

# The prevalence of trachoma in Australia: the National Indigenous Eye Health Survey

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Trachoma, or “sandy blight”, disappeared from urban Australia in the early 20th century,<sup>1</sup> and from regional communities during the 1930s. Despite a chance comment in 1688 by a Dutch navigator, William Dampier, trachoma was not a feature of traditional Aboriginal life.<sup>2</sup> Traditional Aboriginal culture is based on good vision and visual representation, not on blindness and visual disability. Trachoma was reported in Aboriginal communities in the 1930s, and studied systematically by Father Frank Flynn, an army chaplain and ophthalmologist in the Northern Territory during the Second World War.<sup>3</sup> Dame Ida Mann clearly showed trachoma to be a widespread problem in the 1950s and 1960s.<sup>4</sup> The extent of trachoma in Aboriginal communities was further defined by Fred Hollows and the National Trachoma and Eye Health Program (NTEHP) in the 1970s.<sup>5</sup>

However, without coordinated and sustained effort, trachoma control has limited impact,<sup>6</sup> and blinding endemic trachoma still persists in Aboriginal communities<sup>7-10</sup> despite the knowledge that has been gathered about its control.<sup>11,12</sup>

We report the prevalence of trachoma found in a national, population-based random cluster sample survey of eye health among Indigenous children and older adults.

## METHODS

### Sample selection

The sampling method has been described in detail elsewhere.<sup>13</sup> Briefly, we grouped Australian Bureau of Statistics (ABS) Indigenous Areas (IAREs) into five strata based on the Accessibility/Remoteness Index of Australia:<sup>14</sup> “major city”, “inner regional”, “outer regional”, “remote”, and “very remote”. The very remote stratum was then subdivided into “very remote coastal” and “very remote inland”. Within each of these six strata, five sample areas or communities were randomly selected using 2006 ABS census data<sup>15</sup> to identify geographical areas containing about 300 Indigenous people. The sample size of 1500 children aged 5 to 15 years and 1500 adults aged 40 years and older was selected based on the ability to detect changes in vision impairment;<sup>13</sup> it also conformed to the

## ABSTRACT

**Objective:** To determine the prevalence of trachoma among Indigenous Australians.

**Design, setting and participants:** A national, stratified, random cluster sample survey of Indigenous children (5–15 years) and adults ( $\geq 40$  years) in 30 communities across Australia. Data collection was undertaken in 2008.

**Main outcome measures:** Results based on a standardised protocol that included trachoma grading and double grading of photographs of the tarsus.

**Results:** 1694 Indigenous children and 1189 Indigenous adults were examined. Recruitment rates were 84% for children and 72% for adults. The overall rate of follicular trachomatous inflammation among children was 3.8%, ranging from 0.6% in major cities to 7.3% in very remote areas; 50% of communities in very remote areas had endemic rates ( $> 5\%$ ). Trachomatous scarring (TS) occurred among 15.7% of adults, trachomatous trichiasis (TT) among 1.4% and corneal opacity (CO) among 0.3%. TS was found in all regions and TT in all except major cities and inner regional areas. The highest community rates for TS were 58.3%; for TT, 14.6%; and for CO, 3.3%.

**Conclusion:** Blinding endemic trachoma remains a major public health problem in many Aboriginal and Torres Strait Islander communities. Although active trachoma is predominantly seen in very remote communities, scarring and blinding sequelae occur among Indigenous people across the country. The Australian Government's recent commitment to eliminate blinding trachoma is welcomed and much needed.

MJA 2010; 192: 248–253

See also page 275

World Health Organization's recommendation for the assessment of trachoma of 50 children per cluster.<sup>16</sup> Fieldwork was undertaken between January and December 2008.

### Recruitment

An informal census was undertaken at each site using community data and local informants to establish the size of the eligible population of Indigenous children aged 5 to 15 years (inclusive) and Indigenous adults aged 40 years and older.

### Examination procedures

A standardised questionnaire collected data on demographics, general health, eye health and health service utilisation, and a standardised eye examination was performed.<sup>13</sup> Trachoma was graded in each eye using a  $\times 2.5$  loupe according to the WHO simple grading system,<sup>17</sup> where:

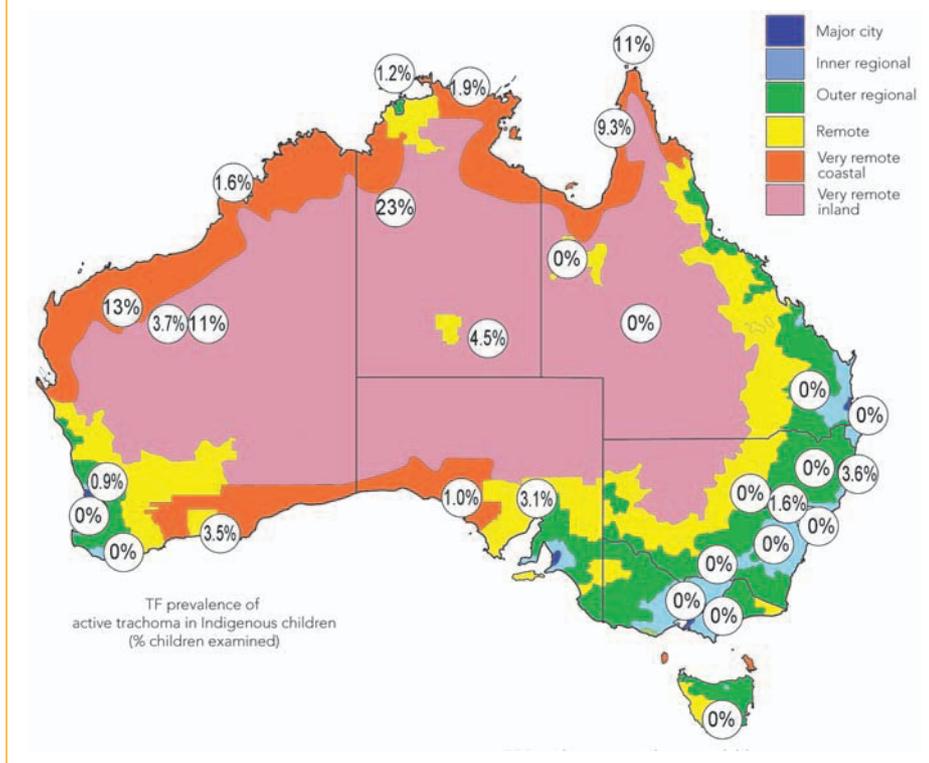
- trachomatous inflammation, follicular (TF) was defined as the presence of five or more follicles in the upper tarsal conjunctiva;
- trachomatous inflammation, intense (TI) as pronounced inflammatory thickening of the tarsal conjunctiva that obscures more than half of the normal deep tarsal vessels;

- trachomatous trichiasis (TT) as the presence of at least one eyelash rubbing on the eyeball;
- trachomatous scarring (TS) as the presence of scarring in the tarsal conjunctiva; and
- corneal opacity (CO) as easily visible corneal opacity over the pupil.

The trachoma graders were given self-directed trachoma grading training using an interactive CD-ROM.<sup>18</sup> Photographs of the everted left tarsal plate were taken with a Nikon D40 digital camera using an 80 mm lens and extension rings (Nikon Corporation, Tokyo, Japan).

All trachoma photographs were graded twice by the same experienced grader using a fine grading system.<sup>19</sup> Follicles 1 ( $F_1$ ) was defined as one or two small follicles in the upper tarsal conjunctiva; Follicles 2 ( $F_2$ ) as greater than two but fewer than five follicles of 0.5 mm in diameter in the upper tarsal conjunctiva (ie, less severe than TF); Scarring 1 ( $S_1$ ) as a small amount of early scarring apparent, but not clearly visible; and Scarring 2 ( $S_2$ ) as a moderate amount of early scarring apparent, but not clearly visible (ie, less severe than TS). Grading was performed on a laptop computer without knowledge of the clinical or photograding.

### 1 Prevalence of active trachoma among Indigenous children (aged 5–15 years) in 30 communities around Australia, 2008



When the two photogradings disagreed on the presence or absence of a WHO-defined sign, the photograph was regraded for a third, definitive time.

In this analysis, the photograding was used to define trachoma (TF, TI and TS) except when photographs were not available, in which case the clinical grading was used. TT and CO were assessed clinically. Participants were considered to have active trachoma if TF and/or TI were present.

#### Data analysis

Data were entered into an electronic database using Access 2000 (Microsoft Corporation, Redmond, Wash, USA). Data were checked for missing values, and missing data were followed up where possible. Analyses were performed using Microsoft Access and Stata, version 10.2 (StataCorp, College Station, Tex, USA). Age-specific rates for adults are shown in 5-year age groups. A rolling 3-year and three-age-group (ie, 15 years) average was used to graph age-specific data for children and adults, respectively.

#### Ethics approval

Primary ethics approval was obtained from the Human Research Ethics Committee of the Royal Victorian Eye and Ear Hospital.

Further separate formal ethics approval was obtained from the Aboriginal Health and Medical Research Council of New South Wales, the Aboriginal Health Council of South Australia, the Menzies School of Health Research, the Central Australian Human Research Ethics Committee, the Western Australian Aboriginal Health Information and Ethics Committee, ACT Health (12 November 2007), the Tasmanian Scientific Research Advisory Committee, the Tasmanian Health and Medical Human Research Ethics Committee, and the Queensland Aboriginal and Islander Health Council.<sup>20</sup> The protocol was also reviewed and approved by the Board of the National Aboriginal Community Controlled Health Organisation and by each community.

Permission was obtained to examine children in schools. This research was conducted in accordance with the tenets of the Declaration of Helsinki as revised in 2000. Written, informed consent was obtained for all participants before examination.

#### RESULTS

The informal census gave a target population of 2007 children and 1655 adults; of these, 1694 children (84.4%) and 1189 adults (71.8%) were examined. Of these,

833 children (49.2%) and 723 adults (60.8%) were female; 171 participants (5.9%) were Torres Strait Islanders.

Trachoma photograding was available for 2663 participants; clinical grading was used for 175 (6.1%) participants without a gradable photograph; and 45 participants (27 children and 18 adults) declined examination.

There was no significant sex difference in the rates of trachoma in children or adults, and the data are presented for the whole population ( $\chi^2$  tests gave *P* values between 0.2 and 1.0).

#### Prevalence of trachoma

The unadjusted rate of active trachoma (TF) in children was 3.8%; after adjustment for sampling, the rate was 2.8%. All the children with TI also had TF, so rates for TF and TI are not presented separately (Box 1). Two adults, both women, had TF; both came from very remote communities, and one also had TI. The prevalence of TF among children in these two communities was 10.1% and 23.0%, respectively. In 14 communities, no children had TF; sporadic single cases of TF occurred in one major city, and one inner regional, two remote, and two very remote coastal sites (Box 2). In 10 communities, two or more children had TF, but the prevalence in five of these communities was less than 5%. However, in five communities, all in the two very remote strata, the prevalence of TF was 5% or greater.

The age-specific rates show a peak prevalence of TF among the youngest children and a progressive overall decrease with increasing age (Box 3). In Australia, the prevalence of TF is usually presented for 5 to 9 year olds;<sup>9</sup> 862 children aged 5 to 9 years were examined for our study. The overall prevalence of TF in these children mirrored that found among all children 5 to 15 years. However, the prevalence of TF among children aged 5 to 9 years was higher in several communities — six of the 10 very remote communities had a prevalence greater than 5%; the highest was 25.7%. The overall prevalence of TF among children aged 5 to 9 years was 5.2%.

Scarring was uncommon among children, even in communities with a higher prevalence of TF (Box 2). Conversely, TS was common among adults and widely spread, occurring in all strata; in three very remote communities, over half the adults were affected (Box 2). The age-specific rates of scarring increased with age, although in

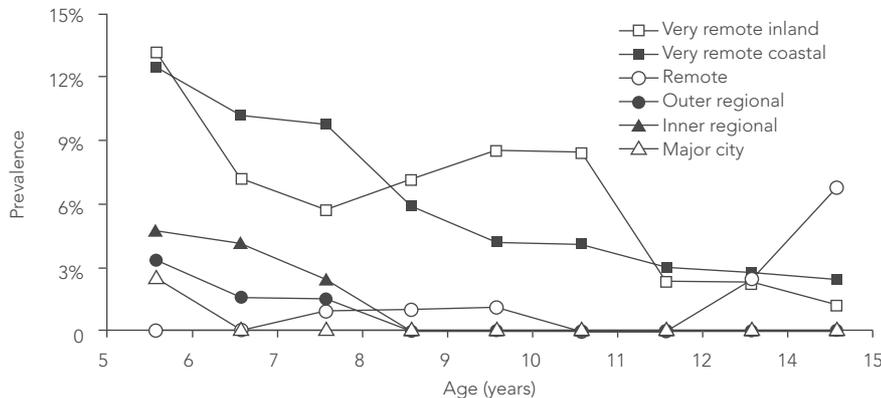
## RESEARCH

### 2 Prevalence of trachomatous disease among Indigenous children and adults in 30 communities around Australia, 2008

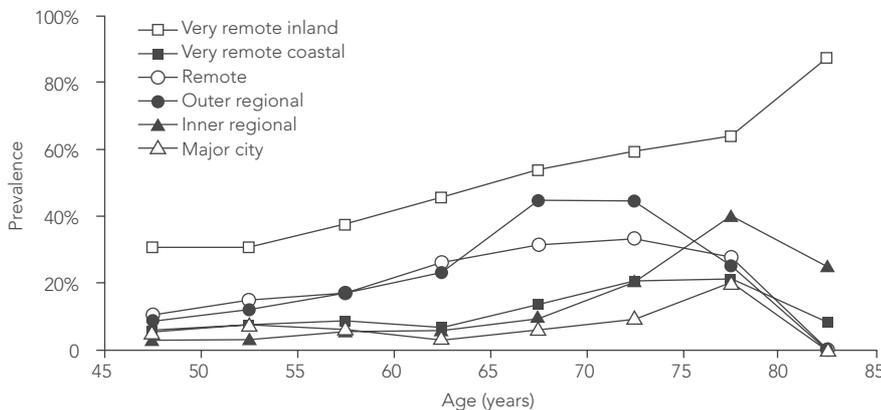
Community*	Children				Adults			
	Total no.	TF, no. (%)	TI, no. (%)	TS, no. (%)	Total no.	TS, no. (%)	TT, no. (%)	CO, no. (%)
<b>Very remote inland</b>								
Western Australia	73	8 (11.0%)	2 (2.7%)	0	60	35 (58.3%)	3 (5.0%)	2 (3.3%)
Northern Territory	44	2 (4.5%)	0	1 (2.3%)	38	21 (55.3%)	3 (7.9%)	0
NT	61	14 (23.0%)	5 (8.2%)	1 (1.6%)	48	27 (56.3%)	7 (14.6%)	1 (2.1%)
WA	82	3 (3.7%)	0	0	22	6 (27.3%)	0	0
Queensland	112	0	0	0	59	1 (1.7%)	0	0
<i>Sub-total</i>	372	27 (7.3%)	7 (1.9%)	2 (0.5%)	227	90 (39.6%)	13 (5.7%)	3 (1.3%)
<b>Very remote coastal</b>								
WA	94	12 (12.8%)	2 (2.1%)	1 (1.1%)	27	8 (29.6%)	0	0
Qld	43	4 (9.3%)	0	1 (2.3%)	50	6 (12.0%)	1 (2.0%)	0
WA	61	1 (1.6%)	0	0	46	1 (2.2%)	0	0
Qld	79	8 (10.1%)	1 (1.3%)	0	72	2 (2.8%)	0	0
NT	82	1 (1.2%)	1 (1.2%)	1 (1.2%)	59	1 (1.7%)	0	0
<i>Sub-total</i>	359	26 (7.2%)	4 (1.1%)	3 (0.8%)	254	18 (7.1%)	1 (0.4%)	0
<b>Remote</b>								
NT	52	1 (1.9%)	0	0	50	17 (34.0%)	0	0
SA	100	1 (1.0%)	0	0	82	14 (17.1%)	1 (1.2%)	0
Qld	44	0	0	1 (2.3%)	36	7 (19.4%)	0	0
WA	85	3 (3.5%)	0	0	32	2 (6.3%)	0	0
Tasmania	32	0	0	0	42	0	0	0
<i>Sub-total</i>	313	5 (1.6%)	0	1 (0.3%)	242	40 (16.5%)	1 (0.4%)	0
<b>Outer regional</b>								
South Australia	64	2 (3.1%)	0	0	46	13 (28.3%)	0	0
New South Wales	29	0	0	0	52	6 (11.5%)	0	0
WA	44	0	0	0	25	3 (12.0%)	1 (4.0%)	0
Qld	44	0	0	0	20	0	0	0
NSW	20	0	0	0	24	0	0	0
<i>Sub-total</i>	201	2 (1.0%)	0	0	167	22 (13.2%)	1 (0.6%)	0
<b>Inner regional</b>								
Australian Capital Territory	45	0	0	0	26	3 (11.5%)	0	0
WA	106	1 (0.9%)	0	0	43	3 (7.0%)	0	0
NSW	29	0	0	0	39	2 (5.1%)	0	0
Victoria	32	0	0	0	24	0	0	0
NSW	56	2 (3.6%)	0	0	33	0	0	0
<i>Sub-total</i>	268	3 (1.1%)	0	0	165	8 (4.8%)	0	0
<b>Major city</b>								
NSW	62	1 (1.6%)	0	0	45	3 (6.7%)	0	0
Qld	12	0	0	0	15	1 (6.7%)	0	0
NSW	35	0	0	0	27	1 (3.7%)	0	0
WA	44	0	0	0	25	1 (4.0%)	0	0
Vic	1	0	0	0	4	0	0	0
<i>Sub-total</i>	154	1 (0.6%)	0	0	116	6 (5.2%)	0	0
<b>Total</b>	<b>1667</b>	<b>64 (3.8%)</b>	<b>11 (0.7%)</b>	<b>6 (0.4%)</b>	<b>1171</b>	<b>184 (15.7%)</b>	<b>16 (1.4%)</b>	<b>3 (0.3%)</b>

TF = trachomatous inflammation, follicular. TI = trachomatous inflammation, intense. TS = trachomatous scarring. TT = trachomatous trichiasis. CO = corneal opacity.  
\* Communities denoted by state to maintain privacy.

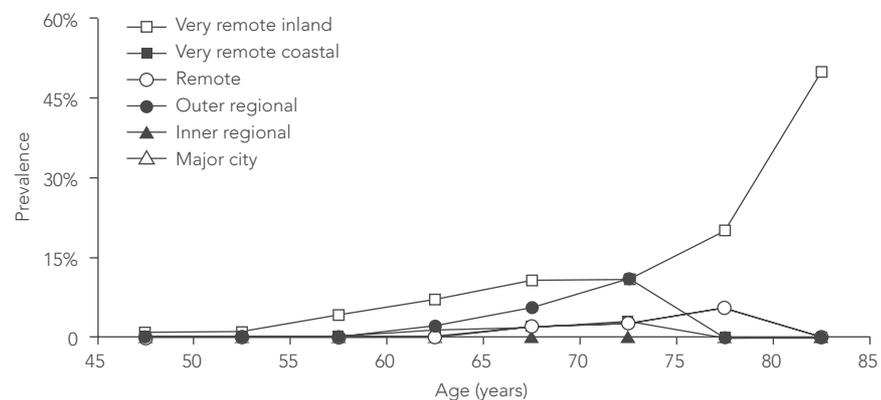
**3 Prevalence of follicular trachomatous inflammation among Indigenous children, by remoteness area (3-year rolling average)**



**4 Prevalence of trachomatous scarring among Indigenous adults, by remoteness area (15-year rolling average)**



**5 Prevalence of trachomatous trichiasis among Indigenous adults, by remoteness area (15-year rolling average)**



most strata, rates fell in the oldest age groups (Box 4).

Seven men and nine women had TT. Their ages ranged from 51 to 88 years. Three of these participants also had CO — two women aged 64 and 88 years and a man

aged 83 years. One had visual acuity of <6/18 in one eye and <6/60 in the other, the second had visual acuity of <6/60 in both eyes, and the third had light perception in one eye and no light perception in the other. A fourth participant had visual acuity of <6/12

associated with TT. An additional participant with TT was blind from cataract. The age-specific rates show a gradual increase of TT in the older age groups (Box 5). No child was found to have TT or CO.

**Specificity of TF and TS**

Overall, 6.2% of children had F<sub>1</sub>, 4.8% had F<sub>2</sub> and 3.8% had TF. None of these signs were seen in six communities, and F<sub>1</sub> alone was detected in three communities (Box 6). F<sub>2</sub> occurred in five communities without TF, although in the remaining 16 communities TF was accompanied by F<sub>1</sub> and F<sub>2</sub> (Box 6). There was a significant correlation between the presence of F<sub>2</sub> and TF ( $r=0.72$ ;  $P<0.001$ ). There was only a weak, non-significant correlation between F<sub>1</sub> and TF ( $r=0.34$ ;  $P=0.07$ ).

Overall, 3.6% of adults had S<sub>1</sub>, 8.5% had S<sub>2</sub> and 15.7% had TS. In three communities, no adults had any signs of scarring (Box 7). S<sub>1</sub> alone was found in one community, S<sub>2</sub> occurred alone in one community and together with S<sub>1</sub> in another, and TS was present in 24 (Box 7). These fine grading signs were clustered strongly. The correlation between the presence of S<sub>2</sub> and TS was strong ( $r=0.49$ ;  $P=0.006$ ), but there was no correlation between S<sub>1</sub> and TS ( $r=-0.002$ ;  $P=0.99$ ).

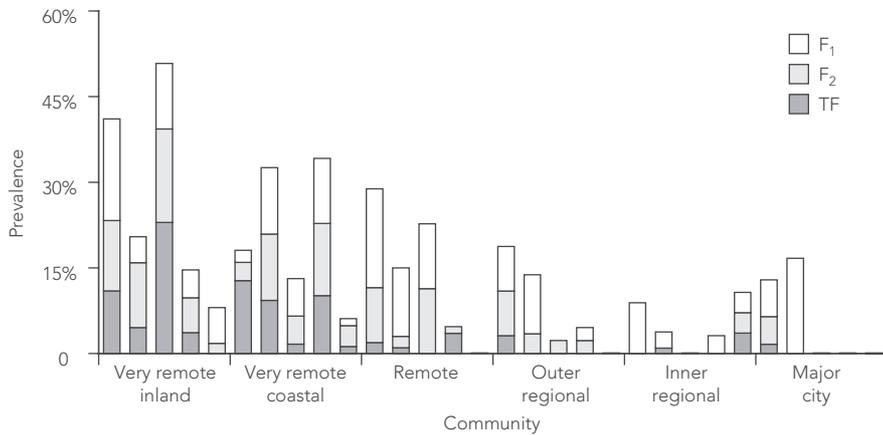
**Examination of ineligible individuals**

In addition to the study population, 375 Indigenous children and 404 adults who lived outside the defined study area presented for examination. Ineligible individuals were examined in 21 of the 30 sites. The prevalence of TS in ineligible adults was 6.7%, and its distribution mirrored that in eligible adults. TT was found in one ineligible adult in a community where TT also occurred in eligible adults. The rate of TF was 4.0% in ineligible children, and its distribution mirrored that seen in eligible children, with one exception. In one outer regional site in Queensland, four of 37 ineligible children (11%) and three of 85 adults (4%) were found to have TF, even though TF had not been found in the eligible participants. Most of those with TF were members of one extended family.

**DISCUSSION**

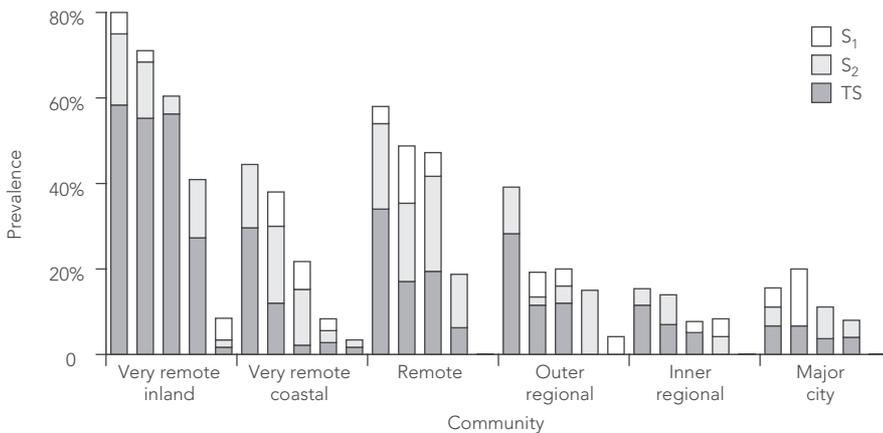
Trachoma is still common among Aboriginal and Torres Strait Islander people in Australia. Active trachoma is still common in children, especially in very remote commu-

**6 Prevalence of fine grades of follicular trachomatous inflammation among Indigenous children in 30 communities around Australia, 2008**



F<sub>1</sub> = 1–2 small follicles in the upper tarsal conjunctiva. F<sub>2</sub> = 2–5 follicles of 0.5 mm in diameter in the upper tarsal conjunctiva. TF = trachomatous inflammation, follicular.

**7 Prevalence of fine grades of trachomatous scarring among Indigenous adults in 30 communities around Australia, 2008**



S<sub>1</sub> = small amount of early scarring apparent, but not clearly visible. S<sub>2</sub> = moderate amount of early scarring apparent, but not clearly visible. TS = trachomatous scarring.

nities, and the blinding sequelae are commonly found in older people in every strata.

The strengths of our study include its national scope, the study design and sampling framework, the standardised methodology and the use of photograding for trachoma. The sampling method also permitted a cost- and time-efficient study. Weaknesses include the small sample size, the limited number of sites and the variation in examination rates between some sites.

These data are the first national trachoma data for Australia since the 1980 report of the NTEHP.<sup>5</sup> The overall prevalence of TF among children aged 5 to 15 years reported by the NTEHP was 17.6%. However, 53.9% of TF was the least severe composite grade, “FTC”,<sup>5</sup> which was not

severe enough to be graded as TF according to our criteria. The adjusted prevalence of TF (“FTA” [the most severe composite grade] and “FTB”) equivalent to TF/TI would be 9.5%. This compares with the overall crude prevalence of 3.8% found in our study. For those aged over 40 years, the NTEHP reported 56.3% had cicatricial trachoma; 40.0% of these cases were graded “CTC”, which would be less severe than TS according to our criteria. The NTEHP also found TT among 6.0% of those over 40 years — of whom 41.0% were blind (2.5% of this age group examined).<sup>5</sup> We found national rates for TS of 15.7% and 1.4% for TT. In our small sample, two adults (0.17%) were blind from trachoma.

These comparisons are limited, as the NTEHP grading system was less stringent and therefore gave higher prevalence. Second, the NTEHP examined few people in major urban centres; over two-thirds of its sample came from remote or very remote areas. The skewed study population would also have given a higher prevalence of trachoma. The NTEHP report did not provide data for individual communities and cannot be analysed retrospectively. However, although the overall rates of trachoma appear to have been reduced, the overall distribution of trachoma is not much altered.

The rates of trachoma reported from screening of Aboriginal school children in outback communities in the Northern Territory, South Australia and Western Australia in 2006 and 2007<sup>9,10</sup> are generally similar to our findings.

The fine grading of follicles identifies milder inflammation. The presence of F<sub>2</sub> closely follows TF, suggesting that it reflects a milder stage of trachoma. However, the presence of a few equivocal follicles (F<sub>1</sub>) seems to be unrelated to trachoma. It is unlikely that milder inflammation (F<sub>2</sub>) would have blinding sequelae, but it indicates an underlying level of tarsal inflammation, some of which will be waxing or waning trachoma. This highlights the need for care in grading TF, especially in areas with decreasing levels of endemicity, as overgrading can be difficult to avoid.

Scarring was uncommon among children, even as measured by fine grading. Children with scarring were all from remote or very remote communities except for one 11-year-old boy in an urban area with S<sub>1</sub>, which may not have been related to trachoma. The high rates of TS among adults and the much lower rates of TS among children in the same communities suggest a real decrease in the severity of trachoma. However, without full cross-sectional data, this observation cannot be confirmed. The infrequency of TI among children (11/64 [17%] of those with TF) also suggests a decrease in the severity of TF. In some communities, specific trachoma control activities have been implemented.<sup>10</sup> In addition, over the years, there have been obvious improvements in housing, water and sanitation and health care in general, including the ready availability and use of antibiotics to treat childhood infections. If the apparent decrease in severity of trachoma is real, it will make the recent Australian Government commitment to eliminate trachoma much more achievable.<sup>21</sup>

## RESEARCH

However, trachoma remains a significant public health problem in many communities, including half of the very remote communities in our study. Significant rates of TT still exist. The observed rate among older adults (1.4%) gives an adjusted population rate of 0.2%, double the WHO threshold.<sup>22</sup> Participants with TS who were at risk of TT were found in 24 of the 30 communities, including major cities and regional areas (presumably, these participants grew up in endemic, more remote areas) and participants with TT were found in four of the six strata. This emphasises the general and ongoing need to carefully check older Indigenous people for signs of past trachoma and TT.<sup>23</sup> Based on the observed prevalence, we estimate that throughout Australia there are 4778 Indigenous children (5 to 9 years) with TF, 16 314 adults (40 years and older) with TS, 1488 with TT and 273 with CO.

Overall, our study confirms that TF remains a problem in Indigenous Australian children in remote and very remote areas, and that the blinding sequelae of trachoma, severe tarsal scarring and TT still occur among older Indigenous people across the country. The Australian Government's recent commitment to eliminate blinding trachoma in Australia is both necessary and timely.

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## COMPETING INTERESTS

None identified.

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