

# Hospitalisations due to pulp and periapical conditions in Australian children from 1998-99 to 2017-18

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**Objective:** To assess the demographic and time trends in hospitalisation rate for Pulp and Periapical Diseases (P&PDs) over 20-years (1998-99 to 2017-18), amongst children and adolescents (under age 19 years) in all states and territories of Australia. P&PDs are considered potentially preventable, with the possibility of them resulting in emergency presentations if timely treatment is not provided. They can result in treatment under general anaesthesia, which is costly. **Design:** Retrospective analysis of hospitalisation for pulp and periapical diseases. **Setting:** Public and private hospitals across Australia. **Main outcome measures:** The number of hospitalisations (measured using the number of separations or cases of hospital admission) for all pulp and periapical diseases by age-group. **Results:** There were about 40,000 hospitalisations regarding P&PDs over the 20 years among Australian children under 19 years old. The rate of admissions ranged from means of 28.5 to 44.1 per 100,000 population. The number of admissions increased over 20 years for all children, except those younger than 4 years. Children aged 5-9 years had the highest rate of admissions and, more days in hospital per admission than other age groups. Most children only had one-day admissions. **Conclusion:** Pulp and periapical diseases hospitalisation rates have increased over two decades. Additional approaches to improve child dental health in Australia need to be considered.

**Keywords:** Children, Australia, hospitalisation, dental pulp diseases, periapical diseases

## Introduction

Although the Australian Commonwealth government implemented a School Dental Scheme in the 1970's (a universal, free, school-based Scheme), this Scheme reverted to being the responsibility of individual states and territories in 1981. The result is considerable variation in the arrangements for child dental services between states and territories. In 2014, the Child Dental Benefits Scheme was introduced, with parents of eligible children reimbursed for private and public dental services by Medicare Australia (Spencer and Do, 2016).

The most recent National Child Oral Health Study (2012-14) showed that over 56% of Australian children who had ever made a dental visit last attended private dental services, with the remainder making their most recent dental visit at public dental services, which was dominated by school dental services (Spencer and Do, 2016). Just over one-fifth of children had an irregular visiting pattern, and this proportion was higher among those children from households where parents had less education or low income. It was also higher among those children whose reason for their last dental visit was a dental problem (Spencer and Do, 2016).

Hospitalisations for pulp and periapical diseases (P&PDs) are potentially preventable. Potentially preventable oral health conditions act as a health system performance indicator in Australia, according to the Australian National Healthcare Agreement (ANHA) (Falster and Jorm, 2017). Consequences of infections of the pulp and periapical tissue, if untreated, include pain, the formation of abscesses, cellulitis, negative impact on oral quality of life, emergency visits and hospitalisations (Nalliah *et al.*, 2006; Spencer and Do, 2016).

Although there has been an overall improvement in child dental health, potentially preventable dental hospitalisations (PPDH) have not diminished (Acharya *et al.*, 2018). In the Australian state of Victoria, in 2013-14, about half of all potentially preventable dental hospitalisations (PPDH) were amongst children and adolescents under 25 years old and the rate of PPDH was the highest rate of all potentially preventable oral health related hospitalisations (VHISS, 2015). During the first decade of the 21<sup>st</sup> century, P&PDs accounted for 11% of oral hospitalisation cases in Western Australian children and cost about \$10 million AUD (Alsharif *et al.*, 2015). A projection study by Alsharif *et al.* (2016) also predicted that P&PDs will remain one of the top preventable dental hospitalisations, especially for 5-9-year-old children until 2026.

Many children with PPDH need treatment under general anaesthesia. However, not all dental care provided under general anaesthetic is for potentially preventable diseases (AIHW, 2022). There are some advantages of providing dental treatment under general anaesthesia in hospital, including that more treatment can be provided in one visit, less stress (especially for very young and uncooperative patients) and easier management of saliva (Williamson *et al.*, 2005). On the other hand, dental treatment in hospital is more expensive (in terms of direct, indirect and intangible cost) and carries the risk of side effects.

Previous work in Western Australia also showed that the most common cause for dental emergency presentations at hospitals was P&PDs (Yap *et al.*, 2018). Therefore, the prevention of P&PDs might contribute to a reduced burden on emergency dental departments, as well as reducing direct costs associated with hospital treatment.

The average direct cost (DRG) for hospitalisation due to pulp and periapical diseases per person in Western Australia was \$2291 from 1999-2009 (Kruger and Tennant, 2016). The indirect and intangible costs related to P&PDs can also be substantially reduced with timely and appropriate management of the condition.

Across all dental hospitalisations, P&PDs were more common among Indigenous and the most socioeconomic disadvantaged children in Western Australia (Alsharif *et al.*, 2015). A systematic review revealed that most studies on preventable dental hospitalisations were conducted in one state of Australia so there is a need to investigate this in other parts of the country (Acharya *et al.*, 2018).

Against this background, the aim of this study was to assess the demographic and time trends in hospitalisations rate for P&PDs over 20 years, amongst children and adolescents in all states and territories of Australia.

## Method

This study was conducted following the guidelines of the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement (von Elm *et al.*, 2008). Exemption from ethics approval was obtained from the Human Research Ethics Committee at the University of Western Australia (RA/4/20/5497) due to the data being obtained from open-access, freely available Australian Institute of Health and Welfare (AIHW) sources.

Children aged 0-19 years old resident in Australia from 1998-99 to 2017-2018 were included. Population data were derived from the Australian Bureau of Statistics (2022) website, based on census population data, using the estimated resident population as at 30 June for respective years. Population size was also determined for each age-sex group (ABS, 2022). The total population of children aged 0-19 years was 5,222,590 in 1998-99, which increased to 6,121,708 in 2017-18 (51% were male).

We used anonymised hospitalisation data from the National Hospital Morbidity Database (NHMD), available from the AIHW (2021). The data included all inpatient and day admissions into public and private hospitals across the states and territories of Australia by age and sex group, length of stay in days and principal diagnosis as per the International Classification of Diseases, Tenth Revision, Australian Modification, (ICD-10-AM). Pulp and periapical tissue diseases (K04) contain the following principal diagnosis sub-categories: K04.0 Pulpitis; K04.1 Necrosis of pulp; K04.2 Pulp degeneration; K04.3 Abnormal hard tissue formation in pulp; K04.4 Acute apical periodontitis of pulpal origin; K04.5 Chronic apical periodontitis; K04.6 Periapical abscess with sinus; K04.7 Periapical abscess without sinus; K04.8 Radicular cyst; K04.9 Other and unspecified diseases of pulp and periapical tissues (AIHW, 2021). The outcome was the number of hospitalisations (measured using the number of separations or cases of hospital admission) for all pulp and periapical diseases based on age-group.

Analysis calculated hospitalisation rates per 100,000 people. The 95% confidence intervals for age-standardised rates were calculated using the normal approximation for the number of cases. Trends over time were assessed using Poisson Loglinear Generalized Models, with hospitalisation as outcome and log population ( $\text{LN}(\text{population}/100000)$ )

as offset, and year as continuous variable. Exponential parameter estimates were used. Significance was tested using the Wald test. Statistical analyses were undertaken using IBM SPSS Statistics Version 27.

## Results

In Australia, a total of 39,449 children under 19 years were admitted to hospitals with pulp and periapical diseases between fiscal years 1998-99 to 2017-18; with an almost even gender distribution (46% female, 54% male). The rate of pulp and periapical hospital admissions in children ranged between means of 28.5 to 44.1 per 100,000 population (Table 1). For both genders, the numbers of patients was highest in children aged 5-9 years old with the duration of hospitalisation also highest for this age group.

The age-standardised rate (ASR) over 20 years was about 35 per 100,000 persons. Almost half (45.1%) of the admissions were for children aged 5-9 years, and

**Table 1.** Characteristics 39,449 children hospitalised for dental pulp and periapical infections 1998-99 to 2017-18.

		%	Rate per 100,000
Years	1998-99	3.8	28.8
	1999-00	3.8	28.5
	2000-01	4.1	30.3
	2001-02	4.6	34.1
	2002-03	4.2	30.6
	2003-04	4.4	32.1
	2004-05	4.5	32.6
	2005-06	4.6	33.1
	2006-07	4.7	33.6
	2007-08	4.8	34.2
	2008-09	5	34.9
	2009-10	5.1	35.1
	2010-11	5.3	36.5
	2011-12	5.2	36.2
	2012-13	5.5	37.7
	2013-14	5.4	36.5
	2014-15	5.6	37.1
Age groups	2015-16	6.1	40.4
	2016-17	6.8	44.1
	2017-18	6.8	44.1
	Total	100	35.2
	0-4	0.03	0.2
	1-4	32.1	56.8
	5-9	45.1	63.7
Sexes	10-14	10.4	14.8
	15-19	12.3	17.1
	Total	100	35.2
	Boys	54	37.1
	Girls	46	33.3
	Total	100	35.2

only 0.03% were under one year old. The second highest admission rate was for 1-4 year-olds (32.1%), while older children (aged 10-19) had lower hospitalisation rates (Table 1). In all age groups, the ASR of hospitalisations increased over 20 years. Especially in the most recent decade, the rate increase was higher for 5-9-year-old males. An almost steadily upward trend was observed in among 10-14-year-olds. The hospitalisation ASR for 1-4-year-olds fluctuated over time (Figure 1). Among 5-9-year-olds hospitalisation rates increased by almost 80 percent from (ASR=46.4) in 1998-99 to the peak (ASR=83.5) in 2017-18. As the study was based on total population rather than a sample, hypothesis tests are unnecessary.

For the first five years (from 1998-99 to 2003-04), the hospitalisation ASR due to P&PDs was higher in 1-4 year-olds than 5-9 year-olds, but this ratio has reversed since then. The greatest hospitalisation burden due to pulp and periapical diseases was originally among 1-4 year-olds, but more recently 5-9 year-olds showed higher rates (Figure 1, Table 2). Except for infants (0-1 years old), the lowest rates of hospitalisations were among 10-14 year-olds, followed by 15-19 year-olds (Figure 1).

Trend analysis by using Poisson Loglinear Generalized Linear Models indicated that over the 20 years, for age 0-1 and 1-4 years the mean annual change (1.5% and 0.1% respectively) have not increased ( $p>0.05$ ). However, the mean annual increases for the 5-9, 10-14 and 15-19 age groups were 2.5, 3.1 and 3.2 percent respectively ( $p<0.05$ ) (Table 3).

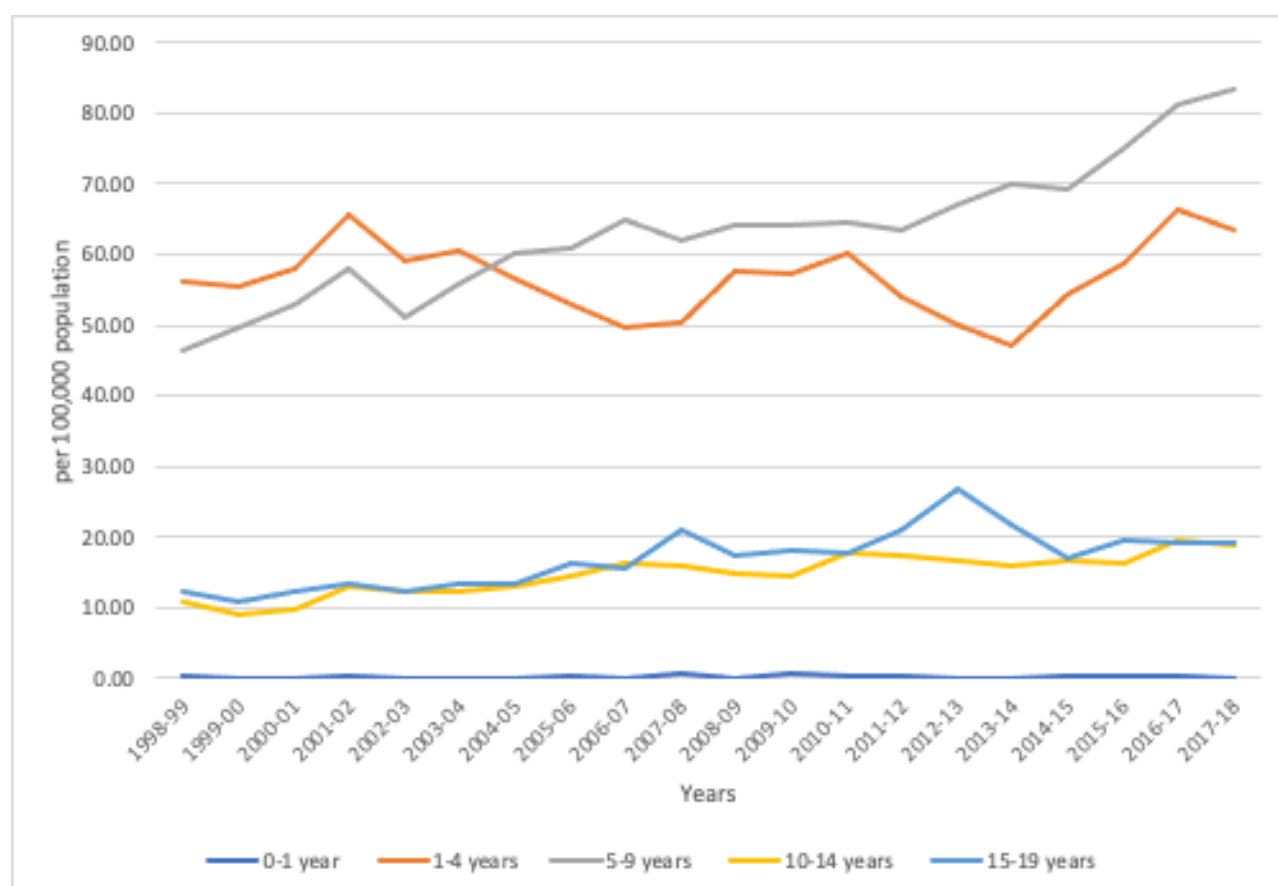
Across all age groups, the annual change was a 2% increase over 20 years ( $p<0.05$ , 95%CI between 1.8% and 2.2%).

Over the 20 years, all hospital admissions amounted to 48,978 bed days, with most patients (76.6%), staying for one day. Younger patients were more likely to have same-day hospitalisations (highest among 1-4 year olds at 85%), but for 15-19-year olds just more than half (53%) stayed for one day.

## Discussion

This study revealed that 39,449 people under 19 years old were admitted to hospitals in Australia for treatment of pulp and periapical diseases over a 20-year period. The rate of hospitalisations due to dental pulp and periapical diseases increased over time. This increase might be the consequence of inadequate primary health care or inappropriate use of the hospital system (Chrisopoulos *et al.*, 2016) although specific factors contributing to the hospitalisations, such as socioeconomic status, a lack of child's communication skills with dental procedures or other reasons could not be identified.

Previous studies predicted that Australians' demand for dental preventive care would increase (Spencer, 2003). According to the AIHW 2016, in 2013, about 2 out of 3 Australians aged 5 and over had had a dental visit in the last year; while the rate of hospitalisation due to pulp and periapical diseases for 5-9 year-olds children increased from 2013 onwards. Although dental preventive



**Figure 1.** Trends in hospitalisations for pulp and periapical diseases rates over 20 years.

**Table 2.** Age-standardised hospitalisation rates for pulp and periapical admissions.

Age Group	0-1	1-4		5-9		10-14		15-19	
Year	ASR*	ASR	95% CI	ASR	95% CI	ASR	95% CI	ASR	95% CI
1998-99	0.4	56.3	52.0, 61.1	46.4	42.9, 50.2	10.8	9.2, 12.7	12.4	10.6, 14.4
1999-00	0.0	55.4	51.0, 60.1	49.6	45.9, 53.5	9.0	7.5, 10.8	10.8	9.2, 12.8
2000-01	0.0	58.1	53.6, 63.0	52.8	49.1, 56.8	9.7	8.2, 11.6	12.4	10.7, 14.5
2001-02	0.4	65.8	61.0, 70.9	58.2	54.2, 62.4	13.0	11.2, 15.1	13.5	11.6, 15.6
2002-03	0.0	59.0	54.5, 63.9	51.3	47.6, 55.2	12.5	10.8, 14.5	12.4	10.7, 14.5
2003-04	0.0	60.7	56.1, 65.6	55.7	51.8, 59.8	12.4	10.6, 14.4	13.4	11.6, 15.5
2004-05	0.0	56.7	52.3, 61.5	60.2	56.2, 64.5	13.1	11.3, 15.1	13.6	11.8, 15.7
2005-06	0.4	52.9	48.7, 57.6	61.1	57.1, 65.4	14.6	12.8, 16.8	16.4	14.4, 18.7
2006-07	0.0	49.5	45.4, 54.0	65.1	60.9, 69.5	16.1	14.2, 18.4	15.6	13.7, 17.8
2007-08	0.7	50.3	46.2, 54.8	62.1	58.0, 66.4	15.8	13.9, 18.1	20.9	18.6, 23.4
2008-09	0.0	57.8	53.5, 62.5	64.0	59.9, 68.4	14.7	12.8, 16.8	17.4	15.4, 19.7
2009-10	0.7	57.4	53.2, 62.0	64.1	60.0, 68.5	14.6	12.7, 16.7	18.0	16.0, 20.3
2010-11	0.3	60.1	55.8, 64.7	64.4	60.3, 68.8	17.7	15.7, 20.1	17.6	15.6, 19.8
2011-12	0.3	53.9	49.8, 58.2	63.6	59.6, 68.0	17.3	15.2, 19.6	21.1	18.8, 23.6
2012-13	0.0	50.2	46.3, 54.4	67.0	62.9, 71.4	16.8	14.8, 19.1	26.8	24.3, 29.6
2013-14	0.0	47.3	43.6, 51.3	69.9	65.7, 74.3	15.8	13.8, 18.0	21.8	19.5, 24.3
2014-15	0.3	54.3	50.3, 58.5	69.4	65.3, 73.8	16.6	14.6, 18.9	17.0	15.0, 19.2
2015-16	0.3	58.9	54.8, 63.3	75.2	71.0, 79.6	16.5	14.5, 18.7	19.6	17.5, 22.0
2016-17	0.3	66.3	62.0, 71.0	81.2	76.9, 85.8	19.5	17.3, 21.9	19.1	17.0, 21.5
2017-18	0.0	63.5	59.3, 68.0	83.5	79.1, 88.1	19.0	16.9, 21.4	19.2	17.1, 21.5

\* The proportion of patients aged 0-1 years was very low so CI was not concluded in this table.

The separation rate for the total column is directly age standardised to the Australian population, using the estimated resident populations for age group as at 30 June for the respective year.

**Table 3.** Annual change in hospitalisations for pulp and periapical diseases over 20 years.

Age (years)	Annual increase (95% Wald CI)
0-1	1.5% (-8, 12.1)
1-4	0.1% (-0.2, 0.4)
5-9	2.5% (2.3, 2.8)
10-14	3.1% (2.5, 3.6)
15-19	3.2% (2.7, 3.7)

services in Australia grew from 1983 to 2010 and young patients presented for more examinations and preventive services, the results of this study have shown that the average rate of child hospitalisations due to dental pulp and periapical diseases increased over time (Figure 1) (Brennan *et al.*, 2015). Since 2014, the Child Dental Benefits Schedule (CDBS) has provided access to the benefits of basic dental services for eligible children aged 2-17, up to \$1026 for every two years. Despite the introduction of the CDBS, the rate of hospitalisation for P&PDs still increased after 2013-14 (Figure 1). In 2019, the Australian Government paid benefits averaging \$60 per service provided under the Child Dental Benefits Schedule (AIHW, 2022). There is a possibility that some eligible families are not aware of the CDBS to enable access to dental care for their children. For instance, a

2018 survey found that a third of parents did not know whether their child was eligible for CDBS and half were unaware of any free or government-funded dental services for children (Royal Children's Hospital, 2018).

The proportion of Australian children aged 5-14 whose last visit was for a dental check-up declined from 2010 to 2013 and the proportion who visited School Dental Services (SDS) fell by more than half from 1999 to 2013 (Chrisopoulos *et al.*, 2016). Reducing regular dental check-ups may lead to an increase in untreated dental caries, which may result in pulp and periapical diseases in children.

The increase in P&PDs hospitalisations should not be considered only as a result of a lack of primary care. Oral diseases are multi-factorial, so other factors can also increase hospitalisation rates in children. Behaviours in some children may cause difficulty for them engaging within the primary health system (Williams *et al.*, 2005). In recent years, secondary health care services for children have grown (AIHW, 2018), therefore there has been more opportunity for patients to choose treatment under general anaesthesia (GA) (especially for very young children and children with special needs). In addition, differences in healthcare policies and medical insurance may impact the children's hospitalisation rate (Kruger and Tennant, 2016). There is no standard Australian policy guideline among states and territories for referral to specialists and hospitals.



As the annual change for P&PDs hospitalisation rates increased over the 20 years, policy-makers need to provide impartial dental services by considering the prior risk groups. By focusing on the promotion of primary health, the incidence of P&PDs hospitalisations for children could be reduced. Service planning or improving preventive dental care allocated for children with special needs can help reduce the burden on hospitals.

Apart from individual factors such as disability, behaviour and communication difficulties that may lead to a need for dental treatment at hospital; the steady increase in hospitalisations due to pulp and periapical diseases in 5-9 year old children might be related to failings in the care of first permanent molar teeth. Some risk factors for poor child dental health in Australia have been identified previously and include age, disadvantage, rural living, Aboriginal status, some disabilities and birth defects, access to water fluoridation, poor oral hygiene, poor diet, system failures and payment systems. Strategic approaches targeted at high-risk groups need to be considered.

In conclusion, pulp and periapical diseases hospitalisation rates increased over two decades. Despite the introduction of targeted schemes such as the CDBS, these rates continue to rise, and additional approaches to improve child dental health in Australia need to be considered.

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