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Child Cancer Survival in New Zealand 2000 - 2009:

The First Outcome Analysis of the New Zealand Children's Cancer Registry

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&
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On behalf of the National Child Cancer Network

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Foreword

New Zealand has a unique multicultural and ethnic mix of people of Maori, Pacific, Asian, and European origins. The diverse make up of our community creates unique health needs, so it is essential we research and report on our own population if we are to understand the health and illness of New Zealanders.

The need to record and report the pattern of cancer seen in New Zealand children was first recognised over 40 years ago when, in 1969, Dr David Becroft, (Paediatric Pathologist), began recording new cases of cancer presenting to the Princess Mary Hospital for Children in Auckland. By the 1980s, members of the Paediatric Oncology Co-ordinating Committee of the Paediatric Society were registering all cases referred to the each of their five children's cancer tertiary centres. This was due, in no small part, to the dogged determination of Dr Margaret Lewis (Paediatrician, Wellington Hospital) who was passionate about establishing a nationwide children's cancer registry. In the early 1990s, Dr John Dockerty (Epidemiologist, Dunedin) and colleagues reported on the incidence and survival of childhood cancer in a cohort of children with cancer diagnosed in the four years between 1990 and 1993. However, these early efforts to collect nationwide data and to define the nature and outcome of childhood cancer in New Zealand were limited in that they were not able to report a complete national picture of childhood cancer that could be compared to other developed countries, nor could the data inform the future development of child cancer services.

When the Ministry of Health established the National Paediatric Oncology Steering Group (POSG) in 1999, one of the goals set for the POSG was to establish a specific national children's cancer registry to provide contemporary data on the diagnosis and long-term outcome of all New Zealand children. Development work on the New Zealand Children's Cancer Registry began in 2002 and the national registry went online with the launch of the Late Effects Assessment Programme in 2006. We now have accrued complete data on the diagnosis and outcome of all children diagnosed with cancer in New Zealand since the 1st of January 2000.

This report on the survival of childhood cancer in New Zealand is one of a series of reports on the incidence and survival of cancer in children (0-14 years), and the incidence and survival of cancer in adolescents and young adults (AYA, 15-24 years). It represents the culmination of over ten years work by multiple individuals who established the New Zealand Children's Cancer Registry and who contributed cancer registrations.

Here, we report on the survival of New Zealand children diagnosed with cancer between 2000 and 2009, with particular regard to the cancer diagnosis as classified by the International Classification of Childhood Cancer (version 3), and the age group, sex, and ethnicity of those diagnosed. This represents the most detailed and accurate analysis yet done on child cancer survival in New Zealand.

We wish to acknowledge and thank all those involved and the financial support from the National Child Cancer Network.

Dr Michael Sullivan & Kirsten Ballantine

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Executive Summary

The purpose of this report is to provide a comprehensive analysis of the survival of childhood cancer in New Zealand for the period of the 1st of January 2000 to the 31st of December 2009. A second companion report contains incidence data for the same time period. Cancer cases were primarily sourced from the New Zealand Children's Cancer Registry. In addition, cross-matching of all registrations held by the NZCCR and the New Zealand Cancer Registry for the study period was undertaken and patient National Health Index numbers were provided to the National Mortality Collection to verify that all deaths had been recorded.

Five-year relative survival for New Zealand children diagnosed with cancer between 2000 and 2009 was 80.7%, with one-year, three-year, and ten-year survival recorded at 89.9%, 83.1% and 78.5% respectively. New Zealand's five-year survival for this period is comparable to the child cancer survival probabilities published by other registries for a similar time period (Great Britain, 78%; Australia, 79.5%; Europe, 81%; the United States, 81.1%; and Germany, 84%).

Overall, five-year child cancer survival has improved from 28% in the 1960s to 66% in the early 1990s, to over 80% today. New Zealand children diagnosed with leukaemia between 2000 and 2009 had a five-year survival probability of 85%, compared to an expected survival of just 6% in the 1960s and 65% for the 1990 to 1993 period.

By diagnostic group, the highest relative survival probabilities were recorded for retinoblastoma (100.3%, i.e. survival was actually slightly better than for the general child population), germ cell tumours (96.8%), renal tumours (96.7%), and lymphomas (92.9%). Neuroblastoma (66.1%) and malignant bone tumours (66.8%) had poorer survival, with approximately one in three children diagnosed not surviving five years. By diagnostic subgroup, acute lymphoblastic leukaemia survival (ALL, 89.4%) was significantly higher than the survival probability for acute myeloid leukaemia (AML, 69.2%) in the same period.

There were few significant differences in overall five-year relative survival by sex and age group. Survival for males was 82.6%, and females, 78.7%. Survival for children aged 0-4 years was 82.8% compared with 79.9% for 5-9 year olds and 78.4% for those aged 10-14 years. The only statistically significant difference in survival by age group was for the neuroblastoma diagnostic group; five-year relative survival for 0-4 year olds diagnosed with neuroblastoma, when incidence peaked, was significantly higher than for those diagnosed in later years.

By diagnostic group, central nervous system tumours (32%) and leukaemias (28%) were associated with the most deaths within the cohort of children diagnosed between 2000 and 2009. Bone and soft tissue tumours accounted for 35% of deaths among those diagnosed at 10-14 years of age.

There were no significant differences in survival by ethnicity; overall five-year relative survival was 76.9% for Maori, 81.4% for Pacific Peoples, and 81.7% for non-Maori/non-Pacific Peoples. ALL is the most common type of childhood leukaemia. As modern treatment of ALL is complex, prolonged, and requires open access to health care, we can therefore use ALL as an indicator disease. The five-year relative survival for ALL across the three prioritised ethnic groups was almost identical: 89.8% for Maori, 88.0% for Pacific Peoples, and 89.4% for non-Maori/non-Pacific Peoples. These survival figures indicate that New Zealand is achieving equitable outcomes for children diagnosed with cancer, regardless of ethnicity.

1 Introduction

1.1 Childhood cancer in New Zealand

Although child cancers account for less than one percent of all cancers diagnosed each year,[1] cancer is nevertheless a significant health issue for New Zealand. Cancer remains the second most common cause of death, after traffic accidents, for 1-14 year olds[2] and around one in five hundred children will be diagnosed with cancer before the age of 15 years.[3] The majority of childhood cancers require intensive treatments conducted over an extended period, placing considerable stress on the child and their whanau. Many child cancer survivors will experience long-term adverse health effects as a result of their cancer and treatments.

Childhood cancer is developmental in origin, arising in growing and developing tissues and caused by the corruption of developmentally regulated genes. Hence, the natural patterns and types of cancer seen in children are very different to cancers seen in adults, which are strongly influenced by age, lifestyle and environmental risk factors. The relative rarity of childhood cancers, their unique biology and response to therapy, combined with the special needs of the child and their family mandates specialised care in dedicated child cancer treatment centres.

New Zealand has two comprehensive childhood cancer centres; the Starship Blood and Cancer Centre in Auckland and the Children's Haematology/Oncology Centre (CHOC) based in Christchurch Hospital. These two centres work closely with dedicated regional shared care services to ensure children can receive as much of their treatment as close to home as possible.

1.2 NZCCR background and purpose

Although diagnostic pathology laboratories are mandated by law to report all cancer diagnoses to the New Zealand Cancer Registry (NZCR),[4] the data collected for each patient is necessarily limited. The New Zealand Children's Cancer Registry was established in 2002 at the request of the Ministry of Health (MOH) to provide more detailed information about childhood cancer incidence, treatment, and outcomes in New Zealand. In addition to the data fields routinely collected by the NZCR, the NZCCR collects detailed clinical information regarding the stage of the disease, the treatments given, and treatment-related late effects for all children receiving treatment in a paediatric oncology setting. The NZCCR also classifies all cancers according to the International Classification of Childhood Cancers (ICCC-3)[5], which allows New Zealand child cancer survival to be directly compared with international benchmarks. The registry is under the governance of the National Child Cancer Network (NCCN). It holds verified demographic and treatment information for all children diagnosed with cancer in New Zealand since the 1st of January 2000.

The NZCCR serves multiple functions. At an individual patient level, the information collected and held by the registry is later accessed by the Late Effects Clinical Nurse Specialist to produce the patient's end of treatment summary and surveillance plan. At a national level, the registry provides anonymised datasets used for service delivery planning, research, and statistical reporting purposes. The NZCCR has approval from the Southern Health and Disability Ethics Committee for the ongoing collection and analysis of registry data. Ongoing analysis of the NZCCR is central to evaluating the health outcomes for New Zealand children with cancer; identifying the spectrum of cancers diagnosed, tracking improvements in survival over time, and assessing whether any disparities exist in treatment outcomes.

1.3 NZCCR data management

All data is initially entered onto the NZCCR by a Clinical Research Associate at each paediatric oncology specialist centre. The data is verified and electronically sent to the NZCCR national database. Access to the NZCCR is controlled by personal login and password and staff can only access patient data entered by their own centre to ensure privacy and confidentiality. Parents are informed of the NZCCR via a parent information sheet and have the opportunity to opt out of the registry at any time. The NZCCR Working Group, reporting directly to the NCCN, is charged with the ongoing administration of the registry. The NZCCR Working Group has representatives from both paediatric oncology treatment centres including the NZCCR Analyst, Clinical Research Associates, and Consultant Haematologists/Oncologists.

1.4 NZCCR registration criteria

In order to ensure that the NZCCR provides an accurate workload model for service delivery planning, all patients who receive cancer treatment in a paediatric oncology centre are registered on the NZCCR.

However, not all NZCCR registrations are included in New Zealand child cancer incidence and outcome statistics. For example, 15-18 year olds diagnosed with cancer in New Zealand may receive their care in a paediatric oncology setting when this is judged to be in the best interests of the adolescent and their family, but these adolescents are not included in New Zealand child cancer statistics. Also, non-New Zealand residents, or children who were diagnosed with cancer and treated overseas before emigrating or returning to New Zealand are also excluded. Finally, children requiring paediatric oncology involvement for some diseases not currently included in the ICCC-3, such as langerhans cell histiocytosis (LCH), are excluded from any overall analysis.

The criteria for inclusion in any NZCCR incidence and outcome statistics are as follows;

- *The child was aged less than 15 years old at diagnosis*
- *The child was diagnosed and received treatment in New Zealand*
- *The child had New Zealand residency at the time of diagnosis*
- *The child's diagnosis is included in the ICCC-3*

1.5 The International Classification of Childhood Cancers (ICCC-3)

The first internationally accepted childhood cancer classification system was developed by Jillian Birch and Henry Marsden in 1987[6] and was used for generating international comparisons for the International Incidence of Childhood Cancer, Volume 1, published by the International Association for Research on Cancer (IARC).[7] While adult cancers are classified according to the location in the body where the cancer originates, the International Classification of Childhood Cancers recognises that for childhood cancers it is the tissue of origin which best predicts the tumour behaviour and dictates the required treatment. The ICCC, currently in its third edition (ICCC-3)[5] is the standard for the presentation of international data on childhood cancer incidence and survival, accepted by the World Health Organisation (WHO), IACR and the United States Surveillance Epidemiology and End Results (SEER). The NZCCR classifies all registrations according to the ICCC-3.

The ICCC-3[5] contains 12 diagnostic groups (see Table 1.5), which are further divided into 47 diagnostic subgroups. Appendix AII provides full details of the ICCC-3 based on the International Statistical Classification of Diseases for Oncology, 3rd Edition (ICD-O-3) site and histology[8].

According to the ICCC-3[5], a cancer diagnosis must be that of a primary **malignant** neoplasm in order to be registered. However, there is one important exception: **all** intracranial and intraspinal neoplasms (including benign tumours or those of uncertain behaviour) are included. This is due to non-malignant intracranial and intraspinal neoplasms having similar prognoses, clinical symptoms, and late effects to malignant neoplasms.[5] The inclusion of non-malignant intracranial/intraspinal neoplasm mostly concerns 'diagnostic group III: central nervous system and miscellaneous intracranial and intraspinal neoplasms', but very occasionally a child may be diagnosed with a benign intracranial/intraspinal germ cell tumour (diagnostic group Xa) which also meets ICCC-3 criteria for cancer registration.

Table 1.5 International Classification of Childhood Cancer (ICCC-3)[5] diagnostic groups

Group	Title (the abbreviated title used throughout this report is highlighted in bold)
I.	**Leukaemias,** myeloproliferative diseases, and myelodysplastic diseases
II.	**Lymphomas** and reticuloendothelial neoplasms
III.	Central nervous system (**CNS**) **tumours** and miscellaneous intracranial and intraspinal neoplasms
IV.	**Neuroblastoma** and other peripheral nervous cell tumours
V.	**Retinoblastoma**
VI.	**Renal tumours**
VII.	**Hepatic tumours**
VIII.	**Malignant bone tumours**
IX.	**Soft tissue sarcomas** and other extraosseous sarcomas
X.	**Germ cell tumours,** trophoblastic tumours, and neoplasms of gonads
XI.	**Other malignant epithelial** neoplasms and malignant melanomas
XII.	**Other and unspecified** malignant neoplasms

1.6 The purpose and structure of this report

The purpose of this report is to provide a comprehensive analysis of the survival of childhood cancer in New Zealand for the period of the 1st of January 2000 to the 31st of December 2009. A second companion report contains incidence data for the same time period. Although this is the first time in which the NZCCR has been analysed, it is envisaged that the on-going input of new cancer diagnoses onto the NZCCR will allow for the continued reporting of the spectrum of childhood cancers and the tracking of overall child cancer incidence and survival over time.

Chapter Two provides a description of the methodology used in this analysis. It details the data selection and verification process and the way in which child cancer survival has been calculated and reported.

Chapter Three contains survival data for children aged less than 15 years first diagnosed with cancer between the 1st of January 2000 and the 31st of December 2009, with follow-up to the 31st of December 2010. Cancer survival is reported by ICCC-3 diagnostic group and subgroup according to sex, age at diagnosis, and prioritised ethnicity. It is expressed in terms of relative survival, which accounts for the underlying survival of the general child population within the same time period. Following the international standard, the survival reported is predominantly five-year survival.

Chapter Four provides an overview of the survival probabilities pertaining to each ICCC-3 diagnostic group and each diagnostic subgroup, where sample size allows. Due to the small number of cases that were assigned to 'diagnostic group XII: other and unspecified malignant neoplasms', no specific analyses were undertaken for this group.

2 Methodology

2.1 Data selection, validation, and conversion

This study was given expedited approval by the Multi-region Ethics Committee (ethics ref: MEC/11/EXP/052) in June 2011.

Prior to any data analysis of the NZCCR, a rigorous data validation process took place. As part of this process, all anomalies were investigated and any remaining data gaps were filled. The information contained on the registry was also cross-matched against the National Mortality Collection to ensure that all deaths had been recorded. Finally, cross-matching of all registrations held by the NZCCR and the NZCR for the study period was undertaken.

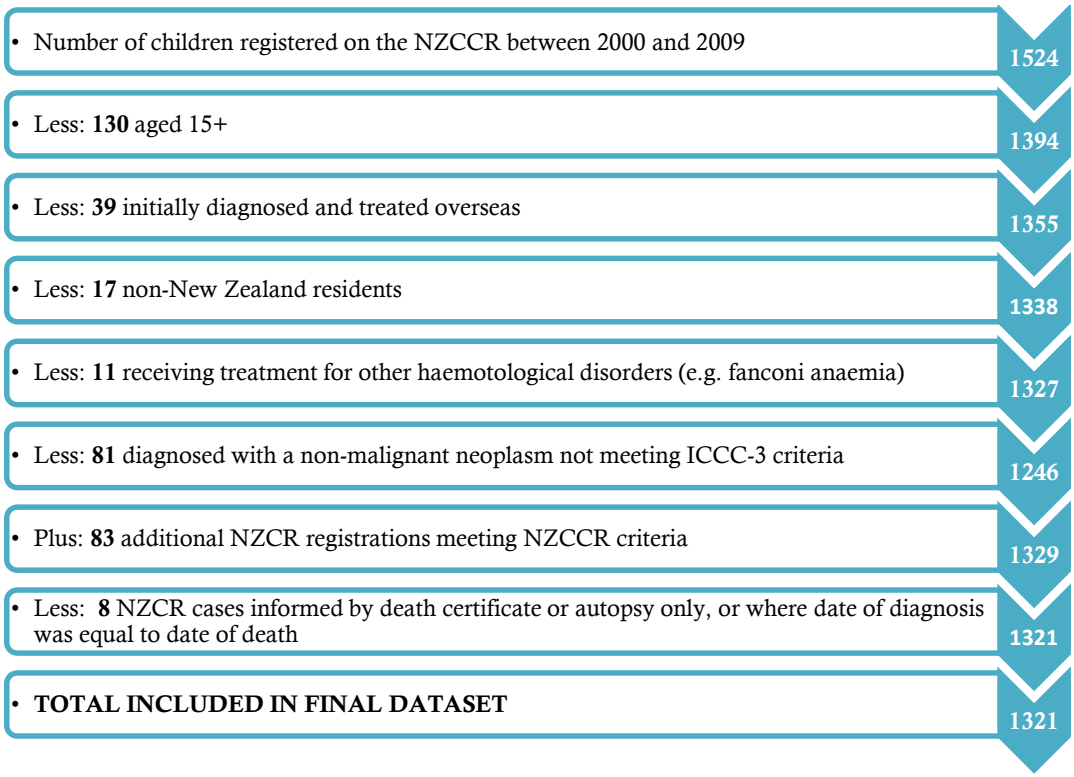
Most differences identified in the NZCR and NZCCR data matching exercise were explained by the different registration criteria used. An important area covered by the ICCC is the benign/low grade CNS tumours. There is international agreement that these classes of tumour should be registered in children as they require significant intervention and are associated with significant morbidity and some deaths.[5] Non-malignant central nervous system tumours are registered on the NZCCR however, many international cancer registries, including the NZCR, register malignant CNS tumours only (i.e. those tumours with a behaviour code of '3: primary malignant neoplasm'). This resulted in an additional 85 non-malignant CNS tumours included on the NZCCR but not the NZCR, including 47 children diagnosed with juvenile pilocytic astrocytoma[a].

The data matching exercise also identified a small number of anomalies in demographic and diagnostic information between the two registries which required further investigation. Errors identified as part of this audit process were either corrected on the NZCCR or provided to the NZCR for correction.

Finally, data matching with the NZCR led to the identification of 83 child cancer cases which were unknown to the NZCCR but which met NZCCR registration criteria. Although the referral of all child cancer cases to paediatric oncology services is mandatory, some children in this time period were treated exclusively by other specialties. For example, in the early 2000s some children diagnosed with retinoblastoma were treated by the ophthalmology service only. Also, some melanomas were treated by surgical resection only without the involvement of paediatric oncology services. Eight of the cases originally omitted by the NZCCR were informed by autopsy or death certificate only, and in an additional six cases the child died within a few days of diagnosis. Such cases would not have come to the attention of the paediatric oncology centres, and therefore were not registered on the NZCCR. Following standard cancer research methodology, the eight cases informed by death certificate or autopsy only have been excluded from the survival analysis (note that these cases were included in incidence calculations). However, all remaining 75 valid cases informed by the NZCR have been included in the final dataset to ensure the accurate reporting of childhood cancer survival in New Zealand for the time period. Figure 2.1 provides a summary of the dataset selection process.

[a] Juvenile pilocytic astrocytoma cases were included in the NZCR up until the end of 2002 but were no longer registered when the neoplasm was reclassified from 'malignant' to 'of uncertain and unknown behaviour' in the third version of the ICD-O, which was adopted by the NZCR on the 1st January 2003.

Figure 2.1 Selection of the final dataset



2.2 Prioritised ethnicity

According to MOH ethnicity data protocols, individuals may select up to three ethnic groups that they identify with.[a] When a prioritised ethnicity system is used, each respondent is assigned to a single ethnic group using a priority system; Maori, Pacific Peoples, and non-Maori/non-Pacific Peoples (European, Asian, Middle Eastern, Latin American, 'Not Elsewhere Reported' and 'Not Stated/Unknown'). Assigning a single ethnicity simplifies the data as the ethnic group populations sum to the total New Zealand population, but there are limitations with prioritisation; an increasing number of New Zealand children and young people identify with more than one ethnic group and the use of prioritised ethnicity goes against the principle of self-identification. However, prioritised output is often used in the health and disability sector to ensure that Maori and Pacific Peoples, whose health status is lower on average than that of other New Zealanders, are not swamped by the European group.[9]

Cancer registrations which had no ethnicity recorded were assigned to the 'non-Maori/non-Pacific Peoples' prioritised ethnic group. In the cases of 'unknown' ethnicity, the fact that no ethnicity data was collected may suggest that the person was diagnosed with a cancer which had an excellent prognosis, requiring minimal treatment and little, if any, involvement with the public health system. Although there was a very small number of 'unknown' ethnicity overall, the inclusion of the 'unknowns' within the 'non-Maori/non-Pacific Peoples' ethnic group has potentially slightly over-inflated this group's cancer survival.

Table 2.2 shows the New Zealand child population according to the 2006 census by prioritised ethnicity, and also by sex and age group.

[a] Note that ethnicity data is not reported directly to the NZCR, this information is obtained from the National Health Index (NHI), hospital discharge summaries, and the Mortality Collection.

Table 2.2 New Zealand's child population by age group, sex, and prioritised ethnicity, 2006 census data

	0-4 years		5-9 years		10-14 years		Total 0-14 years	
	2006 census population[a]	%	2006 census population[a]	%	2006 census population[a]	%	2006 census population[a]	%
Sex								
Male	140 382	51.0	146 535	51.1	157 113	51.3	**444 030**	51.2
Female	134 697	49.0	139 956	48.9	148 893	48.7	**423 546**	48.8
Prioritised Ethnicity								
Maori	66 423	24.2	66 771	23.3	66 726	21.8	**199 920**	23.0
Pacific Peoples	25 176	9.2	25 365	8.9	24 996	8.2	**75 537**	8.7
Non-Maori/non-Pacific Peoples	183 477	66.7	194 352	67.8	214 290	70.0	**592 119**	68.3
Asian Peoples	*21 279*	*7.7*	*22 935*	*8.0*	*26 268*	*8.6*	***70 482***	*8.1*
Other (MELAA and other ethnicities) [a]	*2 094*	*0.7*	*2 244*	*0.8*	*2 409*	*0.8*	***6 747***	*0.8*
European / NZ European	*148 707*	*54.1*	*158 265*	*55.2*	*174 360*	*57.0*	***481 332***	*55.5*
Not elsewhere included [b]	*11 397*	*4.1*	*10 908*	*3.8*	*11 253*	*3.7*	***33 558***	*3.9*
Total 2006 census population[c]	**275 076**		**286 491**		**306 009**		**867 576**	

[a] MELAA: Middle Eastern, Latin American and African.
[b] Includes 'response unidentifiable', 'response outside scope' and 'not stated'.
[c] Statistics NZ applies random rounding to base 3 to census outputs. As each value in a table is rounded independently, the marginal totals can differ very slightly from the corresponding sum of the rows or columns.

2.3 Survival calculations

A range of measures can be used to report cancer survival. The most commonly used measures of survival when reporting data from population-based cancer registries are observed survival and relative survival. Relative survival ratios are calculated by dividing the observed survival (i.e. the proportion of people who remain alive following their cancer diagnosis) by the expected survival of a group from the general population which is comparable with respect to age, sex, and the time period under investigation. Relative survival does not require information about the actual cause of death and allows comparisons between different areas with different population structures. Two approaches are commonly used for calculating relative survival; the cohort method and the period method. This study uses the period method, which provides more accurate survival predictions for recently diagnosed patients.[10]

The data required for calculating observed survival was provided primarily by the New Zealand Children's Cancer Registry, and also the New Zealand Cancer Registry and the Mortality Collection. The final date of follow-up was the 31st of December 2010, and those who were still alive at that date were censored. To avoid bias, patients whose cancer diagnosis was based on death certificate only, autopsy only, or who had a survival time of zero days were excluded. Expected survival data was calculated according to the Ederer II method using life-tables for the total New Zealand resident population. These tables are produced by Statistics New Zealand and based on 2006 census data. The observed survival and expected survival data were used to calculate estimated cancer survival ratios using the Stata® MP12.1 statistical software package.

Although relative survival should technically be expressed as a ratio, we have chosen to convert the ratios to a percentage. This report is intended for a wide audience and we consider that using percentages makes the report easier for the general reader to follow. Also, within this report we are making comparisons with survival data published by other cancer registries, all of which have expressed relative survival as a percentage. Note that it is possible for relative survival to be greater than 100%. That is, those children diagnosed with a particular cancer may have survival which is actually better than the survival for the general child population. For example, five-year

relative survival for children diagnosed with retinoblastoma was 100.3%, as there was not a single death recorded among this group of patients within the study period. While we have produced tables showing cumulative relative survival for up to 10 years, following standard cancer survival methodology we focus primarily on five-year relative survival.

2.4 Confidence intervals and statistical significance

A confidence interval (CI) is used to report the level of accuracy of statistical estimates. The reported 95% confidence intervals can be interpreted as indicating that there is a 95% probability that the true cancer survival lies somewhere within the reported lower and upper values. If two statistics have non-overlapping 95% confidence intervals, they are necessarily significantly different at the $p<0.05$ level. Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

In general, the more cases involved in calculating the estimate, the smaller the confidence interval. For some cancer diagnostic groups and subgroups there were very few cases recorded for children in New Zealand within the ten year period; this is reflected in the wide 95% confidence intervals which are reported alongside. Therefore, **any between-group differences in the incidence or survival reported, or any differences in comparison to other published data, should be interpreted extremely cautiously.**

2.5 Survival comparisons

In Section 3.5 child cancer survival for the 2000-2009 period is compared with earlier published New Zealand data.[11,12] In Section 3.6 our childhood cancer survival is compared with survival data reported from Australia,[13] Europe,[14] Great Britain,[15] Germany,[16] and the United States.[17] These developed countries were selected as they had published childhood cancer survival probabilities by ICCC-3 for 0-14 year olds for a comparable time period. Such comparisons are vital as they describe the progress made in our child cancer survival over time, and allow us to place New Zealand's survival in the context of what is being achieved internationally. However, the data must be interpreted cautiously as the survival probabilities reported may be influenced by differences in timing, population composition, registry data quality, and completeness.[18]

There are also some differences in the way that the registries have treated CNS tumours. For example, survival probabilities published by the United States,[17] Europe,[14] and earlier New Zealand studies included only malignant central nervous system tumours while others included tumours of benign or uncertain behaviour which generally have a more favourable prognosis.

Finally, studies with a range of different survival calculation methods have been included in these comparisons. Although it would be ideal if all studies had calculated survival using the same methodology, it should be noted that mortality in the general child population in industrialised nations is low, so child cancer survival does not typically show much variability according to whether observed survival, cause-specific survival (where non-cancer related deaths are censored), or relative survival has been used.[10] Table 2.5 provides a summary of the inclusion criteria and survival methodology used by each of the registries.

Table 2.5 Summary of national and international child cancer survival data used

Registry	Country / Region	Time period	Total cases	Survival calculation method	Inclusion criteria
New Zealand Children's Cancer Registry	NZ	2000-2009	1 321	Relative survival - period method	As per ICCC-3
New Zealand Cancer Registry	NZ[11]	1961-1970	1 002	Observed survival - cohort method	Non-malignant CNS tumours are excluded
New Zealand Cancer Registry & Children's Cancer Registry	NZ[12]	1990-1993	409	Cause-specific survival - cohort method	Non-malignant CNS tumours are excluded
Australian Paediatric Cancer Registry	Australia[13]	1995-2004	6 177	Relative survival - cohort method	As per ICCC-3
European Cancer Registry (EUROCARE-4)[a]	Europe[14]	2000-2002	11 000[b]	Observed survival - period method	Non-malignant CNS tumours are excluded
Childhood Cancer Research Group	Great Britain[15]	2000-2005	7 768	Observed survival - cohort method	As per ICCC-3
German Childhood Cancer Registry	Germany[16]	1999-2009	18 053	Observed survival - period method	As per ICCC-3
Surveillance Epidemiology End Results (SEER)[c]	United States[17]	2002-2008	22 000[d]	Relative survival - cohort method	Myelodysplastic syndromes and non-malignant CNS tumours are excluded

[a] The cases were contributed by 83 population-based cancer registries in 23 countries participating in EUROCARE-4. The countries included were Denmark, Finland, Iceland, Norway, Sweden, the Czech Republic, Poland, Austria, Belgium, France, Germany, the Netherlands, Switzerland, Italy, Malta, Portugal, Slovenia, Spain, England, Ireland, Northern Ireland, Scotland, and Wales.

[b] The number of childhood cancers diagnosed between 2000 and 2002 was not specifically reported within the study methodology. However, we have estimated that there were approximately 11 000 cases, based on the reported figure of 24 277 children and AYA combined.

[c] SEER includes 18 population-based registries covering 28% of the total US population; San Francisco, Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah, Atlanta, San Jose-Monterey, Los Angeles, Alaska Native Registry, Rural Georgia, California excluding San Francisco/San Jose-Monterey/Los Angeles, Kentucky, Louisiana, New Jersey, and Georgia excluding Atlanta/Rural Georgia.

[d] The number of childhood cancers diagnosed between 2002 and 2008 was not specifically reported within the study methodology. However, we estimate that there were approximately 22,000 cases, based on the 13 695 child cancer cases reported to SEER between 2005 and 2009.

2.6 Deaths within the cohort

In this report we present charts showing the proportionate number of deaths which were recorded within this study population, by ICCC-3[5] diagnostic group. Note that the numbers of deaths reported for this cohort are not the same as the child cancer mortality for 2000-2009, as the figures do not include children who died within this period but who had been diagnosed prior to the year 2000. However, the raw numbers and percentages do provide an *indication* of the diagnostic groups which are the leading cause of death among New Zealand children diagnosed with cancer. As cause of death was retrieved from the NZCCR and the Mortality Collection, it can be confirmed that in all but two cases cancer was the primary/contributing cause of death. Within this particular analysis, the two individuals who died of unrelated causes were not included within the total deaths for their respective diagnostic groups.

3 Childhood Cancer Survival

The following section reports the relative survival for those New Zealand children (0-14 years) diagnosed with cancer between the 1st of January 2000 and the 31st of December 2009, with follow-up to the 31st of December 2010. Relative survival is calculated by dividing the observed survival (i.e. the proportion of people who remain alive following their cancer diagnosis) by the expected survival of a group from the general population which is comparable with respect to age, sex, and the time period under investigation (see Section 2.3 for further details).

For some diagnostic groups and subgroups there were very few cases recorded. In such cases, the true survival cannot be reliably estimated and this is reflected in the wide 95% confidence intervals which are reported alongside. Therefore, any between-group differences in survival should be interpreted cautiously. It should also be noted that confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

3.1 Overall childhood cancer survival

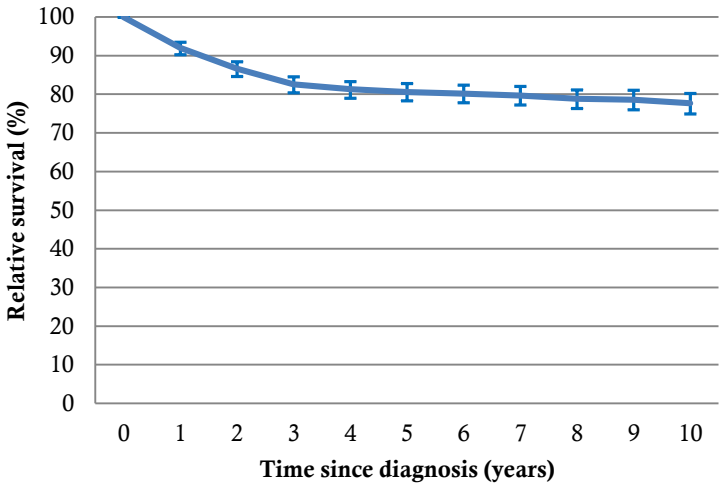
3.1.1 Childhood cancer relative survival by time since diagnosis

There were 1321 new childhood cancer registrations in the ten years between 2000 and 2009[a]. Overall cancer relative survival for children was 89.9% at one year, 83.1% at three years, and 80.7% at five years (see Table 3.1.1 and Figure 3.1.1). There continued to be a slight decline in relative survival (-2.2%) between five years and ten years of follow-up.

Table 3.1.1 Childhood cancer relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	1321	89.9	(88.1 - 91.4)
2	1186	85.7	(83.7 - 87.5)
3	1024	83.1	(80.9 - 85.0)
4	872	81.9	(79.6 - 83.9)
5	758	80.7	(78.4 - 82.9)
6	640	80.1	(77.7 - 82.3)
7	538	79.6	(77.1 - 81.9)
8	432	79.2	(76.7 - 81.5)
9	312	78.9	(76.3 - 81.3)
10	221	78.5	(75.7 - 81.0)

Figure 3.1.1 Childhood cancer relative survival by time since diagnosis, New Zealand, 2000-2009



[a] Note that this figure excludes eight cases which were notified by death certificate/autopsy only which were included in the cancer incidence calculations.

3.1.2 Survival by ICCC diagnostic group

Table 3.1.2 shows that one-year relative survival ranged from 69.4% for hepatic tumours to 100.2% for retinoblastoma (i.e. survival for this diagnostic group was slightly higher than for the general child population). The greatest decline in survival between one and three years was seen for soft tissue sarcomas (-14.8%), malignant bone tumours (-13.7%), and neuroblastoma (-12.4%). There was little decline in survival between three years and five years for any particular diagnostic group.

Table 3.1.2 One-year, three-year and five-year cumulative relative survival by ICCC diagnostic group, New Zealand, 2000-2009

ICCC-3 diagnostic group		Total cases	One-year cumulative relative survival (95% CI)		Three-year cumulative relative survival (95% CI)		Five-year cumulative relative survival (95% CI)	
	All childhood cancers	**1321**	**89.9**	**(88.1 - 91.4)**	**83.1**	**(80.9 - 85.0)**	**80.7**	**(78.4 - 82.9)**
I.	Leukaemias	455	93.7	(91.0 - 95.6)	87.6	(84.0 - 90.4)	85.0	(81.1 - 88.2)
II.	Lymphomas	114	95.6	(89.8 - 98.2)	92.9	(86.2 - 96.4)	92.9	(86.2 - 96.5)
III.	CNS tumours	283	81.0	(75.9 - 85.1)	74.3	(68.7 - 79.0)	70.8	(64.9 - 75.9)
IV.	Neuroblastoma	87	81.8	(71.9 - 88.5)	69.4	(58.2 - 78.1)	66.1	(54.6 - 75.5)
V.	Retinoblastoma	39	100.2	[a]	100.3	[a]	100.3	[a]
VI.	Renal tumours	61	98.5	(90.0 - 99.9)	96.6	(86.8 - 99.3)	96.7	(86.8 - 99.3)
VII.	Hepatic tumours	13	69.4	(90.0 - 99.9)	69.4	(86.8 - 99.3)	69.4	(37.4 - 87.4)
VIII.	Malignant bone tumours	72	86.1	(75.7 - 92.3)	72.4	(60.1 - 81.5)	66.8	(53.8 - 76.9)
IX.	Soft tissue sarcomas	94	90.5	(82.5 - 95.0)	75.7	(65.4 - 83.4)	73.1	(62.4 - 81.2)
X.	Germ cell tumours	57	96.7	(86.8 - 99.3)	96.7	(86.9 - 99.3)	96.8	(86.9 - 99.4)
XI.	Other malignant epithelial	42	90.5	(76.6 - 96.3)	84.8	(69.0 - 92.9)	84.9	(69.1 - 93.0)
XII.	Other & unspecified	4	75.1	(12.8 - 96.2)	50.1	(5.8 - 84.6)	50.1	(5.8 - 84.7)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

3.1.3 Five-year relative survival by ICCC diagnostic group and subgroup

Table 3.1.3 shows that by diagnostic group, the highest five-year survival probabilities were recorded for retinoblastoma (100.3%, 39 cases), germ cell tumours (96.8%, 57 cases), renal tumours (96.7%, 61 cases), and lymphomas (92.9%, 114 cases). Neuroblastoma (66.1%, 87 cases), and malignant bone tumours (66.8%, 72 cases), had poorer survival, with approximately one in three children diagnosed not surviving five years.

Reporting overall survival by diagnostic group can be misleading, as survival can vary considerably according to diagnostic subgroup. By diagnostic subgroup, ALL survival (89.4%) was significantly higher than the survival probability for AML (69.2%) in the same period. Among the central nervous system diagnostic subgroups, 'IIId: Other gliomas' (42.7%, 45 cases) survival was significantly lower than for 'IIIb: Astrocytomas' (77.7%, 116 cases) and 'IIIe: Other specified intracranial and intraspinal neoplasms' (88.8%, 36 cases).

Table 3.1.3 Five-year relative survival by ICCC diagnostic group and subgroup, New Zealand, 2000-2009

	ICCC-3 diagnostic group/subgroup	Total cases	Five-year relative survival (95% CI)	
	All childhood cancers	**1321**	**80.7**	**(78.4 - 82.9)**
I.	**Leukaemias, myeloproliferative & myelodysplastic diseases**	**455**	**85.0**	**(81.1 - 88.2)**
I(a)	*Lymphoid leukaemias*	352	89.4	(85.3 - 92.4)
I(b)	*Acute myeloid leukaemias*	78	69.2	(56.7 - 78.8)
I(c)	*Chronic myeloproliferative diseases*	4	100.1	[a]
I(d)	*Other myeloproliferative diseases*	11	72.9	(37.2 - 90.5)
I(e)	*Other & unspecified leukaemia*	10	60.1	(25.3 - 82.9)
II.	**Lymphoma & reticuloendothelial neoplasms**	**114**	**92.9**	**(86.2 - 96.5)**
II(a)	*Hodgkin lymphomas*	36	97.4	(82.0 - 99.8)
II(b)	*Non-Hodgkin lymphomas (excl. Burkitt lymphomas)*	58	95.0	(84.9 - 98.4)
II(c)	*Burkitt lymphomas*	18	82.3	(54.5 - 94.0)
II(d)	*Miscellaneous lymphoreticular neoplasms*	1	0.0	[a]
II(e)	*Unspecified lymphomas*	1	100.1	[a]
III.	**Central nervous system & intracranial/intraspinal neoplasms**	**283**	**70.8**	**(64.9 - 75.9)**
III(a)	*Ependymomas & choroid plexus tumours*	24	75.6	(49.8 - 89.4)
III(b)	*Astrocytomas*	116	77.7	(68.7 - 84.4)
III(c)	*Intracranial & intraspinal embryonal tumours*	59	66.1	(51.7 - 77.1)
III(d)	*Other gliomas*	45	42.7	(27.7 - 57.0)
III(e)	*Other specified intracranial & intraspinal neoplasms*	36	88.8	(72.7 - 95.8)
III(f)	*Unspecified intracranial & intraspinal neoplasms*	3	66.9	(5.4 - 94.8)
IV.	**Neuroblastoma & other peripheral nervous cell tumours**	**87**	**66.1**	**(54.6 - 75.5)**
IV(a)	*Neuroblastoma & ganglioneuroblastoma*	85	66.5	(54.7 - 75.9)
IV(b)	*Other peripheral nervous cell tumours*	2	50.1	(0.6 - 91.3)
V.	**Retinoblastoma**	**39**	**100.3**	[a]
VI.	**Renal tumours**	**61**	**96.7**	**(86.8 - 99.3)**
VI(a)	*Nephroblastoma & other non-epithelial renal tumours*	59	96.5	(86.3 - 99.3)
VI(b)	*Renal carcinomas*	2	100.1	[a]
VI(c)	*Unspecified malignant renal tumours*	-	-	-
VII.	**Hepatic tumours**	**13**	**69.4**	**(37.4 - 87.4)**
VII(a)	*Hepatoblastoma*	8	75.3	(31.6 - 93.4)
VII(b)	*Hepatic carcinomas*	5	60.1	(12.6 - 88.4)
VII(c)	*Unspecified malignant hepatic tumours*	-	-	-
VIII.	**Malignant bone tumours**	**72**	**66.8**	**(53.8 - 76.9)**
VIII(a)	*Osteosarcomas*	37	66.8	(48.9 - 79.7)
VIII(b)	*Chondrosarcomas*	1	100.3	[a]
VIII(c)	*Ewing tumours & related bone sarcomas*	28	61.3	(37.6 - 78.3)
VIII(d)	*Other specified malignant bone tumours*	5	80.1	(20.4 - 97.0)
VIII(e)	*Unspecified malignant bone tumours*	1	100.2	[a]

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

Table 3.1.3 (cont.) Five-year relative survival by ICCC diagnostic group and subgroup, New Zealand, 2000-2009

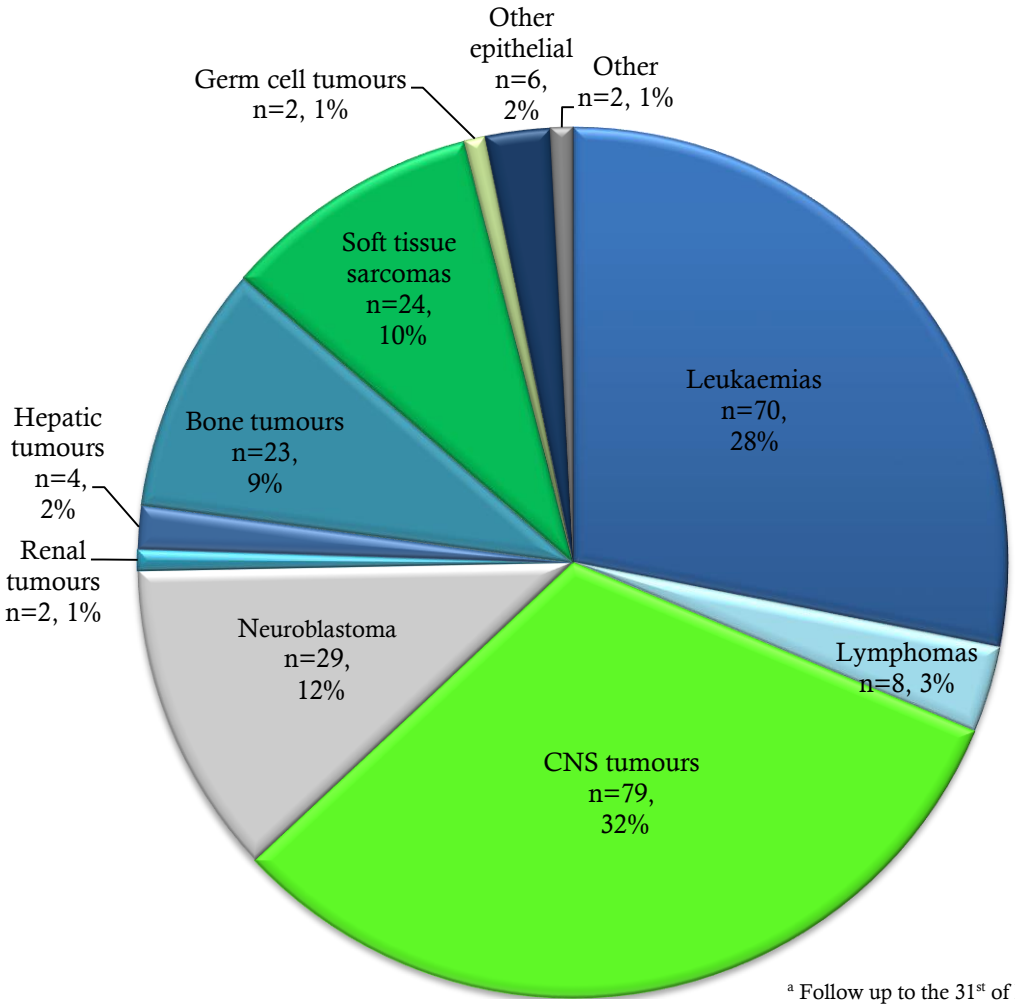
	ICCC-3 diagnostic group/subgroup	Total cases	Five-year relative survival (95% CI)	
IX.	**Soft tissue and other extraosseous sarcomas**	**94**	**73.1**	**(62.4 - 81.2)**
IX(a)	*Rhabdomyosarcomas*	50	70.6	(55.3 - 81.5)
IX(b)	*Fibrosarcomas & other fibrous neoplasms*	7	52.1	(12.3 - 81.8)
IX(c)	*Kaposi sarcomas*	-	-	-
IX(d)	*Other specified soft tissue sarcomas*	27	80.8	(59.6 - 91.6)
IX(e)	*Unspecified soft tissue sarcomas*	10	79.5	(39.6 - 94.6)
X.	**Germ cell tumours, trophoblastic tumours & neoplasms of gonads**	**57**	**96.8**	**(86.9 - 99.4)**
X(a)	*Intracranial & intraspinal germ cell tumours*	18	100.1	[a]
X(b)	*Malignant extracranial & extragonadal germ cell tumours*	16	87.9	(58.9 - 97.1)
X(c)	*Malignant gonadal germ cell tumours*	23	100.3	[a]
X(d)	*Gonadal carcinomas*	-	-	-
X(e)	*Other & unspecified malignant gonadal tumours*	-	-	-
XI.	**Other malignant epithelial neoplasms & malignant melanomas**	**42**	**84.9**	**(69.1 - 93.0)**
XI(a)	*Adrenocortical carcinomas*	2	0.0	[a]
XI(b)	*Thyroid carcinomas*	6	100.1	[a]
XI(c)	*Nasopharyngeal carcinomas*	2	100.2	[a]
XI(d)	*Melanomas*	16	93.9	(63.3 - 99.3)
XI(e)	*Skin carcinomas*	-	-	-
XI(f)	*Other & unspecified carcinomas*	16	80.0	(49.6 - 93.2)
XII.	**Other & unspecified malignant neoplasms**	**4**	**50.1**	**(5.8 - 84.7)**
XII(a)	*Other specified malignant tumours*	3	66.7	(5.4 - 94.6)
XII(b)	*Other unspecified malignant tumours*	1	0.0	[a]

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

3.1.4 Cancer-related deaths in children first diagnosed with cancer between 2000 and 2009

Childhood leukaemias had a five-year survival probability of 85.0% which was higher than overall childhood cancer survival of 80.7%. However, due to the greatest number of childhood cancers being diagnosed in this group, leukaemias nevertheless accounted for 28% of all deaths within the cohort during the study period (70 deaths, see Figure 3.1.4). Central nervous system tumours, with an overall survival probability of 70.8%, accounted for a similar number of child cancer deaths (79 deaths, 32%) as leukaemias, while malignant bone tumours, soft tissue sarcomas, and neuroblastoma each accounted for approximately one in ten deaths within this cohort.

Figure 3.1.4 Cancer-related deaths in New Zealand children first diagnosed with cancer between 2000 and 2009[a]



[a] Follow up to the 31st of December 2010

3.2 Childhood cancer relative survival by age at diagnosis

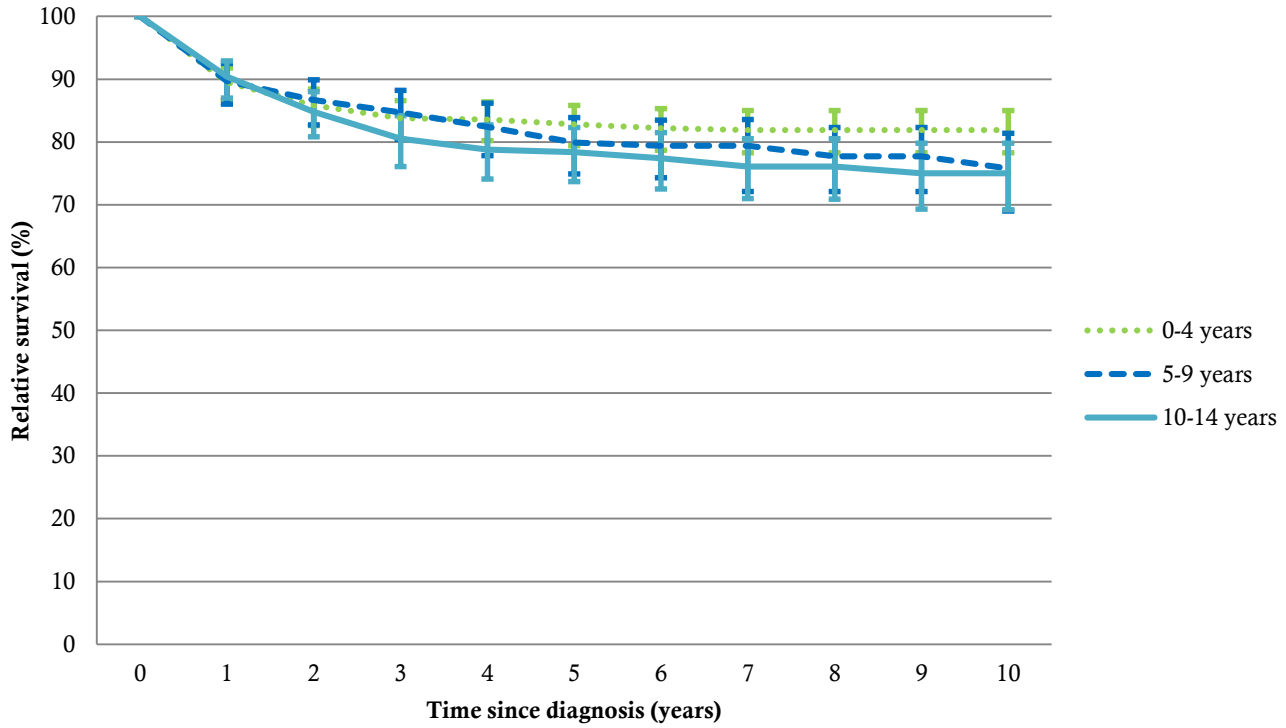
3.2.1 Childhood cancer relative survival, by age group and time since diagnosis

There were no significant differences with respect to relative survival by age group at diagnosis. One-year survival was consistently around 90% and three-year survival ranged between 80.5% for those aged 10-14 years to 84.7% for the 5-9 year age group. But while there was little decline in relative survival for the 0-4 year age group between 3 and 10 years of follow-up (-1.9%), the 5-9 year age group showed a more marked decline (-8.9%), (see Table 3.2.1 and Figure 3.2.1).

Table 3.2.1 Childhood cancer cumulative relative survival by age group and time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	0-4 years			5-9 years			10-14 years		
	n	Cumulative relative survival (95% CI)		n	Cumulative relative survival (95% CI)		n	Cumulative relative survival (95% CI)	
1	576	89.5	(86.7 - 91.8)	350	89.7	(86.0 - 92.5)	395	90.4	(87.0 - 92.9)
2	515	85.8	(82.6 - 88.4)	314	86.7	(82.7 - 89.9)	357	84.8	(80.8 - 88.0)
3	451	83.8	(80.4 - 86.6)	274	84.7	(80.4 - 88.2)	299	80.5	(76.1 - 84.2)
4	399	83.6	(80.2 - 86.4)	235	82.4	(77.8 - 86.2)	238	78.8	(74.1 - 82.7)
5	353	82.8	(79.4 - 85.8)	202	79.9	(74.9 - 83.9)	203	78.4	(73.7 - 82.3)
6	302	82.2	(78.7 - 85.3)	172	79.4	(74.3 - 83.5)	166	77.4	(72.5 - 81.5)
7	261	81.9	(78.3 - 85.0)	143	79.4	(72.1 - 83.6)	134	76.1	(71.0 - 80.5)
8	217	81.9	(78.3 - 85.0)	110	77.7	(72.1 - 82.3)	105	76.2	(71.0 - 80.6)
9	167	81.9	(78.3 - 85.0)	72	77.7	(72.1 - 82.3)	73	75.0	(69.3 - 79.8)
10	118	81.9	(78.3 - 85.0)	54	75.8	(69.0 - 81.4)	49	75.1	(69.3 - 79.9)

Figure 3.2.1 Overall child cancer relative survival by age group and time since diagnosis, New Zealand, 2000-2009



3.2.2 Five-year relative survival by age group and ICCC diagnostic group and selected subgroup

The only statistically significant difference in survival by age group was for the neuroblastoma diagnostic group; five-year relative survival for 0-4 year olds diagnosed with neuroblastoma, when incidence peaked, was significantly higher than for those aged 10-14 years (74.4% c.f. 20.1%). Although not reaching statistical significance, five-year survival for 0-4 year olds was also considerably higher than survival for those diagnosed with neuroblastoma between the ages of 5 and 9 (39.7%), (see Table 3.2.2).

Leukaemia survival was highest for those diagnosed at 0-4 years of age (88.3%). The 5-9 year age group recorded the best survival for the soft tissue sarcomas (85.5%) and malignant bone tumours (77.7%). For the 10-14 year age group, five-year relative survival was highest for lymphomas (98.5%), germ cell tumours (100.2%) and 'other malignant epithelial neoplasms' (90.0%).

Table 3.2.2 Five-year relative survival by age group and ICCC diagnostic group and selected subgroup, New Zealand, 2000-2009

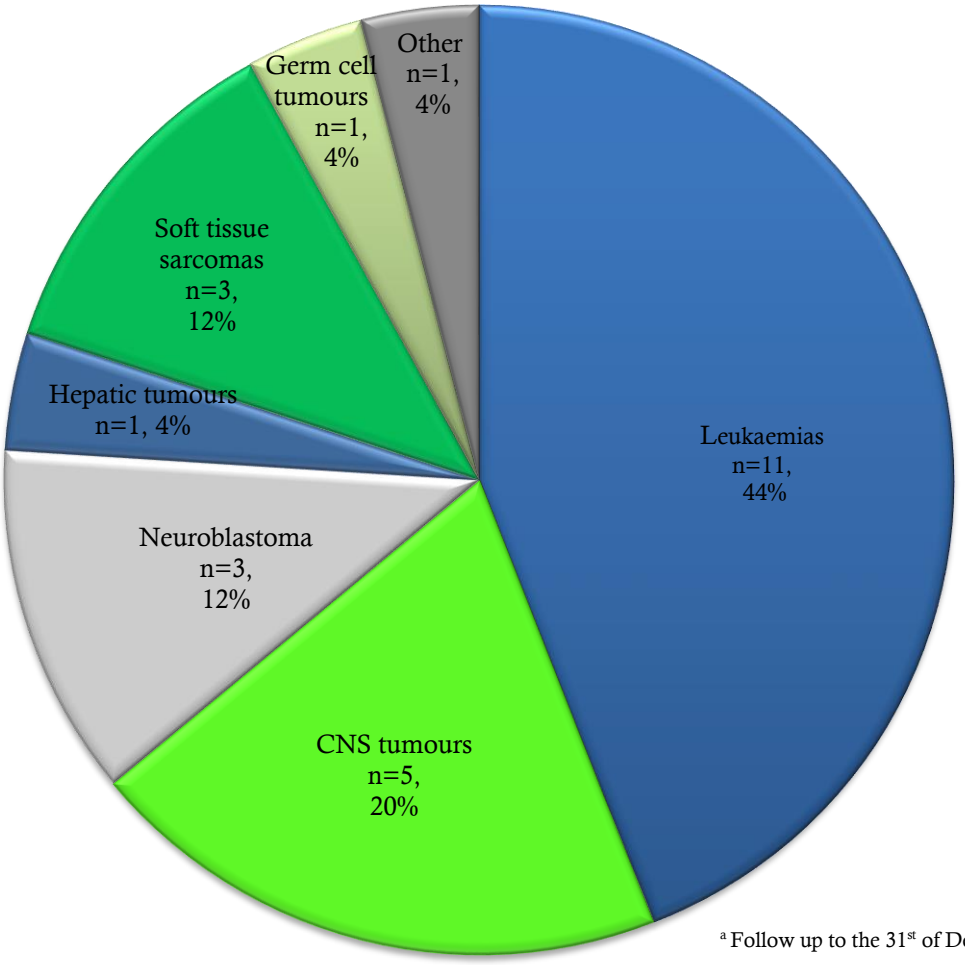
		0-4 years			5-9 years			10-14 years		
		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
	All childhood cancers	**576**	**82.8**	**(79.4 - 85.8)**	**350**	**79.9**	**(74.9 - 83.9)**	**395**	**78.4**	**(73.7 - 82.3)**
I.	Leukaemias	228	88.3	(83.3 - 92.0)	131	83.8	(74.9 - 89.8)	96	77.7	(67.0 - 85.4)
I(a)	*Lymphoid leukaemias*	180	92.5	(87.3 - 95.6)	109	86.7	(76.9 - 92.6)	63	84.2	(71.4 - 91.6)
I(b)	*Acute myeloid leukaemias*	35	74.0	(55.8 - 85.7)	16	64.3	(32.9 - 84.0)	27	65.6	(41.9 - 81.5)
II.	Lymphomas	11	80.1	(40.9 - 94.7)	42	88.1	(73.7 - 94.9)	61	98.5	(89.1 - 100)
II(a)	*Hodgkin lymphomas*	1	100.1	[a]	12	91.7	(53.9 - 98.9)	23	100.2	[a]
II(b)	*Non-Hodgkin lymphomas*	6	100.1	[a]	18	89.0	(62.5 - 97.2)	34	97.2	(81.1 - 99.8)
III.	CNS tumours	98	68.0	(57.2 - 76.6)	97	72.8	(62.2 - 80.9)	88	71.7	(60.7 - 80.2)
III(b)	*Astrocytoma*	38	78.9	(59.9 - 89.6)	42	85.8	(71.0 - 93.4)	36	66.3	(48.3 - 79.4)
IV.	Neuroblastoma	69	74.4	(61.7 - 83.5)	13	39.7	(13.1 - 65.7)	5	20.1	(0.8 - 58.3)
V.	Retinoblastoma	37	100.3	[a]	2	100.1	[a]	-	-	-
VI.	Renal tumours	47	95.6	(82.9 - 99.1)	8	100.1	[a]	6	100.1	[a]
VII.	Hepatic tumours	10	70.3	(33.0 - 89.5)	3	66.7	(5.4 - 94.6)	-	-	-
VIII.	Malignant bone tumours	5	60.1	(12.6 - 88.3)	20	77.7	(49.9 - 91.3)	47	63.0	(46.6 - 75.7)
VIII(a)	*Osteosarcomas*	1	100.1	[a]	11	81.9	(44.8 - 95.2)	25	59.1	(37.2 - 75.6)
VIII(c)	*Ewing tumours*	3	66.7	(5.4 - 94.6)	8	70.0	(22.5 - 91.9)	17	55.3	(24.4 - 78.0)
IX.	Soft tissue sarcomas	38	75.4	(57.8 - 86.5)	22	85.3	(52.3 - 96.2)	34	62.1	(42.7 - 76.7)
IX(a)	*Rhabdomyosarcomas*	24	73.8	(50.5 - 87.4)	15	85.5	(61.0 - 95.2)	11	42.7	(14.0 - 69.3)
X.	Germ cell tumours	25	92.4	(72.0 - 98.4)	6	100.1	[a]	26	100.2	[a]
XI.	Other malignant epithelial	5	80.1	(20.4 - 97.0)	5	57.2	(9.9 - 87.4)	32	90.0	(71.6 - 96.8)
XII.	Other and unspecified	3	33.4	(0.9 - 77.6)	1	[b]	[b]	-	-	-

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.
[b] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

3.2.3 Cancer-related deaths in infancy by ICCC diagnostic group

Figure 3.2.3 shows that during the study period 25 deaths occurred among those who had been diagnosed with cancer in infancy (i.e. aged less than one year at diagnosis). Of these, 11 (44%) were in children diagnosed with 'leukaemias, myeloproliferative diseases and myelodysplastic diseases' (five cases of ALL, three cases of AML and three cases of 'other'). CNS tumours, which accounted for around one in nine cases diagnosed in this age group, accounted for one in five (20%, five cases) of all deaths. Three infants within this cohort diagnosed with neuroblastoma, the most commonly diagnosed cancer in infancy, later died from their disease.

Figure 3.2.3 Cancer-related deaths in New Zealand children aged <1 year, first diagnosed between 2000 and 2009 [a]

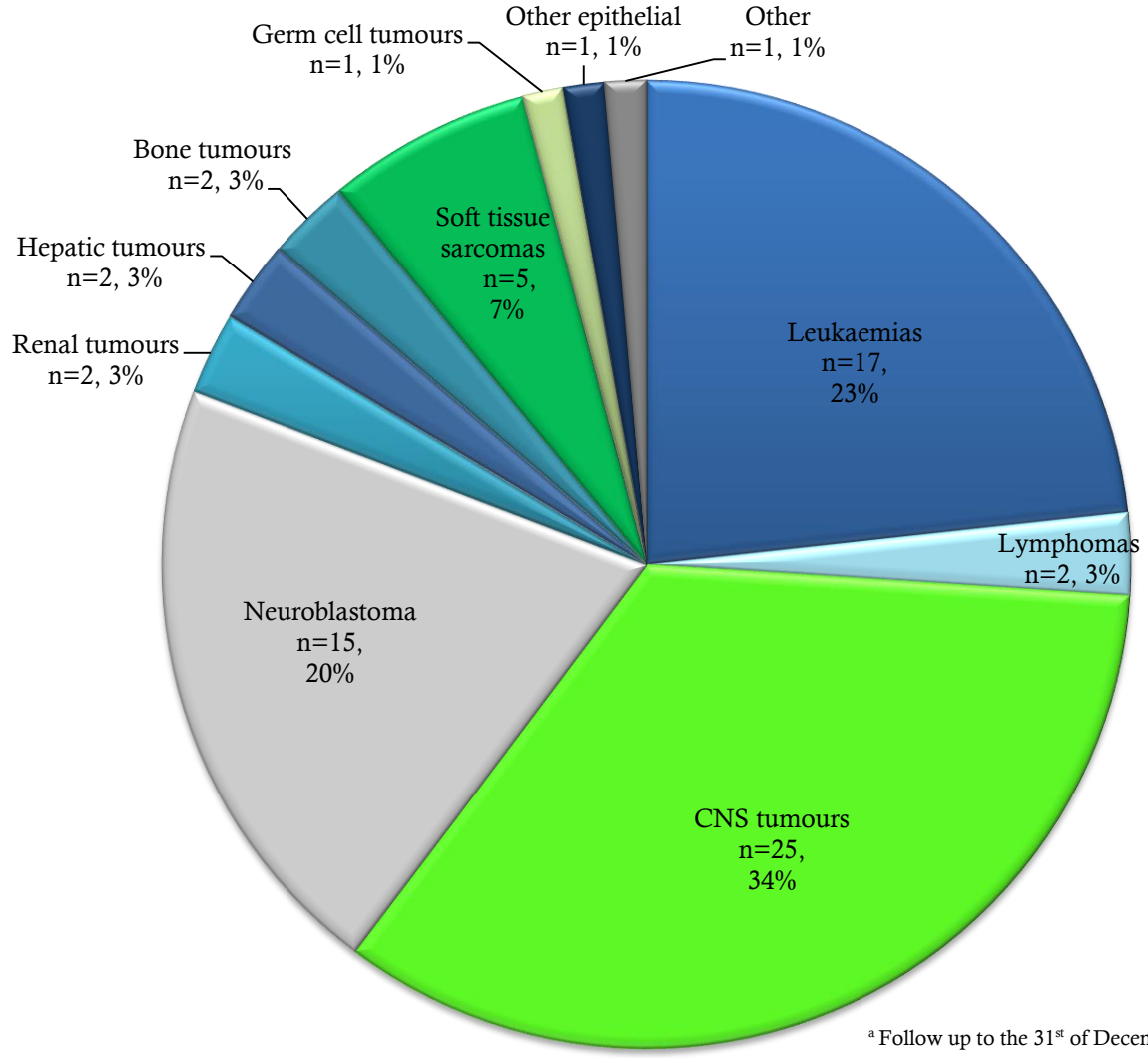


[a] Follow up to the 31st of December 2010

3.2.4 Cancer-related deaths in children aged 1-4 years by ICCC diagnostic group

In contrast to the infant group, neuroblastoma accounted for a sizeable proportion of deaths within the 1-4 year cohort during the study period (15 deaths, 20%). Figure 3.2.4 shows that the greatest number of deaths in children aged 1-4 years at diagnosis were for the diagnostic groups of central nervous system tumours (25 cases, 34%) and leukaemias (17 cases, 23%).

Figure 3.2.4 Cancer-related deaths in New Zealand children aged 1-4 years, first diagnosed between 2000 and 2009 [a]

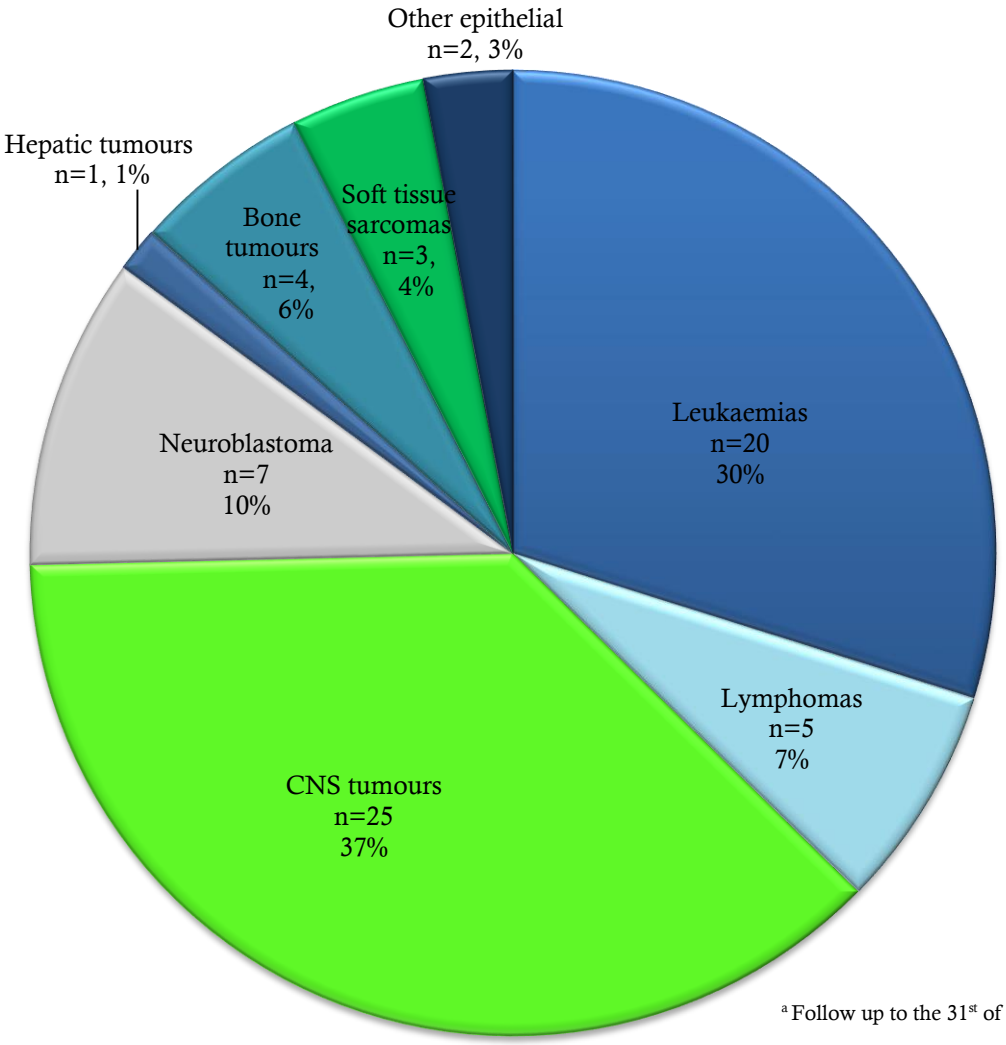


[a] Follow up to the 31st of December 2010

3.2.5 Cancer-related deaths in children aged 5-9 years by ICCC diagnostic group

The leading causes of death within the cohort of 5-9 year olds diagnosed between 2000 and 2009 were central nervous system tumours (25 deaths, 37%) and leukaemias (20 deaths, 30%), (see Figure 3.2.5). Of the leukaemias, 14 were ALL, five were AML and one was 'other'.

Figure 3.2.5 Cancer-related deaths in New Zealand children aged 5-9 years, first diagnosed between 2000 and 2009[a]

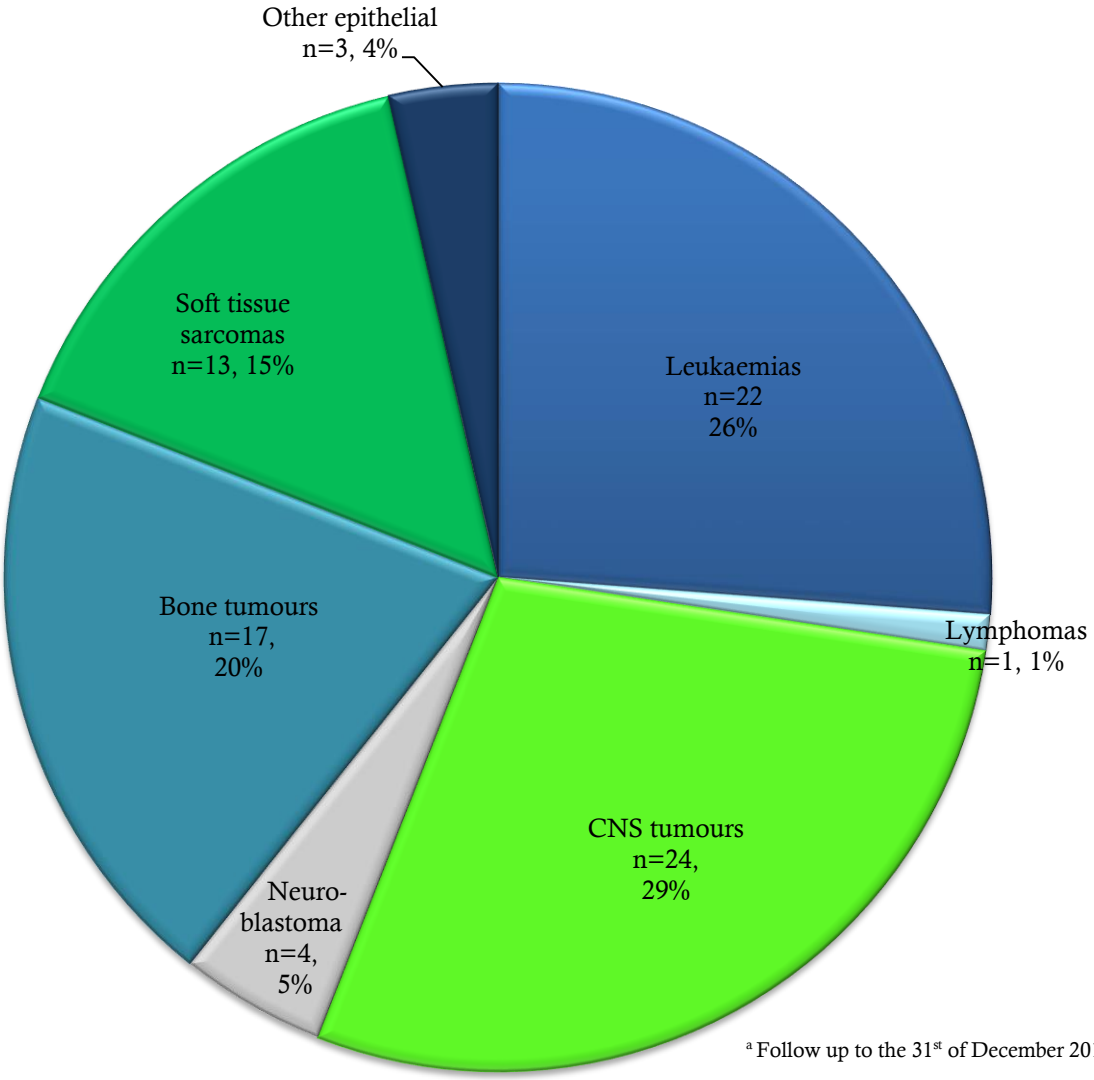


[a] Follow up to the 31st of December 2010

3.2.6 Cancer-related deaths in children aged 10-14 years by ICCC diagnostic group

Within the cohort of 10-14 year olds diagnosed with cancer between 2000 and 2009, 29% of all deaths were associated with CNS tumours (24 deaths), while malignant bone tumours (17 deaths) and soft tissue sarcomas (13 deaths) combined accounted for 35% of all deaths within this age group (see Figure 3.2.6). 22 young adolescents diagnosed with leukaemia died of their disease within the follow-up period; this group included 12 young adolescents were diagnosed with ALL and eight who were diagnosed with AML.

Figure 3.2.6 Cancer-related deaths in New Zealand children aged 10-14 years, first diagnosed between 2000 and 2009[a]



[a] Follow up to the 31st of December 2010

3.3 Childhood cancer relative survival by sex

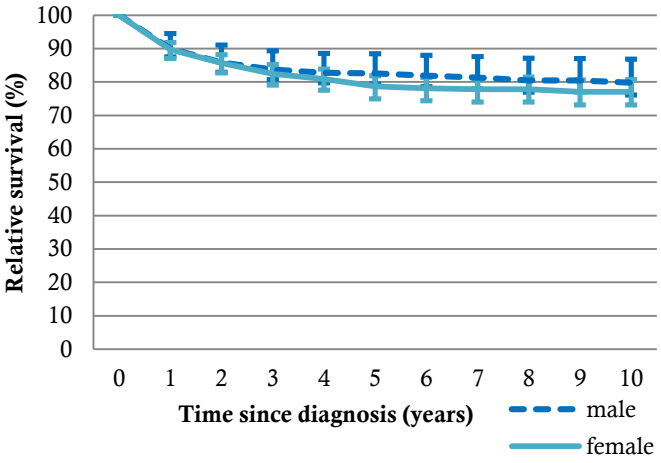
3.3.1 Childhood cancer cumulative relative survival by sex and time since diagnosis

There were no statistically significant differences in cancer survival according to gender (see Table 3.3.1 and Figure 3.3.1). The maximum difference in relative survival was recorded at five years following diagnosis, when males had a survival of 82.6%, 3.9% higher than the 78.7% recorded for females.

Table 3.3.1 Childhood cancer cumulative relative survival by sex and time since diagnosis, New Zealand, 2000-2009

Time since diag-nosis (years)	Male			Female		
	n	Cumulative relative survival (95% CI)		n	Cumulative relative survival (95% CI)	
1	696	90.0	(87.5 - 92.0)	625	89.7	(87.0 - 91.8)
2	626	85.8	(82.9 - 88.2)	560	85.7	(82.7 - 88.2)
3	528	83.7	(80.7 - 86.3)	496	82.4	(79.1 - 85.2)
4	459	82.8	(79.7 - 85.5)	413	80.9	(77.5 - 83.9)
5	406	82.6	(79.4 - 85.3)	352	78.7	(75.0 - 81.9)
6	345	81.9	(78.6 - 84.7)	295	78.1	(74.4 - 81.4)
7	294	81.3	(77.9 - 84.2)	244	77.8	(74.0 - 81.1)
8	246	80.5	(77.0 - 83.6)	186	77.8	(74.0 - 81.5)
9	182	80.5	(77.1 - 83.6)	130	77.1	(73.1 - 80.6)
10	129	79.8	(76.0 - 83.1)	92	77.1	(73.1 - 80.7)

Figure 3.3.1 Childhood cancer cumulative relative survival by sex and time since diagnosis, New Zealand, 2000-2009



3.3.2 Five-year relative survival by sex and ICCC diagnostic group and subgroup

Table 3.3.2 shows that the five-year survival probability for males diagnosed with ALL was 7.4% higher than for females (92.9% c.f. 85.2%), and although this did not reach statistical significance it is an unexpected finding given that childhood ALL survival is generally reported as being better for females than males.[13,17,19] Another noteworthy difference, although again not statistically significant, was the poorer survival for females diagnosed with bone tumours (54.0% c.f. 77.9% for males), particularly for those diagnosed with Ewing tumours (39.0% c.f. 78.1%).

Table 3.3.2 Five-year survival by sex and ICCC diagnostic group and subgroup, New Zealand, 2000-2009

	ICCC-3 diagnostic group/subgroup	Male			Female		
		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
	All childhood cancers	**696**	**82.6**	**(79.4 - 85.3)**	**625**	**78.7**	**(75.0 - 81.9)**
I.	**Leukaemias, myeloproliferative & myelodysplastic diseases**	**239**	**88.5**	**(83.5 - 92.1)**	**216**	**81.1**	**(74.6 - 86.1)**
I(a)	*Lymphoid leukaemias*	193	92.9	(88.0 - 95.9)	159	85.2	(77.8 - 90.3)
I(b)	*Acute myeloid leukaemias*	34	70.5	(50.4 - 83.7)	44	68.2	(51.1 - 80.5)
I(c)	*Chronic myeloproliferative diseases*	2	100.1	[a]	2	100.1	[a]
I(d)	*Other myeloproliferative diseases*	5	60.1	(12.6 - 88.4)	6	83.6	(27.4 - 97.8)
I(e)	*Other & unspecified leukaemias*	5	60.1	(12.6 - 88.4)	5	60.1	(12.6 - 88.3)

Table 3.3.2(cont.) Five-year survival by sex and ICCC diagnostic group and subgroup, New Zealand, 2000-2009

	ICCC-3 diagnostic group/subgroup	Male			Female		
		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
II.	**Lymphoma & reticuloendothelial neoplasms**	**72**	**94.5**	**(85.7 - 98.0)**	**42**	**90.4**	**(76.2 - 96.3)**
II(a)	*Hodgkin lymphomas*	17	100.2	[a]	19	94.9	(68.2 - 99.4)
II(b)	*Non-Hodgkin lymphomas (excl. Burkitt lymphomas)*	42	95.4	(82.4 - 98.9)	16	93.8	(63.3 - 99.2)
II(c)	*Burkitt lymphomas*	12	82.1	(44.9 - 95.3)	6	83.4	(27.3 - 97.5)
II(d)	*Miscellaneous lymphoreticular neoplasms*	-	-	-	1	0.0	[a]
II(e)	*Unspecified lymphomas*	1	100.1	[a]	-	-	-
III.	**Central nervous system & intracranial/intraspinal neoplasms**	**148**	**72.7**	**(66.5 - 79.4)**	**135**	**68.7**	**(59.7 - 76.1)**
III(a)	*Ependymomas & choroid plexus tumours*	15	71.7	(33.5 - 90.4)	9	77.9	(36.5 - 94.1)
III(b)	*Astrocytomas*	47	85.0	(71.1 - 92.6)	69	72.6	(59.7 - 81.9)
III(c)	*Intracranial & intraspinal embryonal tumours*	44	64.9	(48.5 - 77.3)	15	67.8	(32.4 - 87.5)
III(d)	*Other gliomas*	21	51.7	(28.7 - 70.6)	24	37.5	(19.0 - 56.1)
III(e)	*Other specified intracranial & intraspinal neoplasms*	18	83.3	(56.5 - 94.4)	18	94.6	(66.7 - 99.3)
III(f)	*Unspecified intracranial & intraspinal neoplasms*	3	66.9	(5.4 - 94.9)	-	-	-
IV.	**Neuroblastoma & other peripheral nervous cell tumours**	**44**	**59.6**	**(43.0 - 72.9)**	**43**	**72.9**	**(56.0 - 84.2)**
IV(a)	*Neuroblastoma & ganglioneuroblastoma*	42	60.0	(42.9 - 73.6)	43	72.9	(56.0 - 84.2)
IV(b)	*Other peripheral nervous cell tumours*	2	50.1	(0.6 - 91.3)	-	-	-
V.	**Retinoblastoma**	**19**	**100.3**	[a]	**20**	**100.3**	[a]
VI.	**Renal tumours**	**27**	**96.1**	**(74.1 - 99.7)**	**34**	**97.2**	**(81.0 - 99.7)**
VI(a)	*Nephroblastoma & other non-epithelial renal tumours*	26	95.9	(73.1 - 99.6)	33	97.1	(80.5 - 99.7)
VI(b)	*Renal carcinomas*	1	100.1	[a]	1	100.1	[a]
VII.	**Hepatic tumours**	**8**	**62.7**	**(23.0 - 86.4)**	**5**	**80.1**	**(20.4 - 97.1)**
VII(a)	*Hepatoblastoma*	5	60.2	(12.6 - 88.5)	3	100.3	[a]
VII(b)	*Hepatic carcinomas*	3	66.9	(5.4 - 94.8)	2	[b]	[b]
VIII.	**Malignant bone tumours**	**37**	**77.9**	**(60.5 - 88.4)**	**35**	**54.0**	**(34.2 - 70.2)**
VIII(a)	*Osteosarcomas*	20	79.5	(54.0 - 91.9)	17	52.2	(26.7 - 72.7)
VIII(b)	*Chondrosarcomas*	1	100.3	[a]	-	-	-
VIII(c)	*Ewing tumours & related bone sarcomas*	14	78.1	(46.2 - 92.4)	14	39.0	(9.8 - 68.3)
VIII(d)	*Other specified malignant bone tumours*	2	50.1	(0.6 - 91.1)	3	100.1	[a]
VIII(e)	*Unspecified malignant bone tumours*	-	-	-	1	100.2	[a]
IX.	**Soft tissue and other extraosseous sarcomas**	**53**	**68.7**	**(53.9 - 79.6)**	**41**	**78.8**	**(61.8 - 88.9)**
IX(a)	*Rhabdomyosarcomas*	35	68.2	(49.8 - 81.0)	15	75.9	(41.9 - 91.7)
IX(b)	*Fibrosarcomas & other fibrous neoplasms*	2	0.0	[a]	5	78.0	(16.7 - 96.8)
IX(c)	*Kaposi sarcomas*	-	-	-	-	-	-
IX(d)	*Other specified soft tissue sarcomas*	9	77.9	(36.5 - 94.1)	18	82.8	(55.4 - 94.2)
IX(e)	*Unspecified soft tissue sarcomas*	7	84.8	(30.5 - 97.9)	3	66.7	(5.4 - 94.6)
X.	**Germ cell tumours, trophoblastic tumours & neoplasms of gonads**	**27**	**100.4**	[a]	**30**	**93.5**	**(76.0 - 98.5)**
X(a)	*Intracranial & intraspinal germ cell tumours*	8	100.2	[a]	10	100.1	[a]
X(b)	*Malignant extracranial & extragonadal germ cell tumours*	5	100.7	[a]	11	82.1	(44.9 - 95.4)
X(c)	*Malignant gonadal germ cell tumours*	14	100.5	[a]	9	100.1	[a]
X(d)	*Gonadal carcinomas*	-	-	-	-	-	-
XI.	**Other malignant epithelial neoplasms & malignant melanomas**	**20**	**90.2**	**(65.7 - 97.6)**	**22**	**80.3**	**(55.3 - 92.3)**
XI(a)	*Adrenocortical carcinomas*	2	0.0	[a]	-	-	
XI(b)	*Thyroid carcinomas*	3	100.1	[a]	3	100.1	[a]
XI(c)	*Nasopharyngeal carcinomas*	1	100.3	[a]	1	100.1	[a]
XI(d)	*Melanomas*	6	100.2	[a]	10	90.1	(47.4 - 98.7)
XI(e)	*Skin carcinomas*	-	-		-	-	
XI(f)	*Other & unspecified carcinomas*	8	100.2	[a]	8	60.6	(20.6 - 85.4)
XII.	**Other & unspecified malignant neoplasms**	**2**	**100.1**	[a]	**2**	**0.0**	[a]
XII(a)	*Other specified malignant tumours*	2	100.1	[a]	1	0.0	[a]
XII(b)	*Other unspecified malignant tumours*	-	-	-	1	0.0	[a]

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.
[b] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

3.4 Childhood cancer relative survival by prioritised ethnicity

The following section reports child cancer survival by prioritised ethnicity; Maori, Pacific Peoples, and all others (labelled as 'non-Maori/non-Pacific Peoples'). As noted earlier, any between-group differences must be interpreted with caution as often there were few cases diagnosed within the time period and any differences may be within the bounds of chance variation. Also, any differences in overall child cancer survival by ethnicity may be explained by a number of other factors such as a higher incidence of certain cancers, which may have a more favourable/unfavourable prognosis, within a particular ethnic group.

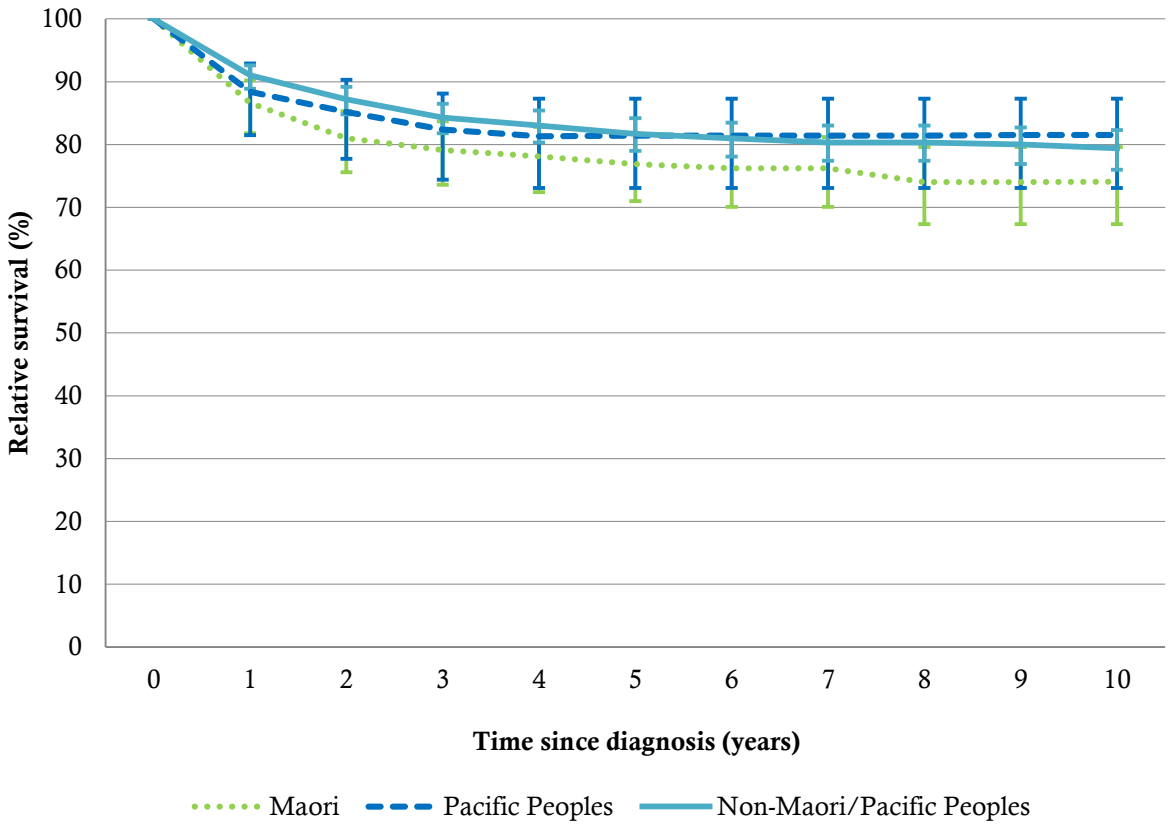
3.4.1 Childhood cancer cumulative relative survival, by prioritised ethnicity and time since diagnosis

In terms of overall cancer survival, there were no significant differences according to ethnicity at any point of follow-up (see Table 3.4.1 and Figure 3.4.1). Five-year survival ranged from 76.9% for Maori to 81.7% for non-Maori/non-Pacific children. For those children who were followed up for the full ten year period, survival ranged from 74.1% for Maori to 81.5% for Pacific Peoples. There were no deaths recorded among Pacific children who had survived for four or more years since their cancer diagnosis. The lack of ethnic differences in child cancer survival is consistent with what was found in an earlier 1990-1993 New Zealand study[12] but is in contrast to what has been found for the New Zealand adolescent and young adult populations.[20]

Table 3.4.1 Childhood cancer cumulative relative survival, by prioritised ethnicity and time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	Maori			Pacific Peoples			Non-Maori/non-Pacific Peoples		
	n	Cumulative relative survival (95% CI)		n	Cumulative relative survival (95% CI)		n	Cumulative relative survival (95% CI)	
1	259	86.6	(81.8 - 90.2)	129	88.4	(81.5 - 92.9)	933	91.0	(88.9 - 92.6)
2	224	81.0	(75.6 - 85.3)	114	85.2	(77.7 - 90.3)	848	87.1	(84.8 - 89.2)
3	193	79.1	(73.6 - 83.7)	98	82.4	(74.4 - 88.1)	733	84.3	(81.7 - 86.5)
4	159	78.1	(72.4 - 82.8)	82	81.3	(73.1 - 87.3)	631	83.0	(80.3 - 85.4)
5	138	76.9	(71.0 - 81.8)	68	81.4	(73.1 - 87.3)	552	81.7	(79.0 - 84.2)
6	113	76.2	(70.1 - 81.2)	61	81.4	(73.2 - 87.3)	466	81.0	(78.1 - 83.5)
7	97	76.2	(70.1 - 81.2)	54	81.4	(73.2 - 87.3)	387	80.3	(77.4 - 83.0)
8	80	74.0	(67.3 - 79.6)	46	81.4	(73.2 - 87.4)	306	80.3	(77.4 - 83.0)
9	56	74.0	(67.3 - 79.6)	34	81.5	(73.2 - 87.4)	222	80.0	(76.9 - 82.7)
10	39	74.1	(67.3 - 79.6)	23	81.5	(73.2 - 87.4)	159	79.4	(76.0 - 82.3)

Figure 3.4.1 Childhood cancer relative survival by prioritised ethnicity and time since diagnosis, New Zealand, 2000-2009



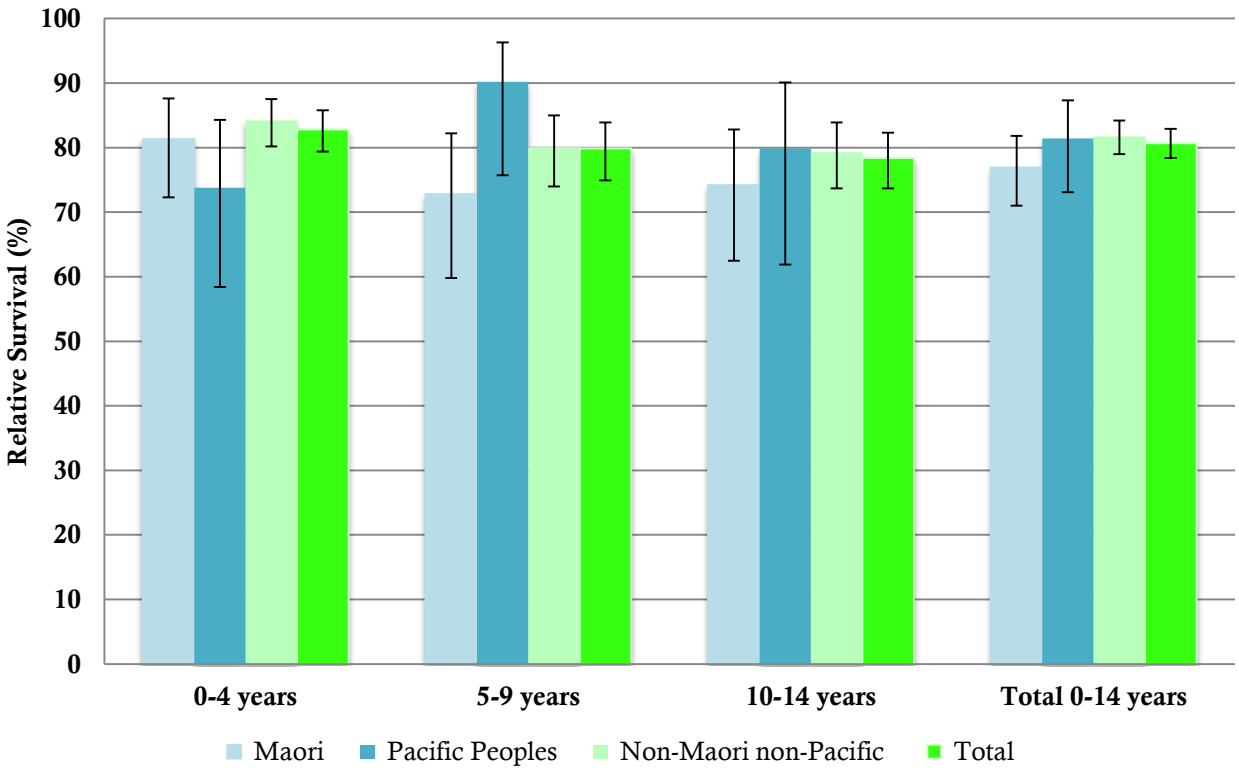
3.4.2 Five-year relative survival for all childhood cancers by age group and prioritised ethnicity

There were no significant differences in the overall survival of childhood cancers by age group and ethnicity. The greatest variability was seen in the 5-9 year group; five-year relative survival ranged from 72.8% for Maori aged 5-9 years to 90.2% for Pacific Peoples aged 5-9 years (see Table 3.4.2).

Table 3.4.2 Five-year relative survival for all childhood cancers by age group and prioritised ethnicity, New Zealand, 2000-2009

	0-4 years			5-9 years			10-14 years			Total 0-14 years		
	Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
Maori	111	81.3	(72.3 - 87.6)	72	72.8	(59.8 - 82.2)	76	74.2	(62.5 - 82.8)	259	76.9	(71.0 - 81.8)
Pacific Peoples	46	73.8	(58.4 - 84.3)	45	90.2	(75.7 - 96.3)	38	79.9	(61.9 - 90.1)	129	81.4	(73.1 - 87.3)
Non-Maori/ non-Pacific Peoples	419	84.2	(80.2 - 87.5)	233	80.1	(74.0 - 85.0)	281	79.3	(73.7 - 83.9)	933	81.7	(79.0 - 84.2)
Total	**576**	**82.8**	**(79.4 - 85.8)**	**350**	**79.9**	**(74.9 - 83.9)**	**395**	**78.4**	**(73.7 - 82.3)**	**1321**	**80.7**	**(78.4 - 82.9)**

Figure3.4.2 Five-year relative survival for all childhood cancers by age group and prioritised ethnicity, New Zealand, 2000-2009



3.4.3 Five-year relative survival by prioritised ethnicity and ICCC diagnostic groups and selected subgroups

As modern treatment of ALL is complex, prolonged, and requires open access to health care, we can therefore use it as an indicator disease. Table 3.4.3 shows that the five-year relative survival for ALL across the three ethnic groups was almost identical; 89.8% for Maori, 88.0% for Pacific Peoples, and 89.4% for all others. The closeness in these survival figures indicates that New Zealand is achieving equitable outcomes for children diagnosed with cancer regardless of ethnicity.

Table 3.4.3 Childhood cancer five-year relative survival by prioritised ethnicity, New Zealand, 2000-2009

ICCC-3 diagnostic group/ subgroup		Maori			Pacific Peoples			Non-Maori/non-Pacific Peoples		
		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
	All childhood cancers	**259**	**76.9**	**(71.0 - 81.8)**	**129**	**81.4**	**(73.1 - 87.5)**	**933**	**81.7**	**(79.0 - 84.2)**
I.	Leukaemias	92	81.2	(70.8 - 88.3)	54	86.2	(72.9 - 93.3)	309	85.9	(81.1 - 89.6)
I(a)	*Lymphoid leukaemias*	62	89.8	(76.3 - 95.8)	37	88.0	(70.6 - 95.4)	253	89.4	(84.6 - 92.9)
I(b)	*Acute myeloid leukaemias*	23	65.4	(42.5 - 81.1)	8	75.1	(31.5 - 93.2)	47	69.3	(51.5 - 81.7)
II.	Lymphomas	22	90.9	(68.0 - 97.7)	9	88.3	(41.1 - 98.4)	83	94.0	(86.0 - 97.5)
II(a)	*Hodgkin lymphomas*	8	100.1	[a]	1	100.1	[a]	27	96.5	(76.6 - 99.6)
II(b)	*Non-Hodgkin lymphomas (excl. Burkitt lymphoma)*	10	90.1	(47.4 - 98.7)	4	100.1	[a]	44	95.6	(83.1 - 99.0)
III.	CNS Tumours	52	66.4	(51.5 - 77.7)	22	63.8	(40.3 - 80.0)	209	72.7	(65.8 - 78.5)
III(b)	*Astrocytomas*	14	78.3	(46.6 - 92.5)	7	85.8	(33.4 - 98.0)	95	77.1	(66.9 - 84.5)
III(c)	*Intracranial & intraspinal embryonal tumours*	20	62.8	(36.7 - 80.6)	8	62.6	(23.0 - 86.2)	31	69.7	(49.5 - 83.1)
III(d)	*Other gliomas*	8	25.0	(3.7 - 55.9)	4	25.1	(0.9 - 66.7)	33	48.9	(30.3 - 65.2)
IV.	Neuroblastoma	19	59.8	(32.3 - 79.2)	3	100.5	[a]	65	66.4	(53.1 - 76.8)
V.	Retinoblastoma	9	100.3	[a]	5	100.5	[a]	25	100.3	[a]
VI.	Renal tumours	8	100.2	[a]	4	71.6	(9.0 - 95.7)	49	98.1	(86.5 - 99.9)
VII.	Hepatic tumours	2	-	[b]	2	-	[b]	9	66.9	(28.3 - 88.1)
VIII.	Malignant bone tumours	14	54.4	(24.9 - 76.6)	13	83.6	(48.4 - 95.7)	45	65.5	(48.3 - 78.3)
VIII(a)	*Osteosarcomas*	8	47.8	(13.1 - 76.5)	7	71.5	(25.9 - 92.1)	22	72.2	(48.1 - 86.5)
VIII(b)	*Ewing tumour*	4	45.1	(3.3 - 83.0)	6	100.1	[a]	18	53.0	(24.8 - 75.0)
IX.	Soft tissue sarcomas	17	64.3	(37.1 - 82.2)	3	-	[b]	74	75.5	(63.4 - 84.1)
IX(a)	*Rhabdomyosarcomas*	9	66.7	(28.2 - 87.9)	2	-	[b]	39	72.3	(54.3 - 84.2)
X.	Germ cell tumours	16	94.1	(63.5 - 99.5)	11	100.1	[a]	30	97.0	(78.8 - 99.8)
XI.	Other malignant epithelial	6	83.4	(27.4 - 97.6)	3	-	[b]	33	90.5	(72.9 - 97.0)
XII.	Other & unspecified malignant neoplasms	2	50.0	[b]	-	-	-	2	50.0	(0.6 - 91.3)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.
[b] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

3.4.4 Cancer-related deaths in children by prioritised ethnicity and ICCC diagnostic group

Figures 3.4.4a-c show that leukaemias and CNS tumours were the leading cause of deaths for all prioritised ethnic groups within this cohort of children diagnosed with cancer between 2000 and 2009. Neuroblastoma was the third most common cause of death for Maori (7 deaths, 12%) and the non-Maori/non-Pacific group (22 deaths, 13%), but there were no neuroblastoma deaths for the Pacific children. This is not unexpected given that only four cases of neuroblastoma were diagnosed in Pacific children within the ten-year period.

Figure 3.4.4a Cancer-related deaths in New Zealand Maori children diagnosed between 2000 and 2009[a]

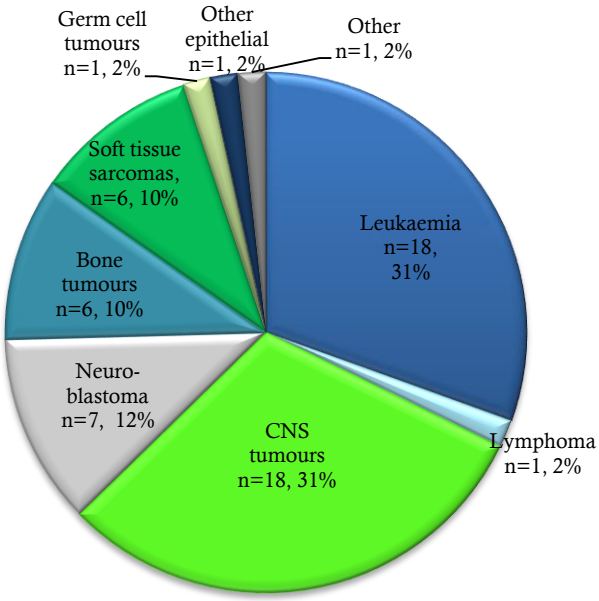


Figure 3.4.4b Cancer-related deaths in New Zealand Pacific children diagnosed between 2000 and 2009[a]

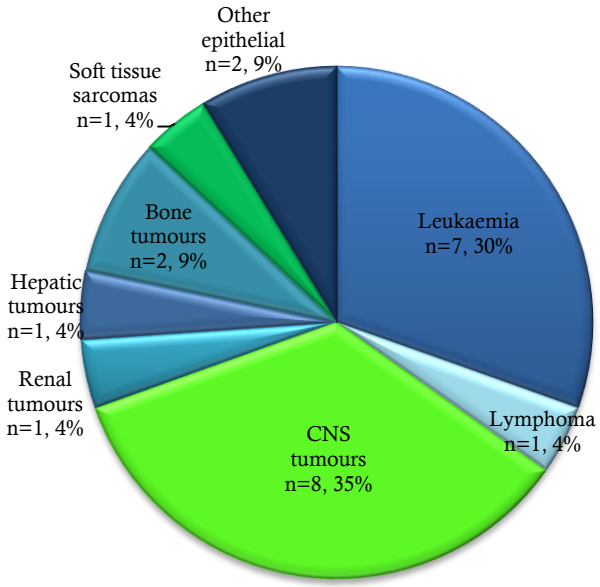
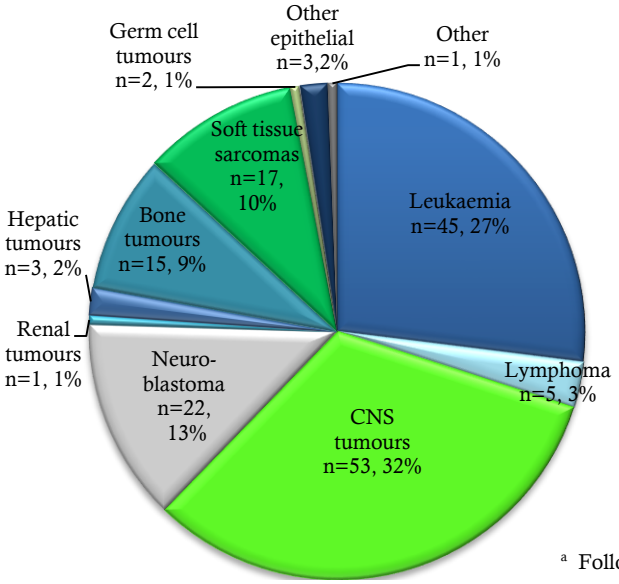


Figure 3.4.4c Cancer-related deaths in New Zealand children of Non-Maori/non-Pacific ethnicity diagnosed between 2000 and 2009[a]



[a] Follow-up to the 31st of December 2010

3.5 New Zealand childhood cancer survival over time

The following section compares New Zealand child cancer five-year survival from 2000 to 2009 with survival for those children diagnosed between 1961 and 1970 and between 1990 and 1993. Due to the methodological differences between studies and New Zealand's relatively small population, caution should be taken when making comparisons between the survival probabilities reported for each time period. Confidence intervals and survival probabilities by diagnostic subgroup were not available for the 1961 to 1970 cohort.

Overall child cancer survival in New Zealand has improved from 28% in 1961-1970, to 66% in 1990-1993 to 80.7% in 2000-2009 (see Table 3.5). Children diagnosed with leukaemia in the 1961 to 1970 period had only a 6% chance of surviving five years, the poorest survival of any diagnostic group. However, leukaemia survival has shown a dramatic improvement since the 1960s. The overall survival for childhood leukaemia in 2000-2009 was 85.0%, which was also significantly higher than the survival probability reported in 1990-1993 (65%).

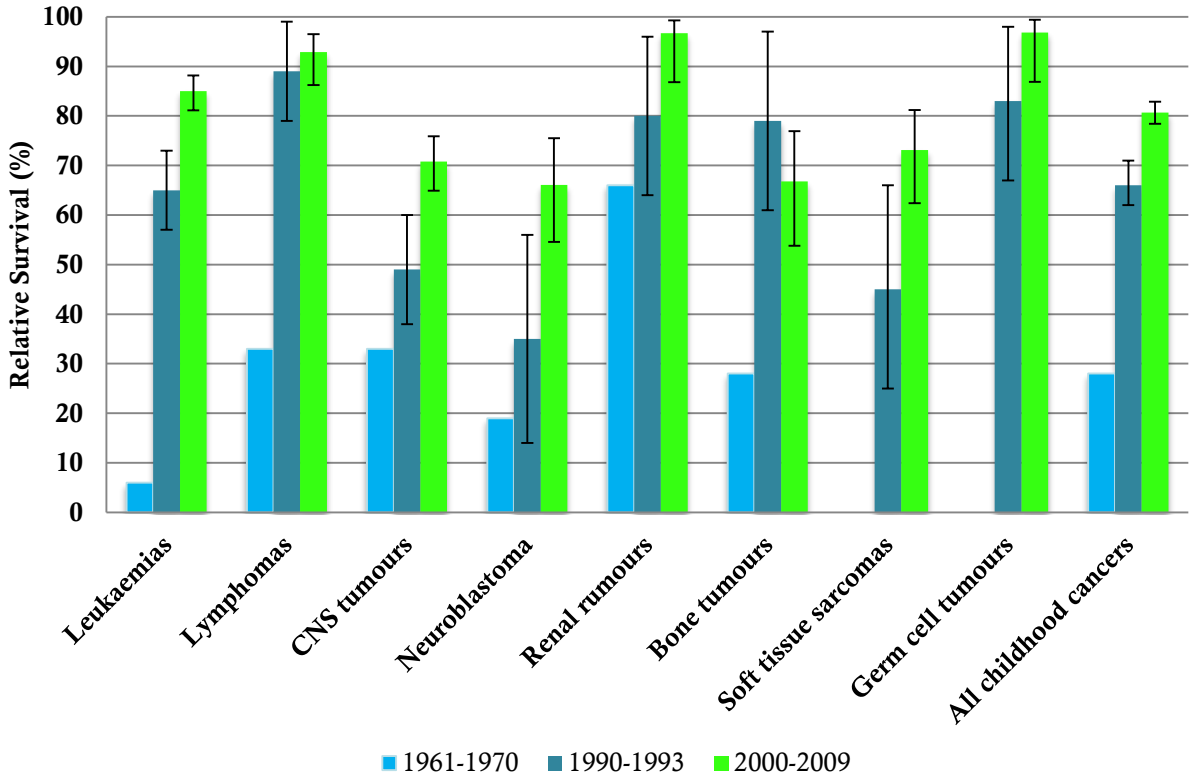
Hepatic tumours survival reported for 1990-1993 (86%) was higher than for the 2000-2009 period (69.4%), but there were only a small number of cases diagnosed in either time period and therefore such a difference is not necessarily indicative of a decline in survival over time. Of greater interest is osteosarcoma survival. Out of the 12 osteosarcomas diagnosed between 1990 and 1993, 11 (91%) survived five years. The survival probability for those 37 children diagnosed in the 2000-2009 period was considerably (although not significantly) lower at 66.8%.

Table 3.5 Five-year survival for childhood cancer in New Zealand over time

ICCC-3 diagnostic group/subgroup		1961-1970[11]		1990-1993[12]			2000-2009		
		Total cases	Five-year observed survival	Total cases	Five-year cause-specific survival (95% CI)		Total cases	Five-year relative survival (95% CI)	
	All childhood cancers	**1002**	**28**	**409**	**66**	**(62 - 71)**	**1321**	**80.7**	**(78.4 - 82.9)**
I.	Leukaemias	345	6	144	65	(57 - 73)	455	85.0	(81.1 - 88.2)
I(a)	*Lymphoid leukaemias*	-	-	111	70	(62 - 79)	352	89.4	(85.3 - 92.4)
I(b)	*Acute myeloid leukaemias*	-	-	26	50	(31 - 69)	78	69.2	(56.7 - 78.8)
II.	Lymphomas	82	33	37	89	(79 - 99)	114	92.9	(86.2 - 96.5)
II(a)	*Hodgkin lymphomas*	-	-	14	93	(79 - 100)	36	97.4	(82.0 - 99.8)
II(b)	*Non-Hodgkin lymphomas*	-	-	23[a]	87	(73 - 100)	58	95.0	(84.9 - 98.4)
III.	Central nervous system tumours	217	33[b]	80	49[b]	(38 - 60)	283	70.8	(64.9 - 75.9)
IV.	Neuroblastoma	36	19	20	35	(14 - 56)	87	66.1	(54.6 - 75.5)
V.	Retinoblastoma	[c]	[c]	12	100	(74 - 100)	39	100.3	[a]
VI.	Renal tumours	66	33	25	80	(64 - 96)	61	96.7	(86.8 - 99.3)
VII.	Hepatic tumours	[c]	[c]	7	86	(60 - 100)	13	69.4	(37.4 - 87.4)
VIII.	Malignant bone tumours	54	28	20	79	(61 - 97)	72	66.8	(53.8 - 76.9)
VIII(a)	*Osteosarcomas*	-	-	12	91	(74 - 100)	37	66.8	(48.9 - 79.7)
VIII(b)	*Ewing tumours*	-	-	7	57	(20 - 94)	28	61.3	(37.6 - 78.3)
IX.	Soft tissue sarcomas	[c]	[c]	23	45	(25 - 66)	94	73.1	(62.4 - 81.2)
IX(a)	*Rhabdomyosarcomas*	-	-	12	42	(14 - 70)	50	70.6	(55.3 - 81.5)
X.	Germ cell tumours	[c]	[c]	23	83	(67 - 98)	57	96.8	(86.9 - 99.4)
XI.	Other malignant epithelial	[c]	[c]	16	81	(62 - 100)	42	84.9	(69.1 - 93.0)
	'Other Sites'[c]	202	59						

[a] Also includes Burkitt lymphoma.
[b] Excludes non-malignant CNS tumours.
[c] Survival for diagnostic groups V, VII, IX, X and XI were combined under 'other sites'. Diagnostic group XII: 'other and unspecified' was not reported in the 1961-1970 or 1990-1993 studies.

Figure 3.5 Changes in New Zealand childhood cancer five-year survival over time, by selected diagnostic group (including 95% CI)



3.6 International comparisons of childhood cancer survival

The following section places New Zealand's child cancer survival in the context of what is being achieved internationally. Childhood cancer survival is reported from Australia,[13] Europe,[14] Great Britain,[15] Germany,[16] and the United States (SEER).[17] These developed countries were selected as they had published childhood cancer survival probabilities by ICCC-3 for 0-14 year olds for a comparable time period. However, the data must be interpreted cautiously as any differences in survival probabilities may be influenced by variations in registry inclusion criteria and survival calculation methodologies used. Please refer to Section 2.5 for further details about the data which is reported in this section.

Table 3.6 shows that New Zealand's overall childhood cancer five-year relative survival (80.7%) is consistent with the relative survival published by other registries (which ranged from 78% in Great Britain to 84% in Germany). New Zealand ranked highly for leukaemia, lymphoma, germ cell tumour and renal tumour survival. At 66.1%, New Zealand's neuroblastoma survival probability was below that reported by Germany (79%) and the US (75.2%). Germany (74%) and the US (73.6%) also achieved the highest malignant bone tumour survival (c.f. New Zealand, 66.8%).

Table 3.6 International comparisons of five-year survival for childhood cancer

ICCC-3 diagnostic group/subgroup		NZ 2000-2009	Australia 1995-2004[13]	Europe 2000-2002[14]	United Kingdom 2000-2005[15]	Germany 1999-2009[16]	US (SEER) 2002-2008[17]
		relative survival	relative survival	population weighted relative survival	observed survival	observed survival	relative survival
	Overall childhood cancers	**80.7**	**79.5**	**81**[a]	**78**	**84**	**81.1**
I.	**Leukaemias**	**85.0**	**80.6**	[b]	**83**	**86**	**83.9**[c]
Ia.	*Lymphoid leukaemias*	89.4	85.3	85.4	88	90	88.7
Ib.	*Acute myeloid leukaemias*	69.2	62.3	66.8	64	66	64.3
II.	**Lymphomas**	**92.9**	**89.6**	[b]	**88**	**93**	**90.1**
IIa.	*Hodgkin lymphomas*	97.4	97.1	95.2	95	98	96.1
IIb.	*Non-Hodgkin lymphomas*	95.0	82.6	82.3	83[c]	89	86.3[d]
III.	**CNS tumours**	**70.8**	**70.8**	**62.8**[e]	**71**	**75**	**71.1**[e]
IIIa.	*Ependymomas*	75.6	68.6	62.0[e]	67	77	69.6[e]
IIIb.	*Astrocytomas*	77.7	77.9	62.9[e]	81	79	84.3[e]
IIIc	*Embryonal CNS tumours*	66.1	50.5	65.8[e]	56	65	59.8[e]
IIId.	*Other gliomas*	42.7	53.8	[b]	44	43	52.1[e]
IV.	**Neuroblastoma & other peripheral nervous cell tumours**	**66.1**	**68.4**	[b]	**64**	**79**	**75.2**
IVa.	*Neuroblastoma*	66.5	67.8	71.9	64	79	75.2
V.	**Retinoblastoma**	**100.3**	**99.1**	**97.5**	**99**	**98**	**97.8**
VI.	**Renal tumours**	**96.7**	**89.2**	[b]	**84**	**93**	**89.0**
VIa.	*Nephroblastoma*	96.5	88.9	89.1	85	93	89.2
VII.	**Hepatic tumours**	**69.4**	**77.3**	[b]	**66**	**68**	**72.0**
VIIa.	*Hepatoblastoma*	75.3	87.1	74.2[f]	[b]	73	77.4
VIII.	**Malignant bone tumours**	**66.8**	**69.5**	[b]	**61**	**74**	**73.6**
VIIIa.	*Osteosarcomas*	66.8	70.6	77.3[g]	54	76	71.4
VIIIb.	*Ewing tumours*	61.3	67.8	66.5	64	72	74.8
IX.	**Soft tissue sarcomas**	**73.1**	**70.6**	[b]	**67**	**70**	**72.4**
IXa.	*Rhabdomyosarcomas*	70.6	68.2	69.1	63	71	68.0
X.	**Germ cell tumours**	**96.8**	**90.5**	[b]	**92**	**95**	**90.2**
XI.	**Other malignant epithelial**	**84.9**	**93.0**	[b]	[b]	**80**	**94.1**
XId.	*Malignant melanomas*	93.9	97.0	88.1[f]	[b]	71	95.1

[a] 81% overall survival is the rounded survival figure reported within the text. Survival by country ranged from 75% (Malta) to 86% (Austria).
[b] Not reported.
[c] Excludes myelodysplastic syndromes.
[d] Includes all non-Hodgkin lymphomas combined (diagnostic groups IIc, IId, & IIe).
[e] Malignant CNS tumours only reported.
[f] Survival is reported for the 1995-2002 period.
[g] Survival is reported for children aged 10-14 years only.

4 Childhood Cancer Survival by Diagnostic Group

The following section describes cancer survival for each of the ICCC-3 diagnostic subgroups in turn. Each subsection begins with a description of the diagnostic group, including the defining characteristics of the group, the initial presenting symptoms, the conditions associated with increased risk, and the typical course of treatment. For some diagnostic groups and subgroups there were very few cases recorded, and in such cases the true survival cannot be reliably estimated; this is reflected in the wide 95% confidence intervals which are reported alongside. In such cases, any between-group differences in survival or any differences in comparison to other published data should be interpreted extremely cautiously. It should also be noted that confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.1 Leukaemias, myeloproliferative diseases, and myelodysplastic diseases

Leukaemias arise from malignant transformation of haematopoietic stem cells in the bone marrow. Leukaemic blasts cause clinical symptoms by impairing normal bone marrow function and by dissemination through the blood into distant sites. There are two main leukaemia cell types; lymphoblastic leukaemias are derived from lymphoid precursor cells and myeloid leukaemias are derived from myeloid precursor cells. Leukaemias are further classified as either acute or chronic. The majority of childhood leukaemias are acute, with acute lymphoblastic leukaemia (ALL) accounting for about 80% of all childhood leukaemias, acute myeloid leukaemia (AML) accounting for about 15%, and the remainder being various chronic leukaemias and other myeloproliferative diseases. The aetiology of leukaemia remains unclear; some cases are familial or are associated with other genetic diseases but 95% of cases are sporadic with no predisposing condition.

The prognosis and treatment of childhood acute leukaemia depends on the leukaemia type, the age at diagnosis, the presence or absence of involvement of the central nervous system or testes, and the presence of specific cytomolecular genetic features. All acute leukaemias require treatment with multi-agent chemotherapy, some patients may be treated with radiotherapy, and a smaller number will undergo a bone marrow transplant. ALL treatment lasts 26 months for girls and 38 months for boys, with differing intensity of treatment depending on the leukaemia subtype, the patient's age and response to initial therapy. AML is treated with an intense course of chemotherapy over six months, with much of that time spent in hospital. New Zealand's two children's cancer treatment centres are members of the Children's Oncology Group (COG), a collaborative clinical trial group that runs clinical trials across the USA, Canada, Australia and New Zealand. Where possible, children diagnosed with ALL and AML are treated according to one of the COG leukaemia clinical trials.

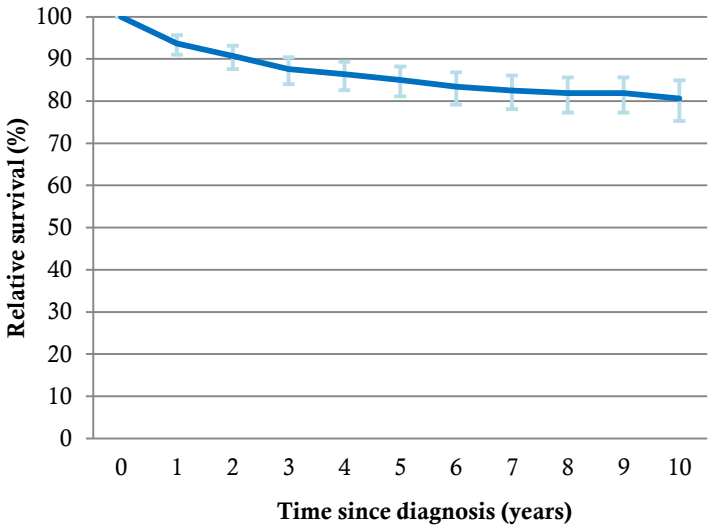
4.1.1 Childhood leukaemias cumulative relative survival by time since diagnosis

Of the 70 deaths within this cohort of 455 children diagnosed with leukaemia, 29 were recorded within the first year following diagnosis. In contrast to what was seen for many other diagnostic groups, relative survival for childhood leukaemias continued to decline after five years following diagnosis (See Table 4.1.1 and Figure 4.1.1). Ten-year relative survival was 80.6%, a 4.4% decrease from the relative survival reported after five years of follow-up (85.0%).

Table 4.1.1 Childhood leukaemias cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	455	93.7	(91.0 - 95.6)
2	426	90.7	(87.6 - 93.1)
3	371	87.6	(84.0 - 90.4)
4	308	86.4	(82.6 - 89.3)
5	264	85.0	(81.1 - 88.2)
6	231	83.4	(79.2 - 86.8)
7	189	82.5	(78.1 - 86.1)
8	154	81.9	(77.3 - 85.6)
9	120	81.9	(77.3 - 85.6)
10	82	80.6	(75.3 - 84.9)

Figure 4.1.1 Childhood leukaemias cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.1.2 Leukaemia survival by sex, age group, and prioritised ethnicity

There were no statistically significant differences in five-year relative survival by sex, age group or prioritised ethnicity. However, survival was 7.4% higher for males than females. This was an unexpected finding given that other cancer registries typically report significantly higher survival for females than males.[13,17,19] There were also differences in five-year relative survival by age at diagnosis, with survival highest for children 0-4 years of age (88.3%) and poorest for those 10-14 years (77.7%). This is consistent with the international literature, which reports the most favourable outcomes for children aged 1-4 years at diagnosis.[13,17,19]

Table 4.1.2 Childhood leukaemias survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total leukaemias	**455**	**100**	**85.0**	**(81.1 - 88.2)**
Sex				
Male	239	52.5	88.5	(83.5 - 92.1)
Female	216	47.5	81.1	(74.6 - 86.1)
Age group				
0-4 years	228	50.1	88.3	(83.3 - 92.0)
5-9 years	131	28.8	83.8	(74.9 - 89.8)
10-14 years	96	21.1	77.7	(67.0 - 85.4)
Prioritised ethnicity				
Maori	92	20.2	81.2	(70.8 - 88.3)
Pacific Peoples	54	11.9	86.2	(72.9 - 93.3)
Non-Maori/non-Pacific Peoples	309	67.9	85.9	(81.1 - 89.6)

4.1.3 Leukaemia survival by diagnostic subgroup

The overall leukaemia five-year relative survival of 85.0% is a remarkable improvement on the New Zealand survival probabilities reported for the 1961-1970[11] and 1990-1993[12] periods (6% and 65% respectively). As has been consistently reported in other child cancer publications,[13,17,19] five-year relative survival for ALL (89.4%) was significantly higher than for AML (69.2%), (see Table 4.1.3).

Table 4.1.3 Childhood leukaemias five-year relative survival by diagnostic subgroup, New Zealand, 2000-2009

		Total cases	% of leukaemias diagnosed	% of all child cancers diagnosed	Five-year relative survival (95% CI)	
I.	**Total leukaemias**	**455**	**100.0**	**34.4**	**85.0**	**(81.1 - 88.2)**
I(a)	*Lymphoid leukaemias*	352	77.4	26.6	89.4	(85.3 - 92.4)
I(b)	*Acute myeloid leukaemias*	78	17.1	5.9	69.2	(56.7 - 78.8)
I(c)	*Chronic myeloproliferative diseases*	4	0.9	0.3	100.1	[a]
I(d)	*Other myeloproliferative diseases*	11	2.4	0.8	72.9	(37.2 - 90.5)
I(e)	*Other & unspecified leukaemia*	10	2.2	0.8	60.1	(25.3 - 82.9)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.1.4 ALL and AML survival by sex, age group, and prioritised ethnicity

Table 4.1.4 shows that the sex differences in leukaemia survival noted in 4.1.2 were due to better survival outcomes for males diagnosed with ALL compared to females (five-year relative survival for males was 92.9% c.f. 85.2% for females). Although these differences did not reach statistical significance, this was nevertheless an unexpected finding given that females with ALL tend to have better survival outcomes than males according to the literature.[13,17] Five-year survival probabilities for ALL were almost identical for the three prioritised ethnic groups; 89.8% for Maori, 88.0% for Pacific Peoples, and 89.4% for non-Maori/non-Pacific Peoples.

Table 4.1.4 Childhood ALL and AML five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Acute lymphoblastic leukaemia				Acute myeloid leukaemias			
	Cases	%	Five-year relative survival (95% CI)		Cases	%	Five-year relative survival (95% CI)	
Total cases	**352**	**100**	**89.4**	**(85.3 - 92.4)**	**78**	**100**	**69.2**	**(56.7 - 78.8)**
Sex								
Male	193	54.8	92.9	(88.0 - 95.9)	34	43.6	70.5	(50.4 - 83.7)
Female	159	45.2	85.2	(77.8 - 90.3)	44	56.4	68.2	(51.1 - 80.5)
Age group								
0-4 years	180	51.1	92.5	(87.3 - 95.6)	35	44.9	74.0	(55.8 - 85.7)
5-9 years	109	31.0	86.7	(76.9 - 92.6)	16	20.5	64.3	(32.9 - 84.0)
10-14 years	63	17.9	84.2	(71.4 - 91.6)	27	34.6	65.6	(41.9 - 81.5)
Prioritised ethnicity								
Maori	62	17.6	89.8	(76.3 - 95.8)	23	29.5	65.4	(42.5 - 81.1)
Pacific Peoples	37	10.5	88.0	(70.6 - 95.4)	8	10.3	75.1	(31.5 - 93.2)
Non-Maori/non-Pacific Peoples	253	71.9	89.4	(84.6 - 92.9)	47	60.3	69.3	(51.5 - 81.7)

4.2 Lymphomas and reticuloendothelial neoplasms

Lymphomas arise from the malignant transformation of primitive lymphoid stem cells in the developing lymphatic system. They spread to involve adjacent and distant lymph nodes, and may involve other locations such as the spleen, bone marrow, bones, and brain. Lymphomas are divided into two distinct categories, Hodgkin lymphomas (HL) and non-Hodgkin lymphomas (NHL), and, like leukaemias, may be acute or chronic. In children and young people, most lymphomas are acute and high grade, with chronic or low grade lymphomas being more common in older adults.

Hodgkin lymphomas arise in specific pre-malignant lymphoma cells within a lymph node region and tend to spread to adjacent lymph nodes. Common symptoms at diagnosis include progressive painless lymph node swelling, fever, weight loss and lethargy. The non-Hodgkin lymphomas are a heterogeneous group of diseases. In children, most NHLs are acute lymphoblastic lymphoma and have a clinical behaviour similar to acute lymphoblastic leukaemia. The most common NHL's in children are T-cell NHL and Burkitt lymphoma. T-cell NHL is treated in a similar manner to ALL, while Burkitt lymphoma is treated with a very intense short course of multi-agent chemotherapy. Most children in New Zealand who are diagnosed with lymphoma will be treated according to a clinical trial (COG or other cooperative clinical trials group) or according to a disease-specific clinical protocol.

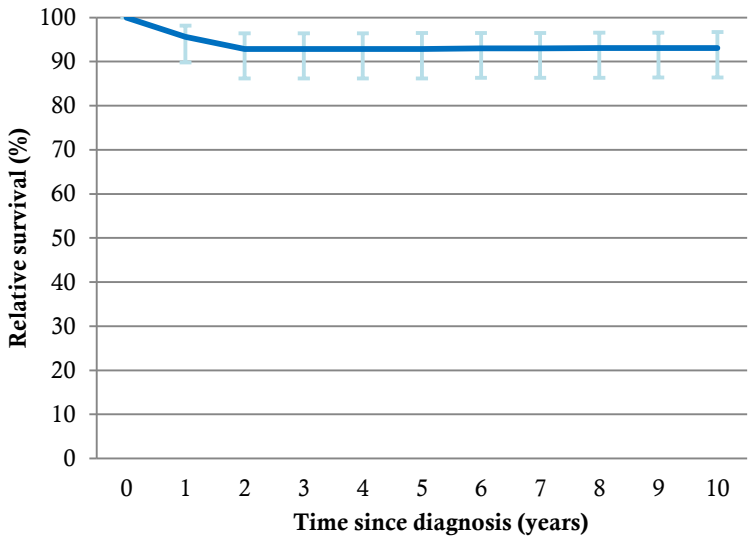
4.2.1 Childhood lymphomas cumulative relative survival by time since diagnosis

Lymphoma five-year relative survival (92.9%) was significantly higher than child cancer survival overall (80.7%). Within the cohort, five deaths were recorded during the first year of follow-up and three deaths were recorded within the following year. No additional deaths occurred during the remaining eight years of follow-up (see Table 4.2.1 and Figure 4.2.1).

Table 4.2.1 Childhood lymphomas cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	114	95.6	(89.8 - 98.2)
2	109	92.9	(86.2 - 96.4)
3	92	92.9	(86.2 - 96.4)
4	80	92.9	(86.2 - 96.4)
5	70	92.9	(86.2 - 96.5)
6	51	93.0	(86.3 - 96.5)
7	44	93.0	(86.3 - 96.5)
8	34	93.1	(86.3 - 96.6)
9	22	93.1	(86.4 - 96.6)
10	18	93.1	(86.4 - 96.7)

Figure 4.2.1 Childhood lymphomas cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.2.2 Lymphoma survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

There were no significant differences in five-year relative survival for lymphoma according to sex, age group or ethnicity (see Table 4.2.2).

In terms of five-year relative survival, there was little variation between the two main diagnostic subgroups; Hodgkin lymphomas (97.4%) and Non-Hodgkin lymphomas (excluding Burkitt lymphoma), (95.0%). This is in contrast to what was seen in the New Zealand AYA population (15-24 years) within the same time period, in which survival for Hodgkin lymphomas (94.6%) was significantly higher than for non-Hodgkin lymphomas (78.8%).[20]

Of the eight deaths recorded within this cohort, three were in children diagnosed with non-Hodgkin lymphomas (excluding Burkitt lymphomas) and three were in children diagnosed with Burkitt lymphoma.

Table 4.2.2 Childhood lymphomas five-year relative survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total lymphomas and reticuloendothelial neoplasms	**114**	**100**	**92.9**	**(86.2 - 96.5)**
Diagnostic subgroup				
II(a) Hodgkin lymphomas	36	31.6	97.4	(82.0 - 99.8)
II(b) Non-Hodgkin lymphomas (except Burkitt lymphoma)	58	50.9	95.0	(84.9 - 98.4)
II(c) Burkitt lymphoma	18	15.8	82.3	(54.5 - 94.0)
II(d) Miscellaneous lymphoreticular neoplasms	1	0.9	0.0	[a]
II(e) Unspecified lymphomas	1	0.9	100.1	[a]
Sex				
Male	72	63.2	94.5	(85.7 - 98.0)
Female	42	36.8	90.4	(76.2 - 96.3)
Age group				
0-4 years	11	9.6	80.1	(40.9 - 94.7)
5-9 years	42	36.8	88.1	(73.7 - 94.9)
10-14 years	61	53.5	98.5	(89.1 - 100.0)
Prioritised ethnicity				
Maori	22	19.3	90.9	(68.0 - 97.7)
Pacific Peoples	9	7.9	88.3	(41.1 - 98.4)
Non-Maori/non-Pacific	83	70.3	94.0	(86.0 - 97.5)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.2.3 Hodgkin and non-Hodgkin lymphomas survival by sex, age group, and prioritised ethnicity

There were no differences in five-year relative survival for the main lymphoma diagnostic subgroups according to sex, age group or ethnicity (see Table 4.2.3). This is as expected given the very small number of deaths which occurred among those diagnosed with lymphoma within the study period.

Table 4.2.3 Childhood Hodgkin and non-Hodgkin lymphomas five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Hodgkin lymphomas				Non-Hodgkin lymphomas (excluding Burkitt lymphomas)			
	Cases	%	Five-year relative survival (95% CI)		Cases	%	Five-year relative survival (95% CI)	
Total cases	**36**	**100**	**97.4**	**(82.0 - 99.8)**	**58**	**100**	**95.0**	**(84.9 - 98.4)**
Sex								
Male	17	47.2	100.2	[a]	42	72.4	95.4	(82.4 - 98.9)
Female	19	52.8	94.9	(68.2 - 99.4)	16	27.6	93.8	(63.3 - 99.2)
Age group								
0-4 years	1	2.8	100.1	[a]	6	10.3	100.1	[a]
5-9 years	12	33.3	91.7	(53.9 - 98.9)	18	31.0	89.0	(62.5 - 97.2)
10-14 years	23	63.9	100.2	[a]	34	58.6	97.2	(81.1 - 99.8)
Prioritised ethnicity								
Maori	8	22.2	100.1	[a]	10	17.2	90.1	(47.4 - 98.7)
Pacific Peoples	1	2.8	100.1	[a]	4	6.9	100.1	[a]
Non-Maori/non-Pacific Peoples	27	75.0	96.5	(76.6 - 99.6)	44	75.9	95.6	(83.1 - 99.0)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.3 Central nervous system tumours and miscellaneous intracranial and intraspinal neoplasms

Tumours of the central nervous system can arise from any structure in the brain, its adjacent coverings and the spinal cord. Within the brain, cancers may develop within primitive neuron-like cells (the embryonal tumours), or the supporting structures such as glial tissue (gliomas), or as remnants of primitive developmental structures (germ cell tumours). This heterogeneous group of tumours vary from relatively benign tumours such as pilocytic astrocytoma, to highly malignant and metastatic tumours such as medulloblastoma and atypical teratoid/rhabdoid tumours. It is likely each group of brain and spinal tumour has a different origin, but some tumours are known to occur in association with familial cancer predisposition syndromes such as Neurofibromatosis type 1, or in association of inherited syndromes such as Gorlin and Li Fraumeni Syndrome. The treatment and prognosis for a CNS tumour depends on the histological type, its location, the presence or absence of metastatic spread, and the age of the child at diagnosis. Most CNS tumours require expert neurosurgical resection, with many needing further treatment with chemotherapy and/or radiotherapy.

The ICD-O-3 used by the New Zealand Cancer Registry (and many other mandatory international cancer registries) classify the benign and low grade gliomas (such as juvenile pilocytic astrocytoma) as non-malignant, so these tumours are not recorded or reported in New Zealand cancer statistics. However, benign and low-grade gliomas in children represent a unique clinical challenge and often require treatment that is similar to malignant CNS tumours and may be associated with long-term morbidity. For this reason, the International Childhood Cancer Classification (ICCC) has included these tumours and, by consensus, international childhood cancer registries record and report on the incidence of non-malignant CNS tumours.

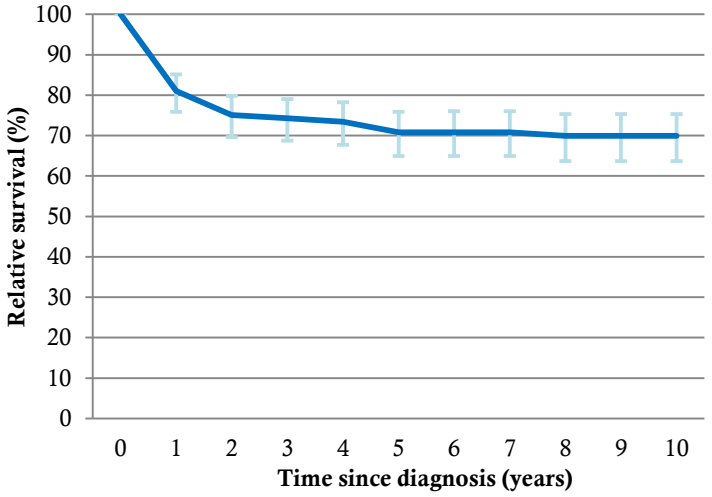
4.3.1 Childhood CNS tumours cumulative relative survival by time since diagnosis

Over two thirds (54 out of 80) of all deaths within this cohort of 283 children diagnosed with a CNS tumour occurred within a year of diagnosis. There was little further decline in CNS tumour survival after three years (see Table 4.3.1 and Figure 4.3.1).

Table 4.3.1 Childhood CNS tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	283	81.0	(75.9 - 85.1)
2	229	75.1	(69.6 - 79.8)
3	195	74.3	(68.7 - 79.0)
4	175	73.4	(67.7 - 78.2)
5	151	70.8	(64.9 - 75.9)
6	127	70.8	(64.9 - 76.0)
7	105	70.8	(64.9 - 76.0)
8	84	69.9	(63.7 - 75.3)
9	55	69.9	(63.7 - 75.3)
10	41	69.9	(63.7 - 75.3)

Figure 4.3.1 Childhood CNS tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.3.2 CNS tumour survival by sex, age group, and prioritised ethnicity

Five-year survival for the largest CNS tumour diagnostic group, astrocytomas, was higher (77.7%), but not significantly, than for the diagnostic group as a whole (70.8%). Astrocytoma survival was also higher for males compared to females (85.0% c.f. 72.6%) and 0-4 and 5-9 year age groups (78.9% and 88.8% respectively) compared to 10-14 year olds (66.3%, see Table 4.3.2).

Table 4.3.2 Childhood CNS tumours five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000–2009

	All CNS tumours				Astrocytomas			
	Total cases	%	Five-year relative survival (95% CI)		Total cases	%	Five-year relative survival (95% CI)	
Total cases	**283**	**100.0**	**70.8**	**(64.9 - 75.9)**	**116**	**100.0**	**77.7**	**(68.7 - 84.4)**
Sex								
Male	148	52.3	72.7	(66.5 - 79.4)	47	40.5	85.0	(71.1 - 92.6)
Female	135	47.7	68.7	(59.7 - 76.1)	69	59.5	72.6	(59.7 - 81.9)
Age group								
0-4 years	98	34.6	68.0	(57.2 - 76.6)	38	32.8	78.9	(59.9 - 89.6)
5-9 years	97	34.3	72.8	(62.2 - 80.9)	42	36.2	85.8	(71.0 - 93.4)
10-14 years	88	31.0	71.7	(60.7 - 80.2)	36	31.0	66.3	(48.3 - 79.4)
Prioritised ethnicity								
Maori	52	18.3	66.4	(51.5 - 77.7)	14	12.1	78.3	(46.6 - 92.5)
Pacific Peoples	22	7.8	63.8	(40.3 - 80.0)	7	6.0	85.8	(33.4 - 98.0)
Non-Maori/non-Pacific Peoples	209	73.9	72.7	(65.8 - 78.5)	95	81.9	77.1	(66.9 - 84.5)

4.3.3 CNS tumours survival by diagnostic subgroup

Five-year relative survival for 'diagnostic group III(d): other gliomas' (42.7%) was significantly lower compared to the 77.7% survival recorded for 'diagnostic group III(b): Astrocytomas' (which are also a type of glioma). Diagnostic group III(c): Intracranial and intraspinal embryonal tumours, the majority of which were medulloblastoma, had a five-year survival of 66.1%.

Table 4.3.3 Childhood CNS tumours five-year relative survival by diagnostic subgroup, New Zealand, 2000-2009

		Total cases	% of CNS tumours diagnosed	Five-year relative survival (95% CI)	
III.	**Central nervous system & miscellaneous intracranial and intraspinal neoplasms**	**283**	**100**	**70.8**	**(64.9 - 75.9)**
III(a)	*Ependymomas and choroid plexus tumours*	24	8.5	75.6	(49.8 - 89.4)
III(b)	*Astrocytomas*	116	41.0	77.7	(68.7 - 84.4)
III(c)	*Intracranial and intraspinal embryonal tumours*	59	20.8	66.1	(51.7 - 77.1)
III(d)	*Other gliomas*	45	15.9	42.7	(27.7 - 57.0)
III(e)	*Other specified intracranial and intraspinal neoplasms*	36	12.7	88.8	(72.7 - 95.8)
III(f)	*Unspecified intracranial and intraspinal neoplasms*	3	0.1	66.9	(5.4 - 94.8)

4.4 Neuroblastoma and other peripheral nervous cell tumours

Neuroblastoma is a heterogeneous group of cancers that arise from primitive neural crest cells within the sympathetic nervous system. Malignant neuroblastoma most commonly originates in the adrenal glands, or from adjacent abdominal sympathetic nerves, but tumours may arise anywhere along the sympathetic chain from the neck, chest, abdomen and the pelvis. These tumours often present as asymptomatic abdominal masses. They vary from benign fully differentiated solid tumours, to highly malignant undifferentiated and metastatic cancers. The aetiology of neuroblastoma remains to be determined; most are sporadic but occasional tumours are associated with familial syndromes.

As many of the early warning signs of neuroblastoma, such as fatigue, pain, loss of appetite, and fever, mimic those of other common childhood illnesses, these tumours may grow to a very large size before becoming clinically apparent. The prognosis and treatment of neuroblastoma depends on the patient's age, the tumour site and histology, the presence of specific molecular features, and the extent of disease at diagnosis. Malignant neuroblastoma requires very aggressive treatment with multi-agent chemotherapy, surgery, radiotherapy, stem cell transplantation, differentiation therapy and immunotherapy. Recent developments in treatment have significantly improved the prognosis for children with advanced stage neuroblastoma. In New Zealand most children are treated according to an international clinical trial.

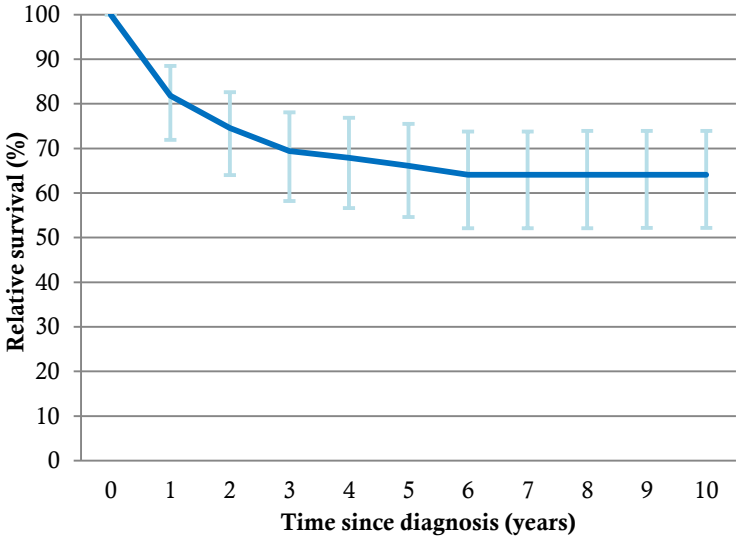
4.4.1 Childhood neuroblastoma cumulative relative survival by time since diagnosis

Within the cohort of 87 children diagnosed with neuroblastoma, 29 died during the follow-up period, including 16 within one year of their initial diagnosis. However, as noted above, a neuroblastoma patient's expected survival is heavily dependent on a number of known risk factors. Table 4.4.1 and Figure 4.4.1 show that there was little further decline in survival after five years following diagnosis.

Table 4.4.1 Childhood neuroblastoma cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	87	81.8	(71.9 - 88.5)
2	71	74.6	(64.0 - 82.6)
3	59	69.4	(58.2 - 78.1)
4	50	67.9	(56.6 - 76.9)
5	42	66.1	(54.6 - 75.5)
6	35	64.1	(52.1 - 73.8)
7	28	64.1	(52.1 - 73.8)
8	24	64.1	(52.1- 73.9)
9	20	64.1	(52.2 - 73.9)
10	10	64.1	(52.2 - 73.9)

Figure 4.4.1 Childhood neuroblastoma cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.4.2 Neuroblastoma survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

There was considerable variability in neuroblastoma survival by age group, with the survival differences between those aged four years and under, when incidence peaks, and those aged 10-14 years reaching statistical significance (74.4% c.f. 20.1%), (see Table 4.4.2). Five-year survival for females (72.9%) was 13.3% higher than for males, but this was not statistically significant. There were no differences in neuroblastoma survival according to prioritised ethnic group.

Table 4.4.2 Childhood neuroblastoma five-year relative survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total neuroblastoma & other peripheral nervous cell tumours	**87**	**100**	**66.1**	**(54.6 - 75.5)**
Diagnostic subgroup				
IV(a) Neuroblastoma and ganglioneuroblastoma	85	97.7	66.5	(54.7 - 75.9)
IV(b) Other peripheral nervous cell tumours	2	2.3	50.1	(0.6 - 91.3)
Sex				
Male	44	50.6	59.6	(43.0 - 72.9)
Female	43	49.4	72.9	(56.0 - 84.2)
Age group				
0-4 years	69	79.3	74.4	(61.7 - 83.5)
5-9 years	13	14.9	39.7	(13.1 - 65.7)
10-14 years	5	5.7	20.1	(0.8 - 58.3)
Prioritised ethnicity				
Maori	19	21.8	66.4	(53.1 - 76.8)
Pacific Peoples	3	3.4	100.5	[a]
Non-Maori/non-Pacific Peoples	65	74.7	66.4	(53.1 - 76.8)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.5 Retinoblastoma

Retinoblastoma forms from primitive retinal cells in the eye and often progresses rapidly to fill the entire posterior chamber of the orbit. Although rare, it is the most common type of eye cancer in children. Retinoblastoma may be sporadic or occur in association with familial mutations in the retinoblastoma gene (RB1). Sporadic retinoblastoma most commonly involves one eye (unilateral RB) and most cases do not have a germline mutation of the RB gene. Hereditary retinoblastoma develops in children inheriting a germline mutation of the RB gene; it may be unilateral, bilateral and in rare cases also involve the pineal gland (trilateral RB). Patients with hereditary RB are at long-term risk of developing additional cancers and second cancers.

The most common presentation of RB is when parents notice a white pupil (leucoria) instead of the typical "red eye" seen in photos taken with a flash. Other symptoms can include squinting, crossed eyes, eye swelling and redness, and double vision. Management of retinoblastoma requires an expert ophthalmology assessment of the affected and unaffected eye and access to high quality diagnostic imaging, expert diagnostic pathology and molecular genetics. Most children are diagnosed with retinoblastoma before they are five years old. Provided the cancer has not spread beyond the eye, retinoblastoma has one of the best survival rates of all childhood cancers.

4.5.1 Childhood retinoblastoma cumulative relative survival by time since diagnosis

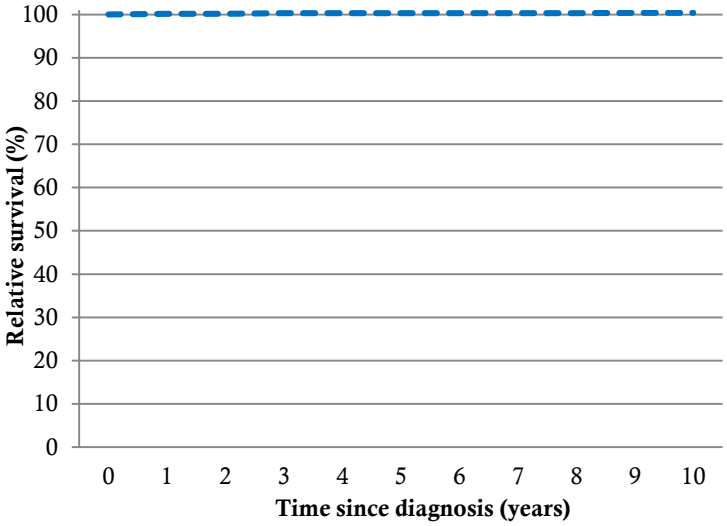
The survival of children diagnosed with retinoblastoma is similar to the survival of New Zealand's general child population. Not a single death was recorded within the cohort during the study period.

Table 4.5.1 Childhood retinoblastoma cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	39	100.2	[a]
2	39	100.2	[a]
3	38	100.3	[a]
4	36	100.3	[a]
5	31	100.3	[a]
6	27	100.3	[a]
7	26	100.3	[a]
8	21	100.3	[a]
9	15	100.4	[a]
10	11	100.4	[a]

[a] Confidence intervals cannot be calculated in instances where no deaths were recorded.

Figure 4.5.1 Childhood retinoblastoma cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.5.2 Retinoblastoma survival by sex, age group, and prioritised ethnicity

As there was not a single death recorded among children diagnosed with retinoblastoma in New Zealand between 2000 and 2009, it follows that there were therefore no differences according to sex, age group, or ethnicity (see Table 4.5.2).

Table 4.5.2 Childhood retinoblastoma five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total retinoblastoma	**39**	**100**	**100.3**	[a]
Sex				
Male	19	48.7	100.3	[a]
Female	20	51.3	100.3	[a]
Age group				
0-4 years	37	94.9	100.3	[a]
5-9 years	2	5.1	100.1	[a]
10-14 years	-	-	-	-
Prioritised ethnicity				
Maori	9	23.1	100.3	[a]
Pacific Peoples	5	12.8	100.5	[a]
Non-Maori/non-Pacific Peoples	25	64.1	100.3	[a]

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.6 Renal tumours

Renal tumours, or malignancies of the kidney, represent around 6% of cancer diagnoses among children younger than 15 years of age. Nephroblastoma (also known as Wilms' tumour) is the most common form of childhood renal cancer. Other primary renal tumours in children include rhabdoid tumour of the kidney, clear cell sarcoma of the kidney, renal carcinoma and rare cases of intra-renal rhabdomyosarcoma and neuroblastoma. While most Wilms' tumours are sporadic, some occur in association with specific developmental disorders such as the Beckwith Wiedemann syndrome, WAGR syndrome and Denys-Drash syndrome. At diagnosis, most Wilms' tumours are unilateral but about 7% are bilateral.

Wilms' tumours arise in the developing kidney from primitive malignant clusters of cells termed nephrogenic rests. These form during growth of the kidney in utero and transform into malignant tumours during post-natal growth and development. Wilms' tumours usually present in children under the age of five with an abdominal mass but occasionally present with pain and haematuria. Treatment usually involves nephrectomy and pre and/or post-operative chemotherapy. Some cases also require radiotherapy. Children in New Zealand are treated according to an international collaborative clinical trial through SIOP or COG.

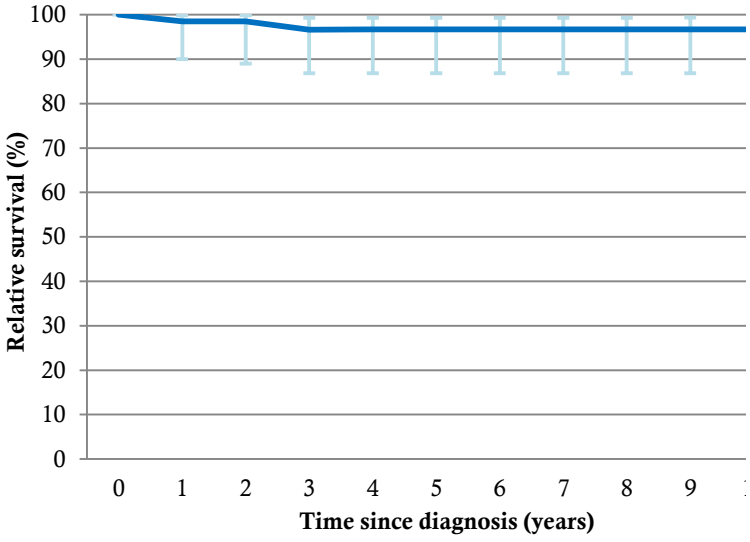
4.6.1 Childhood renal tumours cumulative relative survival by time since diagnosis

Between 2000 and 2009 in New Zealand renal tumours had one of the best survival probabilities of all ICCC-3 diagnostic groups. Of the 61 cases diagnosed within the time period, two deaths were recorded; one within the first year following diagnosis, and the second before the third year of follow-up.

Table 4.6.1 Childhood renal tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	61	98.5	(90.0 - 99.9)
2	60	98.5	(89.0 - 99.9)
3	54	96.6	(86.8 - 99.3)
4	50	96.7	(86.8 - 99.3)
5	48	96.7	(86.8 - 99.3)
6	43	96.7	(86.8 - 99.3)
7	39	96.7	(86.8 - 99.3)
8	28	96.7	(86.8 - 99.3)
9	18	96.7	(86.8 - 99.4)
10	15	96.7	(86.9 - 99.4)

Figure 4.6.1 Childhood renal tumours relative survival by time since diagnosis, New Zealand, 2000-2009



4.6.2 Renal tumour survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

Nephroblastoma (which is commonly known as Wilms' tumour) accounted for 59 of the 61 renal tumours (96.7%) diagnosed between 2000 and 2009. Both of the two renal tumour deaths reported were for children diagnosed with a Wilms' tumour between one and four years of age (see Table 4.6.2).

Table 4.6.2 Childhood renal tumours five-year relative survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total renal tumours	**61**	**100**	**96.7**	**(86.8 - 99.3)**
Diagnostic subgroup				
VI(a) Nephroblastoma & other non-epithelial renal tumours	59	96.7	96.5	(86.3 - 99.3)
VI(b) Renal carcinomas	2	2.3	100.1	[a]
Sex				
Male	27	44.3	96.1	(74.1 - 99.7)
Female	34	55.7	97.2	(81.0 - 99.7)
Age group				
0-4 years	47	77.0	95.6	(82.9 - 99.1)
5-9 years	8	13.1	100.1	[a]
10-14 years	6	9.8	100.1	[a]
Prioritised ethnicity				
Maori	8	13.1	100.2	[a]
Pacific Peoples	4	6.6	71.6	(9.0 - 95.7)
Non-Maori/non-Pacific Peoples	49	80.3	98.1	(86.5 - 99.9)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.7 Hepatic tumours

Primary liver tumours are rare in children. The two most common subgroups diagnosed are hepatoblastoma and hepatocellular carcinoma. Although representing a small proportion of the total number of cases diagnosed, some genetic conditions, such as Beckwith-Wiedemann syndrome, are associated with an increased risk of developing hepatoblastoma, while hepatocellular carcinoma, more commonly diagnosed in adulthood, is associated with a prior history of hepatitis and a number of chronic liver conditions. Hepatic tumours may present with non-specific symptoms including abdominal distension, pain, a palpable mass, weight loss, and jaundice.

Hepatocellular carcinoma can be resistant to chemotherapy and is typically treated with surgery alone. The prognosis for hepatoblastoma depends on the histological subtype, the level of tumour marker (AFP), the extent of tumour in the liver, and the presence or absence of metastatic spread. Hepatoblastoma is usually treated with pre-operative chemotherapy, surgical resection of the tumour or liver transplantation, and post-operative chemotherapy. Children in New Zealand with hepatoblastoma are currently treated according to the SIOPEL international cooperative clinical trial. For those with localised and resectable disease the overall prognosis is excellent.

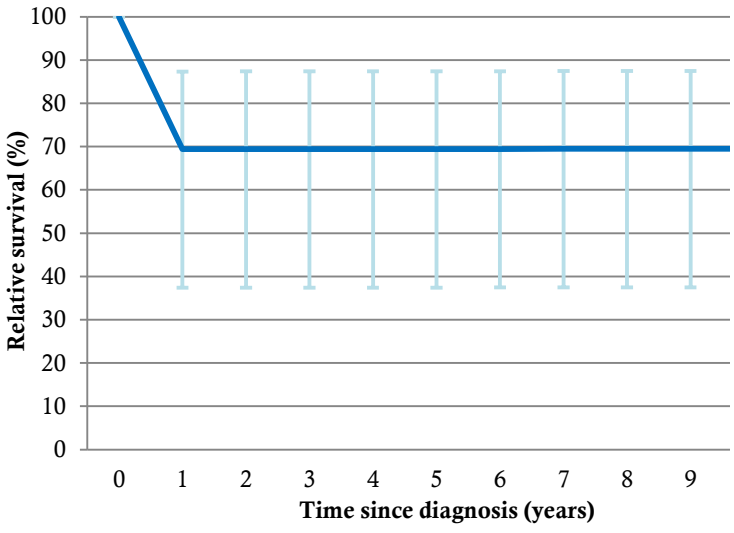
4.7.1 Childhood hepatic tumours cumulative relative survival by time since diagnosis

Of the 13 children who were diagnosed with a hepatic tumour between 2000 and 2009, four died during the follow-up period. In all four cases the deaths occurred within one year of the initial diagnosis (see Table 4.7.1 and Figure 4.7.1).

Table 4.7.1 Childhood hepatic tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	13	69.4	(90.0 - 99.9)
2	9	69.4	(89.0 - 99.9)
3	6	69.4	(86.8 - 99.3)
4	5	69.4	(86.8 - 99.3)
5	5	69.4	(86.8 - 99.3)
6	5	69.4	(86.8 - 99.3)
7	5	69.5	(86.8 - 99.3)
8	4	69.5	(86.8 - 99.3)
9	2	69.5	(86.8 - 99.4)
10	2	69.5	(86.9 - 99.4)

Figure 4.7.1 Childhood hepatic tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.7.2 Hepatic tumour survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

Of the four hepatic tumour deaths recorded, two were cases of hepatoblastoma and two were hepatic carcinomas. Table 4.7.2 shows that there were no discernable differences in survival according to sex, age group, and prioritised ethnicity, which is not unexpected given the rarity of this type of tumour in children.

Table 4.7.2 Childhood hepatic tumours five-year relative survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total hepatic tumours	**13**	**100.0**	**69.4**	**(37.4 - 87.4)**
Diagnostic subgroup				
VII(a) Hepatoblastoma	8	61.5	75.3	(31.6 - 93.4)
VII(b) Hepatic carcinomas	5	39.5	60.1	(12.6 - 88.4)
Sex				
Male	8	61.5	62.7	(23.0 - 86.4)
Female	5	38.5	80.1	(20.4 - 97.1)
Age group				
0-4 years	10	76.9	70.3	(33.0 - 89.5)
5-9 years	3	23.1	66.7	(5.4 - 94.6)
10-14 years	-	-	-	
Prioritised ethnicity				
Maori	2	15.4	[a]	[a]
Pacific Peoples	2	15.4	[a]	[a]
Non-Maori/non-Pacific Peoples	9	69.2	66.9	(28.3 - 88.1)

[a] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

4.8 Malignant bone tumours

The two most common types of primary malignant bone tumour in children are osteosarcomas and Ewing sarcomas. Osteosarcomas originate in the osteoid tissue and usually grow in the long bones of the leg, often directly above the knee joint. Ewing sarcomas arise from primitive mesenchymal elements in the bone or, less often, in soft tissue (those which originate in soft tissue are classified as a soft tissue sarcoma rather than a malignant bone tumour according to the ICCC-3). Ewing sarcomas may develop in any bone but most commonly develop in the long bones or bones of the central axis, including vertebrae, ribs, sternum, clavicle and pelvis.

Most primary bone tumours are sporadic but osteosarcoma can rarely develop in association with the Li Fraumeni syndrome, Rothmund Thomson syndrome, and in children with germline retinoblastoma mutations. Ewing sarcoma is nearly always sporadic with few know risk factors. Most primary bone tumours present as a painful progressive swelling of a bone in a teenager; these grow slowly and are often diagnosed as a soft tissue injury before the correct diagnosis is established. The peak age of onset is 14 years, coinciding with the pubertal growth spurt. The prognosis and treatment depends on the tumour histology, its location and extent of disease. All primary bone tumours require expert treatment with chemotherapy, surgery, and, less often, radiotherapy.

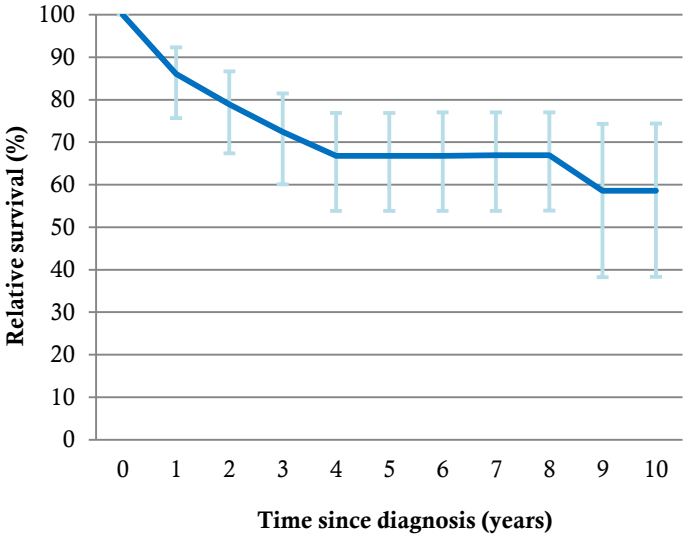
4.8.1 Childhood malignant bone tumours cumulative relative survival by time since diagnosis

Of the 23 deaths recorded within the cohort of 72 children diagnosed with a malignant bone tumour between 2000 and 2009, ten occurred within the first year and 19 within the first three years of follow-up (see Table 4.8.1).

Table 4.8.1 Childhood malignant bone tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	72	86.1	(75.7 - 92.3)
2	62	78.9	(67.4 - 86.7)
3	52	72.4	(60.1 - 81.5)
4	41	66.8	(53.8 - 76.9)
5	33	66.8	(53.8 - 76.9)
6	28	66.8	(53.8 - 77.0)
7	23	66.9	(53.8 - 77.0)
8	18	66.9	(53.9 - 77.0)
9	10	58.6	(38.2 - 74.3)
10	5	58.6	(38.3 - 74.4)

Figure 4.8.1 Childhood malignant bone tumours relative survival by time since diagnosis, New Zealand, 2000-2009



4.8.2 Malignant bone tumour survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

Five-year survival for childhood malignant bone tumours is significantly below survival for childhood cancer overall (66.8% c.f. 80.7%). Table 4.8.2 shows that survival was considerably higher for males (77.9%) compared to females (54.0%), although this did not reach statistical significance. Five-year survival was similar for the two main types of bone tumours diagnosed in children; Ewing tumours (61.3%) and osteosarcomas (66.8%).

Table 4.8.2 Childhood malignant bone tumours five-year relative survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total malignant bone tumours	**72**	**100**	**66.8**	**(53.8 - 76.9)**
Diagnostic subgroup				
VIII(a) Osteosarcomas	37	51.4	66.8	(48.9 - 79.7)
VIII(b) Chondrosarcomas	1	1.4	100.3	[a]
VIII(c) Ewing tumours & related bone sarcomas	28	38.9	61.3	(37.6 - 78.3)
VIII(d) Other specified malignant bone tumours	5	6.9	80.1	(20.4 - 97.0)
VIII(e) Unspecified malignant bone tumours	1	13.9	100.2	[a]
Sex				
Male	37	51.4	77.9	(60.5 - 88.4)
Female	35	48.6	54.0	(34.2 - 70.2)
Age group				
0-4 years	5	6.9	60.1	(12.6 - 88.3)
5-9 years	20	27.8	77.7	(49.9 - 91.3)
10-14 years	47	65.3	63.0	(46.6 - 75.7)
Prioritised ethnicity				
Maori	14	19.4	54.4	(24.9 - 76.6)
Pacific Peoples	13	18.1	83.6	(48.4 - 95.7)
Non-Maori/non-Pacific Peoples	45	62.5	65.5	(48.3 - 78.3)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period

4.8.3 Osteosarcomas and Ewing tumours survival by sex, age group, and prioritised ethnicity

Table 4.8.3 shows that the differences in survival by sex were most marked for Ewing tumours, with survival probabilities for females (39.0%) at close to half the survival for males (78.1%). While overall osteosarcoma five-year survival was only slightly higher than for Ewing tumours (66.8% c.f. 61.3%), this difference was more pronounced for non-Maori/non-Pacific Peoples (72.2% c.f. 53.0%). However, there were only a small number of cases diagnosed and none of these differences reached statistically significance.

Table 4.8.3 Childhood osteosarcomas and Ewing tumours five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Osteosarcomas				Ewing tumour and related bone sarcomas			
	Cases	%	Five-year relative survival (95% CI)		Cases	%	Five-year relative survival (95% CI)	
Total cases	**37**	**100**	**66.8**	**(48.9 - 79.7)**	**28**	**100**	**61.3**	**(37.6 - 78.3)**
Sex								
Male	20	54.1	79.5	(54.0 - 91.9)	14	50.0	78.1	(46.2 - 92.4)
Female	17	45.9	52.2	(26.7 - 72.7)	14	50.0	39.0	(9.8 - 68.3)
Age group								
0-4 years	1	2.7	100.1	[a]	3	10.7	66.7	(5.4 - 94.6)
5-9 years	11	29.7	81.9	(44.8 - 95.2)	8	28.6	70.0	(22.5 - 91.9)
10-14 years	25	67.6	59.1	(37.2 - 75.6)	17	60.7	55.3	(24.4 - 78.0)
Prioritised ethnicity								
Maori	8	21.6	47.8	(13.1 - 76.5)	4	14.3	45.1	(3.3 - 83.0)
Pacific Peoples	7	18.9	71.5	(25.9 - 92.1)	6	21.4	100.1	[a]
Non-Maori/non-Pacific Peoples	22	59.5	72.2	(48.1 - 86.5)	18	64.3	53.0	(24.8 - 75.0)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period

4.9 Soft tissue and other extraosseous sarcomas

Soft tissue sarcomas are amongst the most diverse and challenging of all childhood cancers. They arise from malignant precursor cells in tissue of mesenchymal origin; cells that normally produce muscle, fibrous tissue, fat, blood vessels and other supporting tissue. Therefore, they can they can develop in any location and with highly varied histology. While there are over 50 different histological subtypes, the most common soft tissue sarcoma diagnosed in children are rhabdomyosarcomas, which account for over half of all cases diagnosed.

Rhabdomyosarcomas most commonly develop in the abdomen, trunk, head and neck, and in the extremities. The protean nature of these tumours makes them difficult to diagnose and they may present late and have disseminated by the time of diagnosis. As with other solid tumours of childhood, the prognosis and treatment depends on the location, histology, and extent of spread of the tumour. The malignant sarcomas all require multi-agent chemotherapy, surgery, and many need local radiotherapy. This class of tumour is challenging to diagnose and manage, and their treatment is associated with significant long-term treatment-related toxicity.

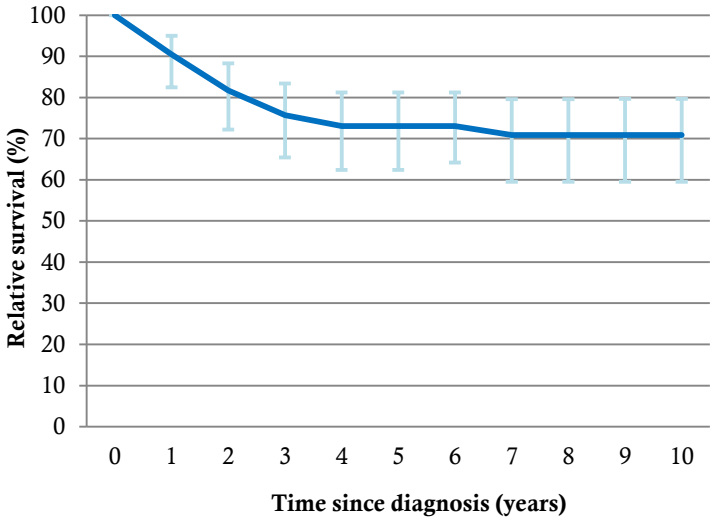
4.9.1 Childhood soft tissue sarcomas cumulative relative survival by time since diagnosis

Table 4.9.1 and Figure 4.9.1 show that most soft tissue sarcoma deaths within this cohort occurred within three years of diagnosis (22 of the 25 cases). Three-year survival for soft tissue sarcomas was 75.7%, 7.4% below the three-year survival for childhood cancers overall.

Table 4.9.1 Childhood soft tissue sarcomas cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	94	90.5	(82.5 - 95.0)
2	85	81.7	(72.2 - 88.3)
3	72	75.7	(65.4 - 83.4)
4	59	73.1	(62.4 - 81.2)
5	51	73.1	(62.4 - 81.2)
6	38	73.1	(64.2 - 81.2)
7	35	70.9	(59.5 - 79.6)
8	29	70.9	(59.5 - 79.6)
9	24	70.9	(59.5 - 79.7)
10	17	70.9	(59.5 - 79.7)

Figure 4.9.1 Childhood soft tissue sarcomas cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.9.2 Soft tissue sarcoma survival by sex, age group, and prioritised ethnicity

Although not statistically significant, soft tissue sarcomas five-year survival was around 10% higher for females than for males (78.8% c.f. 68.7%), non-Maori/non-Pacific Peoples than for Maori (75.5% c.f. 64.3%), and 5-9 year olds than 0-4 year olds (85.3% c.f.75.4%), (see Table 4.9.2).

Table 4.9.2 Childhood soft tissue sarcomas five-year relative survival by sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	All soft tissue tumours				Rhabdomyosarcomas			
	Total cases	%	Five-year relative survival (95% CI)		Total cases	%	Five-year relative survival (95% CI)	
Total cases	**94**	**100**	**73.1**	**(62.4 - 81.2)**	**50**	**100**	**70.6**	**(55.3 - 81.5)**
Sex								
Male	53	56.4	68.7	(53.9 - 79.6)	35	70.0	68.2	(49.8 - 81.0)
Female	41	43.6	78.8	(61.8 - 88.9)	15	30.0	75.9	(41.9 - 91.7)
Age group								
0-4 years	38	40.4	75.4	(57.8 - 86.5)	24	48.0	73.8	(50.5 - 87.4)
5-9 years	22	23.4	85.3	(52.3 - 96.2)	15	30.0	85.5	(61.0 - 95.2)
10-14 years	34	36.2	62.1	(42.7 - 76.7)	11	22.0	42.7	(14.0 - 69.3)
Prioritised ethnicity								
Maori	17	18.1	64.3	(37.1 - 82.2)	9	18.0	66.7	(28.2 - 87.9)
Pacific Peoples	3	3.2	[a]	[a]	2	4.0	[a]	[a]
Non-Maori/non-Pacific Peoples	74	78.7	75.5	(63.4 - 84.1)	39	78.0	72.3	(54.3 - 84.2)

[a] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

4.9.3 Soft tissue sarcoma survival by diagnostic subgroup

Rhabdomyosarcomas was the main type of soft tissue sarcoma diagnosed in children between 2000 and 2009 and had a five year survival probability of 73.1%. The rare diagnostic subgroup, 'fibrosarcomas and other fibrous neoplasms' had the poorest five-year survival probability of 52.1% (see Table 4.9.3).

Table 4.9.3 Childhood soft tissue sarcomas five-year relative survival by diagnostic subgroup, New Zealand, 2000-2009

		Total cases	% of soft tissue sarcomas diagnosed	Five-year relative survival (95% CI)	
IX.	**Soft tissue and other extraosseous sarcomas**	**94**	**100**	**73.1**	**(62.4 - 81.2)**
IX(a)	*Rhabdomyosarcomas*	50	53.2	70.6	(55.3 - 81.5)
IX(b)	*Fibrosarcomas & other fibrous neoplasms*	7	7.4	52.1	(12.3 - 81.8)
IX(c)	*Kaposi sarcomas*	-	-	-	-
IX(d)	*Other specified soft tissue sarcomas*	27	28.7	80.8	(59.6 - 91.6)
IX(e)	*Unspecified soft tissue sarcomas*	10	10.6	79.5	(39.6 - 94.6)

4.10 Germ cell tumours, trophoblastic tumours, and neoplasms of gonads

Germ cell tumours are the archetypal embryonic tumour. They all develop from primitive tissue remnants of embryonal tissues and may form in the developing gonads (gonadal germ cell tumours), or in regions of the chest, abdomen, and brain, where germ cell elements can persist beyond foetal development. Many germ cell tumours are benign (not classified by ICCC).

The presenting symptoms of germ cell tumours will vary considerably depending on the site; a boy with a gonadal germ cell tumour may develop a painless mass in the scrotum, while a child with an intracranial germ cell tumour may experience difficulty with movement or exhibit personality changes. The most common treatment for germ cell tumours is surgery, sometimes in conjunction with chemotherapy. Malignant germ cell tumours respond well to chemotherapy and even metastatic disease has an excellent long-term prognosis.

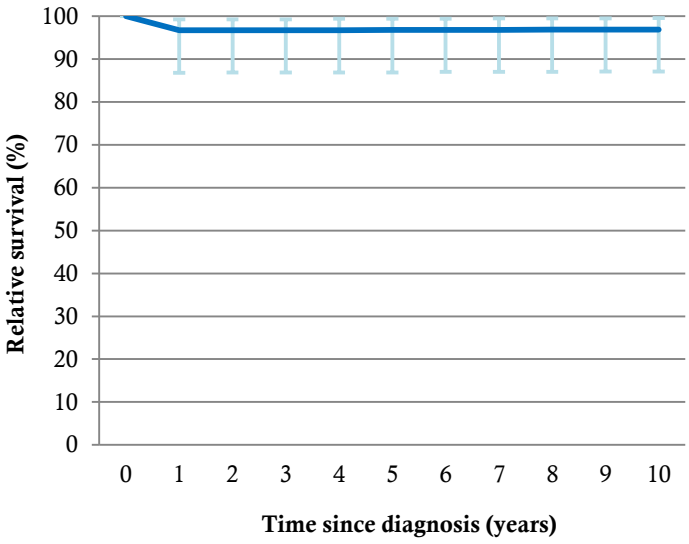
4.10.1 Childhood germ cell tumours cumulative relative survival by time since diagnosis

The germ cell tumour group of cancers has one of the best survival probabilities of all childhood cancers. Within the cohort of 57 children diagnosed between 2000 and 2009, two deaths were recorded; both within one year of diagnosis (see Table 4.10.1 and Figure 4.10.1).

Table 4.10.1 Childhood germ cell tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	57	96.7	(86.8 - 99.3)
2	55	96.7	(86.9 - 99.3)
3	48	96.7	(86.9 - 99.3)
4	41	96.7	(86.9 - 99.4)
5	37	96.8	(86.9 - 99.4)
6	32	96.8	(87.0 - 99.4)
7	28	96.8	(87.0 - 99.5)
8	24	96.9	(87.0 - 99.5)
9	18	96.9	(87.1 - 99.5)
10	14	96.9	(87.1 - 99.6)

Figure 4.10.1 Childhood germ cell tumours cumulative relative survival by time since diagnosis, New Zealand, 2000-2009



4.10.2 Germ cell tumour survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

There was little difference in germ cell tumours survival according to diagnostic subgroup, sex, age group, or ethnicity, which is to be expected given that childhood germ cell tumour have an excellent overall survival. Table 4.10.2 shows that both deaths within the cohort were recorded for girls under the age of five diagnosed with an intracranial and intraspinal germ cell tumour.

Table 4.10.2 Childhood germ cell tumours five-year relative survival by diagnostic subgroup sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total germ cell tumours	**57**	**100**	**96.8**	**(86.9 - 99.4)**
Diagnostic subgroup				
X(a) Intracranial & intraspinal germ cell tumours	18	31.6	87.9	(58.9 - 97.1)
X(b) Malignant extracranial & extragonadal germ cell tumours	16	28.1	100.3	[a]
X(c) Malignant gonadal germ cell tumours	23	40.4	-	-
X(d) Gonadal carcinomas	-	-	-	-
X(e) Other & unspecified malignant gonadal tumours	-	-	100.1	[a]
Sex				
Male	27	47.4	100.4	[a]
Female	30	52.6	93.5	(76.0 - 98.5)
Age group				
0-4 years	25	43.9	92.4	(72.0 - 98.4)
5-9 years	6	10.5	100.1	[a]
10-14 years	26	45.6	100.2	[a]
Prioritised ethnicity				
Maori	16	28.1	94.1	(63.5 - 99.5)
Pacific Peoples	11	19.3	100.1	[a]
Non-Maori/non-Pacific Peoples	30	52.6	97.0	(78.8 - 99.8)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.

4.11 Other malignant epithelial neoplasms and malignant melanomas

Cancers of epithelial origin are the most common cancers seen in adults and are termed carcinomas. Most adult carcinomas arise in a specific location – such as the breast, colon, prostate, lung and pancreas, and are associated with older age and environmental and lifestyle factors. This class of cancer is rare in childhood but they begin to make an appearance in the young adult age group.

The most common malignant epithelial cancer seen in children is melanoma. These may arise in children where there is a family history of melanoma, or in association with congenital melanocytic nevi. Although sun exposure plays less of a role in the development of melanoma in children than in adults, childhood melanoma incidence rates are nevertheless higher in countries with high ultra-violet radiation, such as New Zealand. Melanoma is usually treated with complete removal by surgery and monitored carefully due to the possibility of the cancer spreading to other parts of the body and the increased risk of developing another melanoma in later life.

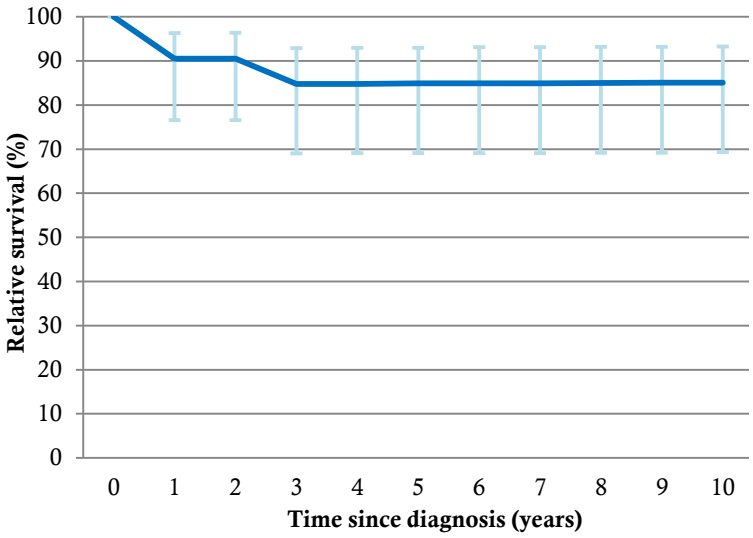
4.11.1 Other childhood malignant epithelial neoplasms cumulative relative survival by time since diagnosis

Within the cohort, 42 children were diagnosed with a cancer from the diagnostic group 'other malignant epithelial neoplasms and malignant melanomas'. Of the six deaths recorded within the follow-up period, four deaths occurred within the first year of diagnosis and the remaining two within the first three years (see Table 4.11.1 and Figure 4.11.1).

Table 4.11.1 Childhood malignant epithelial neoplasms cumulative relative survival by time since diagnosis, New Zealand, 2000-2009

Time since diagnosis (years)	n	Cumulative relative survival (95% CI)	
1	42	90.5	(76.6 - 96.3)
2	38	90.5	(76.6 - 96.4)
3	35	84.8	(69.0 - 92.9)
4	26	84.8	(69.1 - 93.0)
5	25	84.9	(69.1 - 93.0)
6	22	84.9	(69.1 - 93.1)
7	15	84.9	(69.1 - 93.1)
8	11	85.0	(69.2 - 93.2)
9	7	85.1	(69.2 - 93.2)
10	6	85.1	(69.3 - 93.3)

Figure 4.11.1 Childhood malignant epithelial neoplasms cumulative relative survival, New Zealand, 2000-2009



4.11.2 Other malignant epithelial neoplasm survival by diagnostic subgroup, sex, age group, and prioritised ethnicity

The diagnostic group 'other malignant epithelial neoplasms and malignant melanomas' includes a diverse range of tumours and the survival probabilities are known to vary considerably. During the follow-up period, one pre-teen diagnosed with melanoma died (five-year relative survival for melanomas, the main diagnostic subgroup, was 93.9%). The remaining deaths were recorded for both children diagnosed with an adrenocortical carcinoma and three of the 16 children diagnosed with an 'other and unspecified carcinomas' (see Table 4.11.2).

Table 4.11.2 Childhood malignant epithelial neoplasms five-year survival by diagnostic subgroup, sex, age group, and prioritised ethnicity, New Zealand, 2000-2009

	Total cases	%	Five-year relative survival (95% CI)	
Total malignant epithelial neoplasms & melanomas	**42**	**100**	**84.9**	**(69.1 - 93.0)**
Diagnostic subgroup				
XI(a) Adrenocortical carcinomas	2	4.8	0.0	[a]
XI(b) Thyroid carcinomas	6	14.3	100.1	[a]
XI(c) Nasopharyngeal carcinomas	2	4.8	100.2	[a]
XI(d) Melanomas	16	38.1	93.9	(63.3 - 99.3)
XI(e) Skin carcinomas	-	-	-	-
XI(f) Other & unspecified carcinomas	16	38.1	80.0	(49.6 - 93.2)
Sex				
Male	20	47.6	90.2	(65.7 - 97.6)
Female	22	52.4	80.3	(55.3 - 92.3)
Age group				
0-4 years	5	11.9	80.1	(20.4 - 97.0)
5-9 years	5	11.9	57.2	(9.9 - 87.4)
10-14 years	32	76.2	90.0	(71.6 - 96.8)
Prioritised ethnicity				
Maori	6	14.3	83.4	(27.4 - 97.6)
Pacific Peoples	3	7.1	[b]	[b]
Non-Maori/non-Pacific Peoples	33	78.6	90.5	(72.9 - 97.0)

[a] Confidence intervals cannot be calculated in instances where there were either no deaths or no survivors within the period.
[b] Five-year relative survival could not be calculated as no cases had a full five years of follow-up.

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Appendices

AI Abbreviations

ALL	Acute lymphoblastic leukaemia
AML	Acute myeloid leukaemia
AYA	Adolescents and young adults
CI	Confidence Interval
CHOC	Children's Haematology and Oncology Centre
CNS	Central nervous system
COG	Children's Oncology Group
EUROCARE	European Cancer Registry
HL	Hodgkin lymphoma
IARC	International Association for Research on Cancer
ICCC-3	International Classification of Childhood Cancer, Third edition
ICD-O-3	International Statistical Classification of Diseases for Oncology, Third edition
LCH	Langerhans cell histiocytosis
MELAA	Middle Eastern, Latin American and African
MOH	Ministry of Health
NCCN	National Child Cancer Network
NHL	Non-Hodgkin lymphoma
NZCCR	New Zealand Children's Cancer Registry
NZCR	New Zealand Cancer Registry
POSG	Paediatric Oncology Steering Group
RB	Retinoblastoma
SEER	Surveillance Epidemiology and End Results (U.S. Cancer Statistics)
SIOP	Societe Internationale d'Oncologie Pediatrique (International Society of Paediatric Oncology)
SIOPEL	Societe Internationale d'Oncologie Pediatrique – Epithelial Liver Tumour Study Group (recently renamed as the International Childhood Liver Tumors Strategy Group)
WHO	World Health Organisation

AII International Classification of Childhood Cancer, Third Edition (ICCC-3)[5]

The ICCC-3 classifies childhood cancers according to ICD-O-3 histology and site. Cancers are classified into 12 main diagnostic groups, which are further split into 47 subgroups. The following table assigns the morphology and topography codes of ICD-O-3 to the ICCC-3 main diagnostic groups and subgroups.

Table AII International Classification of Childhood Cancer, Third Edition[5]

Diagnostic group/subgroup	ICD-O-3 histology	ICD-O-3 site
I. Leukaemias, myeloproliferative diseases & myelodysplastic diseases		
(a) Lymphoid leukaemias	9820, 9823, 9826, 9827, 9831-9837, 9940, 9948	C000-C809
(b) Acute myeloid leukaemias	9840, 9861, 9866, 9867, 9870-9874, 9891, 9895-9897, 9910, 9920, 9931	C000-C809
(c) Chronic myeloproliferative diseases	9863, 9875, 9876, 9950, 9960-9964	C000-C809
(d) Myelodysplastic syndrome and other myeloproliferative diseases	9945, 9946, 9975, 9980, 9982-9987, 9989	C000-C809
(e) Unspecified and other specified leukaemias	9800, 9801, 9805, 9860, 9930	C000-C809
II. Lymphomas and reticuloendothelial neoplasms		
(a) Hodgkin lymphomas	9650-9655, 9659, 9661-9665, 9667	C000-C809
(b) Non-Hodgkin lymphomas (except Burkitt lymphoma)	9591, 9670, 9671, 9673, 9675, 9678-9680, 9684, 9689-9691, 9695, 9698-9702, 9705, 9708, 9709, 9714, 9716-9719, 9727-9729, 9731-9734, 9760-9762, 9764-9769, 9970	C000-C809
(c) Burkitt lymphoma	9687	C000-C809
(d) Miscellaneous lymphoreticular neoplasms	9740-9742, 9750, 9754-9758	C000-C809
(e) Unspecified lymphomas	9590, 9596	C000-C809
III. Central Nervous System and miscellaneous intracranial and intraspinal neoplasms		
(a) Ependymomas and choroid plexus tumour	9383, 9390-9394	C000-C809
(b) Astrocytomas	9380	C723
	9384, 9400-9411, 9420, 9421-9424, 9440-9442	C000-C809
(c) Intracranial and intraspinal embryonal tumours	9470-9474, 9480, 9508	C000-C809
	9501-9504	C700-C729
(d) Other gliomas	9380	C700-C722,C724-C729, C751, C753
	9381, 9382, 9430, 9444, 9450, 9451, 9460	C000-C809
(e) Other specified intracranial and intraspinal neoplasms	8270-8281, 8300, 9350-9352, 9360-9362, 9412, 9413, 9492, 9493, 9505-9507, 9530-9539, 9582	C000-C809
(f) Unspecified intracranial and intraspinal neoplasms	8000-8005	C700-C729, C751-C753
IV. Neuroblastoma and other peripheral nervous cell tumours		
(a) Neuroblastoma and ganglioneuroblastoma	9490, 9500	C000-C809
(b) Other peripheral nervous cell tumours	8680-8683, 8690-8693, 8700, 9520-9523	C000-C809
	9501-9504	C000-C699, C739-C768, C809
V. Retinoblastoma	9510-9514	C000-C809

Table AII (cont.) International Classification of Childhood Cancer, Third Edition[5]

Diagnostic group/subgroup	ICD-O-3 histology	ICD-O-3 site
VI. Renal tumours		
(a) Nephroblastoma and other non-epithelial renal tumours	8959, 8960, 8964-8967	C000-C809
	8963, 9364	C649
(b) Renal carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8155, 8190-8201, 8210, 8211, 8221-8231, 8240, 8241, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8401, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8576	C649
	8311, 8312, 8316-8319, 8361	C000-C809
(c) Unspecified malignant renal tumours	8000-8005	C649
VII. Hepatic tumours		
(a) Hepatoblastoma	8970	C000-C809
(b) Hepatic carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8140, 8141, 8143, 8155, 8190-8201, 8210, 8211, 8230, 8231, 8240, 8241, 8244-8246, 8260-8264, 8310, 8320, 8323, 8401, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8576	C220, C221
	8160-8180	C000-C809
(c) Unspecified malignant hepatic tumours	8000-8005	C220, C221
VIII. Malignant bone tumours		
(a) Osteosarcomas	9180-9187, 9191-9195, 9200	C400-C419, C760-C768, C809
(b) Chondrosarcomas	9210, 9220, 9240	C400-C419, C760-C768, C809
	9221, 9230, 9241-9243	C000-C809
(c) Ewing tumour and related sarcomas of bone	9260	C400-C419, C760-C768, C809
	9363-9365	C400-C419
(d) Other specified malignant bone tumours	8810, 8811, 8823, 8830	C400-C419
	8812, 9250, 9261, 9262, 9270-9275, 9280-9282, 9290, 9300-9302, 9310-9312, 9320-9322, 9330, 9340-9342, 9370-9372	C000-C809
(e) Unspecified malignant bone tumours	8000-8005, 8800, 8801, 8803-8805	C400-C419
IX. Soft tissue & other extraosseous sarcomas		
(a) Rhabdomyosarcomas	8900-8905, 8910, 8912, 8920, 8991	C000-C809
(b) Fibrosarcomas, peripheral nerve sheath tumours, and other fibrous neoplasms	8810, 8811, 8813-8815, 8821, 8823, 8834-8835	C000-C399, C440-C768, C809
	8820, 8822, 8824-8827, 9150, 9160, 9491, 9540-9571, 9580	C000-C809
(c) Kaposi sarcoma	9140	C000-C809

Table AII (cont.) International Classification of Childhood Cancer, Third Edition[5]

Diagnostic group/subgroup	ICD-O-3 histology	ICD-O-3 site
(d) Other specified soft tissue sarcomas	8587, 8710-8713, 8806, 8831-8833, 8836, 8840-8842, 8850-8858, 8860-8862, 8870, 8880, 8881, 8890-8898, 8921, 8982, 8990, 9040-9044, 9120-9125, 9130-9133, 9135, 9136, 9141, 9142, 9161, 9170-9175, 9231, 9251, 9252, 9373, 9581	C000-C809
	8830	C000-C399, C440-C768, C809
	8963	C000-C639, C659-C699, C739-C768, C809
	9180, 9210, 9220, 9240	C490-C499
	9260	C000-C399, C470-C759
	9364	C000-C399, C470-C639, C659-C699, C739-C768, C809
	9365	C000-C399, C470-C639, C659-C768, C809
(e) Unspecified soft tissue sarcomas	8800-8805	C000-C399, C440-C768, C809
X. Germ cell tumours, trophoblastic tumours, and neoplasms of gonads		
(a) Intracranial and intraspinal germ cell tumours	9060-9065, 9070-9072, 9080-9085, 9100, 9101	C700-C729, C751-C753
(b) Malignant extracranial and extragonadal germ cell tumours	9060-9065, 9070-9072, 9080-9085, 9100-9105	C000-C559, C570-C619, C630-C699, C739-C750, C754-C768, C809
(c) Malignant gonadal germ cell tumours	9060-9065, 9070-9073, 9080-9085, 9090, 9091, 9100, 9101	C569, C620-C629
(d) Gonadal carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8143, 8190-8201, 8210, 8211, 8221-8241, 8244-8246, 8260-8263, 8290, 8310, 8313, 8320, 8323, 8380-8384, 8430, 8440, 8480-8490, 8504, 8510, 8550, 8560-8573, 9000, 9014, 9015	C569, C620-C629
	8441-8444, 8450, 8451, 8460-8473	C000-C809
(e) Other and unspecified malignant gonadal tumours	8590-8671	C000-C809
	8000-8005	C569, C620-C629
XI. Other malignant epithelial neoplasms and malignant melanomas		
(a) Adrenocortical carcinomas	8370-8375	C000-C809
(b) Thyroid carcinomas	8010-8041, 8050-8075, 8082, 8120-8122, 8130-8141, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480, 8481, 8510, 8560-8573	C739
	8330-8337, 8340-8347, 8350	C000-C809
(c) Nasopharyngeal carcinomas	8010-8041, 8050-8075, 8082, 8083, 8120-8122, 8130-8141, 8190, 8200, 8201, 8211, 8230, 8231, 8244-8246, 8260-8263, 8290, 8310, 8320, 8323, 8430, 8440, 8480, 8481, 8500-8576	C110-C119

Table AII (cont.) International Classification of Childhood Cancer, Third Edition[5]

Diagnostic group/subgroup	ICD-O-3 histology	ICD-O-3 site
(d) Malignant melanomas	8720-8780, 8790	C000-C809
(e) Skin carcinomas	8010-8041, 8050-8075, 8078, 8082, 8090-8110, 8140, 8143, 8147, 8190, 8200, 8240, 8246, 8247, 8260, 8310, 8320, 8323, 8390-8420, 8430, 8480, 8542, 8560, 8570-8573, 8940, 8941	C440-C449
(f) Other and unspecified carcinomas	8010-8084, 8120-8157, 8190-8264, 8290, 8310, 8313-8315, 8320-8325, 8360, 8380-8384, 8430-8440, 8452-8454, 8480-8586, 8588-8589, 8940, 8941, 8983, 9000, 9010-9016, 9020, 9030	C000-C109, C129-C218, C239-C399, C480-C488, C500-C559, C570-C619, C630-C639, C659-C729, C750-C768, C809
XII. Other and unspecified malignant neoplasms		
(a) Other specified malignant tumours	8930-8936, 8950, 8951, 8971-8981, 9050-9055, 9110	C000-C809
	9363	C000-C399, C470-C759
(b) Other unspecified malignant tumours	8000-8005	C000-C218, C239-C399, C420-C559, C570-C619, C630-C639, C659-C699, C739-C750, C754-C809

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