



## Comparing the Caries Prevalence between Indigenous and Non-Indigenous Children in Remote New South Wales, Australia: A Cross Sectional Study

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### Abstract

**Objective:** To compare the caries prevalence between Indigenous and non-Indigenous children two to five years of age.

**Methods:** A sample of young Aboriginal and non-Aboriginal children from remote New South Wales Australia was recruited. Children with parental consent participated in dental examinations which were undertaken by one calibrated examiner who recorded the decayed, missing and filled teeth/surfaces.

**Results:** 268 children were examined. The decayed missing and filled teeth scores were significantly higher for Aboriginal children ( $p = <0.01$ ). Most Aboriginal children examined had decayed teeth ( $n = 55, 52.4\%$ ) unlike non-Aboriginal participants ( $n = 27, 16.6\%$ ). Conclusion: Aboriginal children in remote areas of New South Wales have a significantly higher prevalence of dental caries when compared with their non-Aboriginal peers.

**Keywords:** Children; Dental Caries; Early Childhood Caries; Epidemiology; Indigenous

## Introduction

Aboriginal school children have higher levels of dental caries when compared with their non-Aboriginal peers. There is however little information on the dental health of preschool Aboriginal children, especially those living in remote locations. The objective of this paper is to compare the prevalence of dental caries between Indigenous and non-Indigenous preschool-age children in remote New South Wales, Australia.

## Background

Aboriginal people account for 2.6% of the Australian population with the highest proportion (30%) of Aboriginal Australians residing in New South Wales (NSW) [1]. Twenty-five per cent of Aboriginal children live in remote areas which compares with only two per cent of non-Aboriginal children [2]. Aboriginal people had little dental caries in the 1900's but this changed with the introduction of the Western diet and lifestyle which dramatically increased the prevalence of dental caries [3]. Whilst poor dental health has been a major health problem for all Australians there has been a reduction in dental caries over the past two decades for non-Aboriginal children which may be related to changes in diet, improved oral hygiene, use of fluoride toothpaste and availability of water fluoridation [4,5]. However, the level of decay among Aboriginal children continues to rise [5]. The NSW Child Dental Health Survey reported that Aboriginal children of five to six years of age had a dmft index twice that of non-Aboriginal children, with decayed teeth (dt) being the main contributor to inequality in oral health [6].

Dental caries among preschool aged children is also referred to as Early Childhood Caries (ECC) which is very aggressive and rapidly destroys teeth, leading to pain, infection and ultimately extraction of affected primary teeth [4,7]. The high levels of dental caries in Aboriginal children living in remote Australia means

that proportionally they are more likely to have dental treatment under a general anaesthetic when compared with those living in metropolitan areas [2].

Dental caries in primary teeth is also linked to high levels of caries in the permanent dentition, so controlling dental problems in younger children is very important [8]. However accessing dental services and seeking preventive care is much more difficult in remote areas because of the shortage of dental facilities and dental personnel [3]. The Australian National Dental Telephone Survey found that individuals living in remote Australia visited the dentist less frequently and typically only went when there was a problem [9]. Most Australian States and Territories have funded "Fly in Fly out" dental services which visit remote areas; however the main focus is usually placed on emergency treatment and pain relief, rather than the prevention of disease [10]. Data has been published that compares the caries prevalence of school aged Aboriginal and non-Aboriginal children in New South Wales Australia, however this comparison does not exist for preschool aged children which is when the onset of ECC begins. Knowing the caries prevalence of preschool-age children is important so appropriate preventive strategies can be implemented.

A cross sectional study has been published that assesses the caries prevalence of Aboriginal children from rural, remote and metropolitan areas in New South Wales, Australia. This paper is a secondary analysis that aims to compare the prevalence of dental caries between Indigenous and non-Indigenous children in remote New South Wales, Australia. The null hypothesis is that dental health parameters (including dmft, decayed teeth (dt) and decayed surfaces (ds)) for preschool children aged two to five years living in remote NSW is equivalent between Aboriginal and non-Aboriginal children. Aboriginal includes those of an Aboriginal and/or Torres Strait Islander heritage.

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## Methods

Three Aboriginal Community Controlled Health Services (ACCHS) were contacted in remote areas of NSW Australia and Aboriginal Health Workers from all three organisations recommended a total of ten childcare facilities in their local area. All ACCHS were willing to partake in a preventive dental education program if the caries prevalence indicated a need. All childcare facilities were contacted via email inviting them to participate in the dental project and all agreed to join. No type of childcare facility was excluded from the study. Facilities primarily consisted of preschools, primary schools, Aboriginal Medical Services (AMS) and playgroups, where there were preschool-age Aboriginal and non-Aboriginal children.

Childcare facilities were given consent letters to explain the research and children could only be included in the dental examinations if they had written consent from a parent or guardian. The consent form included the child's date of birth and Indigenous status and was not seen by the dental examiner. The Project Manager collected the signed consent forms and only children five years or younger were included in this study. The dental examinations were undertaken in the latter part of 2014.

An experienced dental epidemiologist completed all dental examinations and internal examiner consistency was checked by re-examining 10% of the children. Children were seated during the dental examinations and their teeth were checked visually using a mouth mirror and torch. The diagnostic criteria were the same as the NSW 2007 Child Dental Health Survey, and only clearly visible dental caries was recorded [6]. Paper dental charts were used to record the decayed, missing and filled teeth index (dmft), and surfaces index (dmfs). In addition the Significant Caries Index (SiC) was calculated. The SiC index records the highest 30% of dmft scores and SiC10 records the highest 10% of dmft scores [6].

This index identifies the highest dmft scores to highlight population groups with greater oral health inequalities [6,11]. Data analysis was performed using the Statistical Package R (Open Source Statistical Analysis Software) applying Poisson Regression, and compared statistical differences between Aboriginal and non-Aboriginal children in relation to the dmft, decayed teeth (dt) and decayed surfaces (ds) at the 95% confidence level. Poisson Regression was chosen because the dental parameter data is suited to it, and it is more powerful than conventional t-tests and non-parametric tests. The dmft, dt, ds and dmfs scores were evaluated in terms of mean, standard deviation (SD) and range. Missing and filled teeth and surfaces were examined for mean scores and range only, because the number of children with filled and missing teeth was too small for further analysis. A letter was sent home to parents of children identified with dental caries advising them to arrange a check up with a dental health care professional. All children were provided with a toothbrush and toothpaste for taking part in the examinations.

## Ethics approval

Ethical approval was granted by the Research and Development Office, Royal Prince Alfred Hospital, Sydney, Protocol Number X14-0101 & HREC-09-RPA 85 (previously X09-0052) and the Aboriginal Health and Medical Research Council Ethics Committee (AH&MRC)

Protocol Number 696-09. The research was carried out according to The Code of Ethics of the World Medical Association (Declaration of Helsinki); informed consent was obtained prior to participants being included in the study. The authors' Institutional Review Board has approved the study.

## Results

All families with children attending the childcare facilities were invited to partake in the study. A total of 300 consent forms were issued to families and the

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majority (n =278; 92.7%) were returned with a positive consent. Ten (3.7%) children refused the examination on the day, and 268 were ultimately examined, giving a response rate of 89.3%. Over one third of the children who participated in the examination were Aboriginal (n =105; 39.2%). The children were two to five years of age on the date of the examination, with a mean age of 4.3 years (SD = 0.9). The mean age for Aboriginal children was 4 years (SD = 0.8) and 4.5 years (SD = 0.9) for non-Aboriginal children. Approximately half of the children screened were girls (n = 130; 48.5%) for both Aboriginal (n = 45; 42.9%)

and non-Aboriginal participants (n = 85; 52.1%).

One third of children (n = 87; 32.5%) were referred for dental treatment with the majority being Aboriginal (n = 58; 66.7%). The main reason for a referral was for untreated dental caries (n = 80; 92.0%) that mostly affected Aboriginal children (n = 55; 68.8%). Twenty five (15.3%) non-Aboriginal children required a referral for dental caries. The estimated caries prevalence for Aboriginal children (dmft > 0 = 52.4) was higher than that of non-Aboriginal children (dmft > 0 = 16.6%) (Table 1).

**Table (1):** Summary dmft and dmfs statistics for Aboriginal and non-Aboriginal children in remote NSW

	<i>n</i> (%) > 0	Mean	SD	Min	Max	Range
Aboriginal children decayed, missing, filled teeth (dmft)	55(52.4)	3.4	4.7	0	15	15
Aboriginal children decayed, missing, filled surfaces (dmfs)	55(52.4)	7.8	12.2	0	44	44
Aboriginal children decayed teeth (dt)	55(52.4)	3	4.2	0	15	150
Aboriginal children decayed surfaces (ds)	55(52.4)	6.2	10.4	0	44	44
Aboriginal children missing teeth (mt)	8(7.6)	0.3	-	0	7	7
Aboriginal children filled teeth (ft)	2(1.9)	0.09	-	0	8	8
Non-Aboriginal children decayed, missing, filled teeth (dmft)	27(16.6)	0.6	1.6	0	8	8
Non-Aboriginal children decayed, missing, filled surfaces (dmfs)	27(16.6)	1.1	4.4	0	30	30
Non-Aboriginal children decayed teeth (dt)	25(15.3)	0.5	1.3	0	8	8
Non-Aboriginal children decayed surfaces (ds)	25(15.3)	0.7	2.6	0	20	20
Non-Aboriginal children missing teeth (mt)	2(1.2)	0.04	-	0	5	5
Non-Aboriginal children filled teeth (ft)	5(3.1)	0.06	-	0	2	2

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Aboriginal children had a mean dmft of 3.4 (SD = 4.7) with a range of 15 and non-Aboriginal children had a mean dmft of 0.6 (SD = 1.6) with a range of eight (Table 1). The odds ratio (OR) for this comparison is 2.1 with a 95% CI of (1.7, 2.6). This means the dmft for Aboriginal children living in remote NSW was 2.1 times greater than their non-Aboriginal children (p = <0.01). Aboriginal children had a higher prevalence of decayed teeth (n = 55, 52.4%) compared to non-Aboriginal participants (n = 25, 15.3%). The mean dt for Aboriginal children was 3.0 (SD = 4.2) with a range of 15, whereas non-Aboriginal children had a mean dt of 0.5 (SD = 1.3), with a range of eight. The Odds Ratio (OR) for this

comparison is 6.3 with a 95% CI of (4.9, 8.2). Aboriginal children had 6.3 times more decayed teeth than non-Aboriginal children (p = <0.01). A significantly higher ds score (p <0.01) was noted in the Aboriginal participants; they had a mean ds of 6.2 (SD = 10.4) with a range of 44 compared with a mean ds of 0.7 (SD = 2.6) with a range of 20 for non-Aboriginal children. The OR for this comparison is 4.3 with a 95% CI of (3.3, 5.6) with remote Aboriginal children having 4.3 times as many decayed tooth surfaces than non-Aboriginal children. The overall mean dmfs score for Aboriginal children (7.8, SD = 12.2) was more than seven fold that of non-Aboriginal children (1.1, SD = 4.4). (Table 2).

**Table (2):** Summary dmft and dmfs statistics for children in remote NSW according to age and Aboriginal status

	Aborigin al 2-3 years	Aboriginal 4-5 years	All Aboriginal children	Non- Aboriginal 2-3 years	Non- Aboriginal 4-5 years	All Non- Aboriginal children
<b>N</b>	50	55	105	42	121	163
<b>Mean dmft (SD)</b>	3.4 (4.7)	3.5(4.8)	3.4(4.7)	0.6(1.7)	0.5(1.6)	0.6(1.6)
<b>n(%) dmft &gt;0</b>	27(54.0)	28(50.9)	55(52.4)	9(21.4)	18(14.9)	27(16.6)
<b>Mean dmfs (SD)</b>	7.5 (12.1)	8.0(12.4)	7.8(12.2)	0.9(2.5)	1.2(4.9)	1.1(4.4)
<b>n(%) dmfs &gt;0</b>	27 (54.0)	28(50.9)	55(52.4)	9(21.4)	18(14.9)	27(16.6)
<b>Mean dt (SD)</b>	2.9 (4.0)	3.1(4.3)	3.0(4.2)	0.6(1.6)	0.4(1.3)	0.5(1.3)
<b>n(%) dt &gt;0</b>	27 (54.0)	28(50.9)	55(52.4)	9(21.4)	16(13.2)	25(15.3)
<b>Mean ds (SD)</b>	6.2 (10.1)	6.3(10.7)	6.2(10.4)	0.8(2.1)	0.7(2.8)	0.7(2.6)
<b>n(%) ds &gt;0</b>	27 (54.0)	28(50.9)	55(52.4)	9(21.4)	16(13.2)	25(15.3)
<b>Mean SiC<sup>10</sup> (SD)</b>	13.2 (1.1)	13.7(0.8)	13.5(0.9)	5.2(2.2)	4.7(2.4)	4.8(2.3)
<b>SiC (SD)</b>	9.7 (3.6)	9.9(3.5)	9.8(3.5)	2.1(2.5)	1.8(2.5)	1.8(2.5)
<b>Mean mt</b>	0.3	0.4	0.3	0	0.1	0
<b>n(%) mt &gt;0</b>	3 (6.0)	5(9.1)	8(7.6)	0	2(1.7)	2(1.2)
<b>Mean ft</b>	0.2	0	0.1	0.1	0.1	0.1
<b>n(%) ft &gt;0</b>	1 (2.0)	1(1.8)	2(1.9)	1(2.4)	4(3.3)	5(3.1)

Regardless of the child's age, the majority of Aboriginal children examined

had decayed teeth with children less than three years of age being affected the most (n

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= 27, 54.0%). Approximately one fifth (n = 9, 21.4%) of non-Aboriginal children of the same age had decayed teeth. There was a large disparity between Indigenous and non-Indigenous children four to five years of age with Aboriginal children having more decayed teeth (n = 28, 50.9%) than non-Aboriginal children (n = 18, 14.9%). The main contributor to the dmft score was due to active and untreated dental caries, as only a small number of both Aboriginal children (mean = 0.3) and non-Aboriginal children (mean = 0.04) had missing teeth. Aboriginal and non-Aboriginal children had the same mean number of filled teeth (mean = 0.1).

The Significant Caries index for the highest ten per cent (SiC10) and thirty per cent (SiC) of Aboriginal children with dental caries was 13.5 and 9.8 respectively (Table 2). In contrast, the SiC10 and SiC scores for non-Aboriginal children were 4.8 and 1.8. The SiC10 and SiC scores for Aboriginal children aged two to three years was 13.2 and 9.7 which is up to 4.6 times higher than non-Aboriginal children of the same age who had scores of 5.2 and 2.1. The SiC10 and SiC scores for children aged four to five was up to 5.5 times higher for Aboriginal children (13.7, 9.9) when compared to their non-Aboriginal counterparts (4.7, 1.8). A high level of intra-examiner reliability was found with a mean kappa score of 0.97. The null hypothesis is rejected as there is a statistically significant difference between all parameters assessed; with Aboriginal children aged two to five years living in remote NSW having more dental caries than their non-Aboriginal peers.

## Discussion

Existing studies compare the caries prevalence of school aged children. This is the first cross sectional study that compares the number of decayed, missing and filled teeth between preschool-age Aboriginal and non-Aboriginal children residing in remote NSW Australia. This age is important because ECC commences before children start school, therefore preventive strategies need to start from an earlier age. This study

highlights the early onset and severity of ECC among Australia's Aboriginal population. Indigenous children as young as two years of age are already experiencing a higher prevalence of dental caries when compared to non-Aboriginal children living in the same demographic. Remote dwelling Aboriginal children who are two to five years of age have higher levels of dental caries when mean dmft, dt and ds scores are compared with non-Aboriginal children of the same age and living in the same location which highlights the extent of the disparities. Aboriginal children had substantially greater levels of decayed surfaces than their non-Aboriginal counterparts, and the SiC and SiC10 scores gave a clear indication of the children with the poorest dental health. For all ages, the SiC scores were significantly higher for Aboriginal children, which indicate great inequality. The majority of these young children are experiencing ECC which is largely left untreated and they will no doubt suffer pain, sepsis and sleep loss [4,7].

There is a dearth of studies that assess the prevalence of dental caries in children aged between two and five years in remote areas of NSW Australia, and our research adds to literature that concludes Aboriginal children have poorer oral health than non-Aboriginal children. A study of preschool children in rural Western Australia found a significant difference between the mean dmft scores of preschool aged Aboriginal children (dmft = 4.3, SD = 4.2) and non-Aboriginal children (dmft = 1.9, SD = 2.9)[12]. However the difference in dmft scores between Aboriginal and non-Aboriginal children in our study in NSW was a little lower with a mean dmft score of 3.4 (SD = 4.7) and 0.6 (SD = 1.6).

The results from our study showed Aboriginal children aged four to five years had a substantially higher dmft (dmft = 3.5) and was comparable to children five to six years old who participated in The NSW Child Dental Health Survey (dmft = 3.0)[6]. The average dt for Aboriginal children aged four to five was higher in this study (dt = 3.1) than that of Aboriginal children aged

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five to six examined in The NSW Child Dental Health Survey (dt =2.2) [6]. The difference in dmft and dt scores supports previous studies where children in remote areas in Australia have poorer oral health than those in metropolitan areas. The number of children requiring dental treatment is too large and remote areas do not have dental facilities to meet this demand; therefore preventing dental caries from a young age is a necessity. All results indicate that the prevention of dental caries for young Aboriginal children living in remote areas needs to start at an early age. Once Aboriginal children in remote areas are four years old it is likely they will already have experience of ECC requiring extensive clinical care and prevention alone will not control the caries problem.

The specific reasons for the high disease levels of caries in our study are difficult to explain without behavioural and lifestyle information. Self-reported information was not collected as parents/carers were not present in many preschool facilities and the aim of the study was to only report on caries prevalence. However it is known that ECC is multifactorial disease [13] and poor oral hygiene along with frequent consumption of sugary foods/drinks or sleeping with a bottle of milk as a comforter will increase the likelihood of a child getting ECC. Brushing twice daily with a fluoride toothpaste helps to remineralize the hard tooth tissue and reduces a child's decay risk, however less than five per cent of Australian Aboriginal preschool children living in remote areas brush their teeth daily [14]. All of these factors influence a child's risk to ECC [7,15]. Socioeconomic status also has an impact on oral health and could be a contributing factor if Aboriginal children have social and economic factors which impact on family life and are different to non-Aboriginal children [16,17].

A higher prevalence of dental caries in Indigenous children is not unique to Australia. Indigenous children in Canada, America and New Zealand have poorer dental health when compared to non-

Indigenous children [18]. Multiple studies have shown Indigenous children have two to five times more decay than non-Indigenous children. Other researchers have found that dmft increases with remoteness [13]. In Canada, the dmft for children five years of age ranged from 4.8 to 13.7 with the latter being in remote areas. These Nations including Australia, recognise that the poor oral health of Indigenous children needs to be addressed [18].

A limitation is that the oral health of Indigenous and non-Indigenous children in metropolitan and rural areas was not assessed as part of this study. However, it is well documented that there is an association between ill health and remote dwelling. A limitation may be that the mean age of Indigenous children examined was slightly higher than non-Indigenous children. However, Table Two clearly shows that Aboriginal children have higher dmft and dmfs scores when compared to non-Aboriginal children of the same age. Collecting epidemiological data on very young Indigenous and non-Indigenous children in remote New South Wales is challenging, time consuming and costly. It is less expensive visiting school-age children where a greater number of children can be examined at the one location. These may be some reasons as to why this data has not been previously collected. Although there are limitations within this study, this data provides key information that was not previously known.

It is important to be realistic when implementing a dental health education program in remote locations due to limited dental facilities and the small number of dental professionals available makes access to care and preventive advice more difficult. An alternative option to using oral health care professionals is to involve Aboriginal Health Workers because they have regular contact with Aboriginal families, and may well have the ability to offer advice on preventing dental caries to parents with young children [4]. One example of an Aboriginal community-led dental program

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in NSW Australia involving Aboriginal Health Workers is 'Smiles not Tears' which relies on them informing parents about preventing dental caries[19]. The program begins when a child is six months of age and may be an answer to the shortage of dental personnel in remote NSW and assist in preventing early onset ECC [19].

## Conclusion

This research indicated that across all parameters there was a statistically significant difference between the caries prevalence of Aboriginal and non-Aboriginal children two to five years of age living in remote NSW with Aboriginal children having poorer oral health. The main contributor to the dmft scores was decayed teeth with Aboriginal children having substantially greater levels of untreated dental caries than non-Aboriginal children from the same location. This increased caries risk highlights the need for an easily accessible and culturally appropriate preventive program to reduce the dental disease burden suffered by young Aboriginal children.

## Competing interest

The authors declare that they have no competing interests.

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## Authors' contributions

All authors contributed equally to the manuscript.

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## Declaration

The views expressed are those of the Authors and do not reflect the policies of NHMRC or NSW Health.

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