

# Clinical oral health outcomes in young Australian Aboriginal adults compared with national-level counterparts

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Oral health is an integral component of overall health and wellbeing. Oral diseases are not only major causes of infection and tooth loss, but may cause debilitating pain and difficulties with eating and speaking, as well as limiting social interactions.<sup>1-3</sup> There are established associations between chronic oral infections and heart and lung diseases,<sup>4</sup> diabetes<sup>5</sup> and stroke,<sup>6</sup> and low birthweight in infants born prematurely to mothers with chronic oral infections.<sup>7,8</sup>

Two of the most frequently occurring oral diseases are dental caries and periodontal disease.<sup>9</sup> Dental caries is one of the most prevalent chronic diseases in the world.<sup>8</sup> Risk factors include physical, biological, environmental, behavioural and lifestyle-related factors such as a high-sugar diet, insufficient fluoride exposure, poor oral hygiene, inappropriate oral self-care patterns and social impoverishment.<sup>10</sup> Periodontal disease — inflammation of the tissues surrounding the teeth — results from a complex interplay between bacteria and host risk factors such as long-term smoking, poorly controlled diabetes, stress and genetic predisposition. The total burden of periodontal infections may be significant, accounting for some of the proposed risk for cardiovascular disease and other systemic conditions that share an underlying inflammatory response as a common component of pathogenesis.<sup>11</sup>

It is likely that contemporary young Australian adults have few oral health impairments because of the widespread availability of free school dental services when they were children and because they have grown up through one of Australia's most healthy and wealthy periods, resulting in historically low rates of dental disease in this generation. Young Indigenous adults are likely to be disproportionately represented among those with poor oral health outcomes, but there is limited information on dental disease prevalence and severity in Indigenous adults relative to the general population in Australia.

Traditional techniques of gathering information in oral epidemiological surveys can be unsuccessful in an Indigenous Australian context. The 2004–06 National Survey of Adult Oral Health (NSAOH) was a representative survey of the adult Australian population that was unable to recruit a representative sample

## ABSTRACT

**Objective:** To compare clinical oral health outcomes between a birth cohort of young Australian Aboriginal adults and age-matched, national-level counterparts.

**Design, setting and participants:** Comparison of outcomes between the dental component of Wave-3 of the Aboriginal Birth Cohort (ABC) study — a cross-sectional study conducted between January 2006 and December 2007, nested within a prospective longitudinal investigation in the Northern Territory's Top End — and the 2004–06 National Survey of Adult Oral Health (NSAOH), a representative survey of the Australian population. Data were analysed for 442 ABC study participants and 202 NSAOH participants aged 16–20 years.

**Main outcome measures:** Severity and prevalence of clinical oral health outcomes.

**Results:** The mean number of decayed teeth was 8.0 times higher among ABC study participants than NSAOH participants, while the prevalence of untreated decayed teeth was 3.1 times higher. ABC study participants experienced 10.8 times the prevalence of moderate or severe periodontal disease of NSAOH participants, and 1.9, 4.1 and 4.5 times the prevalence of calculus, plaque and gingivitis, respectively.

**Conclusion:** Adverse clinical oral health outcomes were 2–11 times higher in a cohort of young Australian Aboriginal adults than their age-matched, nationally representative counterparts.

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of Indigenous adults.<sup>12</sup> The proportion of Indigenous adults aged 16–20 years in the NSAOH was 1%, compared with 3.4% in the 2006 Census.<sup>13</sup>

We aimed to compare clinical oral health outcomes of a birth cohort of young Aboriginal adults in the Aboriginal Birth Cohort (ABC) study with those of their age-matched, national-level counterparts in the NSAOH.

## METHODS

### National Survey of Adult Oral Health

The NSAOH was a cross-sectional study of oral health among Australians aged 15 years or older living in all states and territories.<sup>12</sup> Participants completed a telephone interview about their perceptions of oral health and patterns of dental care and received a dental examination. The study used a three-stage, stratified, clustered sampling design. The first stage selected postcodes, the second stage selected households within sampled postcodes, and the third stage selected one adult from each sampled household. Data were weighted to ensure estimates were representative of the Australian population from which participants were selected. Weights were calculated to reflect probabilities of selection and

to adjust for different participation rates across postcodes and among age and sex categories.

### Aboriginal Birth Cohort study

The ABC study is a prospective, longitudinal investigation of a birth cohort of Australian Aboriginals. Babies were eligible for enrolment if they were live-born singletons delivered at the Royal Darwin Hospital, Northern Territory, between January 1987 and March 1990 to a mother recorded as Aboriginal.<sup>14</sup> Within the local region at that time, 90% of pregnant Aboriginal mothers went to the Royal Darwin Hospital to deliver their babies.<sup>15</sup>

Follow-ups were done at mean ages of 5, 11 and, most recently, 18 years. The 18-year follow-up, Wave-3, was conducted between January 2006 and December 2007, when participants were located in more than 40 communities in the NT's Top End, including Darwin. Participants for whom a phone number was obtained were contacted to arrange a physical (including dental) examination at rooms provided by the Royal Darwin Hospital, the Aboriginal Danila Dilba Health Service, or Palmerston Community Health Service. Participants were given reminder calls and were picked up and dropped off. Local



Aboriginal communities in Darwin allowed us to examine participants living in these locations in the community's health service rooms or an outdoor setting, depending on participant preference. Some participants were examined at their homes. Visits were also made to examine participants who were inmates in Berrimah Correctional Facility.

### Clinical examinations

Clinical examinations in the ABC study and the NSAOH followed the same protocols and used the same diagnostic criteria. The dental examiners in both studies were calibrated before study commencement using volunteers who were not study participants, to ensure examiners could correctly identify what was and was not dental disease according to pre-determined thresholds. Dental examinations in the NSAOH were conducted by 29 calibrated dentists. Dental examinations in Wave-3 of the ABC study were conducted by two calibrated dentists.<sup>16</sup> One of the ABC study examiners was also an examiner in the NSAOH. Examinations in both studies included measures of dental caries, periodontal disease and presence of calculus, plaque and gingivitis.

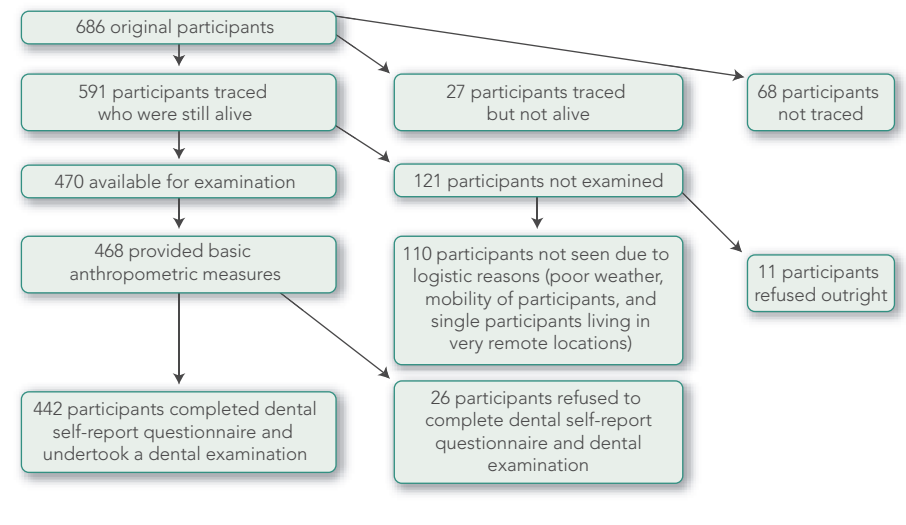
### Dental caries

The DMFT index (sum of decayed [D], missing [M] and filled [F] teeth [T] in the permanent dentition) was used to assess dental caries. This index includes a record of the presence or absence of all teeth, including presumptive cause of tooth loss, and is a cumulative measure of caries experience. Dental caries severity was considered as mean DT, mean MT, mean FT and mean DMFT, and prevalence of dental caries experience was considered as the percentages of DT, MT, FT and DMFT greater than zero.

### Periodontal disease

The US Centers for Disease Control and Prevention and American Academy of Periodontology definitions were used to describe moderate and severe periodontal disease.<sup>17</sup> Moderate periodontal disease was defined as the presence of two or more interproximal sites with clinical attachment loss of  $\geq 4$  mm (not on same tooth) or two or more interproximal sites with pocket depth of  $\geq 5$  mm (not on same tooth). Severe periodontitis was defined as two or more interproximal sites with clinical attachment loss  $\geq 6$  mm (not on same tooth) and one or more interproximal sites with pocket depth of  $\geq 5$  mm. Both the mesial and mid-buccal sites were examined on every tooth except the third molars (wisdom teeth).

### 1 Flow chart of participation in the dental component of Wave-3 (follow-up at mean age of 18 years) of the Aboriginal Birth Cohort study



### Calculus, plaque and gingivitis

Up to six index teeth were assessed for calculus, plaque and gingivitis: the most anterior molar in each quadrant (up to four teeth), the upper right central incisor and the lower left central incisor. Supragingival calculus was defined as the presence of calculus at one or more of the six designated tooth sites. Plaque was defined as visible soft deposits or an abundance of soft matter on one or more of the six designated tooth sites. For gingivitis, moderate inflammation was defined as redness, oedema or glazing, with bleeding upon probing, and severe inflammation as marked redness and oedema, ulceration, and spontaneous bleeding, on one or more of the six designated tooth sites.

### Statistical analysis

Data were analysed using SPSS software, version 17.0 (SPSS Inc, Chicago, Ill, USA). Findings were considered to be statistically significant when 95% confidence intervals were not overlapping.

NSAOH data for participants aged 16–20 years who completed a telephone interview and a dental examination were included in our analysis. Statistical analyses for the NSAOH data took into account the clustered sampling design to yield unbiased standard error estimates and design effects using the “complex sampling” tool in SPSS, thus producing weighted population estimates.

### Ethics approval

The Human Research Ethics Committee (HREC) of the NT Department of Health and

Community Services and Menzies School of Health Research (including an Aboriginal sub-committee with absolute right of veto) granted ethics approval for the ABC study. Study members gave informed consent before participating. Consultation with community leaders was undertaken at the initiation of the study, with letters on file endorsing and supporting the project from concerned Aboriginal leaders, the Northern Land Council and chairpersons of community councils. Written permission from each community for researchers to visit the region was presented to the HREC.

Study information was explained, with visual aids, to a maximum of three cohort members by one researcher during Wave-3 of the ABC study, and a staged consent form was used to gain consent for individual procedures. Feedback of study progress was given to Aboriginal communities when the research team visited, and was presented on local and national Indigenous radio services and published in the *Aboriginal & Islander Health Worker Journal*.<sup>18–20</sup> A website about the cohort has been developed (<http://edison.menzies.edu.au/clancohort>), including stories and pictures of communities and consenting participants.

Ethics approval for the NSAOH was received from the University of Adelaide HREC. Participants provided verbal consent before answering questions in the telephone interview and signed informed consent forms before the oral examination.

### RESULTS

A flow chart of participation in the dental component of Wave-3 of the ABC study is



shown in Box 1. Of the 468 participants aged 16–20 years for whom vital status was obtained, 442 (94%) agreed to be dentally examined and provided complete information in a self-report dental questionnaire (75% of those recruited at birth who were traced and still alive). There were about equal numbers of male and female participants (216 and 226, respectively).

The proportion of the eligible population of 16–20-year-old Indigenous people in the NT's Top End who participated in the dental component of Wave-3 of the ABC study (using 2006 Census data as the denominator<sup>13</sup>) was around 12%. In the NSAOH, there were 202 participants aged 16–20 years (1% Indigenous) with complete dental information. The proportion of ABC study participants who lived in non-capital city locations was twice that of their NSAOH counterparts (Box 2).

The mean number of untreated decayed teeth was 8.0 times higher among ABC study participants than their NSAOH counterparts (Box 3). Conversely, the mean number of missing or filled teeth was substantially lower among ABC study participants than NSAOH participants. When these components were grouped, the mean DMFT of ABC study participants was 1.7 times that of their NSAOH counterparts.

The prevalence of untreated decayed teeth was 3.1 times greater among ABC study participants than their NSAOH counterparts (Box 4). ABC study participants experienced 10.8 times the prevalence of moderate or severe periodontal disease of NSAOH participants, 1.9 times the prevalence of calculus, 4.1 times the prevalence of plaque and 4.5 times the prevalence of gingivitis.

**DISCUSSION**

This study has shown that adverse clinical oral health outcomes were between 2 and 11 times higher in a birth cohort of young Australian Aboriginal adults than their age-matched, nationally representative counterparts. Given the impact of dental diseases on general health and quality of life, this is of public health concern.

Of particular concern is the high rate of untreated dental decay and periodontal disease in young Aboriginal adults, with links between periodontal disease and cardiovascular disease,<sup>21</sup> kidney disease,<sup>22,23</sup> diabetes<sup>24</sup> and obesity.<sup>25</sup> Lifestyle diseases such as these are the most common cause of premature adult mortality among Indigenous Australian populations.<sup>26</sup> The prevalence of moderate and severe periodontal disease was alarmingly

**2 Demographic characteristics of 16–20-year-old participants in the dental component of the Aboriginal Birth Cohort (ABC) study and the National Survey of Adult Oral Health (NSAOH)**

	ABC study		NSAOH		Ratio (ABC/NSAOH)
	No.	% (95% CI)	No.	% (95% CI)*	
No. of participants	442		202		
Aged 16–18 years	301	68.1% (62.8%–73.4%)	130	60.2% (50.1%–69.5%)	1.1
Male	216	48.9% (42.2%–55.6%)	82	52.4% (41.7%–62.9%)	0.9
Non-capital city resident	350	79.2% (74.9%–83.5%)	67	38.4% (31.6%–45.8%)	2.1 <sup>†</sup>
Indigenous	442	100.0%	6	1.0% (0.4%–3.0%)	100 <sup>†</sup>

\* Data are weighted to represent the Australian population aged 16–20 years. † Non-overlapping 95% confidence intervals.

**3 Severity of dental disease among 16–20-year-old participants in the Aboriginal Birth Cohort (ABC) study and the National Survey of Adult Oral Health (NSAOH)**

	ABC study		NSAOH		Relative difference (ABC/NSAOH)
	Mean (95% CI)	SE	Mean (95% CI)*	SE*	
Decayed teeth	4.19 (3.76–4.62)	0.22	0.52 (0.32–0.72)	0.10	8.0 <sup>†</sup>
Missing teeth	0.22 (0.16–0.28)	0.03	0.69 (0.32–1.06)	0.19	0.3 <sup>†</sup>
Filled teeth	0.43 (0.33–0.53)	0.05	1.63 (1.01–2.24)	0.31	0.3 <sup>†</sup>
DMFT <sup>‡</sup>	4.84 (4.37–5.31)	0.24	2.83 (1.95–3.71)	0.44	1.7 <sup>†</sup>

\* Data are weighted to represent the Australian population aged 16–20 years. † Non-overlapping 95% confidence intervals. ‡ Sum of decayed, missing and filled teeth.

**4 Prevalence of dental disease among 16–20-year-old participants in the Aboriginal Birth Cohort (ABC) study and the National Survey of Adult Oral Health (NSAOH)**

	ABC study		NSAOH		Relative risk ratio (ABC/NSAOH)
	No.	% (95% CI)	No.	% (95% CI)*	
Decayed teeth > 0	322	72.9% (68.0%–77.8%)	47	23.6% (16.4%–62.6%)	3.1 <sup>†</sup>
Missing teeth > 0	61	13.8% (5.1%–22.5%)	36	21.4% (13.1%–32.8%)	0.6
Filled teeth > 0	87	19.7% (11.3%–28.1%)	98	49.2% (38.9%–59.7%)	0.4 <sup>†</sup>
DMFT <sup>‡</sup> > 0	342	77.4% (72.9%–81.9%)	122	64.0% (53.7%–73.1%)	1.2
Moderate–severe periodontal disease	119	26.9% (18.9%–34.9%)	3	2.5% (0.7%–8.7%)	10.8 <sup>†</sup>
Calculus	395	89.4% (86.3%–92.5%)	101	46.9% (36.1%–58.0%)	1.9 <sup>†</sup>
Plaque	400	90.5% (87.6%–93.4%)	47	22.1% (14.9%–31.6%)	4.1 <sup>†</sup>
Gingivitis	396	89.6% (86.6%–92.6%)	46	19.7% (13.5%–27.7%)	4.5 <sup>†</sup>

\* Data are weighted to represent the Australian population aged 16–20 years. † Non-overlapping 95% confidence intervals. ‡ Sum of decayed, missing and filled teeth.

high in the young adults of the ABC study. Although it is difficult to ascertain the role that periodontal disease might play in the development of chronic disease among Australia's Indigenous population, with half the Indigenous population currently aged under 21 years,<sup>27</sup> this high prevalence of periodontal

disease may contribute to a heavy burden of chronic disease in the future.

Our study has some comparative limitations. While ABC study participants are likely to be representative of young Indigenous adults in the NT's Top End, they may differ from young Indigenous adults more generally,



given that about 32% of Indigenous Australians live in major cities, compared with 21% of ABC study participants who were living in urban settings.<sup>27</sup> Aboriginal people from remote communities often have traditionally oriented cultural practices, even when living in urban communities, which make them significantly different from urban Aboriginal people in large capital cities who now have largely Western cultural practices. Caution is also needed when comparing the ABC study and NSAOH cohorts, due to multiple confounders including remoteness, poverty, educational attainment and language spoken.

The NT Emergency Response Child Health Check Initiative found an alarming prevalence of dental disease among Indigenous children in the NT, with 40% having untreated caries.<sup>28</sup> However, this figure may be an underestimate, as the initial identification of dental disease was made by non-dental health professionals, who referred only 35% of children for a dental assessment. Our findings indicate that young Indigenous adults may be even more marginalised than Indigenous children in terms of oral health, as they are no longer eligible for care through the school dental service, and fall through the gaps of dental service provision because of lack of access, dental fear or other social issues. Young Indigenous adults frequently experience overwhelming social burdens,<sup>29</sup> and their priorities in life may not include oral health-related issues unless the problem is severe. Presentation for dental care may then be too late for preventive or restorative measures (eg, being kept awake at night by a toothache results in an emergency trip to a dentist for tooth removal).

Young Indigenous adults deserve to have the same level of oral health as their age-matched counterparts at a population level. Given the amenability of many dental diseases to prevention strategies such as community water fluoridation or evidence-based, population-based approaches to plaque control, such as toothbrushing programs in schools and the widespread availability and acceptance of fluoride toothpaste, reducing the disparities between Indigenous and non-Indigenous clinical oral health outcomes should be achievable. However, the difficulties encountered in collecting basic oral epidemiological information from Indigenous populations suggests that the task of reducing disparities in dental disease experience will be even more difficult, and innovative and sustainable programs will therefore be needed to deliver oral health protection and promotion to these marginalised groups.

There is an important public health mandate to achieve complete oral health for all Indigenous Australians. However, it is important not to presume that the simple application of public health principles, spread widely and with enough funding, will eliminate the gap in health discrepancies. Although an essential prerequisite for good health, such programs are being set up for failure unless a more balanced and nuanced discussion of the limitations of front-line health care delivery is undertaken. Our findings emphasise that any program that includes prevention of chronic oral diseases among Indigenous Australians should start at a young age and continue throughout life.

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### COMPETING INTERESTS

None identified.

### AUTHOR DETAILS

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