



Quantifying the changes in survival inequality for Indigenous people diagnosed with cancer in Queensland, Australia



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ABSTRACT

The survival inequality faced by Indigenous Australians after a cancer diagnosis is well documented; what is less understood is whether this inequality has changed over time and what this means in terms of the impact a cancer diagnosis has on Indigenous people. Survival information for all patients identified as either Indigenous ($n = 3168$) or non-Indigenous ($n = 211,615$) and diagnosed in Queensland between 1997 and 2012 were obtained from the Queensland Cancer Registry, with mortality followed up to 31st December, 2013. Flexible parametric survival models were used to quantify changes in the cause-specific survival inequalities and the number of lives that might be saved if these inequalities were removed. Among Indigenous cancer patients, the 5-year cause-specific survival (adjusted by age, sex and broad cancer type) increased from 52.9% in 1997–2006 to 58.6% in 2007–2012, while it improved from 61.0% to 64.9% among non-Indigenous patients. This meant that the adjusted 5-year comparative survival ratio (Indigenous: non-Indigenous) increased from 0.87 [0.83–0.88] to 0.89 [0.87–0.93], with similar improvements in the 1-year comparative survival. Using a simulated cohort corresponding to the number and age-distribution of Indigenous people diagnosed with cancer in Queensland each year ($n = 300$), based on the 1997–2006 cohort mortality rates, 35 of the 170 deaths due to cancer (21%) expected within five years of diagnosis were due to the Indigenous: non-Indigenous survival inequality. This percentage was similar when applying 2007–2012 cohort mortality rates (19%; 27 out of 140 deaths). Indigenous people diagnosed with cancer still face a poorer survival outlook than their non-Indigenous counterparts, particularly in the first year after diagnosis. The improving survival outcomes among both Indigenous and non-Indigenous cancer patients, and the decreasing absolute impact of the Indigenous survival disadvantage, should provide increased motivation to continue and enhance current strategies to further reduce the impact of the survival inequalities faced by Indigenous people diagnosed with cancer.

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1. Introduction

In Queensland, Indigenous Australians (Aboriginal and Torres Strait Islanders) have lower overall incidence rates than non-Indigenous Australians, although higher for some more fatal cancer types [1]. In contrast, several studies have documented

their generally lower survival once diagnosed [2,3]. However, the varying completeness and misclassification of Indigenous status across administrative data collections over time has limited our ability to investigate temporal changes in the extent of the survival inequality faced by Indigenous people diagnosed with cancer compared to their non-Indigenous counterparts.

Relative survival is the most common method for reporting net survival in population-based cancer studies as it does not require cause-of death information, thereby, at least in theory, providing greater validity when comparing survival across populations. However relative survival calculations require accurate life tables for the respective populations. While these are generally available

Abbreviations: CSR, comparative survival ratio.

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for clearly defined populations with robust health administrative datasets, they are less so for those populations in which exact enumeration is not available, as for Indigenous and non-Indigenous Australians [4]. As such the identification of Indigenous status can vary depending on the specific data source. While this has not been quantified, differing approaches to the collection and storage of Indigenous status information can lead to inconsistencies in official statistics, including life tables [4].

In addition, the underlying assumption when using relative survival that the only difference between the cancer cohort and the comparison population is the cancer diagnosis may not be valid when considering, for example, smoking-related cancers [2]. While, in practice, it has been shown to not have a large effect on survival estimates for people diagnosed with lung cancer [5], it is likely that these limitations are particularly relevant when reporting on survival for Indigenous people who have a higher comorbidity burden than non-Indigenous patients [6].

The other commonly used measure of net survival, cause-specific survival, is not immune from biases, since it relies on accurate cause of death coding in the presence of often multiple causes of death. However, cause-specific survival has the advantage of not being impacted by the specific limitations of relative survival that are relevant to studies of Indigenous cancer patients. In addition, the Queensland Cancer Registry independently assigns cause of death information using a wide range of information including death certificates, autopsy reports and pathology reports, giving increased confidence in the registered cause of death information.

Previously, we have reported on the differences in cause-specific survival among Indigenous and non-Indigenous Queenslanders with all types of cancer combined between 1997 and 2006 [3]. This study extends that work by expanding the diagnostic period, estimating the differences in cause-specific survival by individual cancer type and specifically whether there is evidence that these patterns have changed over time.

2. Materials and methods

2.1. Cohort

Following approval from the data custodian, Queensland Health, de-identified data were obtained from the population-based Queensland Cancer Registry [7], to which notifications of any cancer diagnosis (except keratinocyte cancers) from hospitals, pathology laboratories and nursing homes are required by law. All

people who were diagnosed with an invasive primary cancer, as defined by the World Health Organisation [8], between 1 January 1997 and 31st December 2012 while aged between 20 and 89 years were initially included in the study cohort. The Queensland Cancer Registry is one of four Australian states considered to have high accuracy for reporting Indigenous status [9]. We excluded patients with unknown Indigenous status, who were diagnosed at death or autopsy or had more than one primary cancer diagnosis since 1982. The most common specific cancer sites among Indigenous people, (Table 1) in addition to all cancer types combined, were included in the analysis.

2.2. Survival

Patients were followed up to 31st December 2013 with matching to the National Death Index [7]. Survival was measured in days from the date of diagnosis to death or the study end point. Since our previous work [2,3] has shown the greatest inequalities are in the first few years after diagnosis, we restricted the follow-up to five years to enable assessment of changes over time. Those still alive at 31 December 2013 or five years after their diagnosis (whichever came first) were censored at that date, while those who died from a cause other than the cancer they were diagnosed with were censored at the date of death. For comparison, the analyses were repeated for all cause (overall) survival with the results shown in the Supplementary Tables and Figures.

2.3. Statistical analysis

We conducted the analysis within a flexible parametric survival modelling framework [10,11] for which the parametric expression for the baseline hazard enables us to more readily estimate other quantities of interest and gives greater flexibility in modelling non-proportional excess hazards than the widely used Cox proportional hazards model [12]. Specifically, the models used restricted cubic splines to model the log baseline cumulative hazard, and restricted cubic splines to relax the assumption of linearity of log time. The optimal number of knots for the main effects and time varying components were determined based on the Bayesian information criterion (BIC). Median regression models were used to assess the significance of differences in median age at diagnosis by Indigenous status and diagnostic period. All analyses were performed with Stata/SE version 14 (StataCorp LP, Texas, USA). Flexible parametric models were fitted with the *stpm2* package

Table 1
Demographic characteristics by Indigenous status and period of diagnosis for selected cancers, Queensland, 1997–2012, with follow up to 2013.

Cancer	1997–2006				2007–2012			
	Indigenous		Non-Indigenous		Indigenous		Non-Indigenous	
1997–2006	N	Median age at diagnosis (years)	N	Median age at diagnosis (years)	N	Median age at diagnosis (years)	N	Median age at diagnosis (years)
All cancers	1622	57	117,361	66	1546	58	94,254	65 ^{a,b}
Breast cancer	211	52	16,534	58	208	53	13,768	59 ^a
Cervical cancer	92	43	1214	45	45	46	821	45
Colorectal cancer	137	58	16,528	68	142	61	12,189	68 ^a
Head and neck cancer	116	52	3252	61	99	53	2747	61 ^a
Leukaemia	30	49	3231	67	27	44	2390	66 ^a
Liver cancer	47	60	1038	66	52	63	1118	66 ^a
Lung cancer	264	62	12,310	69	242	62	9245	69 ^a
Non-Hodgkin lymphoma	38	57	4189	65	40	53	3457	64 ^a
Unknown cancer	61	62	3526	72	52	63	2142	72 ^a
Uterine cancer	72	60	1953	63	80	57	1790	62

^a Significant ($p < 0.05$) difference in median age at diagnosis by Indigenous status.

^b Significant ($p < 0.05$) difference in median age at diagnosis by diagnostic time period.

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