Cancer Trends

Trends in cancer survival by ethnic and socioeconomic group

New Zealand 1991–2004

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Statistics New Zealand security statement

CancerTrends was initiated by Professor Tony Blakely and his colleagues from the University of Otago, Wellington. It was approved by the Government Statistician as a data laboratory project under the microdata access protocols. All research publications are based on researcher-initiated ideas.

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the authors, not Statistics New Zealand.

Ministry of Health disclaimer

Opinions expressed in this report are those of the authors only and do not necessarily reflect policy advice provided by the Ministry of Health.

Abbreviations

CI	confidence interval
EM	excess mortality
EMRR	excess mortality rate ratio
HL	Hodgkin's lymphoma
ICD	International Classification of Diseases
NHL	Non-Hodgkin's lymphoma
NZCMS	New Zealand Census – Mortality Study
NZCR	New Zealand Cancer Registry
PSA	prostate-specific antigen
RSR	relative survival ratio
SAS	Statistical Analysis System
SEP	socioeconomic position

Foreword

Cancer is a major public health challenge in New Zealand, as in other developed countries. It ranks second as a cause of health loss (after cardiovascular disease) for males and first for females. Cancer incidence provides an important measure of the performance of our health promotion and disease prevention efforts. Cancer survival provides useful information on the quality of cancer treatment services, for policy makers and clinicians alike.

This report presents important new information on trends and inequalities in cancer survival for 21 cancers diagnosed in New Zealand over a 13-year period, from 1991 to 2004. These analyses are based on linking New Zealand Cancer Registry data, anonymously and probabilistically, to Census records.

A key finding of this report is that for all cancers and for both Māori and non-Māori, there was on average a 3% annual improvement in cancer survival. This reflects high quality health sector performance, leading either to earlier diagnosis (when cure is more likely), or to improved treatment of cancer once diagnosed.

Survival for both Māori and non-Māori improved over time, and there was no observed widening of the gap between the ethnic groups, for any cancer type. However unacceptably large gaps in survival still persist between Māori and non-Māori for some cancers. This is clearly a major challenge for the health sector. One explanation for this persistent gap may be the higher prevalence of concurrent diseases for Maori – the co-occurrence of other diseases, such as diabetes or heart disease, together with the cancer may restrict the ability of patients to tolerate certain cancer treatments and so lead to poorer cancer treatment outcomes. Differences in the stage of disease when a cancer is diagnosed, as well as differences in access to and coordination of cancer treatment services, may also explain some of the ethnic (and socioeconomic) inequalities in cancer survival.

Gaps in survival between high and low income groups were less marked than gaps by ethnicity across all cancers, yet improvements in survival over time for low income groups were less than those experienced by high income groups – as a consequence the observed relationship between socioeconomic measures and poor survival outcomes increased over time for many cancers. As with ethnic inequalities, this is a major research, clinical and policy challenge for the health sector.

This report also highlights the importance of the data collected by the New Zealand Cancer Registry for monitoring cancer outcomes, and the added value gained from linking this data to census data by University of Otago researchers and Statistics New Zealand. It also draws attention to the need for better integration of clinical data with cancer registry data in order to answer questions about what is driving changes in survival over time – and in particular to understand the reasons for trends in ethnic and socioeconomic inequalities in cancer survival.

Comments on this report are welcomed and should be sent to Health and Disability Intelligence, Policy Business Unit, Ministry of Health, PO Box 5013, Wellington.

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Executive Summary

Background

Inequalities in cancer survival between ethnic and socioeconomic groups are known to exist in New Zealand. However, trends over time in survival by ethnic and socioeconomic group, and the change in ethnic and socioeconomic cancer survival inequalities, have not previously been purposely analysed. CancerTrends, a record linkage study of Census records, cancer registrations and mortality data, allows the estimation of trends in social inequalities in relation to cancer patient survival from 1991 onwards.

Objective

The objective is to present trends in survival for 21 cancers in the adult population (aged 15–99 years) from 1991 to 2004, by:

- ethnic group (Māori compared to non-Māori)
- income group (patients in the lowest income group compared to patients in the highest income group)

and gaps in survival between:

- Māori and non-Māori, averaged over time and for any change over time
- low- and high-income groups, averaged over time and for any change over time.

Methods

Record linkage

Five Censuses were anonymously and probabilistically linked to cancer registrations, creating five separate cohort studies of the entire population (1981–1986, 1986–1991, 1991–1996, 1996–2001 and 2001–2004. Mortality records from 1988 were also linked, and patients were followed up to the end of 2006. Only data from 1991 was used due to approximately a third of mortality records considered to be missing during the 1980s. The final data used in this study was for patients diagnosed between 1991 and 2004, with mortality follow-up to 2006 (see Table 1). More recent linked Census–cancer mortality data is not currently available, but should be (up to 2011) by 2013 or 2014.

Variables

Using Census records, ethnicity was categorised as Māori or non-Māori (those who did not identify as Māori). Household income, inflation-adjusted and equivalised for the number of people in the household, was categorised into tertiles and quintiles. Using Cancer Registry data, cancer sites were categorised using International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10) coding for 21 adult cancer sites. Records were excluded if (a) the patient was aged below 15 or above 99, (b) their basis of diagnosis was unknown or they were diagnosed with cancer at the time of death or they had zero survival time, (c) their ethnicity and/or income data was missing, (d) they were recorded as being *in situ* cases, or (e) their recorded sex was incompatible with the cancer site.

Background (expected) mortality

Ethnic, income and combined ethnic- and income-specific period life tables were constructed for this study and used in both relative survival analyses and excess mortality rate modelling. The life tables were assembled for the periods 1991, 1996 and 2001. To account for ethnic and income variations in non-cancer mortality, cancer patient data were matched to these life tables by single year of age, sex, ethnicity, income and calendar period of diagnosis. The difference in observed mortality of cancer patients, and the expected mortality from these life tables, is that attributed to cancer.

Relative survival and excess mortality

Two measures of cancer survival are used in this report: relative survival and excess mortality. Relative survival is the proportion in the cancer patient population who survived, divided by the proportion who survived in a comparable population free of cancer. Excess mortality is the difference between the mortality experienced by the cancer patient population and the mortality likely to be experienced by a comparable population free of cancer.

The results of the excess mortality rate modelling are more frequently described in this report because this methodological approach can more easily adjust for factors that might act as confounders in that they are commonly associated with cancer survival and the key exposures (ie, ethnicity and/or income) such as age, sex, ethnicity (for income analyses), time since cancer diagnosis, and calendar period. Due to limited data quality before the early 2000s, stage of disease is not included as a covariate in the excess mortality modelling.

Relative survival ratios

One-year and five-year cumulative relative survival ratios (RSRs) were estimated for each combination of cancer site, ethnic group and income tertile. These analyses were undertaken separately for each Census–cancer cohort (ie, separately for patients diagnosed during 1991–1996, 1996–2001 and 2001–2004). Only cancer registrations up to 31 December 2004 were available for linkage to the Census, resulting in a slightly smaller group of patients in the 2001 Census–cancer cohort. In this study, RSR estimates were not stratified by sex due to sparse data after stratification by ethnic group and income tertile. RSRs presented in this report are neither age- nor stage-standardised.

Excess mortality rates and rate ratios

Using a combined data set for patients diagnosed between 1991 and 2004, excess mortality for cancer patients was modelled using Poisson regression. The covariates included were:

- sex
- age group
- ethnicity
- income
- calendar period of diagnosis
- time since diagnosis (up to five years)
- interaction between the oldest two age groups and the first two years of follow-up since cancer diagnosis (older people have worse survival immediately post-diagnosis)
- interaction between ethnicity and calendar period (to test whether ethnic differences change over time)
- interaction between income and calendar period of diagnosis (to test whether income differences change over time).

Four Poisson regression models were run for each cancer site to estimate excess mortality rate ratios (EMRRs) with 95% confidence intervals (CIs). The first two models estimated ethnic trends in cancer patient survival (without and with the interaction between ethnicity and calendar year), and the second two models calculated income trends in cancer patient survival (without and with the interaction between income and calendar year).

Pooled summary EMRRs

In addition to estimating EMRRs for each of the 21 cancer sites, patterns across all cancer sites were determined and EMRRs pooled across cancer sites for ethnic and income differences in survival, and for any changes over time in EMRRs by ethnicity and income. Pooling was undertaken using inverse variance weighting of the 21 cancer site EMRRs. Separate pooled analyses were also undertaken for 20 cancer sites, excluding prostate cancer, due to the likely artefactual change in cancer survival over time relating to prostate cancer screening. Both sets of pooled estimates are described in this report.

Results: overall

Pooled across all cancers and social groups, survival improved over time, with a 3.0% annual reduction in the excess mortality rate (2.7% excluding prostate cancer). This equates to an EMRR per decade of 0.74 (95% CI 0.72, 0.76) or 0.76 (95% CI 0.74, 0.78) excluding prostate cancer). Further results are presented in section 3.1.

Ethnicity, averaged over time

Of the 21 cancer sites, 17 had an excess mortality rate that was higher for Māori compared to non-Māori by 10% or more. Pooled across all cancers, the EMRR comparing Māori to non-Māori was 1.29 (95% CI 1.24, 1.34), a 29% higher excess mortality on average for Māori cancer patients. Further results are presented in section 3.2.

Income, averaged over time

Of the 21 cancer sites, 11 had an excess mortality rate that was greater than or equal to 10% for the lowest income quintile compared to the highest income quintile. Pooled across all cancers, the EMRR comparing low to high income was 1.12 (95% CI 1.08, 1.15), a 12% higher excess mortality on average for low-income cancer patients. Further results are presented in section 3.3.

Ethnicity: changes over time

Changes in the cancer-site-specific ethnic EMRRs over time were measured with considerable statistical imprecision due to the small patient numbers for some cancer sites. For eight cancer sites the EMRR comparing Māori to non-Māori was estimated to *increase* by more than 10% per decade, but conversely eight cancer sites had an estimated 10% or more *decrease* per decade. In only one cancer site (pancreas) was there a statistically significant change over time: an increasing ethnic disparity in excess mortality (which with 21 cancer sites may just be a chance finding). Pooled across all cancers, the ratio change in the ethnic EMRR over time was estimated at 1.04 (95% CI 0.94, 1.14), with no clear pattern of changing ethnic differences in overall excess mortality over time.

In summary, there was no convincing evidence of either widening or narrowing gaps in excess cancer mortality by ethnicity over time. Further results are presented in section 3.4.

Income: changes over time

Changes in the income EMRR over time were also measured with statistical imprecision, but less so than for ethnicity. For 13 cancer sites the EMRR comparing low to high income was estimated to *increase* by more than 10% per decade, but in only one instance (kidney) did the confidence interval exclude the null. Only three cancer sites had an estimated 10% or more *decrease* per decade in the income EMRR. Pooled across all cancers, the ratio change in the income EMRR over time was estimated at 1.09 (95% CI 1.01, 1.17), a best estimate of a 9% per decade increase in the EMRR comparing low- to high-income groups.

In summary, when looking at patterns across all cancer sites there was some evidence of widening excess cancer mortality rate gaps by income over time. Further results are presented in section 3.5.

Results: by cancer site

Summarised below are:

- the changes over time in cancer survival for each cancer site[1]
- the evidence for ethnic or income differences for each cancer site, averaged over time[2]
- the change in the ethnic and income differences in cancer survival over time for breast, colorectal and lung cancers (Chapters 4, 5 and 6 address these cancers, respectively).

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[1] This report groups cancers into four groups based on: (a) no change in cancer survival over time; (b) a small improvement in cancer survival over time if excess mortality decreased between 1 and 14% every 10 years (ie, an EMRR between 0.86 and 0.99); (c) a moderate improvement in cancer survival over time if excess mortality decreased between 15 and 39% for every 10 years (ie, an EMRR between 0.85 and 0.61); and (d) a large improvement in cancer survival over time if excess mortality decreased by 40% or greater for every 10 years (ie, an EMRR of between 0.00 and 0.60). To help in interpreting statistical significance, this report describes the central estimates for both the RSR and EMRRs as well as their confidence intervals.

[2] This report describes ethnic or income inequalities in cancer survival if the ethnic or income excess mortality rate ratio is greater than or equal to 1.10. To help in interpreting statistical significance, this report describes the central estimates for both the RSR and EMRRs as well as their confidence intervals.

Bladder:	Excess mortality decreased moderately by 21% for every 10-year period, suggesting a moderate improvement in cancer survival over time. There was little evidence of an ethnic difference in survival, but a possible 15% greater excess mortality (poorer survival) for low-income patients.
Brain:	Excess mortality decreased by 6% every 10 years, suggesting a small improvement in cancer survival over time. There was little evidence for ethnic or income differences in survival.
Breast (female):	There was a large survival improvement over time for female breast cancer patients, with a 52% decrease in excess mortality for every 10-year period. Survival was better for non-Māori and the highest-income patients, with 37% greater excess mortality (poorer survival) for Māori patients and 28% greater excess mortality (poorer survival) for low-income patients. Māori excess mortality rates were greater than non-Māori, tending to be more so in the 1990s, with the ethnic difference in excess mortality reducing over time. The income difference in excess mortality probably remained stable over time. Further results are presented in section 4.3 (see also Figures 6 and 7).
Cervical:	Moderate improvements in survival were experienced over time, with a 25% decrease in excess mortality every 10 years. Māori patients had a 61% greater excess mortality (poorer survival) compared to non-Māori patients, and low-income patients had a 25% greater excess mortality (poorer survival) compared to high-income patients.
Colorectal:	There was a moderate increase in survival over time, with a 27% decrease in excess mortality every 10 years. Pooled over time, there was a 36% higher excess mortality for Māori and a 13% higher excess mortality for low-income people. Māori colorectal cancer excess mortality rates were greater than non-Māori rates and tended to be more so in the 1990s, with the ethnic difference in excess mortality reducing over time. There was a possible but small widening of the income gap in excess mortality over time. Further results are presented in section 5.3 (see also Figures 9 and 10).
Head, neck and larynx:	There was a small improvement in survival over time, with a 5% decrease in excess mortality for every 10 years. Survival was poorer for Māori and low-income patients, with a 37% and 28% greater excess mortality compared to non-Māori and high-income patients, respectively.
Hodgkin's lymphoma (HL):	There was a moderate improvement in survival over time, with a 30% decrease in excess mortality every 10 years. There was little evidence for ethnic or income differences in survival.

Kidney:	Excess mortality decreased every 10 years by approximately 30%, suggesting a moderate improvement in cancer survival over time. Averaged over time, there was some evidence for ethnic inequalities but little evidence for an income difference in survival. There was a statistically significant greater reduction in excess mortality among high-income people, but this may be a chance finding.
Leukaemia:	There was a large improvement in survival, with a 60% decrease in excess mortality every 10 years. There was some evidence for poorer survival for Māori and, to a lesser extent, poorer survival for low-income people over all time periods.
Liver:	There was a moderate improvement in survival over time, with a 32% decrease in excess mortality every 10 years. There was some evidence for non-Māori having better survival compared to Māori, but little evidence for an income difference in survival.
Lung:	There was a small improvement in survival over time, with a decrease in excess mortality of 11% every 10 years. There was evidence for ethnic and, to a lesser extent, income differences in excess mortality, with survival again being worse for Māori and low-income patients. There was a possible increase over time of both the ethnic and income gaps in excess mortality. Further results are presented in section 6.3 (see also Figures 12 and 13).
Melanoma:	There was a moderate improvement in survival over time, with a 39% decrease in excess mortality for every 10 years, with limited evidence of survival being better for non-Māori and high-income patients.
Non-Hodgkin's lymphoma (NHL):	There was a large improvement in survival over time, with a 44% decrease in excess mortality every 10 years. Non-Māori patients had better survival, but there was little evidence of any income difference in survival.
Oesophageal:	There was a small improvement in survival over time, with a 10% decrease in excess mortality every 10 years. Non-Māori patients experienced better survival, with Māori patients having 68% greater excess mortality (poorer survival) compared to non-Māori patients. There was some evidence that high-income patients also experienced better survival.
Ovarian:	There was a moderate improvement in survival over time, with a 39% decrease in excess mortality every 10 years. There was little evidence of ethnic or income differences in survival or excess mortality.
Pancreatic:	There was a very small improvement in survival over time, with a 2% decrease in excess mortality every 10 years. There was worse survival for Māori and low-income people pooled over time, and a statistically significant trend of faster reductions in excess mortality for non-Māori, but this may be a chance finding.

Prostate: There was a profound improvement in survival over time, with an 87% decrease in excess mortality every 10 years (at least in part due to artefactual changes relating to prostate cancer screening). Māori patients had 38% greater excess mortality compared to non-Māori, but there was little evidence of an income difference in survival.

Stomach: There was a small improvement in survival over time, with a 14% decrease in excess mortality every 10 years. There was some evidence of ethnic and income differences in excess mortality.

Testicular: There was a modest improvement in survival over time, with a 28% decrease in excess mortality every 10 years, but with little evidence of ethnic and income inequalities in cancer survival.

Thyroid: There was a large improvement in survival over time, with a 46% decrease in excess mortality every 10 years, with little evidence of ethnic or income differences.

Uterine: There was a moderate improvement over time in survival, with a 29% decrease in excess mortality every 10 years and with higher excess mortality for Māori and low-income patients.

Conclusions

Survival improved over time for all cancer sites. The magnitude of the average changes over time in survival differed by cancer site. In general, greater improvements in excess mortality rates were seen for cancers with good and moderate prognosis (ie, high likelihood of cure). For instance, breast and colorectal cancer, with a better than 50% chance of five-year survival, had substantial improvements in survival over time. In contrast, cancers with poor prognosis demonstrated little changes in survival over time (eg, lung and pancreatic cancers). These patterns and changes over time in survival are consistent with international findings.

Ethnic inequalities and, to a lesser extent, income inequalities, in cancer survival were reported for the majority of cancer sites. No single factor can explain these cancer survival inequalities, but they are most likely explained by differences between groups in stage at diagnosis, access to and quality of treatment, host (patient) factors, and possibly differential tumour biology.

There was too much statistical imprecision to draw robust conclusions about changing ethnic and income differences in survival (or, more precisely, excess mortality rates) *by cancer site*, but it was possible to look for patterns across all cancer sites. Doing so, we found evidence of faster reductions in the excess mortality rate among high-income people, such that the pooled EMRR for the interaction between income and calendar year (per decade) was 1.09 (1.01, 1.17; ie, the excess mortality rate ratio comparing low to high-income people was estimated to increase by 9% per decade, on average pooled across all cancer sites). There was no clear pattern of changing ethnic differences in excess mortality over time.

The above analyses should be redone once 2004–2011 cancer registrations are linked to Census data for income trends. Ethnic trends in cancer survival can probably be ascertained reasonably accurately without linkage to the Census, so long as health data sets continue to collect ethnicity in a manner that accords with Census collections.

Understanding changes over time in cancer survival can provide insight into the association between cancer survival and the introduction of improved early detection, screening, diagnostic and treatment technologies. Persistent and large ethnic gaps in cancer survival, and slower improvements in cancer survival over time for low-income people, reveal worrying inequalities and probable inequities in access to and through health services. Constant vigilance is required by the health system to prevent inequalities in cancer survival.

Part A:
Background and methods

Chapter 1: Background

Nearly one-third of all deaths in New Zealand in 2006 were due to cancer, and mortality rates for cancer now approach – and possibly exceed – those for cardiovascular disease. Cancer is among the largest contributors to the burden of disease in New Zealand, and its percentage contribution will probably increase in the future as the incidence and mortality of other diseases (in particular cardiovascular disease) diminish.

For these and other reasons, New Zealand, like many other countries, now has a Cancer Control Strategy.(1) That strategy has two purposes:

- to reduce the impact of cancer
- to reduce inequalities in the impact of cancer.

1.1 What do we know, and what more do we need to know, about trends in cancer survival by social group in New Zealand?

Multiple factors contribute to cancer survival inequalities. Cancer survival currently varies between ethnic and income groups, reflecting differences between groups in stage at diagnosis, the quality and timing of treatment, host factors such as co-morbidities, and possibly differential tumour biology.(2–7) There are also various possible explanations for changes over time in cancer survival, such as improved early detection and screening, improved cancer diagnosis and treatment, changes in the definition of a disease, and improved accuracy of the classification of clinical stages.(8)

Evaluating progress in cancer control requires the simultaneous interpretation of trends in incidence, mortality and survival.(8) A complete interpretation of cancer control requires knowledge of all three of these measures. Previous work from the New Zealand Census – Mortality Study and the CancerTrends study have provided estimates for trends by ethnicity and socioeconomic position on cancer mortality(9–14) and incidence,(15–18) respectively. This report focuses on trends by ethnicity and socioeconomic group in cancer patient survival.

Why is trend data important? It is important because it tells us what the situation was, currently is and potentially may be in the future – the latter aspect being particularly important for the purposes of health service planning and evaluation, and for the planning, funding and prioritisation of public health research. Understanding trends may also contribute to better understanding of the causes of cancer survival differences over time.

Trends in cancer survival by ethnicity and socioeconomic position provide a more complete picture for evaluating cancer control progress with regard to reducing inequalities. Recent data clearly demonstrates ethnic(19, 20) and (to a lesser extent) socioeconomic inequalities in survival.(21, 22) Furthermore, change over time in five-year relative survival between 1998 and 2007 has also been documented by the New Zealand Ministry of Health.(23) and recently updated to 2009.(75) The latter report differs from this report in that it covers a different time period, uses different methods to determine cancer survival and does not include socio-economic inequalities. Changes over time in cancer survival by ethnic group have also been studied in New Zealand using cause-specific survival methods.(24) However, trends in cancer survival by ethnicity and socioeconomic position, measured as both excess mortality and relative survival, have not been purposely examined.

The authors of this report hypothesise that survival will be improving over time for most cancers, but more so among non-Māori and among patients in the highest socioeconomic group. This is particularly so for cancers with good prognosis (for instance, cancers with a relative survival ratio of 0.70 and above). This widening in survival gaps will (theoretically) be most evident as new technologies and approaches are introduced, which is when they are usually more readily accessible by socially advantaged groups – the so-called inverse inequity hypothesis.(25) And then survival gaps will close again (in the absence of a new important treatment or approach) when everyone achieves full access to the innovation (eg, all hospitals have access to the treatment). Such widening and narrowing of survival gaps over time presupposes unequal access to innovations, which is unfortunately the case in most societies,(26) including New Zealand.(27) However, this is not inevitable, and a well-functioning public health system should mitigate such inequities. It should also be noted that survival gaps between social groups may change over time for other reasons, such as differing trends in co-morbidity and stage at presentation.

Returning to the inverse inequity hypothesis, there is some evidence that this has happened with cardiovascular disease (CVD) mortality in the last 30 years: CVD mortality has fallen dramatically overall, but more so among higher socioeconomic groups and non-Māori.(28, 29) Access in the 1990s to coronary artery bypass grafts (CABGs) and angioplasty was much worse for Māori than should have been the case given the mortality disparities,(30) but through the late 1990s and early 2000s there is evidence that the health system's response to Māori is slowly 'catching up', with Māori receiving more CABGs and angioplasties relative to non-Māori.(31) The authors of this report hypothesise that a similar pattern may be occurring for cancers as treatments to cure cancer slowly improve. However, the length of time analysed in this report (14 years) is too short to determine widening and closing gaps. We can only test for linear trends.

The inverse equity hypothesis in the context of trends over time in five-year relative survival ratios for female breast cancer and male rectal cancer was recently explored in England and Wales.(32) This study concluded that socioeconomic differences in tumour or patient factors were unlikely to explain the observed changes over time in socioeconomic inequalities in female breast and rectal cancer survival. They suggest that this may be partially explained by the introduction of different types of advances in cancer treatment. However, the conclusions are altered depending on whether one looks at trends in relative survival or excess mortality.(33) Excess mortality may be a better representation of the public health impact of ethnic and socioeconomic inequalities in cancer survival. This report will use both relative survival and excess mortality, but emphasises excess mortality.

1.2 Data and methodological issues relevant to this report

The New Zealand Cancer Registry (NZCR)

The NZCR was established in 1948 and is one of a number of national population-based cancer registries around the world. On 1 July 1994 the Cancer Registry Act 1993 and associated Cancer Registry Act Regulations came into force, mandating that all newly diagnosed malignant disease (with the exception of basal and squamous cell carcinomas of the skin) be notified to the NZCR. The Act and associated regulations defined, among other things, the scope of information to be reported to the NZCR, timeframes within which new cancers were to be reported and the manner in which they were to be reported. Importantly, the Act mandated reporting by pathologists in laboratories. The Act and Regulations are available at www.health.govt.nz. Note that benign neoplasms are not required to be reported to the NZCR.

Prior to the passing of the Act and Regulations, notification was conducted on a voluntary basis through forms that were sent to the Cancer Registry. Despite this, case ascertainment was thought to be relatively complete, for some cancers at least. However, from the mid-1980s, changes in the health system and increasing societal concerns about patient privacy resulted in declining case ascertainment and case information. This was thought to be particularly problematic in the case of cancers that did not require admission to hospital, such as melanoma and some cancers of the breast.(34) There has been no formal assessment of the extent of under-reporting of cancer incidence prior to the passing of the Act. Implementation of the Act resulted in a sharp increase in the number of melanomas registered. However, for other cancers the impact was much smaller. The effect on cancer incidence as a result of the enactment of the Cancer Registry Act 1993 has been detailed by Blakely et al.(35)

For any artefactual increase in cancer registrations to bias trends in ethnic and socioeconomic differences would require that under-registration of cancer before 1994 varied by ethnicity and socioeconomic status, and there is no empirical evidence for this. However, it is widely suspected that non-public-hospitalised cancer cases were those least likely to be registered prior to 1994 and therefore most likely to show an increase in incidence due to registration changes. In turn, people with these cancers were probably more likely to have a higher SEP and to be of non-Māori ethnicity. If that is true, it may cause a modest decrease in cancer incidence ratios for low compared to high income, and for Māori compared to non-Māori, after 1994. But the effects of any such differential outcome ascertainment bias by social position are likely to be modest, and probably applicable to incidence rates only – not survival.

New Zealand Mortality Collection

Accompanying the linkage of Census and cancer registrations, mortality data from 1988 to the end of 2006 were linked. The mortality data set classifies the underlying cause of death for all deaths registered in New Zealand. All deaths in New Zealand are legally required to be registered with the Department of Internal Affairs, and the Department releases this information to the Ministry of Health.

The Ministry of Health obtains information on cause of death from a number of sources. Cause of death is currently coded in ICD-10-AM 2nd edition, but deaths prior to 2000 are coded in ICD-9-AM. There has been no formal assessment of the accuracy of cause of death data over the 1988–2006 period. Given that the National Health Index numbering system was not introduced in New Zealand until the late 1980s, it was considered by the authors of this report that there were likely to be inaccuracies in the cause of death data, particularly in the late 1980s and early 1990s. The statistical methods employed in this report (relative survival estimation and excess mortality modelling) do not require accurate cause of death data. Specifically, the mortality follow-up variable used in this report was a binary variable of either having died during the study period or being alive at the end of follow-up.

The mortality database contains all deaths from 1988. Death records relating to cancer registrations prior to this time are incomplete, probably by about a third. Using mortality information for all deaths registered between 1980 and 1990 (inclusive), the CancerTrends study researchers attempted to find any missing deaths. However, no new mortality links were found.

Missing mortality data was considered by the authors of this report to bias relative survival and excess mortality results. This was tested by comparing the estimates of five-year relative survival for female breast, colorectal and lung cancers for patients diagnosed between 1988 and 1991 compared to patients diagnosed between 1991 and 1996. It was found that the relative survival estimates for patients diagnosed between 1988 and 1991 were overestimated compared to the estimates for patients diagnosed between 1991 and 1996. For example, the five-year relative survival for non-Māori and Māori lung cancer patients diagnosed between 1988 and 1991 was between 30 and 35%, but for patients diagnosed between 1991 and 1996 it was 8–13%. Thus, we assume that mortality linkage was only complete by 1991, meaning survival analyses pre-1991 cannot be reported with confidence.

Previous studies of ethnic and socioeconomic trends in cancer incidence and mortality have been undertaken for the period 1981 to 2004. The data analysed in this report is for patients diagnosed between 1991 and 2004, with mortality follow-up to 2006.

Measuring ethnicity

Census ethnicity (on the linked Census–cancer records) was used to define ethnic groups for survival analyses. The classification of ethnicity used in this report is consistent with the new statistical standard for ethnicity.(36) The following approach has been adopted for the purposes of this report.

- Ethnic group comparisons have been carried out for Māori cancer patients based on a total response output.
- The remaining New Zealand population (that is, all those not recorded as Māori using the total response output) has been used as the reference group, called non-Māori in this report.

It is acknowledged that, like any social grouping schema, ethnic categories represent heterogeneous groupings. Even the more coherent grouping, Māori, is heterogeneous, containing people from different iwi, and people who self-identify solely as Māori and people who self-identify as both Māori and belonging to another ethnic group or groups.

Measuring socioeconomic position

This report has used equivalised household income as the main measure of socioeconomic position (SEP), for the following reasons.

- Income can be inflation adjusted for each of the Census cohorts.
- Income can be divided into groups by five-year age group to take into account changes in the distribution of income over a life course.
- The number of income categories can be adjusted according to the statistical power required for different analyses (in this report we use both a three- and a five-category classification).
- The categories are clearly hierarchical and behave as ordinal variables, making analytical and interpretational tasks easier.
- Income correlates reasonably strongly with other measures of SEP, such as education and occupation.
- Equivalised household income allows for economies of scale (ie, the number of people in the household).

Measuring cancer survival

There are two main methods for quantifying cancer patient survival: cancer-specific survival and relative survival.(37, 38) Cancer-specific survival censors deaths from causes other than the cancer in question, and only attributes death from the cancer when it is coded as the primary cause of death on the mortality file. Relative survival measures deaths that are in excess of what would be expected for the study population if it did not have cancer. Relative survival does not require accurate cause of death data, only data on the proportion of the patients who died by the end of the study period, compared with an estimate of the proportion who would be expected to die in the absence of cancer, based on period life tables.

Relative cancer survival can either be expressed as a (hazard) rate or as a survival probability. In this report, the hazard rate is referred to as the excess mortality rate, where excess mortality is simply the difference between the mortality experienced by the cancer patient population and the mortality likely to be experienced by a comparable population free of cancer. Comparisons between population groups or time periods can be achieved in excess mortality modelling by determining excess mortality rate ratios (EMRRs) in Poisson regression models, where the dependent variable is 'excess mortality'; namely, the observed mortality minus the expected mortality.

Cancer survival probabilities can also be estimated. In this study, survival probabilities are referred to as a relative survival ratio (RSR), which is simply the proportion who survived in the cancer patient population divided by the proportion who survived in a comparable population free of cancer. Again, sub-population period life tables are required to determine expected survival, just as they are for expected mortality.

In this report, EMRRs are the primary results used to answer the two research objectives of presenting (a) cancer survival trends by ethnic group and income group and (b) gaps in survival between Māori and non-Māori and income groups, averaged over time and for any change over time. In addition, one-year and five-year relative survival ratios (probabilities) by ethnic group and income group were estimated to provide initial findings for ethnic and socioeconomic cancer survival trends over time, and to provide a more intuitive orientation for the reader.

Measures of inequality

The strength of an association between an exposure (such as income or ethnicity) and an outcome (such as cancer survival) can be measured on absolute or relative scales. Absolute scales indicate the absolute difference in survival probabilities (eg, the difference between the Māori and non-Māori five-year RSR), while relative scales indicate the ratio of rates.

In this report, absolute differences in one-year and five-year relative survival are reported to express the difference in survival between Māori compared to non-Māori patients and between low-income and high-income patients. For example, if non-Māori female breast cancer patients had a five-year relative survival ratio of 0.80 and Māori patients had a five-year relative survival ratio of 0.75, there would be an absolute ethnic difference of -0.05 for female breast cancer patients, suggesting that Māori have poorer female breast cancer survival compared to non-Māori patients.

On the relative scale, the ratio of excess mortality rates comparing patient groups are reported in this study. For instance, an EMRR of 1.50 means that Māori patients have 50% greater excess mortality compared to non-Māori patients. In the interests of space, however, we do not present excess mortality rate differences in this report. Thus our main analyses relating to *change* in inequalities over time analyse change in the ethnic and income EMRRs over time. Such analyses are coherent and statistically pliable, but it must be noted that different conclusions might be reached if trends were examined in the absolute difference in excess mortality rates, the absolute difference in relative survival, and the relative difference in relative survival.(33) These latter three ways of looking at change over time have statistical difficulties and cannot be easily 'averaged' across cancers. Although this is beyond the scope of this report, we will investigate such absolute versus relative metrics in future publications.

1.3 Report objectives

The objectives are to present cancer survival trends for 21 adult cancer sites from 1991–2004 by:

- ethnic group (Māori compared to non-Māori; numbers were too few for Pacific and Asian peoples)
- income group (patients in the lowest income group compared to patients in the highest income group)

and to assess gaps in cancer survival between:

- Māori and non-Māori, averaged over time and for any change over time
- income groups, averaged over time and for any change over time.

Chapter 2: Methods

2.1 Ethics and privacy

Approval for this project required a number of steps. In addition to procedures to gain routine ethics approval, a detailed application process was undertaken to gain approval for the data linkage from Statistics New Zealand (the government agency that conducts and analyses the Census) under that agency's data integration policy. The process of gaining approval under this policy includes obtaining a privacy impact assessment, consulting with the Privacy Commissioner and seeking the approval of the Government Statistician.

2.2 Data sets

New Zealand Cancer Registry

An overview of the NZCR has been provided in Chapter 1. Information held by the NZCR includes sociodemographic information as well as cancer-specific information, including the site of the cancer (according to ICD classification), morphology, and extent (stage) of disease. In this report, analyses using morphology and extent (stage) of disease are not included. However, excess mortality modelling using stage data will be available from the Burden of Disease Epidemiology, Equity and Cost-Effectiveness Programme.

New Zealand Census

The New Zealand Census of Population and Dwellings occurs five-yearly, around the first week of March, and is conducted by Statistics New Zealand. Post-enumeration surveys estimate that over 97% of the population completed a Census form in 1996 and 2001.(39) Information is collected on individuals and households, covering demographic, socioeconomic, and some health and disability issues (eg, the Census periodically asks about smoking and disability status, the latter solely to provide a sampling frame for the Postcensal Disability Survey).

2.3 Data linkage

The purpose of the project was to link all (or as many as possible) cancer records with the census record for the same person. Since the Census and cancer files do not contain names, probabilistic links were made on the basis of where the person lived and various demographic characteristics.

The cancer records to be linked with each Census had the following characteristics:

- the person was alive on the day of the Census
- a new cancer record was created in the period from the day after the Census up to the day of the next Census (inclusive)
- if there was more than one cancer for a person, only one record for that person was included in the data for linking; that one record included all information that could be used for linking from all records for the person.

An overview of the CancerTrends data set created by linking Census and NZCR was provided in the CancerTrends incidence report.(35) In summary, five closed cohorts were created, being the New Zealand usually resident population (all ages) on Census night of 1981, 1986, 1991, 1996 and 2001, followed up for incident cancer(s) until the subsequent Census or, in the case of the 2001 cohort, until 31 December 2004 (the date of the most recent Cancer Registry data available at the time of the study). Data from the New Zealand Mortality Collection was then linked for these five Census periods, with follow-up ending on 31 December 2006.

Table 1 shows the data set used in this study to estimate five-year relative cancer survival and excess mortality. Patients diagnosed between 1991 and 2004 were linked to 1991, 1996 and 2001 Census records. Mortality data was also linked until 2006.

Table 1: Period (years) of linked Census–cancer records (1991–2004) used in this study, with mortality follow-up (2006) to estimate five-year relative survival ratio

		Mortality follow-up															
		1991*	**1992**	**1993**	**1994**	**1995**	**1996***	**1997**	**1998**	**1999**	**2000**	**2001***	**2002**	**2003**	**2004**	**2005**	**2006***
Cancer registration period	1991	0–1	1–2	2–3	3–4	4–5											
	1992		0–1	1–2	2–3	3–4	4–5										
	1993			0–1	1–2	2–3	3–4	4–5									
	1994				0–1	1–2	2–3	3–4	4–5								
	1995					0–1	1–2	2–3	3–4	4–5							
	1996						0–1	1–2	2–3	3–4	4–5						
	1997							0–1	1–2	2–3	3–4	4–5					
	1998								0–1	1–2	2–3	3–4	4–5				
	1999									0–1	1–2	2–3	3–4	4–5			
	2000										0–1	1–2	2–3	3–4	5		
	2001											0–1	1–2	2–3	3–4	4–5	
	2002												0–1	1–2	2–3	3–4	4–5
	2003													0–1	1–2	2–3	3–4
	2004														0–1	1–2	2–3

* Census year

2.4 Data preparation

Once the data was linked, a number of steps were required to prepare it for analysis. These steps included (a) extracting records for adults aged 15–99 with a primary cancer in each Census–cancer cohort, (b) generating or recoding variables, (c) applying predetermined exclusion criteria in each Census cohort, and (d) creating a combined data set for all patients diagnosed during 1991–2004, including individual data sets for cancer site groupings.

Patients were excluded from final data sets if (a) they were aged below 15 years at the time of their cancer diagnosis; (b) they were aged above 99 years at the time of their cancer diagnosis; (c) the basis of their cancer registration was derived from their death certificate only, their basis of diagnosis was unknown or they had zero survival time; (d) their cancer registration was recorded as *in situ*; or (e) their recorded sex was incompatible with the cancer site.

Linkage bias

As shown by Blakely et al,(35) for any Census, between 18.3 and 26.8% of cancer records were unable to be linked. To correct for any linkage bias, and to avoid any underestimation of rates using the linked data sets, weights were calculated for strata based on age, sex, ethnicity and small-area deprivation. These weights were not able to be included in the relative survival and excess mortality analyses used in this report due to the prior development of statistical software programming used to estimate relative survival and excess mortality by Dickman et al.(40)

However, although linkage bias matters for calculating incidence, it probably does not matter for calculating survival. For survival analyses, incomplete linkage means some cancer records are 'lost', which may induce a selection bias. However, this selection bias will only arise if the RSR and EMRR are different in those lost compared to those linked. Because the majority of cancer records are linked (greater than 75% for the records included in this report), any difference among the excluded would have to be quite notable for a meaningful selection bias to result.

Thus, we cannot rule out selection bias in our survival analyses due to incomplete linkage, but such bias is likely to be modest or even negligible. Moreover, for selection bias to affect analyses of changes over time in ethnic and socioeconomic inequalities in survival would require varying amounts of selection bias over time, which seems less likely again.

Missing data

Inevitably in a large data set a certain amount of data will be missing. Table 2 shows the amount of data missing for household income by each cohort. Household income data is often missing because it cannot be calculated if a resident adult is absent on Census night or refuses to provide a personal income. (Ethnicity was also missing on occasion, but more rarely.)

Table 2: **Percentage of adults (15+ years) missing data on key analysis variables, by cohort**

	Percentage by cohort total aged 15+ years				
	1981–1986	**1986–1991**	**1991–1996**	**1996–2001**	**2001–2004**
Household income data present	81.1%	83.5%	84.3%	81.6%	79.9%
Household income data absent	18.9%	16.5%	15.7%	18.4%	20.1%

The authors attempted to impute for missing income, but the results were deemed unsatisfactory (see the Technical Report for details).(41) This study therefore only carried out analyses where complete data for the variables was available, as follows.

- Records with missing ethnicity data were excluded from RSR estimation by ethnic group.
- Records with missing income data were excluded from RSR calculation by income strata.
- Records with missing ethnicity or income data were excluded from all excess mortality modelling.

Protection of data confidentiality

Original Census–cohort patient count data used in the relative survival and excess mortality analyses has been transformed to protect the confidentiality of Census data. Specifically:

- cells at or below the threshold value of 5 are suppressed, and higher counts are released
- all patient counts (and totals) have been randomly rounded to base 3
- any derivation from patient counts (percentages and ratios, for example) were random rounded.

Some variation in the reporting of patient data reported throughout this report is due to the random rounding rule. Relative survival ratios and excess mortality rates, and their respective 95% confidence intervals, were not required to be random rounded.

2.5 Variable definitions and categorisation

Age and date variables

Use of linked Census–cancer data required the manipulation of existing variables or the creation of new variables. Age and date variables are described below.

Age at census in months (three-digit variable): existing variable

The Census–cancer data sets contained a variable for an individual's age in months at the time of the Census. This variable was used to calculate an individual's age in years at cancer registration and age in years at death or end of study follow-up.

Age at cancer registration in months (three-digit variable): existing variable

The Census cohort data sets contained a variable for an individual's age in months at the time of their cancer diagnosis.

Age at cancer registration in years (three-digit variable): existing variable

The Census cohort data sets contained a variable for an individual's age in months at the time of their cancer diagnosis.

Date of cancer diagnosis (date/month/year format): new variable

The exact date of cancer diagnosis, as provided by the New Zealand Cancer Registry, was suppressed on the Census–cancer data sets to protect confidentiality. A proxy date of cancer diagnosis was constructed by using existing variables on the Census cohort data set for an individual's age in months at Census and age in months at cancer diagnosis, as well as the Census date created above. The approximated date of diagnosis was constructed using the following data steps:

1. rounding an individual's age in months at cancer diagnosis to the nearest 1
2. calculating the difference between an individual's age in months at their cancer diagnosis and their age in months at the Census date
3. manipulating this difference into days
4. approximating the date of cancer diagnosis by adding the difference in days to the Census date.

Year of diagnosis (single year format): new variable

A new variable to represent the calendar year in which a patient was diagnosed with cancer was created based on the approximate date of diagnosis. The following sections of this chapter detail how calendar year in the cancer population and in the population free of the disease studied are matched to the same variable in the population mortality life tables.

Vital status (one-digit variable): new variable

Cause-of-death data available from mortality records linked to the Cancer Registry, either due to an individual's primary cancer or other cause, was suppressed on the Census cohort data sets. Thus, if an individual was recorded as having a date of death in the Census cohort data set, they were coded as being dead and it was assumed that those individuals that did not have a date of death were alive at the end of follow-up. The Census cohort data contained a variable called 'Dead', which was renamed 'Status' and recoded.

Date of death (date/month/year format): new variable

The exact date of death linked to an individual's cancer registration was suppressed on the Census cohort files to protect confidentiality. A proxy date of death was calculated by:

1. calculating the difference between an individual's age at death in months and the age in months at which they were diagnosed with cancer
2. manipulating this difference into days
3. approximating the death date by adding the difference in days calculated in 2. to the individual cancer diagnosis date.

Ethnicity

The conceptually important aspect of classifying ethnicity has been addressed in Chapter 1. The wording of ethnicity questions has varied across censuses, rendering consistent ethnic classification problematic.(42)

Equivalised household income

Equivalised household income is the main measure of SEP used in this report. In households of different size and composition, different incomes produce similar standards of living (because of economies of scale). The revised Jensen index(43, 44) has been used to equivalise household incomes for this report. Household income has also been adjusted for inflation using the Consumer Price Index (CPI; base year 2001). The methods used to create household equivalised incomes were presented in Blakely et al.(35)

The excess mortality analyses in this report employ quintiles of CPI-adjusted equivalised household incomes, treated as a continuous variable (coded 0, 0.25, 0.5, 0.75, 1, such that EMRRs were for the midpoint of the lowest compared to the midpoint of the highest quintiles). The relative survival analyses in this report were constructed using categorical tertiles of equivalised household income.

To create these income tertiles or quintiles, first, household equivalised incomes were calculated for each household. Then each individual in that household was assigned the value of the household equivalised income. All cohorts were then pooled, and individuals were grouped into five-year age groups (sexes combined), up to the age of 65 (one group comprised everyone aged over 65). The individuals in each age group were then ranked by household income and divided into three equal-sexed groups for tertiles and quintiles, respectively. Records were then disaggregated back to their original cohorts.

This approach to creating income tertiles and quintiles differs from that used in the New Zealand Census – Mortality Study. A new approach was needed due to the inclusion of older age groups in Cancer Trends (the NZCMS did not analyse data for people older than 77 years). The clustering of incomes around the dollar value of New Zealand's government-funded superannuation entitlement in this older age group means that its income distribution is very different to that of younger age groups, making age-specific income thresholds helpful for interpretation purposes. However, by pooling all cohorts before determining age-specific cut-points, the impact of widening income inequality between the 1980s and 1990s will still be evident in regression-based measures of inequalities, as the proportionate distribution of any given age group by income tertile or quintile varies over time due to underlying changes in income inequality.

Cancer site groupings

Table 3 shows the cancer site groupings and ICD10 codes used in this report, along with those of cancer site groupings used in the previous cancer patient survival estimates from the Ministry of Health. In the majority of cases, the cancer site definitions used in this report were the same as those in the previous cancer survival reports published by the Ministry of Health. Bone and connective tissue cancers and myeloma were not reported due to sparse data.

Table 3: Cancer site groupings used in this report

Cancer	Cancer patient survival, 1994–2007[(23)] ICD10 codes	This report ICD10 codes
All cancers	C00–96	
Bladder	C67	C67
Bone and connective tissue	C40–41	
Brain	C71	C71 (malignant tumours only)
Breast (female)	C50	C50
Cervix	C53	C53
Colon, rectum, sigmoid, anus	C18–21	C18–21
Head, neck and larynx	C01–14,C32	C01–14,C32
Hodgkin's disease	C81	C81
Kidney and other urinary	C64–66, C68	C64–66, C68
Leukaemia	C91–95	C91–93
Liver	C22	C22
Lung, trachea, bronchus	C33–34	C33–34
Melanoma	C43	C43
Myeloma	C90	
NHL	C82–85, C96	C82–85, C96
Oesophagus	C15	C15
Ovary	C56	C56
Pancreas	C25	C25
Prostate	C61	C61
Stomach	C16	C16
Testis	C62	C62
Thyroid gland	C73	C73
Uterus	C54–55	C54–55

Prostate cancer

Pooled EMRR estimates are calculated across all 21 cancer sites and across 20 cancer sites excluding prostate cancer. Care must be taken when interpreting survival trends for cancers potentially identified through screening. If a cancer is diagnosed earlier, the survival time will, by definition, be longer even if the outcome is unchanged. Furthermore, screening for cancer tends to result in the identification of inconsequential disease which would not have become apparent in the absence of screening. This results in both an increase in incidence of these cancers and an apparent improvement in survival, even if mortality rates from the cancer in question are unchanged. For these reasons, there is considerable controversy as to whether screening for prostate cancer decreases prostate cancer mortality, but without doubt the large increase in diagnosed cases greatly improves the *observed* survival. Thus pooled EMRR estimates calculated here are given including and excluding prostate cancer estimates.

2.6 Analyses

Follow-up time

We estimated five-year relative survival using two approaches for follow-up time: the cohort (where all patients have been followed up for the survival period of interest) and the hybrid approach (a combination of the cohort approach with the period approach, where survival data from the most recent calendar period is used).(45-48) Follow-up ended on 31 December 2006, so all patients diagnosed as part of the 1991–1996 and 1996–2001 Census–cancer cohorts contributed to the estimation of survival up to five years after cancer diagnosis. Thus, the cohort approach was applied because all patients had been followed up for at least the duration of survival being estimated.

For patients diagnosed during the 2001–2004 period, five-year survival could not be estimated using the cohort approach because only the patients diagnosed in 2001 had been followed up for more than five years. Instead, the hybrid approach was used, which combines the cohort and period approaches to include follow-up from the most recent calendar period. The hybrid approach was used in both relative survival and excess mortality rate analyses.

Relative survival and excess mortality rate modelling

Relative survival methods (Dickman and Adami 2006; Sarfati et al 2010; Dickman et al 2004; Dickman et al 1998)(8, 37, 38, 49) have been applied to New Zealand Cancer Registry data by both the Ministry of Health(23) and university researchers (Jeffreys et al 2005, 2009; Sarfati et al 2010).(19, 50, 51) There are also extensive cross-sectional estimates of cancer-specific survival using Kaplan–Meier and Cox proportional hazards modelling for the total population, and for Māori and non-Māori (for instance Robson et al 2006; Robson et al 2010).(52, 53)

Relative survival is the ratio difference between observed and expected (in the absence of the disease in question – in this case cancer) survival. More precisely, we can define it as follows:

relative survival ratio $_t$ (RSR) = (observed survival $_t$) / (expected survival $_t$)

The observed survival is that up to t years post-diagnosis in the cancer patient cohort, *regardless of the cause of death*, and the expected survival is that determined for a comparable cohort based on population life tables; in our case, 1991, 1996 and 2001 period life tables.

Relative survival and excess mortality are mirror image concepts. The excess mortality rate is simply the difference between the mortality rate of the cancer populations and the background population mortality rates. Excess mortality rates are hazards, and are expressed per unit of time.

Excess mortality rate modelling

Assuming a Poisson distribution of excess deaths due to cancer, the excess mortality model can be written as:

$$\ln(u_j - d_j^*) = \ln(y_j) + x\beta + c_j$$

where:

u_j = observed number of all deaths

d_j^* = expected number of deaths for observation j, due to causes other than the cancer of interest and estimated from general population mortality rates

j = person time for observation j (ie, offset)

x = vector of variables that predict excess mortality to calculate ethnic trends in cancer patient survival: ethnicity (binary variable for Māori:non-Māori); calendar period (change per 10 years of cancer diagnosis); sex, age group (four-level categorical variable: 15–54, 55–64, 65–74, 75+); years (t) of follow-up following cancer registration (five-level); interaction between ethnicity and calendar period, and interactions between the latter two age groups and the first two years of follow-up to allow for commonly observed higher initial excess mortality for older people early in follow-up (65–74, first year; 75+, first year; 65–74, second year; 75+, second year; all other age-by-year combinations as reference)

x = vector of variables that predict excess mortality to calculate income trends in cancer patient survival: income quintile (five-category level from highest to lowest income quintile, treated as continuous variable); ethnicity (binary variable for Māori:non-Māori); calendar period (change per 10 years of cancer diagnosis); sex; age group (four-level categorical variable: 15–54, 55–64, 65–74, 75+); years (t) of follow-up following cancer registration (five-level); interaction between income quintile and calendar period, and interactions between the latter two age groups and the first two years of follow-up to allow for commonly observed higher initial excess mortality for older people early in follow-up (65–74, first year; 75+, first year; 65–74, second year; 75+, second year; all other age-by-year combinations as reference)

c_j = Poisson error term.

Relative survival ratios by ethnic group and income group

Relative survival ratios by ethnic group

One-year and five-year relative survival ratios, with 95% confidence intervals, for Māori and non-Māori patients, were estimated for the three Census–cancer cohorts of patients diagnosed 1991–1996, 1996–2001 and 2001–2004.

Ethnic differences in relative survival

The absolute difference between the one-year and five-year relative survival estimates for Māori patients and non-Māori patients was calculated. It is reported as negative if survival was lower for Māori patients. It is reported as positive if survival was lower for non-Māori patients, and therefore survival was higher for Māori patients. These absolute differences were calculated for each Census–cancer cohort and for each cancer site and provide an initial indication of whether ethnic gaps in survival for individual cancer sites are changing over time.

Relative survival ratios by income tertile

One-year and five-year relative survival ratio estimates, with 95% confidence intervals, for high-, medium- and low-income patients, were estimated from linked Census–cancer cohorts for patients diagnosed during 1991–1996, 1996–2001 and 2001–2004.

Socioeconomic differences in one-year and five-year relative survival ratios

The absolute difference between the one-year and five-year relative survival estimates for patients in the lowest income tertile and patients in the highest income tertile were calculated. The difference is reported as negative if survival was lower for patients in the lowest income tertile. It is reported as positive if survival was lower for patients in the highest income tertile, and therefore survival was higher for patients in the lowest income tertile.

Age standardisation of relative survival estimates

The relative survival ratio estimate results presented in this report are not age standardised. Relative survival analysis age-standardisation techniques were trialled for the calculation of relative survival ratios by ethnic group and income group, including the use of different cancer patient weights and the application of grouped and individual weighting procedures.(54–56) However, age standardisation of the relative survival estimates was not able to be consistently applied across each cancer site and in each period of cancer diagnosis by ethnic group and income strata because of sparse data following stratification by ethnicity or income, particularly in the 1991–1996 cohort.

Appendix 2, however, provides age group distributions by ethnicity and income for patients diagnosed with female breast, colorectal and lung cancers in the 1991, 1996 and 2001 cohorts. Further, age-standardised one-year and five-year RSRs have been calculated, using an individual weighting approach,(54) with age weights derived from the 1996–2001 cohort for each cancer site individually. The central estimates for the age-standardised RSRs presented in Appendix 2 are marginally different to the non-age-standardised RSRs presented in the main body of the report, with only a 0.01–0.02 difference between the age-standardised and non-age-standardised RSRs. Therefore, the absolute ethnic and income differences in the one-year and five-year RSRs varied by 0.01–0.02 between the non-age-standardised and age-standardised RSRs, but the overall patterns stayed the same. The only exception was for Māori colorectal cancer patients diagnosed during 1991–1996, for whom the non-age-standardised five-year RSR was 0.38 compared to the age-standardised RSR of 0.45. This reduced the absolute ethnic gap from -0.18 to -0.11, respectively. Thus, readers should pay greater attention to the excess mortality rate modelling in this report (which can and does adjust for age and other covariates).

Computation

Relative survival ratios were estimated by using and extending the programme *strs*, developed by Dickman et al.(40) Relative survival analyses on unit record CancerTrends data (that is, the linked data sets) were conducted in the data laboratory of Statistics New Zealand. All analyses were conducted using Stata 10 software.(57)

Excess mortality rate ratios

The three individual linked Census–cancer cohorts were combined to construct a data set for all patients diagnosed during 1991–2004. A Stata software ‘do’ file was developed for this study, based on previous work by Dickman et al,(40) to run the excess mortality models for individual cancer sites.

The excess mortality modelling in this study adjusted for background mortality differences in both ethnicity and income. This was achieved by using period life tables that were matched to the cancer patient data by sex, single year of age, calendar period, ethnicity and income. As with the relative survival estimates, the life tables were centred on the calendar years 1991, 1996 and 2001.

Excess mortality models

Four excess mortality models using grouped data with a Poisson distribution were developed for this study. Models 1 and 2 provided EMRR estimates to assess ethnic trends in cancer patient survival. Models 3 and 4 provided EMRR estimates to investigate socioeconomic trends in cancer patient survival. These models are explained further below.

Ethnic trends in cancer patient survival

Model 1: The first model was the main effects model for ethnic trends in cancer patient survival. The ethnic EMRR described the additional excess mortality Māori patients experienced compared to non-Māori patients averaged over time. The calendar period EMRR described the change in excess mortality every 10-year period for both ethnic groups combined. The ethnic EMRR and calendar period EMRR are highlighted in the results tables.

Model 2: The second model investigated the change in the ethnic EMRR for every 10-year period. This was achieved by fitting an interaction term between ethnicity and calendar period of diagnosis where non-Māori patients were the reference category and the year of cancer diagnosis was centred on 1991. This interaction term is highlighted, along with the ethnic EMRR and the calendar period EMRR.

Socioeconomic trends in cancer patient survival

Model 3: The third model was the main effects model for income trends in cancer patient survival. The income EMRR described the additional excess mortality that patients in the lowest income quintile experienced compared to patients in the highest income quintile, averaged over time. The calculation of this income EMRR used the mid-points for all income quintile categories to derive the rate ratio of excess mortality between the lowest and highest income quintiles. The calendar period EMRR described the change in excess mortality every 10 years for all income quintiles combined. The income EMRR and the calendar period EMRR are highlighted in the results tables.

Model 4: The fourth model investigated the change in the income excess mortality rate ratio for every 10-year period where patients in the highest income quintile are the reference category. This was achieved by fitting an interaction term between income and calendar period of diagnosis. This interaction term is highlighted, along with the income EMRR and the calendar period EMRR.

Computation

Analyses on unit record CancerTrends data (that is, the linked data sets) were conducted in the data laboratory of Statistics New Zealand. All analyses were conducted using Stata 10 software.(57)

Pooling EMRRs across cancers

We created pooled EMRRs across cancer sites, using the log of the EMRRs and inverse variance weighting. A weighted average (or pooled summary) is the weighted sum of the results divided by the sum of the weights. In the inverse variance method, the weight for each result equals the inverse of the variance of the log of the EMRR for each cancer. Use of the inverse variance method allowed an assessment of patterns across all cancers of changes in survival over time, the ethnic and income differences in survival averaged over time, and changes in the ethnic and income differences in survival over time.

2.7 Linked and included patients

Number of patients linked to the census

Table 4 shows the number of cancer patients in this study aged 15–99 with a primary malignant cancer diagnosed between 1991 and 2004. NZCR data was used to construct this table. The number of patients from the NZCR data was then compared to the number of patients from linked Census–cancer cohort data. In this study of trends in cancer survival, approximately 80% of patients in the NZCR data were linked to Census records. Further detail of the record linkage is available elsewhere, as well as calculation of the positive predictive value for each cohort.(58, 59)

Table 4: **Number of cancer patients from NZCR data compared to the number linked to Census records at Statistics New Zealand**

Cohort	Number of cancer patients from NZCR data	Number linked to Census records	Percentage of people with cancer included in this survival trends study who were linked to a Census record
1991–1996	61,610	50,064	79
1996–2001	73,023	59,967	80
2001–2004	61,760	51,462	82

Number of excluded patients

Table 5 shows the number and percentage of adults who were excluded from relative survival and excess mortality analyses in this study. Between 6% and 9% of patients were excluded from analyses because their basis of diagnosis was death certificate only, their basis of diagnosis was unknown, or they had zero survival time. Between 11% and 15% of patients had missing income data compared to only 1% with missing ethnicity data.

The number and percentage of patients excluded from analyses has also been calculated by ethnic and income group, including those with missing ethnicity or missing income. This data is available from the authors if required.

Table 5: **Number and percentage of adults with a primary cancer diagnosis excluded, by data exclusion criteria and period of cancer diagnosis**

	Patients diagnosed 1991–1996		Patients diagnosed 1996–2001		Patients diagnosed 2001–2004	
	Number	**%**	**Number**	**%**	**Number**	**%**
Number of linked records	50,064		59,967		51,462	
Data restrictions						
Aged below 15 years at time of diagnosis	264	1	291	0	237	0
Aged above 99 years at time of diagnosis	15	0	18	0	21	0
Zero survival or death certificate only, or unknown basis of diagnosis	4746	9	3864	6	2889	6
Tumour *in situ*	129	0	0	0	6	0
Sex–site incompatibility	78	0	78	0	84	0
Missing ethnicity	159	0	495	1	522	1
Missing income	5484	11	8364	14	7659	15
Patients accepted for analyses in relative survival analysis by ethnic group	44,673	89	55,221	92	47,703	93
Patients accepted for analyses in relative survival analysis by income group	39,345	79	47,445	79	40,569	79
Patients accepted for analyses in excess mortality modelling	39,219	78	47,013	78	40,245	78

Number of included patients

Table 6 shows the number of patients included in the estimation of RSRs and EMRRs by ethnic group and income group by cancer site. To orient the reader, these numbers are summed by the total number of patients in the linked data set diagnosed between 1991 and 2004 rather than by the three Census-cancer cohorts shown above. The difference between the number of patients by ethnic group compared to income group relates to the number of patients excluded based on missing ethnicity or missing income. As was shown in Table 5, there was a larger percentage of patients with missing income compared to patients with missing ethnicity data. The final column in this table provides the number of patients included in excess mortality modelling. This column takes into account the exclusion of patients with both missing ethnicity and missing income data.

Table 6: **Number of adults aged 15–99 with a primary cancer included in the relative survival and excess mortality analyses**

Cancer site	ICD code	Patients diagnosed 1991–2004		
		Relative survival by ethnic group	Relative survival by income group	Excess mortality by ethnicity and income
Bladder	C67	5571	4890	4863
Brain	C71	2163	1842	1830
Breast (female)	C50	21,903	18,792	18,693
Cervix	C53	1987	1594	1578
Colorectum and anus	C18–21	25,764	22,614	22,467
Head, neck and larynx	C01–14, C32	3893	3243	3222
Hodgkin’s lymphoma	C81	612	510	507
Kidney, ureter and urethra	C64–66, C68	2934	2520	2502
Leukaemia	C91–95	4746	4056	4023
Liver	C22	1053	837	834
Lung, trachea and bronchus	C33–34	14,653	12,506	12,419
Melanoma	C43	16,098	14,067	13,083
Non-Hodgkin’s lymphoma	C82–85, C96	5281	4596	4569
Oesophagus	C15	2142	1839	1824
Ovary	C56	2712	2313	2289
Pancreas	C25	2730	2334	2316
Prostate	C61	24,009	21,201	21,045
Stomach	C16	3678	3105	3090
Testis	C62	1116	912	906
Thyroid gland	C73	1368	1107	1095
Uterus	C56	2931	2427	2412

2.8 Presentation of results

This report presents a synthesis of the descriptive data, RSR estimates and EMRR calculations assembled from this study in order to describe ethnic and socioeconomic trends in survival for 21 cancers in New Zealand. Specifically, it presents the results of analyses to answer the two primary research objectives: (a) what are the changes in survival by ethnic group and income stratum for cancer patients diagnosed in New Zealand between 1991 and 2004, followed up to 2006; and (b) are there changes in the ethnic and socioeconomic differences in survival for cancer patients diagnosed during 1991–2004?

The results are shown in three segments:

1. a summary across all cancers of overall *patterns* in ethnic and socioeconomic trends in cancer patient survival
2. a more in-depth presentation of ethnic and socioeconomic trends in cancer patient survival for female breast, colorectal and lung cancers – for these cancers, the excess mortality rate ratios were judged by the authors to be estimated with enough precision to warrant specific presentation
3. ethnic and socioeconomic trends in cancer patient survival for the remaining 18 cancer sites, without separate consideration of changes in ethnic or income cancer survival inequalities over time.

Part B:
Ethnic and income differences and trends in cancer survival

Chapter 3: Summary across all cancer sites

This chapter presents a summary across all sites of the overall patterns in ethnic and socioeconomic trends in cancer patient survival. Specifically, it summarises:

- changes in excess mortality (cancer survival) for every 10 years of cancer diagnosis
- the ethnic excess mortality rate ratio (Māori compared to non-Māori) averaged over time
- the income excess mortality rate ratio (lowest income compared to highest income) averaged over time
- the interaction between ethnicity and calendar period of diagnosis to assess changes over time in ethnic differences in survival
- the interaction between income and calendar period of diagnosis to assess changes over time in income differences in survival.

The subsequent chapters outline the relative survival and excess mortality results for individual cancer sites.

3.1 Changes in excess mortality (cancer survival) for every 10 years of cancer diagnosis

Figure 1 shows a summary across each cancer site of the change in excess mortality rate for every 10 years of cancer diagnosis. All central estimates for the calendar period EMRR were below 1, which is consistent with survival improving over time.

This report groups cancers into four categories:

a) no change in cancer survival over time

b) a small improvement in cancer survival over time if excess mortality decreased between 1 and 14% every 10 years (ie, an EMRR between 0.86 and 0.99)

c) a moderate improvement in cancer survival over time if excess mortality decreased between 15 and 39% for every 10 years (ie, an EMRR between 0.85 and 0.61)

d) a large improvement in cancer survival over time if excess mortality decreased by 40% or greater for every 10 years (ie, an EMRR of between 0.00 and 0.60).

Figure 1 and Table 7 show evidence of:

a) large improvements in survival over time (a greater than 40% decrease in excess mortality every 10 years) for female breast cancer, leukaemia, non-Hodgkin's lymphoma, and prostate and thyroid gland cancers

b) moderate improvements in survival over time (an 11–39% decrease in excess mortality every 10 years) for bladder, cervical, colorectal, kidney, liver, melanoma, ovarian, testicular and uterine cancers, and Hodgkin's lymphoma

c) small improvements in survival over time (a 1–10% decrease in excess mortality every 10 years) for brain, head and neck, lung, oesophageal, pancreatic and stomach cancers.

Pooled across cancer sites, the EMRR per decade was 0.74 (95% CI 0.72, 0.76) (or 0.76 [0.74, 0.78] excluding prostate cancer).[3] That is a 26% per decade, or 3.0% per annum, average reduction in the excess mortality rate (2.7% per annum excluding prostate cancer). However, it can be seen in Figure 1 that there is substantial heterogeneity among cancers, so the pooled estimate should be interpreted in that light – an average across cancers.

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[3] As noted in 'Cancer site groupings' in Chapter 2, the large survival increase over time for prostate cancer reported in this study is likely to be artefactual due to the increased use of prostate-specific antigen screening in New Zealand during the 1990s. Therefore, the pooled estimates have been estimated both including and excluding prostate cancer to account for this artefactual increase.

Figure 1: **Change every 10 years in excess mortality (EMRR by decade), by cancer site, for patients diagnosed during 1991–2004**

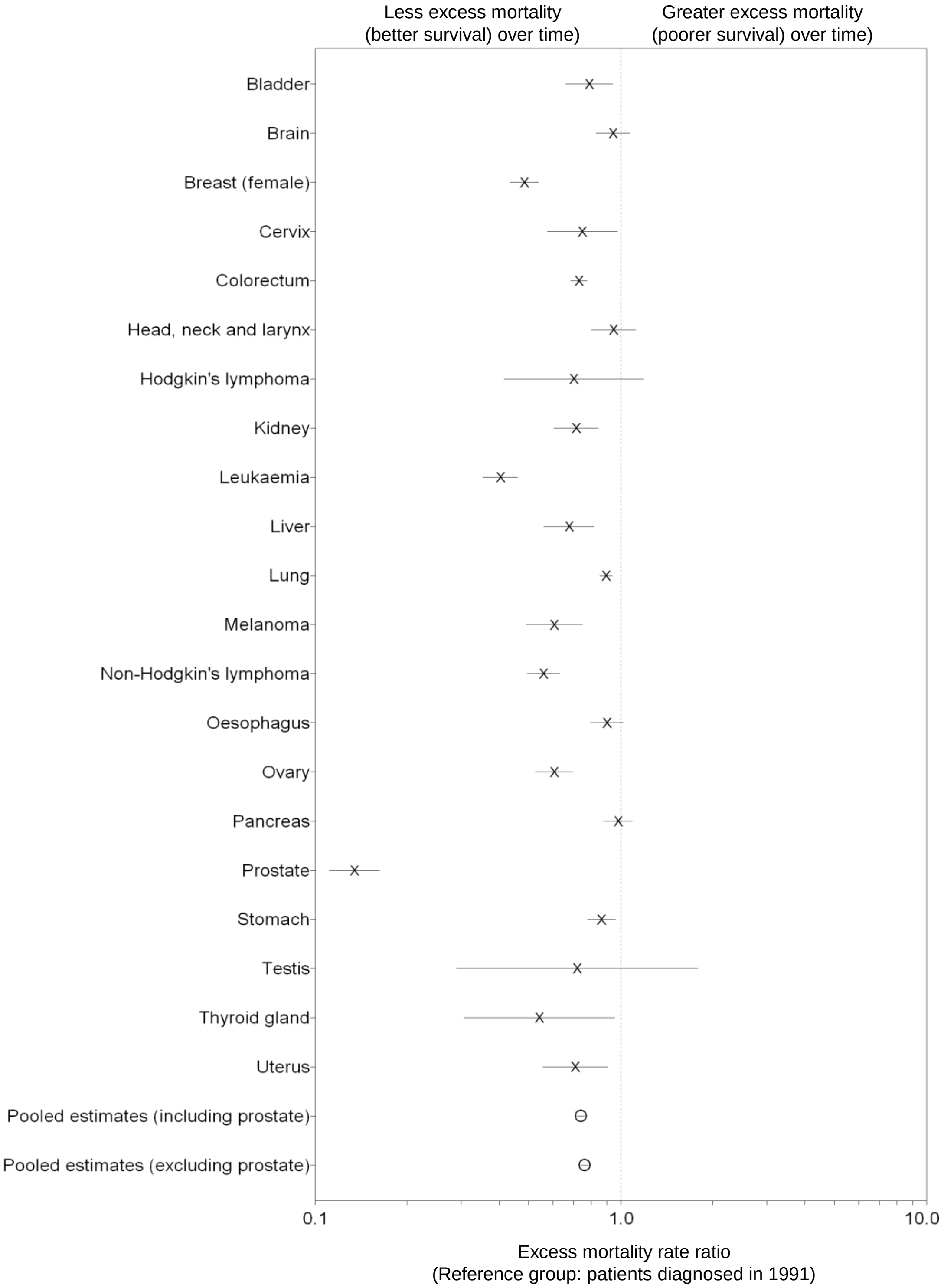


Table 7: **Calendar period EMRRs (change per 10 years of diagnosis) for patients diagnosed during 1991–2004, by cancer site and summed across all cancer sites**

Cancer site	Number of patients at risk	EMRR	95% CI
Bladder	4863	0.79	(0.66, 0.94)
Brain	1830	0.94	(0.83, 1.07)
Breast (female)	18693	0.48	(0.43, 0.54)
Cervix	1578	0.75	(0.58, 0.97)
Colorectum	22,464	0.73	(0.69, 0.78)
Head, neck and larynx	3222	0.95	(0.80, 1.12)
Hodgkin’s lymphoma	510	0.70	(0.41, 1.19)
Kidney	2502	0.71	(0.60, 0.84)
Leukaemia	4023	0.40	(0.35, 0.46)
Liver	834	0.68	(0.56, 0.82)
Lung	12,425	0.89	(0.85, 0.94)
Melanoma	13,983	0.61	(0.49, 0.75)
Non-Hodgkin’s lymphoma	4572	0.56	(0.49, 0.63)
Oesophagus	1824	0.90	(0.79, 1.02)
Ovary	2289	0.61	(0.52, 0.70)
Pancreas	2313	0.98	(0.88, 1.09)
Prostate	21,045	0.13	(0.11, 0.16)
Stomach	3090	0.86	(0.78, 0.96)
Testis	906	0.72	(0.29, 1.79)
Thyroid gland	1098	0.54	(0.31, 0.95)
Uterus	2415	0.71	(0.55, 0.91)
Pooled estimate (including prostate)		**0.74**	**(0.72, 0.76)**
Pooled estimate (excluding prostate)		**0.76**	**(0.74, 0.78)**

3.2 Māori:non-Māori excess mortality rate ratios across cancer sites

Figure 2 shows a summary across all cancer sites in the ethnic EMRR, averaged over time, whereby excess mortality for Māori patients is compared to that of non-Māori patients. In this figure, a central estimate above 1 suggests that Māori patients had greater excess mortality (poorer survival) compared to non-Māori patients, and a central estimate below 1 indicates that Māori patients had less excess mortality (better survival) compared to non-Māori patients.

This report used two ways of describing ethnic differences in excess mortality (cancer survival inequalities) averaged over time:

a) a similar excess mortality for Māori and non-Māori patients if the excess mortality rate ratio was between 0.91 and 1.09

b) a greater excess mortality for Māori patients compared to non-Māori patients if the excess mortality rate ratio was greater than or equal to 1.10.

From Figure 2 and Table 8, we concluded that there was:

- evidence for ethnic differences in cancer survival (excess mortality) for female breast, cervical, colorectal, head and neck, Hodgkin's lymphoma, kidney, leukaemia, liver, lung, melanoma, non-Hodgkin's lymphoma, oesophageal, pancreatic, prostate, stomach, testicular and uterine cancers
- little evidence for ethnic differences in cancer survival (excess mortality) for bladder, brain and ovarian cancers and thyroid gland cancer.

Pooled across all cancers, the EMRR comparing Māori to non-Māori was 1.29 (1.24–1.34), a 29% worse cancer mortality on average for Māori.

Figure 2: Māori:non-Māori EMRRs averaged over time, by cancer site for patients diagnosed during 1991–2004

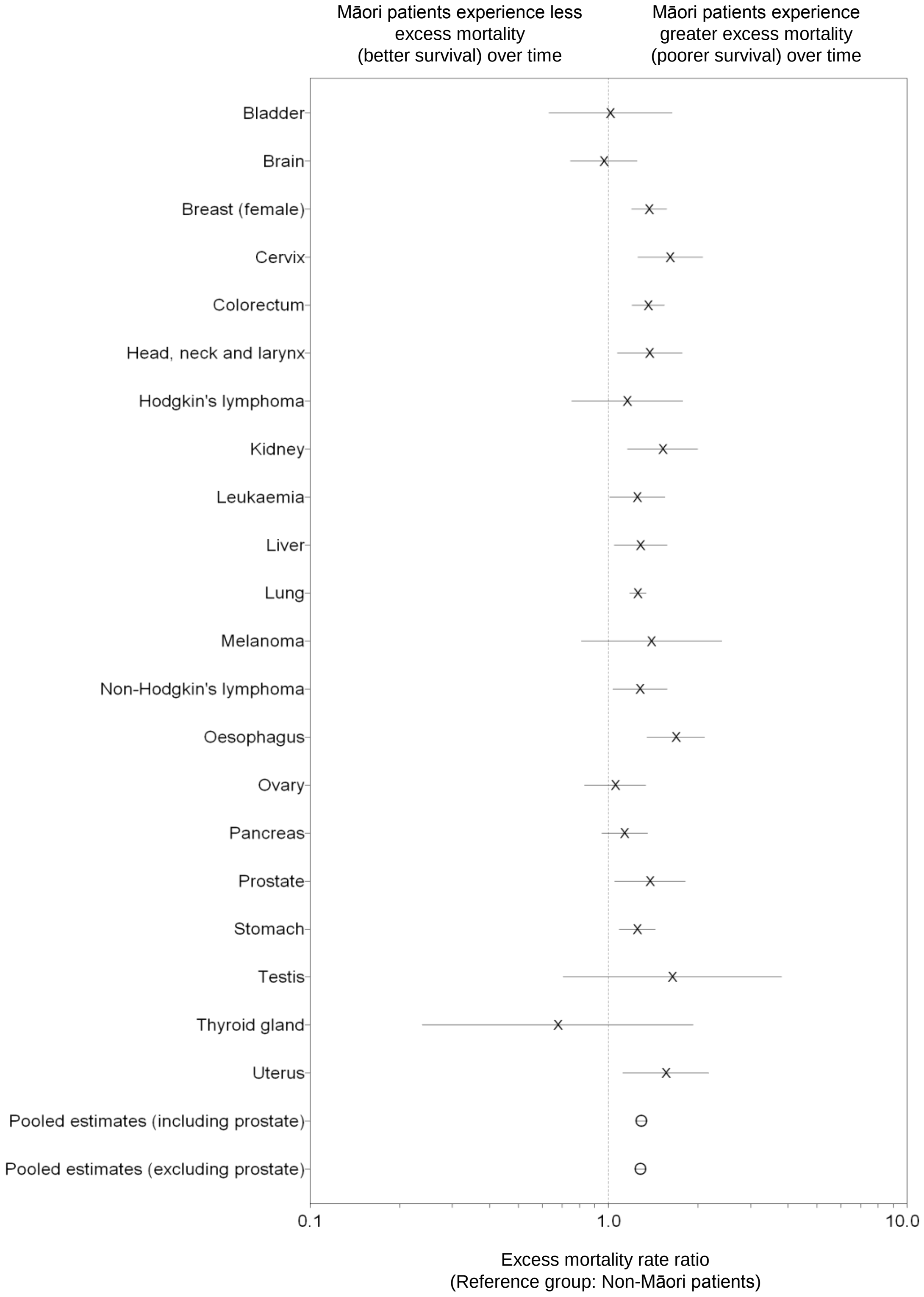


Table 8: Ethnic EMRRs (Māori patients:non-Māori patients) averaged across time for patients diagnosed during 1991–2004, by cancer site and summed across all cancer sites

Cancer site	Number of patients at risk	EMRR	95% CI
Bladder	4863	1.02	(0.63, 1.64)
Brain	1830	0.97	(0.75, 1.25)
Breast (female)	18,693	1.37	(1.20, 1.56)
Cervix	1578	1.61	(1.25, 2.07)
Colorectum	22,464	1.36	(1.20, 1.54)
Head, neck and larynx	3222	1.37	(1.07, 1.77)
Hodgkin's lymphoma	510	1.16	(0.75, 1.77)
Kidney	2502	1.52	(1.16, 1.99)
Leukaemia	4023	1.25	(1.01, 1.54)
Liver	834	1.28	(1.04, 1.57)
Lung	12,425	1.26	(1.18, 1.34)
Melanoma	13,983	1.39	(0.81, 2.39)
Non-Hodgkin's lymphoma	4572	1.28	(1.03, 1.57)
Oesophagus	1824	1.68	(1.35, 2.10)
Ovary	2289	1.05	(0.83, 1.33)
Pancreas	2313	1.13	(0.95, 1.35)
Prostate	21,045	1.38	(1.05, 1.81)
Stomach	3090	1.25	(1.09, 1.43)
Testis	906	1.64	(0.71, 3.80)
Thyroid gland	1098	0.68	(0.24, 1.92)
Uterus	2415	1.56	(1.12, 2.16)
Pooled estimate (including prostate)		**1.29**	**(1.24, 1.34)**
Pooled estimate (excluding prostate)		**1.28**	**(1.23, 1.33)**

3.3 Lowest income:highest income excess mortality rate ratios across cancer sites

Figure 3 shows a summary across all cancer sites of the income EMRRs, averaged over time, where excess mortality for patients in the lowest income quintile was compared to that of patients in the highest income quintile. The income EMRR was calculated using mid-point data from all quintiles in the regression. In Figure 3, central estimates above 1 indicate that the lowest income quintile had greater excess mortality (poorer survival) compared to patients in the highest income quintile; a central estimate below 1 suggests that the lowest income quintile patients had less excess mortality (better survival) compared to patients in the highest income quintile.

This report used two ways of describing income differences in excess mortality (income cancer survival inequalities) averaged over time: (a) a similar excess mortality for patients in the lowest and highest income quintiles if the excess mortality rate ratio was between 0.91 and 1.09; (b) a greater excess mortality for patients in the lowest income quintile compared to patients in the highest income quintile if the excess mortality rate ratio was greater than or equal to 1.10.

From Figure 3 and Table 9, we can conclude that there was:

- evidence for income differences in cancer survival (excess mortality) for cancers of the bladder, female breast, cervix, colorectum, head and neck, leukaemia, lung, melanoma, oesophagus, pancreas, stomach, testis and thyroid gland, where the income EMRRs were above 1.10
- little evidence for income differences in cancer survival (excess mortality) for brain, Hodgkin's lymphoma, kidney, liver, non-Hodgkin's lymphoma, ovarian, prostate and uterine, where the income EMRRs were between 0.91 and 1.09.

Pooled across all cancers, the EMRR comparing low to high income was 1.12 (1.08–1.15), a 12% worse cancer mortality on average for low-income people.

Figure 3: Lowest income quintile:highest income quintile EMRRs averaged over time, by cancer site for patients diagnosed during 1991–2004

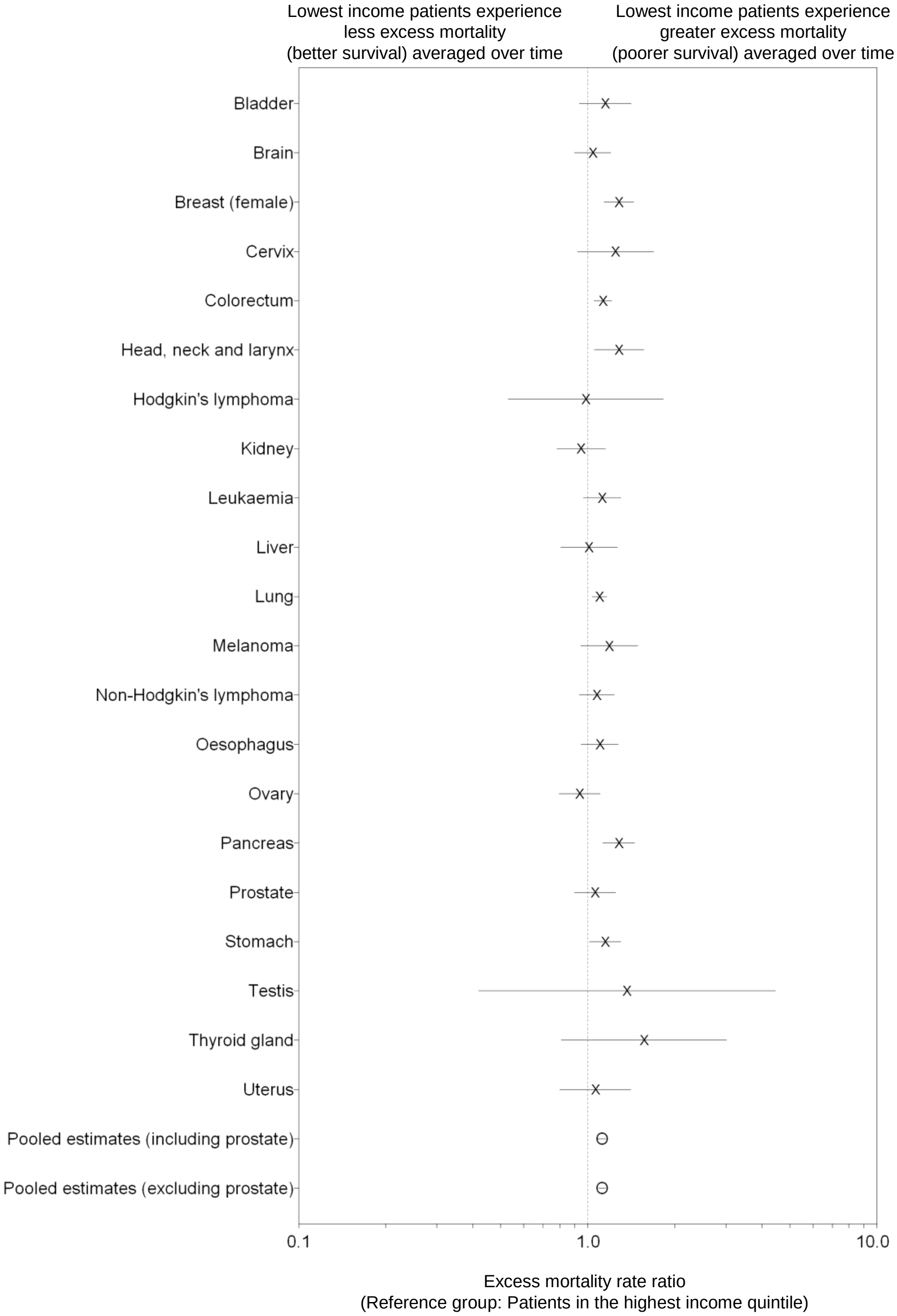


Table 9: **Income EMRRs (lowest income quintile patients:highest income quintile patients) averaged across time for patients diagnosed during 1991–2004, by cancer site and summed across all cancer sites**

Cancer site	Number of patients at risk	EMRR	95% CI
Bladder	4863	1.15	(0.93, 1.41)
Brain	1830	1.04	(0.90, 1.20)
Breast (female)	18,693	1.28	(1.14, 1.44)
Cervix	1578	1.25	(0.92, 1.68)
Colorectum	22,464	1.13	(1.05, 1.21)
Head, neck and larynx	3222	1.28	(1.05, 1.56)
Hodgkin’s lymphoma	510	0.98	(0.53, 1.82)
Kidney	2502	0.95	(0.78, 1.15)
Leukaemia	4023	1.12	(0.96, 1.30)
Liver	834	1.01	(0.81, 1.26)
Lung	12,425	1.10	(1.03, 1.16)
Melanoma	13,983	1.18	(0.94, 1.49)
Non-Hodgkin’s lymphoma	4572	1.07	(0.94, 1.23)
Oesophagus	1824	1.10	(0.95, 1.27)
Ovary	2289	0.94	(0.80, 1.10)
Pancreas	2313	1.28	(1.13, 1.45)
Prostate	21,045	1.06	(0.90, 1.25)
Stomach	3090	1.15	(1.01, 1.30)
Testis	906	1.36	(0.42, 4.45)
Thyroid gland	1098	1.56	(0.81, 3.02)
Uterus	2415	1.06	(0.80, 1.41)
Pooled estimate (including prostate)		**1.12**	**(1.08, 1.15)**
Pooled estimate (excluding prostate)		**1.12**	**(1.09, 1.15)**

3.4 Ethnic trends in cancer patient survival

Figure 4 shows a summary across all cancer sites of the overall pattern in the interaction of the ethnic main effects and calendar period EMRRs. In this figure, a central estimate above 1 suggests that non-Māori excess mortality is decreasing faster over time (ie, non-Māori excess mortality is decreasing faster over time); a central estimate below 1 suggests that Māori excess mortality is decreasing faster over time. This figure can therefore orient the reader to whether, across all cancer sites, ethnic inequalities in excess mortality are changing over time.

Changes in the ethnic EMRR over time were measured with considerable statistical imprecision. For eight cancer sites the EMRR comparing Māori to non-Māori was estimated to increase by more than 10% per decade, but conversely eight cancer sites had an estimated 10% or more decrease per decade. In only one cancer site (pancreas) was there a statistically significant change over time, namely a faster reduction in excess mortality for non-Māori (which, with 21 cancer sites, may just be a chance finding compared to other findings reported). Pooled across all cancers, the ratio change in the ethnic EMRR was estimated at 1.04 (0.94–1.14).

It is prudent to conclude from this pooled estimate, and from Figure 4 and Table 10, that there was no convincing evidence of either widening or narrowing gaps in excess cancer mortality by ethnicity over time. That is, Māori and non-Māori cancer excess mortality roughly changed by similar percentage amounts over time.

Figure 4: **Change every 10 years in Māori:non-Māori EMRRs, by cancer site for patients diagnosed during 1991–2004**

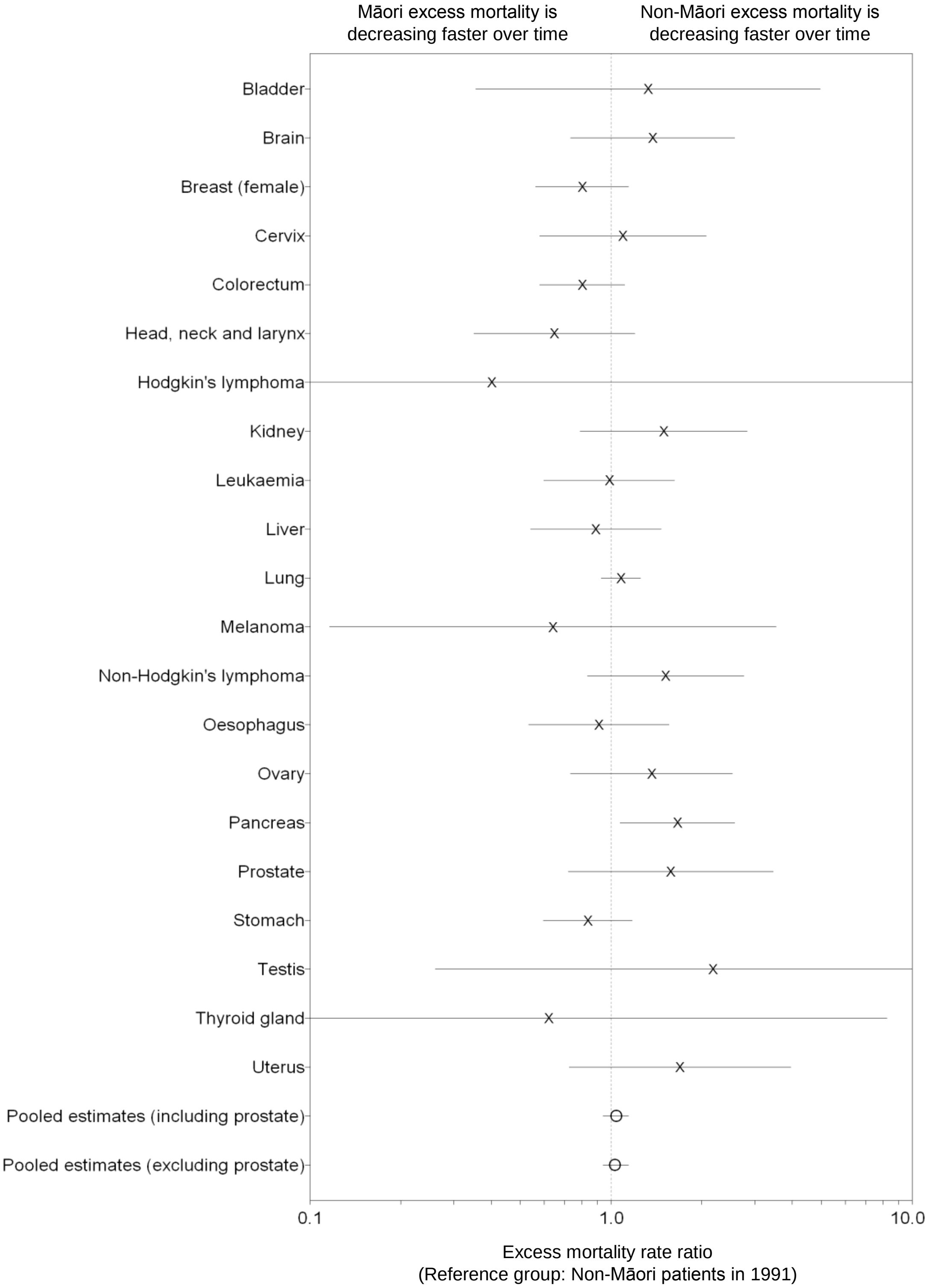


Table 10: **EMRRs for interaction between ethnicity and calendar period (every 10 years)**

Cancer site	Number of patients at risk	EMRR	95% CI
Bladder	4863	1.33	(0.36, 4.94)
Brain	1830	1.37	(0.73, 2.58)
Breast (female)	18,693	0.80	(0.56, 1.14)
Cervix	1578	1.09	(0.58, 2.07)
Colorectum	22,464	0.80	(0.58, 1.11)
Head, neck and larynx	3222	0.65	(0.35, 1.20)
Hodgkin’s lymphoma	510	0.40	(0.00, 83.07)
Kidney	2502	1.49	(0.79, 2.83)
Leukaemia	4023	0.99	(0.60, 1.63)
Liver	834	0.89	(0.54, 1.47)
Lung	12,425	1.08	(0.93, 1.25)
Melanoma	13,983	0.64	(0.12, 3.53)
Non-Hodgkin’s lymphoma	4572	1.52	(0.83, 2.76)
Oesophagus	1824	0.91	(0.53, 1.56)
Ovary	2289	1.36	(0.73, 2.53)
Pancreas	2313	1.66	(1.07, 2.57)
Prostate	21,045	1.58	(0.72, 3.45)
Stomach	3090	0.84	(0.60, 1.17)
Testis	906	2.18	(0.26, 18.25)
Thyroid gland	1098	0.62	(0.05, 8.25)
Uterus	2415	1.69	(0.72, 3.95)
Pooled estimate (including prostate)		**1.04**	**(0.94, 1.14)**
Pooled estimate (excluding prostate)		**1.03**	**(0.94, 1.14)**

3.5 Income trends in cancer patient survival

Figure 5 shows a summary across all cancer sites of the interaction between the income main effects and calendar period EMRRs. In this figure, a central estimate above 1 suggests that excess mortality for patients in the highest income quintile is decreasing faster over time; a central estimate below 1 suggests that excess mortality for patients in the lowest income quintile is decreasing faster over time (ie, inequalities are reducing). This figure can therefore orient the reader to whether, across all cancer sites, income inequalities in excess mortality are changing over time.

Like change over time in the ethnic EMRR, changes in the income EMRR were also measured with statistical imprecision, but less so than for ethnicity. As shown in Figure 5 and Table 11, for 13 cancer sites the EMRR comparing low to high income was estimated to increase by more than 10% per decade, but in only one instance (kidney) did the confidence interval exclude the null. Only three cancer sites had an estimated 10% or more decrease per decade in the income EMRR. Pooled across all cancers, the ratio change in the income EMRR was estimated at 1.09 (1.01–1.17), a best estimate of a 9% per decade increase in the EMRR comparing low- to high-income groups. That is, excess mortality (on average) fell faster for high-income people.

In summary, when looking at patterns across all cancer sites, there was some evidence of widening excess cancer mortality rate gaps by income over time.

Figure 5: **Change every 10 years in lowest income:highest income EMRRs, by cancer site for patients diagnosed during 1991–2004**

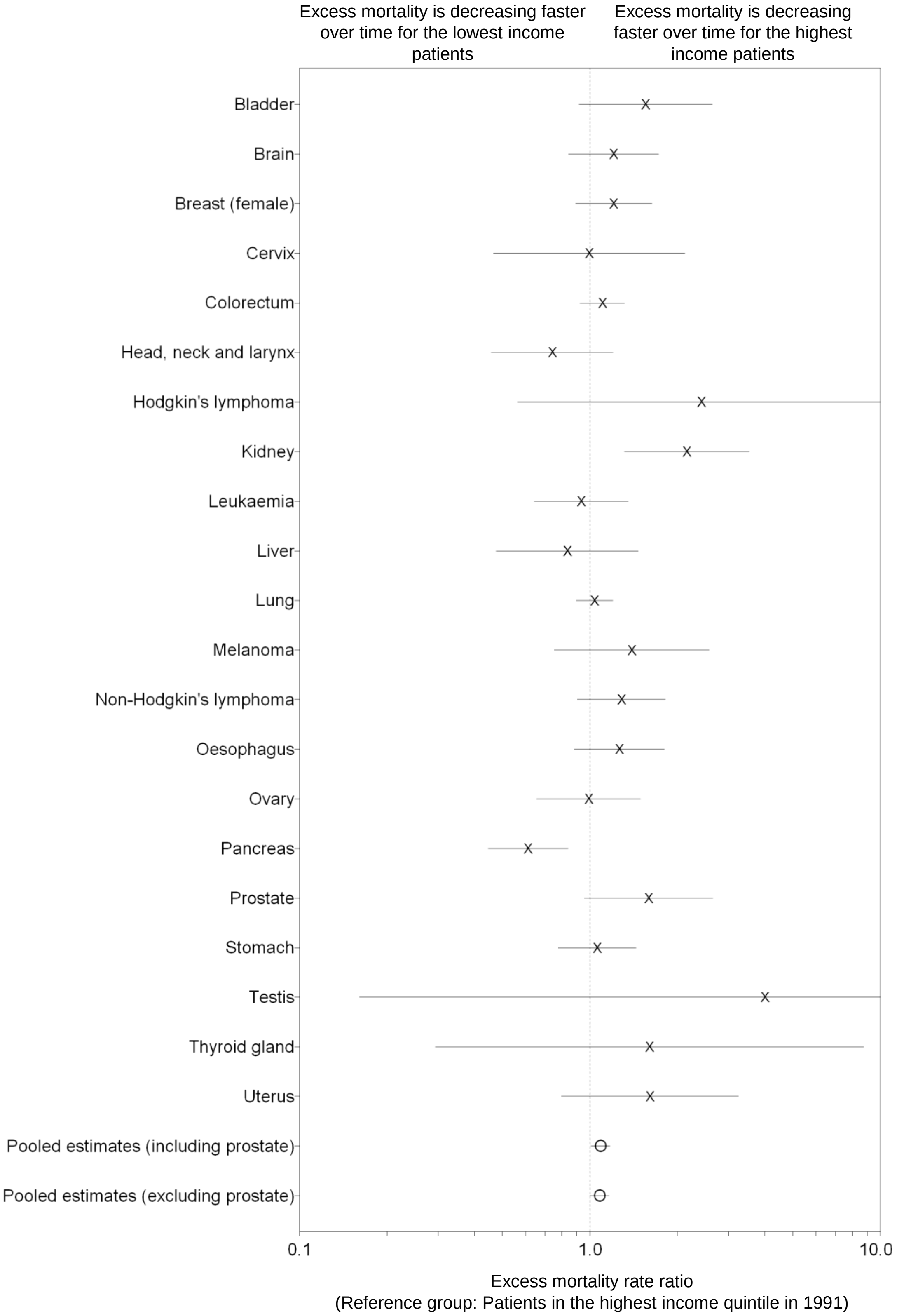


Table 11: **Interaction between income main effects and calendar period EMRRs for every 10 years of cancer diagnosis, by cancer site and summed across all cancers**

Cancer site	Number of patients at risk	EMRR	95% CI
Bladder	4863	1.56	(0.92, 2.64)
Brain	1830	1.21	(0.84, 1.72)
Breast (female)	18,693	1.21	(0.89, 1.64)
Cervix	1578	0.99	(0.47, 2.12)
Colorectum	22,464	1.10	(0.93, 1.32)
Head, neck and larynx	3222	0.74	(0.46, 1.20)
Hodgkin’s lymphoma	510	2.42	(0.56, 10.43)
Kidney	2502	2.16	(1.32, 3.53)
Leukaemia	4023	0.93	(0.64, 1.35)
Liver	834	0.84	(0.48, 1.47)
Lung	12,426	1.04	(0.90, 1.20)
Melanoma	13,983	1.39	(0.75, 2.58)
Non-Hodgkin’s lymphoma	4572	1.28	(0.91, 1.82)
Oesophagus	1824	1.26	(0.88, 1.80)
Ovary	2289	0.99	(0.66, 1.49)
Pancreas	2313	0.61	(0.45, 0.84)
Prostate	21,045	1.59	(0.96, 2.65)
Stomach	3090	1.06	(0.78, 1.44)
Testis	906	4.00	(0.16, 98.97)
Thyroid gland	1098	1.60	(0.29, 8.76)
Uterus	2415	1.61	(0.80, 3.25)
Pooled estimate (including prostate)		**1.09**	**(1.01, 1.17)**
Pooled estimate (excluding prostate)		**1.08**	**(1.00, 1.16)**

Chapter 4: Cancer of the female breast (ICD code C50)

The following three chapters present ethnic and socioeconomic trends for female breast, colorectal and anal, and lung, tracheal and bronchial cancers. There is more explanation in this chapter on female breast cancer to help orient the reader to the results. These three cancers were selected because the interaction EMRRs for ethnicity and calendar period and/or income and calendar period were considered to be worthy of interpretation given the larger number of cases. The interaction terms for the remaining 18 cancer sites were considered to be measured with too much statistical imprecision and therefore are not presented in detail.

This chapter brings together findings from the descriptive data, relative survival analyses and excess mortality modelling to describe ethnic and socioeconomic trends in female breast cancer survival.

4.1 Number of patients

Number of patients included in survival analysis

Three groups of data sets were used to estimate ethnic and socioeconomic trends in female breast cancer patient survival:

(a) patients stratified by ethnic group for the 1991–1996, 1996–2001 and 2001–2004 Census cohorts, with patients with missing ethnicity data excluded

(b) patients stratified by income tertile for the 1991–1996, 1996–2001 and 2001–2004 Census cohorts, with patients with missing income data excluded; or

(c) the total number of patients diagnosed between 1991 and 2004, with patients with missing ethnicity data and missing income data excluded.

The number of female breast cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval (ie, after five years from cancer diagnosis), and the total number of patients who had died after five years of follow-up are presented in full by ethnic group and income group in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of female breast cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 6438, 8184 and 7281, respectively. Of those patients, the number of Māori patients in each cohort was 528, 810 and 531, respectively.

Number of patients included in relative survival analyses, by income group

The number of female breast cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 5571, 6918 and 6303, respectively. Of those patients, the number of high-income patients in each cohort was 1560, 2142 and 2220, and the number of low-income patients in each cohort was 1698, 2199 and 2076, respectively.

Number of patients included in excess mortality modelling

A total of 18,693 female breast cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

4.2 Relative survival

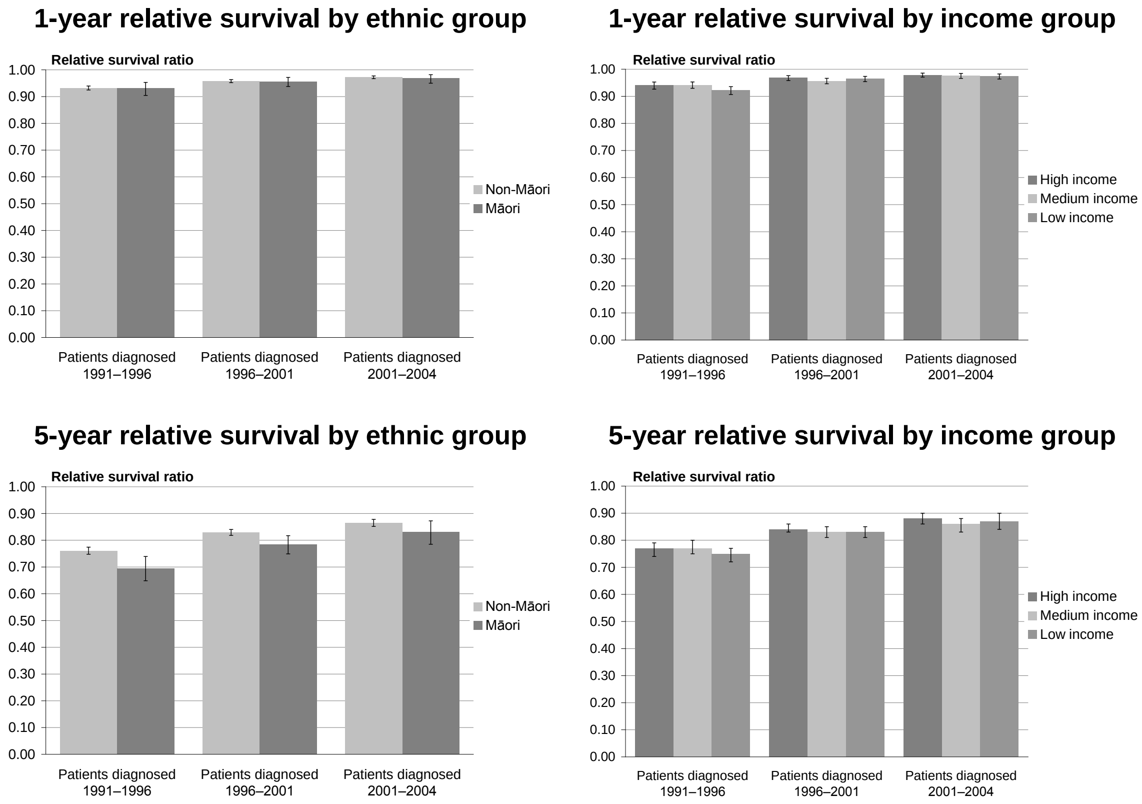
Relative survival by ethnic group

Figure 6 and Table 12 show evidence of large and statistically significant improvements over time in five-year RSRs for both non-Māori and Māori female breast cancer patients.

Relative survival by income group

Figure 6 and Table 12 show evidence of a large and statistically significant improvement over time for one-year and five-year RSRs for high- and low-income female breast cancer patients.

Figure 6: **One-year and five-year RSRs for female breast cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group**



1-year relative survival by ethnic group

1-year relative survival by income group

5-year relative survival by ethnic group

5-year relative survival by income group

Table 12: One-year and five-year RSRs, and their ethnic and income gaps, for female breast cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	**Exposure category**	**Calendar period of diagnosis**		
		Patients diagnosed 1991–1996[1]	**Patients diagnosed 1996–2001**[1]	**Patients diagnosed 2001–2004**[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.93 (0.93,0.94)	0.96 (0.95,0.96)	0.97 (0.97,0.98)
	Māori	0.93 (0.90,0.95)	0.96 (0.94,0.97)	0.97 (0.95,0.98)
5 years	Non-Māori	0.76 (0.75,0.77)	0.83 (0.82,0.84)	0.87 (0.85,0.88)
	Māori	0.70 (0.65,0.74)	0.78 (0.75,0.82)	0.83 (0.78,0.87)
Ethnic gap	1 year	0.00	0.00	0.00
	5 years	-0.07	-0.04	-0.03
Socioeconomic trends in relative survival				
1 year	High income	0.94 (0.93,0.95)	0.97 (0.96,0.98)	0.98 (0.97,0.99)
	Medium income	0.94 (0.93,0.95)	0.96 (0.95,0.97)	0.98 (0.97,0.98)
	Low income	0.92 (0.91,0.94)	0.96 (0.95,0.97)	0.97 (0.96,0.98)
5 years	High income	0.77 (0.74,0.79)	0.84 (0.83,0.86)	0.88 (0.86,0.90)
	Medium income	0.77 (0.75,0.80)	0.83 (0.81,0.85)	0.86 (0.83,0.88)
	Low income	0.75 (0.72,0.77)	0.83 (0.81,0.85)	0.87 (0.84,0.90)
Income group gap	1 year	-0.02	0.00	-0.01
	5 years	-0.02	-0.02	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

4.3 Excess mortality

Ethnic and income trends in female breast cancer patient survival were calculated using four different excess mortality models (see Table 13). The first two models estimated ethnic trends in survival for female breast cancer patients, including an ethnicity main effects model (Model 1) and the interaction between ethnicity and calendar period of diagnosis (Model 2). The last two models calculated income trends in cancer survival for female breast cancer patients, including an income main effects model (Model 3) and the interaction between income and calendar period of diagnosis (Model 4). The EMRR estimates relevant to this study are highlighted in Table 13 and are discussed below.

Table 13: **EMRRs, including 95% CIs, for female breast cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		**Income trends in survival**	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.37 (1.12,1.56)**	**1.57 (1.22,2.01)**	1.32 (1.15,1.51)	1.32 (1.15,1.51)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.28 (1.14,1.44)**	**1.14 (0.92,1.42)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.48 (0.43,0.54)**	**0.62 (0.41,0.93)**	**0.49 (0.44,0.55)**	**0.45 (0.37,0.54)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.80 (0.56,1.14)**		
Income quintiles × calendar year of diagnosis				**1.21 (0.89,1.64)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	1.63 (1.40,1.89)	1.63 (1.40,1.89)	1.63 (1.40,1.89)	1.63 (1.40,1.89)
3 years since diagnosis	1.51 (1.30,1.76)	1.51 (1.30,1.76)	1.51 (1.30,1.76)	1.51 (1.30,1.76)
4 years since diagnosis	1.30 (1.10,1.52)	1.30 (1.10,1.52)	1.30 (1.11,1.53)	1.30 (1.11,1.53)
5 years since diagnosis	1.05 (0.88,1.25)	1.05 (0.88,1.25)	1.05 (0.88,1.25)	1.05 (0.88,1.25)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	0.81 (0.72,0.90)	0.81 (0.72,0.90)	0.80 (0.71,0.89)	0.80 (0.72,0.89)
Aged 65–74	0.78 (0.66,0.93)	0.79 (0.66,0.93)	0.78 (0.65,0.92)	0.78 (0.65,0.92)
Aged 75+	0.68 (0.50,0.91)	0.68 (0.50,0.91)	0.69 (0.51,0.92)	0.69 (0.51,0.92)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.82 (1.38,2.39)	1.82 (1.38,2.39)	1.82 (1.38,2.39)	1.81 (1.38,2.38)
75+, 1 year since diagnosis	3.70 (2.58,5.31)	3.70 (2.58,5.30)	3.65 (2.56,5.12)	3.63 (2.55,5.12)
64–74 years, 2 years since diagnosis	1.17 (0.89,1.52)	1.17 (0.89,1.52)	1.17 (0.90,1.53)	1.17 (0.90,1.52)
75+, 2 years since diagnosis	1.28 (0.84,1.95)	1.28 (0.84,1.94)	1.24 (0.82,1.88)	1.24 (0.82,1.87)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	533	533	2462	2462
AIC (Akaike information criterion)	2307.3	2307.7	6770.9	6771.4
BIC (Bayesian information criteria)	2367.2	2371.9	6858.1	6864.4
Scaled dispersion	1.197	1.197	1.052	1.052
Deviance	621.381	619.851	353.283	350.626

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Changes in excess mortality over time

Table 13 shows evidence of a large and statistically significant decrease over time in excess mortality for female breast cancer patients. For every 10 years of cancer diagnosis, female breast cancer patients experienced a 51–52% decrease in excess mortality with a calendar period EMRR of 0.48 (95% CI 0.43, 0.54) in Model 1 and a calendar period EMRR of 0.49 (95% CI 0.44, 0.55) in Model 3. The confidence limits for both EMRRs were narrow and excluded the null.

Ethnic and income inequalities in cancer survival

Table 13 shows evidence to suggest that ethnic and income differences in excess mortality exist for female breast cancer patients (consistent with the above relative survival analyses). Averaged over time, Māori female breast cancer patients had 37% greater excess mortality, with an EMRR of 1.37 (95% CI 1.12, 1.56) compared to non-Māori patients. Patients in the lowest income quintile experienced 28% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.28 (95% CI 1.14, 1.44), a lesser difference than for ethnicity but still significant.

Ethnic trends in female breast cancer patient survival, 1991–2004

It was possible to predict EMRRs for any combination of ethnicity and calendar year compared to an overall reference group of 'non-Māori female breast cancer patients in 1991'. This was achieved using the EMRRs in Model 2, Table 13. For example, the EMRR for Māori compared to non-Māori in 1991 is the ethnicity EMRR in Model 2, namely 1.57. The EMRR for non-Māori in 2001 compared to non-Māori in 1991 is the calendar period EMRR in Model 2, specifically 0.62.

All other combinations required combining the main effects and interaction terms. For example, the EMRR for Māori in 2004 compared to non-Māori in 1991 is:

$$1.57 \times \{\exp(\ln(0.62) \times ((2004-1991)/10)\} \times \{\exp(\ln(0.80) \times ((2004-1991)/10)\} = 1.57 \times 0.53 \times 0.74 = 0.63$$

where 1.57 is the main effect for Māori compared to non-Māori (in 1991), 0.53 is the main effect in 2004 (within non-Māori), 0.63 is the interaction effect for ethnicity with decade, and 1.3 is the 2004 calendar year of diagnosis (2004–1991/10).

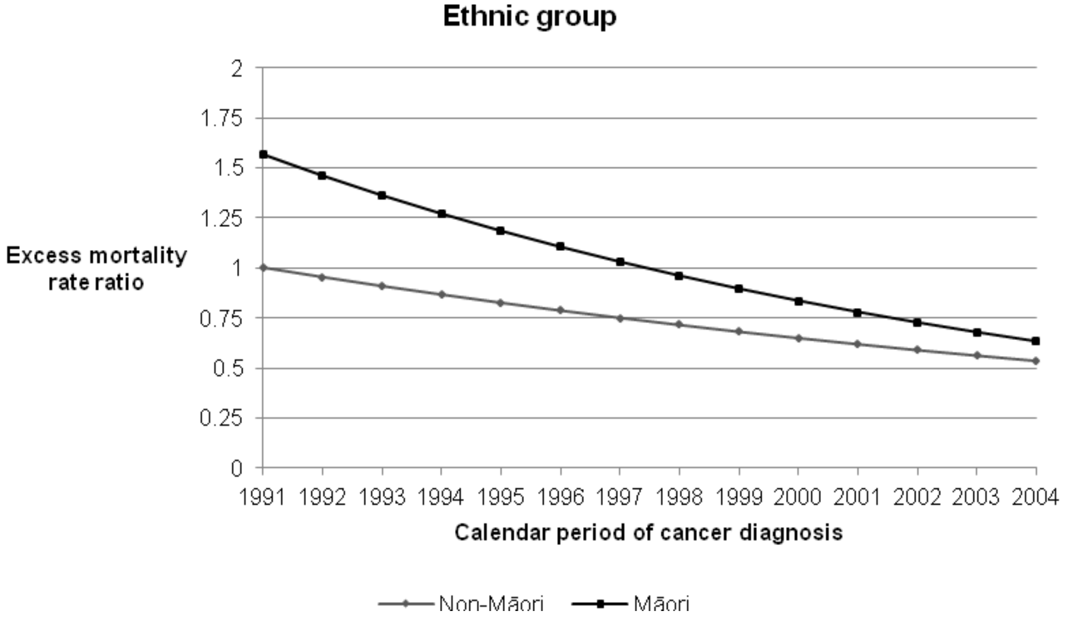
Figure 7 shows ethnicity and calendar EMRR combinations for female breast cancer patients diagnosed during 1991–2004. Note that this graph does not include confidence intervals, so in interpreting the graph it is important to note that both the main effects for ethnicity and calendar year had confidence intervals excluding the null, but the interaction term had a confidence interval including the null. More specifically, the ethnicity and calendar period interaction EMRR was 0.80 (95% CI 0.56, 1.14), suggesting a possible 20% reduction in the EMRR comparing Māori to non-Māori over a decade (but with a 95% CI ranging from a 44% decrease to a 14% increase in the Māori to non-Māori EMRR over a decade). Nevertheless, the graph depicts the best estimates of the joint relative associations between ethnicity and calendar year and is helpful for interpretation.

From Figure 7 we can conclude that for female breast cancer patients:

- excess mortality rates tended to decrease over time for both Māori and non-Māori (perhaps more so for Māori)
- Māori excess mortality rates were greater than non-Māori rates (and tending to be more so in the 1990s).

Note that while the ethnicity–decade interaction was not statistically significant, it is consistent with the narrowing gaps in Māori:non-Māori five-year relative survival over time shown in Figure 7. Also note that with survival approaching 1.0 over time, it is a mathematical necessity that if there is no change over time in the Māori:non-Māori EMRR, the gap in RSRs must close. This highlights the scale dependence in analysis and interpretation.

Figure 7: **Modelled EMRRs for combinations of ethnicity and calendar year for female breast cancer patients diagnosed during 1991–2004, all compared to non-Māori female breast cancer patients diagnosed in 1991**



Income trends in female breast cancer patient survival, 1991–2004

For female breast cancer it was possible to predict EMRRs for any combination of income and calendar year compared to an overall reference group of 'female breast cancer patients in the highest income quintile in 1991'. For example, the EMRR for patients in the lowest income quintile compared to the highest income quintile patients in 1991 is the income main effect in Model 2, namely 1.14. The EMRR for high income in 2001 compared to high income in 1991 is the calendar year EMRR in Model 4, specifically 0.45. As above, all other combinations require combining the main effects and interaction terms. For example, the EMRR for low income in 2004 compared to high income in 1991 is:

$$1.14 \times \{\exp(\ln(0.44)) \times ((2004–1991)/10)\} \times$$
$$\{\exp(\ln(1.21))\times((2004–1991)/10)\}$$
$$= 1.28 \text{ x } 0.35 \text{ x } 1.28$$
$$= 0.58$$

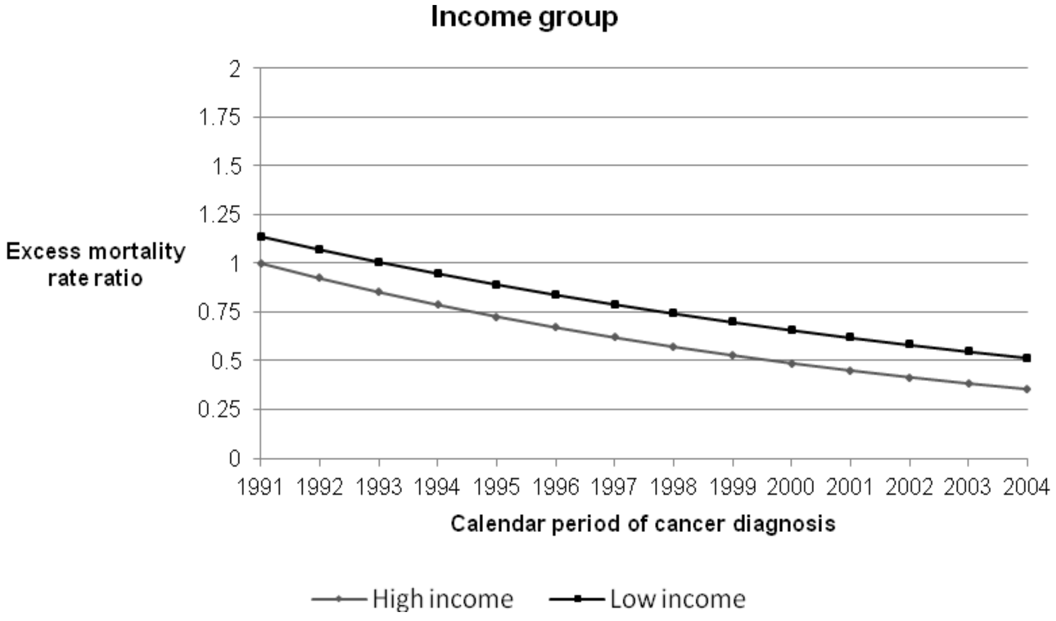
where 1.14 is the main effect for the lowest income patients compared to the highest-income patients (in 1991), 0.35 is the main effect in 2004 (within the highest-income-quintile patients), 0.58 is the interaction effect for income with decade, and 1.3 is the 2004 calendar year of diagnosis (2004–1991/10).

Figure 8 shows combinations of EMRRs by income and calendar period (single year of cancer diagnosis). As for Figure 7 above, this graph does not include confidence intervals. However, in Model 4 the income EMRR and the interaction EMRR included the null while the calendar period EMRR excluded the null. More specifically, the income and calendar period interaction EMRR was 1.21 (95% CI 0.89, 1.63), suggesting a possible 21% increase in the EMRR comparing low-income to high-income patients over a decade (but with a 95% CI ranging from an 11% decrease to a 63% increase in the low-income to high-income EMRR over a decade). The graph depicts the best estimates of the joint relative associations of income and calendar year.

From Figure 8 we can draw the following conclusions.

- There have been substantial and significant reductions in excess mortality rates over time for both the lowest- and highest-income female breast cancer patients. There was a reduction of 0.79 in excess mortality from 1991 to 2004 for the lowest-income-quintile patients and a 0.65 reduction in excess mortality over the same period for the highest-income-quintile patients.
- The absolute gap in excess mortality between the lowest- and highest-income-quintile patients appears to have remained relatively stable over the study period.

Figure 8: **Modelled EMRRs for combinations of income and calendar year for female breast cancer patients diagnosed during 1991–2004, all compared to the highest-income-quintile female breast cancer patients diagnosed in 1991**



Chapter 5: Cancer of the colon, rectum and anus (ICD codes C18–21)

5.1 Number of patients

Number of patients included in survival analyses

The number of colorectal and anal cancer (subsequently referred to as colorectal) patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of colorectal cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 8463, 9327 and 7974, respectively. Of those patients, the number of Māori patients in each cohort was 240, 360 and 315, respectively.

Number of patients included in relative survival analyses, by income group

The number of colorectal cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 7587, 8196 and 6831, respectively. Of those patients, the number of high-income patients in each cohort was 2133, 2406 and 2103, and the number of low-income patients in each cohort was 1938, 2349 and 2334, respectively.

Number of patients included in excess mortality modelling

A total of 22,467 colorectal cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

5.2 Relative survival

Relative survival by ethnic group

Figure 9 and Table 14 show improvements over time in one-year and five-year RSRs for colorectal cancer patients in both ethnic groups.

Relative survival by income group

Figure 9 and Table 14 show improvements in one-year and five-year relative survival for colorectal cancer patients in all income groups.

Figure 9: One-year and five-year RSRs for colorectal cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

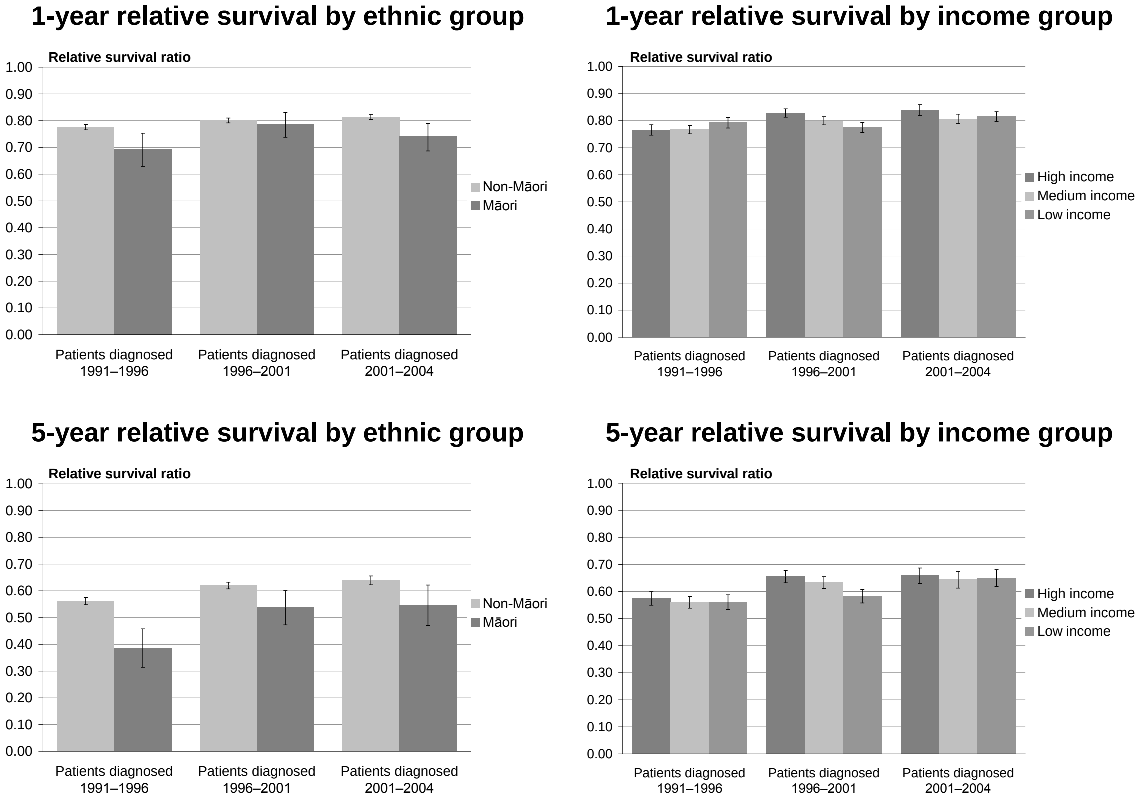


Table 14: One-year and five-year RSRs, and their ethnic and income gaps, for colorectal cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.78 (0.77,0.79)	0.80 (0.79,0.81)	0.81 (0.80,0.82)
	Māori	0.70 (0.63,0.75)	0.79 (0.74,0.83)	0.74 (0.69,0.79)
5 years	Non-Māori	0.56 (0.55,0.57)	0.62 (0.61,0.63)	0.64 (0.62,0.66)
	Māori	0.38 (0.31,0.46)	0.54 (0.47,0.60)	0.55 (0.47,0.62)
Ethnic gap	1 year	-0.08	-0.01	-0.07
	5 years	-0.18	-0.08	-0.09
Socioeconomic trends in relative survival				
1 year	High income	0.77 (0.75,0.78)	0.83 (0.81,0.84)	0.84 (0.82,0.86)
	Medium income	0.77 (0.75,0.78)	0.80 (0.78,0.81)	0.81 (0.79,0.82)
	Low income	0.79 (0.77,0.81)	0.77 (0.76,0.79)	0.82 (0.80,0.83)
5 years	High income	0.57 (0.55,0.60)	0.66 (0.63,0.68)	0.66 (0.63,0.69)
	Medium income	0.56 (0.54,0.58)	0.63 (0.61,0.65)	0.64 (0.61,0.67)
	Low income	0.56 (0.53,0.59)	0.58 (0.56,0.61)	0.65 (0.62,0.68)
Income group gap	1 year	0.03	-0.05	-0.02
	5 years	-0.01	-0.07	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

5.3 Excess mortality

Ethnic and income trends in colorectal cancer patient survival were calculated using four different excess mortality models (see Table 15). The first two models estimated ethnic trends in survival for colorectal cancer patients, including an ethnicity main effects model (Model 1) and the interaction between ethnicity and calendar period of diagnosis (Model 2). The last two models calculated income trends in cancer survival for colorectal cancer patients, including an income main effects model (Model 3) and the interaction between income and calendar period of diagnosis (Model 4). The excess mortality rate ratio (EMRR) estimates relevant to this study are highlighted in Table 15 and discussed below.

Table 15: **EMRRs, including 95% CIs, for colorectal cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.93 (0.89,0.98)	0.93 (0.89,0.98)	0.92 (0.88,0.97)	0.92 (0.88,0.97)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.36 (1.20,1.54)**	**1.58 (1.23,2.03)**	1.34 (1.18,1.52)	1.34 (1.19,1.52)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.13 (1.05,1.21)**	**1.06 (0.93,1.21)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.73 (0.69,0.78)**	**0.92 (0.65,1.30)**	**0.73 (0.69,0.78)**	**0.70 (0.63,0.78)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.80 (0.58,1.11)**		
Income quintiles × calendar year of diagnosis				**1.10 (0.93,1.32)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.64 (0.58,0.71)	0.64 (0.58,0.71)	0.64 (0.58,0.71)	0.64 (0.58,0.71)
3 years since diagnosis	0.44 (0.39,0.49)	0.44 (0.39,0.48)	0.43 (0.39,0.49)	0.43 (0.39,0.48)
4 years since diagnosis	0.29 (0.26,0.33)	0.29 (0.26,0.33)	0.29 (0.26,0.33)	0.29 (0.26,0.33)
5 years since diagnosis	0.19 (0.16,0.23)	0.19 (0.16,0.23)	0.19 (0.17,0.23)	0.19 (0.17,0.23)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	0.97 (0.89,1.05)	0.97 (0.89,1.05)	0.97 (0.89,1.05)	0.97 (0.89,1.05)
Aged 65–74	0.97 (0.85,1.10)	0.97 (0.85,1.10)	0.97 (0.85,1.10)	0.97 (0.85,1.10)
Aged 75+	0.56 (0.45,0.69)	0.56 (0.45,0.69)	0.57 (0.47,0.71)	0.57 (0.47,0.71)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.17 (1.01,1.34)	1.16 (1.01,1.34)	1.16 (1.01,1.34)	1.16 (1.01,1.34)
75+, 1 year since diagnosis	2.42 (1.94,3.01)	2.42 (1.94,3.02)	2.36 (1.90,2.92)	2.36 (1.90,2.92)
64–74 years, 2 years since diagnosis	0.99 (0.84,1.17)	0.99 (0.84,1.17)	0.99 (0.84,1.17)	0.99 (0.84,1.17)
75+, 2 years since diagnosis	1.38 (1.08,1.78)	1.39 (1.08,1.78)	1.35 (1.05,1.72)	1.34 (1.05,1.72)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	1037	1037	4054	4054
AIC (Akaike information criterion)	3991.7	3991.9	11812.6	11813.4
BIC (Bayesian information criteria)	4065.8	4071	11913.5	11920.6
Scaled dispersion	1.048	1.048	1.05	1.05
Deviance	1071.338	1069.548	1969.882	1969.957

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Changes in excess mortality over time

Table 15 shows evidence for a moderate and statistically significant decrease over time in excess mortality for colorectal cancer patients. For every 10 years of cancer diagnosis, colorectal cancer patients experienced a 27% decrease in excess mortality, with an EMRR of 0.73 (95% CI 0.69, 0.78) in Models 1 and 3. The confidence limits for both EMRRs were narrow and excluded the null. It can be confidently concluded that a moderate and statistically significant decrease over time in excess mortality occurred for colorectal cancer patients during the study period.

Ethnic and income inequalities in cancer survival

Table 15 shows evidence to suggest that ethnic and income differences in excess mortality exist for colorectal cancer patients. Averaged over time, Māori colorectal patients had 36% greater excess mortality, with an EMRR of 1.36 (95% CI 1.20, 1.54) compared to non-Māori patients. Colorectal cancer patients in the lowest income quintile experienced 13% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.13 (95% CI 1.05, 1.21), a lesser difference than for ethnicity but with the 95% confidence interval excluding the null.

Ethnic trends in colorectal cancer patient survival, 1991–2004

It was possible to predict EMRRs for any combination of ethnicity and calendar year compared to an overall reference group of 'non-Māori colorectal and anal cancer patients in 1991'. This was achieved using the EMRRs in Model 2, Table 15. For example, the EMRR for Māori compared to non-Māori in 1991 is the ethnicity EMRR in Model 2, namely 1.58. Also, the EMRR for non-Māori in 2001 compared to non-Māori in 1991 is the calendar period EMRR in Model 2, specifically 0.92. All other combinations required combining the main effects and interaction terms.

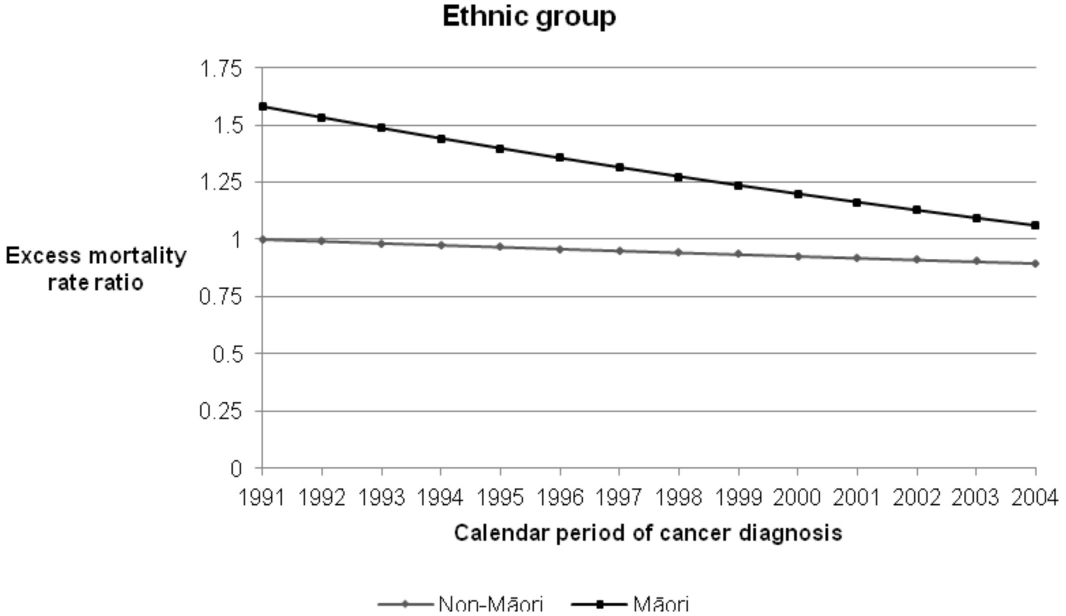
Figure 10 shows ethnicity and calendar period EMRR combinations for colorectal cancer patients diagnosed during 1991–2004. Note that this graph does not include confidence intervals. It is important to note when interpreting this graph that the ethnicity EMRR in Model 2 had a confidence interval excluding the null, but the calendar period EMRR and ethnic and calendar period interaction EMRR in Model 2 had confidence intervals including the null. More specifically, the interaction term of ethnicity and calendar decade was an EMRR of 0.80 (95% CI 0.58, 1.11), suggesting a possible 20% reduction in the EMRR comparing Māori to non-Māori over a decade (but with a plausible range from a 42% decrease to an 11% increase in the Māori to non-Māori EMRR over a decade). Nevertheless, the graph depicts the best estimates of the joint relative associations of ethnicity and calendar year, and is helpful in interpretation.

From Figure 10 we can conclude that:

- excess mortality rates decreased over time for both Māori and non-Māori colorectal cancer patients, although much more so for Māori (a decrease of 52% for Māori and 10% for non-Māori from 1991 to 2004)
- Māori colorectal cancer excess mortality rates were greater than non-Māori, and tended to be more so in the 1990s.

The results for excess mortality stand beside those for five-year RSRs, which also suggest a narrowing of survival gaps (see Figure 9) but statistical imprecision of the change over time in the ethnic EMRR must again be emphasised.

Figure 10: **Modelled EMRRs for combinations of ethnicity and calendar year for colorectal cancer patients diagnosed during 1991–2004, all compared to non-Māori colorectal cancer patients diagnosed in 1991**



Income trends in colorectal and anal cancer patient survival, 1991–2004

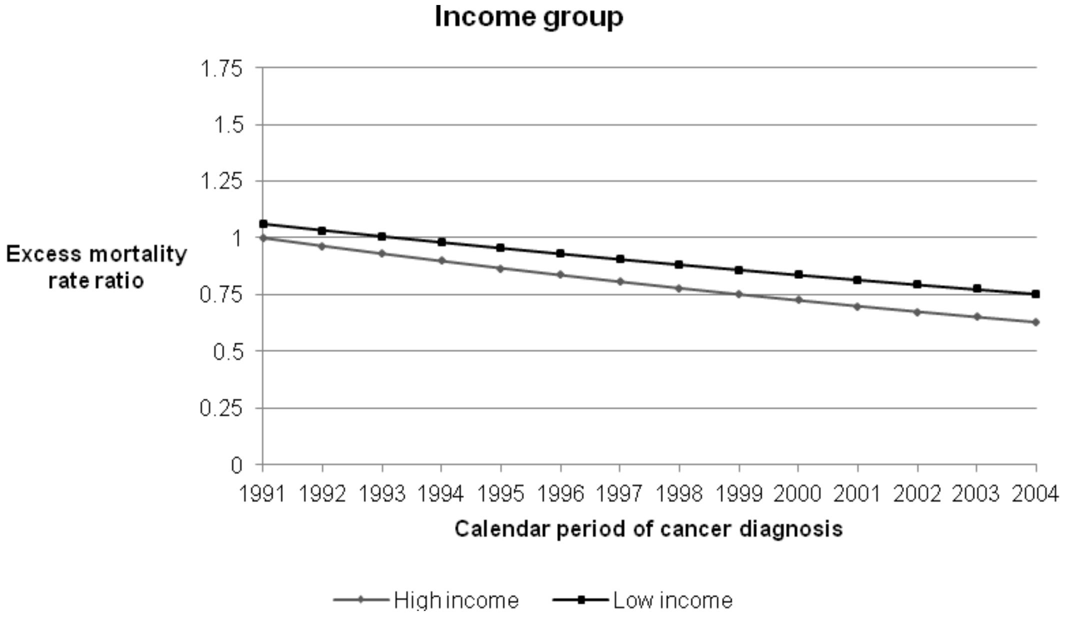
Similarly, it was possible to predict EMRRs for any combination of income and calendar year compared to an overall reference group of 'patients in the highest income quintile in 1991'. For example, the EMRR for patients in the lowest income quintile compared to the highest income quintile in 1991 is the income EMRR in Model 4, namely 1.13. Also, the EMRR for high-income patients in 2001 compared to low-income patients in 1991 is the calendar period EMRR in Model 4, specifically 0.73. All other combinations require combining the main effects and interaction terms.

Figure 11 shows income and calendar period excess mortality rate ratio combinations for colorectal cancer patients diagnosed during 1991–2004. This graph does not include confidence intervals. In interpreting this graph it is important to note that the confidence limits in Model 4 for the income EMRR, and income and calendar period interaction EMRR included the null, while the calendar period EMRR excluded the null. More specifically, the income and interaction EMRR was 1.10 (95% CI 0.93, 1.32) suggesting a possible 10% increase in the EMRR comparing low-income to high-income patients over a decade (but with a plausible range from 7% decrease to a 32% increase in the low-income to high-income EMRR over a decade).

Figure 11 presents the best estimates of the joint relative associations of income and calendar year. We can conclude that:

- excess mortality decreased modestly over time for colorectal cancer patients in both the highest and the lowest income quintiles
- there was a possible but small widening over time of the lowest income:highest income excess mortality rate ratio.

Figure 11: Modelled EMRRs for combinations of income and calendar year for colorectal cancer patients diagnosed during 1991–2004, all compared to the highest-income-quintile colorectal cancer patients diagnosed in 1991



Chapter 6: Cancer of the lung, trachea and bronchus (ICD codes C33–34)

6.1 Excess mortality

Number of patients included in survival analyses

The number of lung, tracheal and bronchial cancer (subsequently referred to as lung cancer) patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of lung cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 5127, 5196 and 4330, respectively. Of those patients, the number of Māori patients in each cohort was 564, 732 and 648, respectively.

Number of patients included in relative survival analyses, by income group

The number of lung cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 4506, 4416 and 3584, respectively. Of those patients, the number of high-income patients in each cohort was 966, 900 and 861, and the number of low-income patients in each cohort was 1386, 1704 and 1495, respectively.

Number of patients included in excess mortality modelling

A total of 12,419 lung cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

6.2 Relative survival

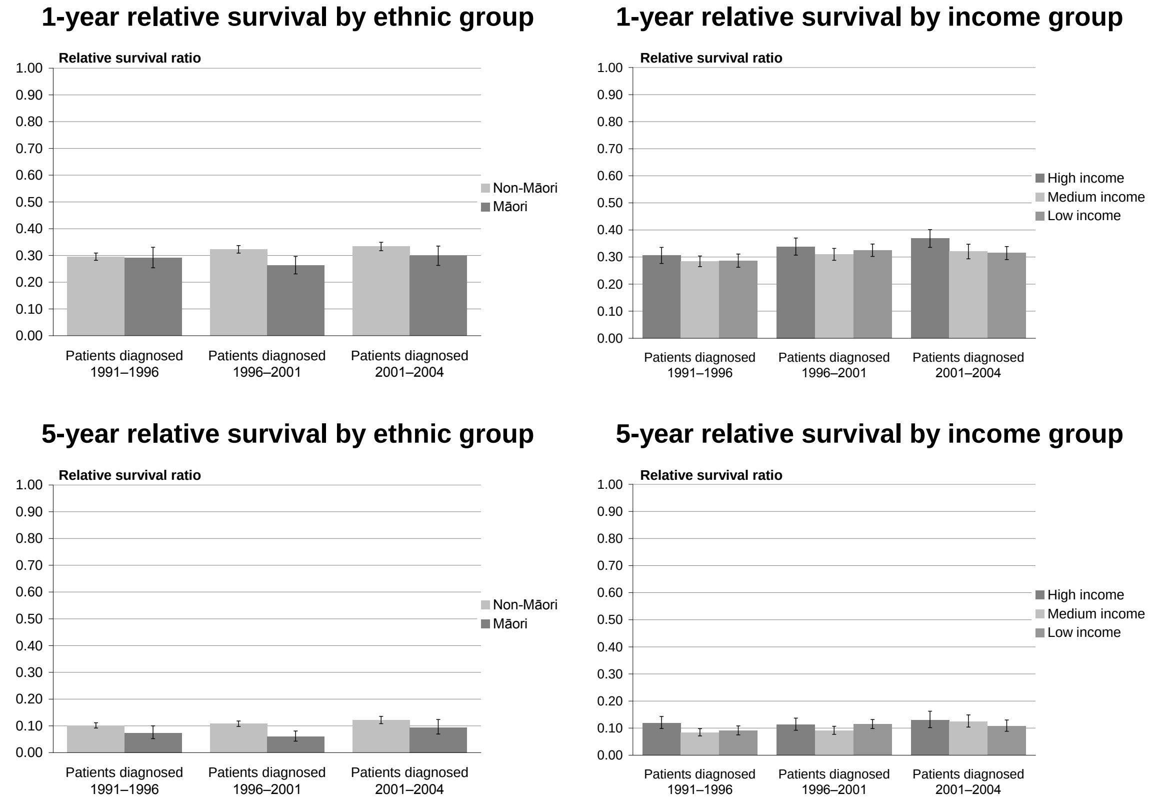
Relative survival, by ethnic group

Overall survival from lung cancer is low, and so only marginal improvements were seen over time. Figure 12 and Table 16 show little improvement over time in one-year and five-year RSRs for lung cancer patients in both ethnic groups.

Relative survival by income group

Figure 12 and Table 16 show little improvement in one-year and five-year relative survival for lung cancer patients in all income groups.

Figure 12: One-year and five-year RSRs for lung cancer patients diagnosed during 1991–2004 with follow-up to 2006, by ethnic and income group



1-year relative survival by ethnic group

1-year relative survival by income group

5-year relative survival by ethnic group

5-year relative survival by income group

Table 16: One-year and five-year RSRs, and their ethnic and income gaps, for lung cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.30 (0.28,0.31)	0.32 (0.31,0.34)	0.33 (0.32,0.35)
	Māori	0.29 (0.25,0.33)	0.26 (0.23,0.30)	0.30 (0.26,0.33)
5 years	Non-Māori	0.10 (0.09,0.11)	0.11 (0.10,0.12)	0.12 (0.11,0.14)
	Māori	0.07 (0.05,0.10)	0.06 (0.04,0.08)	0.09 (0.07,0.12)
Ethnic gap	1 year	0.00	-0.06	-0.03
	5 years	-0.03	-0.05	-0.03
Socioeconomic trends in relative survival				
1 year	High income	0.31 (0.28,0.34)	0.34 (0.31,0.37)	0.37 (0.34,0.40)
	Medium income	0.28 (0.26,0.30)	0.31 (0.29,0.33)	0.32 (0.29,0.35)
	Low income	0.29 (0.26,0.31)	0.32 (0.30,0.35)	0.31 (0.29,0.34)
5 years	High income	0.12 (0.10,0.14)	0.11 (0.09,0.14)	0.13 (0.10,0.16)
	Medium income	0.08 (0.07,0.10)	0.09 (0.08,0.11)	0.13 (0.10,0.15)
	Low income	0.09 (0.07,0.11)	0.11 (0.10,0.13)	0.11 (0.09,0.13)
Income group gap	1 year	-0.02	-0.01	-0.05
	5 years	-0.03	0.00	-0.02

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

6.3 Excess mortality

Ethnic and income trends in lung cancer patient survival were calculated using four different excess mortality models (see Table 17). The first two models estimated ethnic trends in survival for lung cancer patients, including an ethnicity main effects model (Model 1) and the interaction between ethnicity and calendar period of diagnosis (Model 2). The last two models calculated income trends in cancer survival for lung cancer patients, including an income main effects model (Model 3) and the interaction between income and calendar period of diagnosis (Model 4). The EMRR estimates relevant to this study are highlighted in Table 17 and are discussed below.

Table 17: EMRRs, including 95% CIs, for lung cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		**Income trends in survival**	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.93 (0.89,0.97)	0.93 (0.89,0.97)	0.93 (0.89,0.96)	0.93 (0.89,0.96)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.26 (1.18,1.34)**	**1.19 (1.06,1.35)**	1.24 (1.17,1.32)	1.24 (1.17,1.32)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.10 (1.03,1.16)**	**1.07 (0.95,1.12)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.89 (0.85,0.94)**	**0.82 (0.69,0.98)**	**0.89 (0.85,0.94)**	**0.88 (0.80,0.96)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.08 (0.93,1.25)**		
Income quintiles × calendar year of diagnosis				**1.04 (0.90,1.20)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.51 (0.47,0.56)	0.51 (0.47,0.56)	0.51 (0.47,0.56)	0.51 (0.47,0.56)
3 years since diagnosis	0.24 (0.21,0.27)	0.24 (0.21,0.27)	0.24 (0.21,0.28)	0.24 (0.21,0.28)
4 years since diagnosis	0.15 (0.13,0.18)	0.15 (0.13,0.18)	0.15 (0.13,0.18)	0.15 (0.13,0.18)
5 years since diagnosis	0.09 (0.07,0.11)	0.09 (0.07,0.11)	0.09 (0.07,0.11)	0.09 (0.07,0.11)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.06 (0.98,1.14)	1.06 (0.98,1.14)	1.05 (0.98,1.13)	1.05 (0.98,1.14)
Aged 65–74	1.19 (0.99,1.43)	1.19 (0.99,1.43)	1.18 (0.99,1.42)	1.18 (0.99,1.42)
Aged 75+	1.50 (1.21,1.85)	1.50 (1.21,1.85)	1.50 (1.21,1.85)	1.50 (1.21,1.85)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.02 (0.85,1.22)	1.02 (0.85,1.22)	1.02 (0.85,1.22)	1.02 (0.85,1.22)
75+, 1 year since diagnosis	0.96 (0.78,1.19)	0.96 (0.78,1.19)	0.96 (0.78,1.19)	0.96 (0.78,1.19)
64–74 years, 2 years since diagnosis	0.97 (0.78,1.19)	0.97 (0.78,1.19)	0.97 (0.79,1.20)	0.97 (0.78,1.20)
75+, 2 years since diagnosis	0.95 (0.75,1.21)	0.95 (0.75,1.21)	0.95 (0.74,1.21)	0.95 (0.74,1.21)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	922	922	3396	3396
AIC (Akaike information criterion)	3755.3	3756.3	10,579.6	10,581.3
BIC (Bayesian information criteria)	3827.7	3833.6	10,677.7	10,685.5
Scaled dispersion	1.216	1.216	1.227	1.227
Deviance	1103.022	1102.04	2494.623	2494.654

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Changes in excess mortality over time

Table 17 shows evidence of a small decrease over time in excess mortality for lung cancer patients. For every 10 years of cancer diagnosis, lung cancer patients experienced a significant 11% decrease in excess mortality, with an EMRR of 0.89 (95% CI 0.85, 0.94) in Models 1 and 3. The confidence limits for both EMRRs were narrow and excluded the null. It can be confidently concluded that a small but statistically significant decrease over time in excess mortality occurred for lung cancer patients during the study period.

Ethnic and income inequalities in cancer survival

Table 17 shows evidence to suggest that ethnic and income differences in excess mortality exist for lung cancer patients. Averaged over time, Māori lung cancer patients had 26% greater excess mortality, with an EMRR of 1.26 (95% CI 1.18, 1.34) compared to non-Māori patients. Lung cancer patients in the lowest income quintile experienced 10% greater excess mortality compared to patients in the highest income quintile with an EMRR of 1.10 (95% CI 1.03, 1.16), a lesser difference than for ethnicity and with the 95% confidence interval excluding the null.

Ethnic trends in lung cancer patient survival, 1991-2004

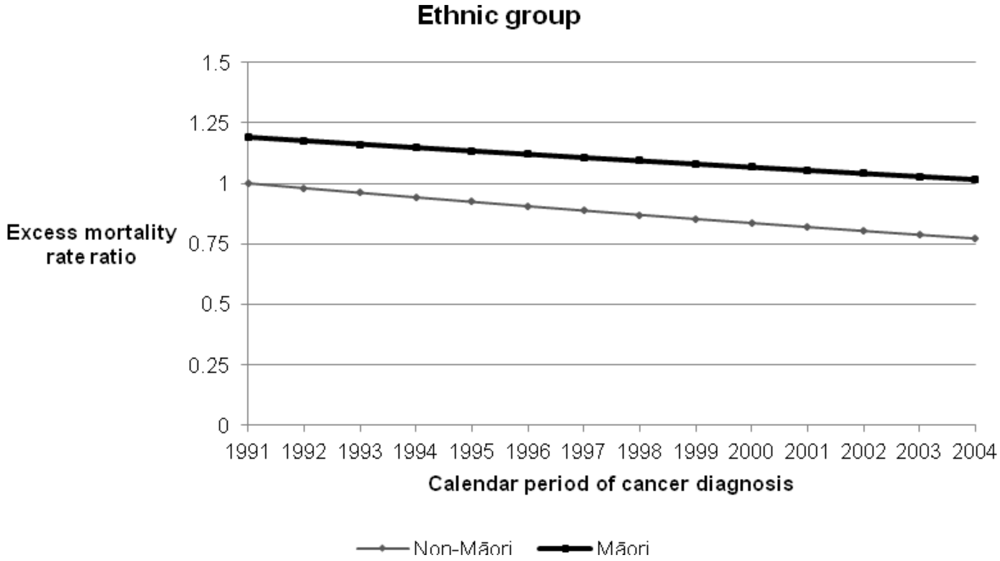
It was possible to predict EMRRs for any combination of ethnicity and calendar year compared to an overall reference group of 'non-Māori lung cancer patients in 1991'. This was achieved by using the EMRRs in Model 2, Table 17. For example, the EMRR for Māori in 1991 compared to non-Māori in 1991 is the ethnicity EMRR in Model 2, namely 1.19. Also, the EMRR for non-Māori in 2001 compared to non-Māori in 1991 is the calendar period EMRR in Model 2, specifically 0.82. All other combinations required combining the main effects and interaction terms.

Figure 13 shows ethnicity and calendar period EMRR combinations for lung cancer patients diagnosed during 1991–2004. Note that this graph does not include confidence intervals. It is important to note when interpreting this graph that the interaction ethnicity and calendar period EMRR in Model 2 had a confidence interval including the null. More specifically, the interaction term of ethnicity and calendar decade was an EMRR of 1.08 (95% CI 0.93, 1.25), suggesting a possible 8% increase in the ethnic EMRR comparing Māori to non-Māori over a decade (but with a plausible range from a 7% decrease to a 25% increase in the Māori to non-Māori EMRR over a decade). Nevertheless, the graph depicts the best estimates of the joint relative associations of ethnicity and calendar year, and is helpful in interpretation.

From Figure 13 we can conclude that:

- excess mortality rates decreased modestly over time for both Māori and non-Māori lung cancer patients
- there has possibly been a small widening in the excess mortality rate ratio difference between Māori and non-Māori lung cancer patients.

Figure 13: **Modelled EMRRs for combinations of ethnicity and calendar year for lung cancer patients diagnosed during 1991–2004, all compared to non-Māori lung cancer patients diagnosed in 1991**



Income trends in lung cancer patient survival, 1991-2004

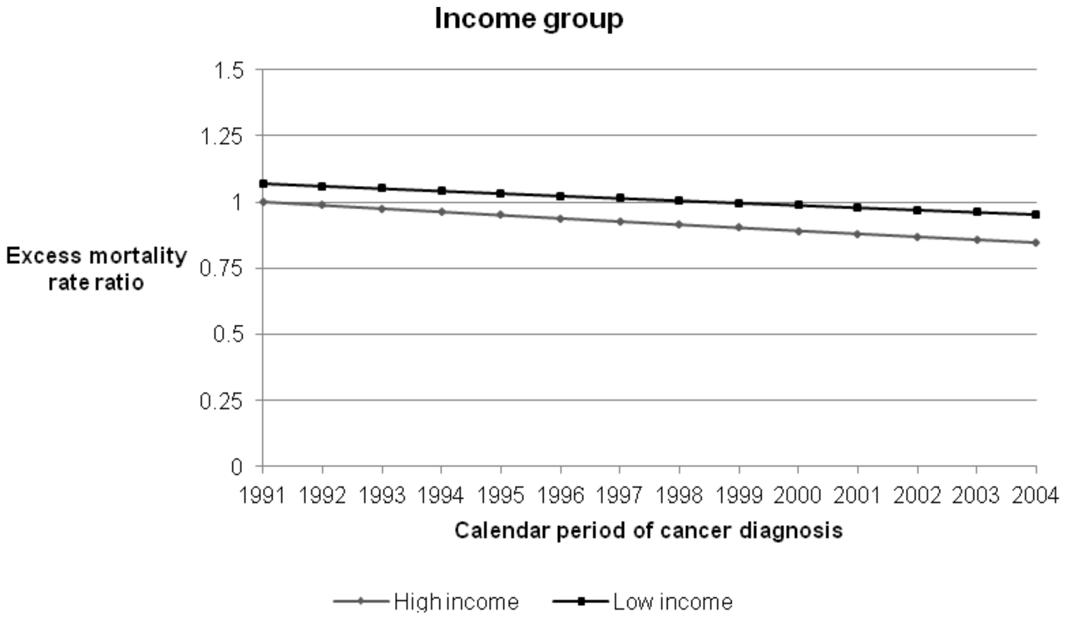
Similarly, it was possible to predict EMRRs for any combination of income and calendar year compared to an overall reference group of 'lung cancer patients in the highest income quintile diagnosed in 1991'. For example, the EMRR for patients in the lowest income quintile compared to the highest income quintile patients in 1991 is the income EMRR in Model 4, namely 1.07. Also, the EMRR for high-income patients in 2001 compared to high-income patients in 1991 is simply the calendar period EMRR in Model 4, specifically 0.88. As above, all other combinations required combining the main effects and interaction terms.

Figure 14 shows income and calendar period EMRR combinations for lung cancer patients diagnosed during 1991–2004. This graph does not include confidence intervals. In interpreting this graph it is important to note that the confidence limits in Model 4 for the income EMRR and income interaction EMRR included the null, while the calendar period EMRR excluded the null. More specifically, the income and calendar period interaction EMRR was 1.10 (95% CI 0.93, 1.32), suggesting a possible 10% increase in the EMRR comparing low-income to high-income patients over a decade (but with a plausible range from 7% decrease to a 32% increase in the low income to high income EMRR over a decade). Figure 14 presents the best estimates of the joint relative associations of income and calendar year.

From Figure 14, we can conclude that:

- there was a small decrease over time in excess mortality for lung cancer patients in the both the highest- and lowest income quintiles
- there was possibly a small widening of the lowest income quintile:highest income quintile excess mortality rate ratio over time.

Figure 14: Modelled EMRRs for combinations of income and calendar year for lung cancer patients diagnosed during 1991–2004, all compared to the highest-income-quintile lung cancer patients diagnosed in 1991



Chapter 7: Cancer of the bladder (ICD code 67)

7.1 Number of patients

Number of patients included in survival analyses

The number of bladder cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of bladder cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1725, 2070 and 1776, respectively. Of those patients, the number of Māori patients in each cohort was 45, 63 and 63, respectively.

Number of patients included in relative survival analyses, by income group

The number of bladder cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1536, 1803 and 1551, respectively. Of those patients, the number of high-income patients in each cohort was 420, 480 and 459, and the number of low-income patients in each cohort was 336, 549 and 510, respectively.

Number of patients included in excess mortality modelling

A total of 4863 bladder cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

7.2 Relative survival

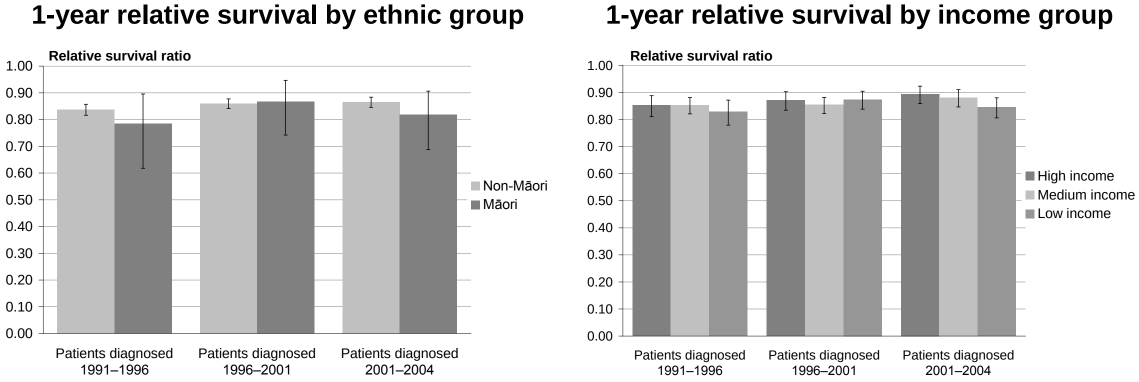
Relative survival by ethnic group

Figure 15 and Table 18 show likely improvements over time in one-year and five-year RSRs for bladder cancer patients in both ethnic groups.

Relative survival by income group

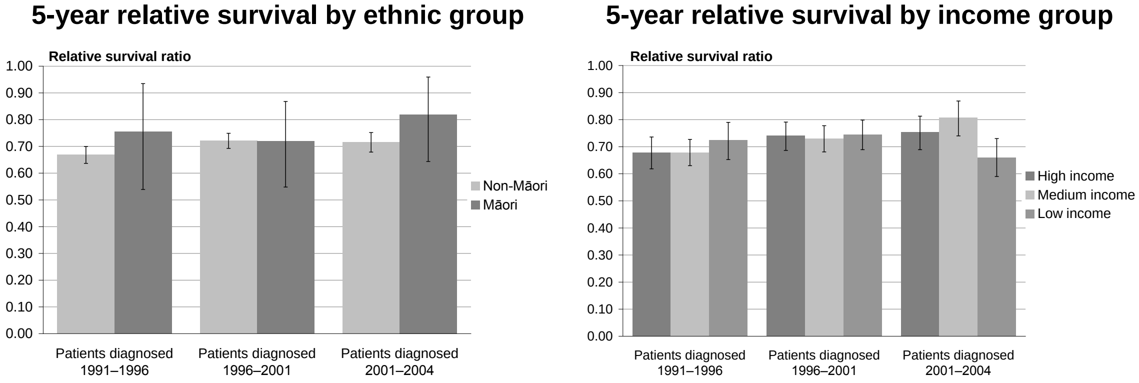
Figure 15 and Table 18 show likely improvements over time in the one-year RSR in bladder cancer for all income groups and improvements in the five-year RSR for high income patients.

Figure 15: One-year and five-year RSRs for bladder cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group



1-year relative survival by ethnic group

1-year relative survival by income group



5-year relative survival by ethnic group

5-year relative survival by income group

Table 18: **One-year and five-year RSRs, and their ethnic and income gaps, for bladder cancer patients diagnosed during 1991–2004, by ethnic and income group**

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.84 (0.82,0.86)	0.86 (0.84,0.88)	0.87 (0.85,0.88)
	Māori	0.78 (0.61,0.90)	0.87 (0.74,0.95)	0.82 (0.69,0.91)
5 years	Non-Māori	0.67 (0.64,0.70)	0.72 (0.69,0.75)	0.72 (0.68,0.75)
	Māori	0.76 (0.54,0.93)	0.72 (0.55,0.87)	0.82 (0.64,0.96)
Ethnic gap	1 year	-0.05	0.01	-0.05
	5 years	0.09	0.00	0.10
Socioeconomic trends in relative survival				
1 year	High income	0.85 (0.81,0.89)	0.87 (0.83,0.90)	0.89 (0.86,0.92)
	Medium income	0.85 (0.82,0.88)	0.85 (0.82,0.88)	0.88 (0.85,0.91)
	Low income	0.83 (0.78,0.87)	0.87 (0.84,0.90)	0.85 (0.81,0.88)
5 years	High income	0.68 (0.62,0.74)	0.74 (0.69,0.79)	0.75 (0.69,0.81)
	Medium income	0.68 (0.63,0.73)	0.73 (0.68,0.78)	0.81 (0.74,0.87)
	Low income	0.72 (0.65,0.79)	0.75 (0.69,0.80)	0.66 (0.59,0.73)
Income group gap	1 year	-0.02	0.00	-0.05
	5 years	0.04	0.00	-0.09

[1] RSRs calculated using the cohort design, with follow-up to 31 December 2006.

[2] RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

7.3 Excess mortality

Ethnic and income trends in bladder cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 19.

Changes in excess mortality over time

Table 19 shows a moderate decrease in excess mortality over time for bladder cancer patients. For every 10 years of cancer diagnosis, bladder cancer patients experienced a 21% decrease in excess mortality, with an EMRR of 0.79 (95% CI 0.66, 0.94) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 19 shows little evidence of ethnic differences in bladder cancer patient survival but some evidence of an income difference. Averaged over time, Māori bladder cancer patients had similar excess mortality to non-Māori patients, with an EMRR of 1.02 (95% CI 0.63, 1.64). Bladder cancer patients in the lowest income quintile experienced 15% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.15 (95% CI 0.93, 1.41).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for bladder cancer patient survival (shown in Table 19). The ethnic interaction EMRR was 1.33 (95% CI 0.36, 4.94) and the income interaction EMRR was 1.55 (95% CI 0.92, 2.64). There is no evidence of changes over time in the ethnic or income gap in excess mortality for bladder cancer patients. No further interpretation of Models 2 and 4 in Table 19 are provided here.

Table 19: EMRRs, including 95% CIs, for bladder cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	1.46 (1.27,1.68)	1.46 (1.27,1.68)	1.44 (1.25,1.66)	1.44 (1.245,1.66)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.02 (0.63,1.64)**	**0.83 (0.28,2.50)**	1.00 (0.62,1.60)	1.00 (0.62,1.60)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.15 (0.93,1.41)**	**0.85 (0.57,1.29)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.79 (0.66,0.94)**	**0.59 (0.15,2.29)**	**0.79 (0.66,0.94)**	**0.64 (0.47,0.87)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.33 (0.36,4.94)**		
Income quintiles × calendar year of diagnosis				**1.56 (0.92,2.64)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.79 (0.55,1.12)	0.79 (0.55,1.12)	0.79 (0.55,1.13)	0.79 (0.55,1.13)
3 years since diagnosis	0.38 (0.25,0.60)	0.38 (0.25,0.60)	0.37 (0.24,0.58)	0.37 (0.24,0.58)
4 years since diagnosis	0.23 (0.14,0.38)	0.23 (0.14,0.38)	0.23 (0.14,0.38)	0.23 (0.14,0.38)
5 years since diagnosis	0.21 (0.12,0.37)	0.21 (0.12,0.37)	0.21 (0.12,0.37)	0.21 (0.12,0.37)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.56 (1.12,2.18)	1.56 (1.12,2.18)	1.53 (1.09,2.14)	1.54 (1.10,2.16)
Aged 65–74	1.93 (1.17,3.18)	1.93 (1.17,3.18)	1.94 (1.18,3.21)	1.96 (1.19,3.24)
Aged 75+	2.87 (1.72,4.78)	2.86 (1.72,4.77)	3.03 (1.84,5.02)	3.03 (1.83,5.01)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.01 (0.59,1.72)	1.01 (0.59,1.72)	0.99 (0.58,1.69)	0.98 (0.58,1.67)
75+, 1 year since diagnosis	1.43 (0.85,2.42)	1.44 (0.85,2.43)	1.34 (0.80,2.26)	1.34 (0.80,2.26)
64–74 years, 2 years since diagnosis	0.99 (0.56,1.76)	1.00 (0.56,1.76)	0.96 (0.54,1.71)	0.96 (0.54,1.70)
75+, 2 years since diagnosis	0.74 (0.41,1.33)	0.74 (0.41,1.33)	0.70 (0.39,1.25)	0.70 (0.39,1.25)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	818	818	2902	2902
AIC (Akaike information criterion)	2018.2	2020	4857	4856.3
BIC (Bayesian information criteria)	2088.8	2095.3	4952.6	4957.8
Scaled dispersion	0.921	0.922	0.808	0.807
Deviance	739.324	739.147	413.848	417.281

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 8: Cancer of the brain (ICD code 71)

Only malignant brain tumours are included in the following analyses. This may vary between international brain cancer survival analyses because benign brain tumours are generally included in survival analyses.

8.1 Number of patients

Number of patients included in survival analyses

The number of brain cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of brain cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 714, 765 and 684, respectively. Of those patients, the number of Māori patients in each cohort was 36, 36 and 54, respectively.

Number of patients included in relative survival analyses, by income group

The number of brain cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 621, 657 and 564, respectively. Of those patients, the number of high-income patients in each cohort was 192, 225 and 219, and the number of low-income patients in each cohort was 195, 198 and 171, respectively.

Number of patients included in excess mortality modelling

A total of 1830 brain cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

8.2 Relative survival

Relative survival, by ethnic group

Sparse data made ethnic trends in brain cancer relative survival difficult to interpret. Figure 16 and Table 20 show little improvement in one-year and five-year RSRs for non-Māori brain cancer patients but no clear pattern for Māori patients.

Relative survival, by income group

Figure 16 and Table 20 show little improvement in brain cancer one-year and five-year relative survival for all income groups.

Figure 16: **One-year and five-year RSRs for brain cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group**

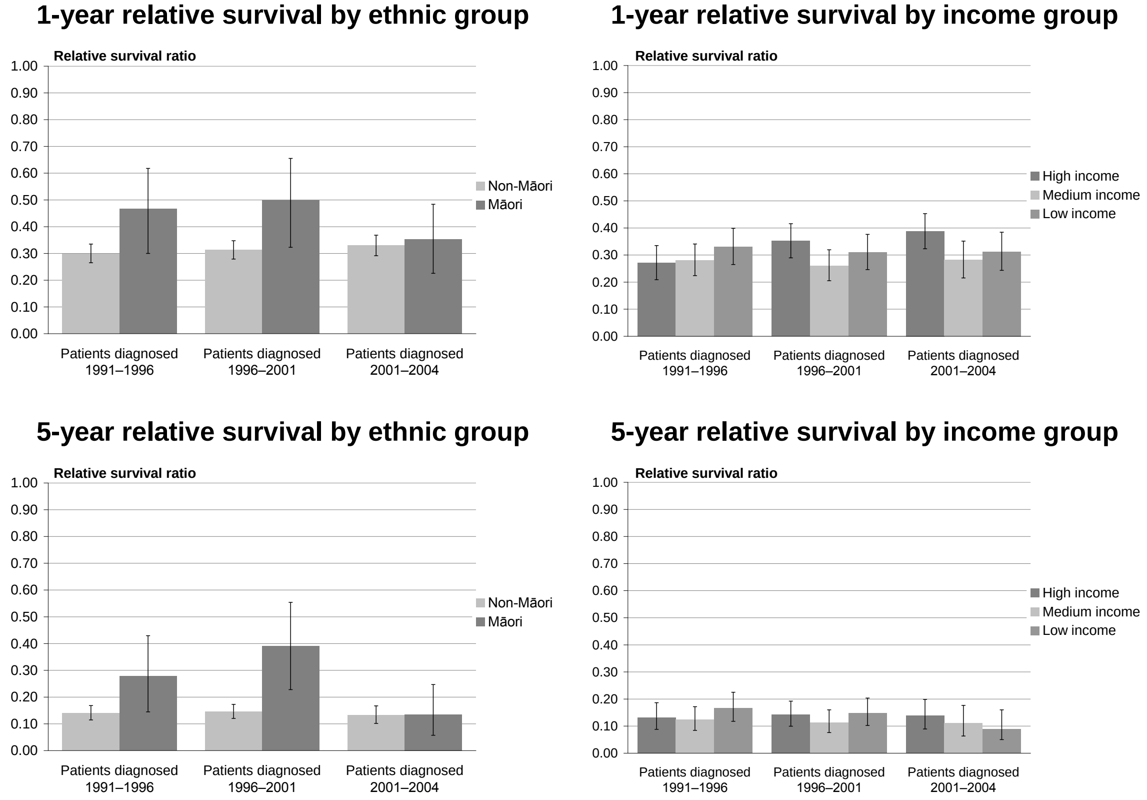


Table 20: One-year and five-year RSRs, and their ethnic and income gaps, for brain cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.30 (0.27,0.33)	0.31 (0.28,0.35)	0.33 (0.29,0.37)
	Māori	0.47 (0.30,0.62)	0.50 (0.32,0.66)	0.35 (0.23,0.48)
5 years	Non-Māori	0.14 (0.11,0.17)	0.15 (0.12,0.17)	0.13 (0.10,0.17)
	Māori	0.28 (0.15,0.43)	0.39 (0.23,0.55)	0.13 (0.06,0.25)
Ethnic gap	1 year	0.17	0.19	0.02
	5 years	0.14	0.25	0.00
Socioeconomic trends in relative survival				
1 year	High income	0.27 (0.21,0.34)	0.35 (0.29,0.42)	0.39 (0.32,0.45)
	Medium income	0.28 (0.22,0.34)	0.26 (0.20,0.32)	0.28 (0.22,0.35)
	Low income	0.33 (0.26,0.40)	0.31 (0.25,0.38)	0.31 (0.24,0.38)
5 years	High income	0.13 (0.09,0.19)	0.14 (0.10,0.19)	0.14 (0.09,0.20)
	Medium income	0.12 (0.08,0.17)	0.11 (0.08,0.16)	0.11 (0.06,0.18)
	Low income	0.17 (0.12,0.22)	0.15 (0.10,0.20)	0.09 (0.05,0.16)
Income group gap	1 year	0.06	-0.04	-0.08
	5 years	0.03	0.01	-0.05

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

8.3 Excess mortality

Ethnic and income trends in brain cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 21.

Changes in excess mortality over time

Table 21 shows that there was a small decrease over time in excess mortality for brain cancer patients. For every 10 years of cancer diagnosis, brain cancer patients experienced a non-significant 6% decrease in excess mortality, with an EMRR of 0.94 (95% CI 0.83, 1.07) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 21 shows little evidence of either ethnic or income differences in excess mortality for brain cancer patients. Averaged over time, Māori brain cancer patients had similar excess mortality to non-Māori patients, with an EMRR of 0.97 (95% CI 0.75, 1.25). Brain cancer patients in the lowest income quintile also experienced similar excess mortality compared to patients in the highest income quintile, with an EMRR of 1.04 (95% CI 0.90, 1.20).

Interaction terms: ethnicity and calendar period, and income and calendar period

Changes over time in ethnic or income differences in excess mortality for brain cancer patients were explored in Models 2 and 4 in Table 21. The ethnic interaction EMRR was 1.37 (95% CI 0.73, 2.58) and the income interaction EMRR was 1.21 (95% CI 0.84, 1.72). There was no evidence of changes over time in the ethnic or income gap in excess mortality for brain cancer patients. No further interpretation of Models 2 and 4 in Table 21 is provided here.

Table 21: EMRRs, including 95% CIs, for brain cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.93 (0.84,1.03)	0.93 (0.84,1.03)	0.93 (0.84,1.03)	0.94 (0.85,1.04)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**0.97 (0.75,1.25)**	**0.75 (0.43,1.33)**	0.96 (0.74,1.24)	0.96 (0.74,1.24)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.04 (0.90,1.20)**	**0.92 (0.69,1.21)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.94 (0.83,1.07)**	**0.68 (0.35,1.31)**	**0.94 (0.83,1.07)**	**0.86 (0.70,1.07)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.37 (0.73,2.58)**		
Income quintiles × calendar year of diagnosis				**1.21 (0.84,1.72)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.87 (0.74,1.04)	0.88 (0.74,1.04)	0.87 (0.73,1.04)	0.87 (0.74,1.04)
3 years since diagnosis	0.27 (0.20,0.37)	0.27 (0.20,0.37)	0.27 (0.19,0.37)	0.27 (0.20,0.37)
4 years since diagnosis	0.22 (0.15,0.33)	0.22 (0.15,0.33)	0.22 (0.15,0.33)	0.22 (0.15,0.33)
5 years since diagnosis	0.19 (0.12,0.31)	0.19 (0.12,0.31)	0.19 (0.12,0.31)	0.19 (0.12,0.31)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	2.67 (2.31,3.09)	2.66 (2.30,3.08)	2.67 (2.30,3.09)	2.66 (2.30,3.08)
Aged 65–74	1.79 (0.83,3.90)	1.78 (0.82,3.88)	1.79 (0.82,3.90)	1.81 (0.83,3.94)
Aged 75+	1.29 (0.23,7.08)	1.27 (0.23,7.03)	1.30 (0.24,7.15)	1.27 (0.23,7.10)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	2.68 (1.22,5.90)	2.69 (1.22,5.92)	2.68 (1.22,5.90)	2.66 (1.21,5.85)
75+, 1 year since diagnosis	5.10 (0.92,28.25)	5.15 (0.93,28.66)	5.04 (0.92,27.84)	5.18 (0.92,29.19)
64–74 years, 2 years since diagnosis	0.99 (0.40,2.46)	0.98 (0.39,2.451	0.99 (0.40,2.47)	0.99 (0.40,2.46)
75+, 2 years since diagnosis	1.27 (0.20,8.17)	1.28 (0.20,8.261)	1.29 (0.20,8.25)	1.32 (0.20,8.56)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	494	494	1336	1336
AIC (Akaike information criterion)	1524.9	1525.9	3437.5	3438.5
BIC (Bayesian information criteria)	1587.9	1593.1	3520.7	3526.8
Scaled dispersion	1.234	1.235	1.145	1.145
Deviance	591.291	590.288	1231.726	1232.372

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 9: Cancer of the cervix (ICD code C53)

9.1 Number of patients

Number of patients included in survival analyses

The number of cervical cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of cervical cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 790, 745 and 452, respectively. Of those patients, the number of Māori patients in each cohort was 164, 151 and 84, respectively.

Number of patients included in relative survival analyses, by income group

The number of cervical cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 638, 606 and 350, respectively. Of those patients, the number of high-income patients in each cohort was 127, 140 and 111, and the number of low-income patients in each cohort was 288, 256 and 129, respectively.

Number of patients included in excess mortality modelling

A total of 1578 cervical cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

9.2 Relative survival

Relative survival, by ethnic group

Figure 17 and Table 22 show improvements over time in the five-year RSR for cervical cancer patients in both ethnic groups, but little change in one-year RSR for non-Māori and Māori patients.

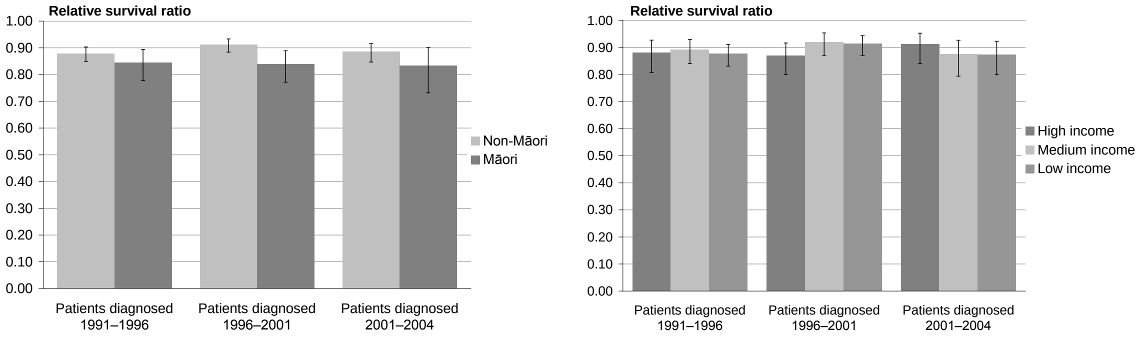
Relative survival, by income group

Figure 17 and Table 22 show some improvements over time in five-year relative survival for cervical cancer patients in all income groups.

Figure 17: One-year and five-year RSRs for cervical cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

1-year relative survival by ethnic group

1-year relative survival by income group



5-year relative survival by ethnic group

5-year relative survival by income group

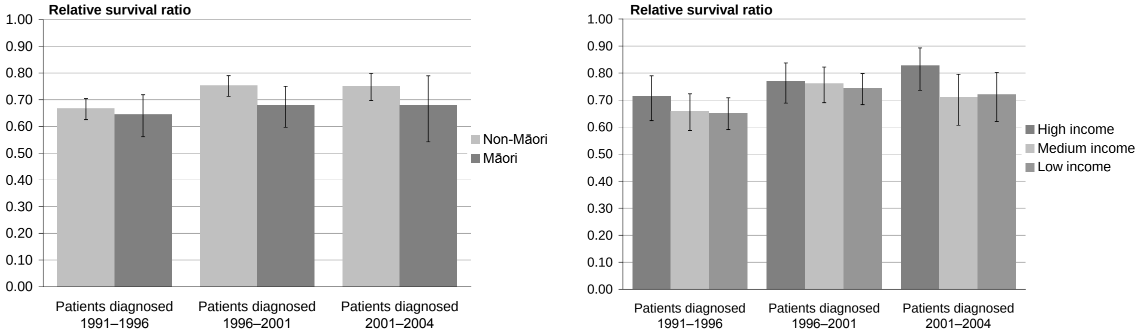


Table 22: **One-year and five-year RSRs, and their ethnic and income gaps, for cervical cancer patients diagnosed during 1991–2004, by ethnic and income groups**

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.88 (0.85,0.90)	0.91 (0.88,0.93)	0.89 (0.85,0.92)
	Māori	0.84 (0.78,0.89)	0.84 (0.77,0.89)	0.83 (0.73,0.90)
5 years	Non-Māori	0.67 (0.63,0.70)	0.75 (0.71,0.79)	0.75 (0.70,0.80)
	Māori	0.64 (0.56,0.72)	0.68 (0.60,0.75)	0.68 (0.54,0.79)
Ethnic gap	1 year	-0.03	-0.0	-0.05
	5 years	-0.02	-0.07	-0.07
Socioeconomic trends in relative survival				
1 year	High income	0.88 (0.81,0.93)	0.87 (0.80,0.92)	0.91 (0.84,0.95)
	Medium income	0.89 (0.84,0.93)	0.92 (0.87,0.95)	0.87 (0.79,0.93)
	Low income	0.88 (0.83,0.91)	0.91 (0.87,0.94)	0.87 (0.80,0.92)
5 years	High income	0.71 (0.62,0.79)	0.77 (0.69,0.84)	0.83 (0.74,0.89)
	Medium income	0.66 (0.59,0.72)	0.76 (0.69,0.82)	0.71 (0.61,0.80)
	Low income	0.65 (0.59,0.71)	0.74 (0.68,0.80)	0.72 (0.62,0.80)
Income group gap	1 year	0.00	0.04	-0.04
	5 years	-0.06	-0.03	-0.11

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

9.3 Excess mortality

Ethnic and income trends in cervical cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 23.

Changes in excess mortality over time

Table 23 shows a moderate decrease in excess mortality for cervical cancer patients. For every 10 years of cancer diagnosis, cervical cancer patients experienced a 25% decrease in excess mortality, with an EMRR of 0.75 (95% CI 0.58, 0.97) in Model 1 and an EMRR of 0.76 (95% CI 0.58, 0.99) in Model 3.

Ethnic and income inequalities in cancer survival

Table 23 shows evidence of ethnic and income differences in excess mortality for cervical cancer patients. Averaged over time, Māori cervical cancer patients had 61% greater excess mortality, with an EMRR of 1.61 (95% CI 1.25 2.07), compared to non-Māori patients. Cervical cancer patients in the lowest income quintile experienced 25% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.25 (95% CI 0.92, 1.68).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for cervical cancer patient survival (see Table 23). The ethnic interaction EMRR was 1.09 (95% CI 0.58, 2.07) and the income interaction EMRR was 0.99 (95% CI 0.47, 2.20). There was no evidence of changes over time in the ethnic or income gap in excess mortality for cervical cancer patients. No further interpretation of Models 2 and 4 in Table 23 is provided here.

Table 23: **EMRRs, including 95% CIs, for cervical cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.61 (1.25,2.07)**	**1.54 (1.00,2.35)**	1.56 (1.21,2.01)	1.56 (1.21,2.01)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.25 (0.92,1.68)**	**1.25 (0.74,2.12)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.75 (0.58,0.97)**	**0.67 (0.23,1.52)**	**0.76 (0.58,0.99)**	**0.76 (0.45,1.29)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.09 (0.58,2.07)**		
Income quintiles × calendar year of diagnosis				**0.99 (0.47,2.20)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	1.01 (0.76,1.36)	1.01 (0.76,1.35)	1.01 (0.76,1.35)	1.01 (0.76,1.35)
3 years since diagnosis	0.48 (0.34,0.69)	0.48 (0.34,0.69)	0.48 (0.33,0.69)	0.48 (0.33,0.69)
4 years since diagnosis	0.40 (0.27,0.60)	0.40 (0.27,0.60)	0.40 (0.27,0.59)	0.40 (0.27,0.59)
5 years since diagnosis	0.23 (0.14,0.38)	0.23 (0.14,0.38)	0.23 (0.14,0.38)	0.23 (0.14,0.38)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.73 (1.31,2.28)	1.73 (1.31,2.28)	1.70 (1.29,2.25)	1.70 (1.29,2.25)
Aged 65–74	2.59 (1.58,4.25)	2.59 (1.58,4.24)	2.56 (1.56,4.21)	2.56 (1.56,4.21)
Aged 75+	4.41 (2.30,8.45)	4.40 (2.30,8.44)	4.42 (2.31,8.49)	4.43 (2.31,8.49)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	0.84 (0.44,1.60)	0.84 (0.44,1.60)	0.85 (0.45,1.62)	0.85 (0.45,1.62)
75+, 1 year since diagnosis	1.18 (0.55,2.52)	1.18 (0.55,2.52)	1.17 (0.54,2.50)	1.17 (0.54,2.50)
64–74 years, 2 years since diagnosis	0.75 (0.38,1.48)	0.75 (0.38,1.48)	0.75 (0.38,1.49)	0.75 (0.38,1.49)
75+, 2 years since diagnosis	0.81 (0.34,1.89)	0.81 (0.34,1.89)	0.80 (0.34,1.88)	0.80 (0.34,1.88)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	439	439	1566	1566
AIC (Akaike information criterion)	1092.9	1094.8	2155.2	2157.2
BIC (Bayesian information criteria)	1150.1	1156.1	2235.6	2242.9
Scaled dispersion	1.135	1.138	0.831	0.831
Deviance	482.535	482.46	199.61	199.618

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 10: Cancer of the head, neck and larynx (ICD codes C01–14, C30)

10.1 Number of patients

Number of patients included in survival analyses

The number of head, neck and laryngeal (subsequently referred to as head and neck) cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of head and neck cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1347, 1434 and 1112, respectively. Of those patients, the number of Māori patients in each cohort was 84, 107 and 109, respectively.

Number of patients included in relative survival analyses, by income group

The number of head and neck cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1171, 1176 and 896, respectively. Of those patients, the number of high-income patients in each cohort was 272, 284 and 243, and the number of low-income patients in each cohort was 388, 427 and 371, respectively.

Number of patients included in excess mortality modelling

A total of 3222 head and neck cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

10.2 Relative survival

Relative survival, by ethnic group

Figure 18 and Table 24 show some improvements over time in one-year and five-year RSRs for Māori head and neck cancer patients, but little change over time for non-Māori patients.

Relative survival, by income group

Figure 18 and Table 24 show some evidence for improvements in five-year RSRs for head and neck cancer patients in all income groups, but little change in one-year RSRs.

Figure 18: One-year and five-year RSRs for head and neck cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

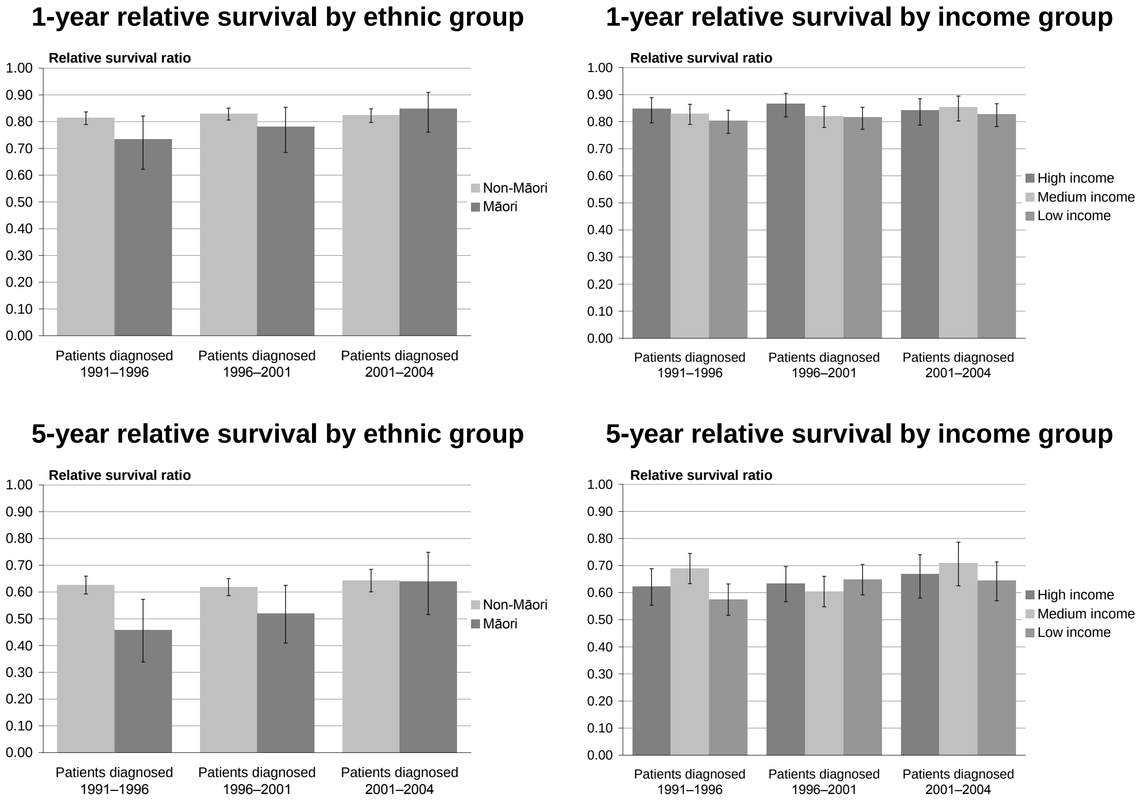


Table 24: **One-year and five-year RSRs, and their ethnic and income gaps, for head and neck cancer patients diagnosed during 1991–2004, by ethnic and income group**

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.81 (0.79,0.84)	0.83 (0.81,0.85)	0.82 (0.80,0.85)
	Māori	0.73 (0.62,0.82)	0.78 (0.68,0.85)	0.85 (0.76,0.91)
5 years	Non-Māori	0.63 (0.59,0.66)	0.62 (0.59,0.65)	0.64 (0.60,0.68)
	Māori	0.46 (0.34,0.57)	0.52 (0.41,0.63)	0.64 (0.52,0.75)
Ethnic gap	1 year	-0.08	-0.05	0.02
	5 years	-0.17	-0.10	0.00
Socioeconomic trends in relative survival				
1 year	High income	0.85 (0.80,0.89)	0.87 (0.82,0.90)	0.84 (0.79,0.88)
	Medium income	0.83 (0.79,0.86)	0.82 (0.78,0.86)	0.85 (0.80,0.89)
	Low income	0.80 (0.76,0.84)	0.82 (0.77,0.85)	0.83 (0.78,0.87)
5 years	High income	0.62 (0.55,0.69)	0.63 (0.57,0.70)	0.67 (0.58,0.74)
	Medium income	0.69 (0.63,0.74)	0.61 (0.55,0.66)	0.71 (0.62,0.79)
	Low income	0.58 (0.52,0.63)	0.65 (0.59,0.70)	0.64 (0.57,0.71)
Income group gap	1 year	-0.04	-0.05	-0.01
	5 years	-0.05	0.02	-0.02

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

10.3 Excess mortality

Excess mortality

Ethnic and income trends in head and neck cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 25 and discussed below.

Changes in excess mortality over time

Table 25 shows evidence of a small improvement over time in excess mortality for head and neck cancer patients. For every 10 years of cancer diagnosis, head, neck and laryngeal cancer patients experienced a non-significant 4–5% decrease in excess mortality, with an EMRR of 0.95 (95% CI 0.80, 1.12) in Model 1 and an EMRR of 0.96 (95% CI 0.81, 1.12) in Model 3.

Ethnic and income inequalities in cancer survival

Table 25 shows evidence of ethnic and income differences in excess mortality for head and neck cancer patients. Averaged over time, Māori head and neck cancer patients had 37% greater excess mortality, with an EMRR of 1.37 (95% CI 1.07, 1.77) compared to non-Māori patients. Head and neck cancer patients in the lowest income quintile experienced 28% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.28 (95% CI 1.05, 1.56).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for head and neck cancer patient survival (see Table 25). The ethnic interaction EMRR was 0.65 (95% CI 0.35, 1.20) and the income interaction EMRR was 0.74 (95% CI 0.46, 1.20). There was no evidence of changes over time in the ethnic or income gap in excess mortality for head and neck cancer patients. No further interpretation of Models 2 and 4 in Table 25 is provided here.

Table 25: EMRRs, including 95% CIs, for head and neck cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.82 (0.71,0.96)	0.82 (0.70,0.95)	0.81 (0.70,0.94)	0.81 (0.70,0.94)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.37 (1.07,1.77)**	**1.88 (1.16,3.04)**	1.32 (1.03,1.70)	1.33 (1.03,1.71)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.28 (1.05,1.56)**	**1.56 (1.07,2.28)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.95 (0.80,1.12)**	**1.51 (0.76,3.00)**	**0.96 (0.81,1.12)**	**1.14 (0.82,1.57)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.65 (0.35,1.20)**		
Income quintiles × calendar year of diagnosis				**0.74 (0.46,1.20)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.91 (0.72,1.16)	0.91 (0.72,1.15)	0.91 (0.72,1.16)	0.91 (0.72,1.16)
3 years since diagnosis	0.47 (0.35,0.63)	0.47 (0.35,0.63)	0.47 (0.35,0.64)	0.47 (0.35,0.63)
4 years since diagnosis	0.33 (0.24,0.47)	0.33 (0.24,0.47)	0.33 (0.24,0.47)	0.33 (0.23,0.47)
5 years since diagnosis	0.32 (0.22,0.47)	0.32 (0.22,0.47)	0.33 (0.23,0.48)	0.33 (0.23,0.48)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.58 (1.28,1.94)	1.58 (1.29,1.95)	1.57 (1.28,1.93)	1.57 (1.27,1.93)
Aged 65–74	1.84 (1.32,2.58)	1.85 (1.32,2.59)	1.83 (1.31,2.56)	1.84 (1.31,2.57)
Aged 75+	1.47 (0.89,2.45)	1.48 (0.89,2.46)	1.55 (0.95,2.51)	1.54 (0.94,2.50)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.32 (0.90,1.94)	1.32 (0.90,1.94)	1.32 (0.90,1.93)	1.31 (0.90,1.93)
75+, 1 year since diagnosis	1.95 (1.13,3.36)	1.94 (1.12,3.35)	1.86 (1.10,3.15)	1.88 (1.11,3.18)
64–74 years, 2 years since diagnosis	0.73 (0.47,1.13)	0.73 (0.47,1.13)	0.73 (0.47,1.13)	0.73 (0.47,1.13)
75+, 2 years since diagnosis	1.05 (0.57,1.94)	1.05 (0.57,1.94)	1.02 (0.57,1.84)	1.03 (0.57,1.86)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	872	872	3090	3090
AIC (Akaike information criterion)	2223.6	2223.7	4853	4853.5
BIC (Bayesian information criteria)	2295.1	2300	4949.6	4956.2
Scaled dispersion	1.042	1.041	0.871	0.871
Deviance	892.77	890.862	308.065	309.347

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 11: Hodgkin's lymphoma (HL) (ICD code C81)

11.1 Number of patients

Number of patients included in survival analyses

The number of Hodgkin's lymphoma (subsequently referred to as HL) patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of HL cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 180, 210 and 222, respectively. Of those patients, the number of Māori patients in each cohort was 18, 24 and 21, respectively.

Number of patients included in relative survival analyses, by income group

The number of HL patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 147, 174 and 189, respectively. Of those patients, the number of high-income patients in each cohort was 51, 63 and 75, and the number of low-income patients in each cohort was 42, 54 and 54, respectively.

Number of patients included in excess mortality modelling

A total of 507 HL patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

11.2 Relative survival

Relative survival, by ethnic group

Sparse data in each ethnic group, particularly Māori, made it difficult to interpret one-year and five-year RSRs for HL patients (see Figure 19 and Table 26).

Relative survival, by income group

Sparse data in each income group made it difficult to interpret one-year and five-year RSRs for HL patients by income strata (see Figure 19 and Table 26).

Figure 19: **One-year and five-year RSRs for Hodgkin's lymphoma patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group**

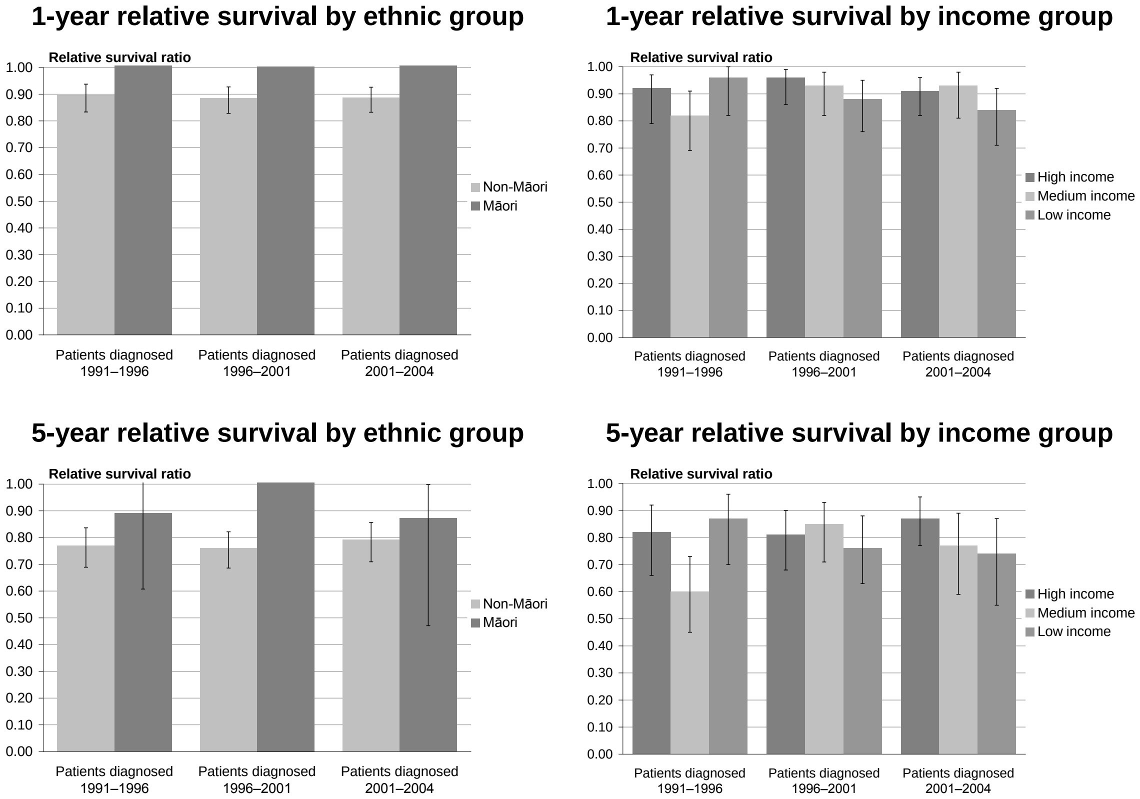


Table 26: One-year and five-year RSRs, and their ethnic and income gaps, for Hodgkin's lymphoma patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.90 (0.83,0.94)	0.89 (0.83,0.93)	0.89 (0.83,0.93)
	Māori	1.01 (1.01,1.01)	1.00 (1.00,1.00)	1.01 (1.01,1.01)
5 years	Non-Māori	0.77 (0.69,0.84)	0.76 (0.69,0.82)	0.79 (0.71,0.86)
	Māori	0.89 (0.61,1.01)	1.02 (1.02,1.02)	0.87 (0.47,1.00)
Ethnic gap	1 year	0.12	0.12	0.12
	5 years	0.12	0.26	0.08
Socioeconomic trends in relative survival				
1 year	High income	0.73 (0.65,0.80)	0.79 (0.72,0.84)	0.86 (0.78,0.91)
	Medium income	0.72 (0.66,0.78)	0.74 (0.67,0.79)	0.76 (0.67,0.83)
	Low income	0.76 (0.69,0.83)	0.76 (0.70,0.82)	0.84 (0.78,0.90)
5 years	High income	0.67 (0.60,0.73)	0.67 (0.61,0.73)	0.70 (0.62,0.76)
	Medium income	0.72 (0.67,0.78)	0.63 (0.58,0.69)	0.72 (0.65,0.79)
	Low income	0.60 (0.54,0.65)	0.65 (0.59,0.70)	0.69 (0.63,0.74)
Income group gap	1 year	0.03	-0.03	-0.01
	5 years	-0.07	-0.02	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

11.3 Excess mortality

Ethnic and income trends in HL patient survival were calculated using four different excess mortality models. The excess mortality rate ratio (EMRR) estimates relevant to this study are highlighted in Table 27 and discussed below.

Changes in excess mortality over time

Table 27 shows that HL patients are likely to have experienced a moderate decrease in excess mortality over time. For every 10 years of cancer diagnosis, HL patients experienced a 30% decrease in excess mortality, with an EMRR of 0.70 (95% CI 0.41, 1.19) in Model 1 and an EMRR of 0.70 (95% CI 0.41, 1.18) in Model 3. Note that both sets of 95% confidence limits included the null, so we cannot rule out the possibility that the decreasing excess mortality is a chance finding.

Ethnic and income inequalities in cancer survival

Table 27 shows little evidence of ethnic or income differences in excess mortality for HL patients. Model 1 shows an ethnic EMRR of 0.22 (95% CI 0.02, 3.06) and an income EMRR of 0.98 (95% CI 0.53, 1.82). We can conclude that little evidence exists for ethnic or income differences in excess mortality for HL patients. No further interpretation of Models 1 and 3 are given here.

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for HL patient survival (see Table 27). The ethnic interaction EMRR was 0.40 (95% CI 0.00, 83.07) and the income interaction EMRR was 2.42 (95% CI 0.56, 10.43). Both interaction terms had very wide confidence intervals. No strong evidence existed for changes over time in the ethnic or income gap in excess mortality for HL patients. No further interpretation of Models 2 and 4 in Table 27 is provided here.

Table 27: **EMRRs, including 95% CIs, for Hodgkin's lymphoma patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		**Income trends in survival**	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	1.16 (0.75,1.77)	1.16 (0.76,1.78)	1.14 (0.74,1.76)	1.16 (0.75,1.79)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**0.22 (0.02,3.06)**	**0.36 (0.02,8.17)**	0.23 (0.02,3.11)	0.22 (0.01,3.44)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**0.98 (0.53,1.82)**	**0.52 (0.15,1.78)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.70 (0.41,1.19)**	**1.77 (0.01,395.28)**	**0.70 (0.41,1.18)**	**0.48 (0.21,1.08)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.40 (0.00,83.07)**		
Income quintiles × calendar year of diagnosis				**2.42 (0.56,10.43)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	1.03 (0.44,2.41)	1.03 (0.44,2.41)	1.04 (0.44,2.44)	1.04 (0.44,2.46)
3 years since diagnosis	0.43 (0.15,1.21)	0.44 (0.16,1.22)	0.42 (0.15,1.21)	0.42 (0.14,1.20)
4 years since diagnosis	0.86 (0.36,2.04)	0.86 (0.36,2.05)	0.88 (0.37,2.09)	0.88 (0.37,2.10)
5 years since diagnosis	0.36 (0.11,1.22)	0.36 (0.11,1.22)	0.36 (0.10,1.23)	0.36 (0.10,1.23)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	2.69 (1.32,5.51)	2.70 (1.32,5.52)	2.68 (1.30,5.54)	2.78 (1.34,5.76)
Aged 65–74	5.03 (1.88,13.50)	5.00 (1.87,13.40)	5.15 (1.94,13.66)	5.11 (1.93,13.55)
Aged 75+	16.78 (5.65,49.86)	16.64 (5.60,49.45)	16.81 (5.63,50.21)	16.88 (5.64,50.53)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.60 (0.46,5.66)	1.61 (0.46,5.67)	1.60 (0.46,5.58)	1.59 (0.45,5.56)
75+, 1 year since diagnosis	1.62 (0.45,5.88)	1.63 (0.45,5.91)	1.63 (0.45,5.96)	1.64 (0.45,6.00)
64–74 years, 2 years since diagnosis	1.02 (0.26,4.10)	1.00 (0.25,4.04)	0.98 (0.24,3.93)	0.98 (0.25,3.93)
75+, 2 years since diagnosis	0.33 (0.06,2.01)	0.34 (0.06,2.02)	0.32 (0.05,2.01)	0.32 (0.05,2.05)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	554	554	1242	1242
AIC (Akaike information criterion)	641.4	643.3	899.2	899.8
BIC (Bayesian information criteria)	706.2	712.3	981.2	986.9
Scaled dispersion	0.719	0.72	0.512	0.511
Deviance	387.651	387.528	155.298	156.273

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 12: Cancer of the kidney, ureter and urethra (ICD codes C64–66, C68)

12.1 Number of patients

Number of patients included in survival analyses

The number of kidney, ureter and urethra (subsequently referred to as kidney) cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of kidney cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 900, 1071 and 963, respectively. Of those patients, the number of Māori patients in each cohort was 63, 72 and 66, respectively.

Number of patients included in relative survival analyses, by income group

The number of kidney cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 786, 912 and 822, respectively. Of those patients, the number of high-income patients in each cohort was 219, 258 and 264, and the number of low-income patients in each cohort was 207, 297 and 270, respectively.

Number of patients included in excess mortality modelling

A total of 2502 kidney cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

12.2 Relative survival

Relative survival, by ethnic group

Figure 20 and Table 28 show evidence of improvements in one-year and five-year RSRs for non-Māori kidney cancer patients but little change for Māori patients.

Relative survival, by income group

Figure 20 and Table 28 show improvements over time in one-year and five-year RSRs for high- and medium-income kidney cancer patients, but little change over time for low income patients.

Figure 20: **One-year and five-year RSRs for kidney cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group**

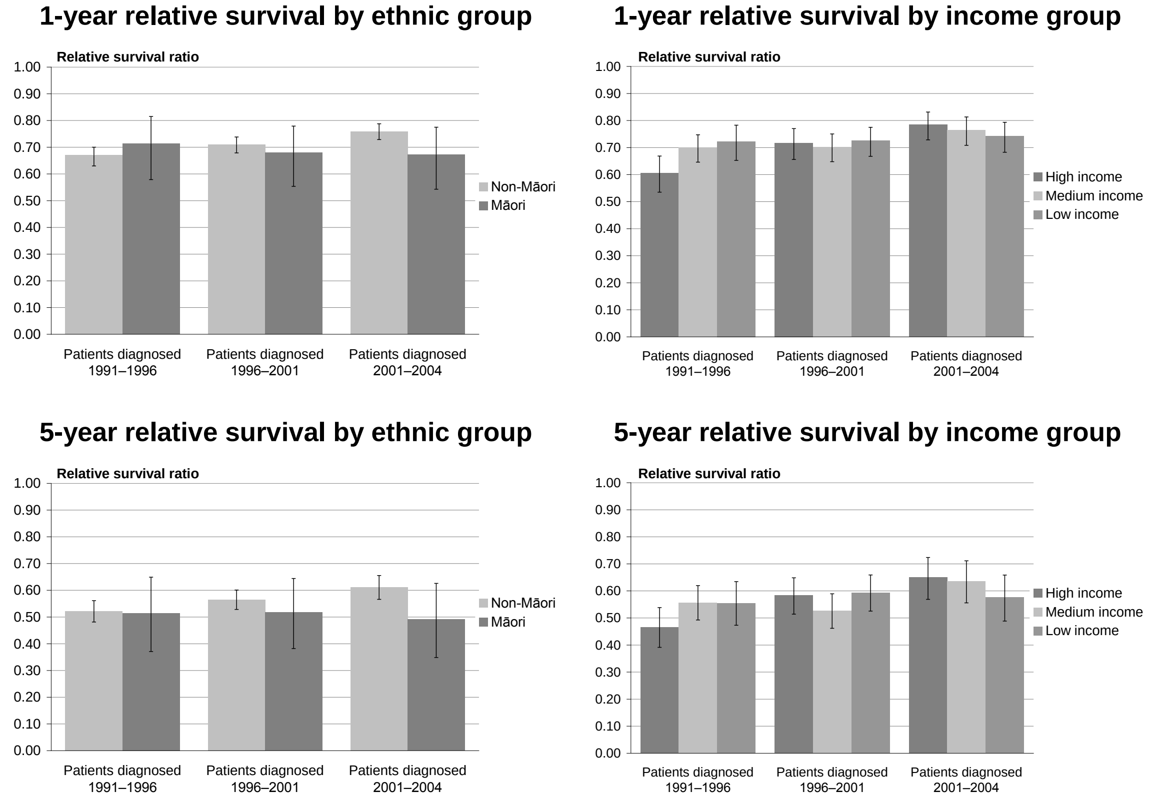


Table 28: One-year and five-year RSRs, and their ethnic and income gaps, for kidney cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.67 (0.64,0.70)	0.71 (0.68,0.74)	0.76 (0.73,0.79)
	Māori	0.71 (0.58,0.81)	0.68 (0.55,0.78)	0.67 (0.54,0.77)
5 years	Non-Māori	0.52 (0.48,0.56)	0.56 (0.53,0.60)	0.61 (0.57,0.66)
	Māori	0.51 (0.37,0.65)	0.52 (0.38,0.64)	0.49 (0.35,0.63)
Ethnic gap	1 year	0.04	-0.03	-0.09
	5 years	-0.01	-0.05	-0.12
Socioeconomic trends in relative survival				
1 year	High income	0.60 (0.53,0.67)	0.72 (0.66,0.77)	0.78 (0.73,0.83)
	Medium income	0.70 (0.65,0.75)	0.70 (0.65,0.75)	0.76 (0.71,0.81)
	Low income	0.72 (0.65,0.78)	0.72 (0.67,0.77)	0.74 (0.68,0.79)
5 years	High income	0.47 (0.39,0.54)	0.58 (0.51,0.65)	0.65 (0.57,0.72)
	Medium income	0.56 (0.49,0.62)	0.53 (0.46,0.59)	0.64 (0.56,0.71)
	Low income	0.56 (0.47,0.63)	0.59 (0.53,0.66)	0.58 (0.49,0.66)
Income group gap	1 year	0.12	0.01	-0.04
	5 years	0.09	0.01	-0.07

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

12.3 Excess mortality

Ethnic and income trends in kidney cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 29 and discussed below.

Changes in excess mortality over time

Table 29 shows evidence that kidney cancer patients experienced a moderate decrease in excess mortality over time. For every 10 years of cancer diagnosis, kidney cancer patients experienced a 29% decrease in excess mortality, with an EMRR of 0.71 (95% CI 0.60, 0.84) in Models 1 and 3. The confidence limits for both EMRRs excluded the null.

Ethnic and income inequalities in cancer survival

Table 29 shows evidence of ethnic differences in excess mortality for kidney cancer patients but little evidence of income differences in excess mortality. Averaged over time, Māori kidney cancer patients had 52% greater excess mortality, with an EMRR of 1.52 (95% CI 1.16, 2.00) compared to non-Māori patients. Kidney cancer patients in the lowest income quintile experienced similar excess mortality compared to patients in the highest income quintile, with an EMRR of 0.95 (95% CI 0.78, 1.15).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for kidney cancer patient survival (see Table 29). The ethnic interaction EMRR was 1.49 (95% CI 0.79, 2.83) and the income interaction EMRR was 2.16 (95% CI 1.31, 3.54). There was no evidence for a change over time in the ethnic EMRR. There was a statistically significant greater reduction in excess mortality among high-income people, but this may be a chance finding. No further interpretation of Models 2 and 4 in Table 29 is provided here.

Table 29: EMRRs, including 95% CIs, for kidney cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.92 (0.80,1.05)	0.92 (0.80,1.05)	0.92 (0.80,1.06)	0.93 (0.81,1.06)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.52 (1.16,2.00)**	**1.16 (0.69,2.00)**	1.54 (1.17,2.02)	1.55 (1.18,2.03)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**0.95 (0.78,1.15)**	**0.56 (0.38,0.83)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.71 (0.60,0.84)**	**0.46 (0.23,0.94)**	**0.71 (0.60,0.84)**	**0.49 (0.36,0.65)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.49 (0.79,2.83)**		
Income quintiles × calendar year of diagnosis				**2.16 (1.32,3.54)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.36 (0.27,0.47)	0.36 (0.27,0.47)	0.36 (0.27,0.48)	0.36 (0.27,0.48)
3 years since diagnosis	0.19 (0.14,0.28)	0.20 (0.14,0.28)	0.20 (0.14,0.28)	0.20 (0.14,0.28)
4 years since diagnosis	0.11 (0.07,0.18)	0.11 (0.07,0.18)	0.11 (0.07,0.18)	0.12 (0.07,0.18)
5 years since diagnosis	0.19 (0.13,0.28)	0.19 (0.13,0.28)	0.18 (0.12,0.27)	0.18 (0.12,0.27)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.57 (1.27,1.94)	1.58 (1.28,1.95)	1.57 (1.27,1.94)	1.57 (1.27,1.94)
Aged 65–74	1.44 (0.92,2.24)	1.42 (0.91,2.22)	1.41 (0.90,2.22)	1.43 (0.91,2.24)
Aged 75+	1.89 (1.10,3.23)	1.88 (1.09,3.22)	1.95 (1.16,3.29)	1.90 (1.12,3.23)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.16 (0.72,1.85)	1.17 (0.73,1.87)	1.18 (0.73,1.90)	1.16 (0.72,1.87)
75+, 1 year since diagnosis	1.44 (0.82,2.52)	1.45 (0.83,2.54)	1.39 (0.81,2.39)	1.41 (0.82,2.44)
64–74 years, 2 years since diagnosis	1.12 (0.63,1.98)	1.13 (0.63,2.00)	1.13 (0.63,2.02)	1.11 (0.62,1.98)
75+, 2 years since diagnosis	0.57 (0.26,1.27)	0.58 (0.26,1.28)	0.59 (0.27,1.26)	0.60 (0.28,1.28)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	787	787	2742	2742
AIC (Akaike information criterion)	1983.4	1983.9	4283.6	4276.3
BIC (Bayesian information criteria)	2053.4	2058.5	4378.2	4376.9
Scaled dispersion	1.084	1.084	0.886	0.883
Deviance	837.13	835.607	595.61	605.838

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 13: Leukaemia – all forms (ICD codes C91–C93)

13.1 Number of patients

Number of patients included in survival analyses

The number of leukaemia patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of leukaemia patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1284, 1698 and 1764, respectively. Of those patients, the number of Māori patients in each cohort was 105, 102 and 129, respectively.

Number of patients included in relative survival analyses, by income group

The number of leukaemia patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1107, 1455 and 1494, respectively. Of those patients, the number of high-income patients in each cohort was 309, 444 and 456, and the number of low-income patients in each cohort was 279, 408 and 498, respectively.

Number of patients included in excess mortality modelling

A total of 4023 leukaemia patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

13.2 Relative survival

Relative survival, by ethnic group

Figure 21 and Table 30 show evidence of substantial improvements in one-year and five-year RSRs for non-Māori and Māori leukaemia patients.

Relative survival, by income group

Figure 21 and Table 30 show evidence of substantial improvements in one-year and five-year RSRs for leukaemia patients in all income groups.

Figure 21: One-year and five-year RSRs for leukaemia patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

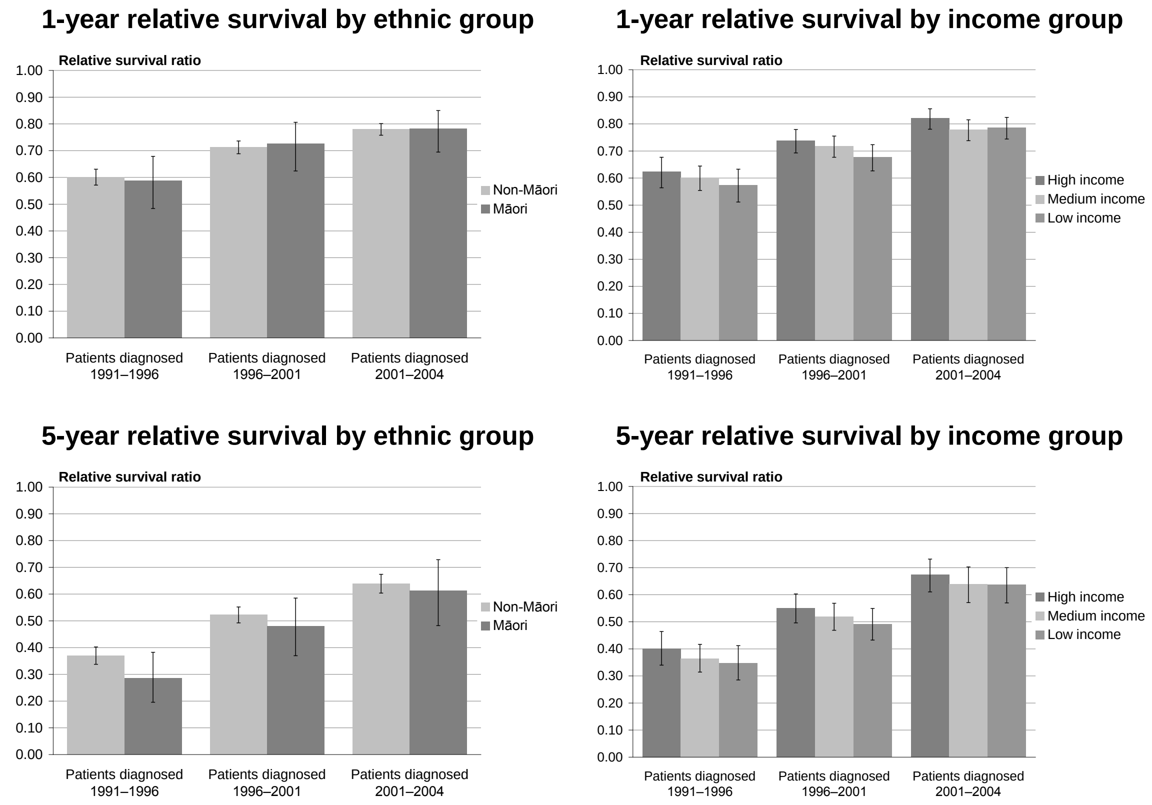


Table 30: One-year and five-year RSRs, and their ethnic and income gaps, for leukaemia patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.60 (0.57,0.63)	0.71 (0.69,0.74)	0.78 (0.76,0.80)
	Māori	0.59 (0.48,0.68)	0.73 (0.62,0.81)	0.78 (0.69,0.85)
5 years	Non-Māori	0.37 (0.34,0.40)	0.52 (0.49,0.55)	0.64 (0.60,0.67)
	Māori	0.28 (0.20,0.38)	0.48 (0.37,0.59)	0.61 (0.48,0.73)
Ethnic gap	1 year	-0.01	0.01	0.00
	5 years	-0.09	-0.04	-0.03
Socioeconomic trends in relative survival				
1 year	High income	0.62 (0.56,0.68)	0.74 (0.69,0.78)	0.82 (0.78,0.86)
	Medium income	0.60 (0.55,0.64)	0.72 (0.68,0.76)	0.78 (0.74,0.82)
	Low income	0.57 (0.51,0.63)	0.68 (0.63,0.72)	0.79 (0.74,0.82)
5 years	High income	0.40 (0.34,0.46)	0.55 (0.50,0.60)	0.67 (0.61,0.73)
	Medium income	0.36 (0.31,0.42)	0.52 (0.47,0.57)	0.64 (0.57,0.70)
	Low income	0.35 (0.29,0.41)	0.49 (0.43,0.55)	0.64 (0.57,0.70)
Income group gap	1 year	-0.05	-0.06	-0.03
	5 years	-0.05	-0.06	-0.04

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

13.3 Excess mortality

Ethnic and income trends in leukaemia patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 31 and discussed below.

Changes in excess mortality over time

Table 31 shows evidence that leukaemia patients experienced a substantial and statistically significant decrease in excess mortality over time. For every 10 years of cancer diagnosis, leukaemia patients experienced a 60% decrease in excess mortality, with an EMRR of 0.40 (95% CI 0.35, 0.46) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 31 shows evidence of some ethnic and income differences in excess mortality for leukaemia patients. Averaged over time, Māori leukaemia patients had 25% greater excess mortality, with an EMRR of 1.25 (95% CI 1.01, 1.54) compared to non-Māori patients. Leukaemia patients in the lowest income quintile experienced a non-significant 12% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.12 (95% CI 0.96, 1.30).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for leukaemia patient survival (see Table 31). The ethnic interaction EMRR was 0.99 (95% CI 0.60, 1.30) and the income interaction EMRR was 0.93 (95% CI 0.64, 1.35). There was no evidence of changes over time in the ethnic or income gap in excess mortality for leukaemia patients. No further interpretation of Models 2 and 4 in Table 31 is provided here.

Table 31: **EMRRs, including 95% CIs, for leukaemia patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.90 (0.81,1.00)	0.90 (0.81,1.00)	0.90 (0.81,0.99)	0.90 (0.81,0.99)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.25 (1.01,1.54)**	**1.26 (0.88,1.80)**	1.23 (1.00,1.53)	1.23 (1.00,1.53)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.12 (0.96,1.30)**	**1.17 (0.89,1.55)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.40 (0.35,0.46)**	**0.41 (0.24,0.71)**	**0.40 (0.36,0.46)**	**0.42 (0.34,0.52)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.99 (0.60,1.63)**		
Income quintiles × calendar year of diagnosis				**0.93 (0.64,1.35)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.52 (0.42,0.65)	0.52 (0.42,0.65)	0.53 (0.42,0.65)	0.53 (0.42,0.65)
3 years since diagnosis	0.23 (0.17,0.23)	0.23 (0.17,0.30)	0.23 (0.17,0.30)	0.23 (0.17,0.30)
4 years since diagnosis	0.22 (0.16,0.29)	0.22 (0.16,0.29)	0.22 (0.16,0.29)	0.22 (0.16,0.29)
5 years since diagnosis	0.20 (0.15,0.28)	0.20 (0.15,0.28)	0.20 (0.15,0.28)	0.20 (0.15,0.28)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.15 (0.96,1.37)	1.15 (0.96,1.37)	1.15 (0.96,1.37)	1.14 (0.96,1.37)
Aged 65–74	1.55 (1.14,2.12)	1.55 (1.14,2.12)	1.56 (1.15,2.13)	1.56 (1.15,2.13)
Aged 75+	1.93 (1.41,2.65)	1.93 (1.41,2.65)	1.89 (1.37,2.60)	1.89 (1.37,2.60)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.09 (0.78,1.54)	1.09 (0.78,1.54)	1.08 (0.77,1.52)	1.08 (0.77,1.52)
75+, 1 year since diagnosis	1.10 (0.78,1.55)	1.10 (0.78,1.55)	1.13 (0.80,1.60)	1.13 (0.80,1.60)
64–74 years, 2 years since diagnosis	0.64 (0.42,0.98)	0.64 (0.42,0.98)	0.63 (0.41,0.97)	0.63 (0.41,0.97)
75+, 2 years since diagnosis	0.40 (0.24,0.64)	0.40 (0.24,0.64)	0.41 (0.25,0.67)	0.41 (0.25,0.67)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	869	869	3020	3020
AIC (Akaike information criterion)	2507	2509	5944.1	5946
BIC (Bayesian information criteria)	2578.5	2585.3	6040.3	6048.2
Scaled dispersion	1.135	1.136	1.046	1.046
Deviance	968.912	968.908	975.135	975.56

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 14: Cancer of the liver and intrahepatic bile ducts (ICD code C22)

14.1 Number of patients

Number of patients included in survival analyses

The number of liver and intrahepatic bile duct (subsequently referred to as liver) cancer patients alive at the start of follow-up, those who died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of liver cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 291, 384 and 378, respectively. Of those patients, the number of Māori patients in each cohort was 54, 81 and 75, respectively.

Number of patients included in relative survival analyses, by income group

The number of liver cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 246, 300 and 291, respectively. Of those patients, the number of high-income patients in each cohort was 63, 69 and 63, and the number of low-income patients in each cohort was 75, 117 and 117, respectively.

Number of patients included in excess mortality modelling

A total of 834 liver cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

14.2 Relative survival

Relative survival, by ethnic group

Sparse data made it difficult to interpret changes in relative survival over time by ethnic group for liver cancer patients. Figure 22 and Table 32 show evidence for some improvements over time in one-year and five-year RSRs for non-Māori and Māori liver cancer patients.

Relative survival, by income group

Sparse data made it difficult to interpret changes in relative survival over time by income group for liver cancer patients. Figure 22 and Table 32 show evidence of improvements in one-year and five-year RSRs for liver cancer patients in all income groups.

Figure 22: One-year and five-year RSRs for liver cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

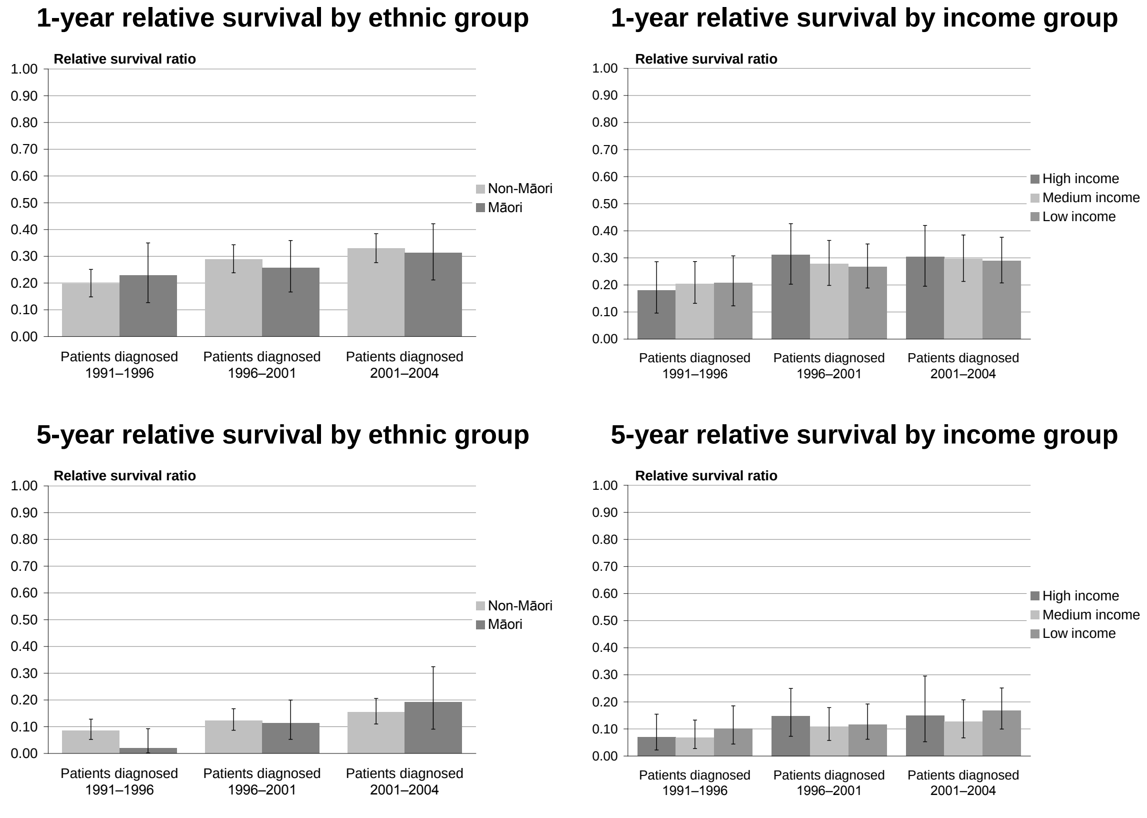


Table 32: **One-year and five-year RSRs, and their ethnic and income gaps, for liver cancer patients diagnosed during 1991–2004, by ethnic and income group**

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.20 (0.15,0.25)	0.29 (0.24,0.34)	0.33 (0.28,0.38)
	Māori	0.23 (0.13,0.35)	0.26 (0.17,0.36)	0.31 (0.21,0.42)
5 years	Non-Māori	0.08 (0.05,0.13)	0.12 (0.09,0.17)	0.15 (0.11,0.21)
	Māori	0.02 (0.00,0.09)	0.11 (0.05,0.20)	0.19 (0.09,0.32)
Ethnic gap	1 year	0.03	-0.03	-0.02
	5 years	-0.07	-0.01	0.04
Socioeconomic trends in relative survival				
1 year	High income	0.18 (0.10,0.29)	0.31 (0.20,0.43)	0.30 (0.20,0.42)
	Medium income	0.20 (0.13,0.29)	0.28 (0.20,0.36)	0.30 (0.21,0.38)
	Low income	0.21 (0.12,0.31)	0.27 (0.19,0.35)	0.29 (0.21,0.38)
5 years	High income	0.07 (0.02,0.15)	0.15 (0.07,0.25)	0.15 (0.05,0.30)
	Medium income	0.07 (0.03,0.13)	0.11 (0.06,0.18)	0.13 (0.07,0.21)
	Low income	0.10 (0.04,0.19)	0.12 (0.06,0.19)	0.17 (0.10,0.25)
Income group gap	1 year	0.03	-0.04	-0.01
	5 years	0.03	-0.03	0.02

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

14.3 Excess mortality

Ethnic and income trends in liver cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 33 and are discussed below.

Changes in excess mortality over time

Table 33 shows evidence that liver cancer patients experienced a moderate decrease in excess mortality over time. For every 10 years of cancer diagnosis, liver cancer patients experienced a 32% decrease in excess mortality with an EMRR of 0.68 (95% CI 0.56, 0.82) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 33 shows evidence that an ethnic difference was likely in excess mortality for liver cancer patients but no evidence of an income difference in excess mortality. Averaged over time, Māori liver cancer patients had 28% greater excess mortality, with an EMRR of 1.28 (95% CI 1.04, 1.57) compared to non-Māori patients. Liver cancer patients in the lowest income quintile experienced no greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.01 (95% CI 0.81, 1.26).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for liver cancer patient survival. The ethnic interaction EMRR was 0.89 (95% CI 0.54, 1.47) and the income interaction EMRR was 0.84 (95% CI 0.48, 1.47). There was no evidence of changes over time in the ethnic or income gap in excess mortality for liver cancer patients. No further interpretation of Models 2 and 4 in Table 33 is provided here.

Table 33: **EMRRs, including 95% CIs, for liver cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		**Income trends in survival**	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.78 (0.66,0.92)	0.78 (0.66,0.92)	0.78 (0.66,0.92)	0.78 (0.66,0.91)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.28 (1.04,1.57)**	**1.39 (0.93,2.07)**	1.28 (1.04,1.58)	1.28 (1.04,1.57)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.01 (0.81,1.26)**	**1.15 (0.72,1.81)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.68 (0.56,0.82)**	**0.78 (0.42,1.44)**	**0.68 (0.56,0.82)**	**0.74 (0.52,1.05)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.89 (0.54,1.47)**		
Income quintiles × calendar year of diagnosis				**0.84 (0.48,1.47)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.21 (0.14,0.31)	0.21 (0.14,0.31)	0.21 (0.14,0.31)	0.21 (0.14,0.31)
3 years since diagnosis	0.15 (0.09,0.25)	0.15 (0.09,0.25)	0.15 (0.09,0.25)	0.15 (0.09,0.25)
4 years since diagnosis	0.05 (0.02,0.12)	0.05 (0.02,0.13)	0.05 (0.02,0.12)	0.05 (0.02,0.12)
5 years since diagnosis	0.04 (0.01,0.12)	0.04 (0.01,0.12)	0.04 (0.01,0.12)	0.04 (0.01,0.12)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	0.94 (0.74,1.20)	0.94 (0.74,1.20)	0.94 (0.74,1.20)	0.95 (0.74,1.20)
Aged 65–74	2.40 (1.16,4.97)	2.39 (1.16,4.95)	2.39 (1.16,4.93)	2.39 (1.16,4.94)
Aged 75+	2.02 (0.71,5.71)	2.01 (0.17,5.68)	2.00 (0.71,5.68)	2.02 (0.71,5.75)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	0.49 (0.23,1.04)	0.49 (0.24,1.04)	0.49 (0.24,1.04)	0.49 (0.24,1.04)
75+, 1 year since diagnosis	0.83 (0.29,2.37)	0.83 (0.29,2.39)	0.83 (0.29,2.39)	0.83 (0.29,2.38)
64–74 years, 2 years since diagnosis	0.97 (0.39,2.39)	0.97 (0.39,2.39)	0.97 (0.39,2.39)	0.97 (0.39,2.39)
75+, 2 years since diagnosis	1.41 (0.42,4.73)	1.41 (0.42,4.74)	1.44 (0.43,4.82)	1.43 (0.43,4.79)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	523	523	936	936
AIC (Akaike information criterion)	1368.6	1370.4	2407.6	2409.2
BIC (Bayesian information criteria)	1432.5	1438.5	2485.1	2491.5
Scaled dispersion	1.279	1.281	1.369	1.37
Deviance	649.625	649.41	286.099	286.483

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 15: Melanoma of the skin (ICD code C43)

15.1 Number of patients

Number of patients included in survival analyses

The number of melanoma patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of melanoma patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 4608, 5880 and 5610, respectively. Of those patients, the number of Māori patients in each cohort was 69, 123 and 99, respectively.

Number of patients included in relative survival analyses, by income group

The number of melanoma patients by income group included in the 1991–1996, 1996–2001 and 2001-2004 cohorts was 4068, 5127 and 4872, respectively. Of those patients, the number of high-income patients in each cohort was 1416, 1818 and 2007, and the number of low-income patients in each cohort was 948, 1347 and 1254, respectively.

Number of patients included in excess mortality modelling

A total of 13,083 melanoma patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

15.2 Relative survival

Relative survival, by ethnic group

Figure 23 and Table 34 show evidence that non-Māori and Māori melanoma patients experienced small shifts in one-year and five-year RSRs over time.

Relative survival, by income group

Figure 23 and Table 34 show evidence of an increase in five-year RSRs for high- and low-income melanoma patients.

Figure 23: One-year and five-year RSRs for melanoma patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

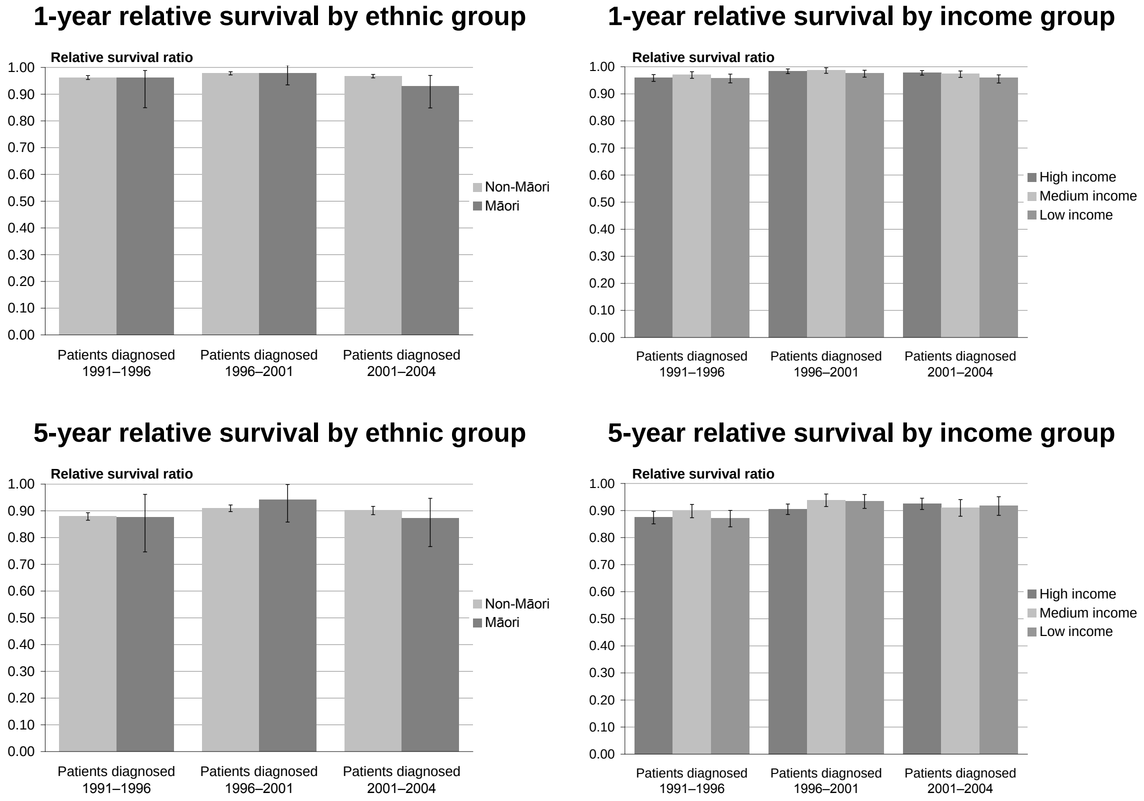


Table 34: One-year and five-year RSRs, and their ethnic and income gaps, for melanoma patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.96 (0.96,0.97)	0.98 (0.97,0.98)	0.97 (0.96,0.97)
	Māori	0.95 (0.86,0.99)	0.99 (0.93,1.01)	0.93 (0.85,0.97)
5 years	Non-Māori	0.88 (0.87,0.89)	0.91 (0.90,0.92)	0.90 (0.89,0.92)
	Māori	0.88 (0.75,0.96)	0.94 (0.86,1.00)	0.87 (0.77,0.95)
Ethnic gap	1 year	-0.02	0.01	-0.04
	5 years	0.00	0.03	-0.03
Socioeconomic trends in relative survival				
1 year	High income	0.96 (0.95,0.97)	0.98 (0.97,0.99)	0.98 (0.97,0.99)
	Medium income	0.97 (0.96,0.98)	0.99 (0.98,1.00)	0.97 (0.96,0.98)
	Low income	0.96 (0.94,0.97)	0.98 (0.96,0.99)	0.96 (0.94,0.97)
5 years	High income	0.87 (0.85,0.90)	0.91 (0.89,0.92)	0.93 (0.90,0.95)
	Medium income	0.90 (0.87,0.92)	0.94 (0.91,0.96)	0.91 (0.88,0.94)
	Low income	0.87 (0.84,0.90)	0.93 (0.91,0.96)	0.92 (0.88,0.95)
Income group gap	1 year	0.00	-0.01	-0.02
	5 years	0.00	0.03	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

15.3 Excess mortality

Ethnic and income trends in melanoma patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 35 and discussed below.

Changes in excess mortality over time

Table 35 shows evidence that melanoma patients experienced a moderate decrease in excess mortality over time. For every 10 years of cancer diagnosis, melanoma patients experienced a 38–39% decrease in excess mortality, with an EMRR of 0.61 (95% CI 0.48, 0.75) in Model 1 and an EMRR of 0.62 (95% CI 0.50, 0.76) in Model 3.

Ethnic and income inequalities in cancer survival

Table 35 shows limited evidence of ethnic and income differences in excess mortality for melanoma patients. Averaged over time, Māori melanoma patients had 39% greater excess mortality, with an EMRR of 1.39 (95% CI 0.81, 2.39) compared to non-Māori patients. Averaged over time, patients in the lowest income quintile had 18% greater excess mortality compared to patients in the highest income quintile, with an income EMRR of 1.18 (95% 0.94, 1.49).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for melanoma cancer patient survival (see Table 35). The ethnic interaction EMRR was 0.64 (95% CI 0.12, 3.53) and the income interaction EMRR was 1.39 (95% CI 0.75, 2.58). There was no evidence of changes over time in the ethnic or income gap in excess mortality for melanoma patients. No further interpretation of Models 2 and 4 in Table 35 is provided here.

Table 35: **EMRRs, including 95% CIs, for melanoma patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.51 (0.43,0.60)	0.51 (0.43,0.60)	0.50 (0.42,0.59)	0.50 (0.43,0.59)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.39 (0.81,2.39)**	**1.82 (0.61,5.45)**	1.31 (0.75,2.28)	1.31 (0.75,2.29)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.18 (0.94,1.49)**	**0.96 (0.61,1.51)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.61 (0.49,0.75)**	**0.95 (0.17,5.49)**	**0.62 (0.50,0.76)**	**0.54 (0.38,0.75)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.64 (0.12,3.53)**		
Income quintiles × calendar year of diagnosis				**1.39 (0.75,2.58)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.78 (0.60,1.01)	0.78 (0.60,1.01)	0.77 (0.59,1.00)	0.77 (0.59,1.00)
3 years since diagnosis	0.60 (0.46,0.79)	0.60 (0.46,0.79)	0.61 (0.46,0.80)	0.60 (0.46,0.79)
4 years since diagnosis	0.63 (0.48,0.83)	0.63 (0.48,0.84)	0.65 (0.49,0.85)	0.65 (0.49,0.85)
5 years since diagnosis	0.54 (0.40,0.74)	0.54 (0.40,0.74)	0.55 (0.41,0.75)	0.55 (0.40,0.75)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.44 (1.17,1.76)	1.44 (1.18,1.76)	1.44 (1.18,1.76)	1.44 (1.18,1.76)
Aged 65–74	1.47 (1.06,2.03)	1.47 (1.06,2.04)	1.46 (1.05,2.01)	1.46 (1.06,2.02)
Aged 75+	2.14 (1.44,3.18)	2.14 (1.44,3.18)	2.15 (1.46,3.17)	2.14 (1.46,3.16)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.13 (0.73,1.75)	1.13 (0.73,1.75)	1.12 (0.73,1.74)	1.13 (0.73,1.74)
75+, 1 year since diagnosis	0.72 (0.40,1.29)	0.72 (0.40,1.28)	0.70 (0.40,1.25)	0.71 (0.40,1.25)
64–74 years, 2 years since diagnosis	1.06 (0.64,1.74)	1.06 (0.64,1.74)	1.07 (0.65,1.76)	1.06 (0.65,1.75)
75+, 2 years since diagnosis	1.02 (0.57,1.84)	1.02 (0.57,1.84)	1.05 (0.59,1.87)	1.04 (0.59,1.86)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	863	863	3381	3381
AIC (Akaike information criterion)	2543.4	2545.2	6653.9	6654.8
BIC (Bayesian information criteria)	2614.8	2621.3	6751.9	6758.9
Scaled dispersion	0.935	0.936	0.924	0.924
Deviance	793.271	792.993	172.156	172.917

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 16: Non-Hodgkin's lymphoma (NHL) (ICD codes C82–85, C96)

16.1 Number of patients

Number of patients included in survival analyses

The number of Non-Hodgkin's lymphoma (subsequently referred to as NHL) patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of NHL patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1494, 2008 and 1779, respectively. Of those patients, the number of Māori patients in each cohort was 72, 141 and 108, respectively.

Number of patients included in relative survival analyses, by income group

The number of NHL patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1320, 1770 and 1506, respectively. Of those patients, the number of high-income patients in each cohort was 402, 543 and 504, and the number of low-income patients in each cohort was 351, 501 and 498, respectively.

Number of patients included in excess mortality modelling

A total of 4569 NHL patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

16.2 Relative survival

Relative survival, by ethnic group

Figure 24 and Table 36 show evidence of improvements over time in one-year and five-year RSRs for non-Māori NHL patients, but smaller shifts in one-year and five-year RSRs experienced by Māori patients.

Relative survival, by income group

Figure 24 and Table 36 show evidence of improvements in one-year and five-year RSRs for NHL patients in all income groups.

Figure 24: One-year and five-year RSRs for NHL patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

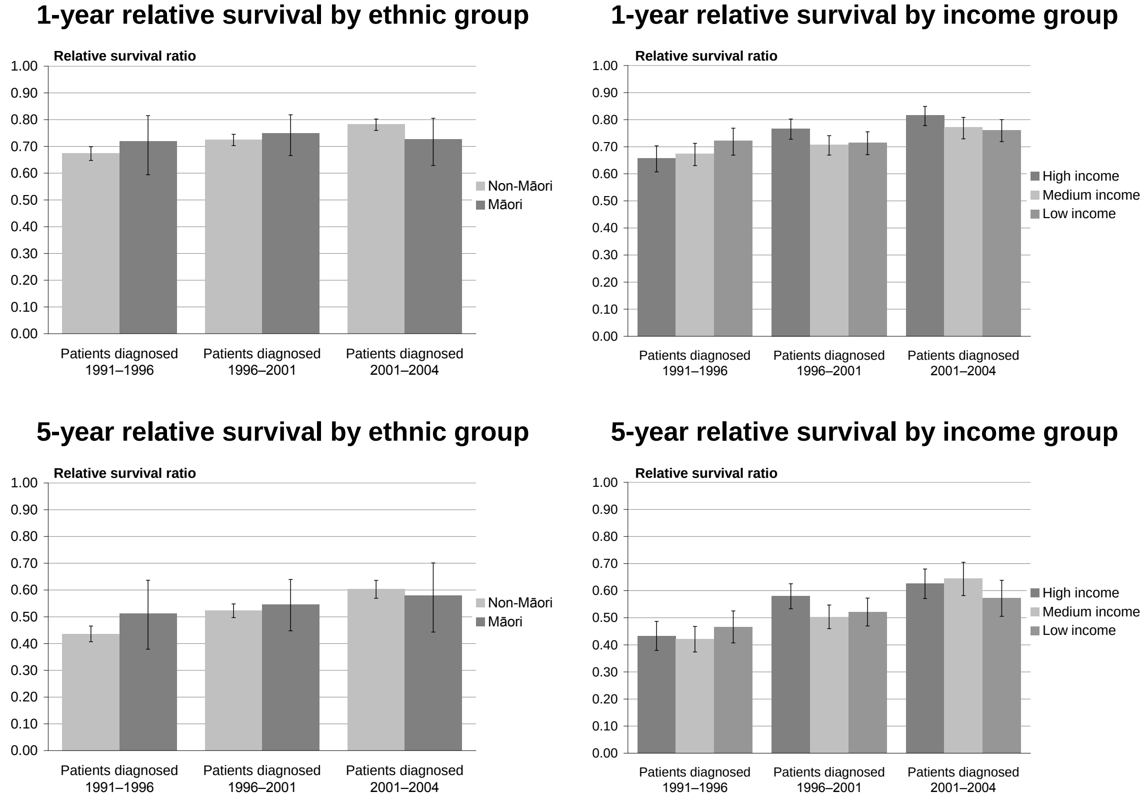


Table 36: One-year and five-year RSRs, and their ethnic and income gaps, for Non-Hodgkin's lymphoma patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.67 (0.65,0.70)	0.72 (0.70,0.75)	0.78 (0.76,0.80)
	Māori	0.72 (0.59,0.81)	0.75 (0.67,0.82)	0.73 (0.63,0.80)
5 years	Non-Māori	0.44 (0.41,0.47)	0.52 (0.50,0.55)	0.60 (0.57,0.64)
	Māori	0.51 (0.38,0.64)	0.55 (0.45,0.64)	0.58 (0.44,0.70)
Ethnic gap	1 year	0.05	0.03	-0.05
	5 years	0.08	0.02	-0.02
Socioeconomic trends in relative survival				
1 year	High income	0.66 (0.61,0.70)	0.77 (0.73,0.80)	0.82 (0.78,0.85)
	Medium income	0.67 (0.63,0.71)	0.71 (0.67,0.74)	0.77 (0.73,0.81)
	Low income	0.72 (0.67,0.77)	0.71 (0.67,0.75)	0.76 (0.72,0.80)
5 years	High income	0.43 (0.38,0.49)	0.58 (0.53,0.63)	0.63 (0.57.0.68)
	Medium income	0.42 (0.37,0.47)	0.50 (0.46,0.55)	0.65 (0.58.0.70)
	Low income	0.47 (0.41,0.52)	0.52 (0.47,0.57)	0.57 (0.50,0.64)
Income group gap	1 year	0.06	-0.05	-0.05
	5 years	0.03	-0.06	-0.05

1 RSRs calculated using the cohort design, with follow up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

16.3 Excess mortality

Ethnic and income trends in NHL patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 37 and discussed below.

Changes in excess mortality over time

Table 37 shows evidence of a large decrease in excess mortality for NHL patients. For every 10 years of cancer diagnosis, NHL patients experienced a 44% decrease in excess mortality, with an EMRR of 0.56 (95% CI 0.49, 0.63) in Model 1 and an EMRR of 0.56 (95% CI 0.50, 0.63) in Model 3.

Ethnic and income inequalities in cancer survival

Table 37 shows evidence of ethnic differences in excess mortality for NHL patients and little evidence of income differences in excess mortality. Averaged over time, Māori NHL patients had 28% greater excess mortality, with an EMRR of 1.28 (95% CI 1.03, 1.57) compared to non-Māori patients. NHL patients in the lowest income quintile experienced similar excess mortality compared to patients in the highest income quintile, with an EMRR of 1.07 (95% CI 0.94, 1.23).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for NHL patient survival (see Table 37). The ethnic interaction EMRR was 1.52 (95% CI 0.83, 2.76) and the income interaction EMRR was 1.28 (95% CI 0.91, 1.82). Both interaction terms had very wide confidence intervals. There was no evidence of changes over time in the ethnic or income gap in excess mortality for NHL patients. No further interpretation of Models 2 and 4 in Table 37 is provided here.

Table 37: **EMRRs, including 95% CIs, for NHL patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.96 (0.88,1.06)	0.96 (0.88,1.06)	0.96 (0.88,1.06)	0.96 (0.88,1.06)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.28 (1.03,1.57)**	**0.94 (0.57,1.55)**	1.26 (1.02,1.56)	1.27 (1.03,1.57)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.07 (0.94,1.23)**	**0.91 (0.70,1.19)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.56 (0.49,0.63)**	**0.36 (0.19,0.68)**	**0.56 (0.50,0.63)**	**0.50 (0.40,0.61)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.52 (0.83,2.76)**		
Income quintiles × calendar year of diagnosis				**1.28 (0.91,1.82)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.58 (0.48,0.70)	0.58 (0.48,0.70)	0.58 (0.48,0.70)	0.58 (0.48,0.70)
3 years since diagnosis	0.34 (0.27,0.42)	0.34 (0.27,0.42)	0.34 (0.27,0.43)	0.34 (0.27,0.42)
4 years since diagnosis	0.25 (0.19,0.32)	0.25 (0.19,0.32)	0.25 (0.19,0.32)	0.25 (0.19,0.32)
5 years since diagnosis	0.22 (0.16,0.29)	0.22 (0.16,0.29)	0.22 (0.16,0.29)	0.22 (0.16,0.29)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.52 (1.29,1.78)	1.52 (1.30,1.78)	1.51 (1.29,1.77)	1.52 (1.29,1.78)
Aged 65–74	1.94 (1.49,2.53)	1.94 (1.49,2.52)	1.92 (1.48,2.50)	1.93 (1.48,2.51)
Aged 75+	2.73 (2.05,3.63)	2.71 (2.04,3.62)	2.74 (2.06,3.64)	2.73 (2.06,3.63)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.07 (0.80,1.43)	1.07 (0.80,1.44)	1.07 (0.80,1.45)	1.07 (0.80,1.44)
75+, 1 year since diagnosis	1.34 (0.99,1.83)	1.35 (0.99,1.84)	1.34 (0.98,1.82)	1.34 (0.98,1.82)
64–74 years, 2 years since diagnosis	0.70 (0.48,1.01)	0.70 (0.48,1.01)	0.70 (0.45,1.01)	0.70 (0.49,1.01)
75+, 2 years since diagnosis	0.60 (0.40,0.90)	0.60 (0.40,0.91)	0.60 (0.40,0.90)	0.60 (0.40,0.90)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	908	908	3208	3208
AIC (Akaike information criterion)	2651.4	2651.5	6294.1	6294.2
BIC (Bayesian information criteria)	2723.6	2728.5	6391.3	6397.4
Scaled dispersion	1.11	1.109	0.999	0.999
Deviance	991.546	989.652	1113.901	1114.603

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 17: Cancer of the oesophagus (ICD code C15)

17.1 Number of patients

Number of patients included in survival analyses

The number of oesophageal cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of oesophageal cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 708, 753 and 681, respectively. Of those patients, the number of Māori patients in each cohort was 42, 48 and 108, respectively.

Number of patients included in relative survival analyses, by income group

The number of oesophageal cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 627, 651 and 561, respectively. Of those patients, the number of high-income patients in each cohort was 150, 156 and 150, and the number of low-income patients in each cohort was 189, 204 and 210, respectively.

Number of patients included in excess mortality modelling

A total of 1824 oesophageal cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

17.2 Relative survival

Relative survival, by ethnic group

Figure 25 and Table 38 show small improvement over time in one-year and five-year RSRs for non-Māori oesophageal cancer patients. Sparse data made the interpretation of Māori one-year and five-year RSRs difficult to interpret.

Relative survival by income group

Figure 25 and Table 38 show evidence of some improvements in one-year and five-year RSRs for oesophageal cancer patients in all income groups.

Figure 25: One-year and five-year RSRs for oesophageal cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

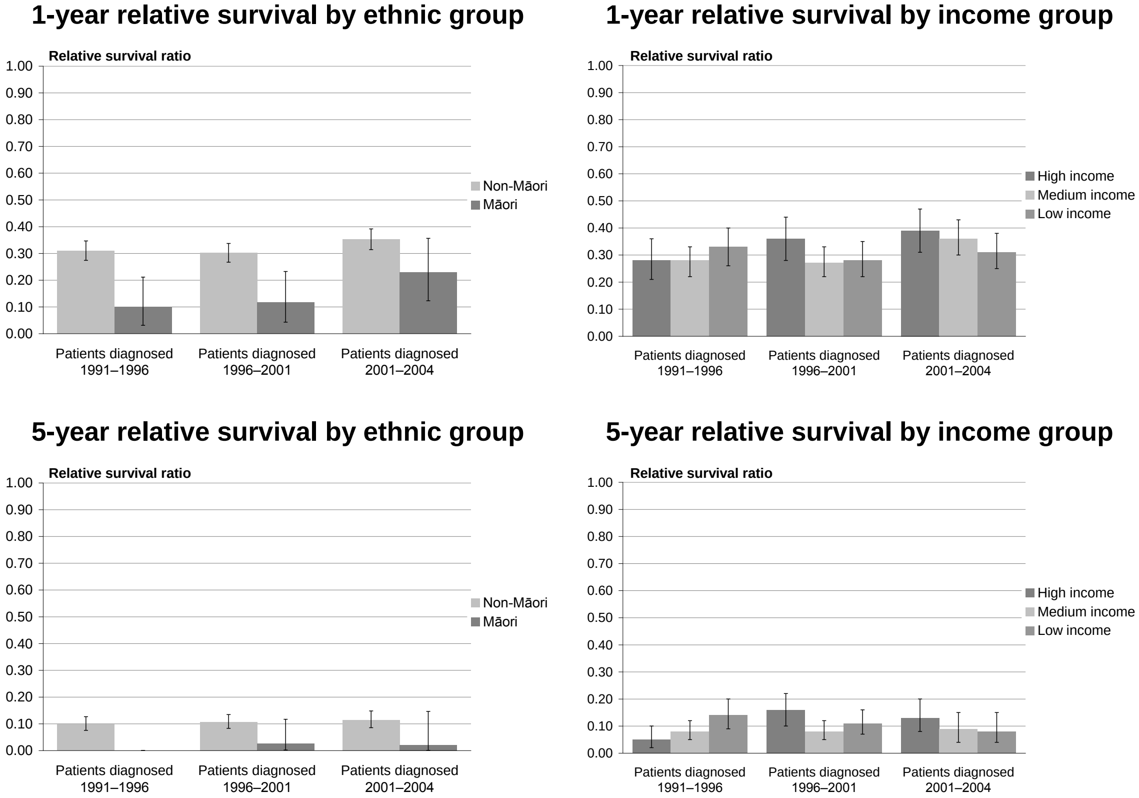


Table 38: One-year and five-year RSRs, and their ethnic and income gaps, for oesophageal cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.31 (0.27,0.35)	0.30 (0.27,0.34)	0.35 (0.31,0.39)
	Māori	0.10 (0.03,0.21)	0.12 (0.04,0.23)	0.23 (0.12,0.36)
5 years	Non-Māori	0.10 (0.08,0.13)	0.11 (0.08,0.13)	0.11 (0.09,0.15)
	Māori	Missing	0.03 (0.00,0.12)	0.02 (0.00,0.15)
Ethnic gap	1 year	-0.21	-0.19	-0.12
	5 years	Missing	-0.08	-0.09
Socioeconomic trends in relative survival				
1 year	High income	0.28 (0.21,0.36)	0.36 (0.28,0.44)	0.39 (0.31,0.47)
	Medium income	0.28 (0.22,0.33)	0.27 (0.22,0.33)	0.36 (0.30,0.43)
	Low income	0.33 (0.26,0.40)	0.28 (0.22,0.35)	0.31 (0.25,0.38)
5 years	High income	0.05 (0.02,0.10)	0.16 (0.10,0.22)	0.13 (0.08,0.20)
	Medium income	0.08 (0.05,0.12)	0.08 (0.05,0.12)	0.09 (0.04,0.15)
	Low income	0.14 (0.09,0.20)	0.11 (0.07,0.16)	0.08 (0.04,0.15)
Income group gap	1 year	0.05	-0.08	-0.08
	5 years	0.09	-0.05	-0.05

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

17.3 Excess mortality

Excess mortality

Ethnic and income trends in oesophageal cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 39 and discussed below.

Changes in excess mortality over time

Table 39 shows evidence of a small decrease in excess mortality for oesophageal cancer patients. For every 10 years of cancer diagnosis, oesophageal cancer patients experienced a 10% decrease in excess mortality, with an EMRR of 0.90 (95% CI 0.79, 1.02) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 39 shows some evidence of ethnic and income differences in excess mortality for oesophageal cancer patient survival. Averaged over time, Māori oesophageal cancer patients had 68% greater excess mortality, with an ethnic EMRR of 1.68 (95% CI 1.35, 2.10). Oesophageal cancer patients in the lowest income quintile experienced 10% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.10 (95% CI 0.95, 1.27).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for oesophageal cancer patient survival (see Table 39). The ethnic interaction EMRR was 0.91 (95% CI 0.53, 1.56) and the income interaction EMRR was 1.26 (95% CI 0.88, 1.80). There was no evidence of changes over time in the ethnic or income gap in excess mortality for oesophageal cancer patients. No further interpretation of Models 2 and 4 in Table 39 is provided here.

Table 39: **EMRRs, including 95% CIs, for oesophageal cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.80 (0.72,0.89)	0.80 (0.72,0.89)	0.80 (0.72,0.89)	0.80 (0.71,0.89)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.68 (1.35,2.10)**	**1.79 (1.17,2.75)**	1.66 (1.33,2.08)	1.66 (1.32,2.07)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.10 (0.95,1.27)**	**0.94 (0.70,1.25)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.90 (0.79,1.02)**	**0.99 (0.56,1.78)**	**0.90 (0.79,1.02)**	**0.80 (0.63,1.00)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.91 (0.53,1.56)**		
Income quintiles × calendar year of diagnosis				**1.26 (0.88,1.80)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.59 (0.45,0.78)	0.60 (0.46,0.78)	0.60 (0.46,0.78)	0.60 (0.46,0.78)
3 years since diagnosis	0.38 (0.27,0.53)	0.38 (0.27,0.54)	0.38 (0.27,0.53)	0.38 (0.27,0.53)
4 years since diagnosis	0.25 (0.16,0.39)	0.25 (0.16,0.39)	0.25 (0.16,0.39)	0.25 (0.16,0.39)
5 years since diagnosis	0.10 (0.05,0.21)	0.10 (0.05,0.21)	0.11 (0.05,0.22)	0.11 (0.05,0.22)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	0.94 (0.75,1.17)	0.94 (0.75,1.70)	0.94 (0.75,1.17)	0.94 (0.75,1.17)
Aged 65–74	1.02 (0.65,1.59)	1.02 (0.65,1.59)	1.01 (0.65,1.57)	1.01 (0.65,1.58)
Aged 75+	1.50 (0.93,2.41)	1.50 (0.93,2.41)	1.51 (0.94,2.43)	1.51 (0.94,2.44)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.22 (0.78,1.92)	1.22 (0.78,1.92)	1.23 (0.78,1.93)	1.23 (0.78,1.92)
75+, 1 year since diagnosis	1.19 (0.74,1.92)	1.19 (0.74,1.92)	1.19 (0.74,1.91)	1.18 (0.73,1.90)
64–74 years, 2 years since diagnosis	1.04 (0.61,1.77)	1.04 (0.61,1.77)	1.04 (0.61,1.78)	1.04 (0.61,1.78)
75+, 2 years since diagnosis	1.00 (0.57,1.74)	1.00 (0.57,1.74)	0.99 (0.57,1.74)	0.99 (0.57,1.73)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	546	546	1391	1391
AIC (Akaike information criterion)	1672	1673.9	3734	3734.3
BIC (Bayesian information criteria)	1736.6	1742.7	3817.8	3823.4
Scaled dispersion	1.164	1.166	1.298	1.298
Deviance	618.094	617.976	404.156	406.044

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 18: Cancer of the ovary (ICD code C56)

18.1 Number of patients

The number of ovarian cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of ovarian cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 909, 1014 and 789, respectively. Of those patients, the number of Māori patients in each cohort was 72, 102 and 63, respectively.

Number of patients included in relative survival analyses, by income group

The number of ovarian cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 792, 864 and 657, respectively. Of those patients, the number of high-income patients in each cohort was 243, 237 and 183, and the number of low-income patients in each cohort was 234, 288 and 258, respectively.

Number of patients included in excess mortality modelling

A total of 2289 ovarian cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

18.2 Relative survival

Relative survival, by ethnic group

Figure 26 and Table 40 show evidence of small improvements over time in one-year and five-year RSR for non-Māori ovarian cancer patients but only small shifts for Māori patients.

Relative survival, by income group

Figure 26 and Table 40 show evidence of improvements in one-year and five-year RSRs for ovarian cancer patients in all income groups.

Figure 26: One-year and five-year RSRs for ovarian cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

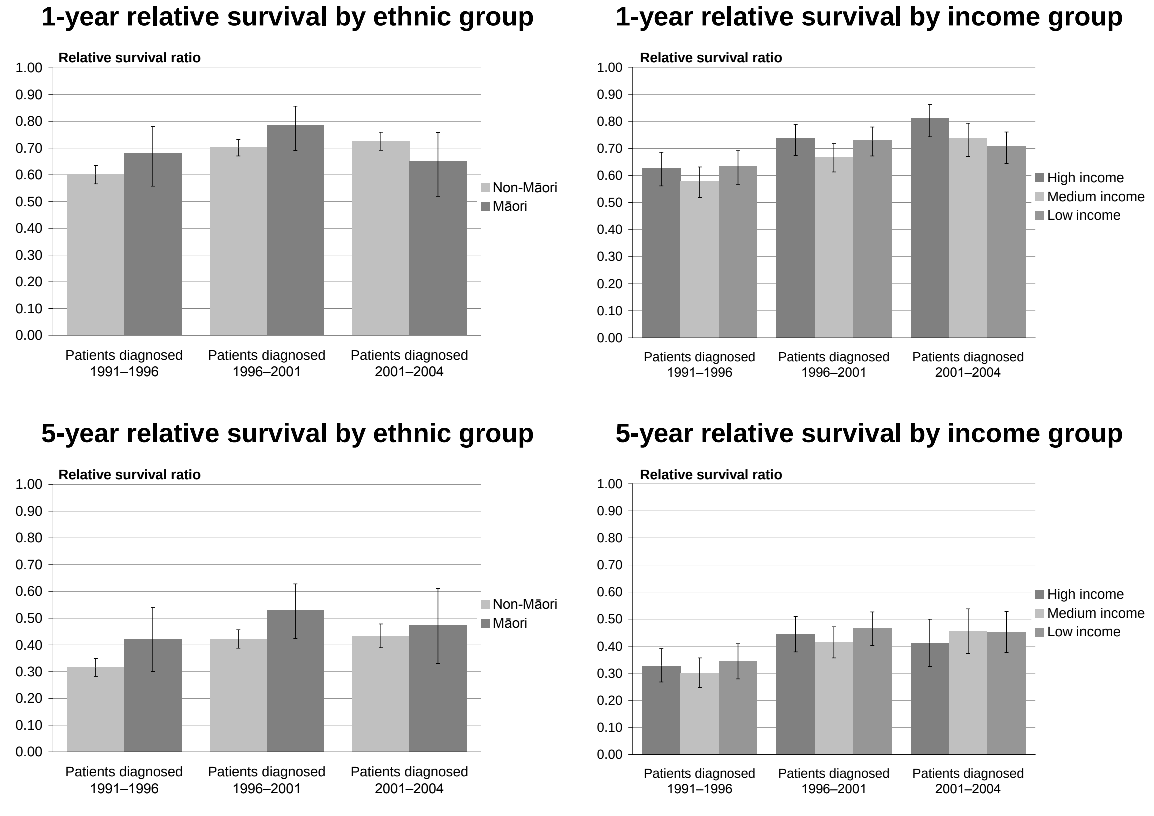


Table 40: One-year and five-year RSRs, and their ethnic and income gaps, for ovarian cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.60 (0.57,0.63)	0.70 (0.67,0.73)	0.73 (0.69,0.76)
	Māori	0.68 (0.56,0.78)	0.79 (0.69,0.86)	0.65 (0.52,0.76)
5 years	Non-Māori	0.32 (0.28,0.35)	0.42 (0.39,0.46)	0.43 (0.39,0.48)
	Māori	0.42 (0.30,0.54)	0.53 (0.42,0.63)	0.48 (0.33,0.61)
Ethnic gap	1 year	0.08	0.08	-0.08
	5 years	0.11	0.11	0.04
Socioeconomic trends in relative survival				
1 year	High income	0.63 (0.56,0.69)	0.74 (0.67,0.79)	0.81 (0.74,0.86)
	Medium income	0.58 (0.52,0.63)	0.67 (0.61,0.72)	0.74 (0.67,0.79)
	Low income	0.63 (0.57,0.69)	0.73 (0.67,0.78)	0.71 (0.64,0.76)
5 years	High income	0.33 (0.27,0.39)	0.45 (0.38,0.51)	0.41 (0.33,0.50)
	Medium income	0.30 (0.25,0.36)	0.41 (0.36,0.47)	0.46 (0.37,0.54)
	Low income	0.34 (0.28,0.41)	0.47 (0.40,0.53)	0.45 (0.38,0.53)
Income group gap	1 year	0.01	-0.01	-0.10
	5 years	0.01	0.02	0.04

[1] RSRs calculated using the cohort design, with follow-up to 31 December 2006.

[2] RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

18.3 Excess mortality

Ethnic and income trends in ovarian cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 41 and discussed below.

Changes in excess mortality over time

Table 41 shows a moderate decrease every 10 years for excess mortality for ovarian cancer patient survival. For every 10 years of cancer diagnosis, ovarian cancer patients experienced a 39% decrease in excess mortality, with an EMRR of 0.61 (95% CI 0.52, 0.70) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 41 shows little evidence of ethnic or income differences in excess mortality for ovarian cancer patients. Averaged over time, Māori ovarian cancer patients had similar excess mortality to non-Māori patients, with an EMRR of 1.05 (95% CI 0.83, 1.33) compared to non-Māori patients. Ovarian cancer patients in the lowest income quintile also experienced similar excess mortality to those in the highest income quintile, with an EMRR of 0.94 (95% CI 0.80, 1.10).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for ovarian cancer patient survival (see Table 41). The ethnic interaction EMRR was 1.36 (95% CI 0.73, 2.53) and the income interaction EMRR was 0.99 (95% CI 0.66, 1.49). There was no evidence of changes over time in the ethnic or income gap in excess mortality for ovarian cancer patients. No further interpretation of Models 2 and 4 in Table 41 is provided here.

Table 41: **EMRRs, including 95% CIs, for ovarian cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.05 (0.83,1.33)**	**0.87 (0.55,1.38)**	1.06 (0.84,1.35)	1.06 (0.84,1.35)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**0.94 (0.80,1.10)**	**0.94 (0.70,1.28)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.61 (0.52,0.70)**	**0.44 (0.22,0.85)**	**0.61 (0.52,0.70)**	**0.61 (0.47,0.79)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.36 (0.73,2.53)**		
Income quintiles × calendar year of diagnosis				**0.99 (0.66,1.49)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.95 (0.77,1.16)	0.95 (0.77,1.16)	0.95 (0.77,1.16)	0.95 (0.77,1.16)
3 years since diagnosis	0.57 (0.45,0.73)	0.57 (0.45,0.73)	0.57 (0.45,0.73)	0.57 (0.45,0.73)
4 years since diagnosis	0.37 (0.27,0.49)	0.37 (0.27,0.49)	0.37 (0.28,0.50)	0.37 (0.28,0.50)
5 years since diagnosis	0.33 (0.24,0.46)	0.33 (0.24,0.46)	0.33 (0.24,0.46)	0.33 (0.24,0.46)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	2.03 (1.71,2.41)	2.03 (1.71,2.41)	2.04 (1.72,2.42)	2.04 (1.72,2.42)
Aged 65–74	2.57 (1.91,3.45)	2.56 (1.91,3.44)	2.58 (1.92,3.46)	2.58 (1.92,3.46)
Aged 75+	1.70 (1.04,2.78)	1.71 (1.05,2.79)	1.75 (1.09,2.82)	1.75 (1.09,2.82)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.13 (0.80,1.60)	1.13 (0.80,1.60)	1.13 (0.80,1.60)	1.13 (0.80,1.60)
75+, 1 year since diagnosis	3.84 (2.30,6.44)	3.83 (2.29,6.41)	3.73 (2.26,6.15)	3.73 (2.26,6.15)
64–74 years, 2 years since diagnosis	1.02 (0.70,1.50)	1.02 (0.70,1.49)	1.02 (0.70,1.49)	1.02 (0.70,1.49)
75+, 2 years since diagnosis	1.50 (0.83,2.67)	1.49 (0.84,2.66)	1.43 (0.81,2.53)	1.43 (0.81,2.53)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	446	446	1604	1604
AIC (Akaike information criterion)	1421.4	1422.4	3501.5	3503.5
BIC (Bayesian information criteria)	1478.8	1484	3582.2	3589.5
Scaled dispersion	1.115	1.115	1.074	1.075
Deviance	481.568	480.614	835.086	835.067

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 19: Cancer of the pancreas (ICD code C25)

19.1 Number of patients

Number of patients included in survival analyses

The number of pancreatic cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of pancreatic cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 921, 999 and 810, respectively. Of those patients, the number of Māori patients in each cohort was 54, 90 and 69, respectively.

Number of patients included in relative survival analyses, by income group

The number of pancreatic cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 804, 834 and 696, respectively. Of those patients, the number of high-income patients in each cohort was 207, 204 and 189, and the number of low-income patients in each cohort was 213, 282 and 255, respectively.

Number of patients included in excess mortality modelling

A total of 2316 pancreatic cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

19.2 Relative survival

Relative survival ratios, by ethnic group

Figure 27 and Table 42 show evidence of little improvement over time in one-year and five-year RSRs for non-Māori pancreatic cancer patients. Sparse data for Māori patients in each cohort combined with the high number of patients who died within the first two years of follow-up make it difficult to interpret Māori relative survival estimates.

Relative survival ratios, by income group

Figure 27 and Table 42 show evidence of little improvement over time in one-year and five-year RSRs for patients in each income group. Sparse data means that interpreting trends in survival over time by income is also difficult.

Figure 27: One-year and five-year RSRs for pancreatic cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

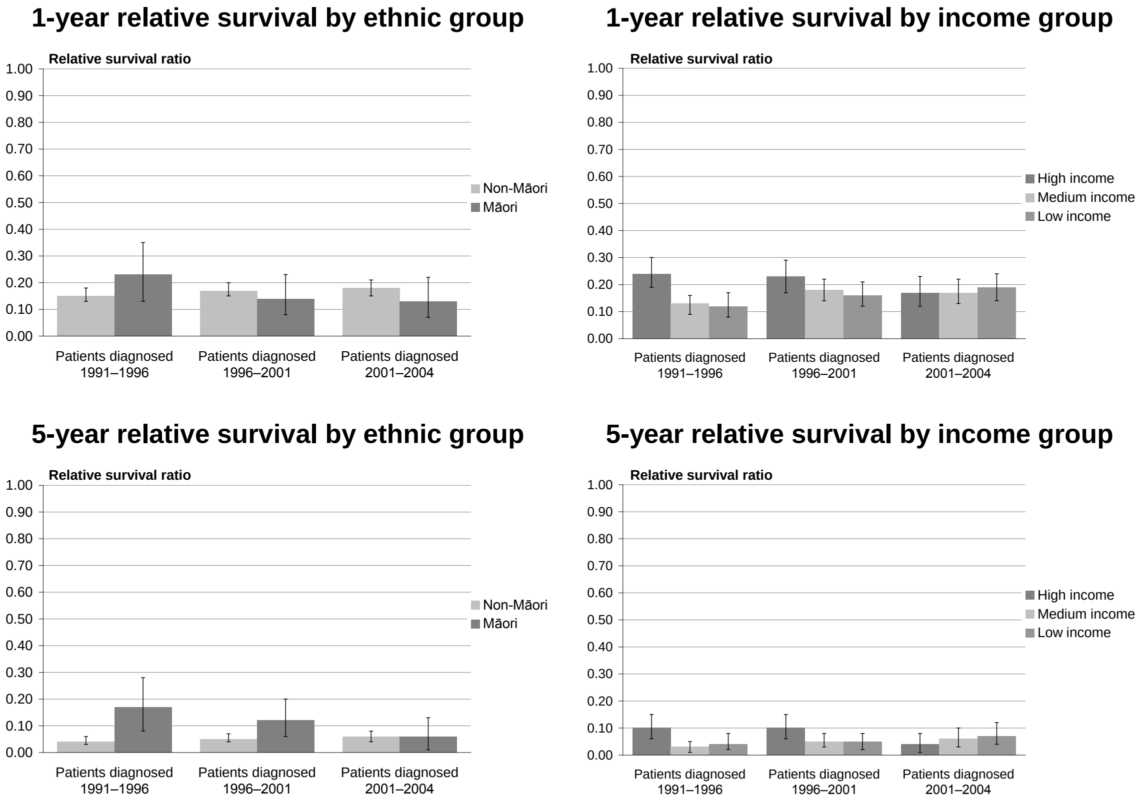


Table 42: One-year and five-year RSRs, and their ethnic and income gaps, for pancreatic cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.15 (0.13,0.18)	0.17 (0.15,0.20)	0.18 (0.15,0.21)
	Māori	0.23 (0.13,0.35)	0.14 (0.08,0.23)	0.13 (0.07,0.22)
5 years	Non-Māori	0.04 (0.03,0.06)	0.05 (0.04,0.07)	0.06 (0.04,0.08)
	Māori	0.17 (0.08,0.28)	0.12 (0.06,0.20)	0.06 (0.01,0.13)
Ethnic gap	1 year	0.08	-0.03	0.05
	5 years	0.13	0.07	0.00
Socioeconomic trends in relative survival				
1 year	High income	0.24 (0.19,0.30)	0.23 (0.17,0.29)	0.17 (0.12,0.23)
	Medium income	0.13 (0.09,0.16)	0.18 (0.14,0.22)	0.17 (0.13,0.22)
	Low income	0.12 (0.08,0.17)	0.16 (0.12,0.21)	0.19 (0.14,0.24)
5 years	High income	0.10 (0.06,0.15)	0.10 (0.06,0.15)	0.04 (0.01,0.08)
	Medium income	0.03 (0.01,0.05)	0.05 (0.03,0.08)	0.06 (0.03,0.10)
	Low income	0.04 (0.02,0.08)	0.05 (0.02,0.08)	0.07 (0.04,0.12)
Income group gap	1 year	-0.12	-0.07	0.02
	5 years	-0.06	-0.05	0.03

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

19.3 Excess mortality

Ethnic and income trends in pancreatic cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 43 and are discussed below.

Changes in excess mortality over time

Table 43 shows evidence of a small decrease in excess mortality for pancreatic cancer patients. For every 10 years of cancer diagnosis, pancreatic cancer patients experienced a 2% decrease in excess mortality, with an EMRR of 0.98 (95% CI 0.88, 1.09) in Model 1 and an EMRR of 0.97 (95% CI 0.87, 1.08) in Model 3.

Ethnic and income inequalities in cancer survival

Table 43 shows some evidence of an ethnic, and particularly an income, difference in excess mortality for pancreatic cancer patients. Averaged over time, Māori pancreatic cancer patients had a non-significant 13% greater excess mortality, with an EMRR of 1.13 (95% CI 0.95, 1.35) compared to non-Māori patients. Pancreatic cancer patients in the lowest income quintile experienced 28% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.28 (95% CI 1.13, 1.45).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for pancreatic cancer patient survival (see Table 43). The ethnic interaction EMRR was 1.66 (95% CI 1.07, 2.57) and the income interaction EMRR was 0.61 (95% CI 0.45, 0.84). Both the ethnic-interaction and income-interaction EMRR confidence intervals included the null, but the point estimates suggest changes in opposite directions: increasing ethnic inequalities and decreasing income inequalities over time. Given the number of interactions we have measured over all cancer sites, it may be that these are chance findings. No further interpretation of Models 2 and 4 in Table 43 is provided here.

Table 43: **EMRRs, including 95% CIs, for pancreatic cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	1.00 (0.92,1.09)	1.01 (0.92,1.10)	0.99 (0.91,1.08)	0.99 (0.91,1.08)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.13 (0.95,1.35)**	**0.78 (0.54,1.14)**	1.10 (0.92,1.31)	1.10 (0.92,1.31)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.28 (1.13,1.45)**	**1.79 (1.39,2.31)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.98 (0.88,1.09)**	**0.57 (0.35,0.92)**	**0.97 (0.87,1.08)**	**1.25 (1.029,1.52)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.66 (1.07,2.57)**		
Income quintiles × calendar year of diagnosis				**0.61 (0.45,0.84)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.45 (0.35,0.58)	0.45 (0.35,0.58)	0.46 (0.36,0.58)	0.46 (0.36,0.59)
3 years since diagnosis	0.13 (0.08,0.22)	0.13 (0.08,0.22)	0.13 (0.08,0.22)	0.13 (0.08,0.23)
4 years since diagnosis	0.04 (0.02,0.09)	0.04 (0.02,0.10)	0.04 (0.02,0.09)	0.04 (0.02,0.09)
5 years since diagnosis	0.02 (0.01,0.07)	0.03 (0.01,0.07)	0.02 (0.01,0.07)	0.03 (0.01,0.07)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.28 (1.08,1.52)	1.29 (1.09,1.53)	1.28 (1.07,1.51)	1.27 (1.07,1.51)
Aged 65–74	2.50 (1.30,4.80)	2.52 (1.31,4.85)	2.48 (1.28,4.79)	2.47 (1.23,4.78)
Aged 75+	2.69 (1.30,5.55)	2.67 (1.29,5.52)	2.64 (1.27,5.49)	2.63 (1.27,5.49)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	0.62 (0.32,1.19)	0.61 (0.32,1.19)	0.62 (0.32,1.20)	0.62 (0.32,1.20)
75+, 1 year since diagnosis	0.66 (0.32,1.36)	0.66 (0.32,1.38)	0.68 (0.32,1.41)	0.68 (0.33,1.42)
64–74 years, 2 years since diagnosis	0.56 (0.27,1.16)	0.56 (0.27,1.16)	0.56 (0.27,1.17)	0.56 (0.27,1.17)
75+, 2 years since diagnosis	0.62 (0.28,1.38)	0.63 (0.28,1.39)	0.64 (0.29,1.43)	0.65 (0.29,1.44)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	565	565	1276	1276
AIC (Akaike information criterion)	1679	1675.6	3762.3	3755.1
BIC (Bayesian information criteria)	1744	1745	3844.8	3842.7
Scaled dispersion	1.121	1.113	1.242	1.235
Deviance	616.303	610.995	428.439	436.934

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 20: Cancer of the prostate (ICD code C61)

20.1 Number of patients

Number of patients included in survival analyses

The number of prostate cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of prostate cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 6018, 9942 and 8049, respectively. Of those patients, the number of Māori patients in each cohort was 189, 438 and 432, respectively.

Number of patients included in relative survival analyses, by income group

The number of prostate cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 5445, 8700 and 7056, respectively. Of those patients, the number of high-income patients in each cohort was 1782, 3036 and 2634, and the number of low-income patients in each cohort was 942, 2274 and 1956, respectively.

Number of patients included in excess mortality modelling

A total of 21,045 prostate cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

20.2 Relative survival

Relative survival, by ethnic group

Figure 28 and Table 44 show evidence of substantial improvement over time in one-year and five-year RSRs for non-Māori and Māori prostate cancer patients.

Relative survival, by income group

Figure 28 and Table 44 show evidence of substantial improvements in one-year and five-year RSRs for prostate cancer patients in all income groups.

Figure 28: **One-year and five-year RSRs for prostate cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group**

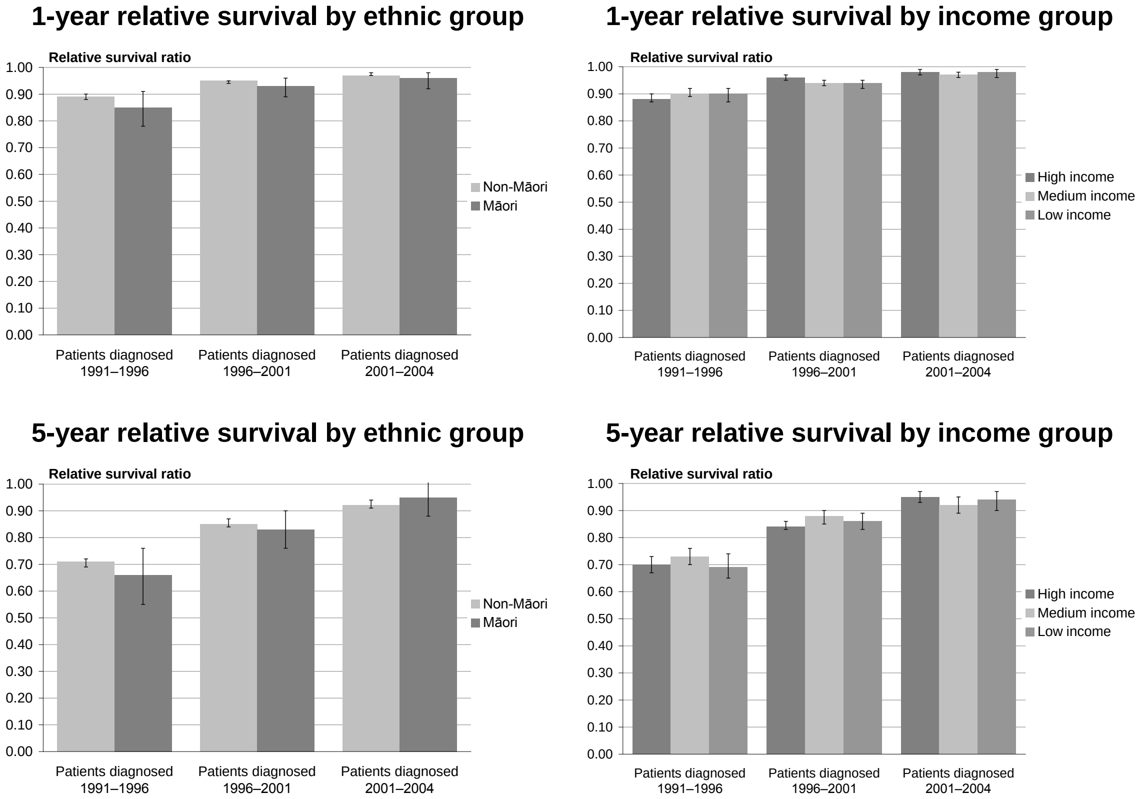


Table 44: One-year and five-year RSRs, and their ethnic and income gaps, for prostate cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.89 (0.88,0.90)	0.95 (0.94,0.95)	0.97 (0.97,0.98)
	Māori	0.85 (0.78,0.90)	0.93 (0.89,0.96)	0.96 (0.92,0.98)
5 years	Non-Māori	0.71 (0.69,0.91)	0.85 (0.84,0.87)	0.92 (0.91,0.94)
	Māori	0.66 (0.55,0.72)	0.83 (0.76,0.90)	0.95 (0.88,1.01)
Ethnic gap	1 year	-0.04	-0.02	-0.01
	5 years	-0.05	-0.02	0.03
Socioeconomic trends in relative survival				
1 year	High income	0.88 (0.87,0.90)	0.96 (0.95,0.97)	0.98 (0.97,0.99)
	Medium income	0.90 (0.89,0.92)	0.94 (0.93,0.95)	0.97 (0.96,0.98)
	Low income	0.90 (0.87,0.92)	0.94 (0.92,0.95)	0.98 (0.96,0.99)
5 years	High income	0.70 (0.67,0.73)	0.84 (0.83,0.86)	0.95 (0.93,0.97)
	Medium income	0.73 (0.70,0.76)	0.88 (0.85,0.90)	0.92 (0.89,0.95)
	Low income	0.69 (0.65,0.74)	0.86 (0.83,0.89)	0.94 (0.90,0.97)
Income group gap	1 year	0.02	-0.02	0.00
	5 years	-0.01	0.02	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

20.3 Excess mortality

Ethnic and income trends in prostate cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 45 and discussed below.

Changes in excess mortality over time

Table 45 shows evidence of a large and statistically significant decrease in excess mortality for prostate cancer patients. For every 10 years of cancer diagnosis, prostate cancer patients experienced an 87% decrease in excess mortality, with an EMRR of 0.13 (95% CI 0.11, 0.16) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 45 shows evidence of an ethnic difference in excess mortality for prostate cancer patients and a lesser income difference in excess mortality for prostate cancer patients. Averaged over time, Māori prostate cancer patients had 38% greater excess mortality, with an EMRR of 1.38 (95% CI 1.05, 1.81) compared to non-Māori patients. Prostate cancer patients in the lowest income quintile experienced similar excess mortality compared to patients in the highest income quintile, with an EMRR of 1.06 (95% CI 0.90, 1.25).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for prostate cancer patient survival (see Table 45). The ethnic interaction EMRR was 1.58 (95% CI 0.72, 3.45) and the income interaction EMRR was 1.59 (95% CI 0.96, 2.65). No further interpretation of Models 2 and 4 in Table 45 is provided here as changes over time in prostate-specific antigen testing and screening make such interactions difficult to interpret (see ‘Prostate cancer’ in Chapter 2 and the conclusion chapter in this report).

Table 45: EMRRs, including 95% CIs, for prostate cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.38 (1.05,1.81)**	**1.12 (0.69,1.81)**	1.37 (1.05,1.80)	1.37 (1.04,1.80)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.06 (0.90,1.25)**	**0.87 (0.66,1.14)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.13 (0.11,0.16)**	**0.08 (0.04,0.19)**	**0.13 (0.11,0.16)**	**0.11 (0.08,0.15)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.58 (0.72,3.45)**		
Income quintiles × calendar year of diagnosis				**1.59 (0.96,2.65)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	1.23 (0.91,1.68)	1.24 (0.91,1.68)	1.24 (0.91,1.68)	1.24 (0.91,1.69)
3 years since diagnosis	0.70 (0.50,0.96)	0.70 (0.50,0.97)	0.68 (0.49,0.95)	0.68 (0.49,0.95)
4 years since diagnosis	0.63 (0.45,0.89)	0.64 (0.45,0.89)	0.65 (0.46,0.90)	0.64 (0.46,0.90)
5 years since diagnosis	0.64 (0.45,0.90)	0.64 (0.45,0.90)	0.64 (0.45,0.90)	0.64 (0.46,0.90)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	0.73 (0.54,0.98)	0.73 (0.55,0.98)	0.72 (0.54,0.96)	0.72 (0.54,0.97)
Aged 65–74	0.81 (0.57,1.14)	0.81 (0.58,1.14)	0.81 (0.58,1.15)	0.80 (0.57,1.13)
Aged 75+	1.49 (1.05,2.10)	1.49 (1.06,2.10)	1.54 (1.10,2.17)	1.52 (1.08,2.13)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.16 (0.80,1.69)	1.16 (0.80,1.69)	1.14 (0.78,1.66)	1.14 (0.79,1.66)
75+, 1 year since diagnosis	1.55 (1.08,2.21)	1.55 (1.08,2.21)	1.48 (1.04,2.12)	1.49 (1.05,2.13)
64–74 years, 2 years since diagnosis	0.88 (0.61,1.28)	0.88 (0.60,1.27)	0.87 (0.60,1.27)	0.87 (0.60,1.27)
75+, 2 years since diagnosis	0.72 (0.50,1.05)	0.72 (0.50,1.04)	0.69 (0.48,1.01)	0.70 (0.48,1.01)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	521	521	2298	2298
AIC (Akaike information criterion)	2168.2	2169	6116.8	6115.6
BIC (Bayesian information criteria)	2227.8	2232.8	6202.9	6207.4
Scaled dispersion	1.391	1.391	1.029	1.028
Deviance	705.189	703.962	1104.448	1100.668

[1] EMRRs averaged over the study period.

[2] Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 21: Cancer of the stomach (ICD code C16)

21.1 Number of patients

Number of patients included in survival analyses

The number of stomach cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of stomach cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1224, 1386 and 1068, respectively. Of those patients, the number of Māori patients in each cohort was 135, 183 and 159, respectively.

Number of patients included in relative survival analyses, by income group

The number of stomach cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 1068, 1155 and 882, respectively. Of those patients, the number of high-income patients in each cohort was 264, 276 and 243, and the number of low-income patients in each cohort was 282, 372 and 303, respectively.

Number of patients included in excess mortality modelling

A total of 3090 stomach cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

21.2 Relative survival

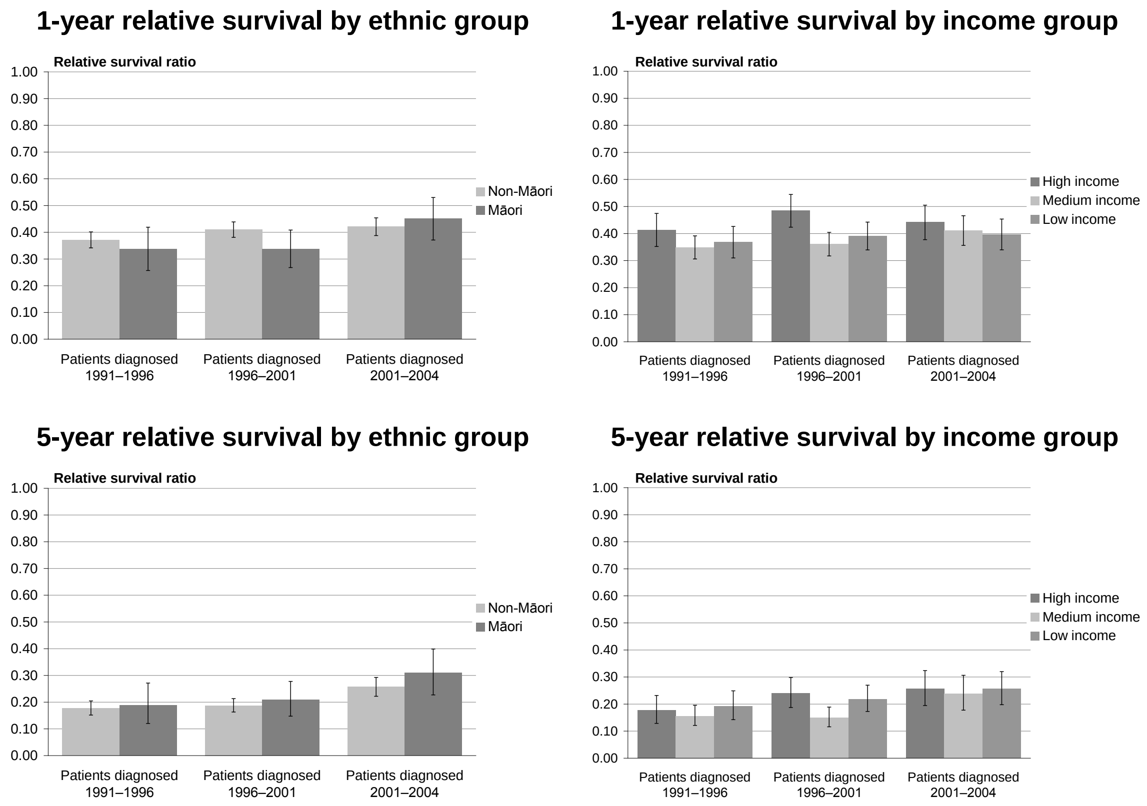
Relative survival, by ethnic group

Figure 29 and Table 46 show some evidence of improvement over time in one-year and five-year RSRs for non-Māori and Māori stomach cancer patients.

Relative survival, by income group

Figure 29 and Table 46 show evidence of some improvements in one-year and five-year RSRs for stomach cancer patients in all income groups.

Figure 29: One-year and five-year RSRs for stomach cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group



1-year relative survival by ethnic group

1-year relative survival by income group

5-year relative survival by ethnic group

5-year relative survival by income group

Table 46: One-year and five-year RSRs, and their ethnic and income gaps, for stomach cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.37 (0.34,0.40)	0.41 (0.38,0.44)	0.42 (0.39,0.45)
	Māori	0.34 (0.26,0.42)	0.34 (0.27,0.41)	0.45 (0.37,0.53)
5 years	Non-Māori	0.18 (0.15,0.20)	0.19 (0.16,0.21)	0.26 (0.22,0.29)
	Māori	0.19 (0.12,0.27)	0.21 (0.15,0.28)	0.31 (0.23,0.40)
Ethnic gap	1 year	-0.03	-0.07	0.03
	5 years	0.01	0.02	0.05
Socioeconomic trends in relative survival				
1 year	High income	0.41 (0.35,0.47)	0.49 (0.42,0.54)	0.44 (0.38,0.50)
	Medium income	0.35 (0.31,0.39)	0.36 (0.32,0.40)	0.41 (0.36,0.47)
	Low income	0.37 (0.31,0.43)	0.39 (0.34,0.44)	0.40 (0.34,0.45)
5 years	High income	0.18 (0.13,0.23)	0.24 (0.19,0.30)	0.26 (0.19,0.32)
	Medium income	0.16 (0.12,0.20)	0.15 (0.12,0.19)	0.24 (0.18,0.31)
	Low income	0.19 (0.14,0.25)	0.22 (0.17,0.27)	0.26 (0.20,0.32)
Income group gap	1 year	-0.05	-0.09	-0.05
	5 years	0.02	-0.02	0.00

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

21.3 Excess mortality

Excess mortality

Ethnic and income trends in stomach cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 47 and discussed below.

Changes in excess mortality over time

Table 47 shows evidence of a moderate decrease in excess mortality for stomach cancer patients. For every 10 years of cancer diagnosis, stomach cancer patients experienced a 14% decrease in excess mortality, with an EMRR of 0.86 (95% CI 0.78, 0.96) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 47 shows some evidence of both ethnic and income differences in excess mortality for stomach cancer patients. Averaged over time, Māori stomach cancer patients had 25% greater excess mortality, with an EMRR of 1.25 (95% CI 1.09, 1.43) compared to non-Māori patients. Stomach cancer patients in the lowest income quintile experienced 15% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.15 (95% CI 1.01, 1.30).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for stomach cancer patient survival (see Table 47). The ethnic interaction EMRR was 0.84 (95% CI 0.60, 1.17) and the income interaction EMRR was 1.06 (95% CI 0.78, 1.44). There was no evidence for changes over time in the ethnic and income differences in excess mortality for stomach cancer patients. No further interpretation of Models 2 and 4 in Table 47 is provided here.

Table 47: **EMRRs, including 95% CIs, for stomach cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.91 (0.83,0.99)	0.91 (0.84,1.00)	0.91 (0.83,0.99)	0.91 (0.83,0.99)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.25 (1.09,1.43)**	**1.42 (1.08,1.86)**	1.22 (1.06,1.40)	1.22 (1.06,1.40)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.15 (1.01,1.30)**	**1.11 (0.87,1.40)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.86 (0.78,0.96)**	**1.06 (0.71,1.56)**	**0.87 (0.78,0.96)**	**0.84 (0.69,1.02)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.84 (0.60,1.17)**		
Income quintiles × calendar year of diagnosis				**1.06 (0.78,1.44)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.45 (0.36,0.55)	0.45 (0.36,0.55)	0.45 (0.36,0.55)	0.45 (0.36,0.55)
3 years since diagnosis	0.23 (0.17,0.31)	0.23 (0.17,0.31)	0.23 (0.17,0.31)	0.23 (0.17,0.31)
4 years since diagnosis	0.13 (0.09,0.18)	0.13 (0.09,0.18)	0.13 (0.09,0.18)	0.13 (0.09,0.18)
5 years since diagnosis	0.10 (0.06,0.15)	0.10 (0.06,0.15)	0.10 (0.06,0.18)	0.10 (0.06,0.16)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.14 (0.98,1.34)	1.14 (0.98,1.33)	1.14 (0.98,1.33)	1.15 (0.98,1.34)
Aged 65–74	1.20 (0.85,1.70)	1.20 (0.84,1.70)	1.20 (0.84,1.70)	1.20 (0.84,1.70)
Aged 75+	1.02 (0.67,1.55)	1.02 (0.67,1.55)	1.05 (0.70,1.58)	1.05 (0.70,1.58)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	1.04 (0.72,1.49)	1.04 (0.72,1.49)	1.04 (0.72,1.49)	1.04 (0.72,1.48)
75+, 1 year since diagnosis	1.57 (1.02,2.39)	1.57 (1.03,2.40)	1.52 (1.01,2.31)	1.52 (1.01,2.32)
64–74 years, 2 years since diagnosis	0.88 (0.57,1.35)	0.88 (0.57,1.35)	0.88 (0.57,1.35)	0.88 (0.57,1.35)
75+, 2 years since diagnosis	0.95 (0.58,1.57)	0.95 (0.58,1.57)	0.93 (0.57,1.53)	0.93 (0.57,1.54)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	827	827	2372	2372
AIC (Akaike information criterion)	2456.2	2457.2	5658.4	5660.3
BIC (Bayesian information criteria)	2527	2532.6	5750.8	5758.4
Scaled dispersion	1.2	1.2	1.21	1.21
Deviance	974.053	972.98	842.406	842.653

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 22: Cancer of the testis (ICD code C62)

22.1 Number of patients

Number of patients included in survival analyses

The number of testicular cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of testicular cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 348, 390 and 378, respectively. Of those patients, the number of Māori patients in each cohort was 69, 99 and 69, respectively.

Number of patients included in relative survival analyses, by income group

The number of testicular cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 282, 315 and 315, respectively. Of those patients, the number of high-income patients in each cohort was 90, 105 and 123, and the number of low-income patients in each cohort was 84, 120 and 93, respectively.

Number of patients included in excess mortality modelling

A total of 906 testicular cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

22.2 Relative survival

Relative survival, by ethnic group

Figure 30 and Table 48 show only minor shifts over time in one-year and five-year RSRs for non-Māori and Māori testicular cancer patients.

Relative survival, by income group

Figure 30 and Table 48 show very small shifts in one-year and five-year RSRs for testicular cancer patients in all income groups.

Figure 30: One-year and five-year RSRs for testicular cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

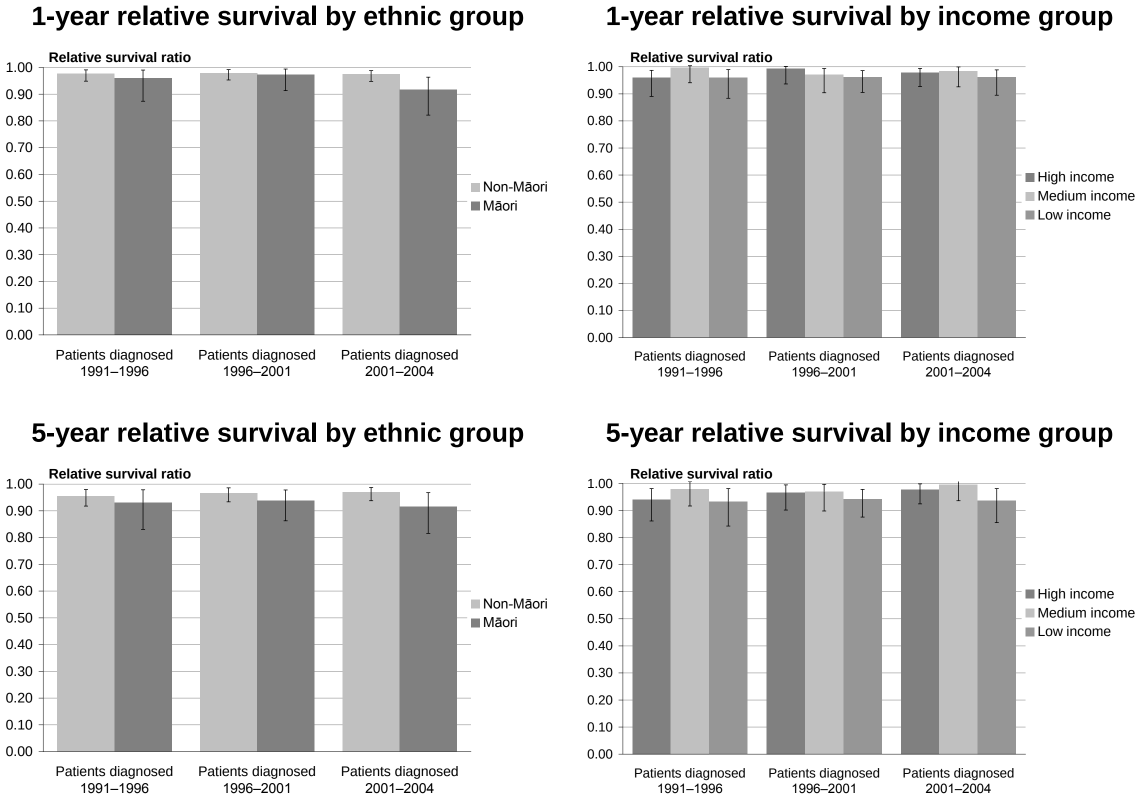


Table 48: One-year and five-year RSRs, and their ethnic and income gaps, for testicular cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.98 (0.95,0.99)	0.98 (0.95,0.99)	0.97 (0.95,0.99)
	Māori	0.96 (0.87,0.99)	0.97 (0.91,0.99)	0.92 (0.82,0.96)
5 years	Non-Māori	0.95 (0.92,0.98)	0.97 (0.93,0.99)	0.97 (0.94,0.99)
	Māori	0.93 (0.83,0.98)	0.94 (0.86,0.98)	0.92 (0.82,0.97)
Ethnic gap	1 year	-0.02	-0.01	-0.06
	5 years	-0.02	-0.03	-0.05
Socioeconomic trends in relative survival				
1 year	High income	0.96 (0.89,0.99)	0.99 (0.94,1.00)	0.98 (0.93,0.99)
	Medium income	1.00 (0.94,1.00)	0.97 (0.90,0.99)	0.98 (0.93,1.00)
	Low income	0.96 (0.88,0.99)	0.96 (0.91,0.99)	0.96 (0.89,0.99)
5 years	High income	0.94 (0.86,0.98)	0.97 (0.90,0.99)	0.98 (0.92,1.00)
	Medium income	0.98 (0.92,1.01)	0.97 (0.90,1.00)	1.00 (0.94,1.01)
	Low income	0.93 (0.84,0.98)	0.94 (0.88,0.98)	0.94 (0.85,0.98)
Income group gap	1 year	0.00	-0.03	-0.02
	5 years	-0.01	-0.02	-0.04

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

22.3 Excess mortality

Ethnic and income trends in testicular cancer patient survival were calculated using four different excess mortality models. These models differ from the previous excess mortality models due to (a) the younger age group distribution of testicular cancer patients, and (b) the high survival probability for testicular cancer patients, leading to marginal excess mortality rates after the fourth year of follow-up. The changes in the excess mortality models for testicular cancer are: stratification of age for younger age groups; reducing the follow-up time to four years instead of five; and exclusion of the covariate assessing interaction between age group and follow-up time. The EMRR estimates relevant to this study are highlighted in Table 49 and discussed below.

Changes in excess mortality over time

Table 49 shows weak evidence of a moderate decrease in excess mortality for testicular cancer patients. For every 10 years of cancer diagnosis, testicular cancer patients experienced a 28–30% decrease in excess mortality, with an EMRR of 0.72 (95% CI 0.29, 1.79) in Model 1 and an EMRR of 0.70 (95% CI 0.26, 1.87) in Model 3.

Ethnic and income inequalities in cancer survival

Table 49 shows weak evidence of ethnic and income differences in excess mortality for testicular cancer patients. Averaged over time, Māori testicular cancer patients had 64% greater excess mortality, with an EMRR of 1.64 (95% CI 0.71, 3.80) compared to non-Māori patients. Testicular cancer patients in the lowest income quintile experienced 36% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.36 (95% CI 0.42, 4.45).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for testicular cancer patient survival (see Table 49). The ethnic interaction EMRR was 2.18 (95% CI 0.26, 18.25) and the income interaction EMRR was 4.00 (95% CI 0.16, 98.97). Given the very wide confidence intervals, there was no strong evidence for changes over time in the ethnic and income differences in excess mortality for testicular cancer patients. No further interpretation of Models 2 and 4 in Table 49 are provided here.

Table 49: EMRRs, including 95% CI, for testicular cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.64 (0.71,3.80)**	**0.97 (0.17,5.48)**	1.67 (0.71,3.95)	1.68 (0.71,3.96)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.36 (0.42,4.45)**	**0.55 (0.05,6.44)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.72 (0.29,1.79)**	**0.27 (0.02,4.43)**	**0.70 (0.26,1.87)**	**0.34 (0.05,2.44)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**2.18 (0.26,18.25)**		
Income quintiles × calendar year of diagnosis				**4.00 (0.16,98.97)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.33 (0.13,0.84)	0.33 (0.13,0.84)	0.35 (0.14,0.93)	0.37 (0.14,0.95)
3 years since diagnosis	0.15 (0.03,0.64)	0.15 (0.03,0.69)	0.18 (0.04,0.76)	0.18 (0.04,0.81)
4 years since diagnosis	0.07 (0.01,1.04)	0.07 (0.01,1.02)	0.09 (0.01,1.13)	0.08 (0.00,1.44)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–24	1	1	1	1
Aged 25–44	0.71 (0.24,2.10)	0.71 (0.24,2.13)	0.70 (0.24,2.05)	0.73 (0.24,2.18)
Aged 45–64	1.19 (0.35,4.01)	1.19 (0.35,4.03)	0.80 (0.21,3.11)	0.80 (0.20,3.19)
Aged 65+	1.70 (1.04,2.78)	1.71 (1.05,2.79)	2.44 (0.22,27.08)	2.12 (0.12,38.20)
Diagnostic criteria for regression models				
Observations	446	446	1095	1095
AIC (Akaike information criterion)	1421.4	1422.4	412.5	413.8
BIC (Bayesian information criteria)	1478.8	1484	462.5	468.7
Scaled dispersion	1.115	1.115	0.271	0.27
Deviance	481.568	480.614	16.85	16.241

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 23: Cancer of the thyroid gland (ICD code C73)

23.1 Number of patients

Number of patients included in survival analyses

The number of thyroid gland cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up was calculated. These results are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of thyroid gland cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 321, 570 and 477, respectively. Of those patients, the number of Māori patients in each cohort was 36, 93 and 69, respectively.

Number of patients included in relative survival analyses, by income group

The number of thyroid gland cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 276, 447 and 384, respectively. Of those patients, the number of high-income patients in each cohort was 69, 150 and 123, and the number of low-income patients in each cohort was 87, 150 and 126, respectively.

Number of patients included in excess mortality modelling

A total of 1095 thyroid gland cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

23.2 Relative survival

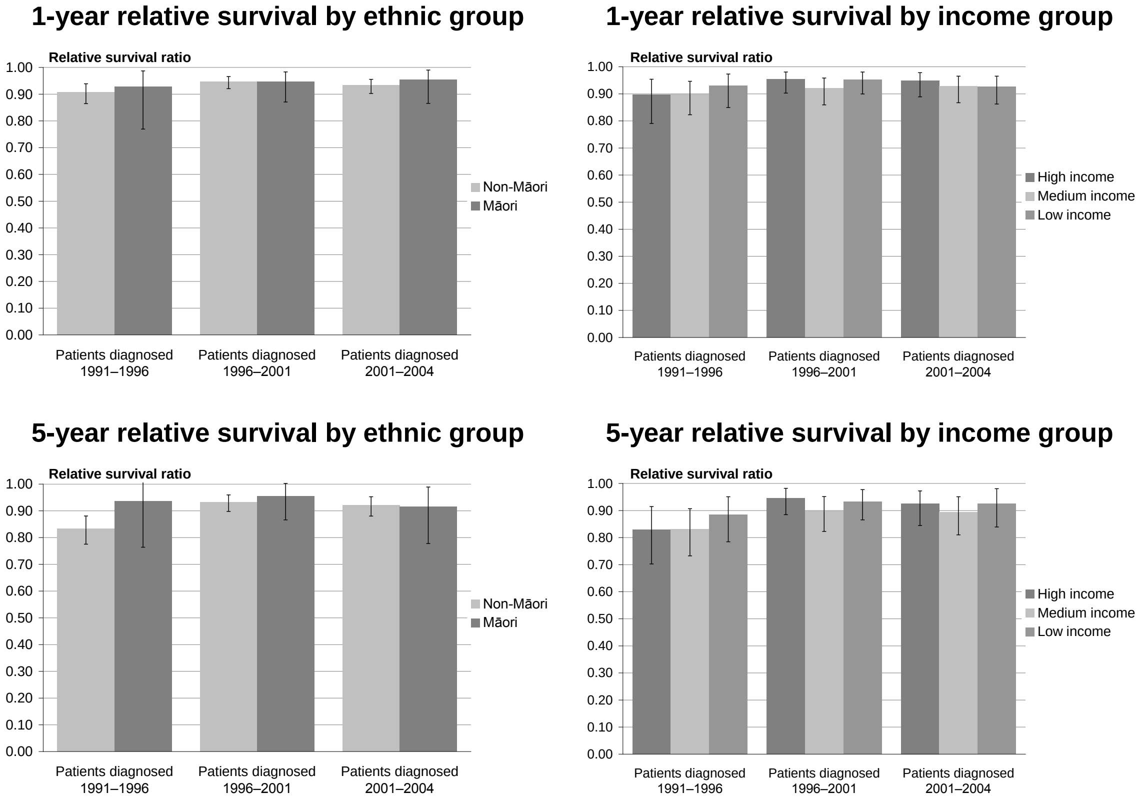
Relative survival, by ethnic group

Figure 31 and Table 50 show small shifts over time in one-year and five-year RSRs for non-Māori and Māori thyroid gland cancer patients.

Relative survival, by income group

Figure 31 and Table 50 show small shifts in one-year and five-year RSRs for thyroid gland cancer patients in all income groups.

Figure 31: One-year and five-year RSRs for thyroid gland cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group



1-year relative survival by ethnic group

1-year relative survival by income group

5-year relative survival by ethnic group

5-year relative survival by income group

Table 50: One-year and five-year RSRs, and their ethnic and income gaps, for thyroid gland cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.91 (0.86,0.94)	0.95 (0.92,0.97)	0.93 (0.90,0.96)
	Māori	0.93 (0.79,0.99)	0.95 (0.87,0.98)	0.95 (0.87,0.99)
5 years	Non-Māori	0.83 (0.78,0.88)	0.93 (0.90,0.96)	0.92 (0.88,0.95)
	Māori	0.94 (0.76,1.01)	0.95 (0.87,1.00)	0.91 (0.78,0.99)
Ethnic gap	1 year	0.02	0.00	0.02
	5 years	0.10	0.02	-0.01
Socioeconomic trends in relative survival				
1 year	High income	0.90 (0.79,0.95)	0.95 (0.90,0.98)	0.95 (0.89,0.98)
	Medium income	0.90 (0.82,0.95)	0.92 (0.86,0.96)	0.93 (0.87,0.97)
	Low income	0.93 (0.85,0.97)	0.95 (0.90,0.98)	0.93 (0.86,0.97)
5 years	High income	0.83 (0.70,0.91)	0.94 (0.88,0.98)	0.93 (0.84,0.97)
	Medium income	0.83 (0.73,0.91)	0.90 (0.82,0.95)	0.89 (0.81,0.95)
	Low income	0.89 (0.78,0.95)	0.93 (0.87,0.98)	0.93 (0.84,0.98)
Income group gap	1 year	0.04	0.00	-0.02
	5 years	0.06	-0.01	0.00

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

23.3 Excess mortality

Ethnic and income trends in thyroid gland cancer patient survival were calculated using four different excess mortality models. These models differ from the previous excess mortality models due to the younger age group distribution of thyroid gland cancer patients. The changes in the excess mortality models for thyroid gland cancer are: stratification of age for younger age groups and exclusion of the covariate assessing interaction between age group and follow-up time. The EMRR estimates relevant to this study are highlighted in Table 51 and discussed below.

Changes in excess mortality over time

Table 51 shows evidence of a decrease in excess mortality for thyroid gland cancer patients. For every 10 years of cancer diagnosis, thyroid gland cancer patients experienced a 44–46% decrease in excess mortality, with an EMRR of 0.54 (95% CI 0.31, 0.95) in Models 1 and an EMRR of 0.56 (95% CI 0.32, 1.00) in Model 3.

Ethnic and income inequalities in cancer survival

Table 51 shows very limited evidence of ethnic and income differences in excess mortality for thyroid gland cancer patients. Averaged over time, Māori thyroid gland cancer patients had 32% less excess mortality, with an EMRR of 0.68 (95% CI 0.24,1.92) compared to non-Māori patients. Thyroid gland cancer patients in the lowest income quintile experienced 56% greater excess mortality compared to patients in the highest income quintile, with an EMRR of 1.56 (95% CI 0.81, 3.02).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for thyroid gland cancer patient survival (see Table 51). The ethnic interaction EMRR was 0.62 (95% CI 0.05, 8.25) and the income interaction EMRR was 1.60 (95% CI 0.29, 8.76). No evidence existed for changes over time in the ethnic and income differences in excess mortality for thyroid gland cancer patients. No further interpretation of Models 2 and 4 in Table 51 is provided here.

Table 51: EMRRs, including 95% CIs, for thyroid gland cancer patients diagnosed during 1991–2004, with follow-up to 2006

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
EMRRs for ethnic and income cancer survival trends				
Sex[1]				
Male	1	1	1	1
Female	0.83 (0.52,1.32)	0.82 (0.52,1.32)	0.81 (0.51,1.31)	0.81 (0.50,1.30)
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**0.68 (0.24,1.92)**	**0.94 (0.14,6.31)**	0.59 (0.20,1.75)	0.60 (0.21,1.75)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.56 (0.81,3.02)**	**1.14 (0.30,4.25)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.54 (0.31,0.95)**	**0.89 (0.06,14.33)**	**0.56 (0.32,1.00)**	**0.43 (0.14,1.30)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**0.62 (0.05,8.25)**		
Income quintiles × calendar year of diagnosis				**1.60 (0.29,8.76)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.20 (0.10,0.41)	0.20 (0.10,0.41)	0.20 (0.10,0.40)	0.19 (0.09,0.40)
3 years since diagnosis	0.20 (0.09,0.45)	0.20 (0.09,0.45)	0.20 (0.09,0.45)	0.20 (0.09,0.44)
4 years since diagnosis	0.09 (0.02,0.36)	0.08 (0.03,0.37)	0.11 (0.04,0.35)	0.11 (0.04,0.35)
5 years since diagnosis	0.03 (0.00,1.12)	0.03 (0.00,1.16)	0.05 (0.01,0.49)	0.05 (0.01,0.49)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
Age group[1]				
Aged 15–24	1	1	1	1
Aged 25–44	2.20 (1.03,4.72)	2.21 (1.03,4.73)	2.20 (1.03,4.69)	2.22 (1.04,4.74)
Aged 45–64	10.22 (5.14,20.34)	10.28 (5.16,20.50)	10.09 (5.08,20.05)	10.11 (5.08,20.09)
Diagnostic criteria for regression models				
Observations	649	649	2029	2029
AIC (Akaike information criterion)	648.8	650.7	1097.8	1099.5
BIC (Bayesian information criteria)	693.6	699.9	1159.6	1166.9
Scaled dispersion	0.61	0.611	0.387	0.387
Deviance	122.01	121.373	126.418	126.38

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Chapter 24: Cancer of the uterus (ICD code C56)

24.1 Number of patients

Number of patients included in survival analyses

The number of uterine cancer patients alive at the start of follow-up, those who had died at the end of the first year of follow-up, those alive at the start of the fifth annual interval, and the total number of patients who had died after five years of follow-up were calculated. These are presented in full, by ethnic group and income group, in Appendix 1.

Number of patients included in relative survival analyses, by ethnic group

The number of uterine cancer patients by ethnic group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 876, 1092 and 963, respectively. Of those patients, the number of Māori patients in each cohort was 75, 114 and 108, respectively.

Number of patients included in relative survival analyses, by income group

The number of uterine cancer patients by income group included in the 1991–1996, 1996–2001 and 2001–2004 cohorts was 756, 891 and 780, respectively. Of those patients, the number of high-income patients in each cohort was 189, 249 and 225, and the number of low-income patients in each cohort was 243, 303 and 312, respectively.

Number of patients included in excess mortality modelling

A total of 2412 uterine cancer patients diagnosed between 1991 and 2004 were included in the excess mortality modelling to estimate ethnic and socioeconomic trends in cancer survival.

24.2 Relative survival

Relative survival, by ethnic group

Figure 32 and Table 52 show evidence of small shifts in one-year RSRs for non-Māori and Māori patients and an increase in the five-year RSR for non-Māori patients.

Relative survival, by income group

Figure 32 and Table 52 show evidence for shifts in five-year RSRs for patients in each income group but less marked changes over time for one-year RSRs.

Figure 32: One-year and five-year RSRs for uterine cancer patients diagnosed during 1991–2004, with follow-up to 2006, by ethnic and income group

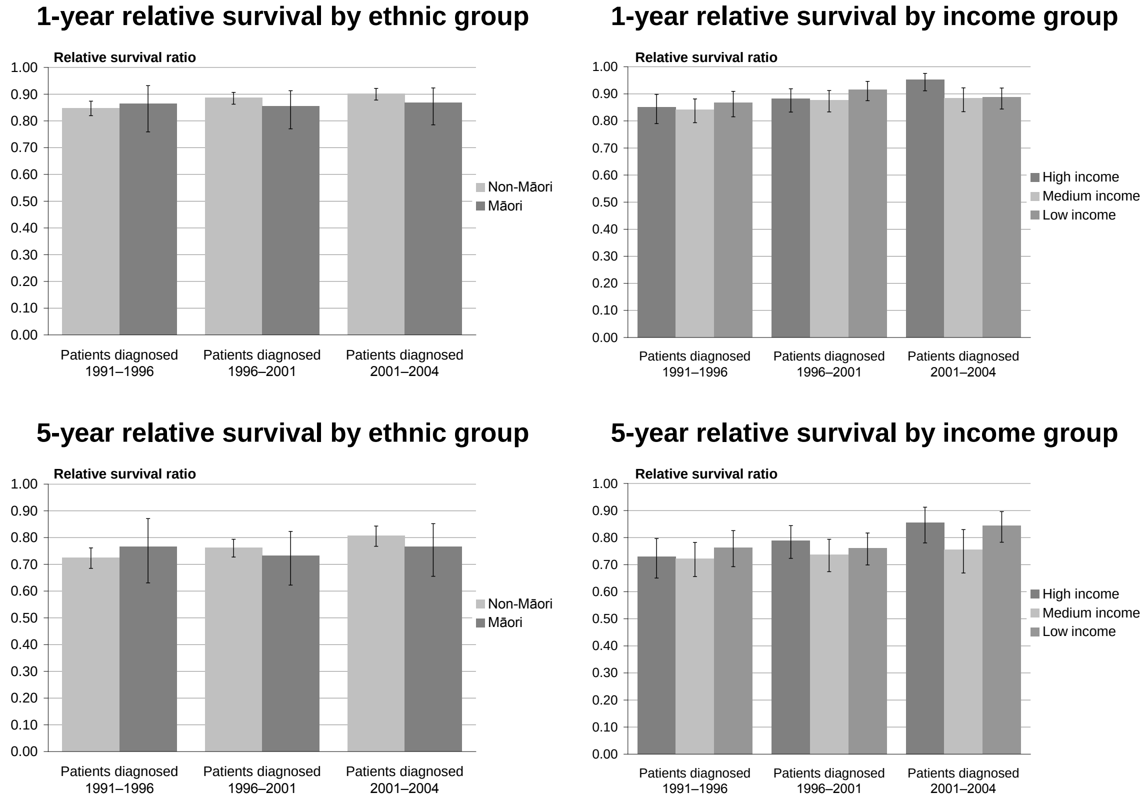


Table 52: One-year and five-year RSRs, and their ethnic and income gaps, for uterine cancer patients diagnosed during 1991–2004, by ethnic and income groups

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.85 (0.82,0.87)	0.89 (0.86,0.91)	0.90 (0.88,0.92)
	Māori	0.86 (0.76,0.93)	0.85 (0.77,0.91)	0.87 (0.79,0.92)
5 years	Non-Māori	0.72 (0.69,0.76)	0.76 (0.73,0.79)	0.81 (0.77,0.84)
	Māori	0.76 (0.63,0.87)	0.73 (0.62,0.82)	0.76 (0.66,0.85)
Ethnic gap	1 year	0.02	-0.03	-0.03
	5 years	0.04	-0.03	-0.04
Socioeconomic trends in relative survival				
1 year	High income	0.85 (0.79,0.90)	0.88 (0.83,0.92)	0.95 (0.91,0.98)
	Medium income	0.84 (0.79,0.88)	0.88 (0.83,0.91)	0.88 (0.83,0.92)
	Low income	0.87 (0.82,0.91)	0.92 (0.87,0.95)	0.89 (0.84,0.92)
5 years	High income	0.73 (0.65,0.80)	0.79 (0.72,0.84)	0.86 (0.78,0.91)
	Medium income	0.72 (0.66,0.78)	0.74 (0.67,0.79)	0.76 (0.67,0.83)
	Low income	0.76 (0.69,0.83)	0.76 (0.70,0.82)	0.84 (0.78,0.90)
Income group gap	1 year	0.02	0.03	-0.06
	5 years	0.03	-0.03	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

24.3 Excess mortality

Ethnic and income trends in uterine cancer patient survival were calculated using four different excess mortality models. The EMRR estimates relevant to this study are highlighted in Table 53 and are discussed below.

Changes in excess mortality over time

Table 53 shows evidence of a moderate decrease over time in excess mortality for uterine cancer patients. For every 10 years of cancer diagnosis, uterine cancer patients experienced a 29% decrease in excess mortality, with an EMRR of 0.71 (95% CI 0.55, 0.91) in Models 1 and 3.

Ethnic and income inequalities in cancer survival

Table 53 presents some evidence of an ethnic difference in excess mortality for uterine cancer patients but little evidence of an income difference in excess mortality. Averaged over time, Māori uterine cancer patients had 56% greater excess mortality, with an EMRR of 1.56 (95% CI 1.12, 2.16) compared to non-Māori patients. Uterine cancer patients in the lowest income quintile experienced similar excess mortality to patients in the highest income quintile, with an EMRR of 1.06 (95% CI 0.80, 1.40).

Interaction terms: ethnicity and calendar period, and income and calendar period

Model 2 shows the estimate for the interaction between ethnicity and calendar period and Model 4 shows the estimate for the interaction between income and calendar period for uterine cancer patient survival (see Table 53). The ethnic interaction EMRR was 1.69 (95% CI 0.72, 3.95) and the income interaction EMRR was 1.61 (95% CI 0.80, 3.25). There was no evidence of changes over time in the ethnic or income gap in excess mortality for uterine cancer patients. No further interpretation of Models 2 and 4 in Table 53 is provided here.

Table 53: **EMRRs, including 95% CIs, for uterine cancer patients diagnosed during 1991–2004, with follow-up to 2006**

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	**Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)**	**Model 3 (income main effects model) EMRR (95% CI)**	**Model 4 (income and calendar period interaction model) EMRR (95% CI)**
EMRRs for ethnic and income cancer survival trends				
Ethnicity[1]				
Non-Māori	1	1	1	1
Māori	**1.56 (1.12,2.16)**	**1.07 (0.53,2.20)**	1.55 (1.11,2.16)	1.55 (1.12,2.16)
Income quintiles[1]				
Highest income quintile			1	1
Lowest income quintile			**1.06 (0.80,1.41)**	**0.77 (0.45,1.34)**
Calendar period of cancer diagnosis				
Change every 10 years of cancer diagnosis	**0.71 (0.55,0.91)**	**0.40 (0.15,1.04)**	**0.71 (0.56,0.91)**	**0.55 (0.35,0.86)**
Change in inequalities over time[2]				
Ethnicity × calendar year of diagnosis		**1.69 (0.72,3.95)**		
Income quintiles × calendar year of diagnosis				**1.61 (0.80,3.25)**
EMRRs for other covariates in regression models				
Follow-up since cancer diagnosis[1]				
1 year since diagnosis	1	1	1	1
2 years since diagnosis	0.39 (0.26,0.60)	0.40 (0.26,0.60)	0.39 (0.26,0.60)	0.40 (0.26,0.60)
3 years since diagnosis	0.38 (0.26,0.57)	0.39 (0.26,0.58)	0.39 (0.26,0.58)	0.39 (0.26,0.57)
4 years since diagnosis	0.16 (0.09,0.29)	0.16 (0.09,0.29)	0.16 (0.09,0.29)	0.16 (0.09,0.29)
5 years since diagnosis	0.13 (0.06,0.26)	0.13 (0.06,0.26)	0.13 (0.07,0.26)	0.13 (0.07,0.26)

	Ethnic trends in survival		Income trends in survival	
	Model 1 (ethnicity main effects model) EMRR (95% CI)	Model 2 (ethnicity and calendar period interaction model) EMRR (95% CI)	Model 3 (income main effects model) EMRR (95% CI)	Model 4 (income and calendar period interaction model) EMRR (95% CI)
Age group[1]				
Aged 15–54	1	1	1	1
Aged 55–64	1.08 (0.79,1.48)	1.10 (0.80,1.51)	1.08 (0.79,1.48)	1.08 (0.79,1.49)
Aged 65–74	1.62 (0.96,2.73)	1.63 (0.96,2.75)	1.61 (0.96,2.71)	1.60 (0.95,2.69)
Aged 75+	2.09 (1.10,3.96)	2.10 (1.11,3.98)	2.21 (1.12,4.08)	2.19 (1.19,4.05)
Interaction, follow-up and age group[1]				
64–74 years, 1 year since diagnosis	0.87 (0.48,1.55)	0.87 (0.49,1.56)	0.87 (0.49,1.55)	0.87 (0.49,1.56)
75+, 1 year since diagnosis	1.19 (0.60,2.35)	1.19 (0.60,2.35)	1.12 (0.58,2.16)	1.13 (0.58,2.17)
64–74 years, 2 years since diagnosis	1.37 (0.69,2.75)	1.37 (0.69,2.74)	1.38 (0.69,2.75)	1.38 (0.69,2.75)
75+, 2 years since diagnosis	1.68 (0.76,3.73)	1.68 (0.76,3.73)	1.56 (0.72,3.39)	1.55 (0.71,3.38)
All other combinations of follow-up and age group	1	1	1	1
Diagnostic criteria for regression models				
Observations	492	492	1829	1829
AIC (Akaike information criterion)	1254.4	1254.8	2643.9	2644.2
BIC (Bayesian information criteria)	1313.1	1317.8	2726.6	2732.4
Scaled dispersion	1.133	1.133	0.829	0.828
Deviance	541.75	540.23	198.036	199.3

1 EMRRs averaged over the study period.

2 Change in the EMRR for every 10 years of cancer diagnosis.

Part C: Conclusion

Chapter 25: Conclusions

Summary of findings

This chapter briefly summarises the report's findings. The findings are framed using the three main areas assessed in this report:

(a) changes over time in cancer survival
(b) ethnic and socioeconomic inequalities in cancer survival
(c) changes over time in the ethnic and socioeconomic inequalities in cancer survival.

It should be noted that the purpose of this report is to provide a broad overview of findings rather than an in-depth interpretation of patterns for each cancer. Future publications from the CancerTrends study will provide more detailed interpretation of survival trends for selected cancer sites.

Changes over time in cancer survival

Pooled across cancer sites, there was a moderate improvement in cancer survival over time in New Zealand during the period 1991–2004, followed up to 2006, with an approximate 25% decrease in excess mortality for every 10-year period. Changes over time in cancer survival (or, more precisely, excess mortality) were grouped in this report in terms of whether the cancer survival improvement was large (a greater than 40% decrease in excess mortality for every 10 years), moderate (a 15–39% decrease in excess mortality for every 10 years), or small (a 1–14% decrease in excess mortality for every 10 years)

From this study, there was evidence of:

- a moderate improvement in survival over time pooled across all cancer sites, with a 25% (95% CI 24–26%) decrease in excess mortality every 10 years
- large improvements in survival over time (a greater than 40% decrease in excess mortality every 10 years) for female breast, leukaemia, non-Hodgkin's lymphoma, prostate and thyroid gland cancers
- moderate improvements in survival over time (an 11–39% decrease in excess mortality every 10 years) for bladder, cervical, colorectal, Hodgkin's lymphoma, kidney, liver, melanoma, ovarian, testicular and uterine cancers
- small improvements in survival over time (a 1–10% decrease in excess mortality every 10 years) for brain, head and neck, lung, oesophageal, pancreatic cancers, and stomach cancers.

Improvements in cancer survival over time may reflect a number of factors, including improved treatments, and earlier or improved diagnostic investigations and/or screening for cancer.

Advances in cancer treatment are likely to explain at least some of the demonstrated improvements in cancer survival. For example, for colorectal cancer patients there has been the introduction of more effective adjuvant chemo- and radiotherapy, increased use of multidisciplinary care teams, as well as evidence for improved outcomes for colorectal cancer patients with metastatic disease after liver resection.(60) There has also been improvement in female breast cancer survival over time in England and Wales, but the extent to which the introduction of a national mammographic screening programme, increased public awareness about breast self-examination and the advances in management for early and metastatic cancer have improved survival over time is difficult to ascertain.(61)

Little has been documented in New Zealand about advances or changes over time in cancer management. This is perhaps due to variation in cancer management practices across the country. As an example, changes over time in colorectal cancer survival are likely to be primarily due to advances in the detection and treatment of rectal cancer (such as improved diagnostic techniques, pre-operative staging, pre-operative radio- and chemo-therapy, and improved surgical techniques) as well as advances in colon cancer management (such as improved diagnostic techniques, advances in chemotherapy, increased public awareness of colorectal cancer risk factors and early detection, but little change in surgical practice).(62) The documentation of major advances in cancer management over time in New Zealand warrants further investigation to help interpret survival trends.

Improved cancer diagnostic techniques may contribute to better survival outcomes over time if cancer is detected earlier. For example, the increased use of endoscopic ultrasonography has been credited with improving diagnostic accuracy and consequent survival benefits for stomach cancer patients in England and Wales during the late 1990s.(63)

There were changes in the pathological criteria for malignant bladder cancer tumours in the late 1990s. Up to half of bladder tumours are now considered as benign or *in situ* tumours (personal communication, B Rachet, November 2011). The changes in pathological criteria may have occurred at different speeds between social groups. This may explain the variation in the number of bladder cancer cases or in the survival differences described in Chapter 7. Furthermore, changes over time in the intensity of treatment in the last few months for patients with brain and ovarian cancers is likely to be associated with changes over time in survival in a given social group. However, there is no clear trend over time in ovarian or brain cancer incidence rates within ethnic groups.(15)

Early detection (eg, greater vigilance for symptoms and signs among the general population and primary care services) and organised screening programmes may also lead to improvements in survival. For example, melanoma awareness results in earlier detection, when cure is more likely. Breast cancer screening programmes have clearly improved patient survival, particularly from the late 1990s, when New Zealand's mammogram screening programme was introduced. However, screening for cervical cancer may have a different impact on survival rates. The aim of cervical cancer screening is to prevent the *occurrence* of cancer. In situations where there is very high coverage in the cervical screening programme and in the absence of treatment improvements over time, the remaining cases are patients with advanced disease, and so survival may even decrease.(64)

Care must be taken when interpreting survival trends for cancers potentially identified through screening. If a cancer is diagnosed earlier, the survival time will, by definition, be longer even if the outcome is unchanged. Furthermore, screening for cancer tends to result in the identification of inconsequential disease which would not have become apparent in the absence of screening. This results in both an increase in incidence of these cancers and an apparent improvement in survival, even if mortality rates from the cancer in question are unchanged. For these reasons, there is considerable controversy as to whether screening for prostate cancer decreases prostate cancer mortality, but without doubt the large increase in diagnosed cases greatly improves the *observed* survival.

This report does not attempt to unpack the impact of these screening-related factors in cancer survival trends. Specifically, it was difficult with the data used in this study to quantify the impact of lead-time bias in cancer survival trends (the time difference between screen-detected tumours and clinical detection in the absence of screening).

Ethnic and socioeconomic inequalities in cancer survival

There was evidence of ethnic differences in cancer survival for 17 of the 21 cancer sites assessed in this report, with Māori patients having poorer survival compared to non-Māori patients. Such 'cross-sectional' differences in cancer survival have been documented before.(19, 23, 50, 52, 53, 65) This report also finds income differences in survival, but to a lesser extent than the ethnic differences: for 13 of the 21 cancer sites assessed here, lower-income patients had poorer survival compared to higher-income patients.

There was notable evidence of ethnic differences in cancer survival for:

- female breast, cervical, colorectal, head and neck, Hodgkin’s lymphoma, kidney, leukaemia, liver, lung, melanoma, non-Hodgkin’s lymphoma, oesophageal, pancreatic, prostate, stomach, testicular, and uterine cancers.

There was notable evidence of income differences in cancer survival, but to a lesser extent than ethnic differences, for:

- bladder, female breast, cervical, colorectal, head and neck, leukaemia, lung, melanoma, oesophageal, pancreatic, stomach, testicular, and thyroid gland cancers.

These inequalities are likely to stem from differences between groups in terms of stage at diagnosis, quality and timing of treatment, host factors such as co-morbidities, and possibly differential tumour biology between social groups. For example, research carried out by Hill et al in New Zealand found that Māori patients with colon cancer had 33% higher mortality cancer-specific mortality than non-Maori.(5, 6) They found that about a third of this disparity was due to differences in co-morbidity and a third due to health service access factors. Research on ethnic differences in lung cancer management in New Zealand carried out by Stevens et al suggests that Māori patients had more presentation of advanced disease, lower rates of curative treatment for non-metastatic disease, and longer transit times from diagnosis to treatment compared to non-Māori patients; socioeconomic deprivation and co-morbidity did not fully explain these ethnic differences.(24, 66, 67)

Changes over time in ethnic and socioeconomic cancer survival inequalities

Given that cancer survival is often improving over time, *and* that there are social group differences in survival, *and* that factors distributed differentially by social group may contribute to survival trends (eg, access to knowledge and health services), it is important to determine if there are trends over time in social group differences (gaps) in cancer survival. Faster improvements in survival in privileged social groups might reflect earlier and more rapid access to and uptake of survival-enhancing processes and treatments. Conversely, faster improvements in survival among disadvantaged populations may reflect more widespread access to effective treatments (and the absence of new breakthroughs that advantaged people are accessing initially). Narrowing or widening inequalities in survival may also reflect how effective the health system is at ensuring equal access to survival-enhancing knowledge and treatments.

However, actually detecting statistically significant changes in social group differences in cancer requires analysing large populations over a long period. Although the data used in this report is nationwide data, the time period over which adequate data was available was only 13 years, and New Zealand is a relatively small country. For some of the most common cancers (female breast and colorectal cancer), Māori patients had substantially greater excess mortality during the 1990s compared to non-Māori patients, with a likely narrowing of the ethnic difference in excess mortality from the late 1990s. The income difference for female breast cancer patients appears to have remained stable over time, but with a possible widening over time of the income gap for colorectal cancer patients. There has been a possible widening of ethnic and income differences in excess mortality for lung cancer patients since the late 1990s. However, it must be emphasised that these cancer-specific trends in ethnic and income differences in excess mortality were not statistically significant.

Although there was too much statistical imprecision *by cancer site* to draw robust conclusions about changing ethnic and income differences in survival (or, more precisely, excess mortality rates), it was possible to look for *patterns across all cancer sites*. Doing so, we found evidence of faster reductions in the excess mortality rate among high-income people, such that the pooled EMRR for the interaction between income and calendar year (per decade) was 1.09 (95% CI 1.01, 1.17; in other words, the EMRR comparing low- to high-income people was estimated to increase by 9% per decade, on average, pooled across all cancer sites). There was no clear pattern of changing ethnic differences in excess mortality over time.

The causes of changing social group differences in cancer survival over time may well vary across countries. For example, if ethnic group gaps in survival are driven by changing income gaps between the ethnic groups, then patterns would (theoretically at least) probably vary across countries. However, if more rapid uptake of new knowledge and treatments by privileged social groups is occurring more generally, given the globalised nature of cancer prevention and treatment, it is plausible that trends may have some commonality between countries, although this may differ depending on the level of commitment each country has to addressing this.

The most robust analyses on changes in social group differences in survival over time come from England and Wales, where it was found that there was an average decrease every five years of 1.90–2.50% in the socioeconomic gap in five-year relative survival for colorectal cancer patients.(68, 69) They also reported a much smaller average decrease every five years in the socioeconomic gap in five-year relative survival for female breast cancer patients (0.10%) and lung cancer patients (0.00–0.30%).(70, 71) The authors suggest that sub-population group differences in survival over time may partially be attributable to differential access to improved cancer treatments.(48)

Implications for monitoring

Analysis of trends in inequalities in cancer survival can assist in the evaluation of our success in reducing social inequality and in the development of cancer and broader health policy. Such analyses also provide a planning tool with regard to future development and funding of cancer services, to the extent that past trends can predict future trajectories. Information about international trends in cancer survival can also be incorporated into predictive models to improve the accuracy of forecasts. Such projections, and integration into modelling of the health gains and costs of cancer control interventions, will be forthcoming from the Burden of Disease Epidemiology, Equity and Cost-Effectiveness Programme (University of Otago, Wellington).[4]

Inequalities in cancer are best interpreted with simultaneous consideration of incidence, survival and mortality (for each major cancer, by age, cohort and period) (see, for instance, Ministry of Health 2010).(65) Previous cancer incidence and mortality projection estimates undertaken in New Zealand are also of value in understanding cancer inequalities.(72, 73) The NZCMS provides a means of monitoring inequalities in mortality, as previously reported.(9–11) By linking cancer registrations to Census records (anonymously and probabilistically), the CancerTrends study has already performed this function for incidence.(35) This current report completes the picture by providing trends by ethnicity and socioeconomic group for cancer survival. Greater understanding and more robust measurement of inequalities can help to optimise cancer policy and resource allocation.

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[4] For more information about this programme, see www.otago.ac.nz/wellington/research/bode3/index.html

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Appendices

Appendix 1: Number of patients alive and those who had died at the end of follow-up, by cancer site, ethnic group and income group

Table A1.1: Number of patients alive at the first and fifth intervals, and the number of deaths from any cause, by cancer site, ethnic group and period of cancer diagnosis

Cancer site	Follow-up interval	Ethnic group	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Bladder	1-year	Non-Māori	1680	351	2007	369	1713	300
		Māori	45	9	63	12	63	15
	5-year	Non-Māori	924	828	1203	894	495	660
		Māori	24	21	42	30	18	21
Brain	1-year	Non-Māori	678	480	729	504	633	402
		Māori	36	18	36	18	51	33
	5-year	Non-Māori	99	591	108	627	51	501
		Māori	12	27	12	21	S	45
Breast (female)	1-year	Non-Māori	5910	528	7374	462	6750	303
		Māori	528	45	810	51	531	36
	5-year	Non-Māori	4239	1908	5712	1899	2718	1152
		Māori	372	198	615	231	276	195
Cervix	1-year	Non-Māori	626	82	584	58	368	46
		Māori	164	27	161	27	84	15
	5-year	Non-Māori	413	228	433	168	141	96
		Māori	103	63	108	57	29	27
Colorectum	1-year	Non-Māori	8223	2106	9009	2082	7656	1662
		Māori	237	78	360	90	315	90
	5-year	Non-Māori	4041	4512	4848	4491	2061	3246
		Māori	81	165	171	210	66	159

Cancer site	Follow-up interval	Ethnic group	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Head, neck and larynx	1-year	Non-Māori	1263	273	1326	264	1002	198
		Māori	84	24	108	24	111	21
	5-year	Non-Māori	714	612	732	633	276	381
		Māori	39	51	54	60	33	45
Hodgkin’s lymphoma	1-year	Non-Māori	162	18	186	24	201	27
		Māori	18	S	24	S	24	S
	5-year	Non-Māori	117	42	138	54	78	42
		Māori	15	S	24	S	12	S
Kidney, ureter and urethra	1-year	Non-Māori	837	297	999	315	894	234
		Māori	60	21	69	24	69	24
	5-year	Non-Māori	396	471	519	519	243	366
		Māori	30	36	33	39	12	36
Leukaemia	1-year	Non-Māori	1179	504	1596	507	1638	408
		Māori	102	42	102	30	126	30
	5-year	Non-Māori	408	831	732	918	402	684
		Māori	30	78	48	57	33	54
Liver	1-year	Non-Māori	237	192	300	216	303	204
		Māori	54	42	78	60	75	51
	5-year	Non-Māori	18	219	33	270	24	255
		Māori	S	54	9	72	6	57
Lung, trachea and bronchus	1-year	Non-Māori	4563	3270	4464	3081	3681	2496
		Māori	564	408	729	546	648	459
	5-year	Non-Māori	444	4179	438	4065	180	3207
		Māori	42	531	42	696	18	582

Cancer site	Follow-up interval	Ethnic group	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Melanoma	1-year	Non-Māori	4539	285	5757	294	5505	321
		Māori	69	6	123	S	99	9
	5-year	Non-Māori	3642	1044	4695	1251	2133	942
		Māori	54	15	108	18	33	21
Non-Hodgkin’s lymphoma	1-year	Non-Māori	1425	498	1944	585	1671	405
		Māori	69	21	141	39	108	33
	5-year	Non-Māori	597	891	942	1068	423	705
		Māori	36	36	66	75	30	48
Oesophagus	1-year	Non-Māori	663	468	705	501	630	420
		Māori	42	39	48	42	51	39
	5-year	Non-Māori	57	609	63	645	30	558
		Māori	S	42	S	45	S	48
Ovary	1-year	Non-Māori	837	345	912	285	723	207
		Māori	72	24	102	24	63	21
	5-year	Non-Māori	270	597	378	558	186	396
		Māori	30	45	54	51	21	33
Pancreas	1-year	Non-Māori	864	741	912	759	735	609
		Māori	57	42	90	75	72	63
	5-year	Non-Māori	33	834	45	873	15	693
		Māori	9	48	9	81	S	69
Prostate	1-year	Non-Māori	5817	945	9486	987	7605	501
		Māori	189	42	435	60	429	39
	5-year	Non-Māori	3309	2853	6651	3273	2928	1545
		Māori	90	108	273	186	147	108

Cancer site	Follow-up interval	Ethnic group	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Stomach	1-year	Non-Māori	1089	708	1206	732	909	543
		Māori	135	90	180	123	159	90
	5-year	Non-Māori	171	942	204	1023	105	696
		Māori	24	117	33	150	21	114
Testis	1-year	Non-Māori	279	6	288	6	309	9
		Māori	69	S	99	S	72	6
	5-year	Non-Māori	261	18	273	15	147	15
		Māori	63	6	93	6	33	9
Thyroid gland	1-year	Non-Māori	285	33	480	30	405	30
		Māori	36	S	93	6	69	6
	5-year	Non-Māori	222	63	429	57	159	45
		Māori	33	6	84	9	21	6
Uterus	1-year	Non-Māori	801	138	978	132	852	96
		Māori	75	12	114	18	108	15
	5-year	Non-Māori	525	294	687	318	297	195
		Māori	54	24	75	42	39	30

Patient counts of 5 and below have been suppressed (S) to protect the confidentiality of linked Census–cancer data.

Table A1.2: **Number of patients alive at the first and fifth intervals, and the number of deaths from any cause, by cancer site, income tertile and period of cancer diagnosis**

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Bladder	1-year	High	420	78	480	78	459	60
		Medium	780	159	774	153	582	96
		Low	336	72	549	93	510	102
	5-year	High	249	189	321	186	138	141
		Medium	426	399	447	366	177	204
		Low	195	165	333	240	144	228
Brain	1-year	High	192	141	225	147	219	135
		Medium	234	171	234	174	174	126
		Low	195	132	198	138	171	120
	5-year	High	24	168	33	195	18	180
		Medium	30	207	27	210	12	150
		Low	36	165	30	171	9	150
Breast (female)	1-year	High	1560	114	2142	96	2220	66
		Medium	2313	198	2577	183	2007	87
		Low	1698	168	2199	117	2076	102
	5-year	High	1182	453	1755	450	963	273
		Medium	1629	774	1935	726	786	354
		Low	1203	570	1719	558	807	390
Cervix	1-year	High	127	16	140	19	111	10
		Medium	223	27	210	20	110	15
		Low	288	38	256	24	129	18
	5-year	High	91	39	109	33	48	18
		Medium	144	84	153	60	43	33
		Low	186	108	188	75	42	39

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Colorectum	1-year	High	2133	552	2406	468	2100	378
		Medium	3513	951	3444	825	2394	546
		Low	1938	459	2349	603	2334	516
	5-year	High	1116	1098	1440	1044	603	780
		Medium	1647	2010	1815	1767	627	1038
		Low	969	1056	1164	1254	636	1026
Head, neck and larynx	1-year	High	273	48	285	45	243	42
		Medium	510	105	465	102	282	48
		Low	390	87	426	93	369	72
	5-year	High	162	123	174	123	75	78
		Medium	300	237	249	237	72	99
		Low	204	198	240	195	102	144
Hodgkin’s lymphoma	1-year	High	51	6	63	S	75	9
		Medium	57	12	57	6	57	6
		Low	39	S	54	6	57	9
	5-year	High	36	12	51	15	27	9
		Medium	33	24	48	12	21	15
		Low	33	6	42	15	21	15
Kidney, ureter and urethra	1-year	High	219	90	258	75	264	60
		Medium	360	117	354	117	288	75
		Low	204	63	297	90	270	75
	5-year	High	99	129	141	120	84	93
		Medium	171	198	168	204	75	120
		Low	108	111	165	147	63	120

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Leukaemia	1-year	High	309	123	444	126	456	90
		Medium	522	228	606	192	537	138
		Low	276	123	408	144	501	126
	5-year	High	123	204	231	231	120	162
		Medium	165	381	267	360	132	228
		Low	90	195	177	243	120	222
Liver	1-year	High	63	51	66	45	63	45
		Medium	108	87	117	84	114	78
		Low	75	60	117	87	117	81
	5-year	High	6	57	9	57	S	51
		Medium	6	102	12	105	6	96
		Low	6	69	12	105	9	99
Lung, trachea and bronchus	1-year	High	969	684	897	603	861	552
		Medium	2151	1572	1812	1278	1227	852
		Low	1389	1005	1704	1173	1494	1044
	5-year	High	111	867	96	810	45	729
		Medium	180	2010	150	1680	57	1080
		Low	120	1281	177	1545	69	1326
Melanoma	1-year	High	1413	84	1818	60	2007	75
		Medium	1704	108	1962	102	1611	96
		Low	948	63	1347	75	1254	99
	5-year	High	1176	288	1542	321	807	234
		Medium	1329	426	1578	459	642	303
		Low	762	219	1110	279	456	252

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Non-Hodgkin’s lymphoma	1-year	High	402	144	540	135	504	102
		Medium	567	201	726	234	504	132
		Low	351	108	501	159	498	132
	5-year	High	171	249	306	258	141	189
		Medium	222	369	318	426	132	210
		Low	162	210	237	282	120	228
Oesophagus	1-year	High	150	111	156	102	150	93
		Medium	285	210	288	216	201	129
		Low	189	132	207	150	210	150
	5-year	High	9	144	21	135	9	129
		Medium	21	267	21	270	9	177
		Low	21	168	18	186	6	192
Ovary	1-year	High	243	93	240	66	180	36
		Medium	318	141	336	117	216	60
		Low	234	90	288	81	258	81
	5-year	High	84	168	105	138	45	96
		Medium	96	234	135	213	57	117
		Low	81	162	129	165	69	138
Pancreas	1-year	High	204	156	201	156	192	159
		Medium	384	339	351	294	249	207
		Low	216	189	279	240	252	207
	5-year	High	18	189	18	186	6	183
		Medium	9	378	15	336	S	234
		Low	9	207	12	270	9	237

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Prostate	1-year	High	1779	279	3036	225	2631	105
		Medium	2715	441	3381	399	2460	189
		Low	939	150	2271	273	1950	147
	5-year	High	1077	807	2274	876	1065	336
		Medium	1497	1389	2307	1245	960	582
		Low	516	471	1530	858	717	480
Stomach	1-year	High	267	162	279	147	243	138
		Medium	519	351	507	333	330	201
		Low	282	183	369	231	306	192
	5-year	High	42	225	60	219	39	183
		Medium	69	462	69	450	27	255
		Low	48	243	69	306	24	240
Testis	1-year	High	90	S	105	S	123	S
		Medium	108	S	90	S	99	S
		Low	81	S	120	6	96	6
	5-year	High	84	9	99	6	54	6
		Medium	105	6	87	6	57	6
		Low	75	9	111	9	42	9
Thyroid gland	1-year	High	69	6	147	9	123	6
		Medium	120	15	147	15	132	9
		Low	87	6	150	9	129	12
	5-year	High	54	15	138	15	36	12
		Medium	93	30	126	24	54	18
		Low	72	15	135	18	54	15

Cancer site	Follow-up interval	Income tertile	Calendar period of diagnosis					
			1991–1996		1996–2001		2001–2004	
			Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval	Number alive at the start of interval	Total dead at the end of interval
Uterus	1-year	High	192	33	249	33	225	12
		Medium	321	60	336	48	246	33
		Low	246	39	303	30	312	42
	5-year	High	132	63	189	69	84	36
		Medium	204	126	219	123	84	69
		Low	171	81	219	99	114	72

Patient counts of 5 and below have been suppressed (S) to protect the confidentiality of linked Census–cancer data.

Appendix 2: Age-standardised one-year and five-year RSRs for female breast, colorectal and lung cancer patients diagnosed during 1991–2004

Table A2.1: Number of female breast cancer patients diagnosed during 1991–2004, by age group, ethnic group and calendar period

Age group	Calendar period of diagnosis								
	Patients diagnosed 1991–1996			Patients diagnosed 1996–2001			Patients diagnosed 2001–2004		
	Non-Māori	Māori	Total	Non-Māori	Māori	Total	Non-Māori	Māori	Total
15–54	2064	309	2373	2553	465	3015	2463	405	2868
55–64	1209	132	1341	1689	192	1884	1767	177	1947
65–74	1320	60	1380	1473	111	1584	1215	111	1323
75+	1320	30	1350	1656	42	1701	1311	45	1359
Total	5910	531	6444	7374	810	8184	6753	741	7494

Table A2.2: Number of female breast cancer patients diagnosed during 1991–2004, by age group, income group and calendar period

Age group	Calendar period of diagnosis											
	Patients diagnosed 1991–1996				Patients diagnosed 1996–2001				Patients diagnosed 2001–2004			
	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total
15–54	672	624	633	1929	951	759	795	2502	993	657	714	2367
55–64	315	378	489	1179	528	495	579	1602	660	498	510	1665
65–74	315	660	294	1266	348	525	525	1398	351	420	390	1161
75+	261	651	285	1200	315	798	300	1413	216	435	462	1110
Total	1563	2313	1701	5577	2142	2577	2199	6918	2220	2010	2076	6303

Table A2.3: Age-standardised (Brenner method) one-year and five-year RSRs, and their ethnic and income gaps, for female breast cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.93 (0.93, 0.94)	0.96 (0.95, 0.96)	0.97 (0.97, 0.98)
	Māori	0.92 (0.89, 0.94)	0.94 (0.91, 0.96)	0.97 (0.94, 0.98)
5 years	Non-Māori	0.76 (0.75, 0.77)	0.83 (0.82, 0.84)	0.86 (0.85, 0.88)
	Māori	0.71 (0.66, 0.76)	0.79 (0.75, 0.82)	0.85 (0.80, 0.90)
Ethnic gap	1 year	-0.02	-0.02	-0.01
	5 years	-0.05	-0.04	-0.01
Socioeconomic trends in relative survival				
1 year	High income	0.94 (0.92, 0.95)	0.96 (0.95, 0.97)	0.98 (0.97, 0.98)
	Medium income	0.95 (0.94, 0.96)	0.96 (0.95, 0.97)	0.98 (0.97, 0.98)
	Low income	0.92 (0.90, 0.93)	0.97 (0.95, 0.97)	0.97 (0.96, 0.98)
5 years	High income	0.76 (0.74, 0.79)	0.84 (0.82, 0.86)	0.88 (0.85, 0.90)
	Medium income	0.77 (0.75, 0.79)	0.83 (0.82, 0.85)	0.85 (0.83, 0.88)
	Low income	0.75 (0.72, 0.77)	0.83 (0.81, 0.85)	0.87 (0.85, 0.90)
Income group gap	1 year	-0.02	0.00	0.00
	5 years	-0.02	-0.01	0.00

[1] RSRs calculated using the cohort design, with follow-up to 31 December 2006.

[2] RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

Table A2.4: **Number of colorectal cancer patients diagnosed during 1991–2004, by age group, ethnic group and calendar period**

Age group	Calendar period of diagnosis								
	Patients diagnosed 1991–1996			Patients diagnosed 1996–2001			Patients diagnosed 2001–2004		
	Non-Māori	Māori	Total	Non-Māori	Māori	Total	Non-Māori	Māori	Total
15–54	864	72	936	894	93	984	747	87	834
55–64	1770	81	1851	1788	108	1896	1404	99	1500
65–74	2763	54	2817	3027	111	3138	2349	96	2448
75+	2829	33	2859	3300	54	3354	3156	30	3192
Total	8223	237	8463	9009	360	9372	7659	975	7974

Table A2.5: **Number of colorectal cancer patients diagnosed during 1991–2004, by age group, income group and calendar period**

Age group	Calendar period of diagnosis											
	Patients diagnosed 1991–1996				Patients diagnosed 1996–2001				Patients diagnosed 2001–2004			
	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total
15–54	276	249	258	783	312	258	255	825	294	180	216	690
55–64	498	543	603	1647	621	516	483	1623	528	384	381	1293
65–74	726	1278	594	2598	795	1086	927	2808	678	744	762	2181
75+	636	1443	480	2559	675	1584	681	2943	603	1083	981	2667
Total	2136	3513	1938	7587	2406	3444	2346	8199	2103	2397	2334	6834

Table A2.6: **Age-standardised (Brenner method) one-year and five-year RSRs, and their ethnic and income gaps, for colorectal patients diagnosed during 1991–2004, by ethnic and income group**

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.78 (0.77, 0.78)	0.80 (0.79, 0.81)	0.82 (0.81, 0.83)
	Māori	0.71 (0.64, 0.77)	0.79 (0.74, 0.84)	0.75 (0.70, 0.80)
5 years	Non-Māori	0.56 (0.55, 0.57)	0.62 (0.61, 0.63)	0.64 (0.62, 0.65)
	Māori	0.45 (0.37, 0.53)	0.56 (0.49, 0.63)	0.56 (0.47, 0.65)
Ethnic gap	1 year	-0.07	-0.01	-0.06
	5 years	-0.11	-0.06	-0.08
Socioeconomic trends in relative survival				
1 year	High income	0.76 (0.74, 0.78)	0.82 (0.80, 0.84)	0.84 (0.82, 0.85)
	Medium income	0.77 (0.75, 0.78)	0.81 (0.79, 0.82)	0.81 (0.79, 0.83)
	Low income	0.79 (0.77, 0.81)	0.78 (0.76, 0.80)	0.82 (0.80, 0.84)
5 years	High income	0.57 (0.55, 0.60)	0.65 (0.63, 0.68)	0.66 (0.63, 0.69)
	Medium income	0.56 (0.53, 0.58)	0.63 (0.61, 0.65)	0.64 (0.61, 0.67)
	Low income	0.56 (0.53, 0.59)	0.59 (0.56, 0.61)	0.65 (0.62, 0.68)
Income group gap	1 year	0.03	-0.05	-0.02
	5 years	-0.02	-0.07	-0.01

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.

Table A2.7: **Number of lung cancer patients diagnosed during 1991–2004, by age group, ethnic group and calendar period**

Age group	Calendar period of diagnosis								
	Patients diagnosed 1991–1996			Patients diagnosed 1996–2001			Patients diagnosed 2001–2004		
	Non-Māori	Māori	Total	Non-Māori	Māori	Total	Non-Māori	Māori	Total
15–54	363	126	489	405	162	570	333	138	468
55–64	906	216	1122	789	252	1041	753	219	969
65–74	1878	168	2046	1707	234	1941	1215	219	1434
75+	1416	54	1470	1560	84	1647	1383	72	1458
Total	4560	564	5127	4467	732	5196	3684	648	4332

Table A2.8: **Number of lung cancer patients diagnosed during 1991–2004, by age group, income group and calendar period**

Age group	Calendar period of diagnosis											
	Patients diagnosed 1991–1996				Patients diagnosed 1996–2001				Patients diagnosed 2001–2004			
	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total	High income	Medium income	Low income	Total
15–54	93	126	159	378	102	141	198	441	117	99	144	363
55–64	195	306	474	975	204	285	372	858	228	225	327	777
65–74	387	945	498	1827	309	654	723	1686	273	402	516	1191
75+	294	777	258	1329	285	732	411	1431	240	501	510	1254
Total	966	2151	1386	4506	897	1812	1704	4416	861	1230	1494	3585

Table A2.9: Age-standardised (Brenner method) one-year and five-year RSRs, and their ethnic and income gaps, for lung cancer patients diagnosed during 1991–2004, by ethnic and income group

Survival time since cancer diagnosis	Exposure category	Calendar period of diagnosis		
		Patients diagnosed 1991–1996[1]	Patients diagnosed 1996–2001[1]	Patients diagnosed 2001–2004[2]
Ethnic trends in relative survival				
1 year	Non-Māori	0.29 (0.28, 0.31)	0.33 (0.31, 0.34)	0.34 (0.32, 0.35)
	Māori	0.27 (0.24, 0.41)	0.25 (0.22, 0.29)	0.28 (0.24, 0.31)
5 years	Non-Māori	0.10 (0.09, 0.11)	0.11 (0.10, 0.12)	0.12 (0.11, 0.14)
	Māori	0.06 (0.04, 0.08)	0.06 (0.04, 0.08)	0.08 (0.06, 0.11)
Ethnic gap	1 year	-0.02	-0.07	-0.06
	5 years	-0.05	-0.05	-0.04
Socioeconomic trends in relative survival				
1 year	High income	0.30 (0.27, 0.33)	0.34 (0.31, 0.37)	0.36 (0.33, 0.40)
	Medium income	0.29, (0.27, 0.31)	0.31 (0.29, 0.34)	0.33 (0.30, 0.35)
	Low income	0.28 (0.26, 0.30)	0.32 (0.30, 0.35)	0.31 (0.29, 0.34)
5 years	High income	0.12 (0.10, 0.14)	0.11 (0.09, 0.14)	0.13 (0.10, 0.16)
	Medium income	0.09 (0.08, 0.10)	0.09 (0.08, 0.11)	0.13 (0.11, 0.15)
	Low income	0.08 (0.07, 0.10)	0.11 (0.09, 0.13)	0.11 (0.09, 0.13)
Income group gap	1 year	-0.02	-0.02	-0.05
	5 years	-0.04	0.00	-0.02

1 RSRs calculated using the cohort design, with follow-up to 31 December 2006.

2 RSRs calculated using the hybrid design, with follow-up to 31 December 2006.