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Trends in ethnic and socioeconomic inequalities in cancer survival, New Zealand, 1991–2004

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ABSTRACT

Improvements in cancer survival may be distributed inequitably throughout populations and across time. We assessed trends in cancer survival inequalities in New Zealand by ethnic and income group. 126,477 people diagnosed with cancer between 1991 and 2004, followed-up to 2006, were included. First, inequalities pooled over time were measured with excess mortality rate ratios (EMRRs). Second, interpretation of changes in inequalities over time can differ depending on whether one uses EMRRs, excess mortality rate differences (EMRD) or absolute differences in relative survival risks (RSRD); we estimated all three by cancer-site and (for EMRRs only) pooled across all sites. We found that pooled over time and all sites, Māori had an EMRR of 1.29 (95% CI, 1.24–1.34) compared to non-Māori. The low compared to high-income EMRR was 1.12 (95% CI, 1.09–1.15). Pooled over cancers, there was no change in the ethnic EMRR over time but the income EMRR increased by 9% per decade (1–17%). Changes over time in site-specific inequalities were imprecisely measured, but the direction of change was usually consistent across EMRRs, EMRDs and RSRDs. There were persistent ethnic inequalities in cancer survival over time, and slower improvements for low-income people.

1. Introduction

Measuring the size of inequalities in cancer survival (deaths from any cause in the cancer population), understanding the factors associated with those inequalities, and whether those inequalities are changing over time are of increasing interest internationally [1–8]. However, there are few contemporary reports where ethnic and socioeconomic inequalities in adult cancer survival have been simultaneously investigated. We have used a retrospective cohort study design to explore the magnitude of ethnic and socioeconomic inequalities in adult cancer in New Zealand during 1991–2004 and whether those inequalities are narrowing or widening over time. We have principally focused on the relative difference in excess mortality rates up to 5-years post diagnosis, namely the excess mortality rate ratio (EMRR), where the estimate is adjusted for heterogeneity across 21 cancer sites.

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2. Materials and methods

2.1. Study population

We used linked records from the New Zealand census of population and dwellings in 1991, 1996 and 2001 (the Census) to New Zealand Cancer Registry (NZCR) data, and the routine national mortality dataset followed-up to 2006. Adults who had one of 21 primary cancers, registered in the NZCR between 6 March 1991 and 31 December 2004 were included in the study; a total of 126,477 people (Supplementary Table 1). Individuals were able to nominate more than one ethnic group on the census form. Individuals were included in the Māori ethnic group if any of these was Māori, otherwise they were included as non-Māori. Equivalised household income was the socioeconomic factor analysed in this paper, and was calculated by summing personal income for all adults in the household, adjusted for inflation using the New Zealand Consumer Price Index (base year 2001), and equivalised for economies of scale by the number of adults and children in the household using a New Zealand-specific index. Household income was missing if either any usually resident adult was absent on census night, or any adult refused to provide their personal income. For these reasons, household income data was often missing, between 11% and 15%, with potential selection bias assessed. We

Table 1
Excess mortality rate ratios (EMRRs) five-years post diagnosis pooled across 21 cancer sites representing (a) the relative difference in ethnic inequalities in cancer survival, New Zealand, during 1991–2004 and (b) the relative per-decade change in those ethnic inequalities in cancer survival.

(a) Ethnic inequalities, averaged over time during 1991–2004, for adult cancer survival 5-years post diagnosis pooled across 21 cancer sites		(b) Relative per-decade change in ethnic inequalities in adult cancer survival 5-years post diagnosis pooled across 21 cancer sites	
Excess mortality rate ratio (EMRR)	95% confidence interval	Excess mortality rate ratio (EMRR)	95% confidence interval
1.29	(1.24, 1.34)	1.04	(0.94, 1.14)

used multi-dimensional sensitivity analyses for the income-cancer survival associations in breast, colorectal and lung cancers. For plausible scenarios, selection bias appeared unlikely. Estimates of the expected number of other deaths were drawn from combined ethnic- and income-specific life tables for 1991, 1996 and 2001 [9]. These life tables included mortality rate data by single year of age, sex, and calendar period for each ethnic, income and combined ethnic and income group to provide expected (i.e. without cancer) survival probabilities.

2.2. Statistical analyses

Four sets of excess mortality rate models [10] were used to determine ethnic and socioeconomic trends in cancer survival. We adjusted for different sets of covariates with the first two models constructed to assess ethnic trends in cancer survival and the last two models to assess socioeconomic trends in cancer survival. The baseline model (model 1) included sex, ethnicity, calendar period, age group, follow-up time since cancer diagnosis, and interaction between age group and follow up time (65–74 and 75+ year age groups with first and second year of follow up only, otherwise age and follow up treated as separate main effects). Model 2 also included an interaction of ethnicity and calendar period (unit of decade) to 'test' for any change in relative ethnic inequalities in excess mortality rates over time. Model 3 included the baseline variables from model 1 and income group, specified such that the regression coefficient for income is for the difference between the lowest and highest income quintile, but incorporating the gradated difference in survival across the whole income range. Model 4 additionally included an interaction of income and calendar period as a test of changing relative inequalities in excess mortality rates over time. Note that ethnicity was included in the models investigating the impact of income on cancer survival because it is a common cause of income and cancer survival (i.e. it confounds the income-survival association), but conversely income was not included in the first two ethnic models as income may mediate the ethnicity-survival association. Each of the four models was run using the combined ethnic- and income-specific life-tables described above.

These models were run separately for each of the 21 cancer sites. Estimates for each of the cancer-specific models were too imprecise for any meaningful interpretation. However for completeness, we have provided these in separate web tables and figures available at www.otago.ac.nz/wellington/departments/publichealth/research/hirp/otago019985.html. These web tables and figures are referenced in the results section.

We calculated an EMRR pooled across all cancer sites and years using inverse variance weighting, i.e. we adjusted for the heterogeneity across cancer sites. To capture changes on both the relative and absolute scales for individual cancer sites [11,12], we estimated absolute differences in both excess mortality and relative survival. Briefly, we estimated the per-decade change in absolute terms for changes over time in ethnic and socioeconomic inequalities on the relative survival and excess mortality rate scales. Methodological details are provided in the supplementary data file. Results are contained in the web tables and figures described above.

3. Results

3.1. Ethnic and socioeconomic cancer survival inequalities, averaged over time

There was evidence of relative ethnic and, to a lesser extent, socioeconomic inequalities in cancer excess mortality rates. Pooled across all cancers, the EMRR comparing Māori to non-Māori was 1.29 (95% CI, 1.24–1.34), a 29% higher excess cancer mortality on average for Māori (Table 1). Pooled across all cancers, the EMRR comparing the lowest income quintile to the highest income quintile group was 1.12 (95% CI, 1.09, 1.15), a 12% greater excess mortality on average for low-income people (Table 2). For each individual cancer site, there was substantial variation in the size and direction of ethnic and socioeconomic inequalities in cancer survival (Web Fig. 1).

3.2. Relative per-decade changes over time in ethnic and socioeconomic cancer survival inequalities

There was no convincing evidence of either widening or narrowing gaps of ethnic cancer survival inequalities over time on a relative scale. The ratio change in the ethnic EMRR was estimated at 1.04 (95% CI, 0.94, 1.14) (Table 1; cancer-site specific results in Web Table 1; Web Fig. 2). There was evidence of widening excess mortality rate relative gaps by income group over time. The ratio change in the income EMRR was estimated at 1.09 (95% CI 1.01–1.17) (Table 2; cancer-site specific results in Web Table 2; Web Fig. 4), 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.

3.3. Absolute per-decade changes over time in ethnic and socioeconomic cancer survival inequalities

For each cancer site, we also estimated absolute changes over time per-decade in ethnic and socioeconomic cancer survival inequalities. For most cancers, a possible increase/decrease over time in relative inequalities was mirrored by a possible increase/decrease in absolute inequalities (Web Tables 1 and 2; Web Figs. 3 and 5).

Table 2
Excess mortality rate ratios (EMRRs) five-years post diagnosis pooled across 21 cancer sites representing (a) the relative difference in socioeconomic inequalities in cancer survival, New Zealand, during 1991–2004 and (b) the relative per-decade change in those socioeconomic inequalities in cancer survival.

Socioeconomic inequalities, averaged over time during 1991–2004, for adult cancer survival 5-years diagnosis pooled across 21 cancer sites		Relative per-decade change in socioeconomic inequalities in adult cancer survival 5-years post diagnosis pooled across 21 cancer sites	
Excess mortality rate ratio (EMRR)	95% confidence interval	Excess mortality rate ratio (EMRR)	95% confidence interval
1.12	(1.09, 1.15)	1.09	(1.01, 1.17)

4. Discussion

We have found patterns of persistent and large ethnic gaps in cancer survival. Benchmarking of ethnic inequalities in cancer survival across countries is difficult due to, among other things, how information about indigenous populations is collected and analysed. However, a recent study from by Withrow et al. assessing ethnic differences in cancer survival for 15 cancers in Canada is informative [13]. The investigators used a sample of 15% of the Canadian population from their 1991 census and linked these records to cancer registration and deaths. They found that there was a statistically significant difference in cancer survival for 9 of the 15 sites between indigenous and non-indigenous cancer populations, with the indigenous group having poorer survival. These differences were present even after accounting for ethnic differences in background mortality.

We also found evidence for inequalities between income groups with slower improvements in cancer survival over time for low-income people. In this study, we have measured socioeconomic differences in cancer survival using an individual measure of socioeconomic position whereas a large number of other studies have used area-based measures of socioecoconomic position to measure differences in adult cancer survival. Despite this, there is evidence from a number of other countries for the presence of inequalities – and increases over time in the socioeconomic gap in survival – with a large evidence base established in England and Wales for instance [14]. A recent study by Nur et al. investigated the impact of age at diagnosis on socioeconomic inequalities in cancer survival [15]. Their findings suggest the need for updating site-specific guidelines to ensure appropriate management of people diagnosed with cancer according to the combinations of age and socioeconomic position.

One possible explanation for our findings regarding an increase over time in income group inequalities in cancer survival that we have reported is that diffusion of access to improved treatments has been fairly constant (and inequitable) by ethnicity over time, but that higher income (either directly through private services, or as a marker of social position) has afforded a greater advantage in access to treatments over time despite the largely universal nature of the New Zealand health system. Another explanation is that comorbidities (e.g. diabetes, respiratory disease) and stage at presentation that confound or mediate social group differences have exerted a similar influence on ethnic cancer survival inequalities over time, but increasingly disadvantaged low-income groups. However, we were not able to direct test these possible explanatory factors. We consider that the inequalities reported here warrant constant vigilance by the health system to prevent inequalities in cancer survival.

Author contribution

Dr. Matthew Soeberg (MS) led the data management and analysis for this study as well as the implementation of the analytical methods used in this thesis, the analyses themselves and the write up and interpretation of results.

Professor Tony Blakely (TB) was the principal investigator on the CancerTrends and the New Zealand Census-Mortality Studies, making collaboration with Professor Blakely an important component of this study.

MS and TB jointly led the specification of the excess mortality rate model parameterisation and the methods for modelling trends in cancer survival using excess mortality rate outputs.

Associate Professor Diana Sarfati assisted with preparation of the manuscript and the interpretation of results.

Conflicts of interest

None.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.canep.2015.10.018.

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