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Water fluoridation and children's dental health

The Child Dental Health Survey, Australia 2002

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THE UNIVERSITY OF ADELAIDE AUSTRALIA

ARCPOH Australian Research Centre for POPULATION ORAL HEALTH

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Contents

Abbreviations

d	deciduous decayed teeth
D	permanent decayed teeth
dift	deciduous decayed, indicated for extraction (due to decay) and filled teeth
dmft	deciduous decayed, missing (due to decay) and filled teeth
DMFT	permanent decayed, missing (due to decay) and filled teeth
ERP	estimated resident population
f	deciduous filled teeth
F	permanent filled teeth
m	deciduous teeth missing due to decay
M	permanent teeth missing due to decay
ppm	parts per million
SD	standard deviation
SEIFA	Socio-Economic Indexes for Areas
SES	socio-economic status
SiC	Significant Caries Index
SiC^{10}	Significant Caries Index (10%)
SOKS	Save Our Kids Smiles

Place Abbreviations

ACT	Australian Capital Territory
Aust	Australia
NSW	New South Wales
NT	Northern Territory
Qld	Queensland
SA	South Australia
Tas	Tasmania
Vic	Victoria
WA	Western Australia

Symbols

n.a.	not available
—	nil or rounded to zero
. .	not applicable
n	number

Executive summary

The Child Dental Health Survey provides national yearly information on the dental health of children attending school dental services in Australia. This report describes and discusses the survey and presents analyses for the year 2002. The data cover 136,505 children from all states and territories except for New South Wales.

In 2002:

Among 6-year-olds—

- nearly one half (47.4%) had a history of decay in the deciduous ('baby') teeth—that is, one or more decayed, missing and filled deciduous teeth
- on average they had two decayed, missing and filled deciduous teeth per child
- but the 10% of children with the most extensive history of deciduous tooth decay had more than nine deciduous teeth affected, which was about four and a half times the national average.

Among 12-year-olds—

- over 40% had some history of decay in their permanent teeth—that is, one or more decayed, missing and filled permanent teeth
- on average they had just over one decayed, missing and filled permanent tooth per child
- but the 10% with the most extensive history of permanent tooth decay had nearly five permanent teeth affected which was almost five and a half times the national average of decayed, missing and filled teeth.

International comparisons and comparisons based on access to fluoridated water:

- children's dental health in Australia is better than in many other countries. Of the 44 countries with comparable national data available, Australia had the seventh lowest average number of decayed, missing and filled permanent teeth among 12-year-olds
- however, children from areas where drinking water contained negligible fluoride had poorer dental health than did children from areas with either naturally or artificially fluoridated water
- the poorer dental health of children from areas with negligible levels of fluoride in the water persisted across differing areas of residential location and levels of socioeconomic disadvantage.

Introduction

This publication describes the patterns and service provision relating to children's dental health in Australia in 2002. The publication's tables and figures describe the demographic composition of the sample, deciduous and permanent decay experience, and the extent of immediate treatment needs, prevalence of fissure sealants and other relevant information. Tables showing national trends and state/territory comparisons precede an examination of differences in dental health between areas with varying levels of fluoride in drinking water, and international comparisons. The publication also describes the survey methods and discusses the findings presented in the national tables.

The dental health of children receiving care in state/territory school dental services has been monitored since 1977. Between 1977 and 1988 the monitoring was managed centrally by the (then) Commonwealth Department of Health as an evaluation of the Australian School Dental Scheme. In 1989, responsibility for collecting national data was transferred to the Australian Institute of Health and Welfare's Dental Statistics and Research Unit at The University of Adelaide, where it is conducted through the Child Dental Health Survey.

Description of survey methods

Source of subjects

Data for this report have been derived from the annual Child Dental Health Survey, which monitors the dental health of children enrolled in school dental services operated by the health departments or authorities of Australia's six state and two territory governments. However, in this 2002 report, results from New South Wales are excluded due to a lack of representativeness of the sample. In all jurisdictions, children from both public and private schools are eligible for school dental services. The care typically provided by the school dental services includes dental examinations, preventive services and restorative treatment as required. However, there are some variations among state and territory programs with respect to priority age groups and the nature of services. As a consequence, there are variations in the extent of enrolment in school dental services, with some jurisdictions serving more than 80% of primary school children and others serving lower percentages.

Sampling

The data for the Child Dental Health Survey are derived from routine examinations of children enrolled in the school dental services. At the time of examination, children are sampled at random by selecting those born on specific days of the month. Victoria and Tasmania adopt other systematic sampling procedures based on a random sample of children.

Different sampling ratios are used across the states and territories according to the scheme presented in Table 1. National data for the Child Dental Health Survey therefore constitute a stratified random sample of children from the school dental services. Children not enrolled with the school dental service are not represented in the sample.

Table 1: Sampling ratios for Australian states and territories, 2002

State/territory	Sampling ratio[(a)]	Days of birth
New South Wales	. .	. .
Victoria	1:8	Systematic
Queensland	1:15	1st and 6th
	1:1	Any[(b)]
Western Australia	1:8.5	28th, 29th, 30th, 31st
South Australia	1:1	Any
	1:5	13th, 26th to 31st[(c)]
Tasmania	1:2.5	Systematic
Australian Capital Territory	1:2.5	1st to 16th
Northern Territory	1:1.9	1st to 16th[(d)]
	1:1	Any[(e)]

. . Not applicable due to exclusion of NSW from 2002 data collection.

(a) Sampling ratios are approximate only.

(b) 6- and 12-year-old children from the Gold Coast.

(c) From non-metropolitan clinics who have previously participated in the Child Fluoride Study.

(d) Includes Darwin.

(e) Includes all Northern Territory outside of Darwin.

Stratification aims to provide similar numbers of children from each state and territory. However, due to full enumeration in South Australia, the number of children sampled in this state is considerably larger than for the other states and territories. In addition, differences in administration and local data requirements of the services have created some variation among the other states and territories in the number of children sampled.

Data items

Data items in the Child Dental Health Survey are collected at the time of routine clinical examinations conducted by dental therapists and dentists. The recorded characteristics of sampled children include some demographic information, including the child's age and sex.

The country of birth and Indigenous status of both child and mother are considered to be two items important to a health monitoring survey (Health Targets and Implementation Committee 1988). Both items have been obtained from information on the patient's treatment card or medical history. However, due to the increasingly limited recording of this information by the state and territory school dental services, they have not been included in this report.

Service provision information includes the dates of current and previous examinations (if the child had been examined previously within the school dental services) and is dealt with in detail within state- and territory-specific reports. Information on last examinations was not collected for a large percentage of children in South Australia as a result of changes to the data collection method employed in that state.

The dental health status of sampled children covers the four areas listed below:

1. Deciduous decay experience is recorded as the number of deciduous teeth that are decayed, missing because of dental decay or filled because of dental decay, and is based on the coding scheme of Palmer et al. (1984). The index of decay experience in deciduous teeth is referred to as dmft. Decay refers to cavities, usually detected clinically using visual and/or tactile criteria. In some instances, radiographic criteria may be used.

2. Permanent decay experience is recorded as the number of permanent teeth that are decayed, missing because of dental decay or filled because of dental decay, and is based on the World Health Organization protocol (WHO 1997). The index of caries experience in permanent teeth is referred to as DMFT.

3. Immediate treatment needs are designated if, in the opinion of the examiner, the child has, or is likely to develop within 4 weeks, pain, infection or a life-threatening condition (WHO 1997). Data collected for the current study do not include information on the immediate treatment needs of children from Victoria, Western Australia, Tasmania or the Australian Capital Territory.

4. Fissure sealants are recorded as the number of teeth, otherwise sound and not restored, which have a fissure sealant. This data item was introduced in most states and territories in 1989.

While average decay experience for a population provides a good summary statistic, it can hide the existence of people within that population who have considerable decay experience. The Significant Caries Index (SiC) was designed to bring attention to those individuals with the highest values in a population (Bratthal 2002; Nishi et al. 2002). The SiC is the average number of decayed, missing and filled teeth of the 30% of the population with the most dental decay experience. A modified index, the SiC^{10}, is the average dmft of the 10% of children with the highest dmft index.

Age-standardised data were used to bring together data from all ages (children aged between 5 and 12 years) in all jurisdictions for interstate comparison. This is useful in the event that any age-specific statistics (for example, for 5- to 6-year-olds) provide an unrepresentative picture of conditions in a specific state or territory. The purpose of age-standardisation is to adjust among states and territories for possible differences in the proportion of specific age groups, which is important because of the age-relatedness of most dental decay measures.

Data items are not collected uniformly across all states and territories. Consequently, some tables in this report only refer to specific states and territories.

The diagnostic criteria employed are based on the clinical judgment of the examining dental therapist or dentist. They follow written criteria for the data items described above; however, there are no formal sessions of calibration or instruction in diagnosis undertaken for the purpose of the survey, and there are no repeat examinations for the purpose of assessing inter- or intra-examiner reliability.

Weighting of data and data analysis

National data contained in this report consist of counts, averages, standard deviations and percentages that have been weighted to represent the relevant state- and territory-specific populations of children aged 4–15 years. Children aged 3 years or less and 16 years or more were excluded from this sample as the small numbers receiving care in those age groups across Australia result in poor reliability of computed statistics for those ages. Furthermore, these children are outside the main target group of many of the school dental services, and it is likely that they have some special characteristics that make them less representative of their respective age groups within the Australian population.

Where computed state or territory age-specific indices resulted in a relative standard error exceeding 40%, or where the number of children sampled was considered very low, the age group for that jurisdiction was excluded from the analysis. As a result, 4-year-old and 15-year-old children from both Victoria and the Australian Capital Territory were excluded, while 15-year-old children from the Northern Territory were also excluded. Hence, results for 4-year-old and 15-year-old children should be interpreted with care and with appreciation that they may not be representative of the Australian child population.

The weighting procedure used in this report is necessary since the Australian sample does not contain representative percentages of children from each state and territory. Unweighted estimates would result in over-representation of children from South Australia or from less populous states or territories and under-representation of those from more populous jurisdictions. The relative sample sizes and population estimates by state and territory as a percentage of the total sample and of the Australian population (4–15 years of age) are shown in Figure 1.

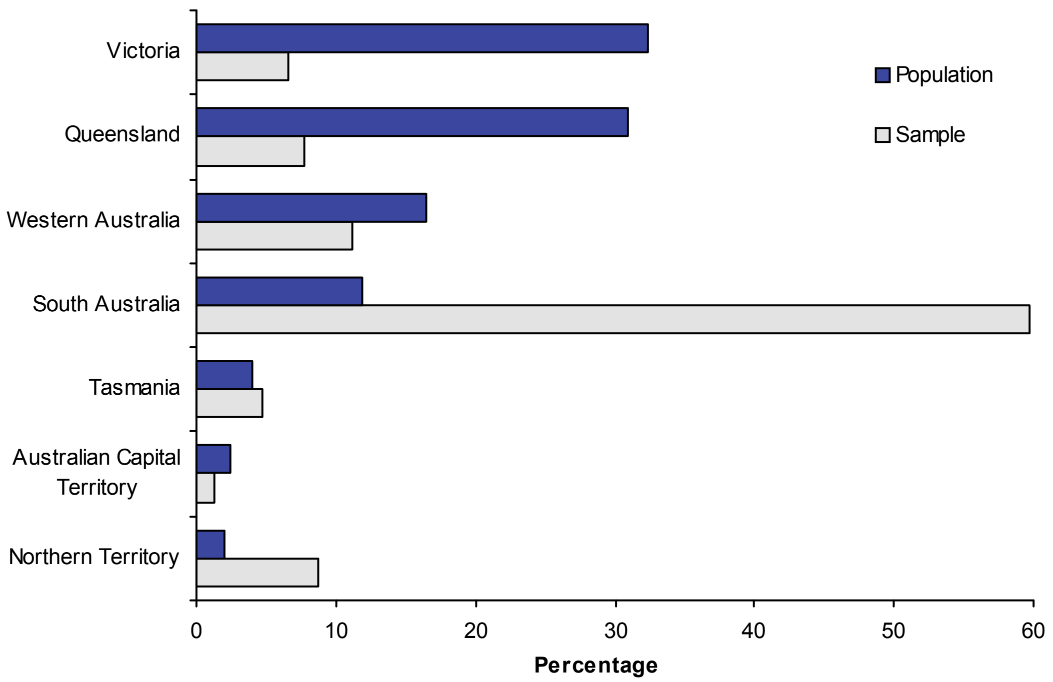


Figure 1: Percentage of children by state and territory for sample and for state/territory population, 2002

The weighting method is based on standard procedures for weighting stratified samples using external data sources (Foreman 1991) and follows the same procedure as previous surveys. State and territory estimates (ABS 2003) of the 2002 estimated resident population (ERP) within individual ages are used to provide numerators for weights that are divided by the age-specific number of cases in the samples from respective states and territories. Hence, observations from more populous states achieve relatively greater weight. The stratum-specific weights are further divided by the national ERP and total sample size to achieve numerical equivalence between the weighted sample and the original number of processed records.

Within the states and territories, data were also weighted according to region or time since last dental examination, this being consistent with statistical analyses presented in state- and territory-specific reports. In 2002, data within Victoria, Queensland, Western Australia, South Australia, Tasmania, the Australian Capital Territory and the Northern Territory were weighted on the basis of area of sampling and sampling fraction so as to give a more representative result for that state or territory. Data within Queensland, Western Australia, Tasmania, the Australian Capital Territory and the Northern Territory were also weighted by time since last dental examination so that children on longer recall intervals, who often have better oral health, were not under-represented in the analysis. Details of these weighting procedures are provided in the relevant state and territory reports.

The weighting protocol aimed to produce estimates that were representative of the population covered by the school dental services in 2002. However, the estimates in this report cannot be applied to children who are not enrolled in the school dental services. Consequently, the results in this report do not represent the complete Australian child population, but only that portion of the population that is enrolled in the school dental services. Enrolment across Australia varies, but in all states and territories is higher for primary-aged children than for children in secondary schooling. Hence, in this report, estimates for primary school children may not differ substantially from those that would be obtained if all children in the country were surveyed; however, estimates for secondary school children may vary from those obtained if all children in the country were surveyed.

It is necessary to be cautious in drawing inferences from age-related trends, particularly among those children aged over 12 years. In most states and territories, access to school dental services for older children tends to be restricted in comparison with access for younger children. Often the older children must meet special eligibility criteria, with the consequence that they may be less representative of their respective age groups within the Australian population than is the case for younger children. Also, in Victoria, the Northern Territory and the Australian Capital Territory children aged 14 years or over are not included in the analysis, so current estimates for 15-year-old children do not take those jurisdictions into account.

Indices of decay experience were calculated from data collected over a 12-month period. Where children received more than one examination during this period, the information derived from examinations other than the first has been excluded. Age-standardised statistics are based on the simple rolling together of weighted data for all relevant age groups.

Comparison of dental decay rates between areas with differing levels of fluoride in drinking water was achieved using each child's postcode of residence. Information on the level of fluoride in reticulated water for each postcode was obtained from a database maintained by the Australian Research Centre for Population Oral Health. The database was compiled from documented sources and from personal communications with state and territory governments and water authorities. Because some small variation can exist in water fluoride concentrations within a postcode, the level of fluoride in the water has been categorised into three categories for this report: <0.3 parts per million (ppm), 0.3–0.69 ppm, and ≥0.7 ppm. It is generally considered that levels at and above 0.7 ppm and less than 1.1 ppm confer optimum oral health benefits. Because there are few locations in Australia with 0.3–0.69 ppm fluoride in the water, this category was not included in the analyses in this report. This resulted in the exclusion of postcodes in Darwin, that has a fluoride concentration of 0.6 ppm. Because children from Darwin make only a small contribution to national estimates, this exclusion makes little difference to the results as presented in this report.

Analyses of socioeconomic status used the Socio-Economic Indexes for Areas (SEIFA) Index of Relative Socioeconomic Disadvantage to assign a value to the postcode of residence of each child. SEIFA values are a composite of a number of items believed to be related to socioeconomic status that are derived from the 2002 Australian Census. High values on the Index of Relative Socio-Economic Disadvantage occur when the area has few families of low income and few people with little training and in unskilled occupations. Low values on the index occur when the area has many low-income families and people with little training and are in unskilled occupations. Cut-points were created to define four groups of approximately equal numbers. It should be noted that the indexes are ordinal and not interval measures. That is, although the indexes can be used to order areas in terms of disadvantage; there are no meaningful arithmetic relationships between index values.

Exclusion of data from New South Wales and implications for assessing national oral health trends

Due to a lack of representativeness of the New South Wales sample in 2002, data from New South Wales are not included in this publication. The implications of this change to national child oral health statistics are significant and, along with other data collection changes in New South Wales, present a challenge when interpreting time series for Australia. Further information on changes in NSW and three series of national time trends for the period 1990–2002 are presented in Appendix A.

Description of national findings

Number in sample and estimated resident population

There were a total of 136,505 children aged between 4 and 15 years surveyed for the 2002 calendar year. The effects of the statistical weighting procedure can be appreciated from examining Table 2. The relatively large numbers of children sampled from South Australia received substantially lower weightings compared with other states and territories. Therefore, the weighted numbers of children, which are used for estimates listed in subsequent tables, represent smaller numbers of children from this jurisdiction. Consequently, the national sample was numerically representative of the relative populations of states and territories, rather than the number of sampled children.

Table 2: Number in sample and estimated resident population (ERP), 2002

State/territory	Number of children sampled	ERP	Weight	Weighted number of children
	n	*n*		*n*
New South Wales	. .	. .	. .	. .
Victoria[(a)]	9,086	654,268	4.58	41,583
Queensland	10,542	637,800	4.60	48,506
Western Australia	15,247	328,820	1.37	20,921
South Australia	81,526	238,120	0.19	15,134
Tasmania	6,356	80,269	0.81	5,134
Australian Capital Territory[(a)]	1,818	48,779	1.54	2,791
Northern Territory[(b)]	11,930	39,886	0.20	2,435
Total	**136,505**	**2,031,942**	**1.00**	**136,505**

. . Not applicable due to exclusion of NSW from 2002 data collection.

(a) Excludes 4-year-old and 15-year-old children.

(b) Excludes 15-year-old children.

Deciduous teeth

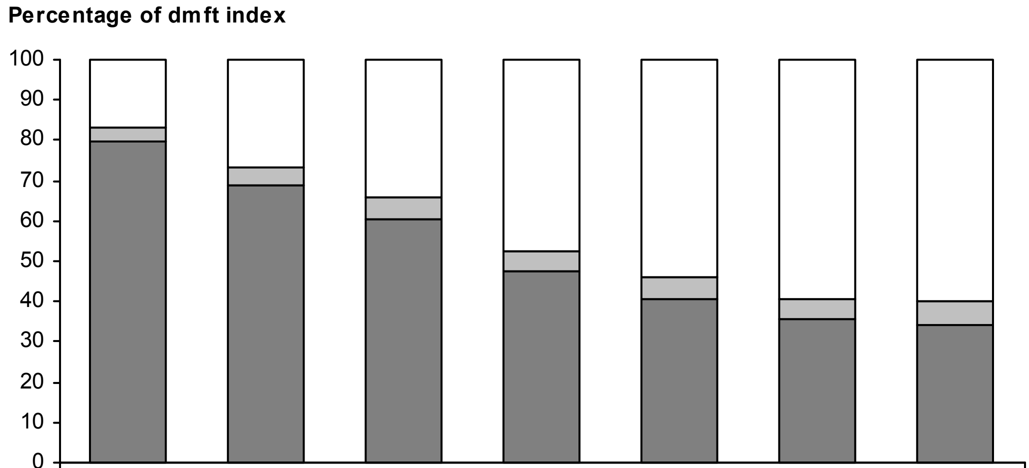
Decay experience in the deciduous teeth is expressed as the average number of decayed, missing (due to decay) and filled teeth. The averages and standard deviations for each of these components for the ages 4–10 years are given in Table 3. There was a steady decline in the presence of clinically detectable decay with increasing age, from 1.31 teeth per child among 4-year-olds to 0.55 teeth per child among 10-year-olds. A different pattern was shown by the average number of filled teeth, increasing from 0.28 teeth per child at age 4 to 1.25 teeth per child at age 8, before declining to 0.96 teeth per child at age 10. Across all age groups, the number of teeth per child that were missing due to decay was small, with averages ranging from 0.03 to 0.13 teeth per child. The average number of decayed, missing (due to decay) and filled teeth (dmft) increased from 1.64 per child at age 4 to 2.32 per child at age 8 before declining to 1.60 teeth per child for 10-year-olds.

Patterns in deciduous decay experience must be interpreted in light of the exfoliation or shedding of deciduous teeth with age. Table 3 shows the steady decline in the average number of deciduous teeth present as children increase in age. From age 5, children shed on average two to three deciduous teeth per year, reducing the total number from an average of 19.8 teeth per child at age 4 to 7.9 teeth per child at age 10.

The decayed, missing and filled components as a percentage of dmft are shown in Figure 2. These ratios refer to the proportion of teeth with caries experience in the population, having either decay, being missing due to decay, or filled. In the youngest age groups decay experience is composed principally of clinically detectable untreated decay. However, with the accumulation of restorations placed over time, the majority of the dmft index from the age of 8 years is represented by the presence of fillings. Relative stability in the percentages of decayed, missing and filled teeth occurs at the age of 9 and 10 years.

Table 3: Deciduous teeth—decayed, missing and filled teeth, 2002

Age (years)	Children	Teeth present	Decayed (d)		Missing (m)		Filled (f)		dmft	
	n	Average	Average	SD	Average	SD	Average	SD	Average	SD
4	6,513	19.8	1.31	2.48	0.05	0.41	0.28	1.08	1.64	2.79
5	10,904	19.4	1.26	2.33	0.08	0.62	0.49	1.46	1.83	3.05
6	9,370	17.3	1.18	2.15	0.10	0.66	0.67	1.54	1.96	3.01
7	12,468	14.3	1.05	1.86	0.13	0.74	1.05	1.89	2.22	2.98
8	12,579	12.2	0.94	1.61	0.13	0.66	1.25	1.96	2.32	2.87
9	12,714	10.6	0.71	1.27	0.10	0.57	1.18	1.81	1.98	2.49
10	13,103	7.9	0.55	1.12	0.09	0.71	0.96	1.65	1.60	2.35

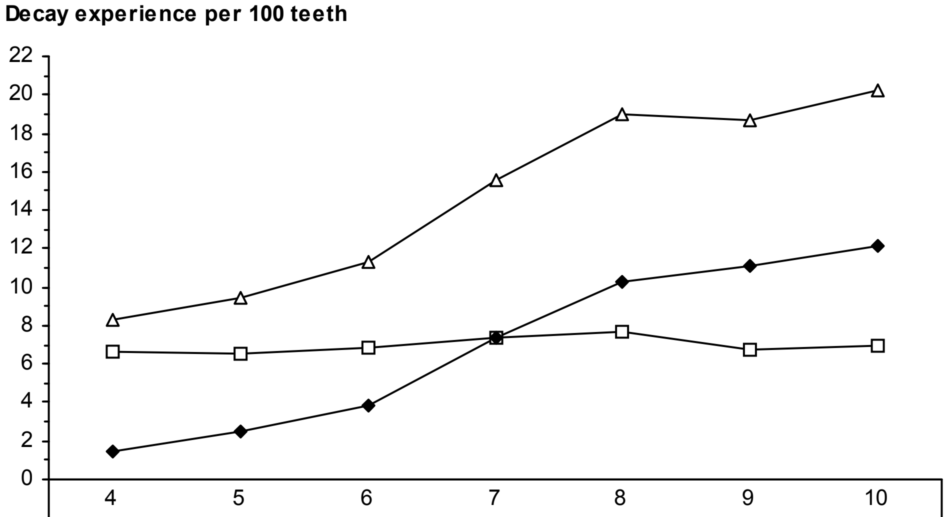


Age (years)	4	5	6	7	8	9	10
Filled	17.1	26.8	34.2	47.3	53.9	59.6	60.0
Missing	3.1	4.4	5.6	5.4	5.6	4.6	5.6
Decayed	79.9	68.9	60.2	47.3	40.5	35.9	34.4

Figure 2: Decayed, missing and filled deciduous teeth as a percentage of dmft index by age, 2002

Decay experience, expressed in terms of decay, fillings and the average dmft index, and after controlling for the number of deciduous teeth present, is shown in Figure 3. Although the average number of decayed teeth was shown to decrease consistently across age groups, the data indicate that this is principally a consequence of the shedding of deciduous teeth. Indeed, the rate of decayed teeth in 2002 remained relatively stable between the ages of 4 and 10 years, ranging from 6.49 per 100 teeth at age 5 to 7.70 per 100 teeth at age 8. The percentage of deciduous teeth with fillings increased with age and together these decay experience indicators combine to produce an increase in the dmft per 100 teeth across age groups. The percentage of deciduous teeth that were decayed, missing and filled increased from 8.3% at age 4 to 20.3% at age 10.

The percentage of children with deciduous decay experience (dmft >0) steadily increased across the age range 4–8 years, from 41.0% to 58.0%; however, this percentage subsequently decreased, and at 10 years of age only 48.0% of children showed evidence at their examination of decay experience in the deciduous teeth (see Figure 4). This decline is due to the shedding of deciduous teeth, leading to an increasing percentage of children with no deciduous teeth and therefore no deciduous decay experience. The mean d/dmft index was highest among younger children (for example, 80.5% at age 4), and declined to 37.8% for children aged 10 years, reflecting the changing distribution of decayed and filled teeth with age.



	4	5	6	7	8	9	10
dmf/100 teeth	8.28	9.43	11.33	15.52	19.02	18.68	20.25
d/100 teeth	6.62	6.49	6.82	7.34	7.70	6.70	6.96
f/100 teeth	1.41	2.53	3.87	7.34	10.25	11.13	12.15

Age (years)

Figure 3: Tooth-level deciduous decay experience per 100 deciduous teeth by age, 2002

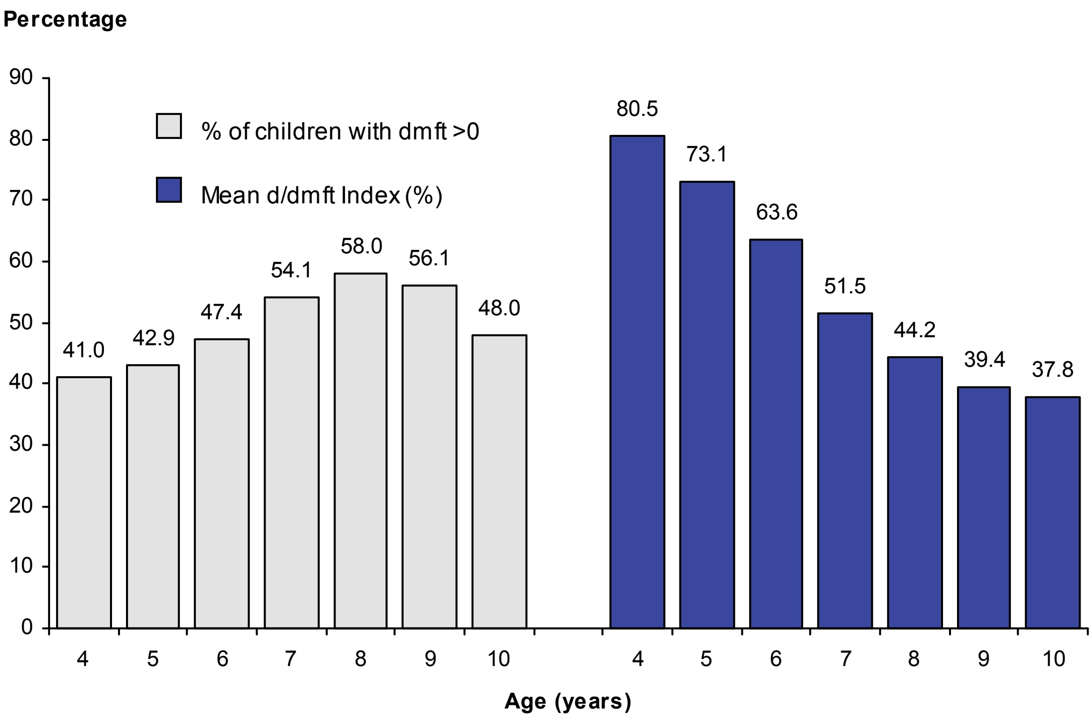


Figure 4: Deciduous teeth—per cent of children with dmft >0 and d/dmft per cent, 2002

While most Australian children had relatively low deciduous decay experience, there was a minority of children who experienced a considerable decay burden. The distribution of deciduous decay experience by age is shown in Figure 5. Between 42.0% (8-year-olds) and 59.0% (4-year-olds) of children between the ages of 4 and 10 years had no deciduous decay experience. Between 9.2% and 12.9% of children in these age groups had a dmft index of 1, with these percentages increasing slightly across older ages (Figure 5). The percentage of any age group with between 2 and 4 decayed, missing and filled teeth varied between 18% and 26%, while less than 7% of children in any age group had 5 decayed, missing and filled teeth. Children with 6 or more decayed, missing and filled teeth comprised between 8.0% (10-year-olds) and 16.2% (8-year-olds) of children in any age group.

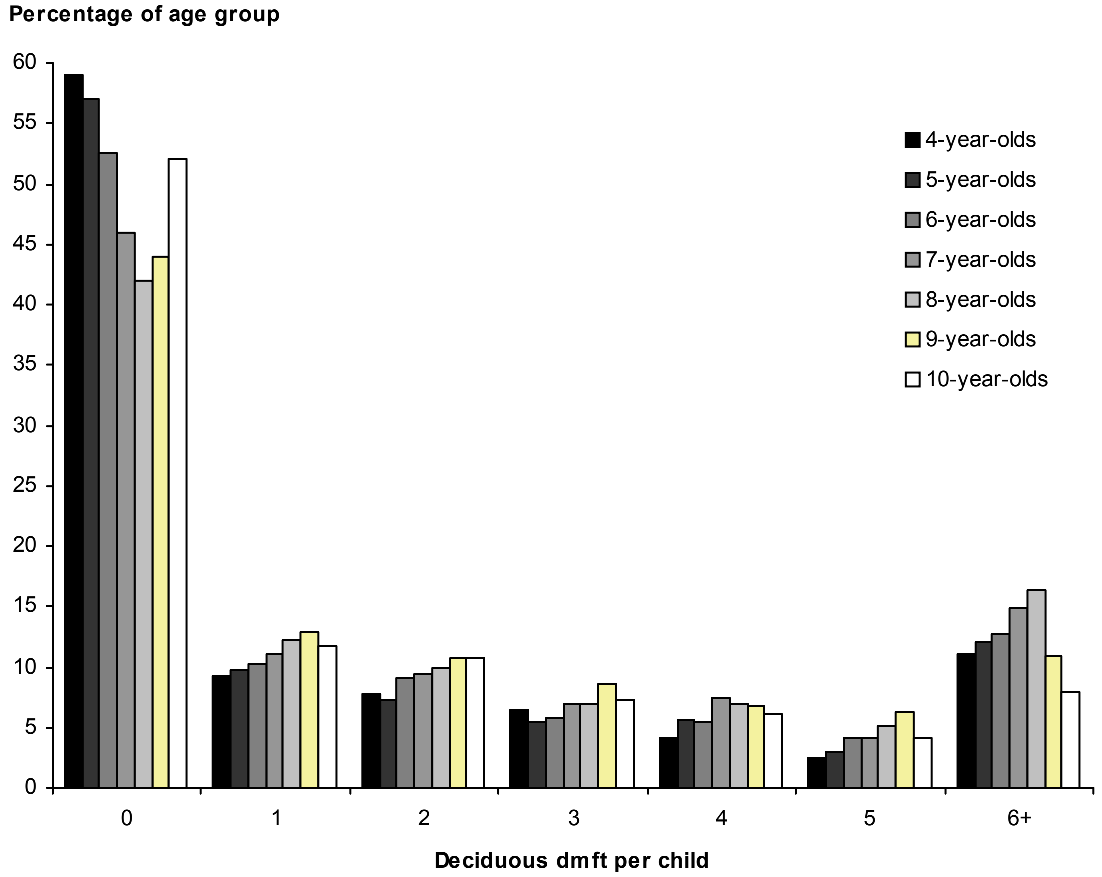
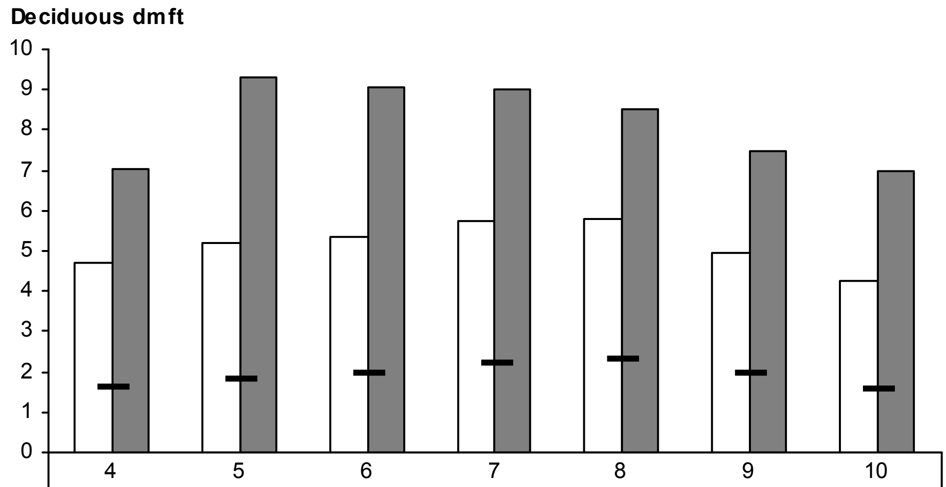


Figure 5: Distribution of deciduous dmft index by age group, 2002

The SiC and SiC^{10} for the deciduous teeth of 4–10-year-olds are shown in Figure 6. For the 30% of children with the most decay experience, the average dmft per child was considerably higher than the average for the entire age group, and ranged between 2.68 and 3.53 dmft per child. The disproportionate burden of disease experienced by a few is dramatically demonstrated for children with the highest 10% of dmft values, where the average dmft was between 3.7-times greater (for 8-year-olds) and more than 5-times greater (for 5-year-olds) than corresponding averages for the entire age group.

The patterns in deciduous decay experience suggest that children enter their school years with moderate decay experience in the deciduous teeth—a large proportion of it manifested as untreated decay (approximately 80% at 4 years of age). With continued treatment in the school dental services, the dmft index becomes dominated by fillings, rather than untreated decay. Despite steady increases in average dmft and the accumulation of fillings across the ages 4–10 years, the shedding of teeth results in a reduction in dmft per child. There is a corresponding increase in the proportion of children having no detectable deciduous decay experience. The majority of decay experience is represented in a minority of children.



	4	5	6	7	8	9	10
SiC	4.70	5.21	5.33	5.75	5.78	4.97	4.28
SiC 10	7.04	9.30	9.08	9.03	8.52	7.46	6.99
National average	1.64	1.83	1.96	2.22	2.32	1.98	1.60

Age (years)

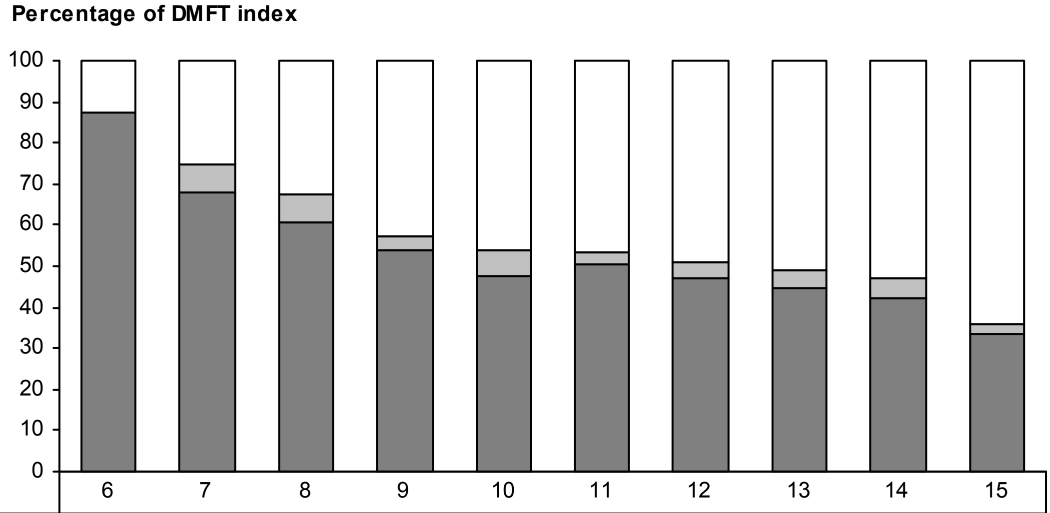
Figure 6: Significant Caries Indices (SiC and SiC^{10}) and average deciduous dmft index of 4–10-year-old children, 2002

Permanent teeth

The average numbers of decayed permanent teeth were smaller than the corresponding averages for deciduous teeth across the age range 5–10 years (Table 4). This primarily reflects the low number of permanent teeth present at younger ages and the reduced time-at-risk of those teeth present. The average number of decayed permanent teeth increased consistently across older ages, peaking at 0.73 per child for 14-year-olds. The average number of teeth that were missing due to decay was very low for most ages, but increased slightly to 0.07 teeth per child for 14-year-old children. The pattern with filled teeth was a consistent increase across the age ranges, from 0.01 teeth per child for 5-year-olds to 1.25 teeth per child for 15-year-olds. Average DMFT per child also increased consistently across older ages, from 0.04 per child at age 5 (at which time only 1 permanent tooth on average was present) to 1.95 teeth per child at age 15 (when an average of 27.3 teeth were present). The average DMFT for 12-year-old children was 1.02 per child.

Table 4: Permanent teeth—decayed, missing and filled teeth, 2002

Age (years)	Children	Teeth present	Decayed (D)		Missing (M)		Filled (F)		DMFT	
	n	Average	Average	SD	Average	SD	Average	SD	Average	SD
5	10,904	1.1	0.03	0.25	0.00	0.11	0.01	0.08	0.04	0.31
6	9,370	4.6	0.07	0.33	0.01	0.31	0.01	0.18	0.08	0.50
7	12,468	8.6	0.19	0.61	0.02	0.46	0.07	0.38	0.28	0.88
8	12,579	11.2	0.26	0.68	0.03	0.65	0.14	0.55	0.43	1.13
9	12,714	13.1	0.29	0.77	0.02	0.38	0.23	0.69	0.54	1.15
10	13,103	16.2	0.31	0.81	0.05	0.65	0.30	0.73	0.65	1.35
11	13,462	20.5	0.38	0.98	0.02	0.23	0.35	0.82	0.75	1.39
12	10,176	24.1	0.48	1.13	0.04	0.35	0.50	1.13	1.02	1.73
13	13,064	26.3	0.61	1.26	0.06	0.42	0.70	1.35	1.37	2.01
14	13,363	27.1	0.73	1.65	0.07	0.42	0.91	1.62	1.72	2.62
15	8,787	27.3	0.65	1.53	0.06	0.41	1.25	1.93	1.95	2.58



	6	7	8	9	10	11	12	13	14	15
Filled	12.5	25.0	32.6	42.6	46.2	46.7	49.0	51.1	52.9	64.1
Missing	0.0	7.1	7.0	3.7	6.2	2.7	3.9	4.4	4.7	2.6
Decayed	87.5	67.9	60.5	53.7	47.7	50.7	47.1	44.5	42.4	33.3

Age (years)

Figure 7: Decayed, missing and filled permanent teeth as a percentage of DMFT index by age, 2002

The average number of decayed, missing and filled permanent teeth expressed as percentages of DMFT is shown in Figure 7. The pattern is similar to that shown in the deciduous teeth. In the youngest ages DMFT was primarily represented by the presence of clinically detectable untreated decay. By the age of 10 years, however, less than 50% of the DMFT index was attributable to untreated decayed teeth.

Less than 20% of children aged 5, 6 or 7 years had permanent tooth decay experience (DMFT >0), however by the end of their primary school years 42.2% of 12-year-olds had permanent tooth decay experience (Figure 8). By the age of 15 years, decay prevalence in the permanent teeth was 60.0%.

After controlling for the number of permanent teeth present, an increase in the rate of decay experience could be seen with increasing age, although the trend was not consistent (Figure 9). Between the ages of 8 and 11 years, the rate of decay decreased from 2.33 to 1.86 per 100 permanent teeth present, before increasing to 2.69 for 14-year-olds. From the age of 12 years, the rate began to climb sharply, increasing from 4.3 to 7.2 per 100 permanent teeth present at age 15 years.

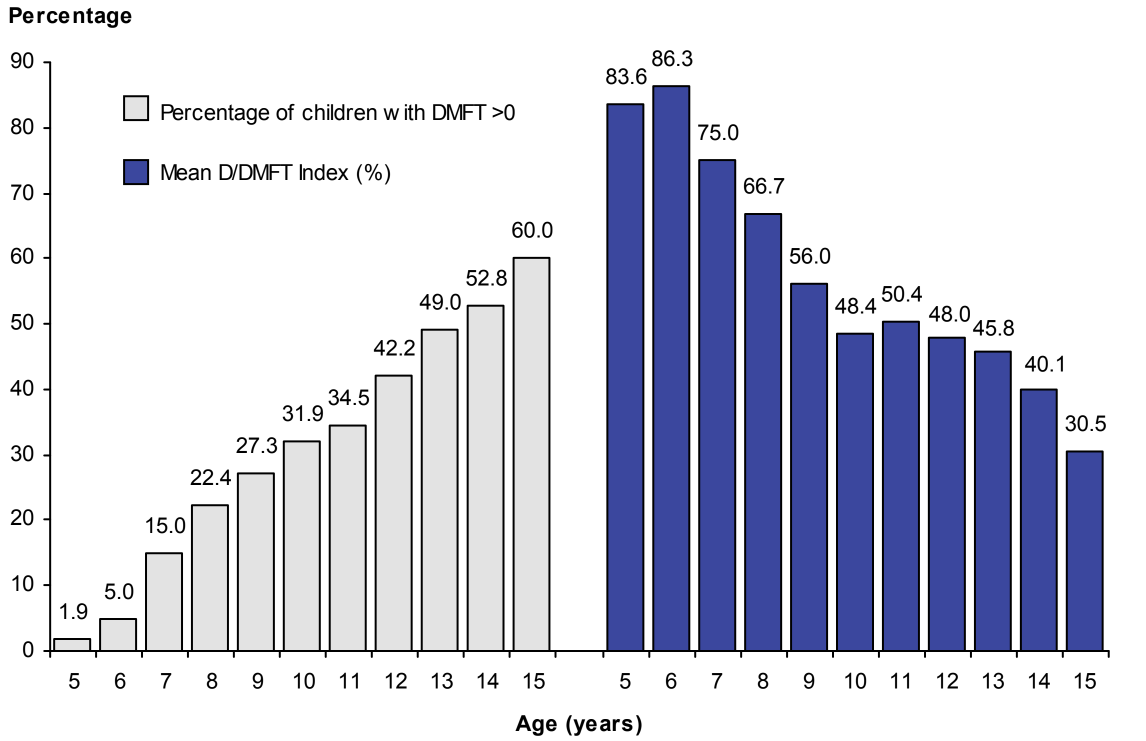
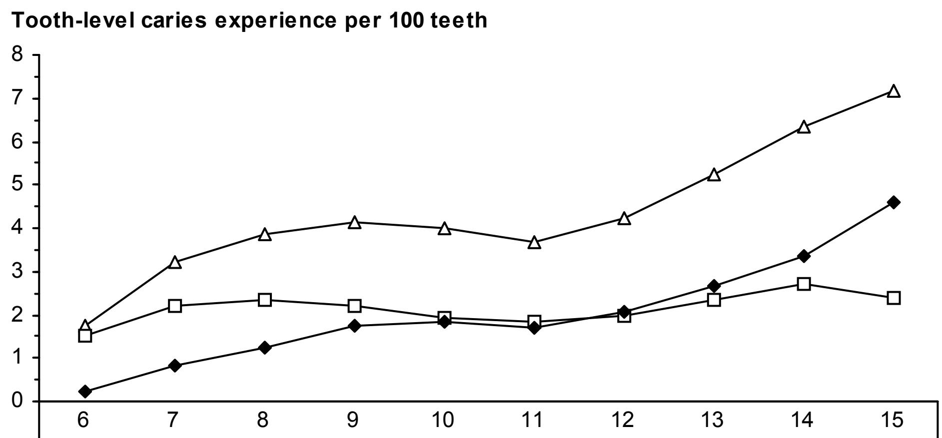


Figure 8: Permanent teeth—per cent of children with DMFT >0 and mean D/DMFT index, 2002



Age (years)	6	7	8	9	10	11	12	13	14	15
DMF/100 teeth	1.74	3.24	3.86	4.12	4.01	3.67	4.25	5.25	6.35	7.15
D/100 teeth	1.53	2.20	2.33	2.21	1.91	1.86	2.00	2.34	2.69	2.38
F/100 teeth	0.22	0.81	1.26	1.76	1.85	1.71	2.08	2.68	3.36	4.58

Figure 9: Tooth-level permanent decay experience per 100 permanent teeth by age, 2002

The distribution of permanent DMFT for children aged between 6 and 15 years is shown in Figure 10. As previously demonstrated in Figure 8, there was a consistent decline across the age range 6–15 years in the percentage of children without decay experience in the permanent teeth, as represented by reductions in the percentage of children with DMFT = 0. However, for the other permanent DMFT scores presented, there were generally consistent increases across older ages. Between the ages of 13 and 15 years, 5.6% to 9.7% of children had 6 or greater DMFT.

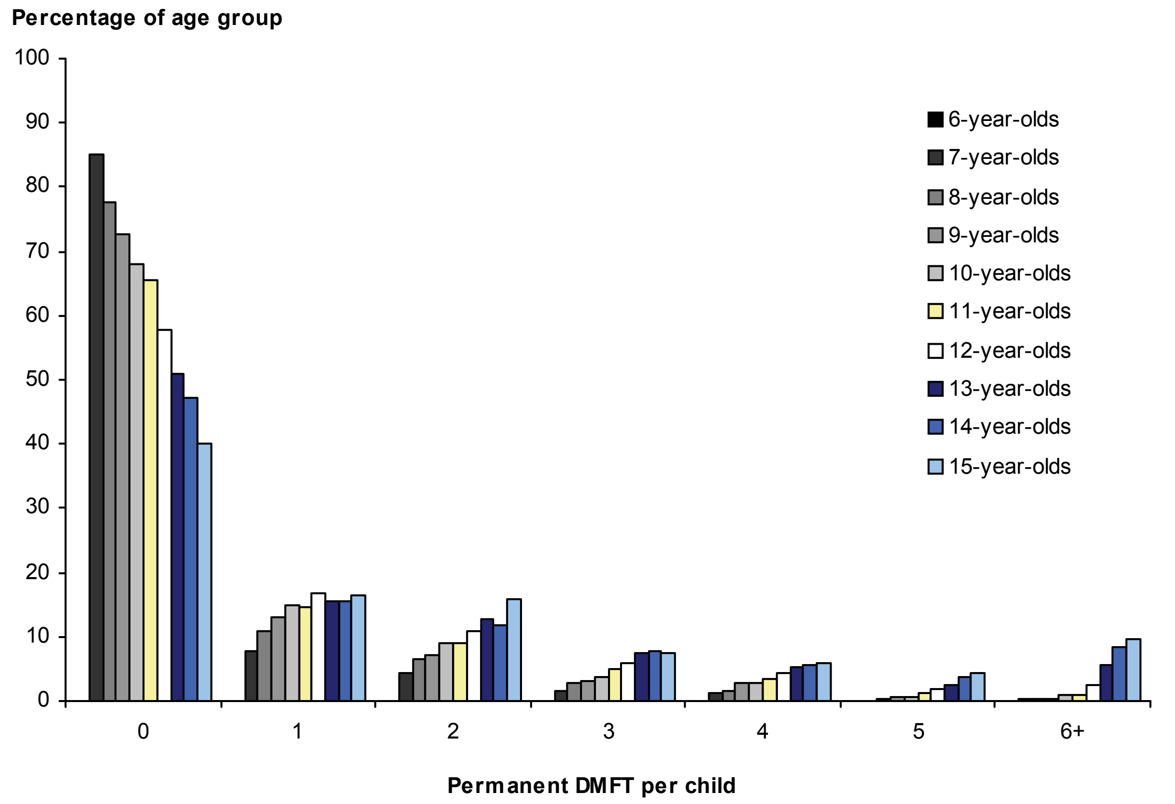
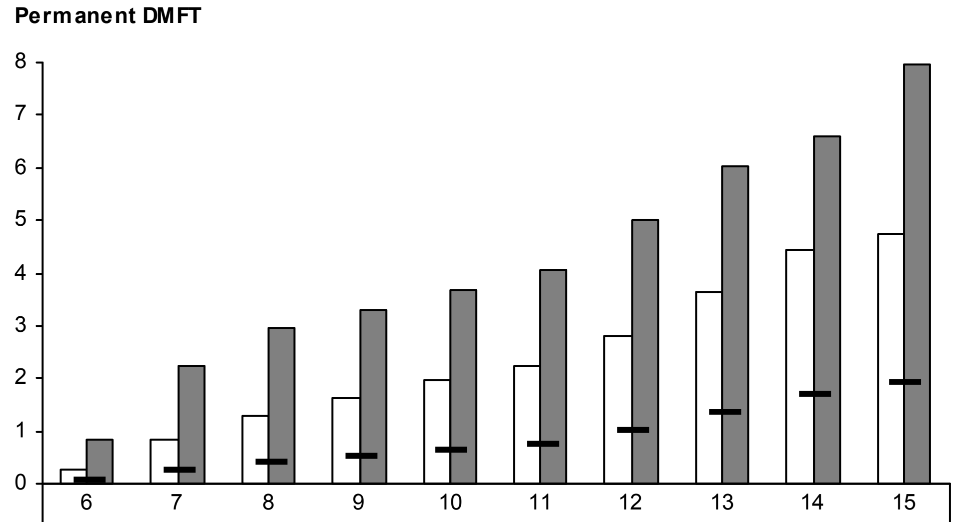


Figure 10: Distribution of permanent DMFT by age group, 2002

The burden of disease in the permanent teeth of children most affected by decay experience is indicated in Figure 11. Although the SiC and SiC[10] were relatively low compared to those in the deciduous teeth, especially in children aged less than 10 years, it should be remembered that permanent DMFT values for all children in these age groups was very low, rising to only 0.65 per child for 10-year-olds. Between the ages of 6 and 10 years, children with the highest 10% of DMFT values (SiC[10]) had average DMFT values that were between 5.6 times and 10.6 times greater than the average for the entire age group. DMFT values for children aged between 11 and 15 years with the highest 10% of DMFT values were some 3.8 times greater (for 14-year-olds) to approximately 5.4 times greater (for 11-year-olds) than the average DMFT for the entire age group. The SiC increased from 0.25 DMFT per child for 6-year-olds to 4.75 DMFT per child for 15-year-olds, and for each age group ranged from approximately 2.5 to 3 times higher than the average national DMFT.



	6	7	8	9	10	11	12	13	14	15
SiC	0.25	0.83	1.30	1.63	1.96	2.23	2.79	3.64	4.45	4.75
SiC 10	0.85	2.25	2.95	3.30	3.66	4.04	4.99	6.03	6.58	7.96
National average	0.08	0.28	0.43	0.54	0.65	0.75	1.02	1.37	1.72	1.95

Age (years)

Figure 11: Significant Caries Indices (SiC and SiC[10]) and average permanent DMFT scores of 6–15-year-old children, 2002

All teeth

Combined components of decay experience from both the deciduous and permanent teeth are shown in Table 5, providing an indication of the total burden of disease among children receiving care within school dental services.

Untreated decay in the combined deciduous and permanent teeth was present for between 28.8% and 45.9% of children in the age range 5–15 years. The highest prevalence of untreated decay was observed among 8-year-olds (where 54.1% had d + D = 0) while the greatest prevalence occurred in the youngest ages (for example, 9.9% of 5-year-olds had 5 or more teeth with clinically detectable untreated decay). Based on observations from previous tables the largest contribution to decay experience among younger children came from deciduous teeth.

Teeth missing due to decay were relatively uncommon among children aged 5–15 years. The percentage of children with no fillings (f + F = 0) and no decay experience (dmft + DMFT = 0) showed a bimodal distribution among age groups, due to shedding of deciduous teeth and the subsequent eruption of the permanent teeth. Among the key age range of 5–12 years, between 36.0% and 56.3% of children in any age group had no decay experience in either their deciduous or permanent teeth.

Table 5: All teeth—age-specific decay experience, 2002

Age (years)	Children	d + D = 0	1	2	3	4	5+	m + M = 0	f + F = 0	dmft+ DMFT = 0
	n	Per cent								
5	10,897	62.4	11.5	7.0	5.2	4.0	9.9	97.4	84.2	56.3
6	9,370	60.2	12.2	9.8	4.9	4.2	8.8	95.5	76.2	51.1
7	12,468	56.5	14.3	11.7	6.1	4.5	7.0	94.1	64.7	42.7
8	12,561	54.1	16.7	12.8	6.1	3.9	6.6	93.0	56.0	36.6
9	12,699	56.3	18.4	12.2	5.5	3.5	4.1	94.4	53.0	36.0
10	13,095	61.3	17.5	9.7	5.1	2.8	3.6	95.0	55.3	39.1
11	13,450	65.0	16.9	9.1	4.7	2.1	2.2	96.9	61.3	45.9
12	10,176	67.3	15.9	8.2	4.2	2.0	2.4	96.8	64.7	46.7
13	13,055	67.0	16.4	8.8	3.1	2.2	2.5	96.8	63.9	46.4
14	13,363	66.7	15.5	8.5	2.4	2.5	4.5	96.0	60.0	44.7
15	8,787	71.2	13.8	5.8	3.8	2.2	3.1	97.4	51.7	39.1

Fissure sealants

The average number of fissure sealants present in permanent teeth increased with increasing age, and for all ages exceeded the average number of decayed permanent teeth for each respective age group (Table 6).

Children aged 7–15 years with permanent decay experience (DMFT ≥1) were between 14.3% (12-year-olds) and 165.7% (7-year-olds) more likely to have a fissure sealant than children with no permanent decay experience (DMFT = 0). This can be interpreted as a tendency towards the preferential provision of fissure sealants to children deemed to have a greater likelihood of developing dental decay.

Table 6: Fissure sealants—age-specific experience, 2002

		Sealants		DMFT = 0		DMFT ≥1	
Age (years)	Weighted number of children	Average	SD	Weighted number of children	Per cent with fissure sealant(s)	Weighted number of children	Per cent with fissure sealant(s)
6	9,369	0.05	0.38	8,896	1.2	476	12.4
7	12,464	0.24	0.85	10,592	7.3	1,872	19.4
8	12,566	0.47	1.16	9,762	15.0	2,805	23.0
9	12,696	0.71	1.36	9,237	23.4	3,459	30.2
10	13,100	0.91	1.47	8,921	28.5	4,179	41.8
11	13,432	0.94	1.50	8,817	31.4	4,615	39.4
12	10,175	0.96	1.64	5,881	32.1	4,294	36.7
13	13,050	1.04	1.77	6,658	29.1	6,392	42.4
14	13,355	1.03	1.80	6,308	27.4	7,047	41.8
15	8,758	0.85	1.71	3,518	19.3	5,241	35.8

Immediate treatment needs

In 2002, immediate treatment need was recorded only in Queensland, South Australia, Tasmania and the Northern Territory. The percentage of children with immediate needs was highest for 4-year-olds (6.4%) and lowest for 15-year-olds (0.9%; Table 7).

Children with immediate treatment needs were found to have greater decay experience in comparison to children judged not in immediate need. Age-specific averages for dmft and DMFT tended to be approximately 1.7–3.0 times higher than the national averages listed in previous tables. For example, 5-year-olds with immediate treatment needs had an average dmft of 5.37 per child compared with 1.83 per child in Table 3. Fifty per cent had d + D ≥ 5 compared with 9.9% in Table 5.

It should be emphasised that the percentage of those deemed to be requiring immediate treatment reflects both the accumulated amount of dental disease and the methods of targeting and delivering school dental services. For example, clinics which provide care for a relatively small proportion of a population and which assign priority to treating those with symptoms will almost certainly record higher percentages of immediate treatment need than other clinics which have universal coverage of all children on a constant recall basis.

Perhaps the most important interpretation of Table 7 is that a subgroup of children with a substantial burden of dental decay could be identified within school dental services. Their state of poor dental health contrasts with the previous observation that between approximately 36% and 57% of 5–14-year-olds have no history of decay experience (Table 5).

Table 7: Immediate treatment needs—age-specific distribution, 2002

Age (years)	All children	Children in need of immediate treatment						d + D =				
				dmft		DMFT		1	2	3	4	5+
	n	*n*	Per cent	Average	SD	Average	SD	Per cent				
4	3,433	219	6.4	4.00	3.61	. .	. .	23.0	0.5	44.5	0.3	24.8
5	3,489	147	4.2	5.37	3.67	0.15	0.63	20.8	6.3	9.5	6.8	50.0
6	1,859	69	3.7	5.73	4.29	0.28	0.78	19.0	11.4	9.7	6.9	44.2
7	4,654	156	3.3	5.41	3.21	0.78	1.11	23.5	17.1	10.2	12.0	29.8
8	4,691	148	3.2	4.29	2.79	0.36	0.88	21.0	18.9	7.8	5.6	28.6
9	4,806	216	4.5	3.66	3.17	1.01	1.49	28.2	14.2	8.0	8.4	15.1
10	5,111	164	3.2	3.95	4.90	1.80	1.90	17.2	24.8	11.0	6.0	24.2
11	5,375	156	2.9	1.86	3.46	2.09	1.76	31.4	18.9	10.5	9.3	15.0
12	2,152	67	3.1	1.50	4.35	1.73	1.87	33.4	16.9	4.3	1.6	8.0
13	5,019	102	2.0	. .	. .	4.12	2.48	8.4	27.5	6.7	23.9	6.2
14	5,247	63	1.2	. .	. .	4.69	3.57	10.8	12.1	47.1	0.0	30.0
15	5,046	44	0.9	. .	. .	7.62	7.07	0.0	0.0	0.0	0.0	47.3

. . Not applicable.

Interstate comparison—5- to 6-year-old dmft

Combined 5- and 6-year-olds represent a standard age group (cited, for example, within World Health Organization publications); this group is, moreover, a useful one to consider in relation to school dental services since it represents, predominantly, the dental health status of children new to these services.

As shown in Table 8, Western Australia had the lowest (average dmft = 1.58 per child) and the Northern Territory had the highest levels of deciduous decay experience (average dmft = 2.30 per child). The level of untreated decay was lowest in South Australia (average d = 0.89 per child) and highest in the Northern Territory (average d = 1.69 per child). The number of fillings also varied appreciably and was approximately twice as high in Queensland and the Australian Capital Territory (averages = 0.78 and 0.86 per child, respectively) than in Victoria (average = 0.40). In assessing these differences it should be noted that there are historical differences in decay experience, as well as marked variations in population density, demography and levels of water fluoridation between these jurisdictions. There are also differences in the organisation and delivery of school dental services between different states and territories.

Variation can also be seen in the percentage of dmft attributable to untreated decay, ranging from a low of 58.0% in the Australian Capital Territory to 77.0% in Victoria (Figure 12). The variation in the percentage of children with no decay experience (dmft = 0), showed less variation than that for average dmft, ranging from 45.9% in the Northern Territory to just under 57% in Victoria, Tasmania, South Australia and Western Australia.

Table 8: Interstate comparison—5- to 6-year-old dmft, 2002

State/ territory	Children *n*	Decayed (d)		Missing (m)		Filled (f)		dmft	
		Average	SD	Average	SD	Average	SD	Average	SD
NSW	. .	. .	. .	. .	. .	. .	. .	. .	. .
Vic	8,125	1.35	2.38	0.10	0.60	0.40	1.26	1.85	3.02
Qld	4,943	1.38	2.40	0.12	0.83	0.78	1.79	2.28	3.40
WA	3,132	0.95	1.93	0.04	0.40	0.59	1.43	1.58	2.65
SA	2,378	0.89	1.81	0.08	0.58	0.66	1.55	1.62	2.68
Tas	760	1.02	2.03	0.08	0.74	0.65	1.57	1.76	2.87
ACT	525	0.98	1.76	0.00	0.00	0.86	1.78	1.84	2.69
NT	412	1.69	2.74	0.09	0.56	0.52	1.35	2.30	3.22
Australia	**20,274**	**1.22**	**2.25**	**0.09**	**0.64**	**0.58**	**1.50**	**1.89**	**3.03**

. . Not applicable due to exclusion of NSW from 2002 data collection.

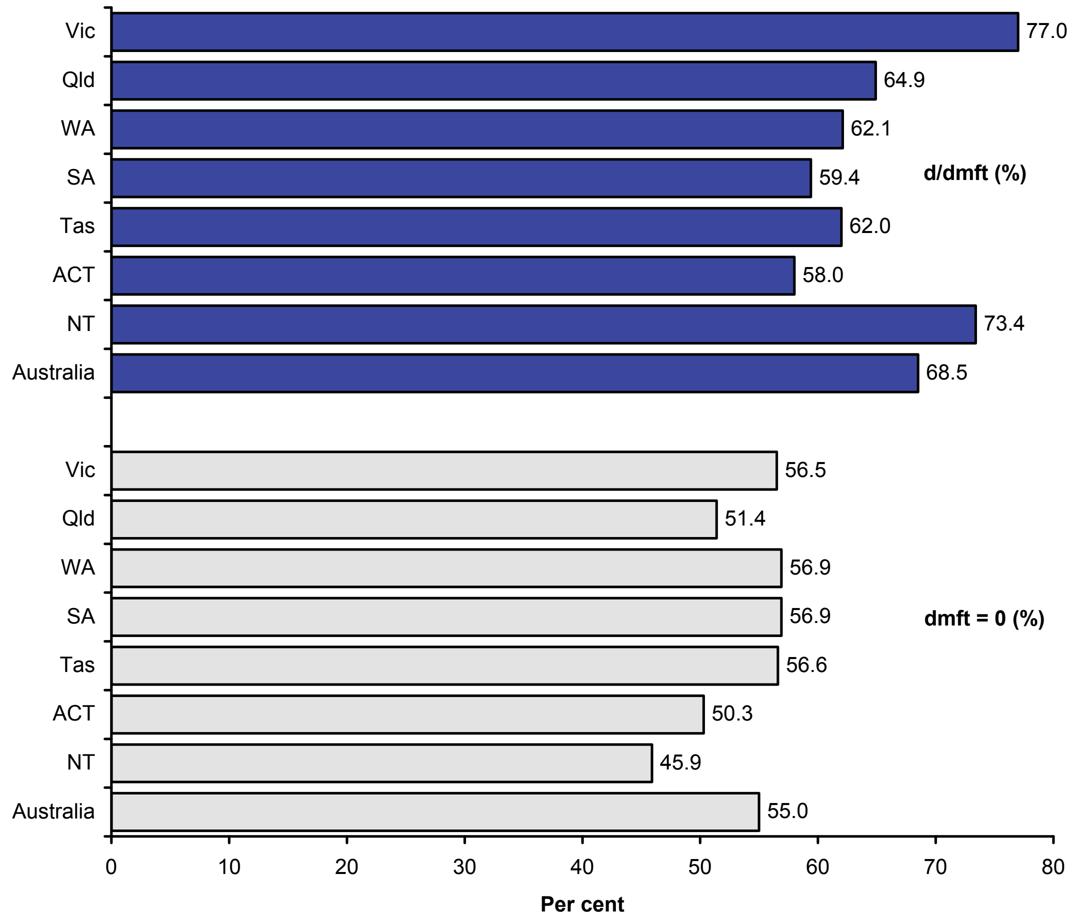


Figure 12: Interstate comparison—5- to 6-year-old d/dmft and per cent of children with dmft = 0, 2002

Interstate comparison—12-year-old DMFT

Variation could be seen in the average 12-year-old DMFT among states and territories (Table 9). The highest average values (1.26 per child in Queensland and 1.27 per child in the Australian Capital Territory) were about one and a half times that of the lowest DMFT value (0.84 per child in South Australia and the Northern Territory). In the case of permanent teeth, there was again quite a strong correspondence between average DMFT and the average number of decayed teeth, but a weaker relationship between DMFT and the average number of filled teeth.

In sharp contrast to the deciduous teeth, the Northern Territory had the highest percentage of children with no decay experience in the permanent teeth, 62.8% of children with DMFT = 0 (Figure 13). The Australian Capital Territory had the lowest percentage of children with DMFT = 0, with only 50.4% of 12-year-olds in that state having no history of decay. It should be noted, however, that the targeting of school dental services to children in greater perceived need in the ACT biases this estimate and it is less representative of the entire child population in that jurisdiction than in other states or territories. There was also quite large variation in the D/DMFT ratio, ranging from 38.5% in Western Australia to 56.1% in Victoria.

Table 9: Interstate comparison—12-year-old DMFT, 2002

State/ territory	Children *n*	Decayed (D) Average	Decayed (D) SD	Missing (M) Average	Missing (M) SD	Filled (F) Average	Filled (F) SD	DMFT Average	DMFT SD
NSW	. .	. .	. .	. .	. .	. .	. .	. .	. .
Vic	4,188	0.55	1.13	0.03	0.30	0.40	0.91	0.98	1.62
Qld	1,925	0.55	1.25	0.04	0.52	0.67	1.37	1.26	2.04
WA	1,786	0.34	0.96	0.05	0.33	0.52	1.20	0.92	1.63
SA	1,315	0.31	0.83	0.01	0.19	0.52	1.10	0.84	1.47
Tas	445	0.63	1.30	0.04	0.33	0.54	1.06	1.21	1.79
ACT	289	0.61	1.81	0.02	0.28	0.64	1.73	1.27	2.56
NT	228	0.45	1.12	0.05	0.39	0.34	0.78	0.84	1.49
Australia	**10,176**	**0.48**	**1.13**	**0.04**	**0.35**	**0.50**	**1.13**	**1.02**	**1.73**

. . Not applicable due to exclusion of NSW from 2002 data collection.

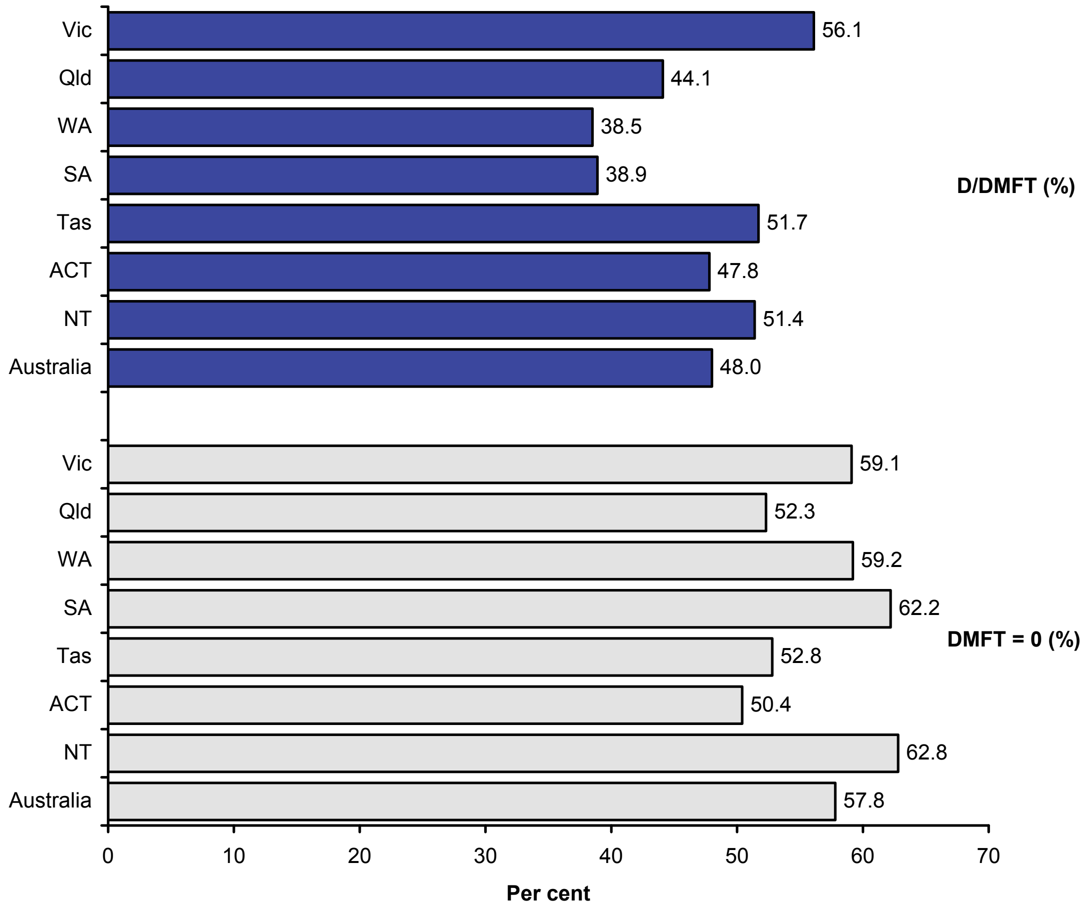


Figure 13: Interstate comparison—12-year-old D/DMFT and per cent of children with DMFT = 0, 2002

Interstate comparison—all teeth

Further areas of interstate variation in decay experience are illustrated in Table 10. For example, there are appreciable differences in the percentage of children with 5 or more decayed teeth ($d + D \geq 5$). Victoria and Queensland have the highest levels of clinically detectable untreated decay (d + D), whereas South Australia, the Australian Capital Territory and Western Australia have the lowest levels. The percentage of children with no decay experience (dmft + DMFT = 0) was highest in Western Australia and South Australia (47.9% and 47.6% respectively). Consistent with Tables 8 and 9, the lowest percentages of children with no decay experience were found in Queensland (40.5%) and the Australian Capital Territory (40.7%).

Table 10: Interstate comparison—all teeth age-standardised decay experience, 2002

State/ territory	Children	Children with d + D =						m + M = 0	f + F = 0	dmft+ DMFT = 0
		0	1	2	3	4	5+			
	n	Per cent								
NSW	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .
Vic	33,317	56.2	15.4	11.1	5.7	4.3	7.3	93.4	68.8	44.3
Qld	30,407	58.9	15.8	11.0	5.8	3.2	5.2	95.6	57.9	40.5
WA	13,684	67.9	15.4	7.8	3.8	2.1	3.0	97.0	63.9	47.9
SA	9,984	67.1	15.2	8.4	4.1	2.3	2.9	97.2	62.8	47.6
Tas	3,378	61.0	15.7	9.2	5.5	3.3	5.3	96.6	63.3	43.2
ACT	2,226	62.6	17.7	9.3	4.8	2.6	2.9	99.2	58.6	40.7
NT	1,727	56.9	15.9	9.2	5.7	3.7	8.7	96.2	70.3	42.0
Australia	**94,723**	**60.2**	**15.6**	**10.2**	**5.3**	**3.3**	**5.4**	**95.3**	**63.6**	**43.8**

. . Not applicable due to exclusion of NSW from 2002 data collection.

National summary

Age-standardised data were used to summarise data from all children aged between 5 and 12 years in all jurisdictions (Table 11). Queensland had the highest levels of decay experience for deciduous teeth (average dmft = 1.97 per child and 51.1% of children had dmft = 0), while children in Western Australia had the least decay experience (average dmft = 1.27 per child and 59.1% of children had dmft = 0). The highest levels of permanent decay experience were found in Tasmania (average DMFT = 0.60 per child and 73.6% of children had DMFT = 0) while the lowest levels were seen in South Australia (average DMFT = 0.40 per child and 79.7% of children had DMFT = 0).

Table 11: National summary of decay experience of 5- to 12-year-old children, 2002

State/ territory	Children in sample	dmft		dmft = 0	DMFT		DMFT = 0	d + D = 0
	n	Average	SD	Per cent	Average	SD	Per cent	
NSW	. .	. .	. .	. .	. .	. .	. .	. .
Vic	33,317	1.70	2.64	54.3	0.47	1.11	77.5	56.2
Qld	30,460	1.97	2.87	51.1	0.55	1.36	75.1	58.9
WA	13,684	1.27	2.14	59.1	0.43	1.08	78.5	67.9
SA	9,984	1.40	2.26	57.4	0.40	0.98	79.7	67.1
Tas	3,379	1.52	2.43	56.9	0.60	1.30	73.6	61.0
ACT	2,226	1.46	2.23	54.3	0.53	1.28	72.9	62.6
NT	1,727	1.66	2.58	53.0	0.41	1.03	79.5	56.9
Australia	**94,777**	**1.68**	**2.61**	**54.4**	**0.49**	**1.19**	**76.9**	**60.2**

. . Not applicable due to exclusion of NSW from 2002 data collection.

Water fluoridation and children's dental health

Water fluoridation is the process of adjusting the level of fluoride in drinking water to achieve a concentration of approximately 1 ppm. That concentration is effective in preventing decay but it does not cause appreciable levels of dental fluorosis, a discolouration of the enamel that, in severe cases, creates a chalky appearance on the tooth surface. Fluoride reduces dental decay by making teeth less susceptible to the acids formed by micro-organisms living on and around the teeth. Fluoride can also assist in reversing the process of decay once it has commenced. While some small communities in Australia have drinking water that contains naturally-occurring fluoride in a concentration of around 1 ppm, that concentration is achieved by water fluoridation in most larger communities and cities. The term 'water fluoridation' therefore is used in this publication to refer to all water supplies that contain around 1ppm fluoride, whether it occurs naturally, or is added in water engineering plants.

Water fluoridation commenced in Australia in 1953, in Beaconsfield Tasmania. The first capital cities to introduce water fluoridation were Hobart and Canberra in 1964, followed by Perth and Sydney in 1968, Adelaide in 1971, Darwin in 1972 and Melbourne in 1977 (Spencer, Slade & Davies, 1996). In 2002, Brisbane was the only state or territory capital city not to have introduced water fluoridation, although there have been some efforts to implement water fluoridation since then. In 2001, 69.1% of Australians lived in areas where drinking water was fluoridated (Armfield 2006).

Decades of research attests to the effectiveness of water fluoridation in reducing dental decay. Early studies were described as 'ecological' because they compared dental decay levels of people living in places that were not fluoridated with that of people living in places where water was fluoridated. Then, in the mid-20th century, a number of international studies found that the addition of fluoride to drinking reduced children's dental decay.

In Australia, early ecological studies that compared lifetime residents of fluoridated and non-fluoridated areas found similar results (Martin & Barnard 1972). During the 1980s and 1990s, when residential mobility meant that fewer children were lifetime residents of one locality; researchers began to assess individuals' exposure to fluoride in drinking water. Those studies also took into account use of non-reticulated drinking water and they controlled for other characteristics of individuals that were associated with decay, such as use of fluoridated toothpaste and socio-economic status (Slade et al. 1995; Slade et al. 1996). While these studies provide excellent quality evidence on the effectiveness of water fluoridation, they are expensive to conduct and often involve smaller populations than that obtained from ecological studies involving all localities. It has recently been argued that while ecological studies can not provide definitive answers regarding the extent of the effectiveness of water fluoridation, they can paint a general picture of the association (AIHW DSRU 2006).

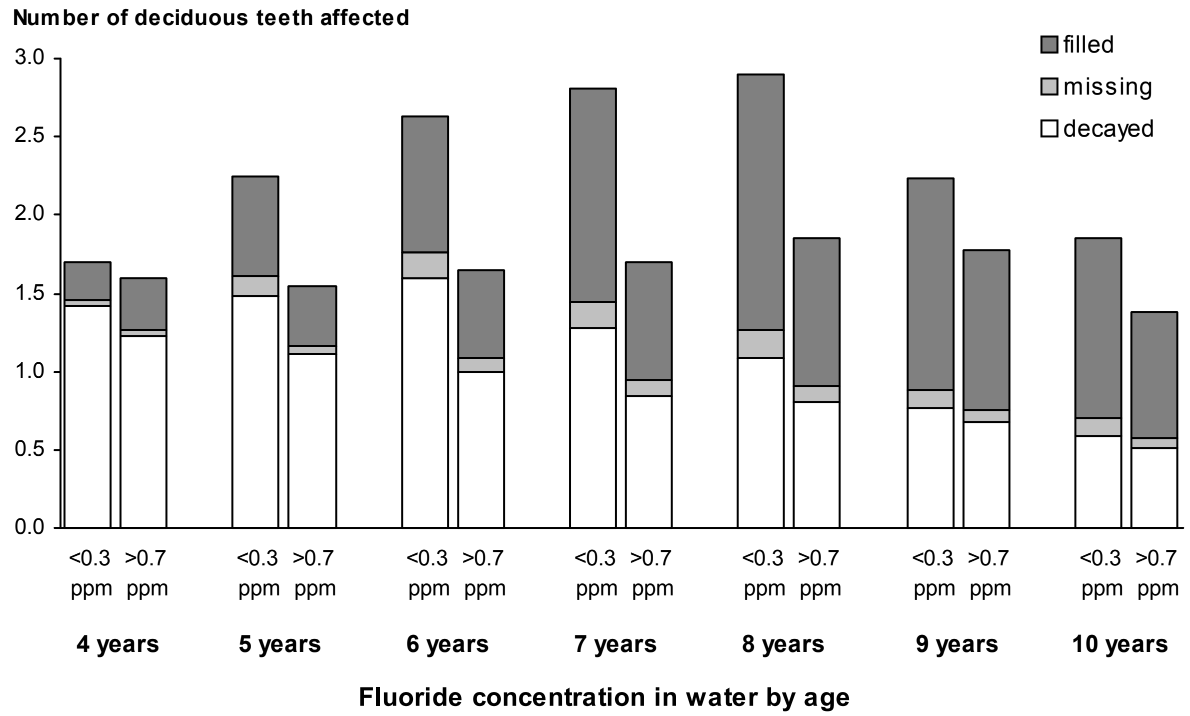


Figure 14: Decayed, missing and filled deciduous teeth by age and fluoride concentration in water, 2002

Figure 14 compares the average dmft of children residing in areas where drinking water contained less than 0.3 ppm fluoride with dmft in areas where drinking water contained 0.7 ppm fluoride or more. Across all age groups, mean dmft was higher for children living in areas with the low concentration of fluoride. Apart from 4-year-olds, the average dmft per child and the average number of missing teeth were all higher for children residing in areas with a lower fluoride concentration than for children residing in areas with a higher fluoride concentration. Relative differences in mean dmft ranged from 7.1% (4-year-olds) to 65.8% (7-year-olds).

A similar pattern can also be seen in the permanent teeth, with higher average DMFT for children in areas with low concentration of fluoride in drinking water compared to areas with a higher concentration of fluoride (Figure 15). Differences ranged between 12.7% (11-year-olds) and 50.6% (12-year-olds).

Non-fluoridated water supplies are more likely in rural and remote areas, and there is evidence that children in these areas are also more likely to have poorer dental health (AIHW DSRU 2006). The observed differences in dental health between varying levels of fluoride in water may therefore be associated with geographic location rather than with water fluoridation status. To address this, Figures 16 and 17 present both dmft and DMFT for differing levels of water fluoridation within metropolitan, rural and remote locations. In the deciduous dentition, irrespective of the residential location, those children from fluoridated areas had less dental decay than children from non-fluoridated areas (Figure 16). A very similar pattern was seen in the permanent dentition with children from areas with more than 0.7 ppm fluoride in the water having less decay experience than children from areas with less than 0.3 ppm, irrespective of whether they resided in metropolitan, rural or remote locations.

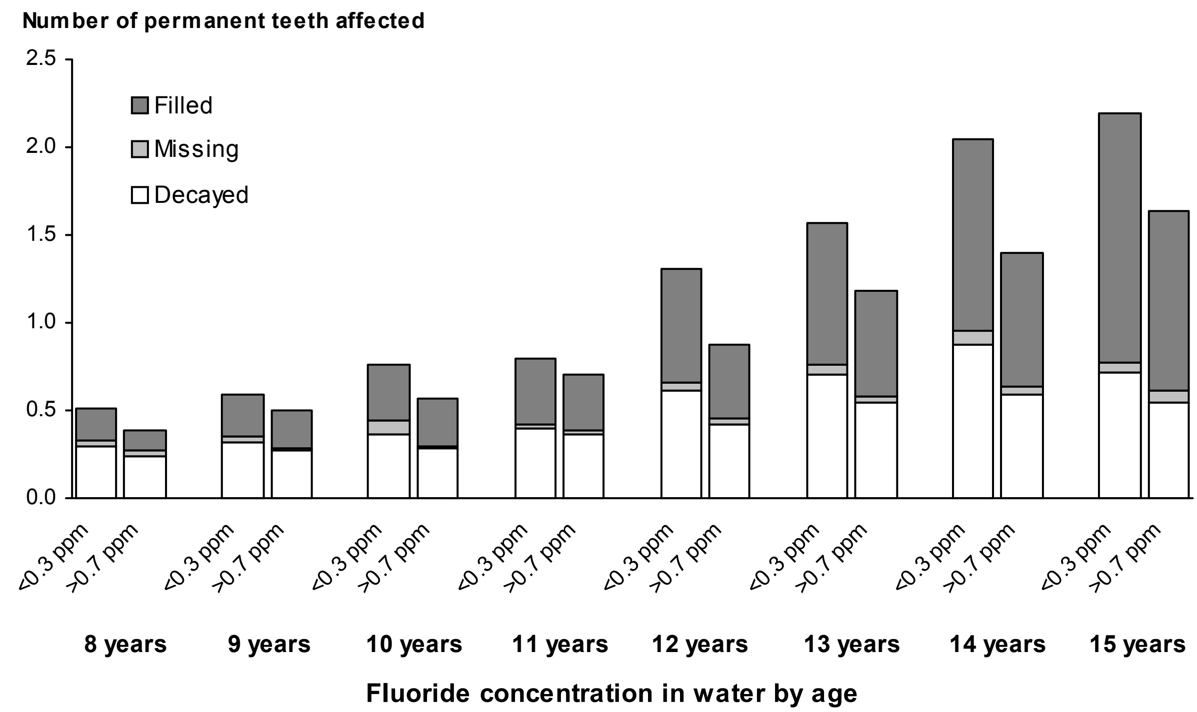


Figure 15: Decayed, missing and filled permanent teeth by age and fluoride concentration in water, 2002

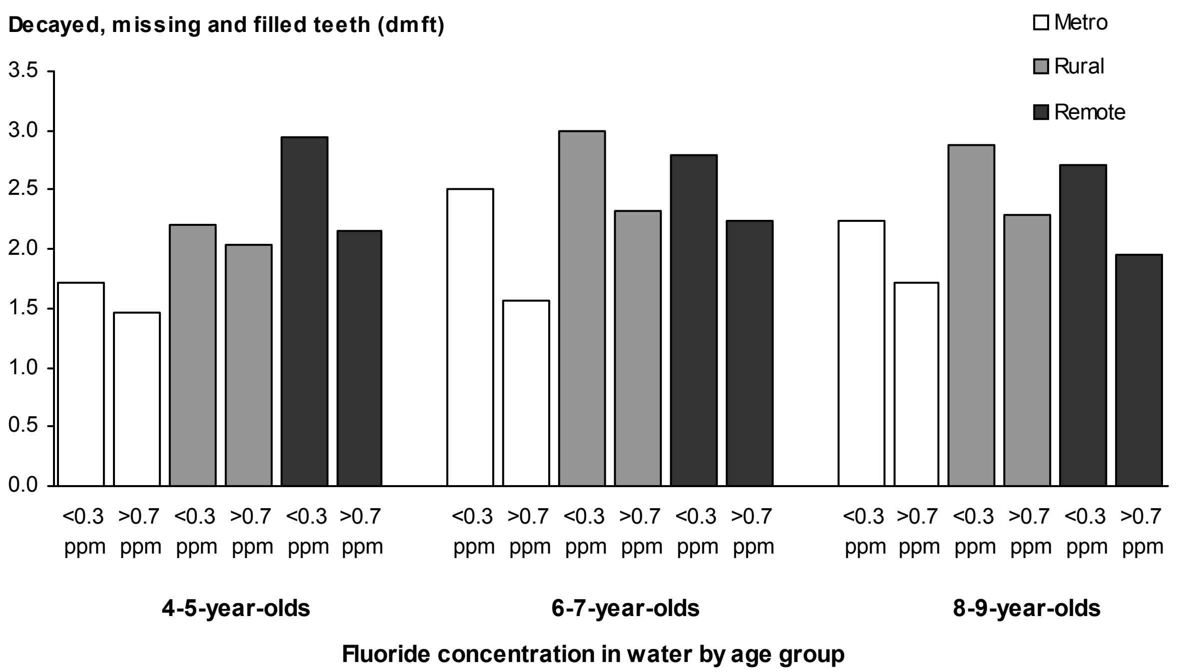


Figure 16: Decayed, missing and filled deciduous teeth by residential location and fluoride concentration in water, 2002

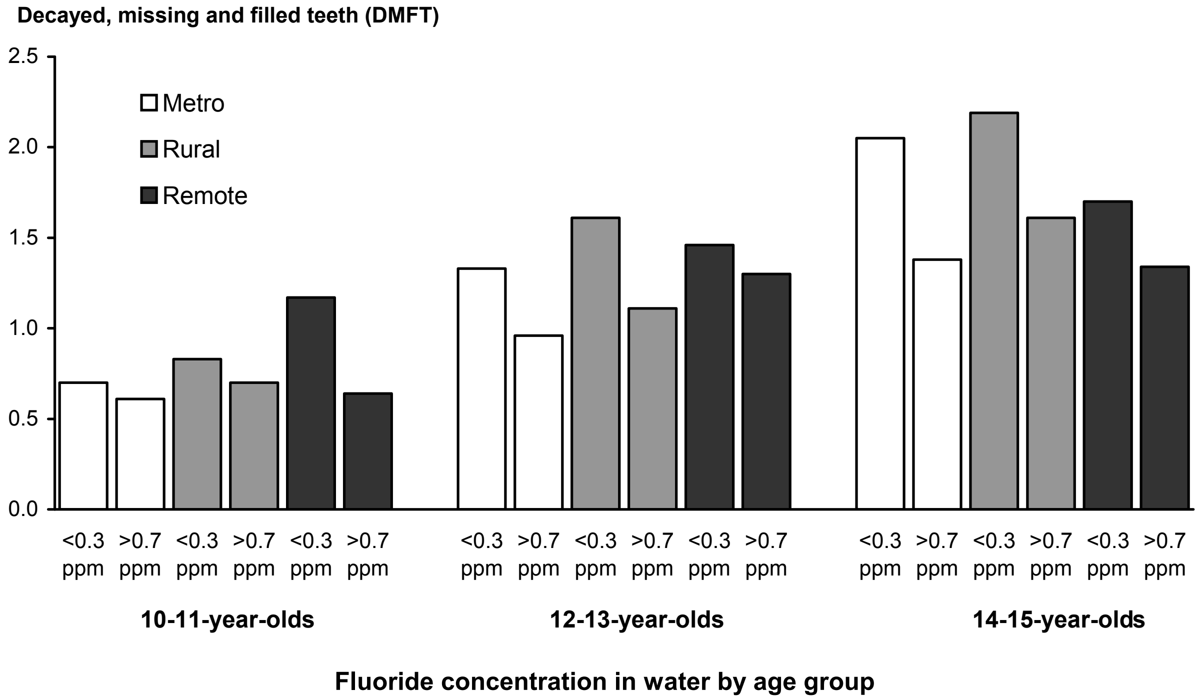
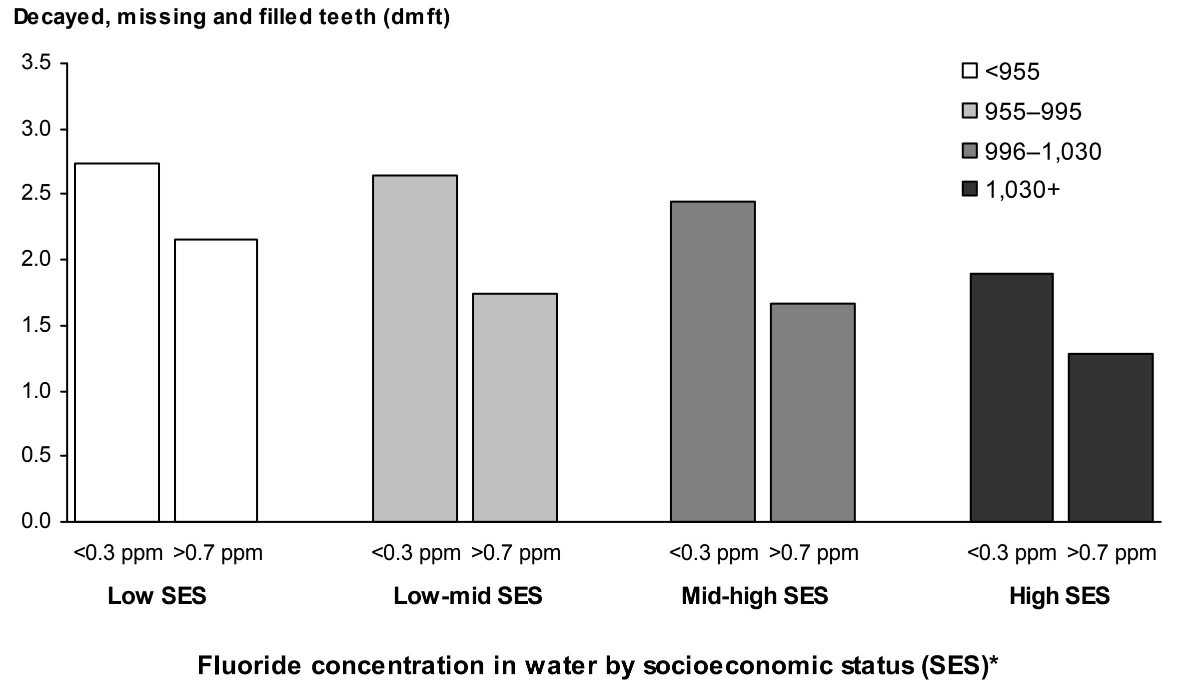


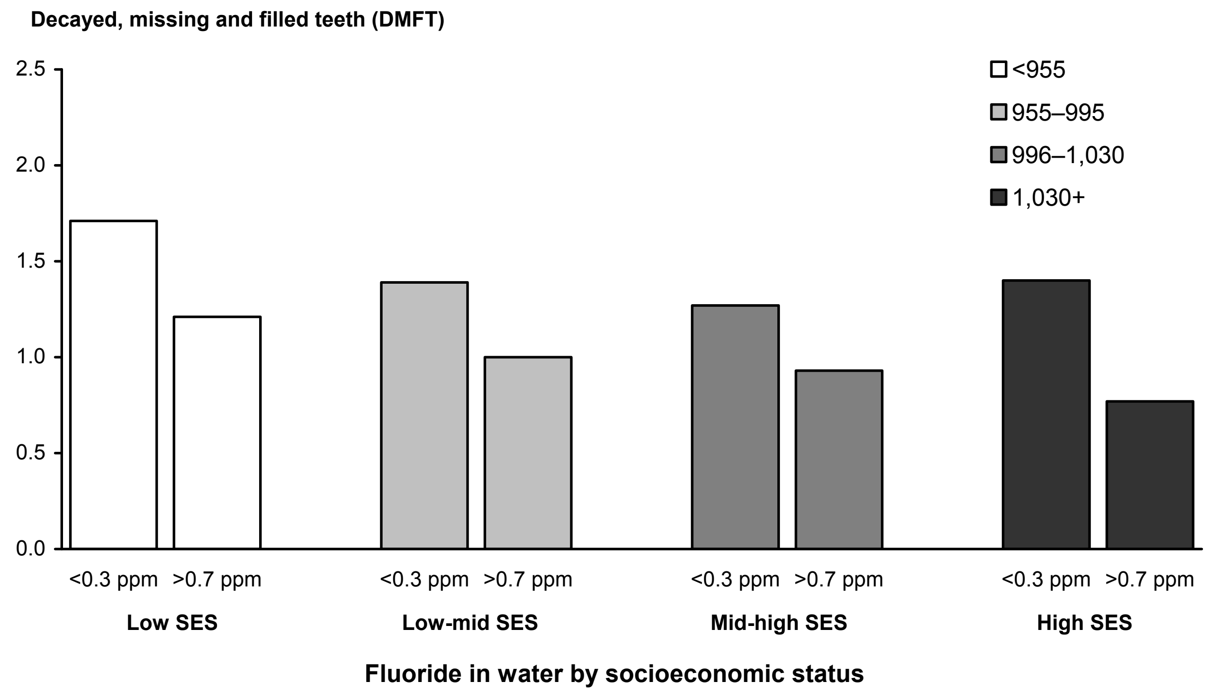
Figure 17: Decayed, missing and filled permanent teeth by residential location and fluoride concentration in water, 2002

It is also possible to examine differences in the relationship between oral health and water fluoridation across different socioeconomic strata. Children from lower socioeconomic backgrounds have previously been found to have poorer oral health (Armfield, Slade & Spencer 2006). Figures 18 and 19 present the average number of decayed, missing and filled teeth for 5–6-year-old children and 11–12-year-old children across water fluoridation categories by socioeconomic status. Lower values of the SEIFA Index of Relative Social Disadvantage represent lower socioeconomic status. In the deciduous dentition of 5–6-year-olds, children from higher fluoride concentration areas had less decay experience than children from low fluoride concentration areas across all socioeconomic categories (Figure 18). Differences ranged from 26.9% for children from the most disadvantaged areas to 51.7% from the second most disadvantaged areas. A similar effect was seen for the permanent teeth of 11–12-year-olds, with children from low fluoride areas having between 36.6% (second least disadvantaged areas) and 81.8% (least disadvantaged areas) more permanent decay experience. These results show large differences in decay experience between areas with varying fluoride concentration across all socioeconomic categories.



* SES = socio-economic status, measured using the SEIFA Index of Relative Socioeconomic Disadvantage; lower scores indicate more disadvantage, or lower SES, higher scores indicate less disadvantage, or higher SES

Figure 18: Decayed, missing and filled deciduous teeth of 5–6-year-old children by SES and fluoride concentration in water, 2002



* SES = socio-economic status, measured using the SEIFA Index of Relative Socioeconomic Disadvantage; lower scores indicate more disadvantage, or lower SES, higher scores indicate less disadvantage, or higher SES

Figure 19: Decayed, missing and filled permanent teeth of 11–12-year-old children by SES and fluoride concentration in water, 2002

Figure 20 compared the average dmft of 5–6-year-old children between areas with lower- and higher-concentrations of fluoride in drinking water for each Australian state and territory. Within each jurisdiction, children from areas with fluoride concentrations at or above 0.7 ppm had fewer dmft per child, on average, than did children residing in areas with relatively low fluoride concentrations. Relative differences ranged from 14.9% (Tasmania) to 61.5% (Victoria). In the Australian Capital Territory there were no areas with <0.3 ppm fluoride in the water. It should be remembered that differences in the distribution of risk factors for decay may vary between fluoridated and non-fluoridated areas, and these might account for at least some of the differences in the apparent effectiveness of water fluoridation seen across the jurisdictions.

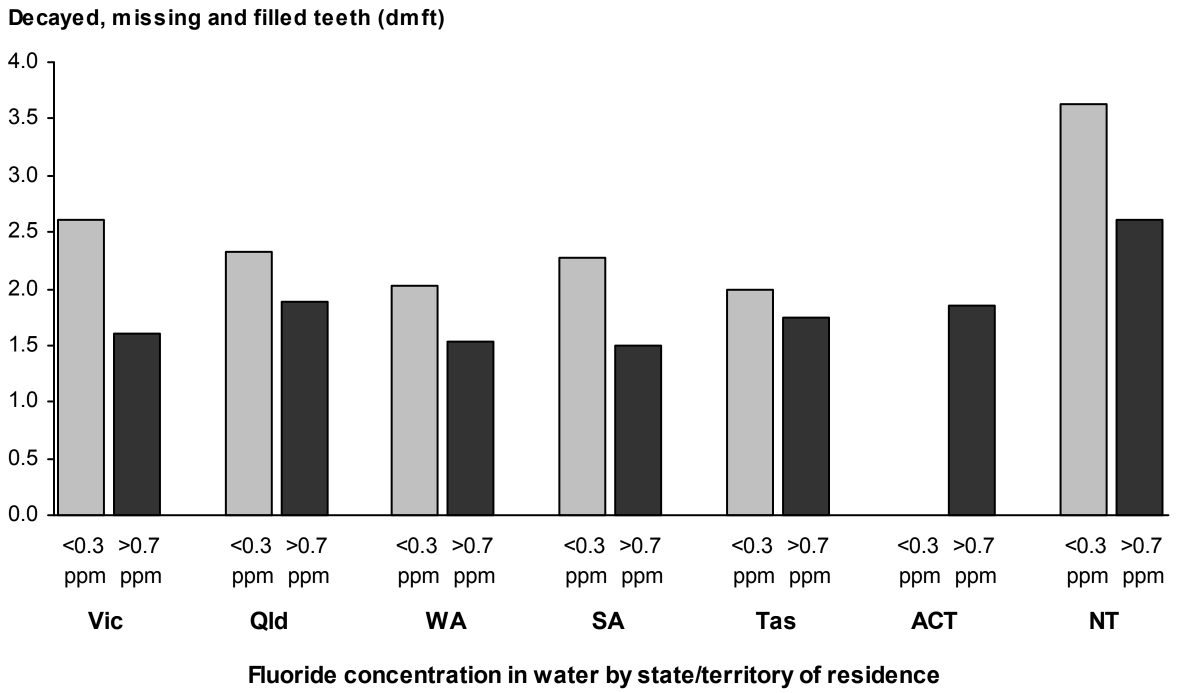


Figure 20: Decayed, missing and filled deciduous teeth of 5–6-year-old children by fluoride concentration in the water and state/territory of residence, 2002

Differences by water fluoride concentration: summary of findings

This analysis investigated the relationship between children's dental decay and fluoride concentration in drinking water among all seven states and territories that contributed data to the Child Dental Health Survey in 2002. The principal findings were:

- Across the age range 5–15 years, children from areas with higher concentrations of fluoride in drinking water had fewer decayed, missing and filled teeth, on average, than children from areas with relatively low concentrations of fluoride in drinking water. Relative differences ranged from 6.9% to 65.3% in the deciduous teeth and from 12.7% to 50.6% in the permanent teeth.

- Children from areas with higher concentrations of fluoride in drinking water had less dental decay than children from areas with low concentration of fluoride in drinking water, irrespective of whether they lived in metropolitan, rural or remote locations.

- Large differences in the average number of decayed, missing and filled teeth were found between areas with differing concentrations of fluoride in drinking water for children from all socioeconomic backgrounds. Water fluoridation was associated with better dental health, regardless of whether children lived in the least or most socioeconomically disadvantaged areas.

- Water fluoridation was associated with lower average levels of decayed, missing and filled teeth for each Australian state and territory were a comparison could be made.

Because this analysis relies on ecological comparisons between children living in different localities, it lacks information about individuals' other risk factors for dental decay that may contribute to some of the observed differences. Yet the findings are consistent with previous Australian studies of individual children that have considered a range of individual risk factors. This analysis extends those findings by confirming a protective benefit of fluoride in drinking water in all seven of the states that participated in the 2002 Child Dental Health Survey.

International comparisons

Children's dental health has improved in most developed countries and many developing countries over the last quarter of a century. A comparison of 12-year-old DMFT scores from 44 countries and 18 of the 30 OECD nations is presented in Table 12. For comparative purposes, only countries with DMFT data within 2 years of that presented for Australia have been included. Of those countries with available data, Australia has the eighth lowest percentage of 12-year-old children with decay experience. It should be noted, though, that both the Netherlands and Switzerland figures are based only on children from a single city, so the international comparative position of Australia would improve if these countries were excluded.

Table 12: DMFT scores and percentage with decay for 12-year-old children by country

Country	Year	DMFT	Per cent affected	Rank
Hong Kong	2002	0.8	37.8	3
Netherlands*[(a)]	2002	0.8	32.0	1
Barbados	2001	0.9	37.0	2
England (incl. Wales)*	2000–01	0.9	37.9	4
Switzerland*[(b)]	2004	0.9	n.a.	. .
Uganda	2002	0.9	40.0	7
Australia*	**2002**	**1.0**	**40.3**	**8**
Austria*	2002	1.0	42.0	10
Bangladesh	2002	1.0	46.4	13
Singapore	2002	1.0	n.a.	. .
Sweden*	2002	1.0	39.0	5
Belgium*	2002	1.1	75.0	24
Ireland*	2002	1.1	46.5	14
Italy*	2004	1.1	43.8	11
Nepal	2000	1.1	41.0	9
Denmark*	2002	1.2	39.6	6
Finland*	2000	1.2	65.0	20
Germany*	2000	1.2	44.7	12
Pakistan	2003	1.4	n.a.	. .
El Salvador	2000	1.4	n.a.	. .
Norway*	2000	1.5	52.0	16
Bahamas	2000	1.6	n.a.	. .
New Zealand*	2004	1.6	54.4	18
Thailand	2002	1.6	57.3	19
Israel	2002	1.7	53.9	17
Iran	2001	1.8	75.0	24
South Africa	1999–02	1.9	51.0	15
Suriname	2002	1.9	n.a.	. .

(continued)

Table 12 (continued): DMFT scores and percentage with decay for 12-year-old children by country

Country	Year	DMFT	Per cent affected	Rank
Mexico*	2001	2.0	n.a.	. .
Greece*	2000	2.2	72.0	23
Grenada	2000	2.2	n.a.	. .
Czech Republic*	2002	2.5	71.0	22
Kuwait	2000	2.6	n.a.	. .
Belarus	2000	2.7	n.a.	. .
Macao	2002	2.7	75.4	26
Brazil	2002–03	2.8	69.0	21
Albania	2000	3.0	n.a.	. .
Lebanon	2000	3.5	80.0	27
Poland*	2000	3.8	88.0	29
Latvia	2002	3.9	n.a.	. .
Bulgaria	2000	4.4	80.0	27
Gabon	2000	4.4	n.a.	. .
Guatemala	2002	5.2	n.a.	. .
Saint Lucia	2004	6.0	n.a.	. .

* Member of the Organization for Economic Co-operation and Development (OECD).

(a) Includes only children from The Hague.

(b) Includes only children from Zurich.

Sources: World Health Organization (WHO) Oral Health Country/Area Profile Programme; OECD health data 2002: a comparative analysis of 29 countries.

Appendix A

In 1996 the New South Wales Health Department (NSW Health), through the school dental service, implemented the Save Our Kids Smiles (SOKS) program, incorporating three main components—oral health education, risk assessment and clinical care. A major change accompanying the program was the move from clinic-based examinations to oral assessments in school classrooms as the primary environment for data collection. In the clinic better lighting and the availability of other facilities such as compressed air optimise conditions for assessing oral health.

Between 1995 and 1996, at the time the SOKS program was introduced, there was an apparent substantial improvement in the oral health of children in New South Wales. There was, for example, a 44% reduction in 5–6-year-old average decay, a 57% reduction in 12-year-old average decay, and a 12% increase in the percentage of 5–6-year-old children free of decay experience (dmft = 0) in their deciduous teeth.

In 2000, New South Wales Health commenced a wide-ranging review of SOKS, with one aspect being a quality assurance project aimed at assessing the reliability and validity of data collected under SOKS assessment conditions. The technical report (New South Wales Health Department, 2000) found that, while there were no statistically significant differences in the reporting of missing and filled teeth between a field SOKS-style assessment and a clinical examination, there was a persistent and statistically significant under-reporting of the number of decayed teeth in non-clinical conditions. In deciduous teeth, the average number of decayed teeth for the SOKS assessment was 36% lower than that collected in the clinic, while the average number of decayed permanent teeth was 41% lower. This underestimation of decay also resulted in a significant underestimation in the dmft and DMFT indices.

From 2001 child dental services in New South Wales were targeted towards designated 'disadvantaged' primary and secondary schools under the School Assessment Program (SAP). Children were prioritised for treatment using a Child Priority Oral Health Program questionnaire, resulting in much smaller numbers of children being seen by the school dental service. Rather than collecting information from all children enrolled in a school dental service, or from screening exams as had been done previously, oral health information on children in 2002 was only captured at the point of examination of prioritised children with designated treatment needs at school dental service clinics. This represents a serious and considerable bias to the results of the data collection in New South Wales in 2002 given that data was predominantly only available on children with immediate treatment needs from targeted 'disadvantaged' schools.

Because of the lack of representativeness of the New South Wales results in 2002 to the state child population for this year, data from New South Wales are not included in the Child Dental Health Survey, Australia 2002. The implications of this change to national child oral health statistics are significant. Given that the estimated resident population (ERP) of children in New South Wales makes up approximately one-third of the Australian child ERP, variations in child oral health in New South Wales have appreciable influence on national estimates.

The changes in data collection in New South Wales from 1996 to 2000 under SOKS and then from 2001 onwards under SAP present a challenge when interpreting time series for Australia. Time trends for 6-year-old and 12-year-old children, for the period 1990–2002, are therefore provided using three time series (Figures 21–26). The first series presents results that include unadjusted data for New South Wales during 1996–2000. The second series presents results with adjustments for the estimated under-reporting of clinically detectable decayed teeth in New South Wales between 1996 and 2000 (derived from a NSW Health review of SOKS). A weighting of 1.56 was used for calculations of decayed deciduous teeth and 1.68 for calculations of decayed permanent teeth in the New South Wales data, resulting in an adjusted national output. The third series presents results with New South Wales data excluded from the national average from 1996 onwards.

In the first time series, a decrease in decay experience is observable after the underreporting associated with SOKS, with a subsequent increase once New South Wales is excluded in 2002. In the deciduous teeth the lowest dmft is seen in 1996 (Figure 21) while in the permanent teeth the lowest point occurs in 1998 (Figure 24). In the third time series, greater stability in the time trend is evident however these results come at the expense of excluding approximately one-third of the child population of Australia. A small dip in both deciduous and permanent decay experience is evidenced in 2002 (Figures 23 and 26). The second time series consists of a compromise between the first and third series. In the deciduous teeth a decline is shown to 1996 followed by a reasonably steady increase in dmft to 2002 (Figure 22). The second time series for the permanent teeth shows a decline to about 1998–1999, followed by a slight increase thereafter (Figure 25).

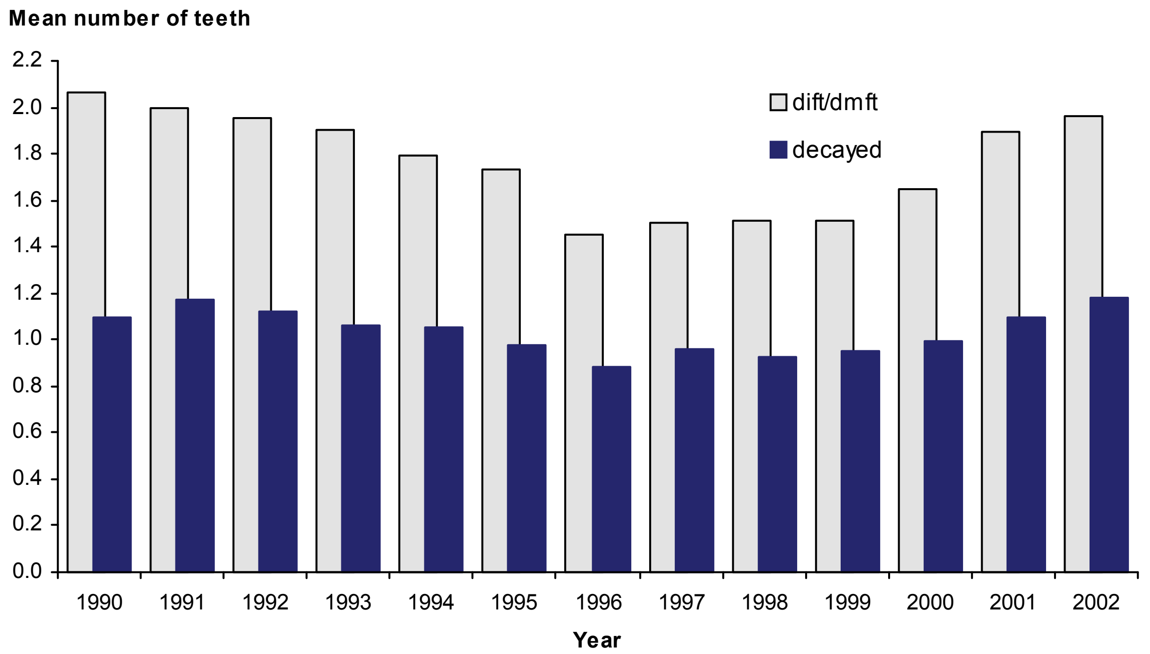


Figure 21: Average dift/dmft and decayed component for 6-year-old children in Australia from 1990 to 2002 (Series 1—including NSW data up to 2000)

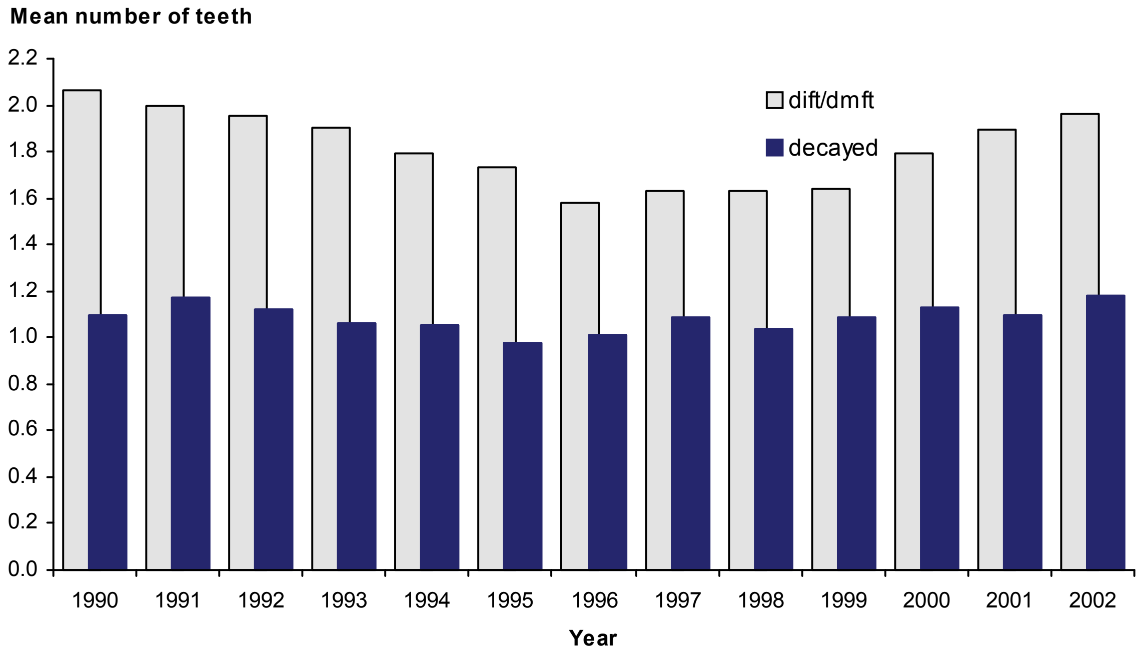


Figure 22: Average dift/dmft and decayed component for 6-year-old children in Australia from 1990 to 2002 (Series 2—adjusting for NSW data, 1996–2000)

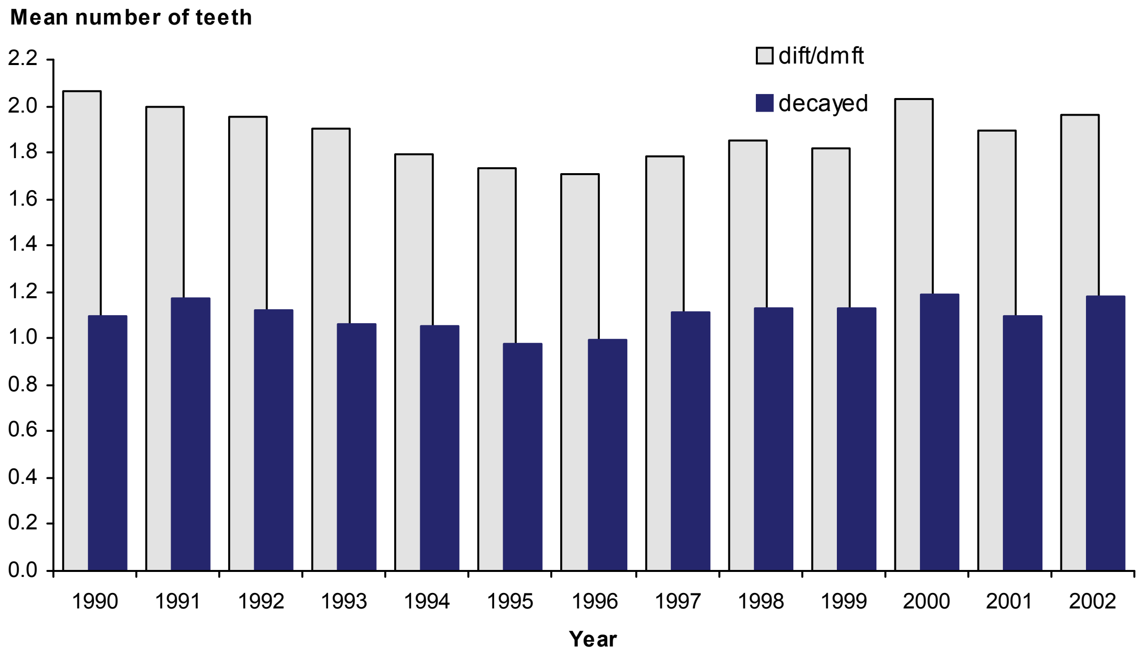


Figure 23: Average dift/dmft and decayed component for 6-year-old children in Australia from 1990 to 2002 (Series 3—excluding NSW data from 1996–2002)

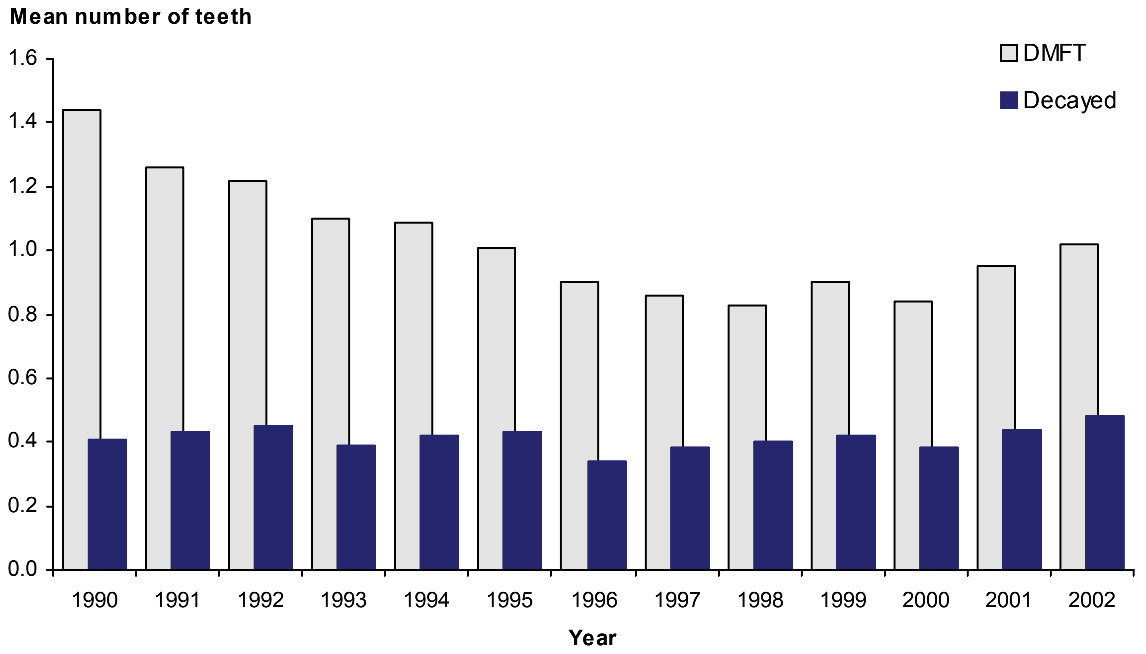


Figure 24: Average DMFT and decayed component for 12-year-old children in Australia from 1990 to 2002 (Series 1—including NSW data up to 2000)

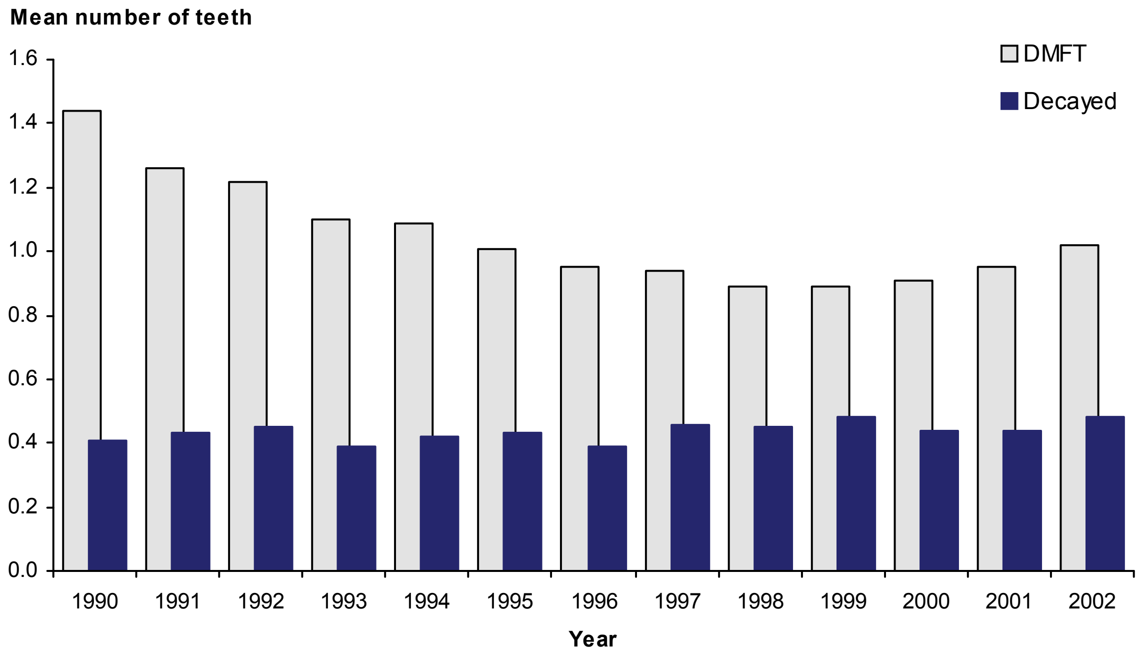


Figure 25: Average DMFT and decayed component for 12-year-old children in Australia from 1990 to 2002 (Series 2—adjusting for NSW data, 1996–2000)

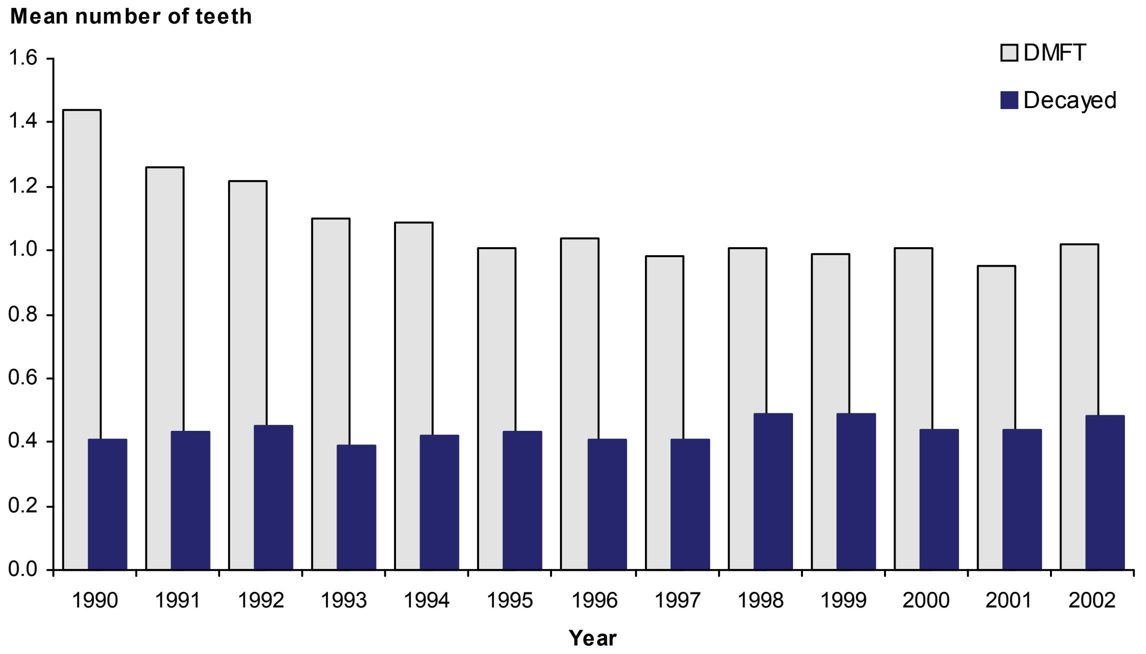


Figure 26: Average DMFT and decayed component for 12-year-old children in Australia from 1990 to 2002 (Series 3—excluding NSW data from 1996–2002)

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