
Susanna M. Cramb
Gall Garvey
Patricia C. Valery
John D. Williamson
Peter D. Baade

Follow this and additional works at: https://ir.lib.uwo.ca/aprci

Part of the Other Public Health Commons

Citation of this paper:
https://ir.lib.uwo.ca/aprci/326
Abstract

Objective: To examine the differential in cancer survival between Indigenous and non-Indigenous people in Queensland in relation to time after diagnosis, remoteness and area-socioeconomic disadvantage.

Design, setting and participants: Descriptive study of population-based data on all 150,059 Queensland residents of known Indigenous status aged 15 years and over who were diagnosed with a primary invasive cancer during 1997–2006.

Main outcome measures: Hazard ratios for the categories of area-socioeconomic disadvantage, remoteness and Indigenous status, as well as conditional 5-year survival estimates.

Results: Five-year survival was lower for Indigenous people diagnosed with cancer (50.3%; 95% CI, 47.8%–52.8%) compared with non-Indigenous people (61.9%; 95% CI, 61.7%–62.2%). There was no evidence that this differential varied by remoteness (P = 0.780) or area-socioeconomic disadvantage (P = 0.845). However, it did vary by time after diagnosis. In a time-varying survival model stratified by age, sex and cancer type, the 50% excess mortality in the first year (adjusted HR, 1.50; 95% CI, 1.38–1.63) reduced to near unity at 2 years after diagnosis (HR, 1.03; 95% CI, 0.78–1.35).

Conclusions: After a wide disparity in cancer survival in the first 2 years after diagnosis, Indigenous patients with cancer who survive these 2 years have a similar outlook to non-Indigenous patients. Access to services and socioeconomic factors are unlikely to be the main causes of the early lower Indigenous survival, as patterns were similar across remoteness and area-socioeconomic disadvantage. There is an urgent need to identify the factors leading to poor outcomes early after diagnosis among Indigenous people with cancer.

Methods

Data were provided by the population-based Queensland Cancer Registry (QCR), under an agreement between Cancer Council Queensland and Queensland Health allowing access to non-identifiable data. For these analyses, all people of known Indigenous status aged 15 years and over who were diagnosed with a primary invasive cancer (International classification of diseases for oncology, 3rd edition [ICD-O-3] codes, C00–C80) during 1 January 1997 to 31 December 2006 were included. We excluded people whose age or residential location at diagnosis was unknown, or whose diagnosis was based on the death certificate or autopsy report only. Cases included in the study were followed to 31 December 2007, with matching to the National Death Index. Those still alive at 31 December 2007 were censored at that date, while those who died from a cause other than the diagnosed cancer were censored at their date of death.

Cancer type

Since the differential in the incidence of cancer between Indigenous and non-Indigenous depends on cancer type, with cancers common among Indigenous people more likely to be associated with low survival rates, we constructed a variable representing broad cancer groups based on 5-year cancer survival estimates for all of Queensland to include in the analysis. These estimates were: <25% (eg, cancers of the oesophagus, liver, lung, pancreas and unknown site); 25%–49% (eg, stomach and ovarian can-
cancers, myeloid leukaemia, myeloma); 50%–74% (eg, colorectal and kidney cancers, non-Hodgkin lymphoma) and 75%–100% (eg, breast, cervical and prostate cancers and melanoma).

Geographical areas
Residential location at diagnosis was obtained from the QCR, according to Statistical Local Area (SLA). These SLAs were then grouped according to the level of geographic remoteness based on the Accessibility/Remoteness Index of Australia (ARIA+). Area-level socioeconomic disadvantage was measured by quintiles of the Index of Relative Socioeconomic Advantage and Disadvantage (IRSAD), because this index is determined without including Indigenous status.15

Demographics
Information on sex, age at diagnosis and Indigenous status was obtained from the QCR. Age at diagnosis was categorised into five age groups (15–49, 50–59, 60–69, 70–79 and 80+ years). The QCR obtains information about Indigenous status of cancer patients through the process of cancer notification from Queensland hospitals. Ascertainment of Indigenous status is based on an individual identifying him- or herself as either Aboriginal only, Aboriginal and Torres Strait Islander or Torres Strait Islander only. As the focus of our analysis was on the survival differential between Indigenous and non-Indigenous people, we also excluded those patients whose ethnicity was unknown.

Statistical methods
Cox proportional hazards regression models were used to quantify the survival differences with Efron’s approximation used to resolve tied data (ie, multiple deaths at the same number of days from diagnosis).16 Data were analysed with Stata, version 11.0 (StataCorp, College Station, Tex, USA).

Variables considered for inclusion in the model were geographic remoteness, area-socioeconomic disadvantage, age group, sex, Indigenous status, and broad cancer group. Cancer stage could not be included because the QCR does not routinely collect these data at diagnosis. Interactions between covariates, including time-varying coefficients, were also considered.

A systematic process was used to develop the final model, considering the proportional hazards assumption, overall model fit and the influence exerted by individual cases. Scaled Schoenfeld residuals, which test for non-zero slope over time, were used to check if the proportional hazards assumptions were satisfied. Model goodness of fit was assessed by Cox-Snell residuals. Deviance residuals were then used to examine model accuracy. We considered the influence of individual cases to determine their impact on each of the estimated individual coefficients (using the DFBETA statistic) as well as their effect on the combined set of coefficients (using the LMAX statistic).16,17

Conditional survival, which reflects the average probability of an individual surviving a certain number of years given they have already survived for x years,18 was calculated for both Indigenous and non-Indigenous cohorts.

Results
Of the original 180 095 people aged 15 years and over who were diagnosed with invasive cancer in Queensland between 1997 and 2006, 14.6% were of unknown ethnicity (Box 1). A further 2.5% were excluded because they were either diagnosed at death (total, 1.5%; Indigenous, 2.9%; non-Indigenous, 1.5%), did not have information on the SLA of residence (total, 0.8%; Indigenous, 0.7%; non-Indigenous, 0.8%) or the number of days between diagnosis and death (total, 0.2%; Indigenous, 0.3%; non-Indigenous, 0.2%), or did not have a SEIFA value assigned (total, 0; Indigenous, 0.4%; non-Indigenous, 0). The final cohort included 150 059 individuals of known ethnicity, of whom 1819 (1.2%) were Indigenous (Box 1). The most common cancers among Indigenous people were lung, breast, colorectal, prostate and cervical cancers. Among non-Indigenous people, the most common cancers were colorectal, breast, prostate and lung cancers and melanoma. A slight majority (55.5%) of people diagnosed with cancers were males.
Bivariate comparisons of survival

There was clear evidence of lower cancer survival for Indigenous compared with non-Indigenous people (Box 2A). The survival curves in Box 2A show the cumulative survival from diagnosis. Unadjusted survival curves by remoteness suggested lower survival for Indigenous people in outer regional and remote areas, but not in more urban areas (results not shown). However, patients in more affluent areas. Nonetheless, differences in survival were not apparent until we looked at the disadvantaged and most disadvantaged quintiles, where Indigenous cancer patients had poorer survival than non-Indigenous patients.

Development of multivariate model

The initial model included all variables in the model (age group, sex, rurality, area-socioeconomic disadvantage, broad category of cancer site and Indigenous status). However, proportional hazards assumptions were clearly not met for each broad cancer group (based on scaled Schoenfeld residuals, each P < 0.001), so the model was adjusted to include cancer site as a stratification variable.

The plot of the hazard function by Indigenous status (not shown) revealed large initial differences in hazards, which decreased over time since diagnosis. After surviving 2 years, there was no difference in unadjusted cumulative survival by Indigenous Status (Box 2B). Therefore, time-varying components (Indigenous status by follow-up years after diagnosis) were incorporated into the model. To prevent a few cases with longer follow-up exerting undue influence on survival estimates, time since diagnosis was categorised up to 5 years of follow-up.

Proportional hazards assumptions were not being met for the final age category (P < 0.001) or sex (P < 0.001). While including the interaction terms Indigenous–sex and Indigenous–age group improved the model fit based on the likelihood-ratio tests, the proportional hazards assumptions were still violated (overall model, P < 0.001). To address this, we further included age and sex in the model as stratification variables.

The final multivariate model

The final model included rurality (ARIA+), area-socioeconomic disadvantage (IRSAD), Indigenous status and time-varying Indigenous components, and was stratified by broad cancer site category, sex and age group. The graph of Cox–Snell residuals (not shown) indicated excellent model fit, and there was no evidence the parameter estimates were being overly influenced by outlying individual datapoints.

Survival estimates and results from the final Cox hazard model are shown in Box 3. Indigenous people experienced poorer survival during the first and second years after diagnosis after stratifying by age, sex and broad cancer site category, and adjusting for area-level disadvantage and remoteness. This disparity decreased with time since diagnosis, and after 2 years there was no survival disparity between Indigenous and non-Indigenous patients with cancer.
Survival was lower for people living in less accessible areas and those in more disadvantaged areas. However, there was no significant evidence for interaction found between Indigenous status and either remoteness ($P = 0.780$) or area disadvantage ($P = 0.845$).

Two sensitivity analyses were conducted. The first included patients of unknown Indigenous status in the non-Indigenous group, while the second included those diagnosed at death (by death certificate or autopsy) by assuming they survived for 1 year. In both cases, the analyses yielded similar results, with hazard ratios slightly higher when including those of unknown Indigenous status.

**Conditional survival**

Conditional survival estimates (Box 4) reinforce the time-dependent nature of the differential in survival between Indigenous and non-Indigenous patients with cancer. Indigenous patients initially had poorer 5-year survival prognoses than non-Indigenous patients, but this disparity in survival expectations vanished once they had survived 2 or more years.

**Discussion**

In this population-based study of cancer in Queensland, we found significant disparities between the survival outcomes for Indigenous and non-Indigenous people after their diagnosis. These differences remained after accounting for remoteness, area-socioeconomic disadvantage, age group, sex and mix of cancers. However, this survival disparity was modified by time since diagnosis, with the comparative risk of death decreasing as the time from diagnosis increased. This varying time effect has not been previously noted in studies examining cancer survival among Indigenous people in Australia, apart from a brief mention of time-varying comparative Indigenous and non-Indigenous survival in patients with colorectal cancer in the Northern Territory.

This is important information for Indigenous patients with cancer to know, because the longer they survive the greater chance they have of continuing to survive. Most of the currently published literature has focused on the poorer survival outcomes of Australian Indigenous people diagnosed with cancer. This is justifiable, and has helped galvanise a concerted government, clinical and research effort to reduce this disparity in cancer survival. However, the perspective that Indigenous cancer patients have a continued poorer prognosis cannot help but limit their own personal optimism and outlook for the future. Thus, our results, based on the total Queensland population, provide an avenue for increased optimism among Indigenous cancer patients that they can successfully complete their cancer journey.

However, this optimism must be constrained by a strong call to action to understand what is causing the very wide disparity in survival within the first 1 to 2 years after diagnosis. A recent Queensland study showed a survival differential for Indigenous patients with breast cancer that remained even after adjusting for spread of disease. This suggests that other factors, such as the impact of poorer general health and increased comorbid conditions among the Indigenous compared with the non-Indigenous population, also play an important role. There may be a healthy cohort effect, as Indigenous patients who survive beyond 2 years after diagnosis may have fewer comorbid conditions or better general health than those who died earlier. Alternatively, Indigenous patients with cancer in Queensland (all cancers) are less likely to undergo treatment for their cancer than other patients.

Indigenous patients who use health services and receive adequate treatment may have better rates of survival. Until Australian cancer registries standardise the collection and recording of stage and treatment data, it will be impossible to explore these factors appropriately.

We found no evidence that the differential in Indigenous versus non-Indigenous survival varied according to geographical area of residence. As the use of any area-based measure of socioeconomic status is likely to overestimate the affluence of Indigenous people, this reinforces the lack of evidence. This may indicate the Indigenous survival differential is not primarily related to access to treatment or socioeconomic barriers, but that other as yet unknown factors are more relevant, including those related to culture and general health, and that these other factors have similar impact across geographical locations. Clearly, having an almost 50% differential in cancer survival within the first 12 months of diagnosis is not acceptable, and our findings should increase the motivation for further efforts in this area. Greater emphasis and research focus should therefore be placed on identifying the factors responsible for the early disparity in survival.

Limitations of our study include the relatively small numbers of Indigenous cases, which gave us limited capacity to investigate differences for specific types of cancer. We were also unable to separate the effects of early diagnosis from other factors, including those of treatment differentials. As it is possible that not all cases of cancer in Indigenous people were identified, there is potential misclassification of...
In conclusion, our findings provide some cause for cautious optimism, as Indigenous patients in Queensland who have already survived 2 years after a cancer diagnosis are likely to have a similar outlook to that of non-Indigenous patients. However, there is still an urgent need to address the unacceptable disparity in survival outcomes early after diagnosis. This important health issue must remain a continuing priority.

Acknowledgements: We thank John Condon, Menzies School of Health Research, Charles Darwin University, for his review of a previous draft of this manuscript. Pete Baade was supported by a National Health and Medical Research Council Career Development Fellowship (No. 1005334). Patricia Valery was supported by an Australian Research Council Future Fellowship (No. FT10010051). Patricia Valery was supported by an Australian Research Council Career Development Fellowship (No. 1005334).

Competing interests: No relevant disclosures.

Received 15 Sep 2011, accepted 13 Dec 2011.