# Australia's Oral Health Tracker

## Technical Paper

### First Edition

## Acknowledgments

The Australian Health Policy Collaboration and the Australian Dental Association, in cooperation with a working group made up of academics, researchers, epidemiologists, public health experts and dental practitioners, have developed report cards and a technical paper to inform and influence oral health policies and services in Australia. It is published for use by everyone with an interest in improving the oral health and general health of Australians. Working group members are acknowledged below:

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## About the Australian Health Policy Collaboration

The Australian Health Policy Collaboration at Victoria University works with and supports a collaborative network of organisations and leading chronic disease experts, bringing together Australia's leading thinkers to translate rigorous research into good policy. The national collaboration has developed health targets and indictors for 2025 that, together, will reduce preventable chronic diseases and reduce the health impacts of chronic conditions on the Australian population.

### About the Australian Dental Association

The Australian Dental Association (ADA) is the peak national professional body representing registered dentists as well as dentist students. ADA members work in both the public and private sectors and across all areas of practice.

The primary objectives of the ADA are to: encourage the improvement of the oral and general health of the public; advance and promote the ethics, art and science of dentistry; and support members of the Association in enhancing their ability to provide safe, high quality professional oral healthcare.

### Suggested Citation

Manton DJ, Foley M, Gikas A, Ivanoski S, McCullough M, Peres MA, Roberts-Thomson K, Skinner J, Irving E, Seselja A, Calder R, Harris B, Lindberg R, Millar L, Nichols T. 2018 *Australia's Oral Health Tracker: Technical Paper*, Australian Health Policy Collaboration, Victoria University, Melbourne.

## Foreward

The *Australia's Oral Health Tracker* is the first of its kind in the world and the Australian Dental Association (ADA) is proud to provide the leadership in the delivery of this project. Indeed, in February 2018 the FDI World Dental Federation acknowledged that there were currently no baselines or indicators for oral health.

Oral health is a basic expectation of all Australians and should be experienced throughout the course of life. It is fundamental to our overall general health, mental wellbeing, and quality of life.

*Australia's Oral Health Tracker* shines a spotlight on the status of our national oral health and aims to arm all stakeholders with the evidence needed to formulate solutions to alleviate the oral health burden in Australia. Oral health problems are among the most common and costly to Australians and the healthcare system.

The ADA is a strong supporter of chronic disease prevention and there is an intrinsic link between oral disease and general disease. Many of the risk factors that impact oral health, also impact several other chronic diseases.

*Australia's Oral Health Tracker* is aimed at policy makers to promote investment and commitment in improving oral health in Australia. National action must be focused on population-level interventions that target risk factors shared by many population groups and communities.

I would like to congratulate the working group chaired by Professor David Manton on bringing this concept to fruition. I'd also like to thank Professor Rosemary Calder AM and her team at the Australian Health Policy Collaboration for their expert advice and strategic support and for allowing us to develop the *Oral Health Tracker* as part of the health tracker series. Finally, I would like to acknowledge Ms Amelia Seselja and Ms Eithne Irving from the ADA Secretariat for having the insight to propose this initiative.

Dr Hugo Sachs
**President**
Australian Dental Association

# Australia's Oral Health Tracker
## Technical Paper

### First Edition

This technical paper (first edition) is the accompanying document for *Australia's Oral Health Tracker*, Australia's Adult *Oral Health Tracker* and Australia's Children and Young People *Oral Health Tracker*.

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| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
| Adults (19+) consuming too much sugar | N/A | 47.8% | 33.5% | N/A | 30% reduction | N/A |
| Proportion of the population with access to optimally fluoridated drinking water | 82.2% | 89% | 94% | 🟢 | N/A | N/A |
| Adults (18+) that brush teeth twice daily | 56% | 51% | 56% | 🟠 | 10% increase | N/A |
| Adults (aged 18+) that have had a dental check-up in the last 12 months | N/A | 55.5% | 61% | N/A | 10% increase | N/A |
| Long term risky drinking (aged 14+) | 20.1% | 17.1% | 13.7% | 🟢 | 20% reduction | 20.4% |
| Daily smokers (aged 14+) | 15.1% | 12.2% | 5% | 🟢 | N/A | 27.4% |
| Adults (18+) who are overweight or obese | 61.1% | 63.4% | 61.1% | 🟠 | Reverse the rise | 71.4% |
| Prevalence of diabetes in adults (25-65 years) | 4.1% | 5.1% | 4.1% | 🟠 | Reverse the rise | N/A |
| Adults (aged 15+) who have never experienced decay in permanent teeth | N/A | 9.9% | 10.9% | N/A | 10% increase | N/A |
| Untreated tooth decay in adults (aged 15+) | N/A | 25.5% | 20.4% | N/A | 20% reduction | N/A |
| Age-standardised incidence rate of oral cancers | 9.7 per 100,000 | 10.9 per 100,000 | 9.7 per 100,000 | 🟠 | Reverse the rise | N/A |

## ADULTS

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (aged 15+) with periodontal pockets (>4mm) | N/A | 19.8% (aged 15+) | **16.8%** | N/A | 15% reduction | N/A |
| Age-standardised mortality rate from oral cancers | 1.7 per 100,000 | 1.6 per 100,000 | **1.4 per 100,000** | 🟠 | 15% reduction | N/A |
| Adults with inadequate dentition (fewer than 21 teeth) | 12.3% | 15.5% | **15.5%** | 🟡 | Halt the rise | N/A |
| Adults who reported toothache in the last 12 months | 14.9% | 16.2% | **14.9%** | 🟠 | Reverse the rise | N/A |

## CHILDREN AND YOUNG PEOPLE

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | 🟢 | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Children (9-13 years) consuming too much sugar | N/A | 70.3% | **49.2%** | N/A | 30% reduction | N/A |
| Young people (14-18 years) consuming too much sugar | N/A | 73.1% | **51.2%** | N/A | 30% reduction | N/A |
| Proportion of the population with access to optimally fluoridated drinking water | 82.2% | 89% | **94%** | 🟢 | N/A | N/A |
| Children (5-14 years) that brush teeth twice daily with fluoridated toothpaste | N/A | 68.5% | **75.4%** | N/A | 10% increase | 54.4% |
| Children (5-11 years) that have had a dental check-up in the last 12 months | N/A | 73.9% | **81.3%** | N/A | 10% increase | N/A |

## CHILDREN AND YOUNG PEOPLE

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Young people (aged 12-17) that have had a dental check-up in the last 12 months | N/A | 78.4% | **86.2%** | N/A | 10% increase | N/A |
| Children (5-6 years) that visited a dentist before age 5 | N/A | 55.8% | **67%** | N/A | 20% reduction | 46.0% |
| Children (5-11 years) who are overweight or obese | 21.6% | 25.6% | **21.6%** | 🟠 | Reverse the rise | 32.8% |
| Young people (12-17 years) who are overweight or obese | 28.3% | 29.5% | **28.3%** | 🟠 | Reverse the rise | 36.3% |
| Children (5-6 years) who have experienced decay in primary teeth | N/A | 34.3% | **30.9%** | N/A | 10% increase | 51.9% |
| Children (6-14 years) who have experienced decay in permanent teeth | N/A | 23.5% | **21.2%** | N/A | 10% increase | 36.0% |
| Children (5-10 years) with untreated tooth decay in primary teeth | N/A | 27.1% | **21.7%** | N/A | 20% reduction | 44.0% |
| Children (6-14 years) with untreated tooth decay in permanent teeth | N/A | 10.9% | **8.7%** | N/A | 20% reduction | 22.9% |
| Potentially preventable hospitalisations in children (5-9 years) due to dental conditions | 9.1 per 1,000 | 9.3 per 1,000 | **8.4 per 100,000** | 🟡 | 10% increase | 11.5 per 1,000 |
| Children (5-14 years) who reported toothache in the last 12 months | 8.0% | 6.8% | **6.1%** | 🟢 | 10% increase | N/A |

## Introduction

Poor oral health is a significant contributor to the burden of disease in Australia. At an individual level it results in pain and discomfort reducing Australians' quality of life, including reduced school and work productivity.[1, 2] Oral diseases are among the most common health diseases and are contributing to the rising rates of health care costs. In 2015-16, an estimated $9.9 billion was spent on oral health,[3] with many of these costs incurred associated with treatment for oral disease that is preventable. In 2005, The World Health Organisation (WHO) called for oral health care to be integrated with all health care:

*"the compartmentalization involved in viewing the mouth separately from the rest of the body must cease because oral health affects general health by causing considerable pain and suffering and by changing what people eat, their speech and their quality of life and well-being".*[4]

This technical paper details the development of oral health targets considered by leading Australian oral health experts to be essential measures for improved oral health for the nation. The targets and indicators add to the targets and indicators for chronic disease prevention in Australia, published in 2015 by the Australian Health Policy Collaboration and developed by a national collaboration of leading Australian chronic disease and population health experts. These targets proposed improvements in the health of Australians in health indicators that contribute most to the rising rates of preventable chronic disease in our population. The target year for these improvements is 2025, in line with the WHO targets for global prevention and reduction in chronic diseases.

The work has supported the national report card, Australia's Health Tracker, published in 2016 which provided the first comprehensive assessment of how Australia's population is faring when measured against the health targets for 2025. Australia's Health Tracker provides the public, policy makers and service providers with a short list of health indicators that contribute most to the rising rates of preventable chronic disease in our population and shows where preventive health policy efforts have been and can be successful in tackling the risk factors.

The ADA and Australian Health Policy Collaboration (AHPC) have partnered to produce the first national report card on oral health - *Australia's Oral Health Tracker*.

*Australia's Oral Health Tracker* graphically highlights the intrinsic link between oral health and preventable chronic diseases, conditions, and their risk factors. Developed and reviewed by experts in the field of dental research, policy, practice, epidemiology and oral health promotion, *Australia's Oral Health Tracker* identifies current indicators and targets for 2025. These targets are in line with the WHO Global Action Plan for the Prevention and Control of Non-communicable Diseases (NCDs) 2013-2020 and Australia's Health Tracker 2016.

*Australia's Oral Health Tracker* places Australia as a world leader in this area of health policy leadership and is supported by a national coalition of leading dental health, public health, and health organisations. Whilst Australia has taken action to tackle oral health through the National Oral Health Plan, these targets are put forward to provide evidence-based tools for policy makers and service providers to use to prevent and reduce the impacts of poor oral health on the physical health and wellbeing of children, young people and adults in Australia.

## Health surveillance

The AHPC's report, *Targets and indicators for chronic disease prevention in Australia 2016*, emphasised the importance of adequate health surveillance – the monitoring of the health of Australians – to enable effective health policy and health services planning for current and emerging health issues in the population. Health monitoring provides survey based and service data that identifies new and emerging health demand and provides critical information on access to and adequacy of services.

Accurate monitoring of chronic diseases and related risk factors requires a national commitment to regular collection of risk factor data for chronic diseases (including anthropometric, biomedical and environmental measures). The Australian Health Survey (AHS), undertaken in 2011-13 by the Australian Bureau of Statistics, provided a baseline for more comprehensive health surveillance than has previously been available nationally. Regular surveillance is needed to assess changes over time, and to provide current information about health needs and risk factors that can inform future policy and planning. Australia's chronic disease and population health experts have strongly supported regular conduct of this survey.

In many cases, available Australian dental health data is even poorer. This Tracker is relying on, in some instances, data which are almost 15 years old. Oral health, as articulated by the WHO, is intricately enmeshed in physical health and wellbeing. It needs to be measured in line with measures of physical health and wellbeing known to be critically significant to the health of people and to the adequacy and effectiveness of policy and planning.

## Summary of Australia's Oral Health Indicators and Measures

| FRAMEWORK ELEMENT | PROPOSED MEASURES TO REACH TARGETS | PROPOSED AUSTRALIAN INDICATORS |
|---|---|---|
| **Risk Factors and Determinants for Poor Oral Health** | | |
| **Sugar intake** | A 30% reduction in the proportion of Australians consuming too much sugar | • Free sugar consumption is greater than 10% overall energy intake (aged 19+)<br>• Free sugar consumption is greater than 10% overall energy intake (young people 14-18 years)<br>• Free sugar consumption is greater than 10% overall energy intake (children 9-13 years) |
| **Access to optimally fluoridated drinking water** | Increased access to optimally fluoridated drinking water across the Australian population | • Proportion of the Australian population with access to optimally fluoridated drinking water |
| **Toothbrushing** | A 10% increase in twice daily toothbrushing | • Adults (aged 18+) that brush their teeth at least twice daily<br>• Children (5-14 years) that brush their twice at least twice daily with fluoridated toothpaste |
| **Dental visiting behaviours** | A 10% increase in the proportion of Australians receiving an annual dental check-up | • Adults (aged 18+) that have visited the dentist for a check-up in the previous 12 months<br>• Young people (12-17 years) that have visited the dentist for a check-up in the previous 12 months<br>• Children (5-11 years) that have visited the dentist for a check-up in the previous 12 months |
| | A 20% increase in the proportion of Australians visiting the dentist before age 5 | • Children (aged 5-6) that visited the dentist before age 5 |
| **Alcohol and tobacco consumption** | A 20% reduction in long-term risky drinking | • Reported average alcohol consumption of more than 2 standard drinks per day over the last year (aged 14+) |
| | A reduction in overall smoking rates to 5% of the Australian population. | • Age standardised prevalence of Australians daily smokers (aged 14+) |
| **Oral Health Conditions** | | |
| **Dental caries** | A 10% increase in the proportion of adults that have never experienced dental caries | • Adults that have never experienced dental caries in their permanent teeth (DMFT = 0). |
| | A 10% reduction in the proportion of children that have experienced dental caries | • Children (5-6 years) that have experienced dental caries in their primary teeth (DMFT > 0)<br>• Children (6-14 years) that have experienced dental caries in their permanent teeth (DMFT > 0) |
| | A 20% reduction in Australians with untreated tooth decay | • Untreated dental caries (aged 15+)<br>• Untreated dental caries in primary teeth (children 5-10 years)<br>• Untreated dental caries in permanent teeth (children 6-14 years) |
| **Oral cancer** | Reverse the rise in oral cancer incidence | • Age-standardised incidence rate of oral cancer per 100,000 population. |
| | A 15% reduction in oral cancer mortality | • Age-standardised mortality rate or oral cancer per 100,000 population. |
| **Gum disease (periodontitis)** | A 15% reduction in gum disease (periodontitis) | • Australians (aged 15+) with periodontal pockets (>4mm) |

| Oral Health Conditions | | |
|---|---|---|
| **Potentially preventable hospitalisations** | A 10% reduction in potentially preventable hospitalisations due to dental conditions for children aged 5-9 years | • Refer to measure |
| **Inadequate dentition** | Halt the rise in Australians with inadequate dentition | • Adults (18+) with inadequate dentition/ severe tooth loss (fewer than 21 teeth) |
| **Toothache** | Reverse the rise in adult toothache prevalence | • Reported toothache in the previous 12 months (aged 15+) |
| | A 10% reduction in child toothache prevalence | • Reported toothache in the previous 12 months (children 5-14 years) |

## 2. Risk Factors and Determinants of Poor Oral Health

### 2.1 Sugar

### 2.1.1 Introduction

Consumption of free sugars is the main contributor to dental caries in children, young people, and adults.[5] Dental caries affects a large proportion of the Australian population and has a range of adverse outcomes including severe impacts on health.

Free sugars include monosaccharides and disaccharides added to foods and beverages by the manufacturer, cook or consumer, and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates.[5] In Australia, the most common sources of free sugars included sugar-sweetened beverages, followed by sugar, sweet spreads, cakes, biscuits, pastries, and batter-based products.[6]

Reducing free sugars across the population is recognised as an effective and cost-effective strategy to improve population oral health.[7-9] Health promotion should focus on the intake amount and frequency of free sugars as both are highly correlated with dental caries.[10]

### 2.1.2 Key issues

- Sugar consumption is the main contributor to dental caries.
- Most Australians have a free sugars intake well above the recommended daily upper level.
- Reducing sugar overconsumption is one of the most cost-effective, efficient, and equitable ways to improve population oral health.

### 2.1.3 Sugar consumption in Australia

Based on representative national data from the recent Australian Health Survey (2011-2013), 47.8% of adults; 73.1% of young people (14-18 years); and 70.3% of children (9-13 years) exceeded the World Health Organization (WHO) recommended free sugars intake of more than 10% of total energy intake.[11]

The 2011-12 Australian Health Survey found the average daily amount of free sugars consumed was 60 g.[11]

In 2012-13, Aboriginal and Torres Strait Islander people consumed an average of 75 g of total sugars per day; an average 14% of total daily energy intake.[12] There are no data available on the proportion of the Aboriginal and Torres Strait Islander population exceeding the WHO recommendations.[5]

### 2.1.4 Relevant benchmarks

For both adults and children, the WHO recommends reducing the intake of free sugars to less than 10% of total energy intake.[5] The WHO further recommends reducing sugars to less than 5% of total energy intake as there is evidence that this will significantly reduce dental caries and there is no evidence that these levels are harmful to health.[5]

There are no published Australian targets for free sugar consumption. Population-level sugar intake was reported on in Australia's Health Tracker 2016, but no 2025 target was nominated. However, the indicator and its link to obesity and diabetes are being monitored.

Data on the proportion of the Australian population whose free sugars intake is greater than 10% of overall energy intake was first collected in the Australian Health Survey 2011-13 and has not been collected at a national level since. Therefore, there are no available trend data. The development of feasible and appropriate 2025 targets for free sugars consumption indicators relied on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

### 2.1.5 Proposed Australian targets and indicators

Given the causal association between free sugars consumption and dental caries, the working group recommended that *Australia's Oral Health Tracker* include a 2025 free sugars intake target.

Two options were considered as suitable 2025 targets – a 50% or a 30% reduction in the proportion of the Australian population exceeding the WHO recommendation for free sugars consumption.

A 50% reduction in the proportion of the Australian population exceeding the WHO recommendation for free sugars consumption would align with the goal of the Australian public health organisation Sugar by Half to "reduce added sugar consumption by half". Aligning with their messaging would have been appropriate as Sugar by Half are supported by a range of organisations, including the Australian Dental Association. However, a 50% reduction is ambitious and considered by the expert working group unlikely to be achievable by 2025.

Aiming for a reduction of 30% in current prevalence would follow a similar approach to that of the WHO and *Australia's Health Tracker* for a 30% reduction in sodium intake by 2025. Given that both free sugars and sodium intakes are consumed well above recommended levels in Australia and are often considered together as 'negative nutrients', the working group recommends aligning the two targets. Achieving this reduction in the proportion of the population exceeding the recommended free sugars daily intake by 2025 is considered challenging but feasible. It would be one of the most cost-effective, efficient, and equitable ways to improve population oral health.

### 2.1.6 Technical data

Prevalence of people consuming above the recommended daily intake of sugar was used rather than the mean percentage daily intake of sugar to develop and report on the target for reducing sugar consumption. These were the data reported at a population level. The only data point available is from the Australian Health Survey 2011-13.[13]

Previous data from the 1995 National Nutrition Survey showed that on average the population intake of free sugars was 66 g, approximately 11% of the total energy intake (%E).[14] However,the National Nutrition Survey

used a different definition of free sugars, as fruit juice and fruit juice concentrate were not included as free sugars. These differences between the two surveys mean the data were not comparable, and trend data cannot be generated.

Comparable Aboriginal and Torres Strait Islander data are not available as the Australian Bureau of Statistics advise that usual intakes of added sugars and free sugars were not calculated for the 2012-13 National Aboriginal and Torres Strait Islander Nutrition and Physical Activity Survey. The National Cancer Institute method requires at least two days of dietary recall which was not available for the majority of participants in this survey. Consequently, there were no comparisons to the WHO guidelines of less than 10% of total energy intake from free sugars.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (19+) consuming too much sugar | N/A | 47.8% AHS 2011-13 | **33.5%** | N/A | 30% reduction | Not available |
| Children (9-13 years) consuming too much sugars | N/A | 70.3% AHS 2011-13 | **49.2%** | N/A | 30% reduction | Not available |
| Young people (14-18 years) consuming too much sugars | N/A | 73.1% AHS 2011-13 | **51.2%** | N/A | 30% reduction | Not available |

## 2.2. Access to optimally fluoridated drinking water

### 2.2.1 Introduction

Community water fluoridation involves the adjustment of the fluoride concentration in drinking water to reach an optimal level, i.e. the level of fluoride in drinking water (~1.0 ppm) that achieves a significant reduction in dental caries across the population, while ensuring that the prevalence and severity of dental fluorosis are kept to an acceptable level.[15]

The association between the consumption of low-concentration fluoride and reduced rates of dental caries was originally established in the 1930s and has been continually reinforced by a robust and expanding evidence base. [15, 16] The practice of community water fluoridation has been utilised since the 1940s as a preventive health activity in various countries.[17]

In Australia, community water fluoridation programs are considered safe and effective public health initiatives to reduce dental caries at a population level.[15] Water fluoridation was first introduced in Australia in Beaconsfield, Tasmania in 1953, second in Yass, NSW in 1956), followed by the first capital cities – Hobart and Canberra in 1964; Perth and Sydney in 1968; Adelaide in 1971; Darwin in 1972; and Melbourne in 1977.[15] Water fluoridation has been correlated with improved dental health across Australia.[15] Australians born after 1970 (when the majority of water fluoridation programs commenced in Australia) have experienced an approximate 50% reduction in dental caries compared with their parents' generation.[15]

### 2.2.2 Key issues

- Access to fluoridated drinking water is a major factor in the prevention of dental caries.

- Access to fluoridated drinking water in Australia has steadily increased over the last 15 years.

- There are still significant variations in access to fluoridated drinking water between states and territories within Australia.

### 2.2.3 Water fluoridation in Australia

Australia's National Oral Health Plan[18] uses collated state and territory health department data to report on the percentage of the population in each state and territory that have access to optimally fluoridated drinking water. In 2017, 89% of the Australian population had access to optimally fluoridated drinking water.

Despite the significant benefits attributed to Australian water fluoridation programs, until recently the population coverage of such programs was suboptimal. In 2003, fewer than 70% of Australians had access to optimally fluoridated drinking water (Table 1).[18] There has been a significant and encouraging increase in the proportion of the Australian population with access to optimally fluoridated drinking water over the last 15 years (Figure 1).

Most states and territories have now achieved more than 90% of the population having access to optimally fluoridated water (100% in the Australian Capital Territory). However, in some areas, fluoridation has decreased over time. In Queensland, only 76% of people have access to optimally fluoridated water.[18] Recent changes (2012) in legislation in Queensland to remove the mandate for water fluoridation may have had a negative effect and could see the national average decline.

There are no comparable data for access to fluoridated drinking water for Aboriginal and Torres Strait Islanders.

TABLE 1: Proportion of Australians with access to fluoridated drinking water 2003-2017

| YEAR | 2003 | 2012 | 2017 |
|---|---|---|---|
| % population with access to optimally fluoridated drinking water | 69.1% | 82.2% | 89% |

*From COAG Health Council. Healthy Mouths Healthy Lives. Australia's National Oral Health Plan 2015-2024.
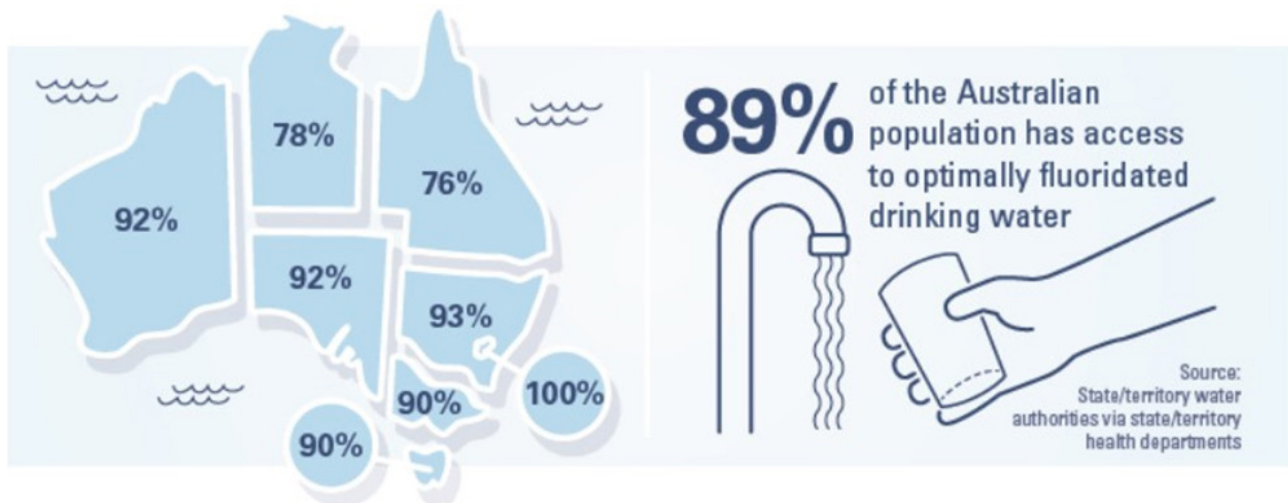


Figure 1: Water fluoridation across Australia in 2017, from draft monitoring report for the National Oral Health Plan[1]

### 2.2.4 Relevant benchmarks

Currently, there is no target or measure for Australia regarding access to optimally fluoridated drinking water or water fluoridation more generally.

### 2.2.5 Proposed Australian targets and indicators

The working group recommends 'Proportion of the Australian population with access to optimally fluoridated drinking water' as the indicator relating to fluoride intake for *Australia's Oral Health Tracker*.

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[1] Draft report supplied by member of the expert working group; reference will be updated when details are provided.

Reporting on the proportion of towns with a population of greater than 1000 and no fluoridated town water supply was preferred by the working group, as this takes into account small and/or remote townships where access to optimally fluoridated water is not practical. However, there are no available data regarding this indicator, and overall population with access was chosen instead as these data are monitored and published. Issues around measuring access rather than consumption were also discussed, but data around actual fluoride intake was not readily available at a population level, and measuring access provides a reasonable indication of intake regarding fluoridated water.

There are useful trend data which illustrated the significant progress made in Australia around water fluoridation over the past 15 years. The working group considered that maintenance of the current trend in population access from 2012 to 2017 is an appropriate and feasible measure. This sets a target of 94% population coverage by 2025.

## 2.2.6 Technical data

Optimally fluoridated drinking water refers to a water supply with fluoride levels ranging from 0.6 to 1.1 mg/L.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| The proportion of the Australian population with access to optimally fluoridated drinking water. | 82.2% (2012) Australia's National Oral Health Plan 2015-2024 | 89% (2017) Australia's National Oral Health Plan 2015-2024 Monitoring report | **94%** | | N/A | Not available |

## 2.3 Toothbrushing

### 2.3.1 Introduction

Toothbrushing is a basic oral hygiene behaviour that mechanically removes and controls the build-up of dental plaque.[19, 20] Dental plaque is a sticky film, including bacteria, which accumulates and forms continuously on the tooth surfaces and is a primary risk factor for gingivitis (gum inflammation) and its potential progression to periodontitis (loss of bone around the teeth).[19] Toothbrushing with a fluoridated toothpaste allows for the delivery of therapeutic agents, such as fluoride. Toothbrushing with a fluoridated toothpaste has been shown to be far more effective in preventing dental caries than if a fluoridated toothpaste is not used.[21]

To assist with effective plaque control, it is recommended that toothbrushing be performed twice-a-day for at least two minutes. The WHO recommends that toothbrushing at least twice a day, (morning and night).[22, 23]

Dental professionals can also provide advice on the type of toothbrush and toothpaste an individual should be using, as well as potentially supervising and modifying their brushing technique, based on their individual needs, to assist with effective plaque removal as well as provide information for improved oral health behaviour.[20, 24, 25]

Caregivers should begin toothbrushing as soon as a child's first tooth erupts, around the age of six months.[23] A pea-sized amount of low-fluoride toothpaste should be introduced from 18 months of age under supervision. Supervising adults should be trained in the techniques of brushing; such as how to estimate the appropriate amount of toothpaste (a smear, the size of the little fingernail, etc.) and not to rinse after brushing. [23] From the age of six years, a standard fluoridated toothpaste (1000 ppm fluoride) can be introduced.[26] Parents should continue supervising and assisting with their child's toothbrushing until around the age of eight years. However, dental professionals may recommend a specific fluoridated toothpaste based on individual risk analysis.[26]

### 2.3.2 Key issues

- Only half of Australian adults and two-thirds of children brush their teeth twice daily.

- Regular toothbrushing reduces the risk of plaque build-up and the associated condition of gum disease.

- Toothbrushing twice a day with fluoride toothpaste is far more effective in preventing dental caries than if a fluoridated toothpaste is not used.

- Tooth cleaning should begin early (~ 6 months of age) and continue throughout life.

- Toothbrushing technique is important and dental professionals should provide education to patients.

### 2.3.3 Toothbrushing in Australia

*Adults*

Data have been collected by the National Survey of Adult Oral Health (NSAOH; 2004-06) on frequency of toothbrushing among the Australian adult population and are routinely collected by the Australian Dental Association in their yearly consumer surveys.[27] The NSAOH item asked respondents to indicate how many times they brushed their teeth in the seven days preceding the survey; the percentage of dentate adults (15 plus years of age) who brushed on average two or more times per day was 55.5% (95% CI 52.7,58.2).[1] For *Australia's Oral Health Tracker*, it was decided that the ADA data would be included as these surveys are conducted more frequently. The ADA's nationally, representative samples include a minimum of 3,800 respondents from capital cities, regional cities, and a large number of regional and rural towns in all States and Territories of Australia. [27]

In 2016, the proportion of Australian adults brushing their teeth twice daily was 51%.[27] A lower percentage of people reporting low socioeconomic circumstances brushed their teeth twice daily or more frequently compared with people reporting high socioeconomic circumstances (49% to 58%, respectively). Younger people reported brushing their teeth twice daily compared with middle-aged and older (55% for 18 – 35-year olds; 44% for 36 –55 year olds; 36% for ≥ 56 years old) and a greater proportion of women brushed twice daily compared with men (57% and 43%, respectively).[27]

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

*Children*

Data on frequency of toothbrushing for children was collected in the National Child Oral Health Survey 2012-14. It is the first nationally representative child oral health survey, encompassing almost 25,000 participants.[28] The National Child Oral Health Survey data are used as the baseline for *Australia's Oral Health Tracker* as there were no suitable earlier data sets with which a time trend could be established.

In 2012-14, 68.5% of Australian children were brushing their teeth twice daily.

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

### 2.3.4 Relevant benchmarks

No targets for rates of toothbrushing have been established in Australia or by the WHO. Australian population level data for adults was collected in 2011 and 2016, but there is only one data point for children. The development of feasible and appropriate 2025 targets for tooth brushing indicators relied on an interpretation of the adult data and on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

### 2.3.5 Proposed Australian targets and indicators

Australian population level data on these indicators for adults are regularly collected by the ADA in their annual Consumer Survey.[27] The proportion of adults brushing their teeth twice daily in 2011 was 56% and in 2016 was 51%.[27]

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[1] These data were provided by the Australian Research Centre for Population Oral Health (personal communication) based on the National Survey of Adult Oral Health 2004-06 data.

The working group recommends a target to increase by 10% the prevalence of twice-a-day toothbrushing so that the decline is addressed and the trend reversed. This target is feasible as it is a return to previous levels.

The working group recommends a target increase of 10% in the proportion of children (5 to 14 years) who brush their teeth twice daily, in line with the adult target. The working group considers this target feasible if a robust systems-based, population health approach is undertaken.

### 2.3.6 Technical data

Twice daily brushing is used as the measure. The addition of fluoride toothpaste is important and the majority of toothpaste sold in Australia contains fluoride.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (18+) that brush teeth twice daily | 56% ADA Consumer Survey 2011 | 51% ADA Consumer Survey 2016 | 56% | | 10% increase | Not available |
| Children (5-14 years) that brush teeth twice daily with fluoridated toothpaste | N/A | 68.5% NOCHS 2012-14 | 75.4% | N/A | 10% increase | 54.4% NOCHS 2012-14 |

## 2.4. Dental visiting behaviours

### 2.4.1 Introduction

The annual dental 'check-up' refers to a dental examination at least once-a-year that is not attributable to acute symptoms such as dental pain. Regular dental check-ups are a preventive measure that have been associated with better oral health outcomes for patients.[29]

Dental check-up frequency should be related to an individual's risk for developing oral disease as well as to detect or review any signs and symptoms.[30, 31] Early detection of disease allows for appropriate and timely intervention by dental professionals. Furthermore, regular check-ups allow for dental professionals to provide on-going preventive advice for lifestyle risk factors, such as dietary advice or smoking cessation as well as education and motivation for at-home oral hygiene practices which are essential for primary prevention of oral diseases.[32]

Regular dental check-ups should begin in early childhood, within six months of the first tooth erupting or by a child's first birthday, as the evidence indicates that early intervention and prevention will reduce a child's future risk of oral disease.[33, 34] Australia's National Oral Health Plan and the World Dental Federation (FDI) both recommend that children visit the dentist for the first time early in life; ideally before two years of age. [18, 35]

### 2.4.2 Key issues

- Dental check-ups are key to prevention and early detection of oral health conditions.
- Almost half of Australian children have not visited a dentist before their fifth birthday.
- Approximately one-quarter of children (5 to 11 years) and young people (12 to 17 years) have not had a dental check-up in the 12 months preceding the survey.
- Almost half of adults have not had a dental check-up in the 12 months preceding the survey.

### 2.4.3 Dental visiting behaviours in Australia

The prevalence of adults who had a dental check-up in the 12 months prior to the National Dental Telephone Interview Survey (NDTIS) 2010 was 55.5%.[36] The corresponding figures for children (5 to 11 years) was 73.9% and for young people (12 to 17 years) was 78.4%.[36] These figures have been calculated from the 2010 NDTIS.[36]

Data on 'dental visit in last 12-months' and 'reason for last dental visit' have been collected on population level oral health surveys,[28, 37] but not for 'dental check-up in last 12 months'. These data could not accurately identify 'dental check-up in the last 12 months' as there would be a proportion of individuals whose last visit was not a check-up that have still attended a check-up in the preceding 12 months.

The only data source that could be used to calculate the proportion of those who had visited the dentist for a check-up in the preceding 12 months was the 2010 National Dental Telephone Interview Survey, [36] as it reported on 'dental visit in the last 12 months' and 'dental services received in the last 12 months' (eg. check-up, filling, scale and clean, etc.). The method for calculating the proportion of each population group (children, young people and adults) who had received a dental check-up in the 12 months prior to the survey is the proportion of people who both visited the dentist and received a check-up (Table 2; Dental visit in past 12 months x (Check-up service received/100) = Dental check-up in last 12 months.

TABLE 2: Calculations for check-up at dental visit in the 12 months prior to the survey

| | Dental visit in past 12 months<br>2010 NDTIS | Check-up service received<br>2010 NDTIS | Dental check-up in last 12 months |
|---|---|---|---|
| **Adults (18+)** | 60.7% | 91.5% | 55.5% |
| **Children (5-11)** | 75.7% | 97.6% | 73.9% |
| **Young people (12-17)** | 81.8% | 95.9% | 78.4% |

Frequency of dental check-ups was associated with age and income levels in Australia.[36] Older people and children tended to visit the dentist more regularly, as do people on higher incomes.[36] In contrast, many young adults avoided the dentist, for various reasons including financial.[38, 39] Other oft-cited reasons for delaying dental visits were fear of blood, fear of needles, fear of cost, and fear of pain.[40]

In 2010, nearly three-quarters of those with a household income of $100,000 or over had last visited for a check-up in the previous 12 months (72%), but only half of people in the $20,000 to $30,000 and $30,000 to $40,000 household income groups had visited for a check-up (51% for both). [36] People living in major cities had higher rates of visiting for a check-up (67%) than those in outer regional areas (57%).[34]

Comparable and representative Aboriginal and Torres Strait Islander data for dental check-ups in the last 12 months are not available.

While Australia's National Oral Health Plan and the FDI recommend that children visit the dentist for the first time before two years of age, [18, 35] data on this indicator are not available at a population level for Australian children. The National Child Oral Health Survey 2012-14 reported that, in 2010, among children aged five to six years, 55.8% had a dental check-up prior to five years of age. At the same time, a lower proportion of Aboriginal and Torres Strait Islander children aged five to six years (46%) visited the dentist prior to five years of age.[28] A greater proportion of children from medium income households compared with low income households visited the dentist before five years of age (58.2% compared with 46.3%).[28] Similarly, children from high income households were 1.5 times more likely to visit the dentist prior to five years of age compared with children from low income households and 1.2 times more likely than children from medium income households. [32]

## 2.4.4 Relevant benchmarks

There are no Australian or WHO guidelines on frequency of dental check-ups, with the recommended frequencies based on individual risk factors. For example, in the case of dental caries, the International Caries Classification and Management System is a comprehensive set of clinical protocols and recommends patient specific recalls based on the current risk status.[41] Consequently, there are no targets.

Australia's National Oral Health Plan and the FDI both recommend that children visit the dentist for the first time before two years of age and that adults should visit at least every two years.[18, 35] No targets for annual dental check-ups or dental check-ups before age two (in line with the guidelines) or age five (in line with available data) have been established in Australia or by the WHO.

The development of feasible and appropriate 2025 targets for dental check-ups relied heavily on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

## 2.4.5 Proposed Australian targets and indicators

Limited scientific evidence is available on the appropriate frequency of dental check-ups. The periodicity for dental check-ups is based on the individual's needs and risk of developing oral disease and therefore patients may require examinations to be more or less frequent depending on their risk status. [34, 42, 43] However, the working group recommended 'annual dental check-up' as an appropriate indicator for most of the Australian population.

The working group recommends that *Australia's Oral Health Tracker* report on annual check-ups rather than yearly visits in general, as a dental check-up is an indicator of proactive and preventive dental visiting behaviour, whereas visiting for a specific issue is not.

A 10% increase in the proportion of adults, young people and children visiting the dentist in a 12-month period for the purpose of a check-up is recommended as feasible by the working group.

A 20% increase in children under five years of age that have visited the dentist was considered appropriate. Additionally, health promotion activities regarding improved awareness and access to dental care are likely to have a more immediate impact on visiting behaviours than on actual oral health conditions.

## 2.4.6 Technical data

Dental check-ups are reported rather than dental visits as dental check-ups reflect proactive, preventive measures whereas dental visits may be reactive for acute conditions. Data were calculated by multiplying 'Dental visit in past 12 months by Check-up treatment service received divided by 100' (Table 2).

The ADA will track this indicator through the ADA's ongoing annual survey.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (aged 18+) that have had a dental check-up in the last 12 months | N/A | 55.5% NDTIS 2010 | **61%** | N/A | 10% increase | Not available |
| Children (5-6 years) that visited a dentist before age 5 | N/A | 55.8% NDTIS 2012-14 | **67%** | N/A | 20% increase | 46% |

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Children (5-11 years) that have had a dental check-up in the last 12 months | N/A | 73.9% NDTIS 2010 | **81.3%** | N/A | 10% increase | Not available |
| Young people (aged 12-17) that have had a dental check-up in the last 12 months | N/A | 78.4% NDTIS 2010 | **86.2%** | N/A | 10% increase | Not available |

## 2.5 Alcohol and tobacco consumption

### 2.5.1 Introduction

Tobacco and alcohol are major risk factors for oral disease, in particular, for oral cancers. Both introduce carcinogenic material into the mouth.[44, 45]

Several reviews and meta-analyses have confirmed the association between long-term alcohol consumption and oral cancers. [44, 46-48] The risk is in the long-term consumption rather than the amount consumed at each event as even light drinking (defined as one drink/day) was associated with oral cancers.[46] A population-level reduction in harmful use of alcohol is recognised as one of the most effective and cost-effective strategies to improve incidence of oral cancers.[7, 8]

Smoking and tobacco use are also major risk factors for oral cancer.[49, 50] In addition to cigarette smoking, included are chewing tobacco,[51] snus/snuff,[51] and betel nut,[50] cigars,[52] marijuana,[53] or any other inhalation that burns the throat. [54] Beyond oral cancer there are a number of other health risks associated with these activities.

### 2.5.2 Key issues

- Alcohol and tobacco are major risk factors for oral cancers.

### 2.5.3 Alcohol and tobacco consumption in Australia

*Alcohol*

Per capita alcohol consumption in Australia has averaged around 10 litres of pure alcohol per person since the early 1990s. It steadily increased between 2000 and 2008 but declined from 10.8 litres in 2008 to 9.7 litres in 2014[55] and remained steady at 9.7 litres[56] in 2015-16.

Similarly, survey-based estimates of both long-term and short-term risky drinking have declined recently with particularly sharp declines among young people.[56] Data from the 2001 National Drug Strategy Household Survey shows about 20% of Australians aged 14 years and over were drinking alcohol at risky levels.[49] This pattern continued until 2010 when a downward trend developed.[10] In 2013, the proportion was 18.2% and in 2016 there was a statistically significant decrease to 17.1% (Figure 2). [57]

In 2016, 20.4% of Aboriginal and Torres Strait Islander people aged 14 years and over reported drinking alcohol at risky levels.[57]
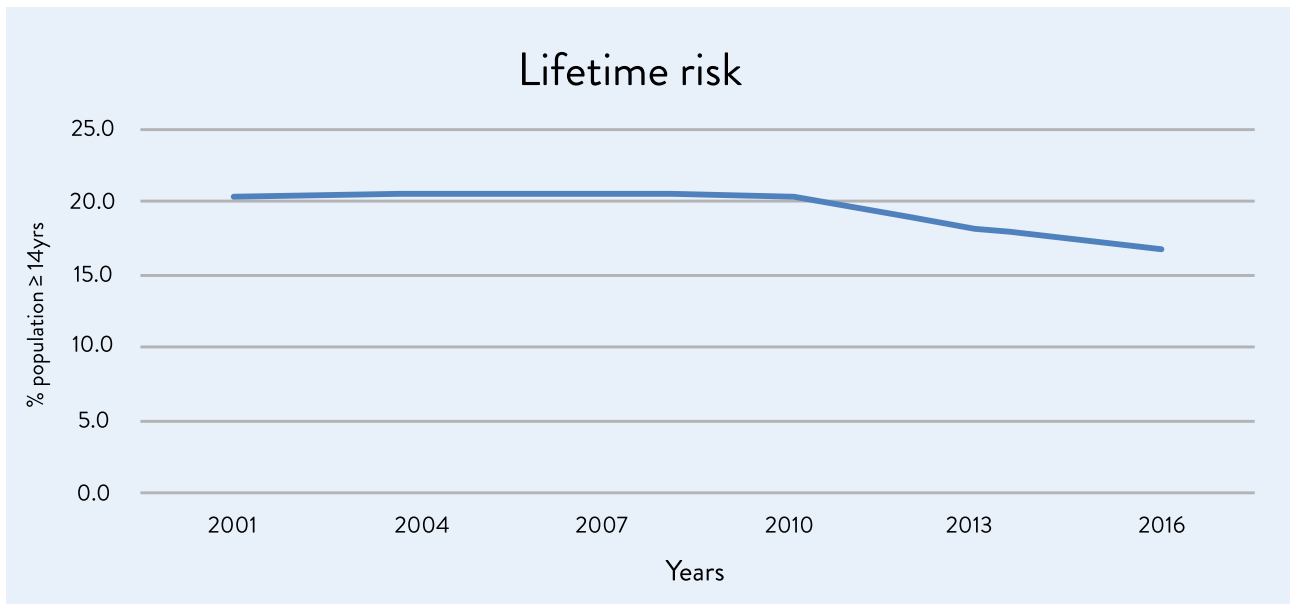
Figure 2: Long term risky drinking of alcohol, people aged 14 years and over, Australia, 2001-2016

### Smoking

As of 2016, 12.2% of Australians aged over 14 years smoked daily, down from 15.1% in 2010.[58, 59]

Each year, smoking is estimated to kill 19,000 Australians and remains the leading cause of preventable death and disability.[60] Over recent decades, there has been a significant decline in the prevalence of smoking in Australia in both adults and children.[61] Contributors to this decline have included a series of tobacco control measures such as bans on tobacco advertising and promotion (including at point of sale), tobacco tax increases, strong public education/mass media programs, smoke-free measures, graphic health warnings and plain packaging, and continuing advocacy and mass media coverage of the harms of smoking.

However, substantial numbers of Australians continue to smoke. Considerable socioeconomic inequities in smoking prevalence are seen across the Australian population, with some disadvantaged populations having substantially higher smoking prevalence than the general population. For example, although smoking prevalence in the general population is decreasing, it is substantially higher among people with any mental illness.[62] Aboriginal and Torres Strait Islander people report a high prevalence of smoking; with 27.4% being daily smokers. Other groups with relatively high rates of daily smoking include those who live in the most disadvantaged areas and those who live in remote/very remote areas (17.7% and 20.7%, respectively).[63]

## 2.5.4 Relevant benchmarks

The WHO has a target of at least a 10% reduction in the harmful use of alcohol nationally by 2025 (from 2011 levels) and a 30% reduction in smoking. *Australia's Health Tracker 2016* includes four targets to reduce the harm caused by alcohol, and a target to reduce daily smoking to 5% of the total population.

## 2.5.5 Proposed Australian targets and indicators

A single indicator for *Australia's Oral Health Tracker* monitoring long-term risk drinking is recommended.

A 20% reduction in this indicator between 2016 (latest data) and 2025 has been established by the alcohol expert working group for Australia's health targets and indicators and *Australia's Health Tracker.* Currently, there is a downward trend in this indicator that is likely to continue if concerted efforts by federal and state governments are maintained and/or increased that ensure reductions in alcohol consumption.

The tobacco expert working group for Australia's health targets and indicators endorsed a 5% or less current smokers target for the year 2025 reflecting the current levels of smoking in the Australian population compared with those in the rest of the world.

The working group for *Australia's Oral Health Tracker* has endorsed the existing targets for long-term risky drinking and smoking in *Australia's Health Tracker*.

### 2.5.6 Technical data

This section incorporates material adapted and taken from *Targets and Indicators for chronic disease prevention in Australia*; authored by Michael Livingston and Kypros Kypri (alcohol) and Michelle Gooey and Mike Daube (tobacco).

'Risky use of alcohol' as defined in the National Health and Medical Research Council guidelines for lifetime risk is the consumption, on average, of more than two standard drinks per day.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Long term risky drinking (aged 14+) | 20.1%<br>NDSHS 2010 | 17.1%<br>NDSHS 2010 | 13.7% | | 20%<br>increase | 20.4%<br>NDSHS 2016 |
| Daily smokers (aged 14+) | 15.1%<br>AIHW 2013 | 12.2%<br>NDSHS 2016 | 5% | | N/A | 27.4%<br>NDSHS 2016 |

## 2.6 Overweight, Obesity and Diabetes

### 2.6.1 Introduction

While overweight, obesity and diabetes are leading public health issues in Australia and around the world,[64-68] these chronic diseases also have adverse impacts on oral health.

Being overweight or obese is associated with oral health conditions among adults, including dental caries,[69] periodontal disease,[69, 70] and inadequate dentition.[71, 72] Childhood obesity is related to dental caries[73-76] and some signs of periodontal disease.[77]

The most obvious shared risk factor for overweight and obesity — poor diet — is also linked to higher risks of oral diseases such as dental caries and periodontal diseases.[78] Changes in dietary patterns such as decreasing rates of fruit and vegetable consumption are increasingly contributing to the prevalence of overweight and obesity and rates of diabetes in Australia.

Diabetes is associated with oral health conditions including periodontal disease,[69, 79, 80] and inadequate dentition.[80] There is also some evidence of relationships between diabetes and dental caries.[80, 81]

The WHO has recognised there is strong evidence that oral and general health are interrelated and share common risk factors such as obesity and diabetes. [82, 83] Addressing the common risk factors of chronic disease from a young age can minimise the significant health impacts of overweight and obesity, diabetes, and poor oral health such as dental caries and periodontal disease in the future.

### 2.6.2 Key issues

- Overweight, obesity and diabetes are associated with poor dental health.
- Poor diet is linked to poor dental health.

### 2.6.3 Overweight, Obesity and Diabetes in Australia

A fuller discussion of overweight, obesity and diabetes in Australia can be found in *Targets and Indicators for chronic disease prevention in Australia*.[84]

*Overweight and obesity in adults*

The Australian Health Survey reports that in 2014-15, 63.4% of Australians aged 18 years and over were overweight or obese (35.5% overweight and 27.9% obese).[61] While the prevalence of overweight and obesity increased in Australia between 1995 (56.3%) and 2011-12 (62.8%), there was no significant increase between 2011-12 and 2014-15.[61] Overall, 70.8% of men were overweight or obese in 2014-15, compared with 56.3% of women.[61]

*Overweight and obesity in children and adolescents*

The percentage of overweight children and adolescents has more than doubled in Australia since the mid-1980s.[85, 86] According to the 2014-15 Australian Health Survey, over one-quarter (27.4%) of children aged 5 to 17 years were overweight or obese.[61] Children who are obese are more likely to maintain their obesity as adults, thereby increasing the risk of developing chronic diseases and complications.[87]

*Diabetes*

Diabetes results in premature mortality and a range of complications including heart disease, stroke, chronic kidney disease, vision loss, amputations, and periodontal disease.[88] The risk of type 2 diabetes increases with increasing weight, even within the normal BMI range, but the greatest increase is seen in individuals with obesity.[89, 90]

In 2010, the prevalence of measured raised blood glucose/diabetes among adults in Australia was 4.8% .[85] Self-reported estimates are likely to underestimate prevalence, as some people will not be aware they have diabetes.[91]

### 2.6.4 Proposed Australian targets and indicators

The working group recommends that *Australia's Oral Health Tracker* adopt the indicators and targets used in *Australia's Health Tracker*, developed by the Australian Health Policy Collaboration's expert working group. A discussion of these indicators and targets can be found in *Targets and Indicators for chronic disease prevention in Australia*.[84]

### 2.6.5 Technical data

This section incorporates material adapted and taken from the 'Diabetes and obesity' chapter of the Australian Health Policy Collaboration's Targets and Indicators for chronic disease prevention in Australia; authored by Stephen Colagiuri, Anna Peeters and Sharleen O'Reilly.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (18+) who are overweight or obese | 61.1% NHS 2007-8 | 63.4% NHS 2014-15 | 61.1% |  | Reverse the rise | 71.4% NHS 2014-15 |
| Prevalence of diabetes in adults (25-65 years) | 4.1% NHS 2007-8 | 5.1% NHS 2014-15 | 4.1% | | Reverse the rise | Not available |

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Children (5-11 years) that are overweight or obese | 21.6% NHS 2007-8 | 25.6% NHS 2014-15 | 21.6% | | Reverse the rise | 32.8% NHS 2014-15 |
| Young people (12-17 years) that are overweight or obese | 28.3% NHS 2007-8 | 29.5% NHS 2014-15 | 28.3% | | Reverse the rise | 36.3% NHS 2014-15 |

## Oral Health Conditions

### 3.1 Dental caries (tooth decay)

#### 3.1.1 Introduction

Dental caries is the localised destruction of susceptible dental hard tissues by acidic by-products from bacterial fermentation of dietary carbohydrates, especially sugar.[92] The signs of demineralisation are seen on the hard dental tissues, but the disease process is initiated within the bacterial biofilm (dental plaque) on the tooth surface.[92]

Dental caries is one of the most common health problems in Australia and considered the most prevalent chronic disease globally.[93] Plaque constantly forms on teeth. When eating or drinking foods containing sugars, the bacteria in plaque produce acids that dissolve tooth enamel. The stickiness of the plaque keeps these acids in contact with teeth and over time, the enamel can break down and a cavitated lesion (hole) forms.[94]

Dental caries can be prevented, and/or the risks can be reduced.[94]

#### 3.1.2 Key issues

- Dental caries is the most prevalent chronic disease worldwide.
- Over 90% of Australian adults have experienced dental caries at some point in their lives.
- Over one-third of Australian children have experienced decay in their primary teeth by age six years and almost one-quarter have experienced decay in their permanent teeth by age 14 years.
- Over one-quarter of Australian children and adults live with untreated decay in their primary teeth.
- Prevalence of dental caries experience and untreated dental caries in both primary and permanent teeth are 1.5 – 2.5 times higher in Aboriginal and Torres Strait Islander children compared with the national average.

#### 3.1.3 Dental caries in Australia

**Total dental caries experience**

Dental caries is the most prevalent chronic disease in both Australian adults and children.[95] Over 90% of Australian adults have experienced dental caries at some point in their lives.[96] There are several ubiquitous risk factors associated with the development of dental caries including a causal relationship between free sugar consumption and decay.[7] Children and young people consume the most free sugars of any age group in Australia, making them a particularly high risk group for the development of decay.[11]

*Adults*

For adults, total dental caries experience is measured by DMFT (decayed, missing or filled teeth due to dental caries – see technical notes).

Table 3 shows the proportion of adults who have never experienced decay (cavitated lesions) in their permanent teeth (DMFT = 0). The vast majority of adults who have never experienced decay fall into the 15 to 34 year age cohort.

TABLE 3: Percentage of adults who have never experienced decay in permanent teeth 2004-06

|  | Australian adult population 15+ | | | | |
|---|---|---|---|---|---|
|  | All ages | 15-34 | 35-54 | 55-74 | 75+ |
| All | 9.9 | 24.1 | 2.4 | 0.0 | 0.8 |
| Male | 10.8 | 26.1 | 2.3 | 0.0 | 1.9 |
| Female | 9.1 | 22.1 | 2.6 | 0.0 | 0.0 |

Data on dental caries prevalence in Australian adults, sourced from the National Survey of Adult Oral Health (NSAOH) 2004-06, is used as the baseline data point for *Australia's Oral Health Tracker*. It is the only nationally representative and robust data source examining adult oral health from the last 25 years.[96] Therefore, trend data are not available. The National Study of Adult Oral Health 2017-18 is underway. Data from this study, when available, will be used to update *Australia's Oral Health Tracker*.

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

*Children*

For children, dental caries experience is measured by dmft (decayed, missing or filled teeth due to dental caries for primary or baby teeth – see technical notes) and DMFT (the same measure in permanent teeth -- see technical notes).

Table 4 shows the prevalence of primary decay for children overall and a more detailed age and gender breakdown. The upward trend in prevalence as children grow older is predictable, as once a cavitated lesion has been experienced these children will always have a dmft index of greater than zero until the tooth exfoliates. A similar upward trend is also observed in decay experience in children's permanent teeth (Table 5).

TABLE 4: Percentage of children who have experienced dental caries in primary teeth 2012-14

|  | Australian child population aged 5-10 years | | | |
|---|---|---|---|---|
|  | All ages | 5-6 | 7-8 | 9-10 |
| All | 41.7 | 34.3 | 45.1 | 46.2 |
| Male | 42.5 | 34.8 | 46.0 | 47.0 |
| Female | 40.9 | 33.7 | 44.0 | 45.3 |
| Aboriginal and Torres Strait Islanders | 60.6 | 51.9 | 67.0 | 63.3 |

TABLE 5: Percentage of children who have experienced dental caries in permanent teeth 2012-14

|  | Australian child population aged 6-14 years | | | |
|---|---|---|---|---|
|  | All ages | 6-8 | 9-11 | 12-14 |
| All | 23.5 | 9.2 | 22.8 | 38.2 |
| Male | 22.4 | 8.4 | 21.7 | 37.5 |
| Female | 24.6 | 10.2 | 24.0 | 38.8 |
| Aboriginal and Torres Strait Islanders | 36.0 | 16.4 | 41.3 | 53.7 |

Data on dental caries experience (both dmft and DMFT) in Australian children was sourced from the National Child Oral Health Study (NCOHS) 201214. This was the first nationally representative child oral health survey, with almost 25,000 participants.[28] The NCOHS 20122014 data were used as the baseline for *Australia's Oral Health Tracker* as there were no suitable earlier data sets with which a time trend could be established.

The prevalence of dental caries experience in both the permanent and primary teeth of Aboriginal and Torres Strait Islander children was considerably higher than the population average. In 2011-12, 36.0% of Aboriginal and Torres Strait Islander children (6-14 years) had experienced dental caries in permanent teeth; and 51.9% of Aboriginal and Torres Strait Islander children (5-6 years) had experienced dental caries in primary teeth.

### Untreated dental caries

Untreated dental caries reflects the access to and use of dental care for individuals.[96] When decay is present, but left untreated, it often results in pain, discomfort, increased sensitivity, and an increased likelihood of requiring treatment such as root canal therapy or extraction.[97] Untreated decay can also cause bad breath and be aesthetically displeasing for individuals.[97] Having dental caries treated at the earliest opportunity is essential for the best possible health outcomes.[97]

### Adults

The proportion of adults with untreated dental caries is similar across all age groups. There is a higher percentage of males than females with untreated dental decay (Table 6). Data on untreated dental caries in Australian adults are sourced from the National Survey of Adult Oral Health (NSAOH) 2004-06.

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

TABLE 6: Percentage of adults with untreated dental caries – 2004-06

| | Australian adult population 15+ | | | | |
|---|---|---|---|---|---|
| | All ages | 15-34 | 35-54 | 55-74 | 75+ |
| **All** | 25.5 | 25.8 | 27.1 | 22.6 | 22.0 |
| **Male** | 28.2 | 25.1 | 34.3 | 23.5 | 26.9 |
| **Female** | 22.7 | 26.6 | 20.1 | 21.7 | 18.2 |

### Children

A similar upward trend is observed in untreated dental caries as with total decay experience as children increase in age (Tables 7 and 8). The slight decrease in the percentage of children with untreated dental caries in primary teeth is likely due to the shedding of decayed primary teeth and eruption of decay-free permanent teeth. The NCOHS 2012-14 was the baseline and only data point used for untreated dental caries in children as there are no other representative and suitable data sources.

The prevalence of untreated dental caries experience in both the permanent and primary teeth of Aboriginal and Torres Strait Islander children was considerably higher than the population average (Tables 7 and 8). In 2011-12, 22.9% of Aboriginal and Torres Strait Islander children (6-14 years) had untreated dental caries in permanent teeth and 44.0% of Aboriginal and Torres Strait Islander children (5-10 years) had untreated dental caries in primary teeth.

TABLE 7: Percentage of children with untreated dental caries in primary teeth 2012-14

| | Australian child population aged 5-10 years | | | |
|---|---|---|---|---|
| | All ages | 5-6 | 7-8 | 9-10 |
| **All** | 27.1 | 26.1 | 28.4 | 27.0 |
| **Male** | 28.1 | 26.8 | 29.6 | 28.0 |
| **Female** | 26.1 | 25.3 | 27.1 | 25.9 |
| **Aboriginal and Torres Strait Islanders** | 44.0 | 44.1 | 50.2 | 37.2 |

TABLE 8: Percentage of children with untreated dental caries in permanent teeth 2012-14

| | Australian child population aged 6-14 years | | | |
| --- | --- | --- | --- | --- |
| | All ages | 6-8 | 9-11 | 12-14 |
| **All** | 10.9 | 5.7 | 11.5 | 15.4 |
| **Male** | 10.8 | 5.3 | 11.2 | 15.9 |
| **Female** | 11.0 | 6.0 | 11.8 | 14.9 |
| **Aboriginal and Torres Strait Islanders** | 22.9 | 13.1 | 25.6 | 31.8 |

### 3.1.4 Relevant benchmarks

No targets for a reduction in dental caries and/or untreated dental caries prevalence have been established in Australia or by the WHO. Australian population level data on these indicators in both children and adults are not collected regularly, and only one viable data point has been established. With no trend data available, the development of feasible and appropriate 2025 targets for dental caries indicators relied heavily on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

### 3.1.5 Proposed targets and indicators

Two factors are reported in *Australia's Oral Health Tracker*; a measure of dental caries, and a measure of untreated dental caries for young children, children, and adults.

A 10% increase in the proportion of adults who have never experienced dental caries (equivalent DMFT = 0) is recommended. Reporting on adults who have never experienced decay is more appropriate than reporting on those who have, given the high prevalence of decay across the population. The key limitation of an indicator based on prevalence of dental caries is that there is no consideration given to the incidence and severity of dental caries over a lifetime (one episode of decay is viewed in the same way as chronic decay). A second limitation is it is difficult to elicit change in prevalence at a population level given that a single incident of dental caries is identified as having permanently experienced decay, even once it is treated. Hence, the modest target of a 10% improvement was chosen (from 9.9% to 10.9% of the population), as the only mechanism to increase the proportion of adults who have never experienced decay is by ensuring adolescents entering adulthood are decay-free. Subsequently, enhancing access to decay prevention and minimising decay risk factors for this particular cohort.

This rationale, coupled with the exfoliation (shedding) of primary teeth, were the major reasons for reporting on primary dental caries experience in five to six-year old children rather than all children. To achieve a change in prevalence requires an increase in the proportion of children entering school decay free. Reporting on this age cohort also avoids any issues related to the exfoliation of decayed or filled primary teeth later in childhood that can misrepresent the true prevalence of decay. A 10% reduction in the proportion of five to six-year olds who have experienced decay in primary teeth was deemed feasible. It would be likely achieved by modest improvements in early childhood decay prevention and reduced exposure to risk factors.

To examine decay experience in children's permanent teeth, the six to 14-year age cohort was selected to reflect the varying ages of tooth exfoliation and eruption. Observing permanent teeth in children needs to encompass a wide age range as the maturation of the oral cavity happens over several years and is often not fully developed until early adolescence.[98] A 10% reduction in the proportion of six to 14-year olds who have experienced decay in permanent teeth was deemed feasible as decay prevention strategies will likely be most effective in newly erupted teeth as their time of exposure to risk factors will be minimal.[99]

For the second measure of untreated dental caries prevalence, a consistent 20% reduction was applied when developing the 2025 targets for adults, children's primary teeth and children's permanent teeth. Untreated dental caries is a function of dental caries prevalence and access to care so there is a much wider scope for improvement than only looking at decay experience. It was agreed that given the much wider scope for improvement, a more ambitious set of targets than those developed for decay experience would be feasible.

Initiatives to enhance access to dental care can also have an immediate impact on untreated dental caries prevalence,[100] whereas initiatives to prevent decay formation will require a lifelong approach.

### 3.1.6 Technical data

To capture the full impact of dental caries (cavitated lesions) prevalence it is often reported as 'decayed, missing or filled teeth due to dental caries', commonly referred to as DMFT.[96] When reporting on dental caries in children's primary teeth the acronym uses lower case letters (dmft) to reflect the difference between primary and permanent teeth.[28] The use of DMFT/dmft at a population level measures dental caries experience (i.e. the cumulative amount of cavitated lesions an individual has experienced in their lifetime). These measures are based on the WHO protocol for measuring total caries experience.[101] Therefore, dental caries 'prevalence' is the percentage of the population with a DMFT/dmft index of > 0. While population percentage DMFT/dmft > 0 is a widely accepted measure of total caries experience, it does not provide an indication of active and/or untreated decay.[28, 96] Measuring untreated dental caries provides information on the use and access to dental care in addition to the experience of the disease.[96]

The proportion of the adult population who had never experienced dental caries is reported, rather than DMFT score (a score that indicates the level of individual decay experience over the lifetime), due to the significant limitations associated with setting a target for DMFT.

Untreated decay was identified via the oral examination included in the National Survey of Adult Oral Health data collection.

The Child Dental Health Survey (2009) was originally considered for use as a baseline dataset for the child indicators. However, these data were not comparable to the NCOHS 2012-14. It is important to note the differences between the Child Dental Health Surveys (CDHS) and NCOHS 2012-14; CDHS uses administrative data and describes patterns of dental health and dental service provision for children attending public dental services, which include school dental services, in Australia from the late 1970s.[102] They contain valuable data but coverage varies by jurisdiction and is not nationally representative.

The NCOHS collected data for 24,664 children from 84 participating schools, providing a nationally representative profile of child oral health.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults (aged 15+) who have never experienced decay in permanent teeth | N/A | 9.9% NSAOH 2004–06 | **10.9%** | N/A | 10% increase | Not available |
| Adults with untreated dental caries (aged 15+) | N/A | 25.5% NSAOH 2004–06 | **20.4%** | N/A | 20% increase | Not available |
| Children (5-6 years) who have experienced decay in primary teeth | N/A | 34.3% NCOHS 2012-14 | **30.9%** | N/A | 10% increase | 51.9% NCOHS 2012-14 |
| Children (6-14 years) who have experienced decay in permanent teeth | N/A | 23.5% NCOHS 2012-14 | **21.2%** | N/A | 10% increase | 36% NCOHS 2012-14 |

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Children (5-10 years) with untreated dental caries in primary teeth | N/A | 27.1%<br>NCOHS<br>2012-14 | **21.7%** | N/A | 20%<br>increase | 44%<br>NCOHS<br>2012-14 |
| Children (6-14 years) with untreated dental caries in permanent teeth | N/A | 10.9%<br>NCOHS<br>2012-14 | **8.7%** | N/A | 20%<br>increase | 22.9%<br>NCOHS<br>2012-14 |

## 3.2 Oral Cancer

### 3.2.1 Introduction

Oral cancer encompasses a range of cancers affecting any part of the oral cavity.[103] This includes any cancer affecting the lips, tongue, salivary glands, and mouth.[103] Oral cancer is often classified more broadly as part of 'head and neck cancers', making up about 85% of these cancers.[104] Oral cancers were the seventh most diagnosed cancer type in Australia in 2013 and are estimated to have remained at seventh in 2017.[104]

Most oral cancers can be prevented, and/or the risks can be reduced. They share common risk factors (such as tobacco use and excessive alcohol consumption) with other cancers, oral health conditions (e.g. periodontal disease), and various chronic diseases.[50, 105]

If not detected early, oral cancer can require surgery, radiation therapy and chemotherapy.[105] It can also be fatal. Part of the reason for this poor prognosis is a failure to recognise the early symptoms or a lack of symptoms until the cancer is already reasonably advanced.[106] The early detection of oral cancer is a key component of successful treatment.[106] Early discovery enables potentially longer survival times, and reduction of treatment-related morbidity, which significantly improves post-treatment quality of life.[105]

### 3.2.2 Key issues

- Oral cancer incidence rose in Australia between 2009 and 2013 (3.7 per 100,000 to 4.2 per 100,000).
- Oral cancer shares risk factors with various other cancers and chronic conditions, including tobacco use and excessive alcohol consumption.
- Mortality from oral cancer has stayed relatively stable from 2010 to 2014 (1.7 per 100,000 to 1.6 per 100,000), despite increasing incidence. This is likely due to improvements in early detection and cancer treatments.

### 3.2.3 Oral cancer in Australia

Data on oral cancer and associated risk factors are available for the Australian population over time, with the Australian Institute of Health and Welfare (AIHW) regularly collating cancer registry data from states and territories since 1982.[104, 107] The AIHW provides extensive data for incidence, prevalence, survival rates, mortality, and risk factors related to all cancer types. The AIHW *Cancer in Australia 2017* report noted that Aboriginal and Torres Strait Islander data were sufficient from five states and territories only and therefore cannot be considered nationally representative.[104]

Table 9 outlines the cancer types considered 'oral cancers' in *Australia's Oral Health Tracker*, taken from the AIHW head and neck cancer classification table.[104] Oropharyngeal cancer is sometimes classified as an 'oral cancer', but was excluded from the definition used for this report. The oropharynx is anatomically part of the throat rather than the oral cavity and is not routinely observable as part of a standard dental examination. [108] Additionally, the major risk factor for oropharyngeal cancer is repeated exposure to oncogenic HPV infections[109] and this risk factor is not reported in *Australia's Oral Health Tracker*.

TABLE 9: AIHW head and neck cancer classifications*

| Cancer site/type | ICD-10 codes |
|---|---|
| Lip | C00 |
| Mouth and tongue | C01-C06 |
| Salivary glands | C07-C08 |

*ICD-10 codes CO9-C14 refer to different areas in the pharynx and make up the remainder of head and neck cancers. Brain cancer has its own separate classification.[104]

The number of new cases and the aged-standardised incidence rate of oral cancer in 2009 and 2013 are illustrated in Table 10.

TABLE 10: Oral cancer incidence by cancer type* 2009-2013

| Cancer site/type | Incidence (2009) | | Incidence (2013) | |
|---|---|---|---|---|
| | No. of new cases | Age-standardised incidence rate (per 100,000) | No. of new cases | Age-standardised incidence rate (per 100,000) |
| Lip | 865 | 3.7 | 1047 | 4.2 |
| Mouth & Tongue | 1172 | 4.9 | 1378 | 5.4 |
| Salivary Glands | 265 | 1.1 | 322 | 1.3 |
| Total Oral Cancers | 2302 | 9.7 | 2747 | 10.9 |

*ICD-10 codes CO9-C14 refer to different areas in the pharynx and make up the remainder of head and neck cancers. Brain cancer has its own separate classification.[104]

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

**Adverse health outcomes due to oral cancer**

Despite the relatively low incidence of oral cancers compared to other oral health conditions, they are responsible for the most adverse health outcomes, chiefly mortality, and often are associated with ongoing functional issues and low quality of life.[110-112] Data on the burden of disease and disability caused by oral cancer is not publicly available and therefore mortality is the only adverse health outcome indicator related to oral cancer available.[104]

Screening and early detection is of paramount importance in reducing mortality and morbidity caused by oral cancer.[106] Oral health professionals have a major role in detecting oral cancers as they are often able to identify cancerous lesions and other signs within the oral cavity and refer patients for additional diagnostic tests.[106]

The number of deaths and the age-standardised mortality rate from oral cancer in 2010 and 2014 are illustrated in Table 11. [104, 107]

TABLE 11: Mortality attributed to oral cancers 2010-14

| Cancer Type | Mortality (2010) | | Mortality (2014) | |
|---|---|---|---|---|
| | No. of deaths | Age-standardised rate (per 100,000) | No. of deaths | Age-standardised rate (per 100,000) |
| Lip | 11 | 0.0 | 2 | 0.0 |
| Mouth & Tongue | 325 | 1.3 | 318 | 1.2 |
| Salivary Glands | 88 | 0.4 | 113 | 0.4 |
| Total Oral Cancers | 424 | 1.7 | 433 | 1.6 |

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

The age-standardised incidence of oral cancer in Australia was 9.7 per 100,000 in 2009 and 10.9 per 100,000 in 2013.[104, 107] Whilst the reported rate increased between 2009 and 2013, there was a modest decrease in reported rates between 2000 and 2009 (Table 12).[113, 114]

TABLE 12: Australian age-standardised oral cancer incidence 2001-2013

| Year | 2000 | 2007 | 2009 | 2013 |
|---|---|---|---|---|
| Age-standardised oral cancer incidence rate (per 100,000 population) | 11.1 | 10.2 | 9.7 | 10.9 |

## 3.2.4 Relevant benchmarks

The WHO non-communicable diseases global action plan has a headline measure for a 25% reduction in mortality and morbidity from chronic diseases across the globe,[115] incorporating cancer. However, this target is not specific to cancer, nor to oral cancers.

Although no targets have been set, the WHO global goals for oral health 2020 does contain an overarching goal and two objectives relating to oral cancers.[83] The goal is to minimise the impact of oral cancers on individuals and society, and the objectives are to reduce mortality morbidity from oral cancers and increase wellbeing.[83]

## 3.2.5 Proposed Australian targets and indicators

As oral cancer is extremely rare in children, it was appropriate to include this condition and associated risk factors in *Australia's Oral Health Tracker* only for adults (18 years and above). Two indicators are reported: oral cancer incidence refers to the rate of new cases diagnosed in a year per people aged 18 years and over and mortality refers to the rate of deaths directly attributable to oral cancer in a year divided by the total population.

A target to reverse the rise in incidence (from 10.9 to 9.7 per 100,000) is appropriate, taking into account both the recent upward trend and the previous modest decrease in reported rates. The target recommended is feasible and achievable. It was important to consider that there is a substantial proportion of undiagnosed and *in situ* oral cancers in the Australian population, meaning that the incidence rate in the short term is unlikely to change appreciably. Policy initiatives aimed at reducing risk factor exposure (predominantly excessive alcohol consumption and tobacco use) would also take time to affect the incidence rate. Therefore, targeting a return to the 2009 baseline by 2025 is recommended as the most suitable.

The age standardised mortality rate from oral cancer was steady at 1.7 per 100,000 in 2010; and 1.6 per 100,000 in 2014, but there was a downward trend from 2005 when the rate was 2.4 per 100,000.[116] Unlike improving incidence which relies heavily on a risk factor prevention focus, earlier detection and more effective oral cancer treatments can positively impact mortality. [117]

Earlier detection is likely to be the reason for the reported increase in incidence rate, and more effective treatments improved mortality rates from 2009-10 to 2013-14. The WHO non-communicable diseases global action plan headline measure for a 25% reduction in mortality and morbidity from chronic diseases across the globe[115] was considered too ambitious in the Australian context, particularly given the baseline rate is already relatively low. A 10% reduction target was not ambitious enough, given how quickly the effectiveness of treatments can improve and new treatments are developed, so a middle figure was considered most suitable. Consequently, a 15% reduction target (from 1.6 to 1.36 per 100,000) was recommended.

### 3.2.6 Technical data

Incidence was preferred over prevalence in respect of oral cancer rates. Regarding cancer data, prevalence refers to the number of people alive with a prior diagnosis of cancer. It is a function of cancer survival and indicates the efficacy of cancer care, as well as the number of new cancers diagnosed. It reflects the number of people undergoing treatment or longer-term management for their cancer, whereas incidence measures the rate at which new cancer cases are diagnosed.

The incidence rates are age standardised to the 2001 Australian Standard Population and are expressed per 100,000 population.

| Indicator | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal and Torres Strait Islander Data |
|---|---|---|---|---|---|---|
| Age-standardised incidence rate of oral cancers | 9.7 per 100,000 AIHW Cancer in Australia 2012 | 10.9 per 100,000 AIHW Cancer in Australia 2017 | **9.7 per 100,000** | | 20% increase | Not available |
| Age-standardised mortality rate from oral cancers | 1.7 per 100,000 AIHW Cancer in Australia 2012 | 1.6 per 100,000 AIHW Cancer in Australia 2017 | **1.36 per 100,000** | | 15% reduction | Not available |

## 3.3 Gum disease (periodontitis)

### 3.3.1 Introduction

Gum (periodontal) disease affects most people at some time during their life.[118] Periodontal diseases are a group of inflammatory diseases that affect the gums (gingival tissues), deeper connective tissues and the jaw bone, which support and protect the teeth.[36]

There are two main stages of gum disease: gingivitis and periodontitis.[118] Gingivitis is early gum disease and occurs when dental plaque builds up on teeth, particularly where the gum joins the tooth.[118] Periodontitis is an advanced gum disease that may occur if gingivitis is not treated. [118] The gum margin, the part of the gum that seals to the tooth, is weakened and spaces form between the tooth and the gum.[118] These spaces are called 'periodontal pockets'.[118] Bacteria become trapped in these pockets causing further inflammation (redness and swelling). [118] Periodontitis can affect the covering of the tooth root (cementum), the bone and the fibres connecting the cementum to the bone (periodontal ligament).[118] As the disease progresses and bone is lost, larger spaces begin to form between the tooth and the gum.[118] This often leads to tooth mobility and can result in tooth loss.[119]

In population studies, periodontitis cases are commonly defined as those having periodontal pockets that reach a certain depth, and while there is not absolute agreement on a given threshold, there is general agreement on a depth of ≥ 4mm.[120-122]

Periodontitis is associated with smoking,[123] diabetes,[124-126] obesity,[127] adverse maternal outcomes,[126] and socioeconomic position,[128, 129] among other factors.

### 3.3.2 Key issues

- Periodontitis rates have remained relatively unchanged over thirty years, despite improvements in oral hygiene.
- The risk of gum disease increases with age.

### 3.3.3 Gum disease (periodontitis) in Australia

Although oral hygiene improved substantially over the 30-year period from 1973 to 2003, globally the levels of periodontitis remained relatively unchanged.[130] However, Australian figures from the global burden of diseases study show that in 1990 the prevalence of severe periodontitis (≥ 6mm pockets) was 5.8%; in 2005 was 6.6%; and had increased to 7.3% in 2015.

The risk of periodontitis increases with age. Almost 40% of Australians aged 55 years or over reportedly experienced moderate to severe periodontitis in 2004-2006 compared to 8% of 15 to 34-year olds (Table 13).[37]

TABLE 13: Percentage of adults with the presence of periodontal pockets (> 4mm) 2004-06

| | Australian adult population 15+ years | | | |
| --- | --- | --- | --- | --- |
| | All ages (%) | 15-34 (%) | 35-54 (%) | ≥ 55 (%) |
| **All (%)** | 19.8 | 8.0 | 19.4 | 38.4 |
| **Male (%)** | 25.0 | 12.8 | 30.3 | 36.3 |
| **Female (%)** | 14.5 | 3.0 | 8.5 | 40.2 |

Data on the prevalence of gum disease in Australian adults are sourced from the National Survey of Adult Oral Health (NSAOH) 2004-06. This was used as the baseline data point for *Australia's Oral Health Tracker* as it is the only nationally representative and robust data source examining adult oral health from the last 25 years.[96] The National Study of Adult Oral Health 2017-18 is underway. Data from this study, when available, will be used to update *Australia's Oral Health Tracker*.

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

### 3.3.4 Relevant benchmarks

No targets for a reduction in gum disease prevalence have been established in Australia or by the WHO. Australian population level data on these indicators in adults are not collected regularly, with only one viable data point for the last 15 years. Therefore, the development of feasible and appropriate 2025 targets for gum disease indicators relied heavily on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

### 3.3.5 Proposed Australian targets, indicators and feasibility

A 15% decrease in the proportion of adults with the presence of periodontal pockets (> 4mm) was selected. This measure was chosen as it is a commonly used measure for periodontitis in epidemiological studies, and the best available indicator of periodontal treatment need in the community.

The 15% decrease is regarded by the expert working group as feasible, acknowledging that demographic changes (increasing number of older people and people retaining teeth throughout life) provide more opportunities for gum disease. This sets a target of 16.8% of the population with periodontal pockets. The expert working group considers that, whilst this is feasible, achievement requires a strong focus on oral health and access to treatment for the affected population.

### 3.3.6 Technical data

Periodontal pocketing of > 4mm was used rather than the prevalence of moderate to severe periodontitis as it is a common measure used in many epidemiological studies and the data are collected in that format in Australia.

| Indicator | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal and Torres Strait Islander Data |
|---|---|---|---|---|---|---|
| Adults (aged 15+) with periodontal pockets (>4mm) | N/A | 19.8% NSAOH 2004–06 | **16.8%** | N/A | 15% reduction | Not available |

## Adverse Oral Health Outcomes

## 4.1 Potentially Preventable Hospitalisations

### 4.1.1 Introduction

Potentially preventable hospitalisations (PPHs) refers to conditions where 'hospitalisation may have been prevented by timely and appropriate provision of primary or community-based health care'. [131]

Adequate access to dental care and poor oral health practices are two major contributors to PPHs for dental conditions and are a significant cost to the health system. [132] Reducing PPHs is a measure of quality or effectiveness of non-hospital care and is an objective of national health care reform.

### 4.1.2 Key issues

- Dental conditions account for one in ten PPHs.
- Major cities have the lowest rates of PPHs and very remote communities the highest.
- The highest rates of PPHs are amongst children aged five to nine years.

### 4.1.3 Potentially preventable hospitalisations due to dental conditions in Australia

There were 67,266 PPHs due to dental conditions in 2015-16,[131] an increase from 57,955 in 2007-08. Dental conditions represented one in ten PPHs in 2015-16. There has been a slight increase in the total proportion of PPHs due to dental conditions over recent years. [133]

Rates of PPHs are highest amongst children (aged 5 to 9 years), followed by children aged 0 to 4 years (Figure 3).[134] There may be a number of factors influencing the high rates of PPHs for dental conditions, including higher prevalence of the conditions in the community, poorer functioning of the non-hospital care system or an appropriate use of the hospital system to respond to greater need.[50] Other factors such as socioeconomic position, geographic remoteness, hospital admission policies, physician admitting style, age, disease prevalence and severity, and propensity to seek care are also recognised as contributing to higher rates of PPHs.[135]

Hospitalisations in young people aged 10 years and over and adults are not always considered preventable as these generally comprise the removal of impacted teeth (such as procedures for impacted wisdom teeth).

Data from 2013-14 show that children in the 5 to 9 years age group had the highest rates of PPHs of 9.3 per 1000. [134] Compared with the baseline data from 2009-10, there has been a slight increase from 9.1 to 9.3 per 1000. [134]

In 2013-14, there were 11.5 per 1000 PPHs for Aboriginal and Torres Strait Islanders children due to dental conditions among children aged 5 to 9 years. [134]



Note: The separation rate (number of separations per 1,000 population) is a crude population rate based on the 2011 ABS estimated resident population. Code for dental care (below).
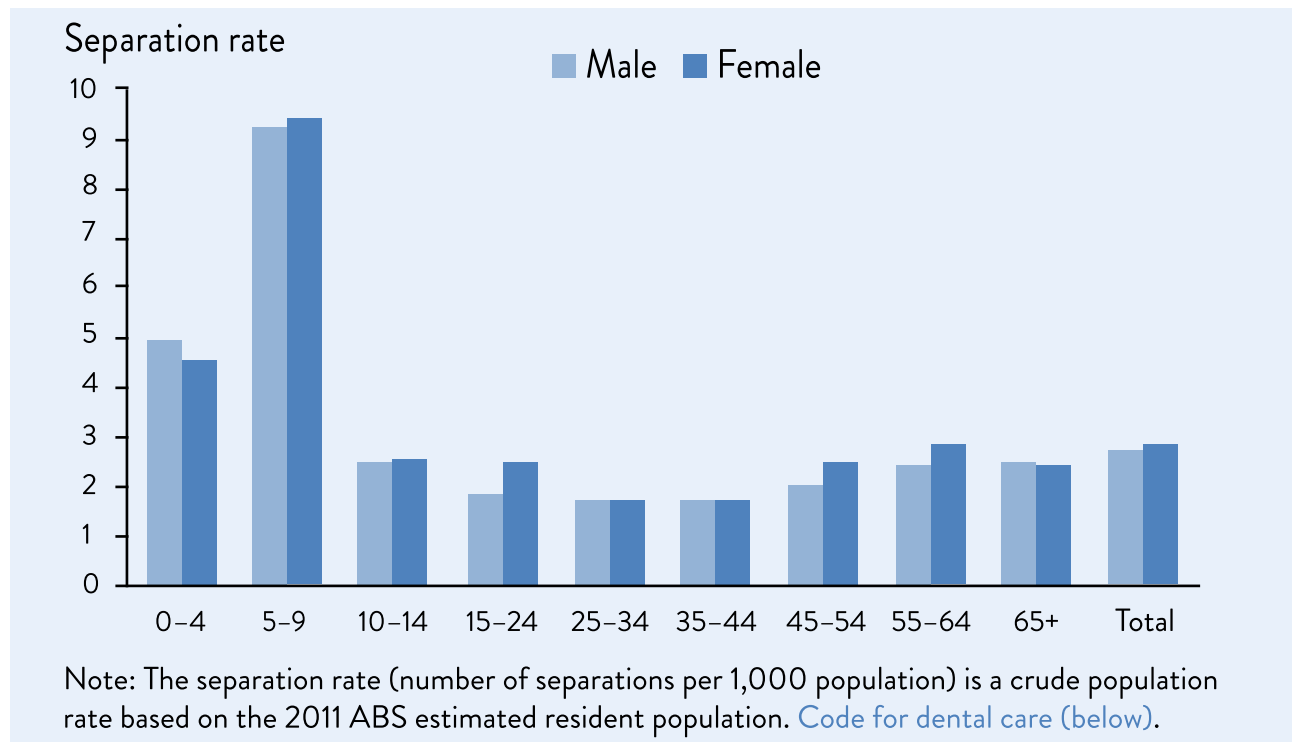
Figure 3: Separation rates for PPHs due to dental conditions by sex and age groups, 2013-14. Source: AIHW Hospital Morbidity database 2013-14, unpublished.

## 4.1.4 Relevant benchmarks

The National Healthcare Agreement has included a performance indicator for PPHs for all state and territory governments, which has a target of reducing the proportion of PPH admissions by 7.6 per cent over the 2006–07 baseline to 8.5 per cent of total hospital admissions by 2014-15. [136]

## 4.1.5 Proposed Australian targets and indicators

Poor oral health conditions and habits that occur in childhood have far reaching effects into adulthood. Based on the data, the working group support an indicator for PPHs due to dental conditions for children aged five to nine years. Not only does this age group present the highest rates of PPHs due to dental conditions but these admissions (largely due to dental caries) are considered preventable. [137]

The working group agreed that the appropriate target should both reverse the rise and achieve a 10% reduction in the current rate of preventable admissions in this age group. A target of 8.4 per 1000 by 2025 is proposed.

## 4.1.6 Technical data

PPHs in children is a subset of the total proportion of PPHs due to dental conditions published regularly by the AIHW on the 'My Healthy Communities' website. [133] PPHs are measured as a key indicator in the National Healthcare Agreement, [136] and are closely monitored by Commonwealth, state and territory governments.

| Indicator | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Potentially preventable hospitalisations in children (5-9 years) due to dental conditions | 9.1 per 1,000 AIHW Hospital Morbidity database 2009–10 | 9.3 per 1,000 AIHW Hospital Morbidity database 2013–14 | **8.4 per 100,000** | | 10% reduction | 11.5 per 1,000 AIHW Hospital Morbidity database 2013–14 |

## 4.2. Inadequate dentition

### 4.2.1 Introduction

The average number of missing teeth provides an indication of the distribution of tooth loss in the dentate population (those with teeth).

A widely-used measure of oral disability resulting from tooth loss is inadequate dentition. Defined as fewer than 21 teeth, inadequate dentition means that a person is unlikely to have enough teeth that have a partner tooth on the opposite jaw (upper versus lower) to be able to chew properly.[138] Australian adults with inadequate dentition are up to five times more likely than those with adequate dentition to have problems with chewing.[36, 139] Having fewer teeth is related to a poorer diet, [140, 141] lower health related quality of life, [142] and associated with many chronic diseases such as diabetes,[143] stroke,[144] cancer,[145, 146] and rheumatoid arthritis.[147-149] Inadequate dentition is associated with socioeconomic disadvantage in Australia and internationally.[149, 150]

Smoking is a major cause of tooth loss.[151-153] Additionally, other oral health conditions such as caries[154] and gum/periodontal disease are related to tooth loss.

### 4.2.2 Key issues

- People are at higher risk of tooth loss as they get older.
- People on lower household incomes and/or without private health insurance generally had fewer teeth.

### 4.2.3 Inadequate dentition in Australia

The proportion of adults with fewer than 21 teeth was 15.5% in 2013 (Table 14), an increase from 12.3% in 2010.

Data on tooth loss in Australian adults was sourced from the National Dental Telephone Interview (NDTI) Survey conducted in 2010 and 2013. It is a nationally representative and robust data source examining adult oral health. The National Study of Adult Oral Health 2017-18 is nearing completion, at which point *Australia's Oral Health Tracker* will be updated with the most recent data.

People are at higher risk of tooth loss as they get older. In the 2013 NDTI survey, people aged 15 to 24 years reported an average of 1.8 missing teeth, compared with an average of 10.8 missing teeth for people aged 65 and over.[134] Consequently, the risk of inadequate dentition increases with age. Almost 40% of Australians aged 55 years or over reporting fewer than 21 teeth in 2013 compared with less than 1% of 18 to 34-year olds.[2]

In 2013, survey results showed that people on lower household incomes generally had fewer teeth than those on higher incomes, varying from an average of 8.6 missing teeth for those in households earning less than $30,000 per year to 3.2 for those in households earning $140,000 or more.[135]

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[2] These data were provided by the Australian Research Centre for Population Oral Health (personal communication) based on the National Dental Telephone Interview Survey data.

People who did not have private health insurance reported fewer teeth than those who were insured (5.6 missing teeth and 4.7, respectively). These differences were particularly noticeable among the older age group (over 65 years) where the uninsured reported an average of 12.8 missing teeth and the insured, 8.9.[140]

TABLE 14: Percentage of adults with fewer than 21 teeth - NDTIS 2013

|  | Australian adult population 18+ years | | | |
|---|---|---|---|---|
|  | All ages (%) | 18-34 (%) | 35-54 (%) | ≥ 55 (%) |
| **All (%)** | 15.5 | 0.7 | 6.6 | 37.8 |
| **Male (%)** | 15.0 | 1.1 | 7.7 | 35.5 |
| **Female (%)** | 16.0 | 0.3 | 5.6 | 39.8 |

Comparable and representative Aboriginal and Torres Strait Islander data are not available.

### 4.2.4 Relevant benchmarks

No targets for a reduction in inadequate dentition have been established in Australia or by the WHO. Australian population level data suggests an upward trend from 2010 to 2013. The development of feasible and appropriate 2025 targets for inadequate dentition indicators relied on interpretation of the trend and on the knowledge and expertise provided by the *Oral Health Tracker* expert working group.

### 4.2.5 Proposed Australian targets and indicators

Halting the rise in inadequate dentition (< 21 teeth) in the population is the recommended target, to maintain inadequate adult dentition rates at 15.5%. This measure is considered feasible and appropriate as a population target for 2025. Whilst the current older population has a high and increasing rate of inadequate dentition, younger adults have high numbers of teeth on average, making it important to set a target and maximise effort to maintain the dental health of this population group.

| Indicator | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Adults with inadequate dentition (< 21 teeth) | 12.3% NDTIS 2010 | 15.5% NDTIS 2013 | **15.5%** | 🟠 | Halt the rise | Not available |

## 4.3 Toothache

### 4.3.1 Introduction

Toothache relates to pain in and around the teeth and jaws and can involve varying levels of pain. Untreated dental decay has been recognised as a major cause of toothache[155] but toothache can also occur as a result of a cracked tooth, loose or broken fillings, receding gums or periapical abscess.[156] Toothache can disrupt daily activities such as eating, concentrating and sleeping habits. [4] While dental caries is often the primary cause of toothache, it is important that the underlying cause is identified and treated.

Although toothache is not a medically diagnosed symptom, it is important to recognise the health and social impacts of toothache in the population and the potential impacts on quality of life. Good oral hygiene practices are key to preventing toothaches.

Toothache in children is one of the most prevalent outcomes of poor oral health. It is caused by a variety of factors including dental caries and infection. Pain from toothache is very distressing for children and is associated with disrupted school attendance, sleep patterns, eating and physical activity.[158-160] Parents, too, are affected by toothache in children as it is related to absenteeism from the workplace when parents take time off to care for and seek treatment for their child.[161]

### 4.3.2 Key issues

- Reported experiences of toothache has increased over time for adults and decreased in children.
- Toothache is most prevalent in adults aged 25-44.

### 4.3.3 Toothache in Australia

The 2013 NDTI Survey reports on adults who reported toothache in the last 12 months. In 2013, 1 in 7 Australians aged 15 and over (16.2%) reported having had a toothache over the last 12 months. The highest rates were amongst adults aged 25-44. [141]

For adults, the trend in toothache has steadily increased since 1994.[160] There have also been associated rises in adverse effects of toothache, including being uncomfortable with appearance and avoiding certain foods (Figure 4).
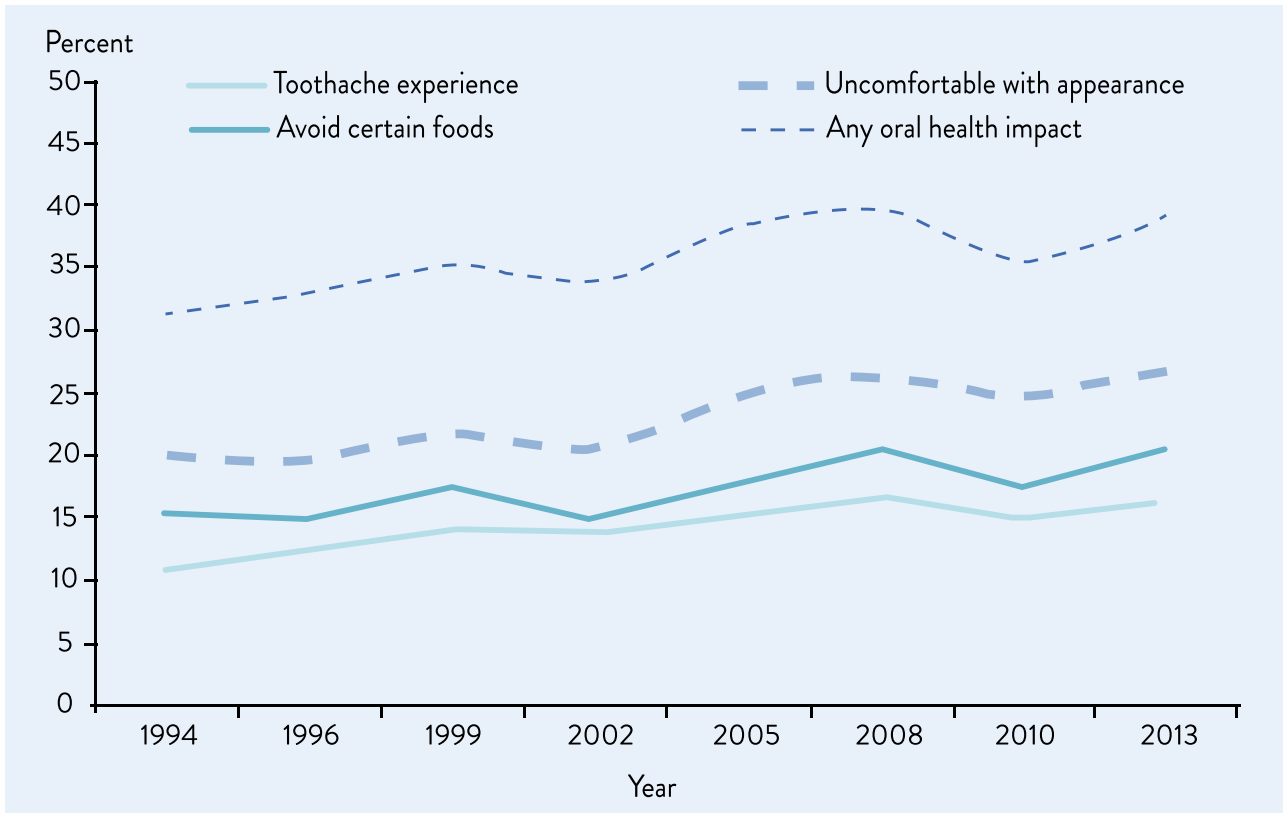


Figure 4: Prevalence of any oral health impact, adults aged 15 and over 1994 to 2013 (%). Source: Oral health and dental care in Australia: facts and figures 2015. Australian Institute of Health and Welfare

In the previous 12 months people experiencing a toothache were:

**17%**
Female

**20%**
WITHOUT dental insurance

**24%**
From the **LOWEST INCOME GROUP**

**15%**
Male

**12%**
WITH dental insurance

**9%**
From the **HIGHEST INCOME GROUP**

Figure 5: People experiencing toothache, taken from Australia's Health 2016.

For children aged five to 14 years, there was a decline of reported toothache between the 2010 and 2013 NDTI Surveys, and a stable decline of reported toothache in children from 2005. However, adverse effects from toothache, including being uncomfortable with appearance and avoiding certain foods, do not show an associated decline (Figure 6).



Figure 6: Prevalence of any oral health impact, children aged 5 to 14, 1994 to 2013 (%). Source: Oral health and dental care in Australia: facts and figures 2015, Australian Institute of Health and Welfare.
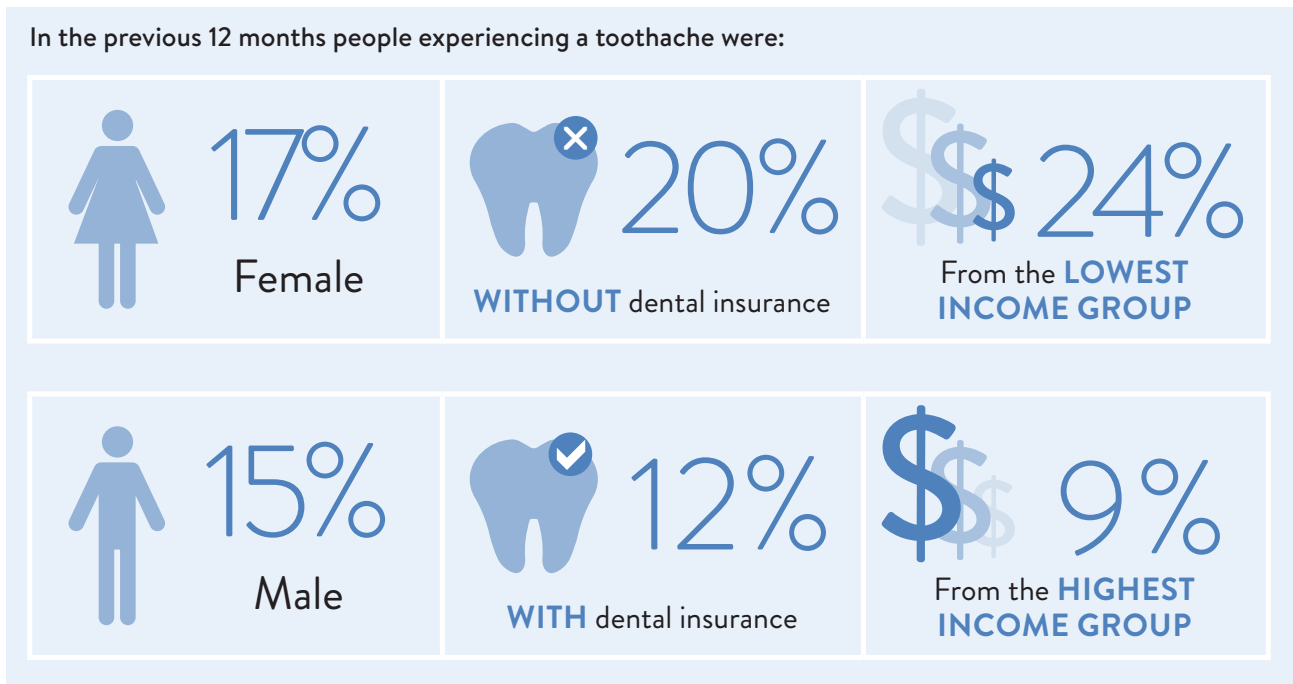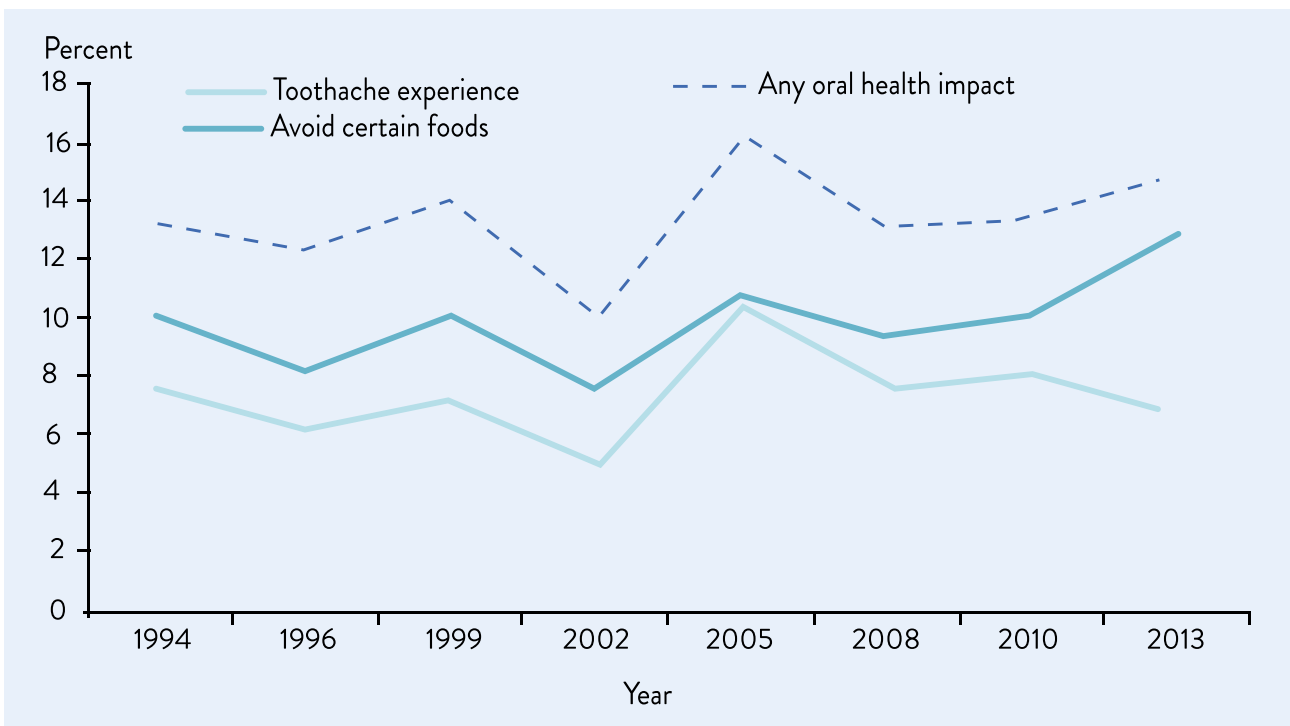
### 4.3.4 Relevant benchmarks

No targets for a reduction in toothache have been established in Australia or by the WHO. The development of feasible and appropriate 2025 targets for toothache indicators relied on interpretation of the trend and on the knowledge and expertise provided by the *Oral Health Tracker* Expert Working Group.

### 4.3.5 Proposed Australian targets and indicators

The targets proposed for both adults and children have been based on the 2010 and 2013 NDTI Surveys.

The recommended target for children (5 to 14 years) is a 10% reduction in toothache reported in the last 12 months. This is based on the decline in the prevalence of reported toothaches between the 2010 and 2013 NDTI Surveys, and a stable decline of reported toothache in children since 2005.

For adults, the trend in toothache has steadily increased since 1994. The working group agreed that the appropriate target should both reverse the rise and achieve a 10% reduction in the prevalence of reported toothache to 14.9%, the 2010 reported rate.

These targets are achievable in Australia if there is greater recognition of the importance of oral health as part of overall health and wellbeing.

| Indicator (risk factor, condition, adverse outcome) | Baseline | Latest | 2025 target | Trend | Measure to achieve 2025 target | Latest Aboriginal & Torres Strait Islander data |
|---|---|---|---|---|---|---|
| Children (5-14 years) who reported toothache in the last 12 months | 8.0% NDTIS 2010 | 6.8% NDTIS 2013 | **6.1%** | 🟢 | 10% reduction | Not available |
| Adults who reported toothache in the last 12 months | 14.9% NDTIS 2010 | 16.2% NDTIS 2013 | **14.9%** | 🟠 | Reverse the rise | Not available |

# References

1. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. Health and Quality of Life Outcomes. 2010;8:126.

2. Kramer PF, Feldens CA, Ferreira SH, Bervian J, Rodrigues PH, Peres MA. Exploring the impact of oral diseases and disorders on quality of life of preschool children. Community Dentistry and Oral Epidemiology. 2013;41(4):327-35.

3. Australian Institute of Health and Welfare. Australian Institute of Health and Welfare 2017. Health expenditure Australia 2015–16: analysis by sector. Health and welfare expenditure series no. 51. Cat. no. HWE 60. Canberra: AIHW. Canberra: AIHW, 2014  Contract No.: Cat. no. HWE 60.

4. World Health Organization. Oral health, general health and quality of life. Geneva: WHO, 2005.

5. World Health Organization. Guideline: Sugars intake for adults and children. Geneva: WHO, 2015.

6. Lei L, Rangan A, Flood VM, Louie JCY. Dietary intake and food sources of added sugar in the Australian population. British Journal of Nutrition. 2016;115(5):868-77.

7. Moynihan P, Kelly S. Effect on caries of restricting sugars intake: systematic review to inform WHO guidelines. Journal of Dental Research. 2014;93(1):8-18.

8. Schwendicke F, Thomson WM, Broadbent JM, Stolpe M. Effects of Taxing Sugar-Sweetened Beverages on Caries and Treatment Costs. Journal of Dental Research. 2016;95(12):1327-32.

9. Sheiham A, James WP. Diet and Dental Caries: The Pivotal Role of Free Sugars Reemphasized. Journal of dental research. 2015;94(10):1341-7.

10. World Dental Federation. Dietary Free Sugars and Dental Caries Geneva: FDI; 2017 [cited 2017 30 November]. Available from: https://www.fdiworlddental.org/resources/policy-statements-and-resolutions/dietary-free-sugars-and-dental-caries.

11. Australian Bureau of Statistics. Australian Health Survey: Consumption of Added Sugars Australia 2011-12 Canberra: ABS; 2016 [cited 2018 8 February]. Available from: http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/84F8A7C39FBBDDEDCA257FA1002308ED/$File/4364.0.55.011_2011-12.pdf.

12. Australian Bureau of Statistics. Australian Aboriginal and Torres Strait Islander Health Survey: Consumption of Added Sugars 2012-13: ABS; 2016 [cited 2018 8 February]. Available from: http://www.ausstats.abs.gov.au/Ausstats/subscriber.nsf/0/BBD20440C7A1DA30CA25805E0019CDD8/$File/4727.0.55.009%20consumption%20of%20added%20sugars.pdf.

13. Australian Bureau of Statistics. Australian Health Survey 2011-13 Canberra: ABS; 2016 [cited 2017 4 December]. Available from: http://www.abs.gov.au/australianhealthsurvey.

14. Cobiac L, Record S, Leppard P, Syrette J, Flight I. Sugars in the Australian diet: results from the 1995 National Nutrition Survey. Nutrition & Dietetics. 2003;60(3): 152-73.

15. Clinical Trials Centre at University of Sydney. Information paper – Water fluoridation: dental and other human health outcomes Canberra: NHMRC; 2017 [cited 2018 8 February]. Available from: https://www.nhmrc.gov.au/_files_nhmrc/file/your_health/fluoridation/17378_nhmrc_-_information_paper.pdf.

16. Fawell J, Bailey K, Chilton J, Dahi E, Fewtrell L, Magara Y. Fluoride in Drinking-water Geneva: WHO; 2006 [cited 2018 8 February]. Available from: http://www.who.int/water_sanitation_health/publications/fluoride_drinking_water_full.pdf.

17. Spencer AJ, Slade GD, Davies M. Water fluoridation in Australia. Community Dental Health. 1996;13 Suppl 2:27-37.

18.   COAG Health Council. Healthy Mouths Healthy Lives. Australia's National Oral Health Plan 2015-2024. Adelaide, South Australia: Government of Australia, 2015.

19.   Valkenburg C, Slot D, Bakker E, Van der Weijden F. Does dentifrice use help to remove plaque? A systematic review. Journal of Clinical Periodontology. 2016;43(12):1050-8.

20.   Yaacob M, Worthington H, Deacon S, Deery C, Walmsley A, Robinson P, et al. Powered versus manual toothbrushing for oral health. The Cochrane Database of Systematic Reviews. 2014;17(6).

21.   Marinho VC, Higgins JP, Sheiham A, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. The Cochrane database of systematic reviews. 2003(1):Cd002278.

22.   Moynihan P, Petersen PE. Diet, nutrition and the prevention of dental diseases. Public health Nutrition. 2004;7(1a):201-26.

23.   World Health Organization. WHO Expert Consultation on Public Health Intervention against Early Childhood Caries,: report of a meeting, Bangkok, Thailand, 26–28 January 2016. Geneva: WHO, 2017 20WHO/NMH/PND/17.1.

24.   van der Weijden G, Hioe K. A systematic review of the effectiveness of self-performed mechanical plaque removal in adults with gingivitis using a manual toothbrush. Journal of Clinical Periodontology. 2005;32 Suppl 6:214-28.

25.   Yevlahova D, Satur J. Models for individual oral health promotion and their effectiveness: a systematic review. Australian Dental Journal. 2009;54(3):190-7.

26.   Spencer AJ. The use of fluorides in Australia: guidelines. Australian dental journal. 2006;51(2):195-9.

27.   APMI Partners. Australian Dental Health Study. Sydney: Australian Dental Association, 2016.

28.   Do L, Spencer A. Oral health of Australian children: the National Child Oral Health Study 2012–14. Adelaide: University of Adelaide Press; 2016.

29.   Murray JJ. Attendance patterns and oral health. British Dental Journal. 1996;181:339.

30.   Patel S, Bay RC, Glick M. A systematic review of dental recall intervals and incidence of dental caries. Journal of the American Dental Association (1939). 2010;141(5):527-39.

31.   Brocklehurst PR, Ashley JR, Tickle M. Patient assessment in general dental practice - risk assessment or clinical monitoring? British Dental Journal. 2011;210(8):351-4.

32.   Deep P. Screening for common oral diseases. Journal of the Canadian Dental Association. 2000;66(6):298-9.

33.   Wang N, Holst D. Individualizing recall intervals in child dental care. Community Dentistry and Oral Epidemiology. 1995;23(1):1-7.

34.   American Academy of Pediatric Dentistry. Policy on the dental home. Pediatric Dentistry. 2005;27(7 Suppl):18-9.

35.   World Dental Federation. The Challenge of Oral Disease – A call for global action. The Oral Health Atlas. Geneva: FDI World Dental Federation, 2015.

36.   Harford J, Islam S. Adult oral health and dental visiting in Australia: results from the National Dental Telephone Interview Survey 2010. Canberra: AIHW, 2013, Contract No.: Cat. no. DEN 227.

37.   AIHW Dental Statistics and Research Unit. The National Survey of Adult Oral Health 2004–06: South Australia. Canberra: AIHW, 2008  Contract No.: Cat. no. DEN 179.

38.   Chrisopoulos S, Luzzi L, Brennan D. Trends in dental visiting avoidance due to cost in Australia, 1994 to 2010: an age-period-cohort analysis. BMC Health Services Research. 2013;13:381-.

39.    Roberts-Thomson KF, Stewart J, Giang Do L. A longitudinal study of the relative importance of factors related to use of dental services among young adults. Community Dentistry & Oral Epidemiology. 2011;39(3):268-75.

40.    Armfield JM. The extent and nature of dental fear and phobia in Australia. Australian Dental Journal. 2010;55(4):368-77.

41.    Pitts NB, Ismail AI, Martignon S, Ekstrand K, Douglas GVA, Longbottom C, et al. ICCMS™ Guide for Practitioners and Educators: ICDAS Foundation; 2014.

42.    Riley P, Worthington HV, Clarkson JE, Beirne PV. Recall intervals for oral health in primary care patients. Cochrane Database of Systematic Reviews. 2013(12).

43.    National Collaborating Centre for Acute C. National Institute for Health and Clinical Excellence: Guidance.  Dental Recall: Recall Interval Between Routine Dental Examinations. London: National Collaborating Centre for Acute Care (UK),National Collaborating Centre for Acute Care.; 2004.

44.    Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Alcohol consumption and site-specific cancer risk: a comprehensive dose–response meta-analysis. British Journal of Cancer. 2015;112(3):580-93.

45.    Radoï L, Luce D. A review of risk factors for oral cavity cancer: the importance of a standardized case definition. Community Dentistry and Oral Epidemiology. 2013(2):97.

46.    Bagnardi V, Rota M, Botteri E, Tramacere I, Islami F, Fedirko V, et al. Light alcohol drinking and cancer: a meta-analysis. Annals of Oncology. 2013;24(2):301-8.

47.    Reidy J, McHugh E, Stassen LFA. A review of the relationship between alcohol and oral cancer. The Surgeon. 2011;9:278-83.

48.    Turati F, Garavello W, Tramacere I, Bagnardi V, Rota M, Scotti L, et al. Review: A meta-analysis of alcohol drinking and oral and pharyngeal cancers. Part 2: Results by subsites. Oral Oncology. 2010;46:720-6.

49.    Sadri G, Mahjub H. Tobacco smoking and oral cancer: a meta-analysis. Journal of Research in Health Sciences. 2007;7(1):18-23.

50.    Chrisopoulos S, Harford J. Oral health and dental care in Australia: key facts and figures 2012. Canberra: AIHW; 2013.

51.    Wyss A, Hashibe M, Lee Y-C, Shu-Chun C, Muscat J, Chu C, et al. Smokeless Tobacco Use and the Risk of Head and Neck Cancer: Pooled Analysis of US Studies in the INHANCE Consortium. American Journal of Epidemiology. 2016;184(10):703.

52.    Chang CM, Corey CG, Rostron BL, Apelberg BJ. Systematic review of cigar smoking and all cause and smoking related mortality. BMC Public Health. 2015;15(1):1-20.

53.    Marks MA, Chaturvedi AK, Kelsey K, Straif K, Berthiller J, Schwartz SM, et al. Association of marijuana smoking with oropharyngeal and oral tongue cancers: pooled analysis from the INHANCE consortium. Cancer Epidemiology, Biomarkers & Prevention. 2014;23(1):160-71.

54.    Randi G, Scotti L, Bosetti C, Talamini R, Negri E, Levi F, et al. Pipe smoking and cancers of the upper digestive tract. International Journal of Cancer. 2007;121(9):2049-51.

55.    Australian Bureau of Statistics. Apparent Consumption of Alcohol, Australia, 2013-14 Canberra: ABS; 2015 [updated 31 August 2017; cited 2017 7 December]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4307.0.55.001Main+Features12013-14?OpenDocument.

56.    Australian Bureau of Statistics. Apparent Consumption of Alcohol, Australia, 2015-16  Canberra: ABS; 2017 [cited 2017]. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Lookup/4307.0.55.001Main+Features12015-16?OpenDocument.

57. Australian Institute of Health and Welfare. National Drug Strategy Household Survey 2016: detailed findings. Canberra: AIHW, 2017.

58. Australian Istitute of Health and Welfare. 2010 National Drug Strategy Household Survey report. Canberra AIHW, 2011.

59. Australian Institute of Health and Welfare (AIHW). National Drug Strategy Household Survey 2016—key findings. Canberra: AIHW, 2017.

60. Australian Institute of Health and Welfare. Australian Burden of Disease Study: impact and casues of illness and death in Australia 2011. Canberra 2016.

61. Australian Bureau of Statistics. National Health Survey: First Results, 2014-15, Key findings Canberra: ABS; 2015 [cited 2017 1 November]. Available from: http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/by%20Subject/4364.0.55.001~2014-15~Main%20Features~Hypertension%20and%20measured%20high%20blood%20pressure~14.

62. Scollo M, Winstanley M. Tobacco in Australia: Facts and issues. Melbourne: Cancer Council Victoria, 2017.

63. Australia Institute of Health and Welfare. National Drug Strategy Household Survey detailed report: 2013. Canberra: AIHW, 2014 Contract No.: Drug statistics series no.28. Cat. no. PHE 183.

64. Shaw JE, Sicree RA, Zimmet PZ. Global estimates of the prevalence of diabetes for 2010 and 2030. Diabetes Research and Clinical Practice. 2010;87(1):4-14.

65. Caballero B. The global epidemic of obesity: an overview. Epidemiologic Reviews. 2007;29:1-5.

66. Swinburn BA, Sacks G, Hall KD, McPherson K, Finegood DT, Moodie ML, et al. The global obesity pandemic: shaped by global drivers and local environments. Lancet. 2011;378(9793):804-14.

67. Walls H, Magliano D, Stevenson C, Backholer K, Mannan H, Shaw J, et al. Projected Progression of the Prevalence of Obesity in Australia. Obesity. 2012;20(4):872-8.

68. Dunstan D, Zimmet P, Welborn T, de Courten M, Cameron A, Sicree R, et al. The Rising Prevalence of Diabetes and Impaired Glucose Tolerance: The Australian Diabetes, Obesity and Lifestyle Study. Diabetes Care. 2002;25(5):839-34.

69. Chapple ILC, Bouchard P, Cagetti MG, Campus G, Carra M-C, Cocco F, et al. Interaction of lifestyle, behaviour or systemic diseases with dental caries and periodontal diseases: consensus report of group 2 of the joint EFP/ ORCA workshop on the boundaries between caries and periodontal diseases. Journal of Clinical Periodontology. 2017;44:S39-S51.

70. Moura-Grec PGd, Marsicano JA, Carvalho CAPd, Sales-Peres SHdC. Obesity and periodontitis: systematic review and meta-analysis. Ciência & Saúde Coletiva. 2014; 19(6):1763-72.

71. Nascimento GG, Leite FRM, Conceição DA, Ferrúa CP, Singh A, Demarco FF. Is there a relationship between obesity and tooth loss and edentulism? A systematic review and meta-analysis. Obesity Reviews. 2016;17(7):587-98.

72. Prpić J, Kuis D, Glazar I, Ribarić SP. Association of obesity with periodontitis, tooth loss and oral hygiene in non-smoking adults. Central European Journal Of Public Health. 2013;21(4):196-201.

73. Chi DL, Luu M, Chu F. A scoping review of epidemiologic risk factors for pediatric obesity: Implications for future childhood obesity and dental caries prevention research. Journal of Public Health Dentistry. 2017;77:S8-S31.

74. Hayden C, Bowler JO, Chambers S, Freeman R, Humphris G, Richards D, et al. Obesity and dental caries in children: a systematic review and meta-analysis. Community Dentistry & Oral Epidemiology. 2013;41(4):289-308.

75. Hooley M, Skouteris H, Boganin C, Satur J, Kilpatrick N. Body mass index and dental caries in children and adolescents: a systematic review of literature published 2004 to 2011. Systematic Reviews. 2012;1:57.

76. Pulgarón ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. Clinical Therapeutics. 2013;35(1):A18-A32.

77. Li L-W, Wong HM, Sun L, Wen YF, McGrath CP. Anthropometric measurements and periodontal diseases in children and adolescents: a systematic review and meta-analysis. Advances in Nutrition. 2015;6(6):828-41.

78. World Health Organization. Risks to oral health and intervention Geneva: WHO; 2018. Available from: http://www.who.int/oral_health/action/risks/en/.

79. Soell M, Hassan M, Miliauskaite A, Haïkel Y, Selimovic D. The oral cavity of elderly patients in diabetes. La cavité buccale du diabétique âgé (French). 2007;33(Supplement 1):S10-S8.

80. Taylor GW, Manz MC, Borgnakke WS. Diabetes, periodontal diseases, dental caries, and tooth loss: a review of the literature. Compendium of Continuing Education in Dentistry. 2004;25(3):179-84, 86-8.

81. Jawed M, Shahid SM, Qader SA, Azhar A. Dental caries in diabetes mellitus: role of salivary flow rate and minerals. Journal of Diabetes and Its Complications. 2011;25:183-6.

82. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century – the approach of the WHO Global Oral Health Programme. Community Dentistry and Oral Epidemiology. 2003;31:3-24.

83. Hobdell M, Petersen PE, Clarkson J, Johnson N. Global goals for oral health 2020. International Dental Journal. 2003;53(5):285-8.

84. McNamara K, Knight A, Livingston M, Kypri K, Malo J, Roberts L, et al. Targets and indicators for chronic disease prevention in Australia Melbourne: Australian Health Policy Collaboration; 2015 [cited 2018 29 January]. No. 2015-08:[Available from: https://www.vu.edu.au/sites/default/files/AHPC/pdfs/targets-and-indicators-for-chronic-disease-prevention-in-australia.pdf.

85. Australian Bureau of Statistics. Australian Health Survey: Updated Results, 2011-12. Canberra: ABS; 2013.

86. Magarey AM, Daniels LA, Boulton TJ. Prevalence of overweight and obesity in Australian children and adolescents: reassessment of 1985 and 1995 data against new standard international definitions. The Medical Journal of Australia. 2001;174(11):561-4.

87. Serdula MK, Ivery D, Coates RJ, Freedman DS, Williamson DF, Byers T. Do Obese Children Become Obese Adults? A Review of the Literature. Preventive Medicine. 1993;22(2):167-77.

88. Stratton IM, Adler AI, Neil HAW, Matthews DR, Manley SE, Cull CA, et al. Association of glycaemia with macrovascular and microvascular complications of type 2 diabetes (UKPDS 35): prospective observational study. British Medical Journal. 2000;321(7258):405-12.

89. Flegal K, Carroll M, Kit B, Ogden C. Prevalence of obesity and trends in the distribution of body mass index among us adults, 1999-2010. JAMA. 2012;307(5):491-7.

90. Ogden CL, Yanovski SZ, Carroll MD, Flegal KM. The Epidemiology of Obesity. Gastroenterology. 2007;132(6):2087-102.

91. Australian Institute of Health and Welfare. Diabetes compendium Canberra: AIHW; 2017 [cited 2018 19 February]. Available from: https://www.aihw.gov.au/reports/diabetes/diabetes-compendium/contents/how-many-australians-have-diabetes.

92. Pitts N, Zero D. White paper on dental caries prevention and management: FDI World Dental Federation 2016 [cited 2018 23 January]. Available from: http://www.fdiworlddental.org/sites/default/files/media/documents/2016-fdi_cpp-white_paper.pdf.

93. AIHW. Australian Burden of Disease Study: Impact and causes of illness and death in Australia 2011. Canberra: AIHW, 2016.

94. Jepsen S, Blanco J, Buchalla W, Carvalho JC, Dietrich T, Dorfer C, et al. Prevention and control of dental caries and periodontal diseases at individual and population level: consensus report of group 3 of joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. Journal of Clinical Periodontology. 2017;44 Suppl 18:S85-s93.

95. Hopcraft MS, Beaumont S. The growing problems of dental caries and obesity: an Australian perspective. Bristish Dental Journal. 2016;221:379.

96. Slade GD, Spencer AJ, Roberts-Thomson KF. Australia's dental generations : The national survey of adult oral health 2004-06: Canberra : Australian Institute of Health and Welfare; 2007.

97. Armfield JM, Slade GD, Spencer AJ. Dental fear and adult oral health in Australia. Community Dentistry & Oral Epidemiology. 2009;37(3):220-30.

98. Moorrees CF. The dentition of the growing child: a longitudinal study of dental development between 3 and 18 years of age. Cambridge, Mass: Harvard University Press; 1959.

99. Dye B, Thornton-Evans G, Li X, Iafolla T. Dental caries and sealant prevalence in children and adolescents in the United States, 2011-2012. NCHS Data Brief. 2015;191:1-8.

100. Li C-H, Albuquerque MS, Gooch BF. Use of dental care and effective preventive services in preventing tooth decay among US children and adolescents—Medical Expenditure Panel Survey, United States, 2003–2009 and National Health and Nutrition Examination Survey, United States, 2005–2010. Use of Selected Clinical Preventive Services to Improve the Health of Infants, Children, and Adolescents—United States, 1999–2011. 2014;63(2):54.

101. Chrisopoulos, Beckwith K, JE JH. Oral health and dental care in Australia: key facts and figures 2011. Canberra: AIHW, 2011.

102. Ha D, Amarasena N, Crocombe L. The dental health of Australia's children by remoteness: Child Dental Health Survey Australia 2009. 2013.

103. Cancer Council Australia. Understanding Head and Neck Cancers Sydney: Cancer Council NSW; 2017 [cited 2018 23 January]. Available from: https://www.cancer.org.au/content/about_cancer/ebooks/cancertypes/Understanding_Head_and_neck_cancers_booklet_May_2017.pdf#_ga=2.118503049.105404656.1516664403-2030700749.1516664403.

104. Australian Institute of Health and Welfare (AIHW). Cancer in Australia 2017. Canberra: AIHW, 2017.

105. Farah C, Simanovic B, Dost F. Oral cancer in Australia 1982–2008: A growing need for opportunistic screening and prevention. Australian Dental Journal. 2014;59(3):349-59.

106. Logan R. Oral cancer screening. Cancer Forum. 2014;38(3):227.

107. Australian Institute of Health and Welfare (AIHW). Cancer in Australia 2012. Canberra: AIHW, 2012.

108. McGurk M, Scott S. The reality of identifying early oral cancer in the general dental practice. British Dental Journal. 2010;208(8):347-51.

109. The Oral Cancer Foundation. Understanding the HPV Connection 2016 [cited 2018 7 January]. Available from: http://oralcancerfoundation.org/understanding/hpv/

110. Barrios R, Bravo M, Gil-Montoya JA, Martínez-Lara I, García-Medina B, Tsakos G. Oral and general health-related quality of life in patients treated for oral cancer compared to control group. Health and Quality of Life Outcomes. 2015;13:9.

111. Infante-Cossio P, Torres-Carranza E, Cayuela A, Gutierrez-Perez JL, Gili-Miner M. Quality of life in patients with oral and oropharyngeal cancer. International Journal of Oral and Maxillofacial Surgery. 2009;38(3):250-5.

112. Kamstra JI, Jager-Wittenaar H, Dijkstra PU, Huisman PM, van Oort RP, van der Laan BFAM, et al. Oral symptoms and functional outcome related to oral and oropharyngeal cancer. Supportive Care in Cancer. 2011;19(9):1327-33.

113. AIHW. Cancer in Australia: an overview, 2010. Canberra: Australian Institute of Health and Welfare, 2010.

114. AIHW. Cancer in Australia 2000. Cacnberra: Australian Institute of Health and Welfare, 2000.

115. World Health Organization. Global action plan for the prevention and control of noncommunicable diseases 2013-2020. Geneva: WHO, 2013.

116. AIHW & AACR. Cancer in Australia: an overview, 2008. Canberra: AIHW, 2008 Contract No.: Cat no CAN 42.

117. Petersen PE. Oral cancer prevention and control–The approach of the World Health Organization. Oral Oncology. 2009;45(4):454-60.

118. Dental Health Services Victoria. Periodontitis (gum disease) 2017 [cited 2017 4 September]. Available from: https://www.dhsv.org.au/dental-health/teeth-tips-and-facts/periodontitis.

119. Schätzle M, Löe H, Lang NP, Bürgin W, Ånerud Å, Boysen H. The clinical course of chronic periodontitis: IV. Gingival inflammation as a risk factor in tooth mortality. Journal of Clinical Periodontology. 2004;31(12):1122-7.

120. Tomar S, Asma S. Smoking-attributable periodontitis in the United States: findings from NHANES III. National Health and Nutrition Examination Survey. Journal of Periodontology. 2000;71(5):743-51.

121. Borrell LN, Papapanou PN. Analytical epidemiology of periodontitis. Journal of Clinical Periodontology. 2005;32:132-58.

122. Brown LJ, Oliver RC, Loe H. Periodontal diseases in the U.S. in 1981: prevalence, severity, extent, and role in tooth mortality. Journal of periodontology. 1989;60(7):363-70.

123. Do L, Slade G, Roberts-Thomson K, Sanders A. Smoking-attributable periodontal disease in the Australian adult population. Journal of Clinical Periodontology. 2008;35(5):398-404.

124. Bagda K, Patel N, Kesharani P, Shah V, Garasia T. Diabetes and Oral Health. National Journal of Integrated Research in Medicine. 2016;7(6):110-3.

125. Crocombe L, Brennan D, Slade G, Loc D. Is self interdental cleaning associated with dental plaque levels, dental calculus, gingivitis and periodontal disease? Journal of Periodontal Research. 2012;47(2):188-97.

126. Nazir MA. Prevalence of periodontal disease, its association with systemic diseases and prevention. International Journal Of Health Sciences. 2017;11(2):72-80.

127. Jin LJ, Armitage GC, Klinge B, Lang NP, Tonetti M, Williams RC. Global Oral Health Inequalities: Task Group—Periodontal Disease. Advances in Dental Research. 2011;23(2):221-6.

128. Boillot A, El Halabi B, Batty GD, Rangé H, Czernichow S, Bouchard P. Education as a Predictor of Chronic Periodontitis: A Systematic Review with Meta-Analysis Population-Based Studies. PLOS ONE. 2011;6(7):e21508.

129.	Klinge B, Norlund A. A socio-economic perspective on periodontal diseases: a systematic review. Journal of Clinical Periodontology. 2005;32 Suppl 6:314-25.

130.	Hugoson A, Sjödin B, Norderyd O. Trends over 30 years, 1973-2003, in the prevalence and severity of periodontal disease. Journal of Clinical Periodontology. 2008;35(5):405-14.

131.	Australian Institute of Health and Welfare. Admitted patient care 2015-16. Canberra: AIHW, 2015.

132.	National Advisory Council on Dental Health. Outcomes and Impacts of Oral Disease Canberra: Department of Health; 2012 [cited 2018 7 January]. Available from: http://www.health.gov.au/internet/ publications/publishing.nsf/Content/report_nacdh~report_nacdh_ch1~report_nacdh_out.

133.	Australia Institute of Health and Welfare. Web update: Potentially preventable hospitalisations in 2015-16 2017. Available from: https://www.myhealthycommunities.gov.au/our-reports/potentially-preventable-hospitalisations-update/july-2017.

134.	Chrisopoulos S, Harford J, Ellershaw A. Oral health and dental care in Australia: key facts and figures 2015. Canberra: Australian Institute of Health and Welfore, 2016 Cat. no. DEN 229.

135.	Ansari Z. The Concept and Usefulness of Ambulatory Care Sensitive Conditions as Indicators of Quality and Access to Primary Health Care. Australian Journal of Primary Health. 2007;13(3):91-110.

136.	Australia Institute of Health and Welfare. National Healthcare Agreement: PI 18-Selected potentially preventable hospitalisations, 2015 Canberra: AIHW; 2016. Available from: http://meteor.aihw.gov.au/content/index.phtml/itemId/629963.

137.	Victorian Government Department of Human Services. The Victorian Ambulatory Care Sensitive Conditions Study: Preliminary Analyses. Melbourne, Victoria: Public Health Division, 2001.

138.	Gotfredsen K, Walls AW. What dentition assures oral function? Clinical Oral Implants research. 2007;18 Suppl 3:34-45.

139.	Brennan DS, Singh KA. General health and oral health self-ratings, and impact of oral problems among older adults. European Journal of Oral Sciences. 2011;119(6):469-73.

140.	Brennan DS, Singh KA, Liu P, Spencer A. Fruit and vegetable consumption among older adults by tooth loss and socio-economic status. Australian Dental Journal. 2010;55(2):143-9.

141.	Zhu Y, Hollis J. Tooth loss and its association with dietary intake and diet quality in American adults. Journal of Dentistry. 2014;42:1428-35.

142.	Haag DG, Peres KG, Balasubramanian M, Brennan DS. Oral Conditions and Health-Related Quality of Life: A Systematic Review. Journal of Dental Research. 2017;96(8):864-74.

143.	Kapp JM, Boren SA, Yun S, LeMaster J. Diabetes and tooth loss in a national sample of dentate adults reporting annual dental visits. Preventing Chronic Disease. 2007;4(3):A59.

144.	Lafon A, Pereira B, Dufour T, Rigouby V, Giroud M, Bejot Y, et al. Periodontal disease and stroke: a meta-analysis of cohort studies. European Journal of Neurology. 2014(9):1155.

145.	Michaud DS, Fu Z, Shi J, Chung M. Periodontal Disease, Tooth Loss, and Cancer Risk. Epidemiologic reviews. 2017;39(1):49-58.

146.	Meyer MS, Joshipura K, Giovannucci E, Michaud DS. A review of the relationship between tooth loss, periodontal disease, and cancer. Cancer Causes & Control. 2008;19(9):895-907.

147.	Demmer R, Molitor J, Jacobs Jr D, Michalowicz B. Periodontal disease, tooth loss and incident rheumatoid arthritis: Results from the First National Health and Nutrition Examination Survey and its epidemiological follow-up study. Journal of Clinical Periodontology. 2011;38(11):998-1006.

148.   de Pablo P, Dietrich T, McAlindon T. Association of periodontal disease and tooth loss with rheumatoid arthritis in the US population. The Journal of Rheumatology. 2008;35(1):70-6.

149.   Peres MA, Luzzi L, Peres KG, Sabbah W, Antunes JL, Do LG. Income-related inequalities in inadequate dentition over time in Australia, Brazil and USA adults. Community Dentistry and Oral Epidemiology. 2015;43(3):217-25.

150.   Elani H, Harper S, Kaufman J, Thomson W, Espinoza I, Mejia G, et al. Social inequalities in tooth loss: A multinational comparison. Community Dentistry and Oral Epidemiology. 2017;45(3):266-74.

151.   Similä T, Auvinen J, Timonen M, Virtanen JI. Long-term effects of smoking on tooth loss after cessation among middle-aged Finnish adults: the Northern Finland Birth Cohort 1966 Study. BMC Public Health. 2016;16(1):1-8.

152.   Krall EA, Dawson-Hughes B, Garvey AJ, Garcia RI. Smoking, smoking cessation, and tooth loss. Journal of Dental Research. 1997;76(10):1653-9.

153.   Albandar JM, Streckfus CF, Adesanya MR, Winn DM. Cigar, pipe, and cigarette smoking as risk factors for periodontal disease and tooth loss. Journal of Periodontology. 2000;71(12):1874-81.

154.   Northridge ME, Ue FV, Borrell LN, De La Cruz LD, Chakraborty B, Bodnar S, et al. Tooth loss and dental caries in community-dwelling older adults in northern Manhattan. Gerodontology. 2012;29(2):e464-73.

155.   Kakoei S, Parirokh M, Nakhaee N, Jamshidshirazi F, Rad M, Kakooei S. Prevalence of Toothache and Associated Factors: A Population-Based Study in Southeast Iran. Iranian Endodontic Journal. 2013;8(3):123-8.

156.   National Health Service. Toothache: NHS; 2015 [cited 2017 12 December]. Available from: https://www.nhs.uk/conditions/Toothache/.

157.   Shepherd MA, Nadanovsky P, Sheiham A. The prevalence and impact of dental pain in 8-year-old school children in Harrow, England. British Dental Journal. 1999;187:38.

158.   Krisdapong S, Prasertsom P, Rattanarangsima K, Sheiham A. School absence due to toothache associated with sociodemographic factors, dental caries status, and oral health-related quality of life in 12- and 15-year-old Thai children. Journal of Public Health Dentistry. 2013;73(4):321-8.

159.   Slade GD, Spencer AJ, Davies MJ, Burrow D. Intra-oral distribution and impact of caries experience among South Australian school children. Australian dental journal. 1996;41(5):343-50.

160.   Granville-Garcia A, Ribeiro GL, Gomes MC, Granville-Garcia AF, de Lima KC, Martins CC, et al. Work absenteeism by parents because of oral conditions in preschool children. International Dental Journal.65(6):331-p7.