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Are outcomes for childhood leukaemia in Australia influenced by geographical remoteness and Indigenous race?

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Abbreviations

SA	South Australia
WA	Western Australia
NT	Northern Territory
WCH	Women's and Children's Hospital

PCH	Perth Children's Hospital
ALL	Acute Lymphoblastic Leukaemia
AML	Acute Myeloid Leukaemia
MRD	Minimal Residual Disease
SES	Socio-economic Status

46 **Abstract:** Are outcomes for childhood leukaemia in Australia influenced by geographical

47 remoteness and Indigenous race?

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Background: Presenting features, biology and outcome for childhood leukaemia are known to vary by ethnic origin, geographic location and socio-economic group. This study aimed to compare presentation patterns, follow-up and outcomes in Indigenous and non-Indigenous children with acute leukaemia in Australia and to assess the impact of remoteness and area-based socio-economic disadvantage on outcome.

Methods: A retrospective review of children aged between 1 day and 18 years who were diagnosed with acute leukaemia in South Australia (SA), Northern Territory (NT) and Western Australia between 2009 and 2018 was performed. Data was collected from children treated at the Women's and Children's Hospital, Adelaide and Perth Children's Hospital.

Results: Analysis of 455 children treated for acute leukaemia showed that children from remote/very remote localities had inferior overall survival (OS) (p=0.004). Five-year OS was 91.7% (95% CI: 87.9%-94.3%) for children with acute lymphoblastic leukaemia and 69.8% (56.7%-79.5%) for acute myeloid leukaemia (AML). A larger proportion of Indigenous children from SA/NT were diagnosed with AML compared to non-Indigenous children (60.0% vs. 14.4%, p=0.001). Indigenous children were less likely to be enrolled on clinical trials (34.5% vs. 53.1%, p=0.03) and more likely to be lost to follow-up (26.1% vs. 9.2%, p=0.009).

Conclusion: Geographic remoteness of residence is associated with inferior overall survival for Australian children with leukaemia. Indigenous children with acute leukaemia suffer from disparities in treatment. These findings provide evidence to guide national policy in supporting appropriate resource allocation to overcome the challenges faced by children within these groups.

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INTRODUCTION

Globally, there is documented variation regarding presenting features, biology and outcome for childhood leukaemia according to different ethnic, geographical and socio-economic groups[1-9] Previous studies worldwide have shown higher mortality in some minority ethnic groups[6-9]. Inferior survival has been identified for children with acute leukaemia from ethnic or racial minority groups in the United States of America, such as African Americans and Hispanics, compared to Caucasian children[6-8]. While early studies showed higher overall cancer mortality in Maori and Pacific Islander people in New Zealand[4,5] more recent work reports no difference in survival compared to non-Maori/non-Pacific people[10]. While no difference in survival was seen between Manitoba First Nations people and non-First Nations children with cancer in Canada[11], survival was shown to be significantly inferior among Indigenous children with cancer in Ontario, Canada compared to non-Indigenous children[9]

Little is known about the impact of race/ethnicity and geographical distribution on survival rates for childhood leukaemia in Australia. Previous observational studies in South Australia (SA) conducted over successive periods identified a trend for more complex leukaemia with greater treatment resistance and higher relapse rates among Indigenous children and in children from remote areas[1,2].

Epidemiological studies have shown the likelihood of survival following childhood cancer diagnosis generally decreases the further an individual lives from a major population centre and in areas with greater socio-economic disadvantage[12]. Contributing factors are yet to be identified, but may be linked to reduced access to treatment and late detection[12].

The purpose of this study was to compare disease presentation and outcome for acute leukaemia in Indigenous and non-Indigenous children and to assess the impact of geographical

remoteness of residence and area-based socio-economic disadvantage in SA, Northern Territory (NT) and Western Australia (WA).

METHODS

Patients and Study Design

We performed a retrospective review of presenting features and outcomes of all children agedbetween 1 day and <18 years who were diagnosed with acute leukaemia between 1st January 2009 and 31st December 2018 at the Women's and Children's Hospital (WCH) in SA and Perth Children's Hospital (PCH) in WA. WCH and PCH are the sole referral sites for children with cancer for their states, with WCH also serving as the primary referral centre for children with suspected malignancies from the NT.

Cases were ascertained from hospital-based registries at WCH and PCH. Indigenous race was self-reported at the time of diagnosis. Demographic characteristics and diagnostic features at presentation, including full blood count, biochemistry, peripheral blast count, blast immunophenotype, blast genotype, molecular studies, central nervous system status, final risk stratification, clinical trial enrolment, treatment regimen and outcomes including remission status, mortality, relapse, follow-up and haematopoietic stem cell transplantation, were collected from the medical records. The World Health Organization classification of myeloid neoplasms and acute leukaemia was used for classification into diagnostic categories[13]. Final risk stratification was according to the co-operative group treatment protocols used in the respective centres, i.e. primarily the Children's Oncology Group for WA and the Berlin-Frankfurt-Munster protocols for SA/NT. Minimal residual disease (MRD) was defined as negative with values of $<5x10^{-4}$ by polymerase chain reaction or <0.01% by flow cytometry. Sibling number was obtained from the initial admission note in the medical records.

Residential address at diagnosis was assessed using two difference categorisations. First, we assessed geographic remoteness using the Australian Statistical Geography Standard Remoteness Index ('remote/very remote', 'outer regional,' 'inner regional' or 'major city')[14] and, second, by area-based socio-economic status (SES) using the Index of Relative Socio-economic Disadvantage ('least disadvantaged' (quintile 5 scores), 'middle SES' (quintiles 2 to 4) and 'most disadvantaged' (quintile 1)[15]. The latter (referred to hereafter as socio-economic status) is derived from national census data and incorporates income, educational attainment, employment and type of occupation.

Ethics Approval

This study was approved by the Women's and Children's Health Network Human Research Ethics Committee (Ethics Approval Number HREC/19/WCHN/72) with ethical approval granted at all sites under the National Mutual Acceptance Agreement and the Aboriginal Human Research Ethics Committee (AHREC Protocol #:04-19-823).

Statistical Analysis

Overall survival was calculated as time in months between diagnosis and last follow-up or death. Patients were considered as lost to follow-up when they had failed to attend scheduled appointments five years following completion of treatment, whereas a hiatus of four or more weeks in scheduled treatment was classified as abandonment of treatment, as defined by the SIOP PODC Working Group[16]. Five-year overall survival rates were estimated using the Kaplan-Meier method with differences assessed using the log-rank test. Analyses were performed using SPSS version 25 (IBM, Somers, NY, USA). p values less than 0.05 were considered statistically significant.

RESULTS

Between 1st January 2009 and 31st December 2018, a total of 455 patients were diagnosed with acute leukaemia at WCH (n=202) and PCH (n=253). Over half of the children were males (57.6%, n=262/455). Patient age at diagnosis ranged from 1 day to 17 years and 10 months (mean age 6.5 years) (Table 1). No significant difference was detected between patients from SA/NT and WA with regards to gender, Indigenous race, leukaemia type, cytogenetic group, relapse rate and mortality status.

Indigenous race was self-reported for all cases. A total of 29 Indigenous children were diagnosed with leukaemia, 15 from SA/NT (7.4%) and 14 from WA (5.5%). All were identified as Aboriginal, with no individuals who identified as Torres Strait Islander from either centre. Indigenous children were significantly more likely to have a higher number of siblings (2.1 vs. 1.3, p=0.002). They were significantly older at diagnosis compared to non-Indigenous children (mean age 8.8 vs. 6.4 years, p=0.01), which was predominantly due to Indigenous children with acute myeloid leukaemia (AML) being older than non-Indigenous children (10.7 vs. 6.8 years, p=0.039).

Type of leukaemia

The majority of patients had acute lymphoblastic leukaemia (ALL) (79.8%; n=363/455), most of which were B-ALL (88.4%, 321/363), with the remainder having T-ALL (11.6%, 42/363). Among patients with B-ALL, blast genotype revealed that the largest group had hyperdiploid ALL (37.0%; n=118/319), followed by ETV6-RUNX1 fusion (17.9%; n=57/319) and normal karyotype (12.9%; n=41/319).

Among patients with AML, the largest subsets had either the t(8;21) fusion (13.4%, n=11/82) or t(15;17) fusion (13.4%, n=11/82). There was an over-representation of AML patients among Indigenous children compared to non-Indigenous children in SA/NT (60.0%, 9/15 vs. 14.4%, 27/187, p=0.001). This difference was not observed in WA (14.3%, 2/14 vs. 22.6%, 54/239, p=0.46). All of the Indigenous children with AML were from remote/very remote areas.

Geographic variation and socio-economic status

Geographically, Indigenous children were less likely to live in major cities than non-Indigenous children (41.4% vs. 72.3%, p<0.001) (Table 1, Fig. 1). There was also significant variation by area-based socio-economic status (p=0.028). In particular, no Indigenous children included in the entire study cohort lived in the least disadvantaged areas compared to 19.5% of non-Indigenous children (Table 1). However, a similar proportion of Indigenous children lived in the most disadvantaged areas compared to non-Indigenous children (20.7% vs. 19.7%) (Table 1).

Treatment and follow-up

Compared to non-Indigenous children, Indigenous children were less likely to be enrolled on clinical trials (34.5% vs. 53.1%, p=0.03) and were more likely to be lost to follow-up (26.1% vs. 9.2% p=0.009) (Table 2). There was no evidence of a difference in loss to follow-up by area-based socio-economic status (p=0.95); however, 31.2% of children from remote/very remote localities were lost to follow-up compared to 12.8% from major cities (p=0.009). A total of 10.1% of patients were lost to follow-up. Six patients abandoned therapy whilst still on treatment.

All Indigenous patients with ALL achieved MRD negativity compared to 78.8% of non-Indigenous patients (n=16/16 vs. n=241/306, p=0.041) (Table 1). There was no association found between MRD-based response and remoteness of residence

Survival

Geographical remoteness of residence was identified as a significant survival factor for the entire cohort of patients with leukaemia (p=0.004, Fig. 2). Cause of death for children from remote/very remote localities was most often due to relapse/progressive disease (57.1%; n=8) followed by infection (28.6%; n=4).

Five-year overall survival was 91.7% (95% CI = 87.9%-94.3%) for children with ALL (Table 3), with a trend towards inferior survival for Indigenous compared to non-Indigenous children with ALL (82.4% vs. 92.2%, p=0.07). Of the Indigenous children with ALL who died, half (n=3) were due to relapse or progressive disease and 2 were due to infection, with an unknown cause of death in the remaining patient. The 5-year overall survival for children with AML was 69.8% (95% CI = 56.7-79.5%) (Table 3). There was no difference in AML survival according to Indigenous race (p=0.88). No significant differences in overall survival were found by either geographical remoteness of residence (p=0.08), state/territory or area-based socio-economic status for ALL or AML (Table 3).

There were no significant differences in five-year event free survival by geographical remoteness of residence (p=0.74) or Indigenous race (p=0.56).

DISCUSSION

Our results suggest an inequity in outcome for children with acute leukaemia from remote/very remote localities and a disparity in treatment received by Indigenous children with acute leukaemia in Australia despite universal access to healthcare.

It is widely known that cancer is more likely to be fatal in Indigenous adults compared to non-Indigenous counterparts[3]. There have been few studies performed in Indigenous children, particularly within a specific cancer type. A study by Valery *et al.* revealed a reduced 5-year cancer-specific survival of 75% for Indigenous children with any type of cancer in Australia compared to 82.3% for non-Indigenous children[3]. Furthermore, Indigenous children had 1.36 times greater risk of death within 5 years of diagnosis after adjustments for rurality of residence, socio-economic disadvantage, type of cancer diagnosis and year of diagnosis[3,17].

Worldwide, there has been inconclusive evidence that geographic residence impacts on overall survival, although previous Australian studies have indicated poorer rates of survival for children with cancer who live in more isolated areas[12]. One would expect that with increasing remoteness comes reduced access to healthcare, advanced disease presentation at diagnosis, poor adherence to therapy and increased challenges associated with diagnosis, treatment and long-term follow-up[18]. In addition, it is unknown as to whether the larger relative percentage of Indigenous people in remote/very remote areas contributes to the reduced survival[12]. A larger proportion of Indigenous compared to non-Indigenous patients came from remote/very remote areas in our study, particularly from SA/NT, highlighting the overlap between geographical remoteness of residence and Indigenous race.

Generally, an inferior outcome has been observed in children with cancer from lower or middle-income countries; however, results from low socio-economic demographics in high-income countries are less consistent[19]. A study from Queensland in the early 1980s reported a significant difference in incidence and survival among children with ALL across different

socio-economic status, despite similar treatments being received[12,20]. Further research is clearly warranted to evaluate causes of poorer outcomes in children from remote areas, lower socio-economic advantage and from various races/ethnicities. There was no association found between MRD-based response and remoteness of residence in our study, suggesting the lower survival among those from remote areas is independent of this measure.

It has been estimated that 76% of Indigenous children under 15 years of age in NT reside in remote and very remote parts of Australia compared to 13% in SA and 36% in WA[21]. However, data on childhood cancer incidence by remoteness of residence and socio-economic status are scarce[18]. Consistent with previous studies[2], our study has shown Indigenous children were less likely to live in major cities. Applying the remoteness index, this showed that Indigenous children were more likely to live in communities further away from medical centres (Table 1). Furthermore, no Indigenous children in our study lived in the least disadvantaged areas. Whilst these numbers were small, this trend warrants further research.

A study by Youlden *et al.* revealed that children living in more urban areas in Australia had higher cancer rates overall, particularly for leukaemia and lymphoma[18]. It was postulated that the reduced incidence of childhood cancers in remote and very remote areas could potentially be related to reduced incidence of cancer in Indigenous residents or missed diagnosis due to lack of presentation. The incidence rates of childhood cancer were slightly higher among children in the least socio-economically disadvantaged areas in Australia compared to those in the most disadvantaged areas[18]. Whilst this study did not yield population data for SA, NT and WA, analysing incidence rates of leukaemia according to geographic remoteness and socio-economic status should be considered for future studies.

An overrepresentation of AML patients in Indigenous children diagnosed and treated in SA (WCH) between 1978 and 1998 was first reported by Bartle *et al.* in 1999[1]. These patients were

less likely to speak English and more likely to come from traditional Indigenous communities[1]. This was confirmed 12 years later by Rotte *et al.*, who again found relatively more cases of AML diagnosed among Indigenous children at WCH between 1997 and 2011[2]. The latest cohort of patients from the same geographical area (SA/NT) reported here has also shown a higher proportion of AML cases and again without specific morphological phenotype or cytogenetic abnormality[1]. The over-representation of AML in Indigenous children in SA/NT observed in three successive cohorts since 1978[1-2] warrants further investigation, in particular with regards to environmental and genetic predisposition, and interestingly was not observed here in Indigenous children from WA. Our study also seems to indicate lower overall survival for children with AML compared to current Australian Childhood Cancer Statistics (69.8% vs. 77.6%)[22], although this may be because the latter only includes children diagnosed before the age of 15 rather than 18 as per our study cohort.

Despite small patient numbers, there was a significant difference observed in clinical trial enrolment and follow-up among Indigenous children. Previous studies have reported lower participation rates in clinical trials[2], which could contribute to a less optimal outcome given less rigorous adherence to diagnostic and therapeutic guidelines[2]. Cultural and language barriers can also make discussions regarding randomised trial and informed consent challenging[2].

Consistent with previous studies[2], we found a lower rate of follow-up among Indigenous children, with a statistically significant increase in those lost to follow-up. As discussed previously, this may reflect inequality in healthcare access for those in rural and remote communities. Improvements could be made by expediting use of tele-conferencing to support a shared care model and utilisation of rural outreach oncology nurses to enhance communication with local healthcare workers[2]. Furthermore, simplification of care,

community involvement, peer support and decentralisation of care may also improve service delivery for Indigenous and remote people[23].

Strengths from this study are the high level of data quality obtained from the contributing centres. However, our paper must be interpreted in light of its limited cohort size and subsequently the small number of Indigenous children analysed, leading to reduced statistical power. We were also unable to investigate potential reasons for poorer outcomes associated with geographic remoteness of residence, such as adherence to therapy and timing of death in relation to treatment. This will be important information to gain in future studies. This study included patients diagnosed in the central and western states of Australia (SA, NT and WA) but not from the eastern states of Australia. Given that this was not a population-based study, there is potential for the analysis to miss cases that were not referred to or treated at the regional referral centres, which could influence the interpretation of our findings. However, given that WCH and PCH are the only sites which are able to treat children with cancer in their respective states and due to the vast geographical distances to the remaining seven paediatric oncology centres in the other Australian states, it is unlikely that patients would be treated elsewhere thus minimising the impact of missing patients who are referred to or treated at other centres. Indigenous status was defined by self-assessment at the involved centres and the accuracy of these data is unknown. Nevertheless, any misclassification of Indigenous status is likely to be random with respect to the factors examined here, thus is unlikely to have biased our results.

CONCLUSION

Our study has demonstrated a disparity in treatment for Indigenous children with acute leukaemia, with reduced enrolment onto clinical trials and increased rates of loss to follow-up.

Geographic remoteness of residence was associated with inferior overall survival for all children with acute leukaemia. Effective strategies are required to ensure children from regional/rural locations and Indigenous children with leukaemia receive appropriate service delivery and resource allocation to improve their survival and follow-up. The inequities highlighted among Australian children with acute leukaemia according to metro-regional divide and ethnicity provide evidence to support recommendations highlighted by the recent National Strategic Action Plan for Blood Cancer; an Australian national policy which aims to achieve "Zero Lives Lost to Blood Cancer"[24].

CONFLICTS OF INTEREST: None

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TABLE 1 Patient Characteristics.

Percentages next to numbers reflect percentages of the row. Percentages under the numbers with 95% Confidence Intervals reflect percentages of the column within the variable. Columns and rows do not always add up to 100% where source data are missing. CNS status; CNS1: absence of blast cells in CSF; CNS2: <5/µl WBCs and cytospin positive for blasts; CNS3: >5/µl WBCs and cytospin positive for blasts and/or clinical signs of CNS leukaemia.

* Inserted within certain cells to maintain confidentiality due to small patient numbers

TABLE 2 Patient Trial Enrolment and Follow-Up Status.

Percentages next to numbers reflect percentages of the row. Percentages under the numbers with 95% Confidence Intervals reflect percentages of the column within the variable. Columns and rows don't always add up to 100% where source data are missing.

**Patients who died while still regularly attending clinic appointments were not included in follow-up data.

TABLE 3 Five-year Overall Survival by Patient Characteristics.

Survival analysis excludes patients where mortality status at last follow-up date was unknown.

FIGURE 1 Geographical Remoteness of Residence according to Race. WA = Western Australia; SA = South Australia; NT = Northern Territory.

397

398 FIGURE 2 Overall Survival according to Geographic Remoteness of Residence

Table 1: Patient Characteristics

		Total Cohort			p-value
Race		**Total**	**Indigenous**	**Non-Indigenous**	
Number of patients		**455** (100%)	**29** (6.4%)	**426** (93.6%)	0.41
Leukaemia type	ALL	363 (100%) 79.8% (75.8%-83.2%)	18 (5.0%) 62.1% (44.0%-77.3%)	345 (95.0%) 81.0% (77.0%-84.4%)	0.014
	AML	92 (100%) 20.2% (16.8%-24.2%)	11 (12.0%) 37.9% (22.7%-56.0%)	81 (88.0%) 19.0% (15.6%-23.0%)	
Mean age (years)		6.5 (6.1-7.0)	8.8 (6.6-10.9)	6.4 (5.9-6.8)	0.01
Gender	Males	262 (100%) 57.6% (53.0%-62.0%)	15 (5.7%) 51.7% (34.4%-68.6%)	247 (94.3%) 58.0% (53.2%-62.6%)	0.509
	Female	193 (100%) 42.4% (38.0%-47.0%)	14 (7.3%) 48.3% (31.4%-65.6%)	179 (92.7%) 42.0% (37.4%-46.8%)	
Number of siblings		1.3 (1.2-1.5)	2.1 (1.6-2.7)	1.3 (1.2-1.4)	0.002
Geographic Remoteness of Residence	Major city	320 (100%) 70.3% (66.4%-74.8%)	12 (3.8%) 41.4% (26.5%-60.9%)	308 (96.3%) 72.3% (68.2%-76.7%)	<0.001
	Inner regional	50 (100%) 11.0% (8.5%-14.3%)	*	48 (96.0%) 11.3% (8.6%-14.7%)	
	Outer regional	50 (100%) 11.0% (8.5%-14.3%)	*	47 (94.0%) 11.0% (8.4%-14.4%)	
	Remote/Very remote	32 (100%) 7.0% (5.1%-9.8%)	11 (34.4%) 37.9% (23.6%-25.7%)	21 (65.6%) 4.9% (3.3%-7.5%)	

Area-based socio-economic status	Most disadvantaged	90 (100%) 19.8% (16.5%-23.9%)	6 (6.7%) 20.7% (10.2%-39.5%)	84 (93.3%) 19.7% (16.3%-0.23.9%)	0.028
	Middle socio-economic status	278 (100%) 61.1% (57.1%-66.0%)	22 (7.9%) 75.9% (60.5%-89.8%)	256 (92.1%) 60.1% (55.8%-65.1%)	
	Least disadvantaged	83 (100%) 18.2% (15.1%-22.2%)	0 (0.0%) 0.0%	83 (100%) 19.5% (16.1%-23.7%)	
Minimal Residual Disease	Positive	65 (100%) 20.2% (16.2%-24.9%)	0 (0.0%) 0.0%	65 (100%) 21.2% (17.0%-26.2%)	0.041
	Negative	257 (100%) 79.8% (75.1%-83.8%)	16 (6.2%) 100% (80.6%-100.0%)	241 (93.8%) 78.8% (73.8%-83.0%)	
CNS Status	CNS1	388 (100%) 89.2% (85.9%-91.8%)	22 (5.7%) 81.5% (63.3%-91.8%)	366 (94.3%) 89.7% (86.4%-92.3%)	0.182
	CNS2 & CNS3	47 (100%) 10.8% (8.2%-14.1%)	5 (10.6%) 18.5% (8.2%-36.7%)	42 (89.4%) 10.3% (7.7%-13.6%)	

Percentages next to numbers reflect percentages of the row. Percentages under the numbers with 95% Confidence Intervals reflect percentages of the column within the variable. Columns and rows do not always add up to 100% where source data are missing. CNS status; CNS1: absence of blast cells in CSF; CNS2: <5/µl WBCs and cytospin positive for blasts; CNS3: >5/µl WBCs and cytospin positive for blasts and/or clinical signs of CNS leukaemia.

* Inserted within certain cells to maintain confidentiality due to small patient numbers

Table 2: Patient Trial Enrolment and Follow-Up Status

		Total Cohort			p-value
Race		**Total**	**Indigenous**	**Non-Indigenous**	
Trial Enrolment	Yes	236 (100%) 51.9% (48.3%-57.5%)	10 (4.2%) 34.5% (22.4%-57.5%)	226 (95.7%) 53.1% (46.0%-55.3%)	0.03
	No	183 (100%) 40.2% (36.6%-45.7%)	16 (8.7%) 55.2% (42.5%-77.6%)	167 (91.3%) 39.2% (33.1%-42.0%)	
Follow-up status *	Yes - currently attending clinic	363 (100%) 89.9% (86.5%-92.4%)	17 (4.7%) 73.9% (53.5%-87.5%)	346 (95.3%) 90.8% (87.5%-93.3%)	0.009
	No - lost to follow-up	41 (100%) 10.1% (7.6%-13.5%)	6 (14.6%) 26.1% (12.5%-46.5%)	35 (85.4%) 9.2% (6.7%-12.5%)	

Percentages next to numbers reflect percentages of the row. Percentages under the numbers with 95% Confidence Intervals reflect percentages of the column within the variable. Columns and rows don't always add up to 100% where source data are missing.
*Patients who died while still regularly attending clinic appointments were not included in follow-up data.

Table 3: Five-year Overall Survival by Patient Characteristics

	Acute Lymphoblastic Leukaemia			Acute Myeloid Leukaemia		
	n	Overall Survival (95% Confidence Interval)	p-value	n	Overall Survival (95% Confidence Interval)	p-value
Total	358	91.7 (87.9-94.3)	-	89	69.8 (56.7-79.5)	-
Ethnicity			0.07			0.88
Indigenous	17	82.4 (54.7-93.9)		11	72.7 (37.1-90.3)	
Other ethnicity	341	92.2 (88.3-94.8)		78	69.4 (55.1-79.9)	
State/Territory			0.22			0.58
South Australia/Northern Territory	166	90.4 (84.5-94.1)		36	67.4 (44.8-82.4)	
Western Australia	192	92.7 (86.9-96.0)		53	70.3 (52.5-82.5)	
Remoteness			0.08			0.08
Major city	256	92.3 (87.7-95.2)		58	74.3 (58.2-85.0)	
Inner regional	39	88.5 (67.6-96.3)		10	77.1 (34.5-93.9)	
Outer regional	39	97.4 (83.2-99.6)		10	60.0 (7.6-90.4)	
Remote/very remote	21	81.0 (56.9-92.4)		11	45.5 (16.7-70.7)	
Area-based socio-economic status			0.51			0.26
Most disadvantaged	71	95.5 (86.7-98.5)		19	55.9 (27.5-76.9)	
Middle socio-economic status	220	90.2 (84.7-93.8)		51	78.6 (61.8-88.7)	
Least disadvantaged	64	93.3 (83.0-97.4)		18	66.3 (34.2-85.5)	

Survival analysis excludes patients where mortality status at last follow-up date was unknown.

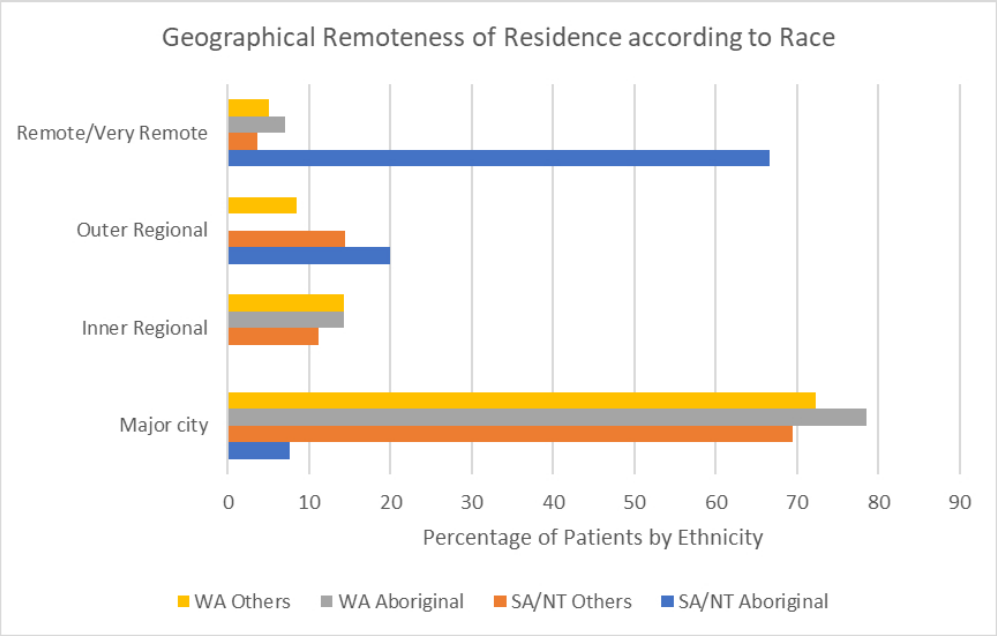

FIGURE 1 Geographical Remoteness of Residence according to Race. WA = Western Australia; SA = South Australia; NT = Northern Territory.

229x149mm (96 x 96 DPI)

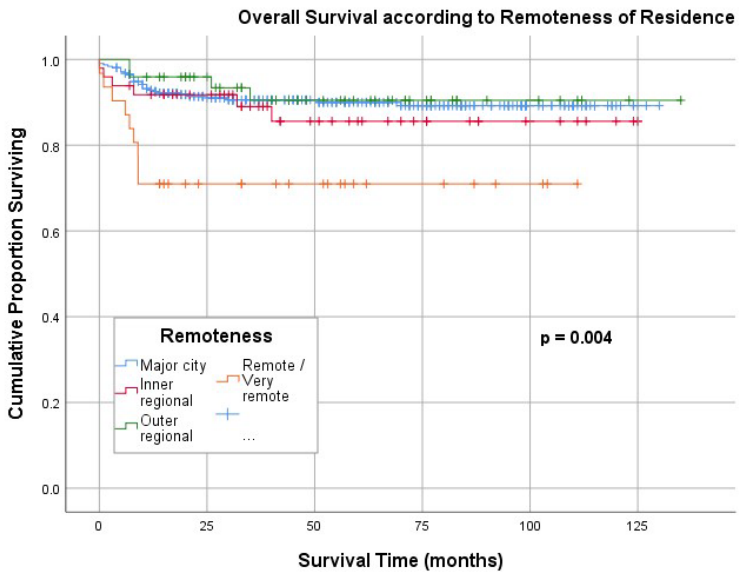

FIGURE 2 Overall Survival according to Geographic Remoteness of Residence.

300x176mm (72 x 72 DPI)