
Dental caries among Australian Aboriginal, non-Aboriginal Australian-born, and overseas-born children

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Few studies have specifically compared the prevalence of dental caries among contemporary Australian Aboriginal and non-Aboriginal children. Historically, Aboriginal groups have had substantially fewer dental caries than non-Aboriginal peoples. More recently, however, this trend appears to have been reversed, with improvements in the oral health of non-Aboriginal children and a deterioration in that of Aboriginal children; this tendency has important implications for dental health services.

This study compared the caries experience among a weighted sample of Community Dental Service patients aged 4–13 years for the period January–December 1992 among 4138 Aboriginal children, 9674 non-Aboriginal Australian-born children, and 957 overseas-born children resident in Northern Territory, Australia. The outcomes considered included the aggregate numbers of decayed, missing and filled deciduous (dmft) and permanent (DMFT) teeth. Oral disease experience and prevalence of untreated oral disease were higher among Aboriginal and overseas-born children. An analysis of variance using planned comparisons indicated that there were significantly more decayed teeth and higher aggregate caries experience in the deciduous and permanent dentition of Aboriginal and overseas-born children than of non-Aboriginal Australian-born children, while overseas-born children also had more fillings and fissure sealants than the non-Aboriginal Australian-born children.

Introduction

The structure of Australian society is one shared by a number of westernized countries, where there is a sizeable indigenous population that is at a significant disadvantage with regard to a range of health outcomes. Current health indices demonstrate that Australian Aboriginal children have substantially shorter life expectancies than non-Aboriginal children and a greater incidence of events such as blindness, infant mortality and accidental death (1, 2). Reported in this article is the current dental health of Australian Aboriginal children living in Northern Territory, Australia.

Surveys of dental health conducted in the 1960s and 1970s in Northern Territory, in the remote Ab-

original settlement of Yuendumu, established that the Aboriginal population had substantially better dental health than non-Aboriginal Australians. The numbers of decayed, missing and filled permanent teeth (DMFT) for juveniles, adolescents and adults (0.2, 0.5, and 2.4, resp.) were among the lowest in the world (3). A series of studies published by Kailis in the early 1970s (4–6) indicated that the better dental health of Aborigines was applicable to several communities in Australia, and was related in part to traditional Aboriginal diets, which were low in cariogenic substances. This finding suggested that adoption by Aboriginal children of a non-traditional diet would have important implications for their dental health.

The impetus for the current study came from two sources. First, there has been a dramatic decline in caries experience in non-Aboriginal children since the 1970s, with the DMFT score for 12-year-olds falling from 4.8 in 1977 to 1.2 in 1992 (7), placing Australia at the bottom of the low range of caries experience as classified by WHO (8). A similar pattern of decline in caries experience has been observed among the general population in Northern Territory (9). As a result, the aggregate DMFT scores for Aboriginal and non-Aboriginal children were the same by 1989, although the former children had greater numbers of untreated caries (10). Sec-

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ond, the cultural and racial mix of contemporary Australian society is rapidly changing because of shifts in the proportions of immigrants arriving in the country; there has been an increase in the numbers immigrating to Australia from South-east Asia in recent decades. This pattern of migration is particularly marked in Northern Territory, where approximately twice as many overseas-born children come from South-east Asia as from countries where English is the principal language spoken (11). The rationale for the present study was therefore to identify segments of the community that have a greater need for dental care; are not benefiting equally from existing dental health services; and that could do so from targeted care programmes.

The study compared the following indices of dental disease in Australian Aboriginal, non-Aboriginal Australian-born, and children born overseas who were resident in Northern Territory, Australia in 1992:

- the number of decayed, missing due to caries, and filled deciduous (dmft) and permanent teeth (DMFT); and
- the components of these indices, e.g. deciduous decay (d) and permanent decay (D).

Method

Aborigines, who constitute approximately 1.5% of the total Australian population, are distributed more evenly across mainland Australia than the extremely urbanized and predominantly coastal dwelling non-Aboriginal population. Northern Territory, although not the state or territory containing the greatest population of Aboriginal children, has the highest proportion of Aborigines (22.7%) (11, 12).

Subjects for this study were drawn from the Community Dental Service (CDS) in Northern Territory, which provides a universal dental health programme for school-age children. The programme covers more than 85% of the estimated resident target population in Northern Territory. Most children receive their first care from CDS during their first year of school at age 5 years. The sample for this study comprised all CDS patients aged 4–13 years in the area outside the capital city, Darwin, and a 52% sample of patients selected by birth dates from within the Darwin region. The study was carried out over the period January to December 1992. The data were weighted to adjust for the sampling variation between sites before proceeding with the analysis. The sample consisted of 9674 non-Aboriginal Australian-born, 4138 Aboriginal, and 957 overseas-born children. Data were collected during routine

dental examinations in CDS clinics by dentists and dental therapists. Clinical decisions were based on WHO definitions (13), while the criteria described by Palmer, Anderson & Downer (14) were used to categorize missing deciduous teeth. Radiographs may have been taken as part of the clinical examination, but any additional caries diagnoses made using them were not recorded as part of this study. Neither formal calibration of examiners, nor replicate examinations were conducted.

Information about the ethnic origin and birthplace of the children was obtained from parents or guardians at the time of enrolment in the CDS, and transcribed by clinicians to the data record at the time of examination. Country of birth was categorized according to a modified Australian Bureau of Statistics protocol, which consolidated individual countries into 10 geographical regions, such as "southern Europe" or "South-east Asia" (15).

Results

Table 1 presents the age distribution by birthplace and ethnic origin of the children. The sample contained 65.5% non-Aboriginal Australian-born, 28.0% Aboriginal, and 6.5% overseas-born children. Major regions represented were South-east Asia ($n = 356$), United Kingdom ($n = 85$), and "other Asia", which included countries such as India ($n = 57$). Other regions were represented by smaller numbers of children. The sample contained approximately equal proportions of males and females (50.3% and 49.7%, resp.). Although not presented, comparison of age-specific caries prevalence estimates by world region indicated that the highest prevalence of both deciduous and permanent caries

Table 1: Age distribution of cases by birthplace and ethnic origin of child

Age (years)	Birthplace:			% of total
	Australia, non-Aboriginal	Australia, Aboriginal	Overseas	
4	958	252	64	8.6
5	1 167	363	82	10.9
6	1 218	429	121	12.0
7	1 138	496	123	11.9
8	1 151	514	106	12.0
9	1 124	512	110	11.8
10	1 094	485	135	11.6
11	1 027	470	124	11.0
12	696	407	82	8.0
13	101	209	11	2.2
%	65.5	28.0	6.5	100.0

experience among migrants to Australia was among children from South-east Asia. Owing to the small sizes of the samples for most world regions, the analyses presented below are based on three consolidated categories: non-Aboriginal Australian-born, Aboriginal, and overseas-born children. The detailed results of the analyses on dental health status are shown in Table 2 and Fig. 1-4. Table 2 presents an age-specific summary of the prevalence of dental caries experience, where age 6 years is included for deciduous caries experience, and age 12 years for caries experience in the permanent dentition. The non-Aboriginal Australian-born children were characterized by a higher percentage with $dmft = 0$, and lower percentages with $dmft = 4+$ and $d = 1+$. The percentage of Aboriginal children with $d = 1+$ was substantially higher than for either of the other groups. A repetition of this pattern was also observed for the permanent dentition: the non-Aboriginal Australian-born children had a higher percentage with $DMFT = 0$, while the Aboriginal children had a higher percentage with $D = 1+$. The percentage of children with $DMFT = 4+$ was substantial in all groups but, as with deciduous dentition, the Aboriginal children had the highest percentage in this category.

Further information can be gained by examining the mean levels of the $dmft$ and $DMFT$ indices, in addition to prevalence estimates. (Fig. 1-4) plot the dental caries outcomes for non-Aboriginal Australian-born children, Aboriginal children, and overseas-born children. Non-Aboriginal Australian-born children were compared with each of the other two groups.

The $dmft$ scores for deciduous teeth for the three groups are shown in Fig. 1, which indicates that both comparison groups had higher $dmft$ scores than

the non-Aboriginal Australian-born group (Aboriginal children, $df = 1, F = 113.58, P < 0.001$; overseas-born children $df = 1, F = 67.48, P < 0.001$). Evidence from the prevalence of disease at age 5 years also shows that a substantial proportion of children entered CDS with significant caries experience, and that there is variation between groups at entry. The $dmft$ score continued to increase across age cohorts to 6 years for Aboriginal children, 7 years for overseas-born children, and 8 years for non-Aboriginal Australian-born children. The rates of increase in $dmft$ score following enrolment in CDS also appeared to vary slightly between groups. This is reflected in the slight divergence in the prevalence scores between groups for children aged 4-7 years. The convergence observed across ages 7-10 years is due to the progressive loss of deciduous teeth owing to exfoliation, which reduces the number of teeth at risk of caries.

Fig. 2 compares the number of decayed teeth in the deciduous dentition, with both comparison groups having higher scores than the non-Aboriginal Australian-born group (Aboriginal children, $df = 1, F = 816.23, P < 0.001$; overseas-born children, $df = 1, F = 58.53, P < 0.001$). The numbers of decayed teeth peaked at age 5 years for all groups, when the majority of children commence school and, subsequently, enter CDS. The general decline in the numbers of decayed teeth across ages is due to the management of caries by the placement of fillings, and the exfoliation of the deciduous dentition, which

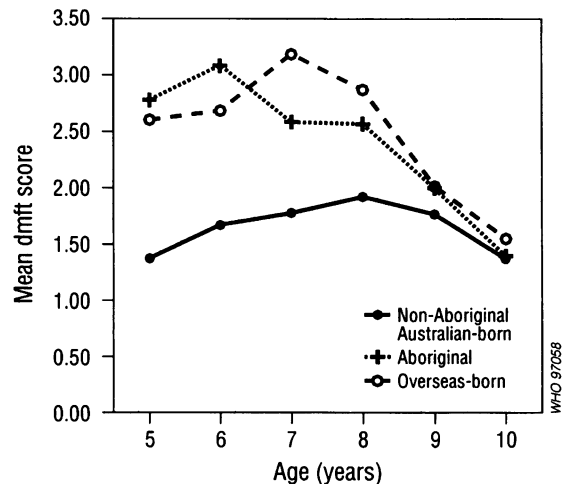
Table 2: Age-specific dental caries prevalence for Australian Aboriginal, non-Aboriginal Australian-born, and overseas-born children

	Non-Aboriginal Australian-born children	Aboriginal children	Overseas-born children
Age 6 years^a	<i>n</i> = 1 218	<i>n</i> = 429	<i>n</i> = 121
% with $dmft = 0$	53.5	26.6	41.5
% with $dmft = 4+$	18.4	36.6	31.3
% with $d = 1+$	33.7	64.9	44.6
Age 12 years^b	<i>n</i> = 696	<i>n</i> = 407	<i>n</i> = 82
% with $DMFT = 0$	60.3	57.0	54.9
% with $DMFT = 4+$	12.4	25.9	15.1
% with $D = 1+$	5.5	10.9	6.2

^a $dmft$ = decayed, missing, and filled deciduous teeth.

^b $DMFT$ = decayed, missing, and filled permanent teeth.

Fig. 1. Mean $dmft$ score in Aboriginal, non-Aboriginal Australian-born, and overseas-born children (MANOVA Aboriginal or overseas-born versus non-Aboriginal Australian-born; $P < 0.05$).



is reflected in the convergence in caries experience observed between groups at age 10 years.

Although not shown, overseas-born children also had a higher number of missing teeth than the non-Aboriginal Australian-born group, but not compared to Aboriginal children (overseas-born children, $df = 1, F = 44.07, P < 0.001$; Aboriginal children, $df = 1, F = 0.53, P = 0.47$). The differences in extraction experiences may indicate variation in the severity of disease and treatment modality between Australia and the countries in which overseas-born children had previously been treated, with extraction for caries being a commoner treatment outcome for overseas-born children. Alternatively, extraction rates may vary within CDS owing to factors such as parental perceptions of appropriate dental care, or difficulties in communication between parents and clinicians. Variation in treatment was also reflected in the finding that overseas-born children had higher numbers of filled deciduous teeth than the non-Aboriginal Australian-born group, while Aboriginal children had lower numbers of filled teeth than the non-Aboriginal Australian-born group (Aboriginal children, $df = 1, F < 154.75, P < 0.001$; overseas-born children, $df = 1, F = 11.65, P = 0.001$).

The ratio of decayed teeth to the dmft score indicates the proportion of caries experience represented by untreated decay. A high ratio indicates a greater unmet need for treatment. Both comparison

groups had significantly higher ratios of decayed teeth to teeth with caries experience than the non-Aboriginal Australian-born children (Aboriginal children, $df = 1, F = 740.22, P < 0.001$; overseas-born children, $df = 1, F = 7.04, P = 0.008$).

Fig. 3 shows the age-specific mean aggregate index of the number of decayed, missing and filled permanent teeth (DMFT), while Fig. 4 shows the corresponding decayed component (D) for Aboriginal and non-Aboriginal groups. From Fig. 3 it can be seen that both comparison groups had higher mean DMFT scores than the non-Aboriginal Australian-born children (Aboriginal children, $df = 1, F = 55.43, P < 0.001$; overseas-born children, $df = 1, F = 14.19, P < 0.001$). The DMFT scores diverge between the groups from 7 years of age, which reflects both the progressive eruption of the permanent dentition and the corresponding increase in the number of teeth at risk of disease, as well as the related accumulation of disease and treatment consequences, such as fillings.

From Fig. 4 it is clear that there was a substantial effect for the decayed (D) component of the DMFT index, with both comparison groups having significantly higher mean numbers of decayed teeth than Australian-born non-Aboriginal children (Aboriginal children, $df = 1, F = 261.78, P < 0.001$; overseas-born children, $df = 1, F = 6.48, P = 0.01$). There was substantial evidence of divergence between the groups from the age of 5 years, with no

Fig. 2. Mean number of decayed deciduous teeth in Aboriginal, non-Aboriginal Australian-born, and overseas-born children (MANOVA for Aboriginal or overseas-born versus non-Aboriginal Australian-born; $P < 0.05$).

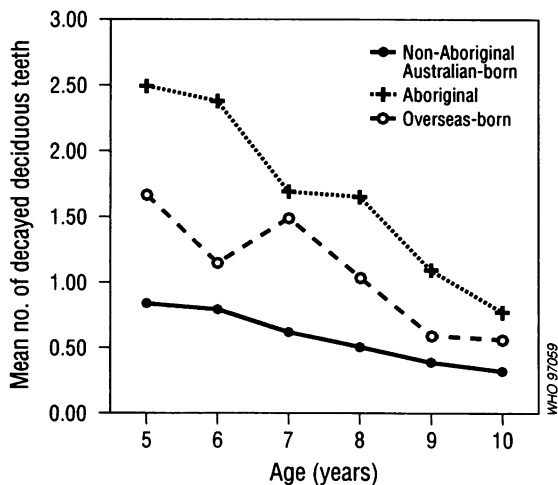


Fig. 3. Mean DMFT score in Aboriginal, non-Aboriginal Australian-born, and overseas-born children (MANOVA for Aboriginal or overseas-born versus non-Aboriginal Australian-born; $P < 0.05$).

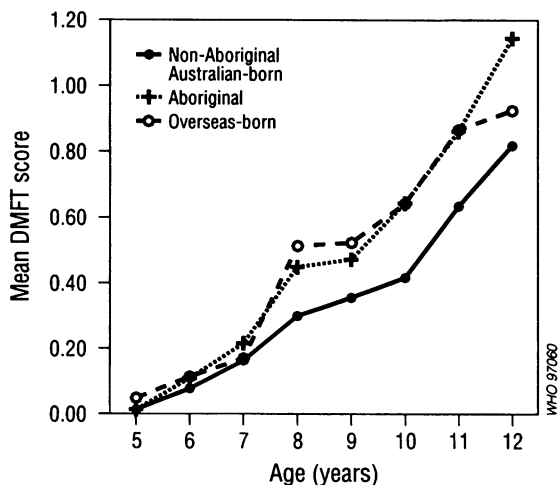
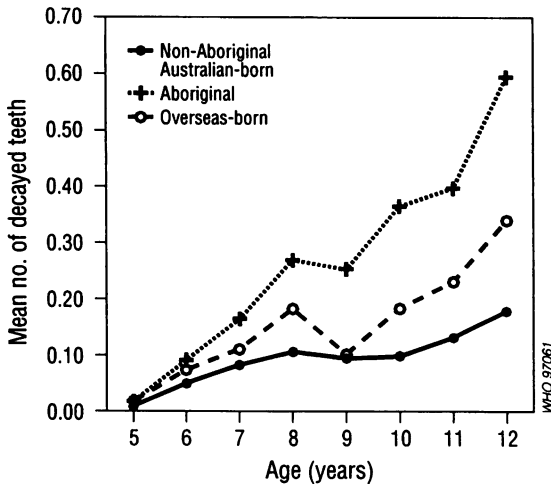


Fig. 4. Mean number of decayed permanent teeth in Aboriginal, non-Aboriginal Australian-born, and overseas-born children (MANOVA for Aboriginal or overseas-born versus non-Aboriginal Australian-born; $P < 0.05$).



apparent plateauing of the gradients across years. Indeed, there is a threefold variation in the mean number of decayed teeth by the age of 12 years between non-Aboriginal Australian-born children and Aboriginal children. The divergence may be due to variations in the use of non-invasive fissure sealants, which are placed on grooved tooth surfaces as a preventive measure to reduce the risk of caries (B. Simmons, unpublished data, 1996). The variation in levels of fissure sealants between groups was confirmed in the present study: Aboriginal children had a lower and the overseas-born children a higher mean number of sealed teeth than non-Aboriginal Australian-born children (Aboriginal children, $df = 1$, $F = 239.41$, $P < 0.001$; overseas-born children, $df = 1$, $F = 8.75$, $P = 0.003$). The variation between groups in the pattern of treatment is consistent with children from overseas having had relatively high rates of disease prior to arrival in Australia, which are subsequently successfully targeted for care. In contrast, Aboriginal children had greater caries experience than non-Aboriginal children, and had been less successfully targeted for care.

Further variation in treatment was also evident in the numbers of filled permanent teeth; overseas-born children had higher mean numbers of filled teeth than non-Aboriginal Australian-born children, and Aboriginal children had lower mean numbers of filled teeth than non-Aboriginal Australian-born children (Aboriginal children, $df = 1$, $F = 8.63$, $P =$

0.003; overseas-born children, $df = 1$, $F = 9.13$, $P = 0.003$). Unlike the deciduous dentition, there were no significant differences between the groups for missing permanent teeth, and the mean numbers of missing permanent teeth were very small for all groups.

As with the deciduous dentition, the proportion of the DMFT index for permanent teeth that is accounted for by the D component provides an indication of the degree of unmet need. The proportion was higher in Aboriginal children than in non-Aboriginal Australian-born children and overseas-born children (Aboriginal children, $df = 1$, $F = 120.05$, $P < 0.001$; overseas-born children, $df = 1$, $F = 239.4$, $P < 0.001$). Combined with the information that the comparison groups both had higher DMFT scores, this indicates a double disadvantage for Aboriginal children: more disease experience and a higher proportion of disease experience going untreated.

The number of decayed teeth and the ratio of decayed:filled teeth are indications of the timeliness and the appropriateness of care, and are related to the interval between visits. Aboriginal children had significantly longer periods (mean, 14.0 months) since their last visit to CDS than non-Aboriginal Australian-born children (mean, 10.9 months; $df = 1$, $F = 480.05$, $P < 0.01$). This is in contrast to the similar time since last visit for non-Aboriginal Australian-born (10.9 months) and overseas-born children (10.7 months).

Discussion

It is important to consider sources of potential bias and confounding in the data before proceeding to an interpretation of our results. One factor that may explain the observed differences between groups is the impact of geographical isolation. However, an earlier study on the comparative dental health of Aboriginal children, controlling for the effect of remoteness by comparing urban and remote communities separately, indicated that the differences between Aboriginal and non-Aboriginal children were not influenced by remoteness from urban centres (10).

Further potential sources of error included participation within CDS of a particularly unhealthy subgroup of the Aboriginal population, or the recording of Aboriginal for only those children who conformed to a particular cultural and health stereotype. However, the proportion of this total sample that was recorded as Aboriginal (28%) was close to the 1986 census estimate of 30% for the same age group. This suggests that this source of bias did

not operate to a substantial degree. The risk of selection bias and sampling error was also greatly reduced in our study by the adoption of high rates of sampling in the capital city (1:1.9) and the complete enumeration of the patient population for the rest of the Northern Territory.

These findings demonstrate that the dental health profiles of Aboriginal and overseas-born children in Northern Territory are distinctively different from those of non-Aboriginal Australian-born children. Relative to that of Australian-born non-Aboriginal children, the dental health profile of the deciduous teeth of the Aboriginal children was characterized by a relatively high prevalence of caries experience, high numbers of decayed teeth, and low numbers of filled and missing teeth. This profile reflects problems in the prevention and management of dental disease even among those children using CDS.

The profile of overseas-born children reflects both greater experience of disease, and more treatment in the form of restorations and extractions than that of non-Aboriginal Australian-born children. Of particular note for the former children was the comparatively high number of missing deciduous teeth, which may be indicative of experiences prior to arriving to Australia, in particular, dietary practices (e.g. inappropriate patterns of bottle-feeding resulting in nursing caries), less exposure to fluoride, or a combination of these factors which placed these children at substantially greater risk of caries that could progress to stages sufficiently serious to warrant extraction.

The profile of the non-Aboriginal Australian-born group was significantly better than that of either of the other groups with regard to most measures of caries experience in the permanent dentition. An exception was with regard to the number of missing permanent teeth: neither of the comparison groups was different from the non-Aboriginal Australian-born group. Again the profile of the Aboriginal group was characterized by relatively high DMFT scores, low numbers of filled teeth, high numbers of decayed teeth and low numbers of sealed permanent teeth.

The profile of caries experience of Aboriginal children appears to have been different from that of non-Aboriginal children since 1989, when the aggregate DMFT scores for Aboriginal and non-Aboriginal children were not significantly different (10). It is important to note that this change in Northern Territory is attributable to the continued nationwide decline in DMFT prevalence in the non-Aboriginal population rather than to substantial changes among the Aboriginal population in Northern Territory. Nevertheless, there has been an in-

crease in the number of indices for which Aboriginal children are disadvantaged compared with non-Aboriginal Australian-born children.

Conclusion

It appears that the relative advantage in dental health noted historically for Aboriginal children has been eroded through slight increases in the level of caries experience within the Aboriginal population, but predominantly through large reductions in the caries experience in the non-Aboriginal population. It is also apparent that migrant groups have distinguishing patterns of higher caries experience, although they appear to have been more successful in gaining access to treatment than Aboriginal children. The implication of these data is that Aboriginal children have not benefited to the same extent as non-Aboriginal children from improvements in dental health in Northern Territory or the delivery of dental services. The findings of less favourable health profiles are consistent with longer periods between visits for dental care, a lack of exposure to community-based preventive measures, and problems in service delivery and utilization for Aboriginal children. It is not possible, however, to determine from these data which of these factors, or combination thereof gives rise to the observed differences.

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Résumé

La carie dentaire chez les enfants aborigènes australiens, les enfants non aborigènes nés en Australie et les enfants nés à l'étranger

Peu d'études récentes ont expressément comparé la prévalence de la carie dentaire de nos jours chez les enfants australiens aborigènes et non aborigènes. Historiquement, les populations aborigènes d'Australie ont enregistré une incidence beaucoup moins importante de la carie dentaire que les Australiens non aborigènes. La baisse rapide de l'incidence de la carie chez les populations non aborigènes observée ces dernières décen-

nies a toutefois effacé en partie cet avantage. La présente étude compare l'expérience en matière de carie de 4183 enfants aborigènes australiens avec celle de 9674 enfants nés en Australie mais non aborigènes et de 957 enfants nés à l'étranger et habitant le Northern Territory en Australie. Ces cas constituent un échantillon pondéré de patients du Service dentaire communautaire (CDS) âgés de 4 à 13 ans, pour la période janvier-décembre 1992. Le CDS propose un service dentaire universel à tous les enfants d'âge scolaire, dont la couverture est très large dans la population. Les données considérées étaient les suivantes: la somme des dents de lait (DCAO) et des dents permanentes (DCAO) cariées, absentes et obturées. Les comparaisons prévues, avec les enfants nés en Australie mais non aborigènes comme groupe témoin, ont fait apparaître un nombre beaucoup plus important de dents cariées et, dans l'ensemble, une incidence plus élevée de la carie dans les dentitions de lait et permanentes chez les enfants aborigènes et nés à l'étranger. Des comparaisons plus poussées ont montré que les enfants aborigènes avaient un nombre moins important de dents de lait et de dents permanentes obturées tandis que les enfants nés à l'étranger avaient davantage de dents permanentes obturées et de scellements et davantage de dents de lait absentes que les enfants nés en Australie non aborigènes. Ces résultats indiquent un niveau plus élevé de morbidité et de problèmes non traités chez les enfants aborigènes et les enfants nés à l'étranger. Les différences observées dans le tableau de la carie dentaire et son traitement ont des répercussions importantes sur l'allocation des ressources en vue de réduire les inégalités sociales en matière de santé bucco-dentaire chez les enfants.

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