**Abstract**

Objective: To identify all evidence about the prevalence and severity of clinically measured caries and periodontal disease in Indigenous adults in Australia published in peer-reviewed journals and to summarise trends over time. We also examined whether the studies investigated associations between putative risk factors and levels of caries and periodontal disease.

Methods: PubMed was searched in September 2014, with no date limitations, for published peer-reviewed articles reporting the prevalence rates and/or severity of caries and periodontal disease in Indigenous adults living in Australia. Articles were excluded if measurement was not based on clinical assessment and if they reported oral disease only in a specific or targeted sample, and not the general population.

Results: The search identified 18 papers (reporting on ten primary studies) that met the inclusion criteria. The studies published clinical data about dental caries and/or periodontal disease in Australian Indigenous adults. The studies reported on oral health for Indigenous adults living in rural (40%), urban (10%), and both urban and rural (50%) locations. Included studies showed that virtually all Indigenous adults living in rural locations had periodontal disease. The data also showed caries prevalence ranged from 46 to 93 per cent. Although 10 studies were identified, the peer-reviewed literature was extremely limited and no published studies were identified which provided statistics for a significant proportion of Australia (Victoria, Tasmania, Queensland or the Australian Capital Territory). There were also inconsistencies in how the data were reported between studies, making comparisons difficult.

Conclusions and Implications: This review highlights a lack of robust and contemporary data to inform the development of policies and programs to address the disparities in oral health in Indigenous populations living in many parts of Australia.

**Key words:** Indigenous,Aboriginal, adult, caries, decay, periodontal disease, periodontitis, Australia, oral health, prevalence

**What is known about the topic?**

Many studies report that Indigenous people have poorer general health in Australia compared to non-Indigenous people.

**What does this paper add?**

This paper documents the available caries and periodontal disease prevalence and experience for Indigenous adults in Australia published in peer-reviewed journals. It demonstrates significant limitations in the data. These limitations include: no data in a number of large Australian jurisdictions, inconsistency with reporting methods, and most data available being for Indigenous adults living in rural locations. Therefore, the oral health data available in the peer-reviewed literature do not reflect the situation of all Indigenous people living in Australia.

**What are the implications for practitioners?**

It is important for oral health practitioners to have access to current and relevant statistics on the oral health of Indigenous Australians. However, we have highlighted significant evidence gaps for this population group within the peer-reviewed literature and identified the limitations of the available data upon which decisions are currently being made. This paper also identifies ways to capture and report oral health data in the future to enable more meaningful comparisons and relevance for use in policy development.

**Introduction**

Oral health is fundamental to both general health and quality of life[1](#_ENREF_1) and is influenced by a range of socioeconomic, environmental, behavioural, biological, and cultural factors.[2](#_ENREF_2), [3](#_ENREF_3) Both dental caries (decay) and periodontal disease (gum disease) are largely preventable, and even reversible in the early stages[4](#_ENREF_4), [5](#_ENREF_5) and the impacts of poor oral health include cardiovascular disease and poorer general health[5-7](#_ENREF_5). As it progresses, oral disease can result in debilitating pain, difficulty eating and speaking, embarrassment and other negative impacts.[8](#_ENREF_8) Australia’s National Oral Health Plan 2015-2024[9](#_ENREF_9) highlights Aboriginal and Torres Strait Islander (within this paper referred to as Indigenous) people as a priority population group for targeting improvements in oral health. A key action of the National Oral Health Plan is to provide culturally appropriate and accessible oral health services through partnerships between mainstream and Indigenous-specific oral health services. Until the late twentieth century, the available data suggest that Indigenous Australians generally had better oral health than their non-Indigenous counterparts, with the main complaint being tooth wear.[10](#_ENREF_10), [11](#_ENREF_11) Dental caries and periodontal disease were uncommon at this time within Indigenous communities.[10](#_ENREF_10) Current research indicates that Indigenous people now experience considerably poorer general health[12](#_ENREF_12) and oral health[13-19](#_ENREF_13) than that of the non-Indigenous population. Although several reports suggest that Indigenous people suffer from more dental caries and periodontal disease than non-Indigenous people,[13](#_ENREF_13), [19](#_ENREF_19) there are very few studies which provide data on the oral health of Indigenous adults in Australia.[15](#_ENREF_15), [20-22](#_ENREF_20) These studies are often undertaken with small population groups, or remote communities, which are less generalisable to the current, broader Australian Indigenous population.[20](#_ENREF_20), [23](#_ENREF_23), [24](#_ENREF_24) Recent census data shows that the Indigenous population of Australia makes up approximately three per cent of the national population [25](#_ENREF_25) , and is largely concentrated on the eastern coastline and clustered in cities. [12](#_ENREF_12)

The aims of this review were to identify all published evidence about the oral health in Indigenous adults, clinically measured, in Australia and summarise trends over time, in order to provide a robust evidence base for the purposes of planning public dental service policy and program planning. The review also aimed to examine the data on the association between known risk factors and the prevalence of oral disease in this population group.

**Methods**

***Search strategy and search terms***

Clinical outcomes included in the search were caries (e.g. DMFT; decayed, missing and filled permanent teeth) and periodontal disease (e.g. CPI; Community Periodontal Index). PubMed was searched independently by one author (JM-K) and a research assistant (AG) to locate papers published prior to September 2014. The search terms were “Aboriginal”, “Indigenous” and “Torres Strait Islander”, in association with “oral health”, “oral disease”, “rural and remote”, “models of care”, “primary care”, “dental caries”, “periodontal disease”, “DMFT”, “dental decay”, “oral disease prevention”, “fluoride”, “access to dental services”, “dental services”, “oral hygiene”, “oral health care” and “oral health interventions”. Only journal articles were included in this study, grey literature was not searched.

***Inclusion and exclusion criteria***

Two people (JM-K and AG) independently screened abstracts for inclusion. Key inclusion and exclusion criteria were: the study must report the prevalence or severity of a clinical oral health outcome (caries or periodontal disease) in Australian Indigenous adults; and data must have been collected during clinical examination (i.e. not self-reported dental experience or self-reported dental health). Papers were also excluded if the study sample was a targeted group (e.g. only individuals with oral disease selected from a disease registry) rather than the general population. Following the initial screening process, full-length articles were retrieved and the inclusion and exclusion criteria again applied.

***Data extraction***

Data extraction was undertaken for all papers by two authors independently. The data extracted from each paper included: age of study sample; study design; year of study; year of data collection; the prevalence and severity of oral diseases; the clinical criteria used for measurement and diagnosis; and all data reporting the relationship between measured risk factors and oral disease. Extracted data was entered into a Microsoft Excel spreadsheet and closely scrutinised to identify (and remove) duplication of data through different publications of the same study/sample.

**Results**

***Search results***

Figure 1 provides a summary of the results of the PubMed searches. The initial search identified studies of both children and adults. For this review only adult studies were included. When papers reported a broader range of ages, such as studies which grouped 16-20 year olds, these papers are included here; studies of children aged less than 15 years were excluded. Eighteen papers were identified as meeting the criteria for caries and/or periodontal disease prevalence and/or severity in Indigenous adults. A summary of these papers is provided in Table 1. Of the 18 papers, 10 were primary studies[14](#_ENREF_14), [16-18](#_ENREF_16), [20](#_ENREF_20), [24](#_ENREF_24), [26-29](#_ENREF_26) and eight were associated papers, reporting the same data in a different way[21](#_ENREF_21), [23](#_ENREF_23), [30-35](#_ENREF_30) (Table 1).

***Study characteristics***

Table 2 presents temporal and geographical information about the studies included in the review. In most (seven) studies, data were collected in only one jurisdiction. One study collected data from two jurisdictions, one study collected from all jurisdictions except the Australian Capital Territory and Tasmania, and one study did not report the location from where the data was collected. Across these jurisdictions, four studies (40%) reported on Indigenous adults living only in rural locations, five studies in both urban and rural locations (with most reporting data for the total population in the sample rather than reporting the data by urban or rural location), and one study only in an urban sample. Only two studies (20%) reported the fluoride status of the study’s location. Data were presented using a variety of age groupings which makes comparisons between studies difficult.

***Caries prevalence and severity***

As can be seen from Table 1, the diagnostic criteria and manner in which clinical data was reported varied across the studies. The earliest study[36](#_ENREF_36) reported caries using the DIMFT (decayed, indicated for extraction, missing or filled permanent teeth) index. All other studies investigating caries used the DMFT (decayed, missing, filled permanent teeth) index but many did not report which specific World Health Organisation (WHO) criteria was used. All studies that examined caries (nine primary studies) reported mean DMFT (or DIMFT). Caries data as reported in the papers are summarised in Table 2. Only four papers reported caries prevalence data. Caries prevalence ranged from 46 to 93 per cent of Indigenous adults experiencing caries. Mean DMFT also varied considerably across the studies. Two studies[14](#_ENREF_14), [20](#_ENREF_20) also included a non-Indigenous sample as a comparison group.

***Periodontal disease prevalence and severity***

Periodontal disease data from included studies are presented in Table 3. Eight primary studies (80%) reported levels or prevalence of periodontal disease. Periodontal disease was primarily measured using the CPI score of between 0 and 4; with 0 being normal/healthy gums, 1 being bleeding, 2 being calculus present, 3 being moderate periodontal disease and 4 being severe periodontal disease. Often data were reported with CPI levels collapsed into fewer groups. Three studies reported data only at the level of moderate and/or severe periodontal disease whilst three studies reported data across all CPI scores. The level of periodontal disease identified in the study samples varied. Three studies reported periodontal disease ranging from 12-27 per cent,[17](#_ENREF_17), [20](#_ENREF_20), [24](#_ENREF_24)although these studies only reported periodontal disease at the more severe levels (of CPI 3 and/or 4). Four studies[16](#_ENREF_16), [18](#_ENREF_18), [26](#_ENREF_26), [28](#_ENREF_28) reported the prevalence of periodontal disease to be above 85 per cent; three of these studies included all four CPI scores which may explain the high reported prevalence (one of the studies reporting high periodontal disease prevalence only reported CPI 3 and 4).

***Association between risk factors and prevalence of oral disease***

Eight of the eighteen papers reported associations between the presence of known risk factors and the prevalence of caries or periodontal disease (see Table 4). High dietary sugar content was significantly associated with dental caries in two papers[23](#_ENREF_23), [33](#_ENREF_33) and diabetes was significantly associated with a higher prevalence of moderate or severe periodontal disease in three papers.[16](#_ENREF_16), [26](#_ENREF_26), [28](#_ENREF_28) One study examined the relationship between abuse of various substances (such as marijuana and petrol sniffing) and oral disease and identified that a higher prevalence of periodontal disease was associated with these risk factors.[30](#_ENREF_30) Two studies identified associations between the prevalence of severe periodontal disease and being male, and aged over 45 years.[16](#_ENREF_16), [17](#_ENREF_17) Tobacco smoking is considered an established risk factor for periodontal disease and two studies examined this relationship. One study reported a positive association with periodontal disease prevalence[28](#_ENREF_28); however, the other study did not.[18](#_ENREF_18)

**DISCUSSION**

This review is the first review to summarise oral disease data for Indigenous adults living in Australia, documenting the clinically measured dental caries and periodontal disease data for Indigenous adults published in peer review literature until September 2014. We endeavoured to identify the best available research evidence throughout Australia, to underpin the development of new services, policies and programs to both increase access to the public oral health care system for Indigenous people, and to ensure that we are delivering the right strategies to meet the needs of this priority population group.

. It identified limited data for clinically measured caries and periodontal disease in Indigenous adults. It highlights that due to inconsistencies in how the data were collected and reported, conclusions about the level of oral health in Indigenous adults are difficult to make. However, periodontal disease and caries levels are high, particularly in rural locations, where most of the studies in this review were undertaken. Most studies did not report the fluoride status for the study location, therefore information about water fluoride levels and levels of caries were not possible.

Approximately 700,000 Indigenous people live in Australia with almost 80 per cent living in major cities and regional areas. Despite this, almost all studies identified in this review report oral health data for Indigenous adults living in rural locations. Furthermore, a recent report projects that 67 per cent of the Indigenous population in Australia live in the eastern jurisdictions but there were only two studies which included New South Wales and no studies in the other jurisdictions. This is an evidence gap which could be addressed by better utilisation and publication of public oral health data that are already routinely collected by each jurisdiction. In Victoria, for example, 1,125 Indigenous adults attended the Royal Dental Hospital Melbourne over a two year period (unpublished manuscript). This was captured during routine clinical and administrative data collection. We are aware that in 2014/15, public oral health care was provided across Victoria to more than 8,500 Indigenous adults; however this data is not publicly available within the peer-reviewed literature. We do acknowledge that oral health data is available in the grey literature

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Undertaking data collection for the oral health of specific population groups is met with difficulties, such as associated costs and time requirements as well as difficulties achieving a representative sample. This review identified inconsistencies in data capture and reporting, limiting the ability for meaningful comparisons and analysis. There was inconsistency in the way that the data were presented, including various age groupings used, which made it difficult for comparisons to be made across studies. Despite some studies looking at the oral health of Indigenous adults living in rural and urban locations, the data were not separated by location making it difficult to determine if living in a rural location affected oral health status of Indigenous adults in the study. We found that the usefulness of the available scientific data for decision makers is extremely limited and is not contextually relevant in many cases.

A similar review was recently undertaken to identify oral health data for Indigenous children published in peer-reviewed literature and this identified significant gaps in the available published research data.[37](#_ENREF_37) This current review has identified that the data available for the oral health of Indigenous adults living throughout Australia are more limited than that available for Indigenous children. This is despite approximately one third of Indigenous people attending the public oral health care system.[38](#_ENREF_38) We are aware that administrative and clinical data are collected in many jurisdictions and that this could be better utilised and published in the peer-reviewed literature to make it more readily available.

***Caries***

All studies that examined caries presented this using mean DMFT, but standard deviation was often not reported. Mean DMFT reported in this review ranged considerably from 1.8 (in young adults in 1987) through to 20.7 with the mean DMFT generally being higher in the older age groups. The caries data presented in this review represent a total sample size of 3,390 Indigenous adults living in Australia. We are aware of one paper[39](#_ENREF_39) that reported caries in Indigenous people which was not identified through the search terms used in this review because it examined overall caries levels in adults in Australia, and did not use Indigenous or Aboriginal as a key term nor as a focus of the paper. This paper reported national data from the National Survey of Adult Oral Health (NSAOH; 2004-06) for all adults (mean DMFT 12.8), with Indigenous people being one component (mean DMFT 14.8). This suggests that caries levels in the general adult community are high and in some instances are similar to caries levels in Indigenous adults identified in this review. Overall caries prevalence data were only reported in a small number of studies.

***Periodontal disease***

The periodontal disease prevalence and severity data presented in this review represent a total sample size of 2,602 Indigenous adults living in Australia. The proportion of Indigenous adults affected by periodontal disease within the studies in this review was extremely high. Prevalence was virtually 100% in all rural locations, which was the vast majority. Interestingly, the few studies which included urban samples had a lower prevalence of periodontal disease. We have identified one paper[40](#_ENREF_40) that reported periodontal disease in Indigenous people that was not found through the search terms used in this review because it focused on overall adult periodontal disease and did not focus on periodontal disease in Indigenous people. The paper also did not use the term Indigenous or Aboriginal as a key search term nor did it refer to Aboriginal or Indigenous in the abstract. This paper reported data from the NSAOH 2004-06 and indicated that 22.9% of the general adult population, and 29% of Indigenous adults, within the survey had moderate to severe periodontal disease. This difference in periodontal disease prevalence compared to the prevalence reported in this review may reflect the difference in reporting with respect to disease severity, as well as the population groups and geographic locations included in the studies.

***Risk factors for oral disease***

It was of interest to identify studies which examined the links between risk factors and caries or periodontal disease and interventions designed to improve the levels of these conditions. Previous research has identified a relationship between periodontal disease and other systemic conditions, including diabetes and cardiovascular disease.[41](#_ENREF_41), [42](#_ENREF_42) The association between diabetes and periodontal disease reported in a number of the papers in this review relates to the possible bi-directional relationship between diabetes and periodontal disease.[41](#_ENREF_41) However, a recent systematic review has suggested that there is limited evidence that periodontal treatment can produce sustainable decreases in blood glucose.[43](#_ENREF_43) Given the findings of this systematic review, more research into the specific risk factors and pathogenesis of periodontal disease in Indigenous adults is critical in order to develop and implement preventive strategies, and to promote early identification and treatment of the disease. This review also identified one interventional trial examining the effect of periodontal therapy for Indigenous Australians and whether this affects arterial structure and function, as inflammation (which is present in periodontal disease) is a key factor in the development of vascular disease such as atherosclerosis.34 However, there was a lack of studies that addressed risk factors as a way of improving oral health levels in Indigenous adults with most studies simply describing the level of oral disease in this population, and a small number of studies describing associations between risk factors and oral disease. It would be beneficial to design studies which attempt to address a known risk factor for the development of oral disease.

**Strengths and Limitations**

This review highlights the available data on clinically measured caries and periodontal disease in Indigenous adults, published in the peer-reviewed literature. We chose to search only peer-reviewed literature to identify the best quality evidence available, and were surprised that such a limited number of articles were identified that provided clinically measured caries and periodontal disease data for Indigenous adults throughout Australia. It identifies a lack of data for this priority population group. A limitation of the study is that it does not include grey literature. We acknowledge that evidence is available within grey literature, however this study aimed to explore what was available and accessible specific to Indigenous oral health in the research/evidence base.

**Conclusions and Recommendations**

This review highlights that despite Indigenous people being a priority group for the public oral health care system, the data available have significant limitations. Due to small numbers, variations in data capture and reporting, and the different age groups studied, further analysis of the reported data were not possible. The learnings from this study however have led us to make the following recommendations:

1. A consistent approach to the reporting of oral health data in Indigenous adults in relation to age groupings and prevalence statistics, as well as identification of classification of geographic location as rural or urban etc.
2. Research which goes beyond simply describing oral disease and undertakes more sophisticated exploration of risk and protective factors, to inform the development of solutions.
3. Better utilisation, and publication in peer-reviewed journals, of routinely collected public oral health data for Indigenous adults, particularly in metropolitan and regional areas of Australia such as Victoria, New South Wales, and Queensland, and the regular publication of prevalence statistics.

**Table 1: Study characteristics**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Authors, year** | **Study design** | **Caries index** | **Caries diagnostic criteria** | **Periodontal disease index/ measures** | **Periodontal disease diagnostic criteria/definitions** |
| Schamschula *et al.* 1980[36](#_ENREF_36) | Cross-sectional | DIMFT | WHO | Periodontal indices including oral debris |  |
| Endean *et al.* 2004[26](#_ENREF_26) | Cross-sectional | DMFT | Not reported | CPI | WHO 1997 |
| Roberts-Thomson, ARCPOH 2004[14](#_ENREF_14) | Cross-sectional | DMFT | Not reported | CPI | WHO |
| Smith *et al.* 2007[18](#_ENREF_18) | Cross-sectional | DMFT | WHO 1997 | CPI | WHO |
| Brennan *et al.* 2007[20](#_ENREF_20) | Cross-sectional | DMFT | US National Institute of Dental Research (NIDR) | CPI | WHO 1997 |
| Kruger *et al.* 2008[16](#_ENREF_16) | Cross-sectional | DMFT | WHO 1997 | CPI | WHO 1997 |
| **ABC Study(two main papers):**Jamieson *et al.* 2010[24](#_ENREF_24)Jamieson *et al.* 2010[27](#_ENREF_27)*Associated studies:*Jamieson *et al.* 2010[23](#_ENREF_23)Jamieson *et al.* 2010[31](#_ENREF_31)Jamieson *et al.* 2010[30](#_ENREF_30)Jamieson *et al.* 2013[33](#_ENREF_33)Jamieson *et al.* 2013[32](#_ENREF_32) | Cohort | DMFTDMFT | Not reportedUntreated dental decay was defined as ‘cavitation of enamel or dentinal involvement or both being present’ or ‘visible caries that is contiguous with a restoration. | Probing depth (distance from probe tip to gingival margin) and gingival recession (distance from gingival margin to amelo–cemental junction) were recorded by a disposable probe with 2–3 mm markings.n/a | The US Centers for Disease Control and Prevention and American Academy of Periodontology definitions were used to describe moderate and severe periodontal disease.n/a |
| **PerioCardio Study**Kapellas *et al.* 2014[28](#_ENREF_28)\**Associated studies:*Kapellas *et al.* 2014[34](#_ENREF_34" \o "Kapellas, 2014 #1501)Kapellas *et al.* 2013[21](#_ENREF_21)Kapellas *et al.* 2014[35](#_ENREF_35) | Cross-sectional | DMFT | Not reported | Probing depth (distance from probe tip to gingival margin) and gingival recession (distance from gingival margin to amelo–cemental junction) were recorded by a disposable probe with 2–3 mm markings. | The US Centers for Disease Control and Prevention and American Academy of Periodontology definitions were used to describe moderate and severe periodontal disease. |
| Roberts-Thomson *et al.* 2014[17](#_ENREF_17) | Cross-sectional | n/a | n/a | Prevalence of severe periodontitisExtent of periodontal destructionSeverity of periodontal destruction. | The proportion of Aboriginal people with severe periodontitis was defined using the US CDC/AAP case definition. Extent was estimated as the percentage of sites with CAL of 6+ mm. Severity was defined as the highest measure of CAL in millimetres. |

\*Primary study; associated studies reported baseline data from main paper

DMFT: **D**ecayed, **M**issing, **F**illed permanent **T**eeth

DIMFT: **D**ecayed, **I**ndicated for extraction; **M**issing, **F**illed permanent **T**eeth

CPI: Community Periodontal Index

WHO: World Health Organisation

ABC: Aboriginal Birth Cohort Study

ARCPOH: Australian Research Centre for Public Oral Health

**Table 2: Caries prevalence and severity (DMFT) by year data was collected**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, year**  | **Year data collected** | **Jurisdictions** | **Location (rural/urban) and fluoridation status** | **n** | **Age** **(years)** | **% with caries** | **DMFT B (sd)A** |
| **Schamschula *et al.* 1980**[**36**](#_ENREF_36) | Approx.1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 77 | 16-70 | 93.5%\*# | nr |
|  | Approx. 1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 18 | 16-23 | 55.6% | 17.1 (5.9) |
|  | Approx. 1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 18 | 24-29 | 55.8% | 17.1 (6.6) |
|  | Approx. 1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 12 | 30-39 | 66.4% | 20.7 (6.7) |
|  | Approx. 1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 13 | 40-49 | 50.9% | 16.3 (10.6) |
|  | Approx. 1978 | New South Wales | Rural (Brewarrina and Walgett) FC | 16 | 50+ | 45.6% | 14.6 (10.2) |
| **Endean *et al.* 2004**[**26**](#_ENREF_26) | 1987 | South Australia | Rural (Anangu Pitjantjatjara) | nr | 15-19 | nr | 1.76 |
|  | 1987 | South Australia | Rural (Anangu Pitjantjatjara) |  nr | 20-29 | nr | 3.11 |
|  | 1987 | South Australia | Rural (Anangu Pitjantjatjara) |  nr | 30-39 | nr | 3.53 |
|  | 1987 | South Australia | Rural (Anangu Pitjantjatjara) |  nr | 40+ | nr | 2.05 |
| **Endean *et al.* 2004**[**26**](#_ENREF_26) | 1999-2000 | South Australia | Rural (Anangu Pitjantjatjara) – FD | 289 | 15+ | nr | nr |
|  | 1999-2000 | South Australia | Rural (Anangu Pitjantjatjara) – FD | nr | 15-19 | nr | 2.7 |
|  | 1999-2000 | South Australia | Rural (Anangu Pitjantjatjara) – FD | nr | 20-29 | nr | 4.89 |
|  | 1999-2000 | South Australia | Rural (Anangu Pitjantjatjara) – FD | nr | 30-39 | nr | 6.85 |
|  | 1999-2000 | South Australia | Rural (Anangu Pitjantjatjara) – FD | nr | 40+ | nr | 8.68 |
| **Roberts-Thompson 2004**[**14**](#_ENREF_14) | 1999-2000 | South Australia & New South Wales | Rural and urban | 924 | 18+ | nr | nr |
|  | 1999-2000 | South Australia | Rural | nr | 18-24 | nr | 3.6 |
|  | 1999-2000 | South Australia & New South Wales | Urban | nr | 18-24 | nr | 10.6 |
|  | 1999-2000 | New South Wales | Rural | nr | 18-24 | nr | 8.4 |
|  | 1999-2000 | South Australia | Urban | nr | 18-24 | nr | 10.8 |
|  | 1999-2000 | South Australia | Rural | nr | 25-44 | nr | 6 |
|  | 1999-2000 | South Australia & New South Wales | Urban | nr | 25-44 | nr | 15.1 |
|  | 1999-2000 | New South Wales | Rural | nr | 25-44 | nr | 13.5 |
|  | 1999-2000 | South Australia | Urban | nr | 25-44 | nr | 12.4 |
|  | 1999-2000 | South Australia | Rural | nr | 45+ | nr | 8.5 |
|  | 1999-2000 | South Australia & New South Wales | Urban | nr | 45+ | nr | 18.5 |
|  | 1999-2000 | New South Wales | Rural | nr | 45+ | nr | 16.3 |
|  | 1999-2000 | South Australia | Urban | nr | 45+ | nr | 16.7 |
| **Brennan *et al.* 2007**[**20**](#_ENREF_20) | 2001-02 | All except Australian Capital Territory and Tasmania | Urban and rural | 157 | 18+ | nr | 14.24 (9.3) |
| **Kruger et al. 2008**[**16**](#_ENREF_16) | 2004 | Western Australia | Rural | 208 | 18-88 | 92.7%\* | 9.8 (8.3) |
|  | 2004 | Western Australia | Rural | 377 | 18-24 | nr | 4.61 (4.0) |
|  | 2004 | Western Australia | Rural | 86˙ | 25-44 | nr | 8.4 (6.9) |
|  | 2004 | Western Australia | Rural | 47˙ | 45-64 | nr | 12.7 (7.5) |
|  | 2004 | Western Australia | Rural | 21˙ | 65-88 | nr | 15.5 (12.6) |
|  | 2004 | Western Australia | Rural (Bidyadanga) | 68 | 41.0 ± 17.3 | nr | 10.3 (8.8) |
|  | 2004 | Western Australia | Rural (Derby) | 79 | 43.6 ± 16.8 | nr | 11.2 (8.1) |
|  | 2004 | Western Australia | Rural (Jarlmadangah) | 34 | 30.4 ± 13.8 | nr | 5.8 (6.5) |
|  | 2004 | Western Australia | Rural (Pandanus Park) | 27 | 34.6 ± 14.3 | nr | 9.2 (8.4) |
| **Smith *et al.* 2007**[**18**](#_ENREF_18) | 2004-05 | Western Australia | Rural (5 towns) | 981¥ | 18-85 | nr | 8.5 (6.6) |
|  | 2004-05 | Western Australia | Rural (5 towns) | 178¥ | 18-24 | nr | 6.6 (4.8) |
|  | 2004-05 | Western Australia | Rural (5 towns) | 475¥ | 25-44 | nr | 8.2 (5.4) |
|  | 2004-05 | Western Australia | Rural (5 towns) | 267¥ | 45-64 | nr | 9.4 (6.9) |
|  | 2004-05 | Western Australia | Rural (5 towns) | 66¥ | 65-85 | nr | 12.2 (12.1) |
|  | 2004-05 | Western Australia | Rural (Carnarvon) | 253¥ | 40.9 ±16.2 | nr | 8.4 (7.0) |
|  | 2004-05 | Western Australia | Rural (Geraldton) | 254¥ | 39.1 ± 13.6 | nr | 9.2 (6.7) |
|  | 2004-05 | Western Australia | Rural (Wiluna) | 128¥ | 37.1 ± 13.7 | nr | 6.3 (5.8) |
|  | 2004-05 | Western Australia | Rural (Kalgoorlie) | 276¥ | 36.6 ± 13.3 | nr | 9.5 (6.6) |
|  | 2004-05 | Western Australia | Rural (Roebourne) | 70¥ | 45.4 ± 15.9 | nr | 6.2 (4.8) |
| **Jamieson *et al.* 2010**[**24**](#_ENREF_24) | 2006-07 | Northern Territory | Rural and urban | 442 | 16-20 | 77.4% | 4.84 (3.5) |
| **Jamieson *et al.* 2010**[**27**](#_ENREF_27) | 2006-07 | Northern Territory | Rural and urban | 145 | 18-20 | 81.4% | 5.6 (5.4) |
| **Kapellas *et al.* 2014**[**28**](#_ENREF_28) | 2010-12 | Northern Territory | Rural and urban | 312 | 22-73 | nr | 9.7 (6.7) |
|  | 2010-12 | Northern Territory | Urban (Darwin) | 180 | nr | nr | 11.6 (8.0) |
|  | 2010-12 | Northern Territory | Rural (Katherine) | 28 | nr | nr | 5.4 (4.2) |
|  | 2010-12 | Northern Territory | Alice Springs correctional facility | 46 | nr | nr | 7.1 (5.8) |
|  | 2010-12 | Northern Territory | Urban (Darwin correctional facility) | 58 | nr | nr | 8.0 (6.4) |

A sd = standard deviation, reported where available

B DIMFT: **D**ecayed, **I**ndicated for extraction, **M**issing, **F**illed permanent **T**eeth used in Schamschula *et al*. paper

C Fluoride was ≤0.02-0.26 ppm

D 50.4% water supplies exceed 1.5mg/L F

DMFT: **d**ecayed, **m**issing and **f**illed permanent **t**eeth

F/NF: fluoridated/non-fluoridated water

nr: not reported

\* calculated from % caries-free data
¥ All data reported in the table as it appears in the paper however this symbol indicates there is a clear error in the original publication regarding sample size (total does not correlate with total of individual sample numbers)

# Total caries prevalence extracted from paper (based on reported caries-free prevalence) is incorrect based on other data reported

**Table 3: Periodontal prevalence and severity (based on CPI levels) for Aboriginal adults, by jurisdiction**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Author, year** | **Year data collected** | **Jurisdictions** | **Location (rural/urban) and fluoridation status** | **n** | **Age (years)** | **% affected by periodontal disease** | **% with periodontal disease** | **% free of periodontal disease**  |
| **CPI 1** Bleeding gums | **CPI 2** Calculus present | **CPI 3** Moderate pockets 4-5mm | **CPI 4** Severe pockets 6+mm | **CPI 3&4**Moderate-severe  |
| **Endean *et al.* 2004**[**26**](#_ENREF_26) | 1999- 2000 | South Australia | Rural (Anangu Pitjantjatjara) F  | 289 | 15+  | 4.7% | 63.9% | 15.3% | 14.9% | 30.2% | 98.8% | 1.2% |
| **Brennan *et al.* 2007**[**20**](#_ENREF_20) | 2001-2 | All except ACT and Tasmania | Urban and rural | 157 | 18+ | nr | nr | nr | 17.9% | nr | 17.9%^\*\* | 82.1%^ |
| **Roberts-Thomson *et al.* 2014**[**14**](#_ENREF_14) | - | - | Urban | 251 | 15+ (51.2% aged 45+) | nr | nr | nr | 11.9%  | nr | 11.9%^\*\* | 88.1%^ |
| **Smith *et al.* 2007**[**18**](#_ENREF_18) | 2004-5 | Western Australia | Rural | 960 | 18-85 | 5.3% | 31.5% | 37.7% | 23.1% | 60.8% | 97.6% | 2.4% |
|  | 2004-5 | Western Australia | Rural | 176 | 18-24 | 13.1% | 47.2% | 31.8% | 4.5% | 36.3% | 96.6% | 3.4% |
|  | 2004-5 | Western Australia | Rural | 473 | 25-44 | 2.5% | 34.9% | 43.6% | 16.9% | 60.5% | 97.9% | 2.1% |
|  | 2004-5 | Western Australia | Rural | 254 | 45-64 | 2.0% | 16.9% | 37.4% | 43.7% | 81.2%  | 100.0% | 0% |
|  | 2004-5 | Western Australia | Rural | 57 | 65-85 | 1.8% | 19.3% | 24.6% | 54.4% | 79.0% | 100.% | 0% |
|  | 2004-5 | Western Australia | Rural (Carnarvon) | 246 | 40.9 (16.2) | 11.0% | 31.8% | 33.7% | 19.7% | 53.4% | 96.2% | 3.8% |
|  | 2004-5 | Western Australia | Rural (Geraldton) | 250 | 39.1 (13.6) | 3.4% | 33.6% | 44.2% | 17.4% | 61.6% | 98.6% | 1.5% |
|  | 2004-5 | Western Australia | Rural (Wiluna) | 132 | 37.1 (13.7) | 0.8% | 41.4% | 34.6% | 21.8% | 56.4% | 98.6% | 1.5% |
|  | 2004-5 | Western Australia | Rural (Kalgoorlie) | 267 | 36.6 (13.3) | 4.8% | 28.9% | 38.1% | 25.3% | 63.4% | 97.1% | 2.9% |
|  | 2004-5 | Western Australia | Rural (Roebourne) | 65 | 45.4 (15.9) | 1.5% | 12.3% | 32.3% | 53.8% | 86.1% | 100% | 0 |
| **Jamieson *et al.* 2010**[**24**](#_ENREF_24) | 2006-7 | Northern Territory | Rural and urban | 442 | 16-20 | nr | nr | nr | nr | 27.0% | 27.0%\*\* | 73.1% |
| **Kruger *et al.* 2008**[**16**](#_ENREF_16) | 2008 | Western Australia | Rural | 191 | 18-88 | 11.0% | 46.1% | 25.7% | 13.6% | 39.3% | 96.4% | 3.7% |
|  | 2008 | Western Australia | Rural  | 37 | 18-24 | 28.6% | 51.4% | 11.4% | 0% | 11.4% | 91.4% | 8.6% |
|  | 2008 | Western Australia | Rural | 86 | 25-44 | 8.4% | 54.2% | 24.1% | 10.8% | 34.9% | 97.5% | 2.4% |
|  | 2008 | Western Australia | Rural  | 47 | 45-64 | 6.8% | 40.9% | 34.1% | 15.9% | 50.0% | 97.7% | 2.3% |
|  | 2008 | Western Australia | Rural | 21 | 65-88 | 6.7% | 10.0% | 33.3% | 53.3% | 86.6% | ≥100.0%# | 6.7 |
|  | 2008 | Western Australia | Rural (Bidyadanga) | 58 | 41.0 (17.3) | 5.2% | 29.3% | 43.1% | 22.4% | 65.5% | 100% | 0% |
|  | 2008 | Western Australia | Rural (Derby) | 7 | 43.6 (16.8) | 13.5% | 52.7% | 14.9% | 13.5% | 28.4% | 94.6% | 5.4% |
|  | 2008 | Western Australia | Rural (Jarlmadangah) | 34 | 30.4 (13.8) | 8.8% | 58.8% | 23.5% | 2.9% | 26.4% | 94.0% | 5.9% |
|  | 2008 | Western Australia | Rural (Pandanus Park) | 25 | 34.6 (14.3) | 20.0% | 48.0% | 20.0% | 8.0% | 28.0% | 96.0% | 4.0% |
| **Kapellas *et al.* 2014**[**28**](#_ENREF_28) | 2010-12 | Northern Territory | Rural and urban | 312 | 22-73 | nr | nr | nr | nr | 87.5% | 87.5%\*\*\* | 12.5% |

^ Calculated from reported percentage free of periodontal disease or reported percentage with periodontal disease

\*\*based on CPI 3 & 4

\*\*\* based on CPI 4

# total added up to more than 100%

nr: not reported

**Table 4: Associations between risk factors and oral disease**

|  |  |  |
| --- | --- | --- |
| **Author, year** | **Risk factors** | **Associations#** |
| Roberts-Thomson 2014[17](#_ENREF_17) | SmokingDiabetesAge (over 45 years)Gender | Significant associations of risk factors with presence of severe periodontal disease, and extent of severe periodontal destruction. Being male was significantly associated with severe periodontal destruction. |
| Smith *et al.* 2007[18](#_ENREF_18) | SmokingDental hygiene | No association of risk factors with the presence of oral disease (periodontal disease or caries). |
| Endean *et al.* 2004[26](#_ENREF_26) | Diabetes | Significant associations between diabetes and higher levels of periodontal disease and missing teeth |
| Jamieson *et al.* 2010[30](#_ENREF_30)  | Substance useDental service utilisationDental behavioursGender | Significant association between prevalence of moderate-severe periodontal disease and the following risk factors: male; tobacco use; marijuana use; petrol sniffing; and not owning a toothbrush. |
| Jamieson *et al.* 2010[23](#_ENREF_23)Jamieson *et al.* 2013[33](#_ENREF_33)\* | Soft drink/fruit juice/ cordial/ milk/ tea/ fruit /sweets/ sugar consumptionSocioeconomic factors | Higher mean DMFT associated with being female, drinking soft drink every day; having sugar in tea; consuming sweets every day; poor/moderate diet (compared to good diet); living more than 100 km from dental service or nearest hospital; inadequate community infrastructure (non-operational public toilets/flooding/non-working public toilets). |
| Kapellas *et al.* 2014[28](#_ENREF_28) (ADJ) | SmokingDiabetesAgeSocioeconomic factors | Significant associations between severe periodontal disease and older age, male, and having diabetes. |
| Kruger *et al.* 2008[16](#_ENREF_16) | Diabetes | Significant association between diabetes and advanced (CPI 3 & 4) periodontal disease. |

# Significance indicated by p value <0.05

\*Another publication by Jamieson *et al.* examined the risk factors: socioeconomic factors, diet and dental behaviours but did not measure association with risk factors with clinical outcomes; examined association of risk factors with self-reported oral health (e.g. pain, appearance etc).

18 articles were included in the review

(10 primary and 8 associated studies)

Articles were excluded for the following reasons:

* oral health data not captured in clinical examination
* reported prevalence of oral disease in dental admission patients without reporting a wider population, or data within a clinical registry
* review papers with no primary data

89 full text reviewed for eligibility

157 abstracts screened for eligibility

4,653 titles screened, and duplicates removed

4,653 records identified through search (includes duplicates)

**Figure 1:** Overview of search results

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**Figure 2:** Estimated Indigenous population and number of primary studies reporting oral health of Indigenous adults in each jurisdiction (n=9)\*.

\*one primary study did not report the location of the study and could not be mapped.**References**

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