

## RESEARCH COMMUNICATION

# Comparing Cancer Profiles and Survival of Aboriginal and non-Aboriginal Patients in South Australia: Where are the Opportunities for Improving Aboriginal Health?

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### Abstract

Data from the South Australian Cancer Registry (SACR) for 1977-2003 were used to calculate expected and actual distributions of cancer sites in Aboriginal versus non-Aboriginal populations. Expected distributions were calculated using indirect standardisation and compared with actual distributions using a global Chi-square test. Individual contributions to the Chi-square statistic (from each cancer site) were examined using a z-test and Bonferroni corrected p-value. The expected figure for each cancer site corresponds to the number of cancers we would have expected in Aboriginal patients if they had the same cancer distribution of site by age as the non-Aboriginal population. Expected 5- and 10-year survivals were also calculated and compared to expected survivals drawn from Statewide survivals adjusted for age at diagnosis. There was an overall significant difference in expected and actual cancer site distributions for South Australian Aboriginal male ( $\chi^2$  (17df) = 202.94) and female ( $\chi^2$  (20df) = 311.93) patients, and all patients collectively ( $\chi^2$  (22df) = 485.43). Aboriginal patients had poorer expected 5- and 10-year survival compared with South Australian non-Aboriginal patients, and even poorer actual 5- and 10-year survival than expected. The differences between the expected and actual cancer site distributions reflect the disparities in risk factor prevalence for largely preventable cancers and the survival results reflect the multitude of obstacles confronting Aboriginal patients with cancer compared with non-Aboriginal cancer patients. This study provides areas of focus for interventions to reduce cancer levels in the Aboriginal population and to improve survival of Aboriginal people diagnosed with cancer.

**Key Words:** Indigenous people - cancer - survival - Aboriginal

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### Introduction

Good information is needed to provide a basis for cancer prevention and to measure the impact of cancer control efforts within a community (AIHW, 2004). While the general population has experienced an overall reduction in cancer burden through improvements such as increased participation in cancer screening and increased survival after cancer, there is little evidence of such improvements among the Australian Aboriginal population. Studies carried out in other States/Territories and across the whole of Australia have shown that Aboriginal Australians have a higher risk of largely preventable cancers, such as liver, cervical, lung, and oropharyngeal, and a higher risk of death from cancer, compared with non-Aboriginal Australians (Coory et al., 2000; Condon et al., 2004; Valery et al., 2006; Condon et al., 2005b; Supramaniam et al., 2007).

In South Australia the last published information on cancer in the Aboriginal population was released 10 years ago by the South Australian Cancer Registry (SACR, 1997). This revealed high rates of lung, liver, cervical,

head and neck, oesophageal, pancreatic, stomach and gall bladder cancers; low rates of large bowel, female breast, skin (melanoma) and lip cancers; and poorer 5-year survival (for all cancers combined) for Aboriginal patients compared with non-Aboriginal patients.

Effective cancer control in any population requires an understanding of the current cancer burden within that community. More than a decade-old data is therefore inadequate as a basis for the development of interventions to reduce the impact of cancer in the South Australian Aboriginal community. This study analyses the most recent SACR data to provide a current picture of cancer in the Aboriginal population of South Australia. We examine the actual and expected cancer profiles of South Australian Aboriginal patients, diagnosed between 1977-2003 and discuss possible reasons for differences between these profiles in light of factors influencing cancer risk and survival. This study identifies areas that need to be addressed as a priority and areas where further research is required to better understand cancer in this population.

For the purpose of the paper, Aboriginal refers to Australian Aboriginal and Torres Strait Islander peoples.

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## Materials and Methods

All residents of South Australia diagnosed with invasive cancer in 1977-2003 were eligible for inclusion in the study. Unidentified data were obtained from the South Australian Cancer Registry (SACR). The SACR records all new cases of invasive cancer diagnosed in South Australia; these notifications are mandated by law. Cases were identified from the SACR as Aboriginal/Torres Strait Islander, Asian, or Caucasian/other.

The age-specific distributions of primary sites of all non-Aboriginal cancers recorded on the SACR 1977-2003 (using 5-year age groups and with 85+ as an open ended category) were weighted to the age distribution for Aboriginal cancers to give an "expected" site distribution of Aboriginal cancers. The calculation of "expected" distributions was undertaken separately for males (21 sites) and females (18 sites), and added together to give a collective total (23 sites). In some cases, individual cancer types were grouped together based on anatomical proximity to increase cell size. Actual and expected site distributions of Aboriginal cancers were compared using the Chi-square goodness of fit test. A z-test with a Bonferroni correction to account for multiple testing was used to determine significance of the contribution to the Chi-square statistic for each cancer site. These p values were interpreted to determine which individual cancer sites may be related to the overall difference. The authors are aware that the Chi-square statistic is sensitive to low sample sizes and that the expected frequencies for some cancer sites may be lower than generally recommended (Cochran, 1954).

The published site-specific 5-year and 10-year relative survivals for all races combined in South Australia, for the 1977-98 diagnostic period, were weighted to the age distribution for Aboriginal cancers. This gave "expected" 5- and 10-year survival for Aboriginal patients for all sites combined. Actual survival estimates (Kaplan-Meier product-limit estimates) were then produced for Aboriginal patients for all sites combined, using the 1977-2003 diagnostic period, and with December 31 2003 being employed as the date of censoring of live cases. The standard errors of the calculated expected and actual estimates were used to examine differences in 5- and 10-year Aboriginal survival from these expected values.

All statistical analyses were carried out using the Microsoft Office Excel software. Calculating incidence is problematic for Aboriginal people due to misclassification and under-ascertainment of Aboriginal status. We recognised that had incidence been calculated, data would have been incomplete and would have produced falsely low cancer rates. Therefore we limited our analyses to determining which cancers were relatively more frequent and less frequent in Aboriginal than non-Aboriginal patients. We have assumed that those identified as Aboriginal in the SACR were largely Aboriginal and representative of the Aboriginal population of South Australia. Data for the whole State were regarded for practical purposes as being non-Aboriginal when calculating expected survivals, since the proportion of Aboriginals among the State population is very small (i.e.,

2%) and would have little effect on overall survivals.

This study was approved by the Human Research Ethics Committee of Adelaide University and the Aboriginal Health Research Ethics Committee (AHREC). The Aboriginal Health Council of South Australia Inc (AHCSA) provided support and consultation throughout the study to ensure a culturally acceptable approach.

## Results

For the period between 1977 and 2003, the pattern of expected cancers and the pattern of actual cancers are different for male, female, and South Australian Aboriginal patients collectively. The calculated global Chi-square results for male ( $\chi^2$  (17df) = 202.94) (Table 1) and female ( $\chi^2$  (20df) = 311.93) (Table 2). Aboriginal patients, and all Aboriginal patients collectively ( $\chi^2$  (22df) = 485.43) (Table 3) easily achieved conventional levels of statistical significance ( $p < 0.001$ ).

The probabilities assigned to differences in individual actual and expected cancer sites assist in identifying which sites are likely to be influencing the overall significant difference. The expected figure for each cancer site corresponds to the number of cancers we would have expected in Aboriginal patients if they had the same cancer distribution of site by age as the non-Aboriginal population. The actual figure for each cancer site reflects the true distribution of cancer sites among Aboriginal patients. The results show that South Australian Aboriginal patients presented with higher than expected numbers of lung, laryngeal, mouth, oropharyngeal, oesophageal, stomach, hepato-biliary (liver and gall bladder), and unknown primary cancers. Males presented with higher numbers of pancreatic cancers than expected, and women presented with higher numbers of cancers of the cervix than expected. South Australian Aboriginal patients of both

**Table 1. Differences in Actual and Expected Cancer Distributions, by Cancer Site, in South Australian Aboriginal Males Diagnosed 1977-2003**

Cancer site	Actual	Expected	p-value
lip	0	9.06	0.0023
mouth, pharynx and oesophagus	29	7.51	0.0002
stomach	11	5.71	0.1854
bowel	13	26.26	0.0255
hepato-biliary	13	2.29	0.0052
pancreas	12	3.55	0.0287
larynx/lung	36	25.36	0.1382
connective tissue/soft tissue	2	2.77	0.7233
melanoma	1	19.23	0.0000
prostate	15	30.46	0.0146
testes	4	4.12	0.9671
bladder	4	5.92	0.5373
kidney	5	6.24	0.7079
brain	5	6.08	0.7414
thyroid	3	1.37	0.4329
primary unknown	14	5.05	0.0353
haematological	17	23.61	0.2727
other	6	6.42	0.8720
all cancers	216	216.00	
Global Chi-square result	202.94 df=17 ( $p < 0.001$ )		

**Table 2. Differences in Actual and Expected Cancer Distributions, by Cancer Site, in South Australian Aboriginal Females Diagnosed 1977-2003**

Cancer site	Actual	Expected	p-value
lip	0	2.69	0.1002
mouth, pharynx and oesophagus	16	3.46	0.0036
stomach	9	2.89	0.0721
bowel	9	25.84	0.0029
hepato-biliary	14	2.30	0.0031
pancreas	1	2.93	0.3273
larynx/lung	26	10.94	0.0096
connective tissue/soft tissue	3	2.16	0.7109
melanoma	3	23.58	0.0000
female breast	33	69.96	0.0000
cervix	30	7.69	0.0001
uterus	10	10.08	0.9852
ovary	6	7.42	0.6945
other/unspecified female genital organs	7	1.43	0.0529
bladder	2	2.04	0.9856
kidney	4	3.99	0.9971
brain	4	4.41	0.8867
thyroid	7	4.65	0.4850
primary unknown	17	5.12	0.0095
haematological	10	18.51	0.0991
other	6	3.92	0.7148
All cancers	191	191.0	
Global Chi-square result	311.93	df=20	(p<0.001)

sexes presented with lower than expected numbers of melanoma, bowel, breast, prostate and lip cancers.

The expected survival corresponds to the survival that Aboriginal patients would have experienced, had they had the same survival by age as South Australian residents in general for the cancers with which they presented. Figure 1 shows that the expected 5-year survival percentage for all South Australian Aboriginal patients (44.91; 95% CI: 40.08, 49.74) is lower than that for South Australia overall (56.77; 95% CI: 56.50, 57.04). This lower 5-year expected survival for all South Australian Aboriginal patients is consistent by gender. The actual 5-year survival percentages for males, females and all South Australian Aboriginal patients, compared to the expected, are consistently lower (See Figure 1).

This pattern is unchanged at ten years following diagnosis (Figure 2), with expected 10-year survival percentage for all South Australian Aboriginal patients (39.02; 95% CI: 34.28, 43.76) being lower than for South Australia overall (51.19; 95% CI: 50.90, 51.48). This pattern is again consistent by gender. Actual 10-year survival percentages, for male, female and all South Australian Aboriginal patients, are also lower than the expected 10-year survival percentages (See Figure 2).

## Discussion

Our study found that during the period 1977 to 2003, both the actual site distributions and actual survival of South Australian Aboriginal patients differed from our expected profile. We found higher than expected numbers of cancers that are amenable to prevention and early

**Table 3. Differences in Actual and Expected Cancer Distributions, by Cancer Site, in All South Australian Aboriginal Patients Diagnosed 1977-2003**

All Aboriginal patients	Actual	Expected	p-value
lip	0	11.75	0.0006
mouth, pharynx and oesophagus	45	10.97	0.0000
stomach	20	8.59	0.0298
bowel	22	52.12	0.0002
hepato-biliary	27	4.58	0.0000
pancreas	13	6.49	0.1355
larynx/lung	62	36.31	0.0057
connective tissue/soft tissue	5	4.93	0.9822
melanoma	4	42.80	0.0000
female breast	33	69.96	0.0001
cervix	30	7.69	0.0002
uterus	10	10.08	0.9856
ovary	6	7.42	0.6959
other/unspecified female genital organs	7	1.43	0.0538
prostate	15	30.46	0.0183
testes	4	4.20	0.9440
bladder	6	7.95	0.5967
kidney	9	10.23	0.7765
brain	9	10.49	0.7326
thyroid	10	6.02	0.3152
primary unknown	31	10.17	0.0009
haematological	27	42.12	0.0573
other	12	10.34	0.7217
All cancers	407	407.0	
Global Chi-square result	485.43	df=22	(p<0.001)

detection with screening, and poorer survival than expected, at both five and ten years after diagnosis with cancer. These findings are comparable to previous observations about cancer in Aboriginal Australians in Queensland (Coory et al., 2000), the Northern Territory (Condon et al., 2005a) and New South Wales (Supramaniam et al., 2007) and, are consistent with those found in the SACR report from ten years ago (SACR, 1997). One exception however is that in the Queensland study, liver cancer was not found to be higher in Aboriginal people compared to the Queensland average (Coory et al., 2000).

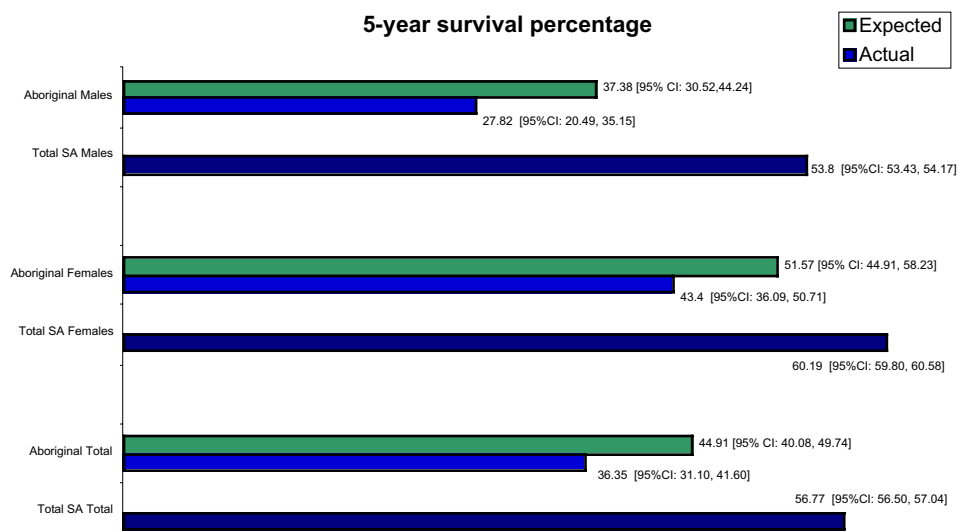
The distribution of cancer sites seen in this study is largely shaped by the constellation of cancer risk factors within the Aboriginal community. Smoking is a major risk factor for almost all of the cancers where presentations were higher than expected (AIHW, 2004). South Australian data indicate that in 2004-05, 52.9% of the adult Aboriginal population were daily smokers (ABS, 2004-05), compared to the State average of 19.1% (DASSA, 2006). These figures demonstrate the difficulty in coordinating and funding tobacco control programs for this population in comparison to the general population (Briggs et al., 2003). Increased alcohol consumption is also associated with many of these same cancers (Key et al 2004). A high proportion of Aboriginal adults drink alcohol at harmful levels (ABS, 2006) reflecting poorly funded alcohol misuse strategies in Aboriginal communities. Other factors such as high rates of Hepatitis B and Hepatitis C infection (Scrimgeour and Bartlett,

1998), the likely high prevalence of *Helicobacter pylori* infection (Windsor et al., 2005) and high rates of diabetes (ABS, 2006) among the Aboriginal population, are likely to have influenced the higher presentations of liver, stomach and pancreatic cancers respectively (CCCR, 2001). The higher than expected numbers of cervical cancer are most likely related to the high prevalence of the Human Papilloma Virus (HPV) in Aboriginal women (Condon et al., 2003) and poor participation in cervical screening, as noted in Queensland (Coory et al., 2002) and Northern Territory (Binns and Condon, 2006). However, exact figures are unknown as data on cervical screening participation among Aboriginal women is not collected in South Australia nor reliably at a national level (Bailie et al., 1998; Binns and Condon, 2006). The high numbers of unknown primary cancers may reflect limited access to specialised diagnostic services, and the presence of advanced cancer at diagnosis.

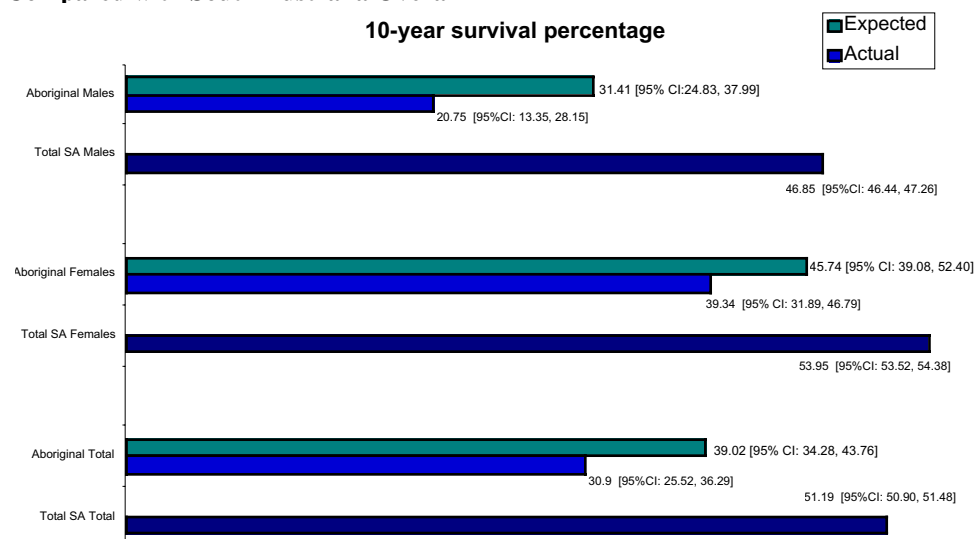
Increasing age is a risk factor for cancer, particularly cancers of the breast, prostate and bowel (AIHW, 2004). Although Aboriginal patients had a lower than expected

presentations of these cancers, our data also show that these cancers represent a large proportion of the cancer burden in Aboriginal patients and therefore in absolute terms they are important. As a comparison, breast, prostate and bowel cancers are also three of the most common cancers in Aboriginal people in other States/Territories of Australia (AIHW, 2005). While the protective factors of breastfeeding and childbirth at an early age, common in Aboriginal women (McLean and Condon, 1999) may partly account for lower presentations with breast cancer seen in this study, Condon et al (2005a) found that breast cancer incidence rates rose by 200% in the last ten years suggesting risk factor patterns may be changing. The protective factor of high melanin pigmentation is the major reason for presentations with melanoma of the skin and lip cancers being low (CCCR, 2002).

These data provide a focus for future prevention efforts in South Australia. Although a detailed and comprehensive discussion of how to address each risk factor is beyond the scope of this paper, the more influential factors are discussed below as priorities for reducing the impact of



**Figure 1. Actual and Expected 5-Year Percentage Survival (all cancers combined) of South Australian Aboriginal Patients Compared with South Australia Overall**



**Figure 2. Actual and Expected 10-Year Percentage Survival (all cancers combined) of South Australian Aboriginal Patients Compared with South Australia Overall**

cancer in the South Australian Aboriginal community.

Effective tobacco control programs would have a significant effect in reducing cancer presentations in Aboriginal communities. However, the development of such programs must account for the complexity involved in changing smoking behaviour in this population; Brady (2002) and Briggs et al (2003), have stressed the need for a nationally funded and coordinated tobacco control program, to reduce smoking rates among Aboriginal Australians. Furthermore, evaluation of current or future tobacco control programs is needed to determine their effectiveness. Similarly, culturally appropriate and well-funded alcohol misuse programs could potentially reduce cancer among Aboriginal communities in South Australia.

When addressing smoking, alcohol and other risk factors, consultation with the Aboriginal community will ensure the development of culturally acceptable approaches to cancer control that incorporate their holistic view of health (Hunt and Geia, 2002). In addition, the employment of Aboriginal Health Workers may mean the health promotion messages are communicated more appropriately at the community level. An emphasis on lifestyle change will also positively impact on rates of other chronic diseases such as heart disease and diabetes, which share many of the same risk factors as cancer (Zhao and Dempsey, 2006).

National vaccination programs for measles, mumps, rubella and tetanus have successfully reduced communicable disease in Aboriginal Australians (Menziez et al., 2004). This suggests the recently introduced vaccine for HPV (Cancer Institute NSW, 2006) has the potential to reduce cervical cancer incidence in Aboriginal women in South Australia. Hepatitis B vaccinations became part of the schedule for Aboriginal children in the 1980's, but consequential reduction in liver cancer will be delayed (Condon et al., 2003).

It must be noted that this study relates to risk factors for the current cancer presentations in Aboriginal South Australians. However, over time risk factor patterns may change in this population and the focus of cancer control measures must be adjusted accordingly.

The expected Aboriginal 5- and 10-year survival reflects the differences between cancer types in Aboriginal patients compared with the rest of South Australia. In this study, Aboriginal patients presented with high numbers of cancers which have a poor prognosis such as oesophageal, liver, pancreatic, lung and unknown primary (CCCR, 2001; Condon et al., 2005a) and as expected they experience a lower expected survival as a natural consequence.

The tendency for lower actual than expected survivals in South Australian Aboriginal patients probably reflects the plethora of other factors influencing survival. In particular these findings are indicative of the disadvantage experienced by this population when diagnosed with cancer. A nationwide study reported similar results, with Aboriginal people diagnosed with cancers such as oropharyngeal, pancreatic and breast, at a higher risk of dying than non-Aboriginal people (Condon et al., 2005a). International studies comparing mortality from specific cancers across Indigenous and non-Indigenous people in

New Zealand (Shaw et al., 2006) and black and white Americans (Krieger, 2002), have also shown a similar pattern. More advanced disease at diagnosis is one explanation for poorer survival, and the literature highlights that Aboriginal people are more likely to be diagnosed with advanced disease and distant metastases (Cunningham, 2002; Shaw and Elston, 2003; Valery et al., 2006). It is most likely that more advanced disease is due to delay in seeking medical advice. More advanced disease only partly accounts for poor survival in Aboriginal people (SACR, 1997) yet research into other reasons is limited. Cultural barriers have been identified as affecting treatment choices and effectiveness. Within Australia, these include how the immediate family will cope with illness and treatment (McMichael et al., 2000), concerns that treatment is not effective or worthwhile (Hall et al., 2004), difficulties communicating in a culturally appropriate manner (Fisher and Weeramanthri, 2002) or cancer being perceived as a "payback" for offending a relative (Lowenthal et al., 2005). Other issues cited include remoteness, deciding against curative treatment, incomplete treatment, the presence of co-morbidities and systematic differences such as waiting longer to have surgery (Cunningham, 2002; Hall et al., 2004; Jong et al., 2004; Wilkinson and Cameron, 2004; Condon et al., 2005a; Underhill et al., 2006; Valery et al., 2006). Despite this large list, there is currently no evidence of the impact any of these reasons have on survival.

Addressing the survival disparities highlighted in this study is limited until further research establishes the specific contributing factors. However, increasing participation in screening is a potential solution that can be implemented immediately. The national screening programs for breast and cervical cancer have significantly reduced mortality among Australian women over the last decade (AIHW, 2004). While there is no data on participation in cervical screening among Aboriginal women in South Australia, the results of this study and knowledge of participation in other states (Condon et al., 2003) indicate that providing Aboriginal women with a culturally appropriate service to access regular Pap tests will have a significant effect on presentations of and mortality from cervical cancer in South Australia. In addition, the consistent recording of cervical screening participation in Aboriginal women would provide evidence for the development of policies and resources to increase involvement. Similarly increased participation in breast screening may improve survival in Aboriginal women by increasing early detection of cancers. Breast screening participation rates in South Australia among Aboriginal women in the target age group of 50-69 years in 2002 were 41.5% (BreastScreen SA, 2005). This was lower than 64.6% for the rest of South Australia and the recommended 70% by the National Accreditation (BreastScreen SA, 2005). While not well documented, identified barriers to screening for Aboriginal women appear to be multifaceted and complex, ranging from low awareness of screening benefits and reluctance to attend, to poor access and inflexible appointment time (O'Brien et al., 2000; McMichael et al., 2000). Studies have shown that high levels of screening can be achieved when

culturally appropriate strategies are employed (Gilles et al., 1995; Reath and Usherwood, 1998; McLean and Condon JR, 1999). Screening programs may also benefit from integration into primary care settings, ideally within an Aboriginal Community-Controlled Health Service (Scrimgeour and Bartlett, 1998).

This study is a first step in the analysis of cancer data for the South Australian Aboriginal population and more sophisticated statistical analysis may provide additional information. Under-identification of Aboriginal status is a potential source of bias in this study; although any misclassification is likely to have only a small effect on our results, given incidence was not calculated. Aboriginal people were included in the site-specific survival for South Australia in the calculations for expected survival, but given they comprise such a small percentage of population (1.7%) (HREOC, 2006) it is likely to have minimal effect on the survival calculations. The data on cancer types is not incidence data and therefore cannot be compared directly with other studies about Aboriginal Australians that have used incidence data.

Another limitation of this study is the possibility of reporting bias. It is possible that under-reporting of cancer occurs more commonly in Aboriginal people or that cancers are reported erroneously as primary unknown, affecting the accuracy of our results. However, this is likely to have only a small effect on the difference between the expected and actual cancer distributions. A further limitation is the lower life expectancy of Aboriginal people. The high death rates at young ages in Aboriginal people (AIHW, 2005) may mean that cancers were latent at time of death and therefore were not registered with the SACR. Finally, the authors are aware that these results cannot be easily generalised to all Aboriginal cancer patients in South Australia, as there are likely to be differences between and within those living in remote, rural and urban areas.

The effectiveness of cancer control with regard to program development, evaluation and ability to influence policy relies heavily on evidence from research and service usage patterns. Despite its limitations, this study provides valuable information about cancer in Aboriginal South Australians and has identified areas for action, and highlighted the need for further research about cancer in the South Australian Aboriginal population. In particular, research must focus on exploring the impact of the multitude of reasons for poor survival following cancer diagnosis.

Our research has direct implications for reducing the impact of cancer in South Australian Aboriginal patients. Many of the contributing risk factors could be readily addressed, particularly those for lesions with infectious and behavioural origins. Improved participation in cancer screening will ultimately improve survival. Successes in the general population are evidence for these being achievable goals in general and they highlight the need for cancer control in the Aboriginal population to be at the forefront of policy and health promotion programs in South Australia. Addressing the cancer disparities in Aboriginal South Australians is not only essential, it is overdue.

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