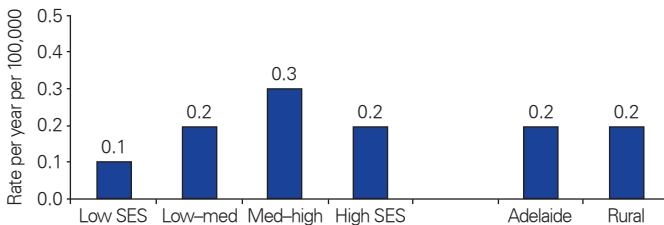


Figure 7.6

Age standardised mortality rates among 0–14 yrs by place of residence and SES: renal tumours (South Australia 1977–2004)



Time trends

There is no evidence of any change in incidence or mortality rates over the period for which records are available in South Australia, although rates are very low, which makes it difficult to determine whether there are any real trends over time. (Figure 7.7, Table 7.3)

Figure 7.7

Trends in incidence and mortality among 0–24 year olds: renal tumours (Age standardised rate, South Australia 1977–2004)

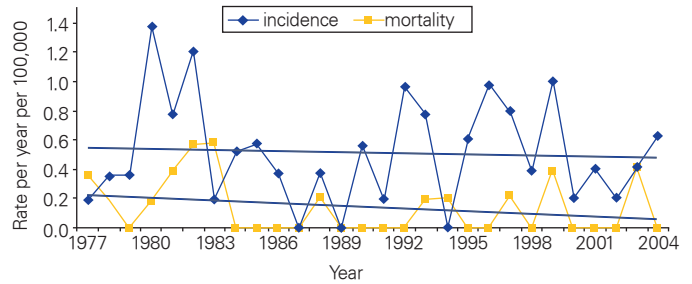


Table 7.3

Rate ratios showing annual change in incidence and mortality for renal tumours, by age group (South Australia 1977–2004)

age group	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–14yrs	1.001	0.972–1.030	0.979	0.922–1.040
15–24yrs	0.958	0.879–1.045	1.052	0.940–1.178

Global comparisons

Australia has relatively high rates of renal cancers among children compared with other regions of the world, but is surpassed by Northern Europe, Northern America and New Zealand according to Globocan estimates for the year 2000. The lowest rates are found in parts of Asia and Africa. (Figure 7.8)

Figure 7.8

Comparison of renal cancer incidence rates by country/region among 0–14 year olds (Globocan estimates for 2000)

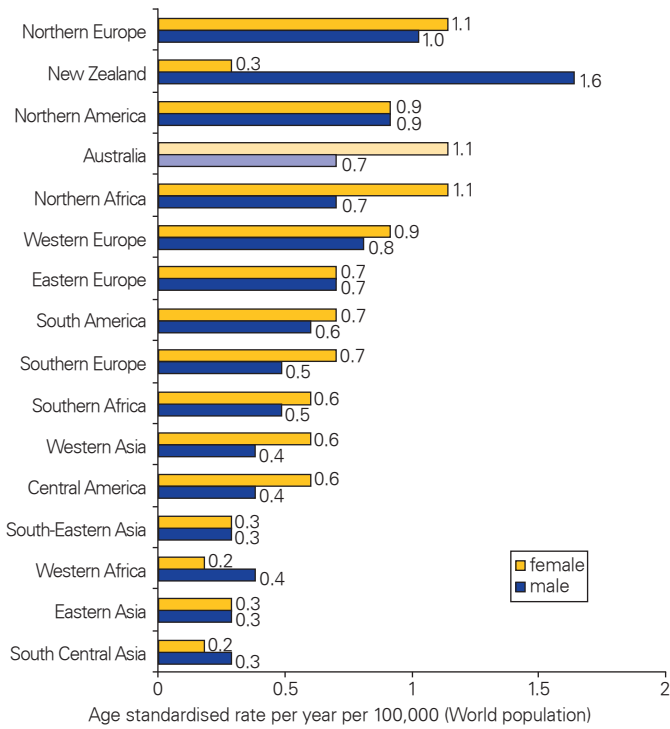


Figure 7.9

Survival from renal tumours (South Australia 1977–2004)

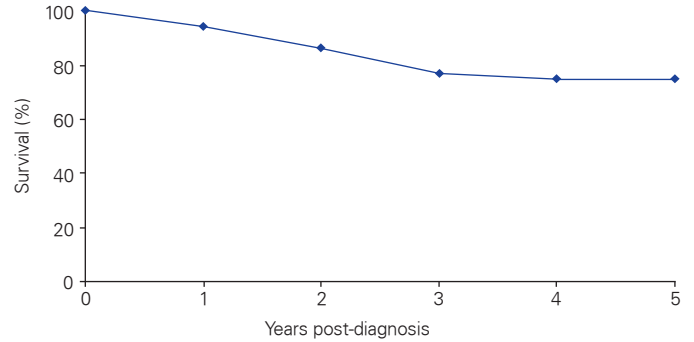
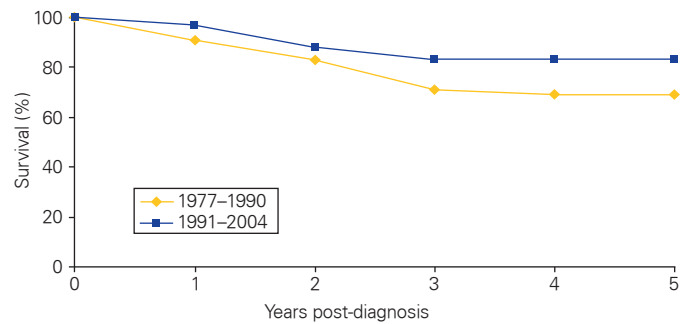


Figure 7.10

Survival from renal tumours by diagnostic period (South Australia 1977–2004)

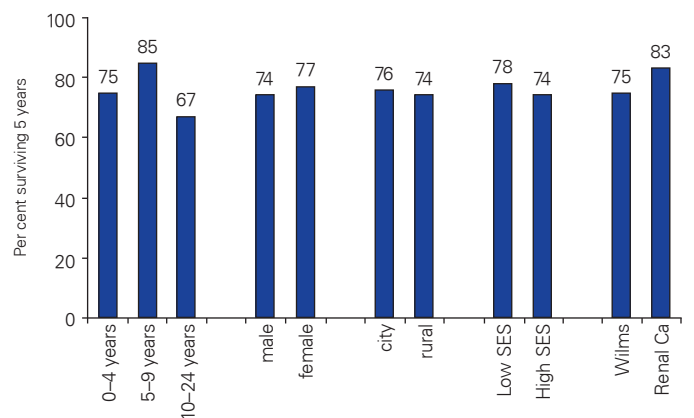


Survival

Overall, five-year survival for young people with renal tumours in South Australia was 75%. (Figure 7.9) Survival outcomes during the period 1991–2004 were more favourable than in the earlier period 1977–1990, although the difference in survival between the early and later periods was not statistically significant ($\chi^2=2.2$, $df=1$, $p=0.138$). (Figure 7.10) The proportion of young people diagnosed during the earlier period who survived five years after diagnosis was 69%. This compares with a five-year survival of 83% for young people diagnosed during the later period. There were no differences in survival outcomes according to age, gender, place of residence, SES or type of cancer. (Figure 7.11)

Figure 7.11

Five year survival from renal tumours for 0–24 year olds by age group, gender, residence, SES and cancer type (South Australia 1977–2004)



Renal tumours

Between 1977 and 2004, there were 74 cases of renal tumours diagnosed among young South Australians (3 cases per year). The majority were Wilm's tumours affecting children (88%).

While renal cancers are rare in children, Australia has relatively high rates of childhood renal cancers compared to other regions of the world, similar to those in other developed countries.

Renal tumours are most commonly diagnosed during the first five years of life, with the peak incidence occurring in children aged two to three years. Renal cancers are rare in young people after the age of five years.

There is no evidence of differences in incidence or mortality rates according to gender, SES or place of residence.

Incidence and mortality rates appear to have remained stable over time in South Australia.

Seventy five percent of young people in South Australia diagnosed with renal tumours survive for five years or more after diagnosis.

There are no differences in survival outcomes according to age, gender, SES or place of residence.

Comparisons over time suggest an improvement in survival outcomes, although the differences are not statistically significant (Five-year survival: 69% for the period 1977–1990; 83% for period 1991–2004).

Chapter 8

Hepatic tumours (cancers of the liver)

Hepatic tumours (cancers of the liver)

Introduction

Hepatic tumours are cancers that form in the liver. The liver is a vital organ in the body which helps to filter harmful substances in the blood, makes important enzymes to digest fat and regulates the storage of energy in the body (glycogen).

There are two types of primary liver cancers that affect young people. These are hepatoblastoma, a type of cancer originating from immature liver cells, which usually occurs in children under five years of age, and hepatocellular carcinoma, which usually affects older children and young adults. This latter type is more likely to spread to other parts of the body.

Liver cancer is very rare in children and young adults. One or two children per million develop liver cancer each year. Eight out of ten hepatic tumours in children (under 15 years) are hepatoblastomas.

Signs of liver cancer include:

- swelling in the abdomen with or without pain
- weight loss
- loss of appetite
- nausea or vomiting.

Surgery to remove the tumour is the most likely treatment. The liver can continue to function even when only a small part is working. The liver has four sections or lobes and cancer can be present in one or more lobes. If the tumour is present in all four lobes a liver transplant may be necessary depending on the tumour type. Treatment will usually also include chemotherapy. Sometimes chemotherapy and radiotherapy are used to shrink the tumour before surgery. Other specialised treatments are often considered for hepatocellular carcinoma, such as chemoembolisation (administering chemotherapy locally to the vein going to the liver) and antiangiogenic treatment (preventing the tumour from developing a blood supply).

Prognosis (chances of cure) depends on several factors including whether the cancer affects all or part of the liver and whether it can be completely removed by surgery, the type of cancer (hepatoblastoma or hepatocellular carcinoma) and grade (amount of cellular change in the cancer cells).

Risk factors

The causes of liver cancer in children in more developed countries are not well understood.

In less well developed countries, hepatitis B infection, transferred from mother to child at birth, is linked to the development of hepatocellular carcinoma in older children and young adults.

Risk factors for hepatoblastoma include:

- being male
- having the familial adenomatous polyposis (FAP) gene
- having Beckwith-Wiedemann syndrome
- having a very low birth weight.

Certain parental occupations (related to metals, petroleum products and paints) have been implicated but evidence is limited to one study.

Being male, having hepatitis B or C infection, or having other diseases causing liver damage, increases the risk of hepatocellular carcinoma.

Occurrence

Thirteen cases of liver cancer were diagnosed in young people in South Australia between 1977 and 2004. Seventy percent of cases were diagnosed in children under five years of age. (Table 8.1) During this period, there were seven deaths from liver cancer in people under 25 years of age. Deaths were more common in very young children. There was no discernible difference in rates according to gender. (Figure 8.1) Over the period 1977–2004, 75% of young people diagnosed with hepatic cancers were alive five years after diagnosis. Numbers are too small to make a meaningful assessment of trends over time. Only one death has been recorded since 1989.

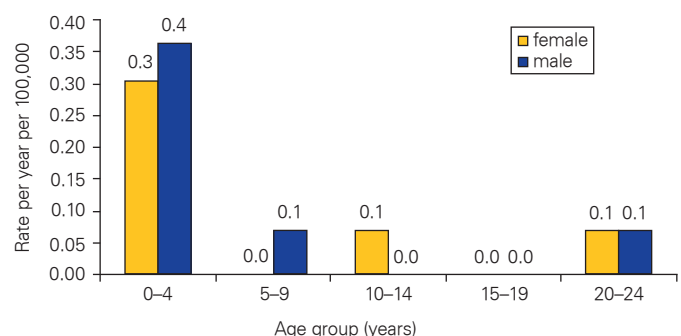
Table 8.1

Number of cases of liver cancers diagnosed in South Australia 1977–2004, by cancer subtype

type	0–14 yrs		15–24 yrs		0–24 yrs	
	n	%	n	%	n	%
New cases	11	84.6	2	15.4	13	100.0
Deaths	6	85.7	1	14.3	7	100.0

Figure 8.1

Age specific incidence rate by gender: liver cancers (South Australia 1977–2004)



Hepatic tumours (liver cancers)

Liver cancers in children and young people are very rare. Between 1977 and 2004, there were 13 cases of liver cancer diagnosed and seven deaths from liver cancer among young people under 25 years of age in South Australia. Most of these cases and deaths were in young children.

There are too few cases in South Australia to determine any demographic patterns or time trends.

Chapter 9

Malignant bone tumours

Malignant bone tumours

Introduction

Half of all bone tumours that occur in children and young adults are non malignant. This section only relates to primary bone tumours that are malignant (referred to as bone cancers in this report). Primary malignant bone tumours are cancers that start in the bones, as opposed to secondary bone tumours which start in other parts of the body but spread to the bones. Primary bone tumours have the potential to spread to other parts of the body.

Bone cancers are rare in children and young people, accounting for around 5% of cancers in those under 25 years of age. There are several different types of bone cancer that occur in children and young people. The most common types are osteosarcoma and Ewing sarcoma. Osteosarcomas are tumours that develop in the newly forming bone tissue and commonly occur in bones around the knee during adolescence and early adulthood. Ewing sarcomas are thought to start in immature nerve tissue around the bone and can occur in a variety of bones but most commonly in bones of the pelvis or upper leg. Both osteosarcoma and Ewing sarcomas occur in young people around the time of rapid bone growth. The peak incidence of these cancers is seen at around 14–16 years of age.

Another type of bone cancer that is relatively rare in young people is chondrosarcoma. This type of cancer begins in the cartilage and tends to grow relatively slowly. Chondrosarcoma tends to be diagnosed most frequently among people aged 40–75, years but can occur in children and young adults.

Symptoms of bone cancer vary depending on which part of the body is affected as well as the size of the tumour. Common signs of bone cancer include:

- pain or swelling in the affected area
- weakness
- unexplained broken bones
- fatigue, weight loss, anaemia, fever.

Treatment also depends on the location of the tumour as well as the size and degree of spread. The main treatments include:

- surgery to remove the tumour
- radiotherapy
- chemotherapy.

For tumours of the arms and legs, amputation may be necessary to remove all of the cancer, although in some cases, limb saving surgery may be possible, where only part of the bone is removed and replaced through bone grafting or metal prostheses. Radiotherapy may be given in conjunction with, or instead of, surgery. Chemotherapy may also be used in combination with other treatments.

Chances of survival are good, particularly when the cancer is amenable to removal through surgery or radiotherapy. In cases where the tumour has spread, prognosis depends on how well the cells respond to chemotherapy.

Risk factors

The causes of bone cancers are not well understood. The increase in incidence of these cancers around the time of rapid bone growth is thought to occur because rapidly dividing cells are more vulnerable to DNA damage by chance or by as yet unknown factors. Osteosarcomas have been linked with retinoblastoma and other rare, inherited syndromes. Ewing sarcoma and other closely related tumours appear to share a genetic abnormality where part of the DNA on one chromosome is transferred to another chromosome. This produces an abnormal gene which may be linked with the development of tumours.

Different risk factors have been implicated for the different types of bone cancer.

Known risk factors for osteosarcomas include:

- radiotherapy treatment for cancer during childhood
- chemotherapy treatment (alkylating agents) for cancer during childhood
- retinoblastoma and other rare syndromes
- exposure to radium (known to be linked with bone cancer in adults). The potential for exposure through drinking water to cause bone cancer in adults or children is unclear.

Risk factor for which evidence is limited or inconsistent include:

- being taller
- prior injury of the affected area
- shorter birth length
- foetal X-rays
- parental exposure to fertilisers, herbicides or pesticides
- fluoride in drinking water.

The only known risk factor for Ewing sarcoma is race. Tumours are almost exclusively found in Caucasian children. Other risk factors for which evidence is limited or inconclusive relate to:

- height/weight/age at onset of growth spurt
- having had a hernia
- parental occupation in agriculture
- ingestion of poison/medication overdose.

Occurrence

The incidence of bone cancer in young people in South Australia is relatively low. About one in every 100,000 persons under 25 years of age develops bone cancer each year.

During the period between 1977 and 2004, 119 young South Australians were diagnosed with malignant bone tumours. This is equivalent to about four cases per year. Just over half of these cases occurred in young people aged 15 to 24 years, while the remaining cases were among children under 15 years of age.

Osteosarcomas were the most common type of bone cancer occurring in young South Australians, accounting for 44% of bone tumours among those under 25 years of age. This was followed by Ewing sarcoma, which accounted for 34% of all bone cancers in young people. Osteosarcomas were more common among adolescents and young adults (15–24 years) than among children (under 15 years). Ewing sarcomas, however, were more common among children than among adolescents and young adults. (Figure 9.1, Table 9.1)

There were 50 deaths from bone cancers among young people under 25 years of age in South Australia during the period 1977–2004. Three quarters of these deaths occurred in young people aged 15 years or older.

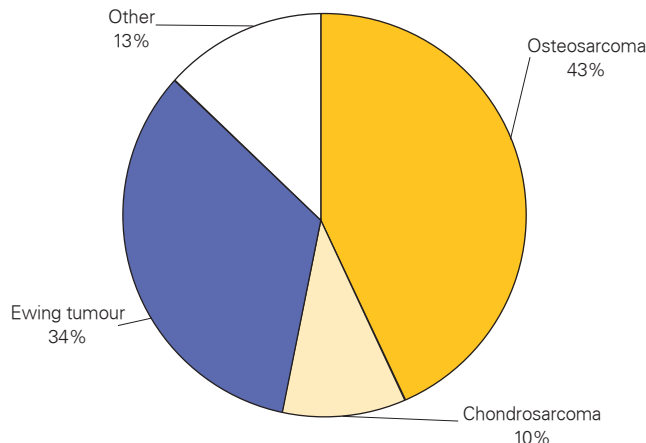
Table 9.1

Number of cases of bone cancers diagnosed in South Australia 1977–2004, by cancer subtype

type	<15yrs		15–24yrs		0–24yrs	
	n	%	n	%	n	%
Osteosarcomas	22	37.9	30	49.2	52	43.7
Chondrosarcomas	5	8.6	7	11.5	12	10.1
Ewing’s sarcomas	24	41.4	16	26.2	40	33.6
Other bone cancers	7	12.1	8	13.1	15	12.6
Total	58	100.0	61	100.0	119	100.0

Figure 9.1

Types of bone cancer diagnosed among young South Australians aged 0–24 year olds (1977–2004)



Age differences

The peak incidence for bone cancer among young South Australians occurs around 17 years of age. (Figure 9.2) Incidence is relatively low for those under 10 years and those over 20 years of age. This is consistent with trends by age in other developed countries (eg USA). Death rates followed a similar pattern with the peak mortality rates occurring in young people between 15 and 19 years of age. Deaths were rare before the age of 10 years. (Figure 9.3)

Figure 9.2

Age specific incidence rate: bone cancer (South Australia 1977–2004)

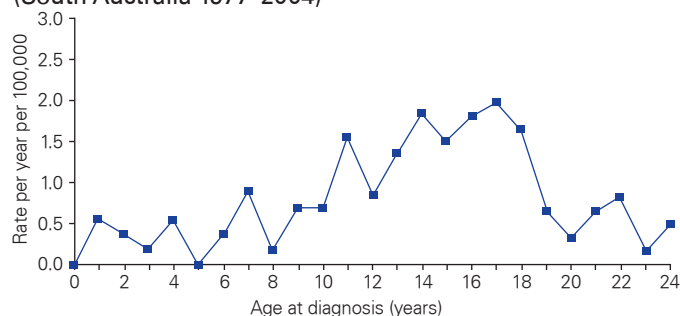
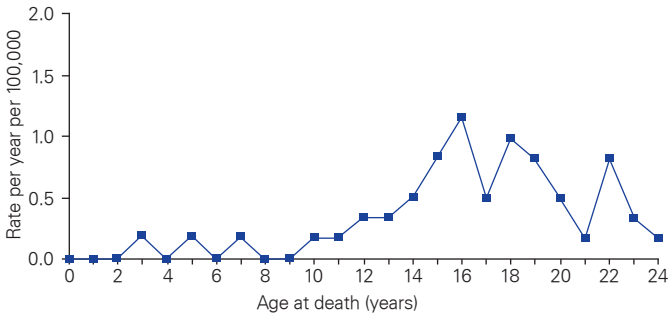


Figure 9.3

Age specific mortality rate: bone cancer (South Australia 1977–2004)



Differences by gender

Age-specific incidence rates for bone cancers are slightly higher for males than females in all age categories except 10–14 year olds. (Figure 9.4) However, the difference overall was not statistically significant. (Table 9.2) Internationally, gender differences have been noted in relation to osteosarcoma and Ewing sarcoma, with young males having a slightly higher incidence than females of both these cancers. There are no statistically significant differences by gender evident in relation to mortality from bone cancers among young South Australians. (Figure 9.5, Table 9.2)

Figure 9.4

Age specific incidence rates by gender: bone cancer (South Australia 1977–2004)

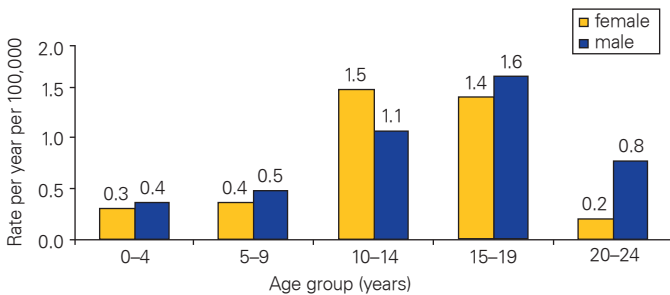


Figure 9.5

Age specific mortality rates by gender: bone cancer (South Australia 1977–2004)

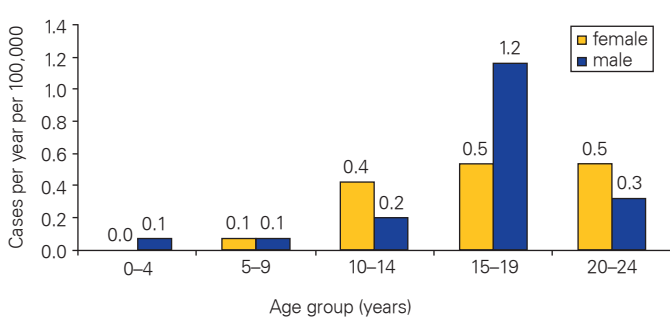


Table 9.2

Male to female incidence and mortality rate ratios for bone cancers, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	IR ratio male : female	95% CI	IR ratio male : female	95% CI
0–4yr	1.19	0.26–5.99	-	-
5–9yrs	1.32	0.36–5.31	0.95	0.01–74.4
10–14yrs	0.72	0.35–1.45	0.47	0.08–2.21
15–19yrs	1.13	0.61–2.14	2.15	0.89–5.72
20–24yrs	3.85	1.04–21.26	0.69	0.17–2.51
M-H* 0–24 yrs.	1.14	0.80–1.65	1.22	0.70–2.13

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

Among children aged 0–14 years, the incidence of bone cancer did not differ by place of residence or by socio-economic status. Among adolescents and young adults, the incidence rate of bone cancer did vary significantly across socio-economic groups. The rate was highest among young people living in areas of middle to high social advantage. (Figure 9.6) Whether this observation is due to random variation or represents a real difference in the SA population is difficult to determine. Similar patterns were observed in relation to rates of death from bone cancer, although differences by SES among the 15–24 year old group were not statistically significant. (Figure 9.7)

Figure 9.6

Age standardised incidence rate by place of residence and SES: bone cancer (South Australia 1977–2004)

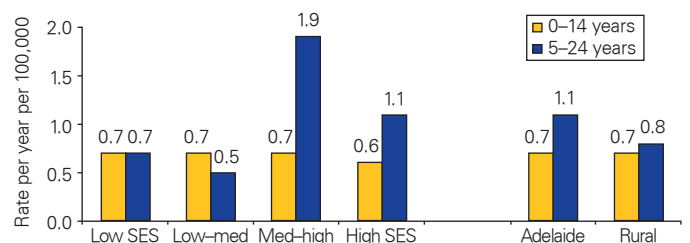
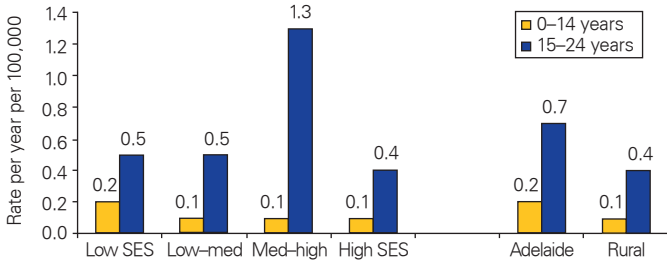


Figure 9.7

Age standardised mortality rate by place of residence and SES: bone cancer (South Australia 1977–2004)



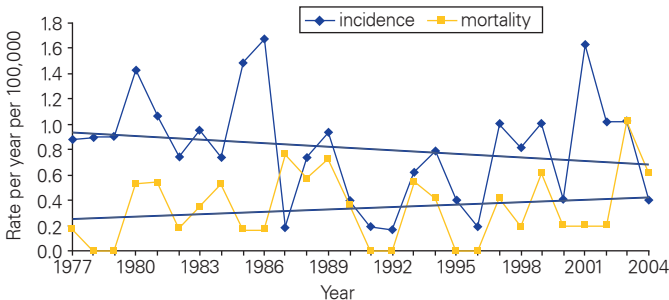
Trends

Trends in incidence over the period between 1977 and 2004 indicate a decline in bone cancer among young people in South Australia. (Figure 9.8, Table 9.3) The decrease is only evident in the older age groups. The decline of 2–3% per annum is of borderline significance, which means that there is a possibility that this pattern is due to random variation rather than representing a true decline in incidence.

There is no evidence of a parallel decline in mortality over this period.

Figure 9.8

Trends in incidence and mortality among 0–24 year olds: bone cancer (Age standardised rate, South Australia 1977–2004)



Survival

Compared with many other types of cancers affecting young people, outcomes for young South Australians with bone cancers are not as favourable. For the period 1977–2004, the proportion of young people with bone cancer surviving five years was 59%, compared with 77% for all cancers combined. (Figure 9.9)

Furthermore, there is no evidence of any improvement in survival outcomes over time. The five year survival rate for young people diagnosed between 1977 and 1990 was 62% while the five-year survival rate for those diagnosed between 1991 and 2004 was 56%. This difference is not statistically significant.

No statistically significant differences in bone cancer survival outcomes were noted in relation to age group, gender, SES, or place of residence. Differences in survival outcomes were noted in relation to specific types of bone tumour. Young people diagnosed with chondrosarcoma had very favourable outcomes (five-year survival rate of 91% compared with 50–62% for other types of bone cancer). Those with the least favourable outcomes were young people diagnosed with Ewing tumours (five-year survival rate of 50%). (Figure 9.10)

Figure 9.9

Survival from bone cancer by diagnostic period (South Australia 1977–2004)

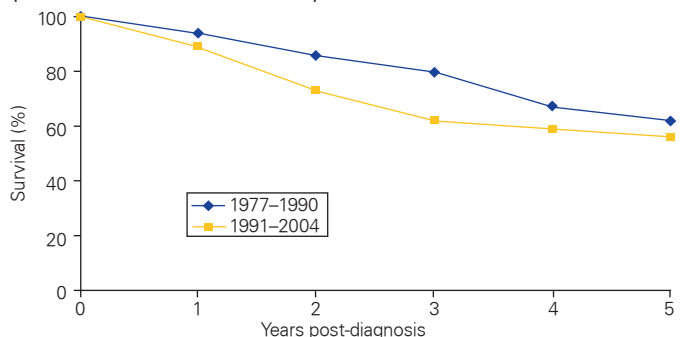
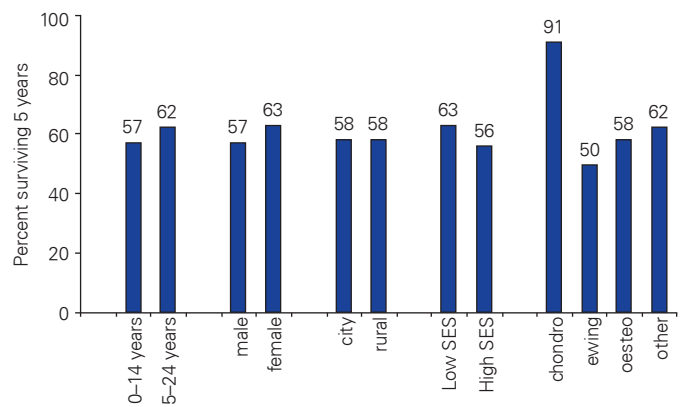


Figure 9.10

Five year survival from bone cancer for 0–24 year olds by age group, gender, residence, SES and cancer type (South Australia 1977–2004)



Statistically significant differences in survival outcomes according to the type of bone cancer identified ($\chi^2=8.81$, $df=3$, $p=0.032$).

Table 9.3

Rate ratios showing annual change in incidence and mortality for bone cancers, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–14yrs	1.004	0.969–1.033	1.047	0.975–1.124
15–24yrs	0.974	0.944–1.006	0.999	0.961–1.039

Bone cancer

Between 1977 and 2004, there were 119 cases of bone cancer diagnosed among young South Australians under 25 years of age (approximately four cases per year). Fifty young people died from bone cancer during this period.

The incidence of bone cancers peak during the mid to late teens. Death rates follow a similar pattern.

In South Australia, there are no demonstrable differences in incidence of bone cancers according to gender or place of residence. However, among young people aged 15–24 years, the incidence of bone cancer was higher among those from areas of higher social advantage. Patterns were similar in relation to death rates, but differences were not statistically significant.

Rates of bone cancer among young people in South Australia appear to have declined over the period at approximately 2–3% per year. The reason for, and clinical significance of, this trend is not clear. It is possible that it simply reflects random variations over time.

Survival outcomes for primary bone cancers are less favourable than for other types of cancers affecting young people (overall five-year survival was 59%). No differences were evident by age, gender, SES or place of residence.

Outcomes did differ significantly according to the type of cancer, with the best outcomes occurring for patients with chondrosarcomas (91%) and the worst outcomes for those with Ewing sarcoma (50%).

There was no evidence of any change in survival over time.

Chapter 10

Soft tissue sarcomas

Soft tissue sarcomas

Introduction

Childhood soft tissue sarcomas are a group of malignant tumours that start in immature cells of the soft tissues that support, surround and connect various organs and other parts of the body. These tumours are classified according to the type of tissue they resemble. For example, fibrosarcomas are tumours that involve cells of fibrous or connective tissue, while liposarcomas involve cells of fatty tissue and leiomyosarcomas involve cells of smooth muscle.

Rhabdomyosarcomas, tumours that start in the striated muscle, are the most common type of soft tissue sarcoma found in children. These tumours, along with undifferentiated sarcomas that behave like rhabdomyosarcomas, account for 50% of soft tissue sarcomas in children. They often start in the muscles behind the eye (causing the eye to bulge), in the nasal cavity (causing congestion, nose bleeds or bloody mucous), around the testis or vagina (presenting as a lump or lumps, or as vaginal bleeding) or in the genitourinary track (leading to blockages in the bladder or blood in the urine).

Other soft tissue sarcomas, sometimes referred to as non-rhabdomyosarcomas, are more common in adults than children. These tumours are often found in the trunk, arms and legs. They can present as a solid mass in the affected part of the body without any other symptoms. Occasionally if the tumour interferes with particular body functions, other symptoms may be present.

These other soft tissue sarcomas include Kaposi sarcoma. Kaposi sarcoma is a cancer that often presents as lesions under the skin around the nose, mouth, throat and other organs. This form of sarcoma is most likely to develop when the immune system is weakened by disease or drugs. It often occurs in patients with acquired immunodeficiency syndrome (AIDS). A large increase in Kaposi sarcomas was observed in the US during the 1980s and 1990s among young males.

Treatment for soft tissue sarcomas may involve surgery, chemotherapy and/or radiotherapy, depending on the type of tumour. Standard treatment usually involves surgery to remove the tumour, which may be preceded by chemotherapy or radiotherapy to shrink the tumour. If the tumour has spread, radiotherapy or chemotherapy generally would be administered after surgery. In some cases, a second round of surgery may be undertaken to remove some residual tumour.

Survival outcomes for children with rhabdomyosarcoma depend on the age of the patient, the site of the tumour, whether the tumour can be removed completely by surgery, the extent of spread or metastases and subtype of tumour cell. Survival at five years ranges from 50% to 90% depending on these factors. Survival outcomes for children with non-rhabdomyosarcomas are more favourable (especially for infants and very young children).

Children who have had multimodal treatment (a combination of chemotherapy and radiotherapy or different types of chemotherapy) for soft tissue sarcomas are at increased risk of developing other cancers.

Risk factors

Children with certain rare genetic syndromes (e.g. Li-Fraumeni syndrome, Beckwith-Wiedemann syndrome, Recklinghausen's disease) are at increased risk of developing soft-tissue sarcomas. There is also some association between rhabdomyosarcoma and genetic abnormalities in general. However most cases of soft-tissue sarcoma develop sporadically and are not linked with any inherited genetic abnormality.

Several environmental factors have been indicated in studies looking at potential causes of rhabdomyosarcoma in children. However, the evidence for each of these is limited to one study.

These factors include:

- low socio-economic status
- foetal exposure to x-rays
- parental use of recreational drugs (i.e. marijuana and cocaine) during pregnancy.

The extent to which these factors apply to tumours in adolescents and young adults is unknown.

Occurrence

Between 1977 and 2004, there were 157 cases of soft-tissue sarcomas (STS) diagnosed among young South Australians, or nearly six cases per year. Just over half were diagnosed in older adolescents and young adults. The incidence of soft tissue cancers among young South Australians was around one case per 100,000 per year. These tumours accounted for 6% of cancer cases in children under 15 years of age and around 5% of cancer cases in adolescents and young adults (15–24 years of age). During the same period, 44 young people died from STS. This is equivalent to less than two deaths among young people per year. Nearly two thirds of deaths occurred in the older age group (15–24 years). (*Table 10.1*)

Nearly half of the soft tissue sarcomas reported among children were rhabdomyosarcomas. (*Table 10.2*) Among adolescents and young adults, non-rhabdomyosarcomas predominated. No cases of Kaposi sarcoma were reported among young South Australians under 25 years of age.

Table 10.1

Number of new cases of and deaths from soft tissue sarcoma in South Australia 1977-2004

type	<15yrs		15-24yrs		0-24yrs	
	n	%	n	%	n	%
New cases	73	46.5	84	53.5	157	100.0
Deaths	16	36.4	28	63.6	44	100.0

Table 10.2

Number of cases of soft tissue sarcoma diagnosed in South Australia 1977-2004, by cancer subtype

type	<15yrs		15-24yrs		0-24yrs	
	n	%	n	%	n	%
Rhabdomyosarcomas	33	45.2	11	13.1	44	28.0
Non-Rhabdomyosarcomas	40	54.8	73	86.9	113	72.0

By age

The incidence of STS in South Australia appears to increase gradually with increasing age. Soft tissue sarcomas were slightly more common in adolescents and young adults than in young children (Figure 10.1). A similar pattern is observed in relation to deaths from STS, with very low death rates among children (under 15 years) but higher rates among young adults, peaking out around 20-21 years.(Figure 10.2)

Figure 10.1

Age specific incidence rate: soft tissue sarcomas (South Australia 1977-2004)

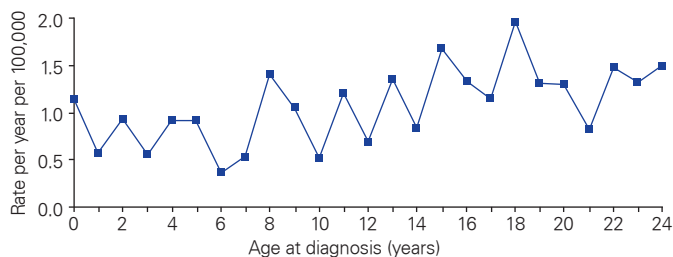
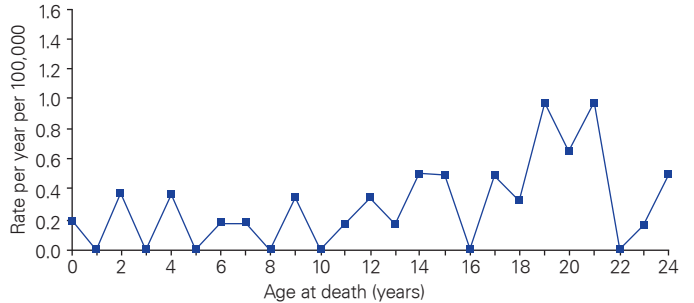


Figure 10.2

Age specific mortality rate: soft tissue sarcomas (South Australia 1977-2004)



Gender differences

International literature indicates a slightly higher incidence of STS among male children, although there was no significant difference in incidence or mortality rates between young males and females in South Australia during the past 28 years. (Figures 10.3 & 10.4, Table 10.3)

Figure 10.3

Age specific incidence rate by gender: soft tissue sarcomas (South Australia 1977-2004)

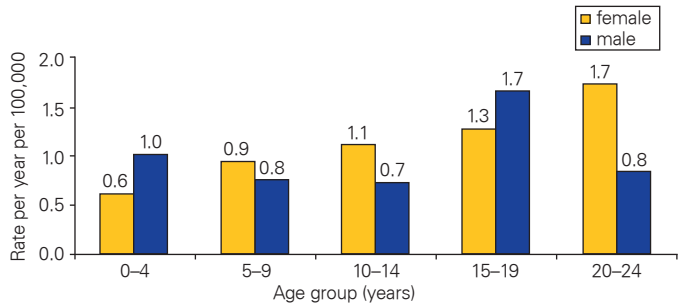


Figure 10.4

Age specific mortality rate by gender: soft tissue sarcomas (South Australia 1977-2004)

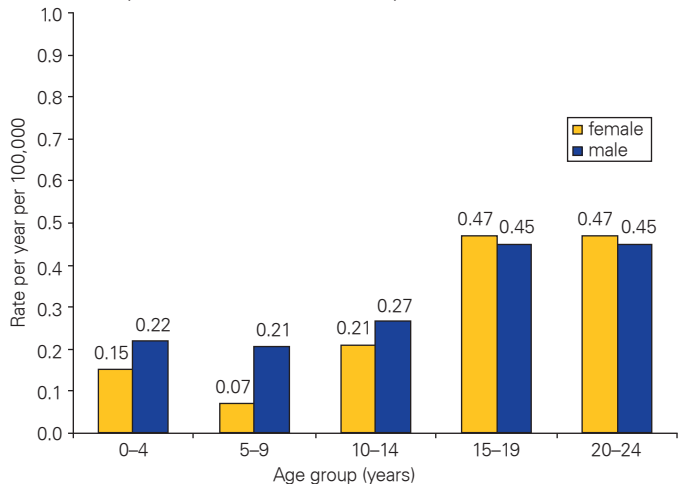


Table 10.3

Male to female incidence and mortality rate ratios for soft tissue sarcomas, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate ratio male : female	95% CI RR	rate ratio male : female	95% CI RR
0–4yrs	1.66	0.65–4.58	1.43	0.16–17.1
5–9yrs	0.80	0.33–1.94	2.85	0.23–149.4
10–14yrs	0.65	0.27–1.49	1.26	0.21–8.62
15–19yrs	1.31	0.70–2.50	0.96	0.29–3.20
20–24yrs	0.48	0.23–0.97	0.96	0.29–3.22
M-H* 0–24yrs	0.87	0.64–1.19	1.15	0.63–2.07

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status.

No statistically significant differences were observed in relation to the incidence of soft tissue sarcomas by socio-economic grouping or place of residence. Nor were there any differences in relation to rates of death from soft tissue sarcomas. (Figures 10.5 & 10.6)

Figure 10.5

Age standardised incidence rate among 0–24 year olds by place of residence and SES: soft tissue sarcomas (South Australia 1977–2004)

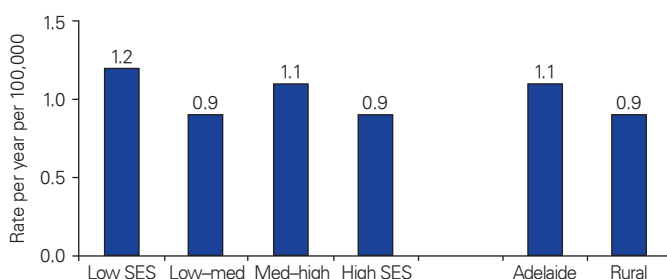
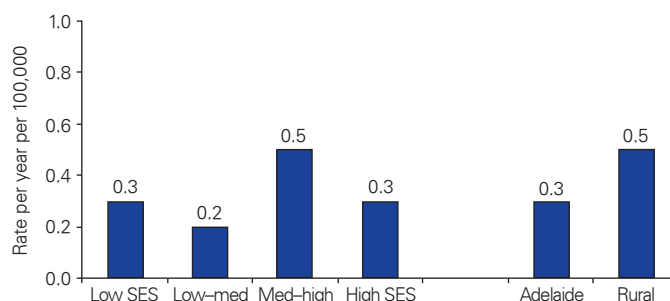


Figure 10.6

Age standardised mortality rate among 0–24 year olds by place of residence and SES: soft tissue sarcomas (South Australia 1977–2004)



Trends

Due to the small number of cases per year, there has been considerable variation in the annual incidence rates for STS in South Australia during the period for which records are available. The overall trend suggests that incidence rates have remained steady over this period. Trends in mortality rates over the period also indicate little change in death rate among young South Australians. (Figure 10.7 Table 10.4)

Figure 10.7

Trends in incidence and mortality among young people aged 0–24 years: soft tissue sarcomas (Age standardised rate South Australia 1977–2004)

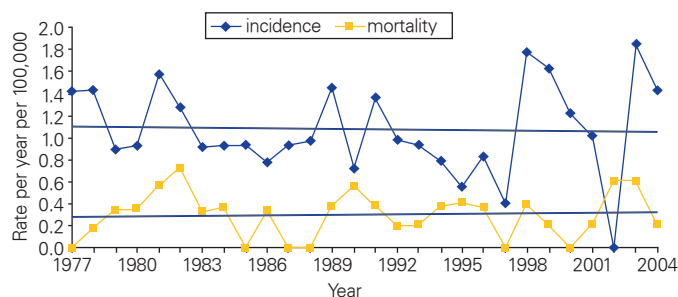


Table 10.4

Rate ratios showing annual change in incidence and mortality for soft tissue sarcomas, by age group (South Australia 1977–2004)

age groups	Incidence		Mortality	
	rate change per annum	95% CI	rate change per annum	95% CI
0–14yrs	0.996	0.967–1.026	1.021	0.960–1.085
15–24yrs	1.010	0.982–1.037	0.983	0.938–1.029

Survival

Overall, 69% of young South Australians diagnosed with soft tissue sarcoma were alive five years after a diagnosis. (Figure 10.8)

Survival outcomes for young people diagnosed with rhabdomyosarcoma (RMS) were significantly poorer than for those diagnosed with other types of soft tissue sarcomas. The five-year survival for young people with rhabdomyosarcoma was only 51% compared with 75% for those with other soft tissue sarcomas ($p=0.0053$). (Figure 10.9)

No significant difference in survival outcomes was evident in relation to age at diagnosis, gender, place of residence or SES. There is no evidence of any change in survival when comparing outcomes for cases diagnosed between 1977 and 1990 with cases diagnosed between 1991 and 2004. (Figure 10.10)

Figure 10.8

Survival from soft tissue sarcomas among 0–24 year olds (South Australia 1977–2004)

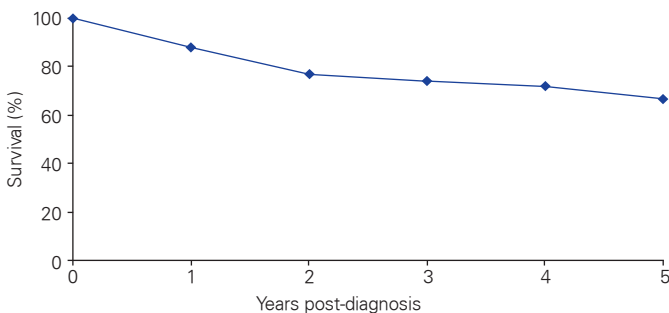


Figure 10.9

Survival from soft tissue sarcomas by cancer type among 0–24 year olds (South Australia 1977–2004)

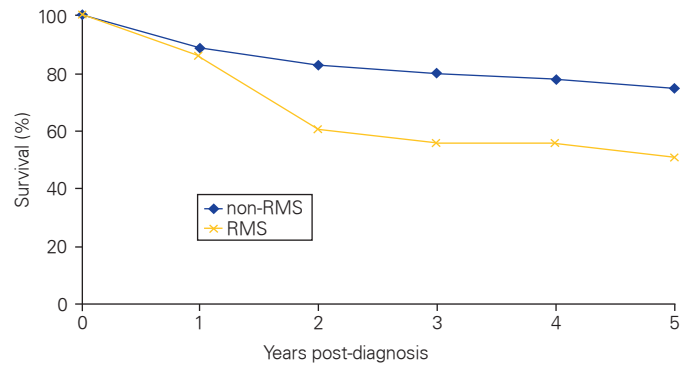
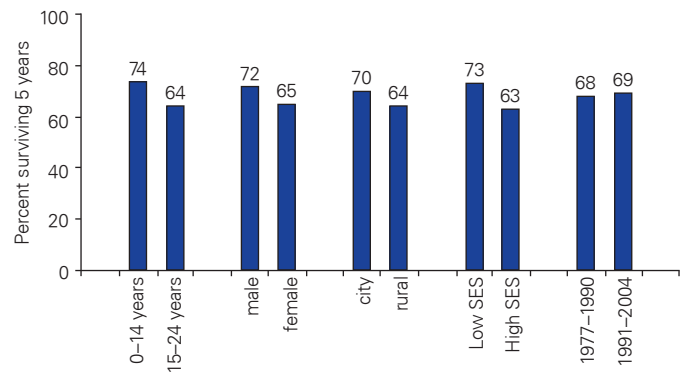


Figure 10.10

Five year survival from soft tissue sarcomas among 0–24 year olds, by age group, gender, residence, SES and time period (South Australia 1977–2004)



Soft tissue sarcomas

Between 1977 and 2004, there were 157 cases of soft tissue sarcomas diagnosed among young South Australians (about six per year). During this period, 44 young people died from these cancers.

Soft tissue sarcomas occur over the entire age range from 0–24 years, with slightly higher incidences in the older age group. Death rates follow a similar pattern.

There is no evidence of any difference in incidence or mortality rates according to gender, SES or place of residence.

Incidence and mortality rates have remained steady over the period 1977 to 2004.

Overall the proportion surviving five years after diagnosis with soft tissue sarcoma is 69%, with no observable difference by age group, gender, SES or place of residence.

Survival outcomes were poorer for cases of rhabdomyosarcoma (51%) than for other types of soft tissue tumours (75%).

There was no evidence of any change in survival over time.

Chapter 11

Germ cell, trophoblastic and
other gonadal neoplasms
(GCTOG tumours)

Germ cell, trophoblastic and other gonadal neoplasms (GCTOG tumours)

Introduction

Germ cell tumours are a group of tumours that develop from germ cells or other cells involved in reproduction. During foetal development, germ cells normally migrate to the ovaries or testes to form the ova (eggs) or sperm cells. Tumours arise when these cells fail to mature properly and become cancerous (divide uncontrollably). They most commonly occur in the ovaries and testes but can occur in other places of the body such as the brain, abdomen and base of the spine if the immature germ cells fail to migrate. Other cells such as trophoblasts (cells involved in assisting fertilised eggs to attach to the wall of the uterus and in the development of the placenta) can become cancerous.

Germ cell tumours in young people are categorised into five subtypes under the International Classification of Childhood Cancers, based on the cell type (germ cell, trophoblast or other) and the site of the tumour (brain, gonads or other). However, there is considerable variation in the biological characteristics and clinical behaviour of tumours within some of these subtypes. Germ cell tumours in children are quite distinct from those occurring in adolescents and young adults.

The major types of germ cell tumours include testicular germ cell tumours in infants, young children, adolescents and adults (each with distinct characteristics); ovarian germ cell tumours; germ cell tumours that occur in the brain and germ cell tumours that occur outside the gonads but not in the brain in young children, and in adolescents and young adults (again with distinct characteristics).

Symptoms will vary depending on the location of the tumour but testicular cancers will often present as a lump where the tumour develops.

The main treatment for germ cell tumours involves surgery or chemotherapy or a combination of both. Tumours that can be removed completely by surgery may not require chemotherapy, whereas tumours that have spread or can't be removed would normally be treated with a combination of different chemotherapy drugs.

Age and location of the tumour affect prognosis. More than 90% of patients with germ cell tumours will be cured.

The incidence of germ cell tumours has doubled over the past four decades. In children, rates of tumours outside the gonads have increased while gonadal tumour rates have remained steady. In adolescents and young adults, most of the increase is due to an increase in the incidence of gonadal tumours.

Risk factors

Risk factors for germ cell tumours in children and young people are not well understood. The only confirmed risk factor for testicular germ cell cancer is cryptorchidism (testes that have not developed or descended properly).

The dramatic increase in incidence of germ cell cancers over the past few decades implies that environmental factors play an important role. However, these factors are not known. Suggested risk factors arise mainly from studies of testicular cancers among adults.

These include:

- use of oral contraceptives or high levels of maternal hormones during pregnancy
- preterm birth
- hernia
- trauma.

Other possible risk factor (for which evidence is inconsistent or limited) include:

- high birth weight
- viral infection
- parental occupation (medical, aircraft industry, exposure to solvents, plastics and resins)
- pre-natal X-rays.

Occurrence

A total of 205 young South Australians under 25 years of age were diagnosed with GCTOG tumours between 1977 and 2004. This is equivalent to around seven cases in South Australia per year.

Germ cell tumours account for around 3% of childhood cancers in SA and around 10% of cancers among adolescents and young adults (15–24 years). The incidence among children in South Australia between 1977 and 2004 was low (0.5 per 100,000 children aged 0–14 years per year developed germ cell cancer) compared with the incidence in adolescents and young adults (2.5 per 100,000 young people 15–24 years per year developed germ cell cancer). Germ cell cancer was the third most common cancer affecting 15–24 year olds after melanoma and lymphoma.

Nearly two thirds of all germ cell tumours diagnosed were testicular tumours occurring in adolescents or young adults. Among children under 15 years, tumours other than testicular germ cell tumours predominated (69%), while in those aged 15 years or over, testicular germ cell tumours were the main type of germ cell tumour diagnosed (84%). (Table 11.1)

In the same period, there were 21 deaths from GCTOG tumours in people under 25 years of age in South Australia. This was less than one death per year. Sixteen of these were among 15–24 year olds, while the remaining five were among those under 15 years of age.

Table 11.1

Number and type of germ cell tumours diagnosed in South Australia 1977–2004

type	<15yrs		15–24yrs		0–24yrs	
	n	%	n	%	n	%
Testicular tumours	13	31.0	137	84.0	150	73.0
Other	29	69.0	26	16.0	55	27.0

Age differences

Rates of GCTOG tumours are relatively high in the first few years of life, but then decline until adolescence when they increase steadily through to their highest levels at age 24 years. The peak incidence rate in early childhood (during the second year of life) was 1.5 per 100,000 per year (SA 1977–2004). This compares with the peak incidence at 24 years of age among young adults of 5.1 per 100,000 per year. (Figure 11.1)

Death rates are generally low across all ages and particularly among children under 14 years of age. Mortality rates are slightly higher for those in their late teens and early twenties. (Figure 11.2)

Figure 11.1

Age specific incidence rates: germ cell (GCTOG) tumours (South Australia 1977–2004)

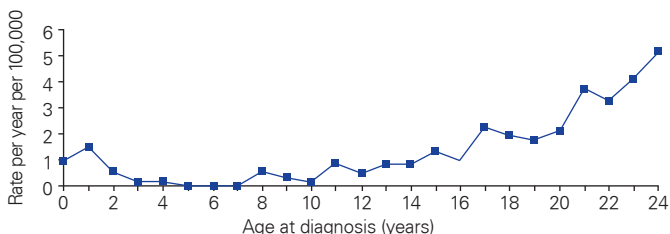
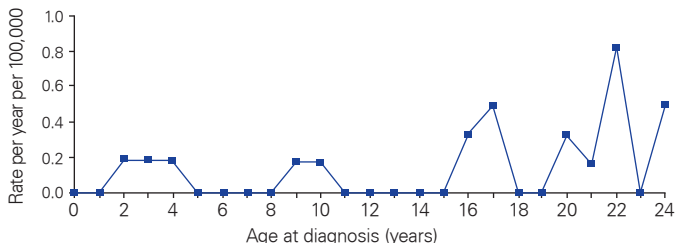


Figure 11.2

Age specific mortality rate: germ cell (GCTOG) tumours (South Australia 1977–2004)



Gender differences

There is little difference in rates of GCTOG tumours among male and female children under 15 years of age. However, between the ages of 15 and 24 years, cases are much more common in males than females. This is due to the predominance of testicular cancers in this age group. The highest incidence of germ cell cancer among females was for girls aged between 10 and 14 years. (Figure 11.3, Table 11.2)

Mortality rates show a similar pattern to incidence rates with large gender differences among the older age groups. Mortality rates are extremely low for females in all age groups and for males under 20 years of age. (Figure 11.4)

Figure 11.3

Age specific incidence rates by gender: germ cell (GCTOG) tumours (South Australia 1977–2004)

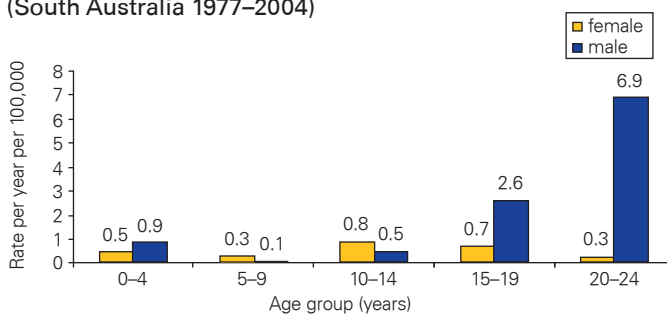


Figure 11.4

Age specific mortality rates by gender: GCTOG tumours (South Australia 1977–2004)

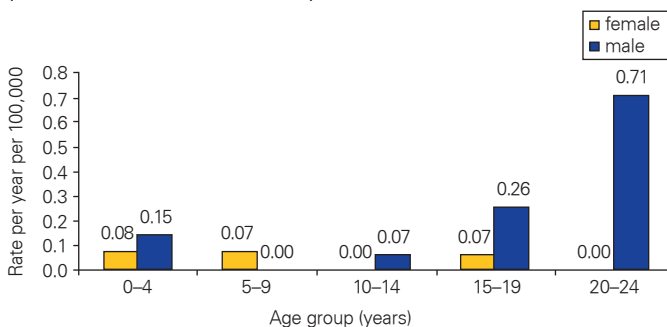


Table 11.2

Male to female incidence rate ratios for GCTOG tumours, by age group (South Australia 1977–2004)

age groups	Incidence	
	rate ratio - male : female	95% CI RR
0–4yrs	1.90	0.66–6.18
5–9yrs	0.24	0.005–2.40
10–14yrs	0.55	0.18–1.52
15–19yrs	3.48	1.75–7.52
20–24yrs	26.0	9.86–97.10
M-H* 0–24yrs	4.34	3.04 - 6.19

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

No significant differences are evident in relation to the incidence or death rates among young people from germ cell and related tumours across socio-economic grouping or by place of residence. (Figures 11.5 & 11.6)

Figure 11.5

Age standardised incidence rate: GCTOG tumours by place of residence and SES (South Australia 1977–2004)

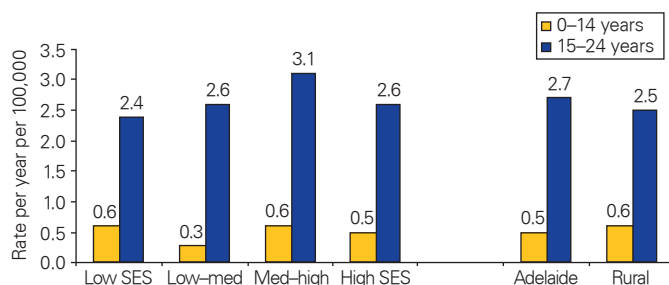
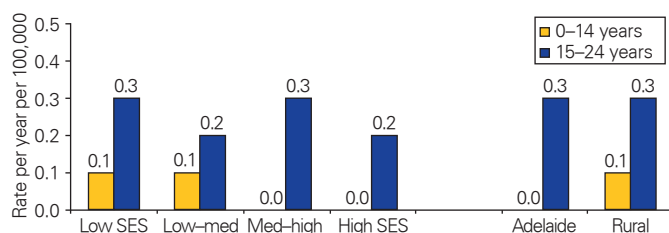


Figure 11.6

Age standardised mortality rate by place of residence and SES: GCTOG tumours (South Australia 1977–2004)



Time trends

The trend in incidence of germ cell cancers over the period 1977–2004 suggests that there has been an increase in these tumours among young people in South Australia. However, the overall trend was not statistically significant, when testing either the incremental annual change or comparisons between the incidence rate in the earlier period (1977–1990) and the later period (1991–2004). Changes in germ cell tumours over time were approaching statistical significance for cases diagnosed among adolescents and young adults (15–24 years), with an annual increase of around 1.7% (CI: 0.99–3.7%). (Figure 11.7, Table 11.3)

There was no evidence of any change in the rates of death from germ cell cancers (due to the low number of deaths from these cancers).

Figure 11.7

Trends in incidence and mortality among 0–24 year olds: GCTOG tumours (Age standardised rate South Australia 1977–2004)

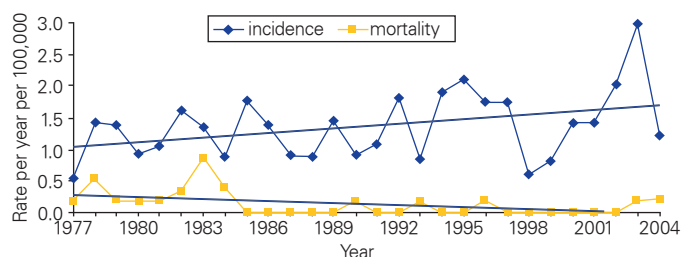


Table 11.3

Rate ratios showing annual change in incidence and mortality for germ cell tumours by age group (South Australia 1977–2004)

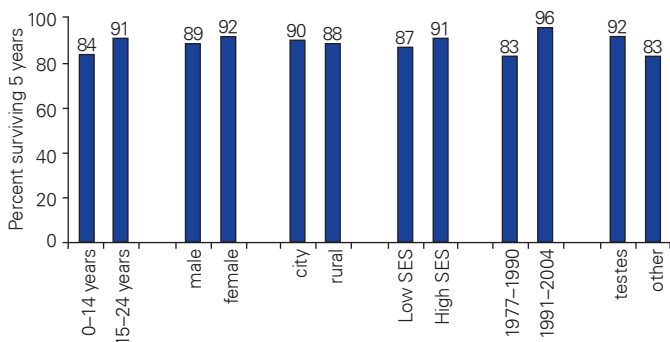
age groups	change in incidence rate per annum	95% CI
0–14yrs	1.022	0.984–1.062
15–24yrs	1.017	0.998–1.037

Survival

Survival outcomes are extremely favourable for young people diagnosed with GCTOG tumours. Overall, the percent surviving at five years was 90%. No differences in survival outcomes were noted in relation to age at diagnosis, gender, place of residence or socio-economic status, although survival outcomes improved significantly in the period 1991–2004 compared with 1977–1990 ($p=0.003$). Five-year survival were significantly higher among those diagnosed with gonadal testicular cancers compared with other types of GCTOG tumours combined ($p=0.0136$). (Figures 11.8 & 11.9)

Figure 11.8

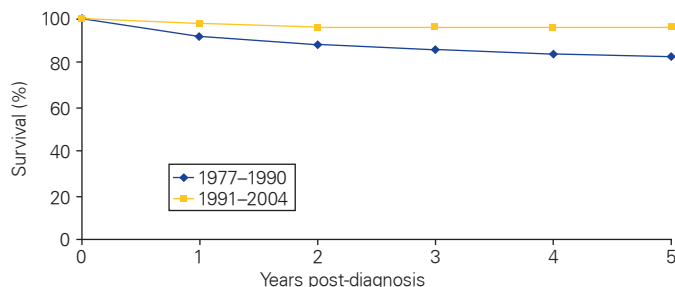
Five year survival from GCTOG tumours for 0–24 year olds, by age group, gender, residence, SES, time period and type (South Australia 1977–2004)



Significant differences in survival by time periods ($\chi^2=8.79$, $df=1$ $p=0.003$), and type of cancer, ($\chi^2=6.09$, $df=1$ $p=0.014$).

Figure 11.9

Survival from germ cell (GCTOG) tumours by diagnostic period (South Australia 1977–2004)



Germ cell tumours

Between 1977 and 2004, there were 205 cases of germ cell tumours diagnosed in young South Australians under 25 years of age (seven cases per year). During the same period, there were 21 deaths from germ cell tumours in this age group.

Germ cell tumours are the third most common cancer affecting young people 15–24 years of age. They account for 3% of cancers in children and 10% of cancers in young people.

Among children, the incidence of germ cell tumours is highest in the second year of life. Among adolescents and young adults, the incidence increases with age. Deaths are rare but the rate is highest among those in their late teens and early twenties.

Among children, there is no difference in the incidence of germ cell tumours between males and females. Among 15–24 year olds, incidence rates are much higher among males, due to the predominance of testicular cancers. The pattern in relation to death rates is similar.

The incidence of germ cell tumours appears to have increased between 1977 and 2004. The annual increase among adolescents and young adults was of borderline statistical significance.

Survival outcomes are extremely favourable for young people diagnosed with germ cell tumours (90% surviving five years or more).

No differences in survival were evident in relation to age, gender, SES or place of residence.

Outcomes were significantly better for testicular cancers than for other types of germ cell tumours.

There has been an improvement in survival outcomes over time (83% for 1977–1990 compared with 96% for 1991–2004).

Chapter 12

Carcinomas (epithelial neoplasms)

Carcinomas (epithelial neoplasms)

Introduction

Carcinomas are malignancies that arise in epithelial cells. Epithelial cells are cells that line the external surface of the body, the internal cavities and many of the glands and organs of the body. Carcinomas include cancers of the lung, bowel, breast and skin. These cancers are much less common in children than other cancers like leukaemia, lymphoma and brain cancers. However, carcinomas represent a substantial cancer burden among adolescents and young adults.

Melanoma (a type of skin cancer) and carcinoma of the thyroid are the most common epithelial carcinomas in young people and will be the major focus of this section of the report.

Occurrence (all carcinomas combined)

Over the period 1977–2004, 876 carcinomas of various types were diagnosed among young South Australians under 25 years of age. There were considerably more epithelial carcinomas among young people aged between 15 and 24 years (806 cases) than among children under 15 years (70 cases). Collectively carcinomas accounted for 48% of all cancers among 15–24 year olds in South Australia, but only 6% of all cancers in children under 15 years.

Melanoma was the most common type of carcinoma in both age groups, comprising 44% of cancers in this category among children (under 15 years) and 59% among older adolescents and young adults (15–24 years). The next most common cancer in this category was thyroid cancer, making up 14% of all carcinomas in young people under 25 years. (*Figure 12.1*) Other less frequently occurring carcinomas in young people included lip, bowel, breast, cervix and non-gonadal cancers of the ovary and testes. All were more frequent among the older age group. (*Table 12.1*)

Young females were around 1.6 times more likely than young males to have developed any type of carcinoma (due to an excess of melanoma and thyroid cancers in females and a moderate number of cancers of the breast, cervix and ovaries).

During the same period, there were 58 deaths due to carcinomas and other epithelial tumours among South Australians under 25 years of age. Ninety percent of these were among young people aged 15–24 years of age. The most deaths from any single type of carcinoma were for melanoma (20 deaths during the period). Deaths from bowel cancer were the next highest contributor (five deaths).

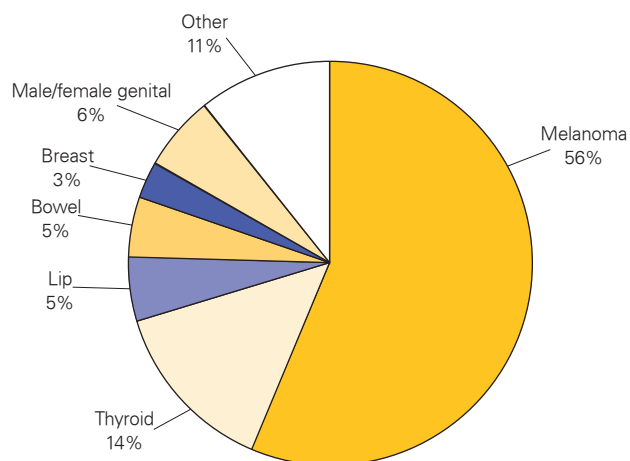
Table 12.1

Number and percent of carcinomas in South Australia (1977–2004) by cancer type

type	0–14yrs		15–24yrs		0–24yrs	
	n	%	n	%	n	%
Melanoma	31	44	474	59	505	58
Thyroid	8	11	114	14	122	14
Lip	1	1	41	5	42	5
Bowel	7	10	33	4	40	5
Breast	0	0	23	3	23	3
Ovary (non-germ)	3	4	20	2	23	3
Cervix	1	1	17	2	18	2
Testes (non-germ)	1	1	9	1	10	1
Other	18	26	75	9	93	11
Total	70	100	806	100	876	100

Figure 12.1

Other carcinomas and epithelial tumours among 0–24 year olds (South Australia 1997–2004)



a) Melanoma

Introduction

Melanoma develops from melanocytes, cells in the skin that produce melanin, a pigment that gives the skin its colour. Melanomas can develop in the skin on any part of the body, but very rarely they may develop in other parts of the body such as the eye, mouth or internally. Melanoma is the most serious form of skin cancer, due to its potential to spread to the lymph nodes and, via the lymphatic system, to other parts of the body such as the brain, bone and liver.

While melanoma is relatively rare in young people, it is the most common cancer affecting adolescents and young adults. Rates of melanoma have been rising in many western countries including Australia. Melanomas are more common in females than males. Females tend to present with melanomas on the upper and lower limbs, whereas males have a higher proportion occurring on the trunk of the body. Earlier diagnosis and better treatment outcomes tend to occur among females.

Melanomas usually present as a change in the shape, colour, size or feel of an existing mole or new mole. Common changes include:

- darker colouration or uneven colour
- asymmetrical shape
- ill-defined edges or ragged borders
- increases in the size of a mole
- itchiness or bleeding.

Treatment for melanoma usually involves surgery to remove the cancer and sometimes additional treatments to reduce the chance of melanoma recurring (immunotherapy or chemotherapy), and radiotherapy to control the cancer if it has spread to the brain or bones.

Depending on the size of the tumour, a skin graft may be required. Chemotherapy may be given either orally or locally to an affected limb. Immunotherapy may involve giving Interferon and Interleukin to enhance the immune system.

Survival outcomes for patients with melanoma are generally good. Prognosis varies according to age, site of the tumour, level of invasion and extent of spread. Patients who are younger, female or have melanomas on their limbs generally have a better prognosis. Chances of cure are very high for melanomas that have not invaded the surrounding tissue or spread to other areas of the body.

Risk factors

The exact causes of melanoma in young people are not well understood.

Exposure to ultraviolet radiation (UVR) from the sun is the primary risk factor for melanoma but determining the precise nature of high-risk exposure is complex. There are large variations in melanoma rates in young people according to the levels of UVR in different regions of the world. Also there is strong evidence of increased risk in relation to intermittent sun exposure and for an association between severe sunburn in childhood and development of melanoma later in life. The relationship between occupational exposure and melanoma risk, and total sun exposure and melanoma risk, is less clear.

The extent to which sun exposure is linked to increased risk of melanoma in children, adolescents and young adults has been questioned. Researchers have suggested that there may be different causes for melanomas in younger and older people, with a switch between causes occurring between the ages of 20 and 40 years. Non-environmental factors may play a bigger role in the development of melanoma in young people than in older adults, given that young people often develop melanomas in areas that are likely to have been protected from sun exposure.

Known risk factors, in addition to sun exposure, include:

- having fair skin
- having a large number of moles (particularly abnormal moles)
- having a family history of melanoma/inheritance of specific gene mutations
- being female
- having exposure to artificial UV (eg through solarium/tanning beds).

Because of the increased risk among females, researchers have explored possible hormonal links. However there is no conclusive evidence that melanoma risk is related to use of hormonal contraception, high internal hormone level or pregnancy related factors.

Occurrence

Melanoma is the most common cancer among 15–24 year olds, but it is relatively rare in children under 15 years of age. During the period 1977–2004, 505 cases of invasive melanoma were diagnosed among young South Australians under 25 years of age. This is equivalent to approximately 18 cases each year. Ninety-four percent of cases (474) occurred in 15–24 year olds, while 6% of cases (31) occurred in those aged under 15 years.

Deaths from melanoma in people aged under 25 are rare but do occur occasionally in older teenagers and young adults. Twenty deaths occurred between 1977 and 2004. All but one of these deaths occurred in young people aged 15–24.

By age and gender

Melanoma in young children has occurred very rarely in South Australia over the past three decades, with only four cases being diagnosed in children under 10 years of age. From the age of 10 years, the incidence rate began to increase moderately,

with a more rapid increase after 15 years of age. The highest rates were in young people in their twenties. (Figure 12.2) The pattern of melanoma deaths follows a similar pattern. (Figure 12.3) In the age range 20–24 years, there was a higher rate of melanoma among females than males, but rates were similar for males and females in other age groups. (Figure 12.4, Table 12.2) The number of deaths was too few to indicate any difference in mortality by gender. (Figure 12.5)

Figure 12.2

Age specific incidence rate: melanoma (South Australia 1977–2004)

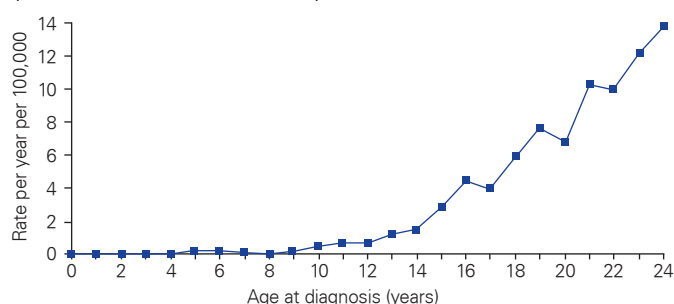


Figure 12.3

Age specific mortality rate: melanoma (South Australia 1977–2004)

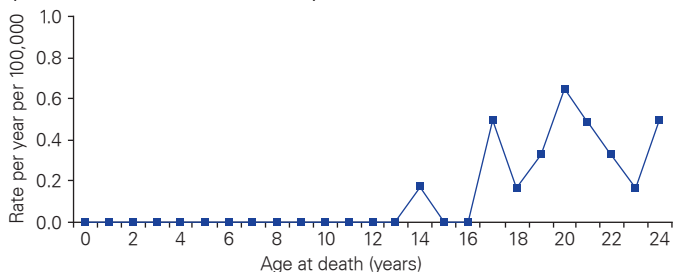


Figure 12.4

Age specific incidence rate by gender: melanoma (South Australia 1977–2004)

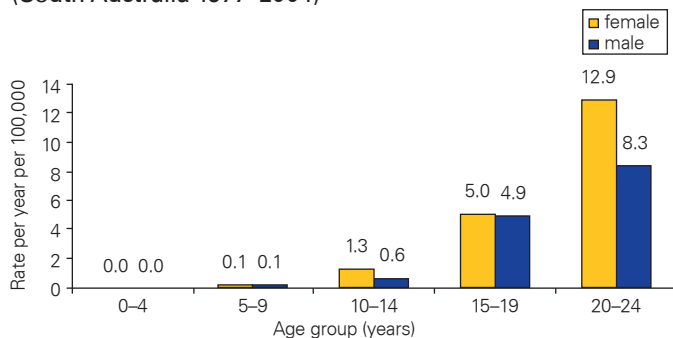


Figure 12.5

Age specific mortality rate by gender: melanoma (South Australia 1977–2004)

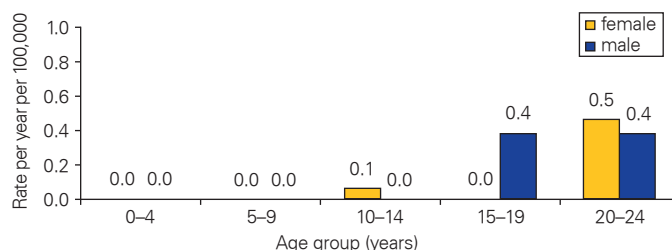


Table 12.2

Male to female incidence rate ratios for melanoma, by age group (South Australia 1977–2004)

age groups	Incidence	
	rate ratio male : female	95% CI RR
0–4yrs	-	-
5–9yrs	0.95	0.07–13.1
10–14yrs	0.47	0.19–1.11
15–19yrs	0.97	0.70–1.35
20–24yrs	0.65	0.52–0.81
M-H* 0–24yrs	0.72	0.61–0.862

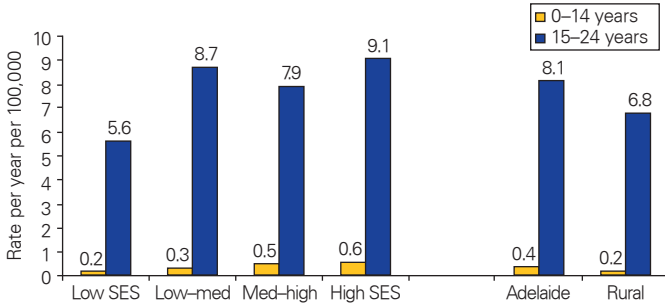
* M-H = Mantel-Haenszel estimate for overall rate ratio.

Differences by place of residence and socio-economic status

The incidence of melanoma among both children and young people increases with increasing socio-economic status. The difference in rates across SES groups was not significant among children (likely to be due to the low number of cases) but was significant in the older age group. Incidence rates were also higher among young people in the metropolitan area compared with those from rural areas, although differences were not significant in either age group. (Figure 12.6)

Figure 12.6

Age standardised incidence rate by place of residence and SES: melanoma (South Australia 1977–2004)



Trends

Over the period 1977 to 2004, there has been a significant increase in the incidence of melanoma in young people in South Australia. The annual increment in melanoma cases in South Australia since 1977 is in the order of 2% per year. Despite the increase in incidence, mortality rates have remained extremely low, with only one death recorded since 1997. (Figure 12.7, Table 12.3)

Figure 12.7

Trends in incidence and mortality among 0–24 year olds: melanoma (Age standardised rate South Australia 1977–2004)

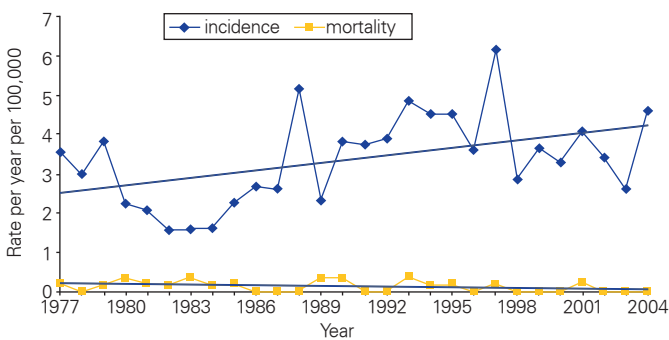


Table 12.3

Rate ratios showing annual change in the incidence of melanoma, by age group (South Australia 1977–2004)

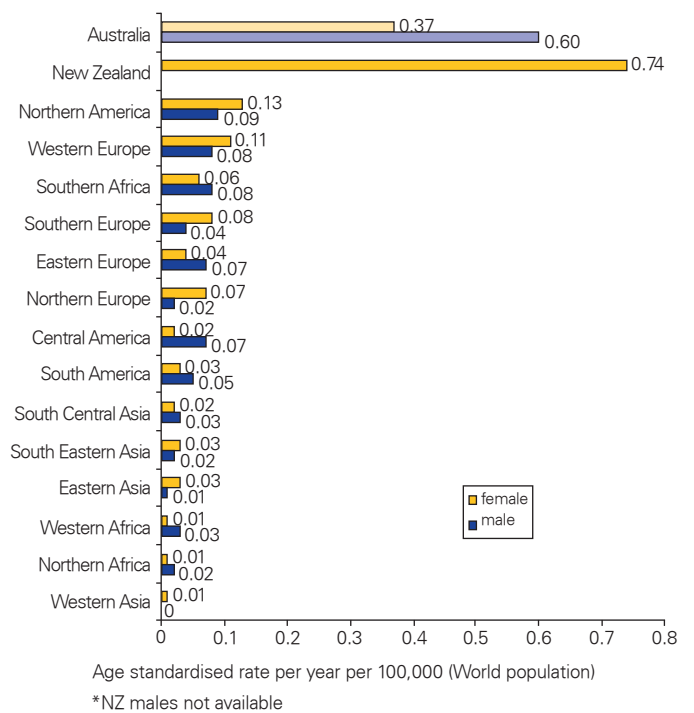
age groups	Incidence	
	rate change per annum	95% CI
0–14yrs	0.990	0.947–1.034
15–24yrs	1.022	1.011–1.034

Global comparisons

In comparison with other regions in the world, Australian childhood incidence rates for melanoma are very high, being more than four times that of other western countries (New Zealand is the only country with a comparable rate). (Figure 12.8) The regions with the next highest rates are North America and Western Europe regions, with the lowest incidence rates in Asia and Africa. These patterns are likely to be functions of variations in predominant skin types, levels of UVR across the various regions and differences in lifestyles (e.g. time spent outdoors/exposure of skin to sunlight).

Figure 12.8

Comparison of melanoma incidence rates by country/region among 0–14 year olds (Globocan estimates for 2000)



Survival

Survival outcomes are extremely favourable for young people diagnosed with melanoma. Overall for the whole period, five-year survival was 95%. A significant improvement in survival was observed for cases diagnosed between 1991 and 2004 compared with cases diagnosed between 1977 and 1990 (98% compared with 92%, $p=0.0013$). (Figure 12.9) No differences in survival outcomes were detected in relation to age, gender, place of residence or SES. (Figure 12.10)

Figure 12.9

Survival from melanoma by diagnostic period
(South Australia 1977–2004)

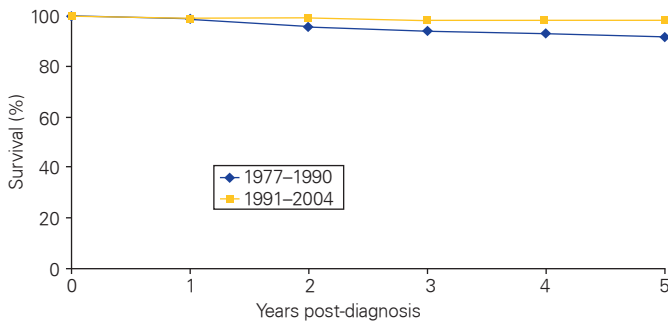
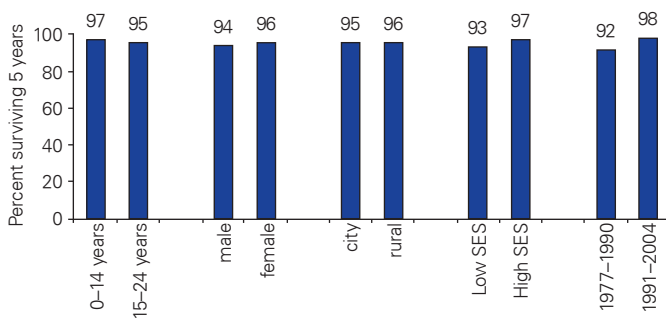


Figure 12.10

Five year survival from melanoma for 0–24 year olds,
by age group, gender, residence, SES and time period
(South Australia 1977–2004)



b) Thyroid cancer

Introduction

Thyroid cancer starts in cells of the thyroid gland. The thyroid gland is located in the base of the neck. It produces hormones which control normal bodily functions. To produce thyroid hormones, the thyroid gland requires iodine which it acquires through dietary sources. It is the only organ in the body to absorb iodine from the blood stream (which is significant in relation to treating thyroid cancer).

Thyroid cancer rarely affects children under 10 years of age, but sometimes it affects adolescents and young adults. The biological and clinical characteristics of thyroid cancer in young people are distinct from thyroid cancer in older people. The long term prognosis for young people with thyroid cancer is very good.

There are several types of thyroid cancer which affect adolescents and young adults. These include papillary thyroid carcinoma, follicular thyroid carcinoma and medullary thyroid carcinoma. Papillary and follicular thyroid carcinomas are the most common in adolescents and young adults.

Thyroid cancer often causes no symptoms. The most common sign is a lump or nodule in the neck near the Adam's apple. Other signs can include:

- hoarseness or difficulty speaking
- difficulty swallowing
- swollen lymph glands in the neck
- pain in the throat or neck.

There are different treatment options depending on age, type of cancer and degree of spread. The standard treatment usually involves surgery (either a complete or partial thyroidectomy) to remove the cancer. This may be followed by hormone therapy to suppress hormones that stimulate the thyroid cells to produce hormones themselves and/or radiotherapy treatment using radioactive iodine. Because thyroid cells are the only cells to absorb iodine, radioactive iodine becomes concentrated within these cells, destroying them but leaving other cell types undamaged. Hormone treatment may be required for life to replace the functions of the thyroid gland in cases where it is completely removed.

Survival outcomes are extremely good for young people with papillary and follicular thyroid cancers, with five-year survival around 95%.

Risk factors

Thyroid cancer in young people is a poorly studied disease.

A significant increase in the occurrence of thyroid cancer world wide has been noted over the past few decades, although the reason for this increase is unclear. It may be due to increased awareness and better diagnostic methods or to changes in

some environmental factor which is not well understood, or both.

Thyroid cancer is much more common in females than males, suggesting that hormonal factors play a role. It is also more common among Asians and Caucasians than among other races.

The only known risk factors for thyroid cancer are:

- exposure to ionising radiation through:
 - a) treatment therapies (e.g. prior treatment for cancer, acne, tinea, enlarged thymus).
 - b) environmental sources (radiation fallout, especially radioactive iodine fallout as at Chernobyl)
- genetic factors (increased risk for people with mutations linked to regulation of cell growth, and other inherited cancer susceptibility syndromes e.g. FAP)
- benign thyroid disease.

Occurrence

In South Australia, there were 122 cases of thyroid carcinoma diagnosed in people under 25 years of age between 1977 and 2004. The majority of thyroid cancers occurred in young people 15–24 years of age. (Figure 12.11) Only two cases were diagnosed in children under 10 years of age.

No one in this age range died from thyroid cancer between 1977 and 2004.

There is a strong gender bias in relation to the incidence of thyroid cancer in South Australia. Incidence rates in females are seven times those of males. (Figure 12.12, Table 12.4)

There is no significant difference in the incidence of thyroid cancer across socio-economic groups or by place of residence. (Figure 12.13)

Figure 12.11

Age specific incidence rate: thyroid cancer (South Australia 1977–2004)

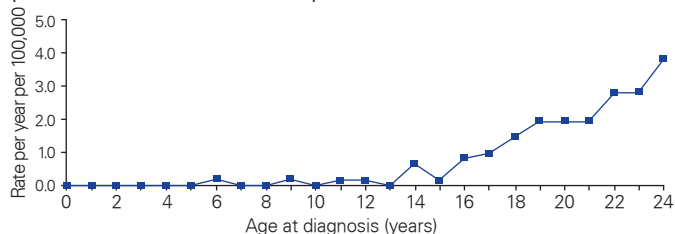


Figure 12.12

Age specific incidence rate by gender: thyroid cancer (South Australia 1977–2004)

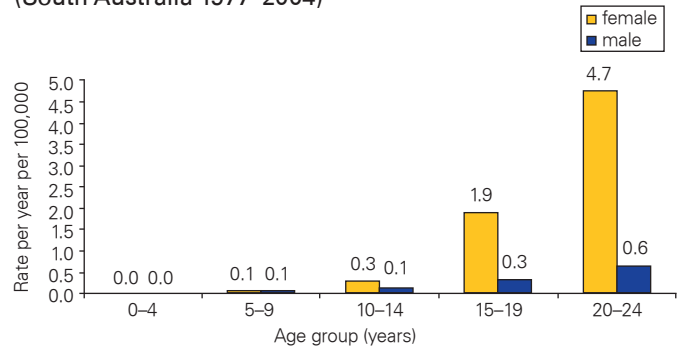


Table 12.4

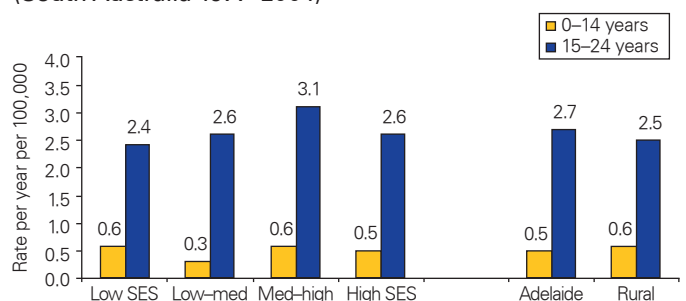
Male to female incidence rate ratios for thyroid cancer, by age group (South Australia 1977–2004)

age groups	Incidence	
	rate ratio - male : female	95% CI RR
0–4yrs	-	-
5–9yrs	0.95	0.01–74.4
10–14yrs	0.47	0.04–3.3
15–19yrs	0.17	0.05–0.45
20–24yrs	0.14	0.06–0.26
M-H* 0–24yrs	0.17	0.10–0.27

* M-H = Mantel-Haenszel estimate for overall rate ratio.

Figure 12.13

Age standardised incidence rate: thyroid cancer by place of residence and SES (South Australia 1977–2004)



Trends over time

There has been a significant increase in incidence of thyroid cancer in South Australia. (Figure 12.14) The annual increment in incidence is of the order of 3% per year. (Table 12.5) This is the largest increase in incidence of any specific cancer among young people seen in South Australia over the past three decades.

Figure 12.14

Trends in incidence rates among 0–24 year olds: thyroid cancer (South Australia 1977–2004)

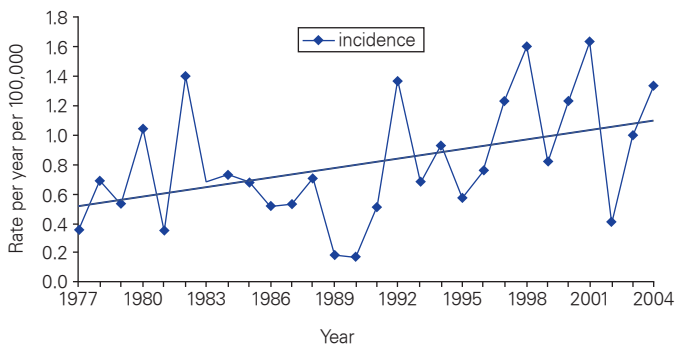


Table 12.5

Rate ratios showing annual change in the incidence of thyroid cancer, by age group (South Australia 1977–2004)

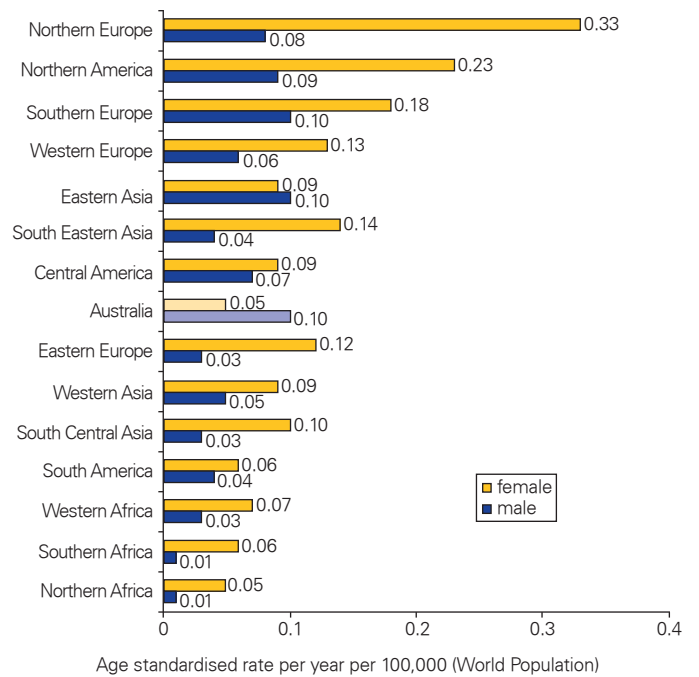
age groups	Incidence	
	rate change per annum	95% CI
0–14yrs	0.968	0.887–1.058
15–24yrs	1.031	1.007–1.055

Global comparison

Rates of thyroid cancer in children in Australia are relatively low compared with other regions with a similar level of economic development such as Northern America and Europe. (Figure 12.15) Highest rates are recorded in Northern Europe and Northern America while regions of Africa have the lowest rates. Rates in Australia are comparable to those in many regions in Asia. These patterns may reflect differences in diagnostic experience and differences in susceptibility by race, or both.

Figure 12.15

Comparison of thyroid cancer incidence rates by county/region among 0–14 year olds (Globocan estimates for 2000)



Carcinomas (epithelial neoplasms)

Collectively, carcinomas (cancers arising in epithelial cells) constitute a large proportion of the cancers experienced by young people (especially by those aged 15–24yrs).

Between 1977 and 2004, there were 876 cases of epithelial carcinomas diagnosed among South Australians under 25 years of age. Ninety two percent of these cancers occurred in adolescents and young adults (15–24yrs).

During this period there were 58 deaths from carcinomas among young South Australians.

Young people experienced a range of different types of carcinoma, although melanoma and thyroid cancers were by far the most common (accounting for 57% and 14% of all carcinomas in this age group respectively).

a) Melanoma

Melanoma is the most common cancer occurring in adolescents and young adults in South Australia.

Australia and New Zealand have the highest rates of melanoma among children in the world.

There were 505 cases of melanoma diagnosed among South Australians aged under 25 years between 1977 and 2004, 94% among 15–24 year olds. Twenty young people died during the same period.

Melanoma is rare among children but the incidence rises sharply from around the age of 15 years.

In the age range 20–24 years, the incidence of melanoma was higher among females than males. Incidence rates were higher for young people in areas of higher social advantage and in metropolitan regions (though differences by region were not statistically significant).

Trends over time show an increase in the incidence of melanoma in young people in South Australia over the past 28 years, of the order of 2% per year. Melanoma death rates have not changed.

Survival outcomes for young people with melanoma are good (overall five-year survival of 95%).

No differences in survival were evident in relation to age, gender, SES or place of residence, although there has been an improvement in survival outcomes over time (five-year survival of 92% for cases diagnosed in 1977–1990, compared with 98% for 1991–2004).

b) Thyroid cancer

Between 1977 and 2004, there were 122 cases of thyroid cancer among South Australians aged under 25 years and no deaths from thyroid cancer.

The incidence of thyroid cancer increases with age and is much higher in females than in males.

The incidence of thyroid cancer has increased significantly in South Australia over the past 28 years, at a rate of 3% per year, the largest increase of any cancer affecting young people.

Appendix 1

Resources

Resources

Camp Quality South Australia

08 8239 0844

www.campquality.org.au

2/250 Melbourne Street,
North Adelaide SA 5006

Recreational activities for children with cancer and their parents and siblings.

CanTeen (SA Division)

08 8161 7488

www.canteen.org.au

Level 1, Norwich Centre,
77 King William Road,
North Adelaide 5006

Health information, peer support, recreation activities for people 12–24 years with cancer.

Child and Youth Health Parent Helpline

1300 364 100

www.cyh.com

295 South Terrace
Adelaide SA 5000

Child and Youth Health Youth Helpline

1300 131 719

www.cyh.com

295 South Terrace
Adelaide SA 5000

Childhood Cancer Association Incorporated

08 8239 1444

www.childhoodcancer.asn.au

Level1/55 King William Road
North Adelaide SA 5006

Information on childhood cancer. Volunteers provide some practical assistance and emotional support.

Compassionate Friends

08 8351 0344

PO Box 26

Kent Town SA 5071

Support and information for any parent, grandparent or sibling who has experienced the death of a child.

Kid's Counselling

1800 55 1800

Kids Helpline

07 3369 1588

Leukaemia Foundation

08 8357 3555 or 1800 620 420

130 Rose Terrace
Wayville SA 5034

The Leukaemia Foundation is dedicated to the care and cure of patients and families living with leukaemias, lymphomas, myeloma and related blood disorders.

Make a Wish Foundation of Australia

1800 032 260

www.makeawish.org.au

383 Swan Street
Richmond Vic 3121

Support for children and families that grants wishes to children under the age of 18 years with a life threatening illness.

Star Bear Association

08 8301 4200

184 Port Road

Hindmarsh SA 5007

Grief support for children who have experienced loss and grief as well as their parents and siblings.

Starlight Children's Foundation Australia

www.starlight.org.au

Delivers programs that restore the fun, laughter and joy that serious illness takes away.

Appendix 2

Bibliography

Bibliography

- American Cancer Society website. All about cancer in children home page. <http://www.cancer.org/docroot/cricri_2x.asp>
- Australian Institute of Health and Welfare and Australasian Association of Cancer Registries (AACR) 2007. *Cancer in Australia: An overview 2006*. AIHW Cat. No. CAN 37. Canberra.
- Australian Institute of Health and Welfare 2005. *A Picture of Australia's Children*. AIHW Cat. No. PHE 58. Canberra.
- Australian Institute of Health and Welfare 2007. *Young Australians: Their health and wellbeing*. AIHW Cat. No. PHE 87. Canberra.
- Becroft D, Dockerty J, Barrie B, Chan Y, Lewis M, Skeen J, Synek B and Treague L 1999. Childhood Cancer in New Zealand 1990–1993. *Pathology* (1999) Vol 31: 83–89.
- Bleyer A, O'Leary M, Barr R and Ries L 2006. *Cancer Epidemiology in older adolescents and young adults 15 to 29 years of age including SEER incidence and survival 1975–2000*. National Cancer Institute, NIH Pub. No. 06–5767. Bethesda MD.
- Cancer Research UK website. Children's cancer questions. <<http://www.cancerhelp.org.uk/help/default.asp?page=6155>>
- Giles G, Waters K, Thursfield V and Farrugia H. 1995. Childhood cancer in Victoria, Australia 1970–1989. *Int. J Cancer*. Vol. 63: 794–797.
- Mitchell A, Scarcella D, Rigutto G, Thursfield V, Giles G, Seton M and Ashley D. 2004. Cancer in Adolescents and young adults: treatment and outcome in Victoria. *Medical Journal Australia*. Vol.180 (2): 56–62.
- National Cancer Institute cancer.gov website. Childhood cancers home page. <<http://www.cancer.gov/cancertopics/types/childhoodcancers>>
- Parkin D, Kramarova E, Draper G, Masuyer E, Michaelis J, Neglia J, Qureshi S and Stiller C 1998. *International incidence of childhood cancer Vol II* International Agency for Research on Cancer, IARC Scientific Pub. No 144. Lyon, France.
- Pediatric Oncology Resource Center website. <<http://www.acor.org/ped-onc/>>
- Ries L, Smith M, Gurney J, Linet M, Tamra T, Young J and Bunin G (eds). 1999. *Cancer incidence and survival among children and adolescents: United States SEER Program 1975–1995*, National Cancer Institute, SEER Program. NIH Pub. No. 99–4649. Bethesda, MD.
- South Australian Cancer Registry 2007. *Cancer in South Australia 2004 with incidence projections to 2007*. Adelaide: South Australian Department of Health.
- Stiller C 1994. Population based survival rates for childhood cancer in Britain, 1980–1991. *British Medical Journal*: Vol. 309: 1612–1616.
- Whirter W and Petroeschevesky A 1991. Incidence trends in childhood cancer in Queensland 1973–1988. *Medical Journal of Australia*. Vol 154: 453–455.
- Whirter W, Dobson C and Ring I. 1996. Childhood cancer in Australia, 1982–1991. *Int. J. Cancer*. Vol. 65: 34–38.
- Williams G 2006. *Cancer among New Zealand Adolescents and young people 1988–2002: An occasional paper*. Wellington: Ministry of Health.

Appendix 3

Glossary

Glossary

adolescent

A young person in the developmental stage between puberty and maturity.

astrocytomas

A type of brain cancer that begins in the brain or spinal cord in small star shaped cells called astrocytes.

acquired immunodeficiency syndrome (AIDS)

An epidemic disease caused by infection with human immunodeficiency virus, a retrovirus that causes immune system failure and debilitation and is often accompanied by infections such as tuberculosis.

acute lymphoid leukaemia (ALL)

A rapidly progressing type of leukaemia (blood cancer) in which too many immature lymphocytes (a type of white blood cell) are found in the blood and bone marrow. It is the most common cancer in children but can also affect adults.

acute myeloid leukaemia (AML)

A rapidly progressing type of leukaemia (blood cancer) in which too many immature white blood cells (not lymphocytes) are found in the blood and bone marrow. It is more common in adults than in children.

age standardised

A statistical adjustment to make the age distributions of different populations statistically equivalent. This enables comparisons of cancer rates between populations with different age distributions. The results show the differences in cancer rates that would have applied, had the age distributions of the populations been the same.

Burkitt lymphoma

A type of non-Hodgkin lymphoma involving B-cells of the immune system that occurs most often in children and young adults.

blastoma

A cancer thought to arise in embryonic tissue. The term blastoma is commonly used as part of the name for a tumour, for example hepatoblastoma (a liver tumour), neuroblastoma (Wilm's tumour of the kidney) and neuroblastoma (a childhood tumour of immature nerve cells).

carcinoma

A term used for cancer that starts in epithelial tissue (i.e., in tissue that forms the base of the skin and the lining of the body's inner surfaces, bowel, reproductive organs, etc.).

central nervous system

Refers to the brain, and spinal cord. It does not include peripheral nerves to the muscles and other organs.

cerebrospinal fluid

A clear, colourless fluid that flows in and around the spaces of the brain and the central canal of the spinal cord.

cervix

Part of the female genital track sometimes referred to as the "neck of the womb," the cervix is the lower narrow end of the uterus that forms the canal between the uterus and the vagina.

chemotherapy

Cancer treatment by chemical agents or drugs that kill cells which are rapidly dividing (i.e. cancer cells).

chondrosarcoma

A type of cancer that forms in cartilage tissue.

chromosomes

The self-replicating genetic structures of cells containing the cellular DNA that code for the body's proteins and enzymes.

chronic myeloid leukaemia (CML)

A slowly-progressing type of leukaemia (blood cancer) in which too many white blood cells (not lymphocytes) are made in the bone marrow.

cryotherapy

Any method of treatment that uses cold temperature to treat disease.

cryptorchidism

A condition in which one or both testicles fail to move from the abdomen, where they develop before birth, into the scrotum. Cryptorchidism may increase the risk for development of testicular cancer. Also called undescended testicles.

electromagnetic fields

Fields representing the joint interplay of electric and magnetic forces.

epithelial

Refers to cells that line the internal or external surfaces of the body or cover an organ.

ependymomas

A type of brain cancer that begins in cells lining the spinal cord central canal or the ventricles (spaces) in the brain.

Epstein-Barr virus (EBV)

A common type of herpes virus occurring world-wide and infecting most people at some time in their lives. Mostly, these infections produce no symptoms, but they cause glandular fever and have been implicated as a cause of nasopharyngeal cancer and some types of lymphoma.

Ewing sarcoma

A type of cancer that forms in the bone or soft tissue. They arise most commonly in the first three decades of life and are highly malignant (prone to spread).

familial cancer

Cancer that occurs in families more often than would be expected by chance. These cancers often occur at an early age, and may indicate the presence of a gene mutation that increases the risk of cancer. They may also be a sign of shared environmental or lifestyle factors.

five year cancer survival

The % of patients surviving their cancers at five years from diagnosis.

genetic

Inherited; being passed from parents to offspring through genes in the sperm or egg.

genitourinary track

Referring to the genital and urinary organs.

germ cell

A reproductive cell of the body. Germ cells in females are called eggs or ova and in males are called sperm cells.

gonads

A part of the body that produces germ cells. Ovaries in females produce and release ova (eggs), while testes in males produce sperm cells.

glioma

A cancer of the brain that begins in the glial cells that surround and support the nerve cells.

helicobacter pylori

Bacteria that cause inflammation and ulcers of the stomach, and potentially gastric cancer.

Hodgkin lymphoma

Cancers of the immune system that are characterised by the presence of a particular type of cell called the Reed-Sternberg cell.

hepatic

Refers to the liver.

hereditary

Transferred via genes from parent to child.

Human Immunodeficiency Virus (HIV)

The virus responsible for Acquired Immune Deficiency Syndrome (AIDS). The virus kills or damages disease-fighting cells (T-cell lymphocytes), thereby harming the body's immune response.

immunosuppression

Suppression of the body's immune system and its ability to fight infections, as may be caused by radiation, certain drug therapies or diseases such as AIDS.

incidence rate (cancer)

The rate at which cancers arise in the population. It may be expressed as the number of new cases diagnosed annually per 100,000 people.

intracranial

Within the brain or skull.

intraspinial

Within the spine (backbone) or spinal cord.

in utero

A term meaning within the uterus (womb).

ionising radiation

X-rays and rays emitted by radioactive materials. They may occur naturally as cosmic rays and radiation from air, food and water; and from soil and rocks.

Kaposi sarcoma

A type of cancer that is characterised by abnormal growth of blood vessels that develop into skin lesions or occur internally. This type of cancer is common among people with AIDS.

leukaemia

Cancers that starts in blood forming tissue such as the bone marrow and cause large numbers of blood cells to be produced and enter the blood stream.

lymphoma

Cancers that begin in cells of the immune system. There are two major categories of lymphoma. One kind is Hodgkin lymphoma which is characterised by the presence of a particular type of cell called the Reed-Sternberg cell. The other is non-Hodgkin lymphoma which is a large diverse groups of cancers of the immune system. Both types can occur in children and young people as well as adults.

malignant bone tumour

Cancer that begin in cells within the bone, that has the ability to invade locally or spread to a distant part of the body. Sometimes referred to as bone sarcoma or bone cancer. Tumours classified as bone cancers in the international classification of childhood cancers include oesiosarcoma (cancer of immature bone cells), chondrosarcoma (cancer of the cartilage) and Ewing's sarcoma

melanoma

A form of skin cancer that begins in melanocytes (the cells that make the pigment melanin).

metastases

The process of spread of a cancer to distant organs through the blood and/or lymphatic system.

mortality rate (cancer)

The rate at which deaths from cancer occur in the population. It may be expressed as the number of deaths occurring annually per 100,000 people.

neuroblastoma

Cancer that starts in immature nerve cells and affects mostly infants and children.

neuroectodermal tumour

Cancer that arises in the neuroectoderm, the portion of the early embryo that gives rise to the central and peripheral nervous systems, including some glial cells.

non-Hodgkin lymphoma (NHL)

Any one of a large group of cancers of the immune system, excluding Hodgkin lymphomas (which are distinguished by the presence of a particular cell type). There are different types of non-Hodgkin lymphoma, some aggressive and some slow growing, which are classified by their different cell types.

osteosarcoma

A cancer of the bone that usually affects the large bones of the arm or leg. It mostly affects young people

ovaries

Two oval-shaped organs located on either side of the uterus. Their primary roles are the production of eggs (ova) and sex hormones (oestrogen and progesterone).

placenta

An organ that nourishes the foetus during development in the uterus.

pituitary gland

A small oval shaped endocrine gland situated at the base of the brain that produces hormones that control many body functions, including growth.

prenatal

Prior to birth

primitive neuroectodermal tumour (PNET)

Refers to a group of tumours that arise in the neuroectoderm, part of the embryo that gives rise to the brain and peripheral nerve system.

prognosis

A forecast as to the probable outcome of a disease, the prospect of recovery from a disease as indicated by the nature and symptoms of the case.

radiotherapy

Treatment by radiation (eg, by X-rays or gamma rays) to kill cancer cells or shrink tumours.

rate ratio

A method of comparing incidence or mortality rates between two or more populations. Rate ratios are calculated as the relative proportion of the rate in one group compared the rate in a reference group (which is assigned a value of one). For example, the male to female rate ratio of developing cancer before age 25 years is 1.06 to 1.00).

renal

Referring to the kidney.

retinoblastoma

A cancer that forms in the retina (the light sensitive nerve tissue at the back of the eye), usually occurring in infants and young children. It can be hereditary (passed from parent to child) or non-hereditary (sporadic).

rhabdomyosarcoma

A cancer that forms in a type of muscle tissue called striated muscle.

sarcoma

A term used for cancer that starts in the supportive tissues such as bone, cartilage, fat, muscle or other connective tissue.

socio-economic status

Pertaining to social or economic status.

soft tissue sarcoma

Cancer (sarcoma) that begins in the muscle, fat, fibrous tissue, blood vessels, or other supporting tissue of the body. Does not include bone cancers.

sympathetic nervous system

The system of nerve cells outside the brain and spinal cord that control bodily organs such as the heart, lungs and liver.

syndrome

A set of signs or a series of events occurring together that often point to a single disease or condition.

testicular

Refers to the testes, male reproductive organs that produce sperm.

thyroid

A butterfly-shaped endocrine gland in the neck that is found on both sides of the trachea (windpipe). It produces hormones which controls metabolism and growth.

trophoblast

Epithelial cells that are involved in assisting the egg to attach to the uterus wall.

tumour

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive, also called a neoplasm. Tumours may be benign (not cancerous) or malignant (cancerous).

Wilms tumour

Wilms tumour (sometimes called nephroblastoma) is a cancerous tumour of the kidney which usually occurs in children under 5 years of age.

