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Original Article

Disparities in cataract surgery between Aboriginal and non-Aboriginal people in New South Wales, Australia

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ABSTRACT

Background: To investigate variation in rates of cataract surgery in New South Wales, Australia by area of residence for Aboriginal and non-Aboriginal adults.

Design: Observational data linkage study of hospital admissions.

Participants: Two hundred eighty-nine thousand six hundred forty-six New South Wales residents aged 30 years and over admitted to New South Wales hospitals for 444 551 cataract surgery procedures between 2001 and 2008.

Methods: Analysis of linked routinely collected hospital data using direct standardization and multilevel negative binomial regression models accounting for clustering of individuals within Statistical Local Areas.

Main Outcome Measures: Age-standardized cataract surgery rates and adjusted rate ratios.

Results: Aboriginal people had lower rates of cataract procedures than non-Aboriginal people of the same

age and sex, living in the same Statistical Local Area (adjusted rate ratio 0.71, 95% confidence interval 0.68–0.75). There was significant variation in cataract surgery rates across Statistical Local Areas for both Aboriginal and non-Aboriginal people, with the disparity greater in major cities and less disadvantaged areas. Rates of surgery were lower for Aboriginal than non-Aboriginal people in most Statistical Local Areas, but in a few, the rates were similar or higher for Aboriginal people.

Conclusions: Aboriginal people in New South Wales received less cataract surgery than non-Aboriginal people, despite evidence of higher cataract rates. This disparity was greatest in urban and wealthier areas. Higher rates of surgery for Aboriginal people observed in some specific locations are likely to reflect the availability of public ophthalmology services, targeted services for Aboriginal people and higher demand for surgery in these populations.

Key words: Aboriginal health, cataract surgery, data linkage, disadvantage.

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INTRODUCTION

Aboriginal people experience a higher burden of eye disease than the general Australian population. When accounting for differences in age between Aboriginal and non-Aboriginal populations, the rate of blindness among Aboriginal adults is 2.8%, 6.2 times the rate for the total population, and the rate of low vision is 14.4%, 2.8 times the total population rate.¹ The occurrence of cataract is also higher, with 11% of Aboriginal people aged over 55 reporting a history of cataract compared with 7% of non-Aboriginal people.² Cataract causes 32% of blindness and 27% of low vision in Aboriginal adults (aged over 40 years),¹ with only 65% of those with vision loss from cataract having received surgery.³

A disparity has been shown in cataract surgery rates between Aboriginal and non-Aboriginal people. Accounting for differences in age, the cataract procedure rate in New South Wales (NSW) was 561 per 100 000 for Aboriginal people and 817 for non-Aboriginal people in the financial year 2010/2011, a significantly lower rate for Aboriginal people.⁴ However, the extent to which this disparity is due to the different geographic distribution of Aboriginal people, who are more likely to live in more remote areas, or due to variation in surgery rates within local areas, has not previously been quantified. Quantifying variation in surgery rates by area will help identify local areas where barriers to access may be greatest.

This study used linked hospital data for NSW to (i) quantify the disparity in rates of cataract surgery for Aboriginal and non-Aboriginal people; (ii) determine whether this disparity persisted once geographical area of residence was taken into account; and (iii) identify how this disparity varied across local areas.

METHODS

Design, setting and participants

This was an observational study of linked hospital records for the period 2001–2008. Data on cataract procedures were obtained from the NSW Admitted Patient Data Collection (APDC). The APDC includes records of all inpatient separations (discharges, transfers and deaths) from NSW public and private hospitals and day procedure centres. Diagnoses related to each hospital admission were coded at the time of separation according to the 10th revision of the International Classification of Diseases, Australian Modification, and procedures were recorded according to the Australian Classification of Health Interventions.⁵ The APDC was linked by the NSW Centre for Health Record Linkage using probabilistic methods, involving the calculation of linkage

weights based on the observed agreements and disagreements of variables including name, date of birth and address, to create longitudinal records for individuals.

Study subjects were aged 30 years and over and had at least one cataract procedure (procedure block codes 195–200) between 2001 and 2008. They were grouped into 189 Statistical Local Areas (SLAs) of residence in NSW (2006 boundaries) using geocoded census district of residence at the time of procedure. Ten NSW SLAs were excluded from the analysis because these were located on the border with either the Australian Capital Territory or Victoria, and had the lowest crude rates of cataract procedures (<4310 per 1 000 000): Balranald, Cooma-Monaro, Murray, Palerang – Pt A, Palerang – Pt B, Queanbeyan (C), Snowy River, Wakool, Wentworth and Yass Valley (A). It is likely that residents of these SLAs received cataract procedures in hospitals across the border, the details of which were not included in the NSW hospital data. In a sensitivity analysis, including these 10 border SLAs had no impact on the Aboriginal to non-Aboriginal cataract surgery rate ratio (RR).

Variables

A person was reported as being an Aboriginal person if they were recorded as such on their most recent public hospital separation, or most recent private hospital separation where there were private hospital separations only, for any diagnosis. This increased the number of cataract surgery admissions reported for Aboriginal people by 16% compared with reporting based on the admission for cataract surgery alone. Because of the small proportion of admissions recorded as 'Torres Strait Islander but not Aboriginal' in the NSW hospital data (0.1%), Aboriginal and Torres Strait Islander peoples were considered as one group and referred to as Aboriginal people. Other individual characteristics were sex, age at admission, patient status (public, private, and Veteran's Affairs), hospital type (public and private) and a record of smoking and type 2 diabetes on the cataract surgery admission.

Characteristics of the area of residence, or SLAs, included remoteness of residence classified using the Accessibility/Remoteness Index of Australia,⁶ socioeconomic status (SES) based on the Australian Bureau of Statistics (ABS) Socio-Economic Index for Areas Index of Relative Socioeconomic Disadvantage⁷ and percentage of Aboriginal residents at the 2006 Australian Census.⁸

Statistical analysis

Demographic characteristics of Aboriginal and non-Aboriginal subjects were compared using chi-square

tests. Directly age-standardized cataract surgery rates per 1 000 000 people were calculated for NSW using the Australian Standard Population (2001). Estimated resident populations for each SLA were obtained by age, sex and Aboriginal status using the 2001 and 2006 Australian Census data (Australian Bureau of Statistics, unpublished data) and combined with year-specific population projections⁹ to obtain synthetic estimates of the midyear populations of Aboriginal and non-Aboriginal people by SLA, year, age group and sex.¹⁰

Multilevel negative binomial regression was used to estimate the disparity in the rate of procedures between Aboriginal and non-Aboriginal people, using total cataract surgery admissions as the numerator and the estimated midyear population by SLA as the denominator, producing a RR. This analysis adjusted for geographic clustering by including a random intercept, allowing the overall cataract surgery rate to vary by SLA and quantified variation at the SLA level (τ^2). Using area-level 'shrunken' residuals from multilevel models that borrow information from the average to stabilize estimates,¹¹ we estimated cataract surgery rates in each SLA for both Aboriginal and non-Aboriginal people (separately), as well as the RR of Aboriginal to non-Aboriginal procedures. Confidence intervals (CIs) were calculated at the 95% level. All analyses were carried out using SAS 9.2¹² and MLwiN 2.24.¹³

RESULTS

Patient characteristics

Study subjects were $n = 289\,646$ individuals aged over 30 years who had at least one cataract procedure between 1 January 2001 and 30 December 2008, with 444 551 cataract procedures in total. Of these, 1893 (0.43%) were Aboriginal and 442 658 (99.57%) were non-Aboriginal people. Overall, more women received a cataract procedure than men, and more than half of the procedures (54%) were for those aged 75 years and over. Aboriginal people admitted for cataract surgery were younger than non-Aboriginal people (mean age 67 compared with 74), more likely to have type 2 diabetes and smoking recorded on the admission, more likely to be a public patient, go to a public hospital, live in a more disadvantaged area and less likely to live in a major city (Table 1).

Age-standardized rates

The overall age-standardized rate (ASR) of cataract surgery for Aboriginal people in NSW between 2001 and 2008 was 9416 per 1 000 000 per year, compared with 13 278 for non-Aboriginal people, a ratio of

Table 1. Characteristics of patients 30 years and over admitted for cataract surgery in New South Wales, 2001–2008

	Aboriginal <i>n</i> = 1893	Non-Aboriginal <i>n</i> = 442 658	χ^2 <i>P</i> =
Age			<0.01
30–44	63 (3.3%)	3461 (0.8%)	
45–59	380 (20.1%)	32 817 (7.4%)	
60–74	972 (51.3%)	165 117 (37.3%)	
75 and over	478 (25.3%)	241 263 (54.5%)	
Sex			0.94
Men	783 (41.4%)	183 465 (41.4%)	
Women	1110 (58.6%)	259 193 (58.6%)	
Risk factors			<0.01
Diabetes (type 2)	678 (35.8%)	58 287 (13.2%)	
Smoking	305 (16.1%)	23 114 (5.2%)	
Patient status			<0.01
Public patient	1506 (79.6%)	125 893 (28.4%)	
Private patient	320 (16.9%)	275 141 (62.2%)	
Veterans affairs	61 (3.2%)	38 743 (8.8%)	
Missing or invalid	6 (0.3%)	2881 (0.7%)	
Hospital type			<0.01
Private	407 (21.5%)	310 275 (70.1%)	
Public	1486 (78.5%)	132 383 (29.9%)	
SES quintiles			<0.01
1 least disadvantaged	63 (3.3%)	93 434 (21.1%)	
2	156 (8.2%)	75 328 (17.0%)	
3	260 (13.7%)	85 556 (19.3%)	
4	582 (30.7%)	99 535 (22.5%)	
5 most disadvantaged	832 (44.0%)	88 788 (20.1%)	
ARIA+ of residence			<0.01
Major city	427 (22.6%)	247 648 (55.9%)	
Inner regional	676 (35.7%)	136 094 (30.7%)	
Outer regional	522 (27.6%)	55 830 (12.6%)	
Remote/very remote	268 (14.2%)	3069 (0.7%)	
% Aboriginal residents			<0.01
≤1%	148 (7.8%)	174 136 (39.3%)	
>1 and ≤3%	562 (29.7%)	174 055 (39.3%)	
>3 and ≤6%	479 (25.3%)	70 203 (15.9%)	
>6 and ≤10%	298 (15.7%)	16 858 (3.8%)	
>10%	406 (21.4%)	7389 (1.7%)	

ARIA+, Accessibility/Remoteness Index of Australia; SES, socioeconomic status.

0.71 (95% CI 0.69–0.73; Table 2). The rate of surgery increased with age, as did the disparity in surgery rates between Aboriginal and non-Aboriginal people as shown by the decreasing RR. There were higher rates for women compared with men for both Aboriginal and non-Aboriginal people. Aboriginal people living in the most disadvantaged or remote SLAs had higher rates of cataract surgery than those in the least disadvantaged or major city SLAs.

Modelling

After adjusting for age and sex and geographical clustering, Aboriginal people had a 29% lower rate

Table 2. Age-standardized cataract surgery rates for people aged 30 years and over in New South Wales,[§] 2001–2008

	Aboriginal ASR per 1 000 000 per year	Non-Aboriginal ASR per 1 000 000 per year	Rate ratio	95% CI
Total	9416	13 278	0.71	0.69–0.73 [†]
Individual characteristic				
Age [‡]				
30–44	283	298	0.95	0.74–1.22
45–59	2835	3224	0.88	0.79–0.97 [†]
60–74	19 876	26 680	0.74	0.70–0.79 [†]
75 and over	43 554	71 331	0.61	0.56–0.67 [†]
Sex				
Men	8403	12 447	0.68	0.64–0.71 [†]
Women	10 116	14 087	0.72	0.69–0.75 [†]
Area characteristic				
SES quintiles				
1 least disadvantaged	7348	14 058	0.52	0.44–0.62 [†]
2	7345	12 967	0.57	0.51–0.63 [†]
3	7379	12 508	0.59	0.54–0.64 [†]
4	10 238	13 278	0.77	0.73–0.82 [†]
5 most disadvantaged	10 720	13 515	0.79	0.76–0.83 [†]
Remoteness of residence				
Major city	6563	12 954	0.51	0.48–0.54 [†]
Inner regional	10 792	13 685	0.79	0.75–0.83 [†]
Outer regional	10 383	13 848	0.75	0.70–0.80 [†]
Remote/very remote	12 788	12 255	1.04	0.95–1.15
% Aboriginal residents				
≤1%	6184	13 552	0.46	0.41–0.51 [†]
>1 and ≤3%	7691	12 495	0.62	0.58–0.65 [†]
>3 and ≤6%	10 694	14 958	0.71	0.67–0.76 [†]
>6 and ≤10%	12 735	13 148	0.97	0.89–1.05
>10%	12 417	12 783	0.97	0.90–1.05

[†]Significant at the 0.05 level. [‡]Crude rates, not standardized. [§]10 Statistical Local Areas (SLAs) with very low cataract procedure rates removed. ASR, age-standardized rate; CI, confidence interval; SES, socioeconomic status.

Table 3. Procedure rate ratios for cataract surgery among people aged 30 and over in New South Wales, 2001–2008

	ARR	95% CI	P-value
Aboriginal			
No (ref)	1.00		<0.01
Yes	0.71	0.68–0.75	
Sex			
Male (ref)	1.00		<0.01
Female	1.11	1.10–1.13	
Age group			
30–44 (ref)	1.00		<0.01
45–59	10.56	10.17–10.96	
60–74	86.14	83.16–89.24	
75 and over	232.06	224.02–240.39	

Multilevel negative binomial regression model with a random intercept for Statistical Local Area (SLA) of residence and the log of the population as an offset. There was significant variation at the SLA level, with $\tau^2 = 0.051$. ARR, adjusted rate ratio; CI, confidence interval; ref, referent value for that variable.

of cataract surgery than non-Aboriginal people of the same age group and sex (Table 3; adjusted RR 0.71, 95% CI 0.68–0.75), indicating that geographical clustering of the Aboriginal population did not

explain the disparity in ASRs. Addition of SLA-level variables (Table 4) showed that cataract surgery rates did not vary significantly by remoteness, but did differ by SES in a 'u'-shaped pattern (lowest rates in the middle quintile) and by percentage of Aboriginal people living in the area (lower rates in areas where 1–3% of the population were Aboriginal people compared with areas where <1% of the population were Aboriginal people).

Interactions between Aboriginal status and the SLA-level variables were added into the age- and sex-adjusted model one at a time to determine whether there were different patterns for Aboriginal and non-Aboriginal people (Fig. 1). There was a strong gradient of decreasing disparity with increasing disadvantage for Aboriginal people (Fig. 1a). Similarly, the disparity was high in major city localities, but the disparity reduced with increasing remoteness (Fig. 1b). There was a similar pattern for decreasing disparity with increasing percentage of Aboriginal people as residents (Fig. 1c).

Models allowing the rate of cataract surgery for Aboriginal and non-Aboriginal people to vary between SLAs, and the Aboriginal to non-Aboriginal

Table 4. Procedure rate ratios for area characteristics[†] for people aged 30 and over in New South Wales, 2001–2008

	ARR	95% CI	P-value	τ^2
SES quintiles				
1 – least disadvantaged (ref)	1.00		0.04	0.048
2	0.89	0.79–1.01		
3	0.85	0.76–0.96		
4	0.94	0.84–1.05		
5 – most disadvantaged	0.96	0.86–1.07		
Remoteness of residence				
Major city (ref)	1.00		0.91	0.051
Inner regional	0.99	0.91–1.08		
Outer regional	0.98	0.90–1.07		
Remote/very remote	0.95	0.83–1.10		
% Aboriginal residents				
≤1% (ref)	1.00		<0.01	0.045
>1 and ≤3%	0.88	0.81–0.95		
>3 and ≤6%	1.05	0.96–1.16		
>6 and ≤10%	0.99	0.87–1.12		
>10%	0.95	0.83–1.08		

[†]Area characteristics added one at a time into the multilevel negative binomial regression model with a random intercept for Statistical Local Area (SLA) of residence and the log of the population as an offset. Also adjusting for age group, sex and Aboriginal status. ARR, adjusted rate ratio; CI, confidence interval; ref, referent value for that variable; SES, socioeconomic status; τ^2 , variation at SLA level.

RR to vary, indicated that there was significant variation in the age- and sex-adjusted rate of cataract surgery for Aboriginal people between SLAs ($P < 0.01$), in the rate of surgery for non-Aboriginal people between SLAs ($P < 0.01$), and in the Aboriginal to non-Aboriginal RR (i.e. the disparity) by SLA ($P < 0.01$; Fig. 2). Figure 2 shows that most of the SLAs had lower rates of cataract surgery for Aboriginal people than non-Aboriginal people, but some had similar rates and two – Moree Plains and Armidale Dumaresq (City) – had a significantly higher rate of cataract surgery for Aboriginal people compared with non-Aboriginal people. Nine more SLAs – Wagga Wagga (Part A), Bourke, Central Darling, Richmond Valley (Casino), Wellington, Bathurst Regional (Part A), Narrabri, Parkes and Walgett – had higher rates for Aboriginal people, but not significantly so.

DISCUSSION

This study found that the age-adjusted rate of cataract surgery in NSW for Aboriginal people was 29% lower than for non-Aboriginal people. This is despite previous evidence showing that rates of cataracts are higher among Aboriginal people.¹ There may be a greater risk of cataract-related vision impairment for Aboriginal people because of a higher prevalence of risk factors such as lower SES, smoking, exposure to

ultraviolet light and diabetes.^{14,15} However, it may be that much of the disparity is due to the lower rate of cataract surgery for Aboriginal people and consequent higher rates of untreated cataracts.

The lower rate of cataract surgery in our study persisted after additionally adjusting for SLA of residence in a multilevel model, indicating that the disparity was not explained by the higher proportion of Aboriginal people living in more regional and remote areas. In fact, our results showed that there was no significant difference in overall cataract surgery rates by remoteness categories. There was a difference by SES quintiles, with the lowest rates of surgery in the areas that were grouped into the middle quintile. This 'u'-shaped relationship between cataract surgery rates and SES was also shown in Western Australia in 2001, although in that study, rates of cataract surgery were significantly higher in the least-disadvantaged areas compared with the most disadvantaged areas.¹⁶ Ng and colleagues hypothesized that these results by SES, as well as higher rates in metropolitan than rural areas, reflected the availability of privately provided cataract surgery in more advantaged, urban areas. National data for 2005/2006 to 2007/2008 found that the availability of eye health services was lower in areas with a larger proportion of Aboriginal people,¹⁷ whereas we found a similar rate in areas with the lowest and highest proportions of Aboriginal people. The similar levels of cataract surgery found in our study for those living in remote and disadvantaged areas and areas with higher proportions of Aboriginal people, compared with those in more urban, advantaged areas of NSW, is likely to reflect concerted efforts to improve access to cataract surgery services in regional and remote areas of NSW.

Our study found the greatest disparity in cataract surgery rates for Aboriginal people in urban and least-disadvantaged areas, and areas with lower percentages of Aboriginal people. Although urban areas should have more cataract surgical services per person than regional and remote areas, the procedures are concentrated in the private sector. Private hospitals may be inaccessible to Aboriginal people because of low levels of private health insurance and because they may not provide 'culturally safe' environments where Aboriginal people feel respected and secure in their identity, culture and community.¹⁸ In our data, almost 80% of Aboriginal people had their cataract surgery in a public facility, and only 17% were admitted as private patients. Waiting lists for public ophthalmology clinics and surgery services are long, and Aboriginal people appear to experience longer waiting times than non-Aboriginal people.¹⁹ This suggests that the level of public sector service provision is a key driver of the disparity in surgery rates. Indeed, a recent report by Maher and colleagues showed that in Western NSW,

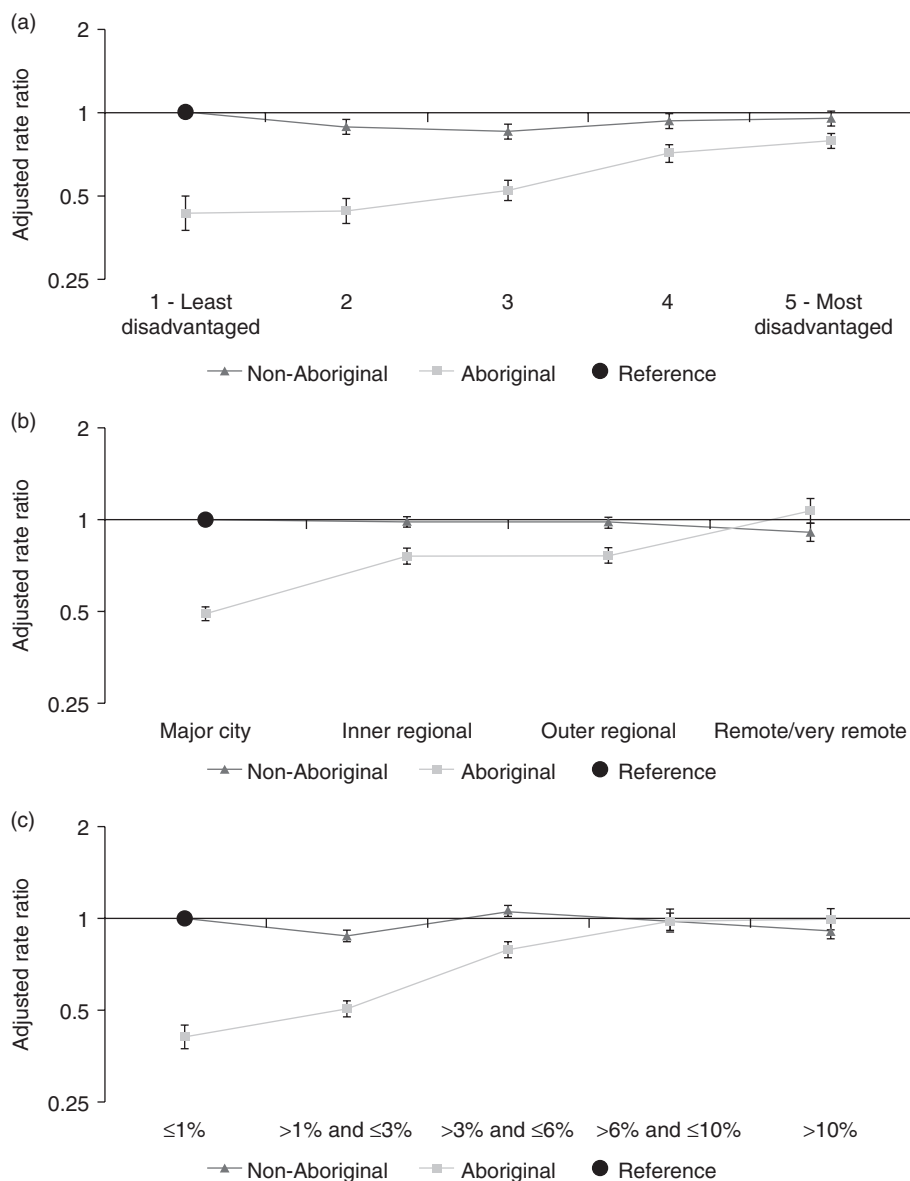


Figure 1. Adjusted procedure rate ratios for interactions between Aboriginal status and (a) socio-economic status of area, (b) remoteness of residence and (c) percentage of residents who are Aboriginal people, for those aged 30 and over in New South Wales, 2001–2008. Adjusted for age and sex, and accounting for Statistical Local Area of residence through a random intercept. The reference group for each is the first non-Aboriginal group, that is non-Aboriginal people in the least disadvantaged quintile, etc. A value over 1 indicates that the rate of procedures in the group is higher than in the reference group, and a value under 1 indicates that it is lower.

cataract surgery rates for Aboriginal people were significantly higher in local government areas where public ophthalmology clinics are available.²⁰ In areas without public ophthalmology clinics or outreach clinics, patients are required to attend a private clinic in order to access public surgical services, and this may incur a cost if bulk billing to Medicare is not provided. The Aboriginal perspective on access barriers to cataract surgery is not clearly documented and could assist in identifying ways to address the disparity.

Although we found that Aboriginal people had lower rates of cataract surgery than non-Aboriginal people in most SLAs in NSW, we also found evidence of success in tackling this disparity in a small number of areas. Two areas, Moree Plains and Armidale Dumaresq (City), had significantly higher

rates of cataract surgery for Aboriginal people. In 2007, Moree District Health Service, Pius X Aboriginal Coporation and the Outback Eye Service established an integrated eye health service in Moree for Aboriginal people, including a public clinic with eye health nursing, optometry and ophthalmology, as well as cataract surgery services.²¹ Similarly, in Bourke, where the rate of Aboriginal cataract surgeries was higher than that for non-Aboriginal people, although not significantly so, the Outback Eye Service provides bulk-billed ophthalmology services and cataract surgery, in partnership with the Local Health District and the Bourke Aboriginal Health Service.²⁰ In Armidale, the New England Medicare Local provides culturally competent care coordination, transport and financial support for eligible Aboriginal people to attend a private

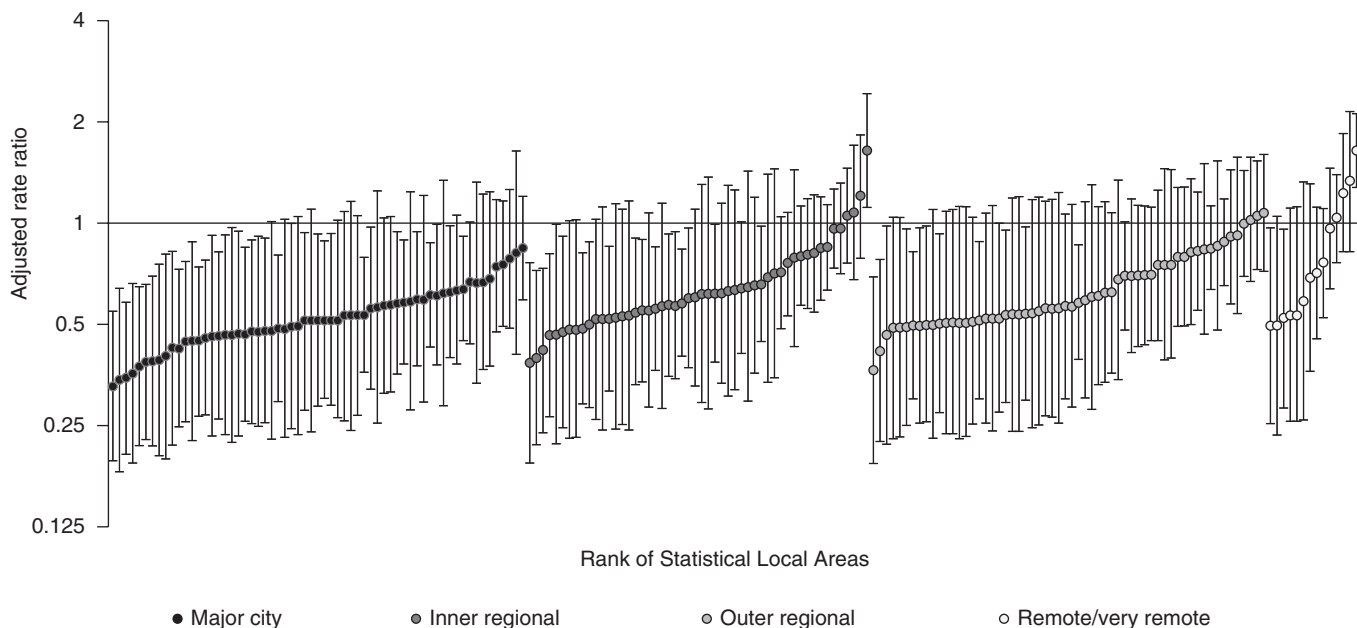


Figure 2. Variation in the Aboriginal to non-Aboriginal cataract surgery rate ratios in New South Wales by Statistical Local Area (SLA) for people aged 30 years and over, 2001–2008, grouped by remoteness categories. Cataract surgery rate ratios for each SLA calculated from the ‘shrunk’ area-level residuals from a random intercept and slope multilevel model adjusted for age group and sex. A ratio less than 1 indicates that Aboriginal people have fewer procedures than non-Aboriginal people, and a ratio greater than 1 indicates that Aboriginal people have more procedures than non-Aboriginal people.

ophthalmologist consultation at no cost, and collaborative partnerships exist between primary health-care and eye health services providers. These examples indicate that the development of accessible, affordable and culturally competent eye health services for Aboriginal people can positively impact cataract surgery rates for Aboriginal people. Outreach eye services can assist in overcoming barriers of distance, communication and cultural inappropriateness of services,¹⁸ and outreach eye services with better integration of optometry and ophthalmology roles improve the efficiency of the services.¹⁹

The use of administrative data in this study conferred some limitations. Firstly, Aboriginal people are known to be underreported in the NSW APDC, particularly in major city areas. We enhanced reporting of Aboriginal people by using Aboriginal status as recorded on the most recent public hospital admission in the data. This approach takes advantage of improvements in the recording of Aboriginal status over time, and better reporting in public hospitals, and results in an increase in Aboriginal enumeration of similar magnitude to the known level of underreporting.²² Our results by SLA demonstrated a lower rate of surgery for Aboriginal people in most SLAs, not just the major city SLAs with the poorest recording. Secondly, rates for SLAs were calculated using synthetic population denominators derived from ABS-estimated Aboriginal populations using a number of assumptions; the reliability of these are

unknown.¹⁰ Finally, we did not have information on cataract surgery procedures for those who may have travelled across the border to a facility in another State. However, our main estimate of the Aboriginal to non-Aboriginal disparity in surgery rates was unchanged regardless of whether we included or excluded the 10 border SLAs with the lowest rates of cataract surgery.

CONCLUSION

Aboriginal people in NSW receive less cataract surgery than non-Aboriginal people, even though their rates of cataract are higher. This disparity is greatest in urban and wealthier areas. The level of public sector service provision appears to be the key driver of the disparity, and higher rates of surgery for Aboriginal people than non-Aboriginal people in specific areas is likely to reflect the availability of public ophthalmology services, high level of need and targeted services for Aboriginal people.

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