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ORIGINAL ARTICLE

Comparison of cancer survival in New Zealand and Australia, 2006–2010

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Abstract

Background and aims Previous studies have shown substantially higher mortality rates from cancer in New Zealand compared to Australia, but these studies have not included data on patient survival. This study compares the survival of cancer patients diagnosed in 2006–10 in the whole populations of New Zealand and Australia.

Method Identical period survival methods were used to calculate relative survival ratios for all cancers combined, and for 18 cancers each accounting for more than 50 deaths per year in New Zealand, from 1 to 10 years from diagnosis.

Results Cancer survival was lower in New Zealand, with 5-year relative survival being 4.2% lower in women, and 3.8% lower in men for all cancers combined. Of 18 cancers, 14 showed lower survival in New Zealand; the exceptions, with similar survival in each country, being melanoma, myeloma, mesothelioma, and cervical cancer. For most cancers, the differences in survival were maximum at 1 year after diagnosis, becoming smaller later; however, for breast cancer, the survival difference increased with time after diagnosis.

Conclusion The lower survival in New Zealand, and the higher mortality rates shown earlier, suggest that further improvements in recognition, diagnosis, and treatment of cancer in New Zealand should be possible. As the survival differences are seen soon after diagnosis, issues of early management in primary care and time intervals to diagnosis and treatment may be particularly important.

Cancer survival, the survival of cancer patients from the time of diagnosis, is the key indicator used to assess the effectiveness of cancer care in diagnosis and treatment. In principle, if equivalent cancer care at an equivalent time is provided for patients with the same cancer and the same background health status, the outcomes for cancer patients should be similar regardless of variations in geography, ethnicity, or socioeconomic position. Thus differences in cancer survival may reflect possible deficiencies in cancer care and indicate the potential for improvement in cancer care services.[1–3]

Differences in cancer survival are substantial, between and within countries. It has been estimated that 6.5% of cancer deaths in Britain could have been avoided annually if Britain's cancer survival had been equal to the mean European level during 1995–99.[4] A study of Nordic countries estimated that 2.5% of deaths from 12 cancer sites between 2008 and 2012 could be saved by eliminating the regional variations.[5] Variation in 3-year survival between deprived and affluent groups accounted for 11% of cancer deaths in England during 2004–06.[6] These findings signal that discrepancies in cancer survival should be investigated.

Comparisons of cancer survival to investigate international differences have been conducted in Europe, e.g. by the EUROCARE studies [1], and extended globally, e.g. the CONCORD studies [2]. The published CONCORD studies have involved Australia, but not New Zealand, although New Zealand is involved in the current studies. Internal comparisons of cancer survival have been reported addressing variations with regard to ethnicity, geography, and socioeconomic position in both New Zealand[7–11] and Australia.[12–14] New Zealand and Australia have taken part in recent OECD health policy studies based on exploratory survival analysis of four selected cancers (breast, cervix, colorectum, and lung) among OECD countries [15].

New Zealand and Australia have similar data systems and health care systems, and their training programmes for health professionals are similar and often integrated. Despite that, New Zealand had a higher cancer mortality rate than Australia in 1996-97, and the mortality to incidence ratios for New Zealand were higher for many cancer sites.[16] A more recent study of 2000–07 data found a persisting discrepancy, despite reductions in overall cancer death rates in a both countries; overall cancer mortality was 15.1% higher in women, and 4.7% higher in men, in New Zealand compared with Australia [17]. These studies had no survival data. For this analysis, we explored the differences in cancer survival between the two countries using whole-population survival data for 2006–10.

Methods

Survival data for Australia were from the Australian Institute for Health and Welfare (AIHW).[14] These data relate to all new primary cancers, excluding basal cell and squamous cell carcinoma of the skin, diagnosed in Australia and recorded by state and territory cancer registries, with standardised coding practices to minimise errors and duplications [14]. New Zealand data were from the New Zealand Cancer Registry (NZCR), with similar coverage and quality controls [18], and required specific analyses to produce data for the same time periods given in the Australian data.

For both countries, relative survival ratios (RSRs) yearly from 1 to 10-year time points with corresponding 95% confidence intervals (95%CIs), for the whole population in each country, were extracted by type of cancer and sex for patients registered (diagnosed) in 2006-10, using a period approach.[19;20] The expected survivals by year, age, and sex for the whole population of each country were derived by the Ederer II method, used in recent US studies [21]. Cancer sites were coded using ICD-10 for site[22] and ICD-O for morphology [23] in both countries; comparisons were made for 24 sites in men and 26 cancer sites in women, although only sites accounting for more than 50 deaths per year in New Zealand are presented here.

The main comparisons shown are for three time points; 1, 5, and 10 years. Conditional survival ratios from 1 to 5 years, and from 5 to 10 years, were also calculated, but not shown. The differences of RSRs between the two countries were calculated for each site of cancer, for men and women separately, and the statistical significance of the difference determined by a z test. The age distributions were compared between the two countries, by 5 year age group in each sex, for all cancers and for the most common cancers, and found to be virtually identical; thus, age adjustment was not used in the survival analyses.

The numbers of 'potentially avoidable' deaths were estimated, using the terminology and method defined in other studies [4], for total cancer at all ages. Here it is the difference in numbers of deaths from cancer that occur within 5 years of diagnosis in New Zealand, and the (lower) numbers that would occur if the survival rates had been equal to the Australian rates. To make this estimate, the expected non-cancer mortality was assessed from New Zealand life tables applied to the 5-year age distributions of cancer patients by sex, and the observed relative survival ratios in each country used.

Results

Survival for all cancers combined shows that in both men and women, survival ratios up to 10 years from diagnosis were higher in Australia (Figure 1), with 5 year relative survival ratios in males of 65% in Australia and 61% in New Zealand; and in females 67% in Australia and 63% in New Zealand (both comparisons $p<.01$). [Relative survival represents cancer survival in the absence of other causes of death; the relative survival ratio is the observed survival of a group of cancer patients at a given time from diagnosis, divided by the expected survival of a sex- age- and time- matched group from the general population; thus adjusting for the expected mortality without cancer].

Figure 1 shows that the differences in survival occur early; at 1 year from diagnosis there is a significantly higher survival in Australia, and that difference is little changed in later years, showing that survival ratios after the first year are similar in the two countries.

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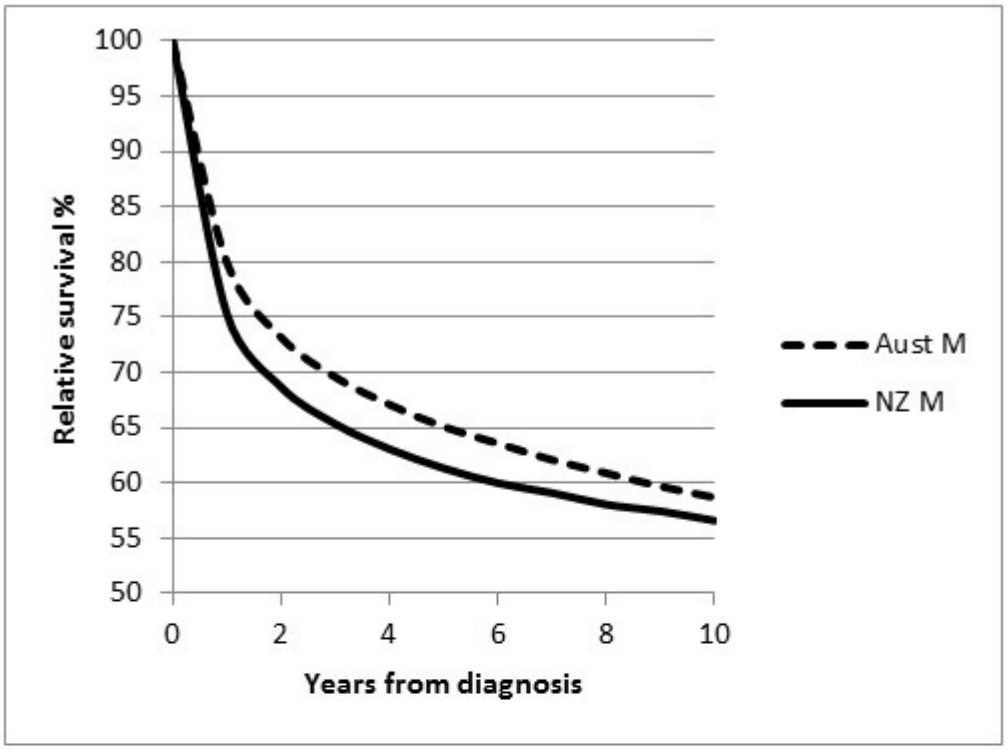
Figure 1: Survival (relative survival ratios) for all cancer combined, in males and females, in New Zealand and in Australia, patients diagnosed in 2006-2010



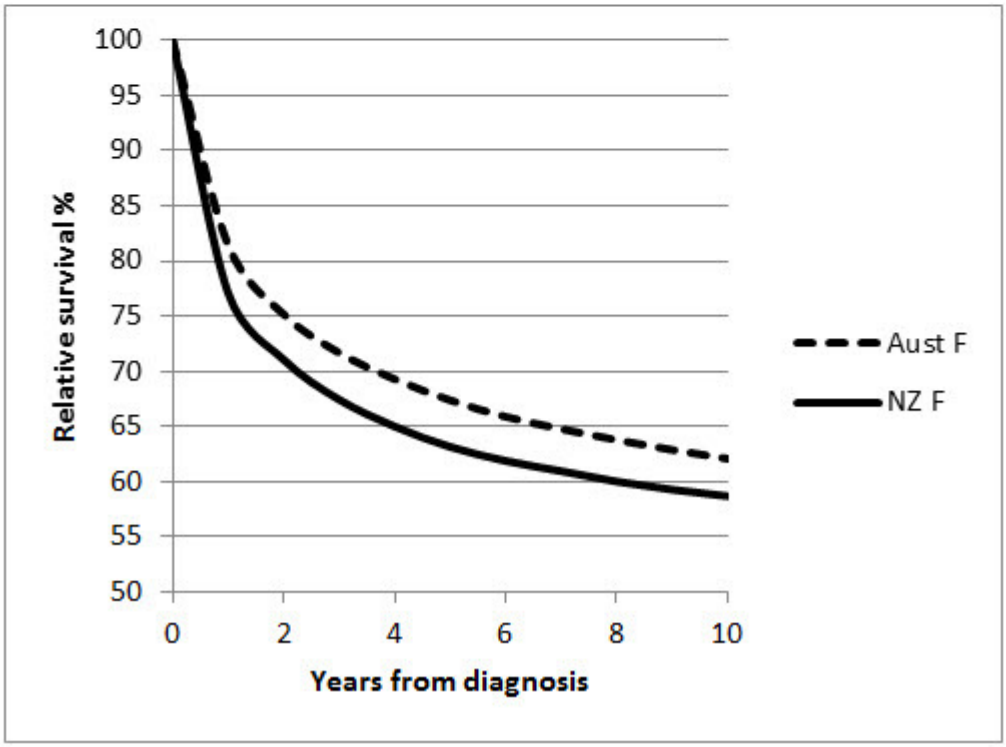


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Table 1: Cancer relative survival ratios in New Zealand, by time from diagnosis, and differences from Australia

Cancers in order by related annual numbers of deaths

Sex	cancer site	NZ deaths annual (2008)	New Zealand relative survival rates						Difference from Australia rates (bold/ul if significant)			Pattern
			1 yr	5 yr		*5 yr 95% limits*		10 yr	1 yr	5 yr	10 yr	
female	all cancers	4005	77.2	63.2	(	*62.7*	*63.7*	) 58.7	-4.4	-4.2	-3.4	Max diff yr 1, reduces but still sig
male	all cancers	4561	75.4	61.3	(	*60.8*	*61.9*	) 57.0	-4.6	-3.8	-2.0	Max diff yr 1, reduces but still sig
female	lung	745	32.1	10.6	(	*9.6*	*11.6*	) 8.3	-10.4	-6.0	-4.0	Max diff yr 1, reduces but still sig
male	lung	889	25.8	8.5	(	*7.7*	*9.4*	) 7.0	-10.2	-4.1	-2.0	Max diff yr 1, reduces but still sig
female	colorectal	580	78.2	62.2	(	*60.7*	*63.7*	) 58.6	-6.1	-4.9	-3.7	Max diff yr 1, reduces but still sig
male	colorectal	684	79.7	60.4	(	*58.9*	*61.8*	) 55.0	-5.8	-5.0	-4.0	Max diff yr 1, reduces but still sig
female	pancreas	197	12.6	4.3	(	*3.2*	*5.6*	) 4.2	-7.9	-1.3	0.0	Max diff yr 1, later ns
male	pancreas	176	14.1	4.7	(	*3.5*	*6.1*	) 5.0	-8.7	-0.2	0.9	Max diff yr 1, later ns
female	melanoma	115	98.4	93.8	(	*92.6*	*94.9*	) 92.9	-0.1	-0.2	-1.5	No sign diffs
male	melanoma	202	96.3	88.2	(	*86.8*	*89.5*	) 85.0	-0.1	-0.4	-0.1	No sign diffs
female	stomach	110	41.0	22.8	(	*19.4*	*26.4*	) 21.3	-9.1	-3.6	-2.5	Max diff yr 1, later ns
male	stomach	173	43.7	24.2	(	*21.5*	*27.0*	) 23.0	-7.5	-2.7	0.0	Max diff yr 1, later ns
female	NHL	134	75.7	64.0	(	*61.2*	*66.8*	) 54.8	-7.1	-7.3	-8.4	Diff constant or increase
male	NHL	160	79.6	65.2	(	*62.6*	*67.8*	) 57.0	-4.1	-4.8	-4.0	Diff constant or increase
female	brain	98	41.8	23.1	(	*19.6*	*26.7*	) 18.2	-5.0	-0.8	-1.7	Max diff yr 1, later ns

male	brain	109	41.6	18.5	(	*15.7*	-	*21.5*	)	15.0	-5.4	-1.9	-1.0	Max diff yr 1, later ns
female	oesophagus	75	36.9	11.0	(	*8.0*	-	*14.5*	)	7.4	-6.9	-6.0	-5.7	Max diff yr 1, reduces but still sig
male	oesophagus	154	35.5	10.3	(	*8.2*	-	*12.7*	)	9.0	-8.1	-5.2	-3.0	Max diff yr 1, reduces but still sig
female	bladder	66	61.0	45.7	(	*40.7*	-	*50.8*	)	44.5	-8.9	-3.9	0.7	Max diff yr 1, later ns
male	bladder	134	72.5	53.1	(	*49.9*	-	*56.3*	)	49.0	-9.2	-6.9	-3.0	Max diff yr 1, later ns
female	liver	66	22.4	13.1	(	*9.9*	-	*16.8*	)	8.7	-14.7	-2.3	-3.6	Max diff yr 1, later ns
male	liver	124	31.0	12.9	(	*10.5*	-	*15.6*	)	12.0	-7.1	-2.6	1.0	Max diff yr 1, later ns
female	kidney	67	78.6	67.4	(	*63.3*	-	*71.3*	)	64.2	-5.3	-5.1	-2.6	Max diff yr 1, later ns
male	kidney	98	78.7	62.2	(	*59.0*	-	*65.3*	)	55.0	-5.9	-9.4	-9.2	Diff constant or increase
female	myeloma	68	75.9	39.0	(	*34.4*	-	*43.7*	)	24.6	-1.7	-3.8	0.2	No sign diffs
male	myeloma	96	76.1	43.5	(	*39.2*	-	*47.8*	)	26.0	-2.8	-0.4	2.0	No sign diffs
male	prostate	670	96.5	90.3	(	*89.5*	-	*91.2*	)	85.0	-1.3	-1.7	0.0	Max diff yr 1, later ns
male	mesothelioma	65	40.1	3.4	(	*1.7*	-	*5.9*	)	3.0	-3.5	-2.0	1.0	No sign diffs
female	breast	618	97.2	86.6	(	*85.9*	-	*87.4*	)	79.7	-0.7	-2.8	-3.5	Diff constant or increase
female	ovary	184	64.9	35.9	(	*33.2*	-	*38.5*	)	31.0	-11.6	-7.5	-3.0	Max diff yr 1, reduces but still sig
female	uterus	82	90.2	77.5	(	*75.2*	-	*79.7*	)	75.5	-2.6	-4.5	-3.0	Max diff yr 1, later ns
female	cervix	59	86.3	71.0	(	*67.5*	-	*74.3*	)	67.9	-0.3	-1.1	-0.7	No sign diffs

Explanations of descriptions:

Max diff yr 1, reduces but still sig	Maximum NZ-Australia difference at year 1, reduces at year 5 or 10, but remains significant
Max diff yr 1, later ns	Maximum NZ-Australia difference at year 1, reduces at year 5 or 10, becomes non-significant
Diff constant or	Difference ay year 1 remains similar or increased at year 5 or 10

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increase
No sign diffs
NHL = non-Hodgkin lymphoma

No differences at years 1, 5, or 10 are significant

Compared to Australia, cancer survival at 1 year is lower in New Zealand by 4.4 % in females and by 4.6% in males; these differences persist, with some reduction, at 5 and 10 years from diagnosis (Table 1).

The conditional survivals after 1 year (that is, the survival over further time of those who have survived 1 year) were very similar: of those surviving 1 year, 76% of females survived to 10 years in both countries; in males, 74% in Australia, 76% in New Zealand.

Results for major cancers, those accounting for 50 or more deaths per year in New Zealand, are shown in Table 1. The 1, 5, and 10 years' survival in New Zealand are shown, with the confidence limits at 5 years (the width of the limits is similar at other time points), and the differences from Australia, in absolute terms.

Most cancers show the pattern seen with all cancers combined: that is, survival in New Zealand is significantly ($P<0.01$) lower than in Australia at 1 year, and the difference persists at 5 and 10 years, with a similar or smaller difference in absolute terms. For lung, colorectal, and oesophageal cancer, in both sexes, and for ovary, the differences remain significant. For many other sites, the same pattern is seen, but the differences become non-significant at 5 or 10 years. This of course is partially due to the numbers of observations reducing. This pattern is shown by stomach, brain, pancreas, liver, and bladder cancer, in both females and males; and in prostate, and uterus (endometrial) cancer. The differences in survival at 5 years are up to 7 percent.

A few cancers show no inter-country differences, with similar survival ratios at all time-points: melanoma and myeloma in both sexes, cervical cancer, and mesothelioma in men (where there were too few cases to assess in women).

Breast cancer is unusual, as the lower survival in New Zealand increases over time; 1 yr. survival is 97.2% in NZ and 97.9% in Australia, but 10 yr. survival is 79.7 and 83.2% respectively. For non-Hodgkin lymphoma in both sexes, the survival difference remains similar from 1 to 10 years. Kidney cancer is the only site showing different patterns in the two sexes: in males the survival difference increases by time of follow up, while in females the difference decreases.

So while survival from melanoma, myeloma, mesothelioma in men, and from cervical cancer is similar in the two countries, for every other major cancer survival in New Zealand is lower, especially in the first year.

Discussion

In this study, we found that the survival from all cancers combined in New Zealand (NZ) was significantly lower than in Australia, for both men and women, at 1 year and up to 10 years after diagnosis, for patients diagnosed in 2006-2010. The 5-year relative survival ratios in NZ were 3.8% lower (61.3% vs 65.1%) for men, and 4.2% lower (63.2% vs 67.4%) for women, than in Australia. These numbers may appear small; however, this difference in survival represents a substantial number of deaths.

In New Zealand, the difference for all cancer combined equates approximately to 341 deaths annually in men in New Zealand, and 364 deaths in women, calculated as deaths from cancer in 5 years from diagnosis, taking into account background mortality from other causes [4]. This represents 11.7% of cancer deaths within 5 years of diagnosis in men, and 12.1 % in women. These estimates are approximate and may be conservative; a fuller assessment would use ethnic- and age-specific comparisons. However, these estimated proportions are considerably greater than those estimated for Britain in 1985-89, using the average European relative survival ratio as the comparator, 6–7% [4]: a result which was a trigger for major cancer health systems reform in England.[24;25]

The generally lower survival shown in New Zealand raises the question of differences in how the data has been collected, coded, or analysed. While a full audit would be needed to rule this out, the systems of cancer registration, death coding, and linkage of cancer registry and mortality data are the

same in the two countries, as far as we can determine; and the methods of survival analysis used are the same. Relative survival ratios are based on deaths from all causes in cancer patients, and deaths expected in that year-age-sex group in the whole population, so do not depend on the cause of death recorded in the death certificates.

The same issues of data quality have been extensively studied in European and world-wide comparisons of similar data systems [1;2;26;27]. In our study, comparing the whole populations of each country, the age distributions of patients for all cancer combined and for major cancer sites (lung, colorectal, prostate, breast, melanoma) between NZ and Australia were found to be virtually identical; thus, the survival differences were not due to different age distributions.

In international comparisons, Australia shows very good overall cancer survival outcomes, similar to those from Canada and Sweden, and better than those in the UK or Denmark.[2;28] Cancer survival has improved substantially in both Australia and New Zealand over recent years.[14;29]

The lower survival in New Zealand than in Australia is seen for most cancers, including the leading causes of death of lung and colorectal cancer, and for 14 of the other 18 cancers accounting for over 50 deaths per year in New Zealand (Table 1). This suggests a health system issue, rather than a biological or treatment issue specific to certain types of cancer.

It is easy to say that the NZ deficit in survival means that NZ cancer care could be improved to match the Australian processes and outcomes, and we could regard the differences in cancer survival as representing 'avoidable deaths' in New Zealand. This terminology has been used in arguing for improvements in the cancer care in the UK [4;30]. However, specifying the changes needed in New Zealand, and prioritising these with regard to costs and effectiveness, is more challenging. However, the demonstration of these substantial and general survival deficits compared to a neighbouring country should stimulate both local and national, clinical and health management, attention and actions.

This study on cancer survival comparisons complements the previous studies on cancer mortality comparing the two countries. In a similar period 2000–2007, NZ had substantially higher overall cancer mortality than Australia, an average of 5% more deaths in NZ men and 15% in NZ women each year; while overall cancer incidence for NZ men was 5% less than that for Australia, and incidence for NZ women was only slightly higher (3%) for Australian women.[17] Thus, the differences were mainly found to be in mortality, implying differences in survival. These differences were only slightly reduced compared to an earlier period, 1996-97.[16]

The modest differences in incidence imply that the two countries were not greatly different in cancer primary prevention. However, the lower survival in NZ found in the current study, supported by the differences in cancer mortality, implies that NZ is lagging behind in diagnosis and treatment. While the current survival study and the previous mortality studies all show less good outcomes in New Zealand, a difference is that the current study gives similar results for males and females, whereas the mortality studies showed greater differences in females. The recent mortality study related to cancer deaths in 2000–-2007, and therefore to cancers diagnosed in earlier years. The current study relates to cancers diagnosed in 2006-2010, so is more recent; the similarity between male and female results may better reflect the present situation.

The pattern of the survival differences seen for most cancers, being apparent in the first year from diagnosis and continuing at 5 and 10 years without much change, strongly suggests the reasons relate to diagnosis and initial presentation, relating in turn to awareness of symptoms, time intervals to referral, investigation, and diagnosis. These aspects will affect when the cancer is diagnosed in its biological progression, determining its stage distribution.

This pattern of survival differences has also been seen in European and world-wide comparisons.[1,2] As a response, efforts to improve the early management of patients in primary care and through referral processes have been made. These include studies of cancer presentation in primary care ,[31-33]

studies of the diagnostic time intervals [34] ('delays', although that word can be pejorative and maybe should be avoided), and studies of health system issues related to these. [35] A major international focus is through the International Cancer Benchmarking Project (ICBP), which is conducting studies in primary and secondary care to clarify reasons for international variations in cancer survival. [28;36;37].New Zealand is involved in one part of that work; we are conducting a study of primary care in relation to cancer diagnosis.[37]

Assessments in the UK have concluded that more premature cancer deaths can be avoided from small gains in survival for common cancers rather than large gains for uncommon cancers [30]. Other factors such as comorbidity are also relevant; comorbidity in common in cancer patients, and in New Zealand it contributes to ethnic differences in outcomes and to variations in treatment choices [38-40].

With regard to specific cancers, colorectal cancer showed the highest excess deaths in NZ compared to Australia in mortality studies,[17] and in this study, 5-year relative survival was 5% lower in NZ for both males and females. A Bowel Cancer Programme was set up by the NZ Ministry of Health in 2009 aiming at health service improvement in diagnosis, surveillance and treatment, and a pilot bowel cancer screening programme started in 2011.[41]

In Australia, bowel cancer screening has been available since 2006 [42] and it was stated in a 2010 report that 1,056 people had been detected with bowel cancer or suspected cancer through screening.[43] In New Zealand, the PIPER project (Presentation, Investigation, Pathways, Evaluation, Rx (treatment)) is a comprehensive management and outcome study of some 6000 colorectal cancer patients, which will indicate priorities for improvement .[44]

Lung cancer has low survival in both countries, but NZ is still at a disadvantage, lagging in 5-year survival ratios by 4% in males, and 6% in females. Prevention has been successful, with a reduction in NZ smoking rates by half;[45] however, the higher mortality and lower survival in NZ show potential for improvements in diagnosis and effective treatment. Lung cancer shows large differences between Maori and non-Maori in New Zealand[46;47] and was the subject of the first New Zealand service standards report.[45]

Prostate cancer had high survival ratios in both countries, but 1- and 5-year survival ratios were slightly lower in New Zealand. Prostate cancer survival can be considerably affected by overdiagnosis, related mainly to PSA screening, and incidence trends have shown divergence, with increases in Australia but decreases in New Zealand over the 2000-07 period;[17] so these differences are difficult to interpret.

For breast cancer, unlike bowel and lung cancers, survival difference increased with time, being 1%, 3%, and 4% lower in NZ at 1,5, and 10 years, respectively. This suggests that early diagnosis, including successful mammographic screening, may be comparable in the two countries but there may be differences in further treatment. Reductions in breast cancer mortality in Australia have been shown to be linked with the increased use of adjuvant hormonal and chemo-therapy [48].

Studies in NZ show that there are internal ethnic disparities, particularly for Maori, who are significantly more likely to have adverse survival in major cancer sites than other New Zealanders due to residing in deprived areas, late stage at presentation, longer waiting time from diagnosis to initial treatment, and lower curative treatment rates.[7;8;10;47;49]

A major analysis of survival trends from 1991-2004 in New Zealand showed lower survival in Maori and in low income groups, with little change in the ethnic differences over time, and some evidence of widening of the income-based differences [7]. Pacific peoples also show more disadvantage in many cancers.[50]

Clearly, improving NZ cancer care for early diagnosis and treatment of disadvantaged groups is a high priority. In this study we have compared the whole of each country. Australia also has the challenges of providing good care to disadvantaged groups, including its indigenous people and ethnic minorities, and has socioeconomic inequities and even greater geographic disparities than New

Zealand; cancer survival is similarly lower in indigenous peoples, and varies by geographic and socioeconomic factors;[12;51–53] although the indigenous population forms a much smaller proportion of the total than in New Zealand.

Australia has conducted many state based and several national audit studies of cancer management on population-based groups of patients, which have allowed comparisons of actual management with evidence-based guidelines, and may have stimulated improvements.[54] There have been few similar comprehensive studies of cancer management in NZ until recently; but the PIPER study noted above is more comprehensive than most Australian management studies.

Recent studies have found that economic factors such as total national expenditure on health, and number of CT scanners per million population, are significant predictors of survival outcomes when comparing countries. Setting targets and timeframes, monitoring, case management, and establishing cancer networks may all improve cancer outcomes.[15;55] Insightful studies on health system issues could also be beneficial for the development of further policies to strengthen NZ cancer care.

In conclusion, the survival differences found in this study are likely due to differences in diagnosis and treatment services. As significant differences were mainly found in initial years after diagnosis for most cancers, attention needs to be given particularly to aspects of early diagnosis.

Competing interests: Nil.

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