Community Dent Oral Epidemiol 2006; 34: 267–76

Community Dentistry and Oral Epidemiology

Oral health inequalities among indigenous and nonindigenous children in the Northern Territory of Australia

Lisa M. Jamieson, Jason M. Armfield and Kaye F. Roberts-Thomson

Australian Research Centre for Population Oral Health, The University of Adelaide, Adelaide, SA, Australia

Jamieson LM, Armfield JM, Roberts-Thomson KF. Oral health inequalities among indigenous and nonindigenous children in the Northern Territory of Australia. Community Dent Oral Epidemiol 2006; 34: 267–76. © Blackwell Munksgaard, 2006

Abstract – *Objective:* To describe oral health inequalities among indigenous and nonindigenous children in the Northern Territory of Australia using an area-based measure of socioeconomic status (SES). *Methods:* Data were obtained from indigenous and nonindigenous 4–13-year-old children enrolled in the Northern Territory School Dental Service in 2002–2003. The Socio-Economic Indices For Areas (SEIFA) were used to determine socioeconomic relationships with dental disease experience. *Results:* Some 12,584 children were examined, 35.1% of whom were indigenous. Across all age-groups, socially disadvantaged indigenous children experienced higher mean dmft and DMFT levels than their similarly aged, similarly disadvantaged nonindigenous counterparts. Indigenous children aged 5 years had almost four times the dmft of their nonindigenous counterparts in the same disadvantage category ($P < 0.05$), while indigenous children aged 10 years had almost five times the DMFT of similarly disadvantaged nonindigenous children ($P < 0.05$). A distinct social gradient was apparent among indigenous and nonindigenous children, respectively, whereby those with the highest dmft/DMFT levels were in the most disadvantaged SES category and those least disadvantaged had the lowest dmft/DMFT levels. In most age-groups, indigenous children who were least disadvantaged had worse oral health than the most disadvantaged nonindigenous children. *Conclusions:* The findings suggest that indigenous status and SES have strong oral health outcome correlations but are not mutually dependent, that is, indigenous status influences oral health outcomes irrespective of social disadvantage. From a health policy perspective, greater oral health gains may be possible by concentrating public health and clinical effort among all indigenous children irrespective of SES status.

Key words: children; indigenous; oral health; social inequalities

Lisa M. Jamieson, Australian Research Centre for Population Oral Health, University of Adelaide, Adelaide, SA 5005, Australia
Tel: +61 8 8303 4611
Fax: +61 8 8303 4858
e-mail: lisa.jamieson@adelaide.edu.au

Submitted 13 April 2005;
accepted 8 September 2005

Socioeconomic status (SES) plays an important role in oral health and is understood to be in a complex interplay with other oral health determinants such as knowledge and beliefs, behaviors and biomedical factors (Fig. 1) (1). The role of SES in child oral health has been well documented, with children of low SES being consistently shown to have poorer oral health than higher-SES children (2, 3). The measurement of SES varies according to culture and, in Western society, includes factors such as individual/household income, residential location, occupation, education, housing, access to health care, language group and mobility (4, 5). Various indices exist to measure SES and these are often tailored to more adequately fit the unique situation of specific countries and communities (4, 6). Increased understanding of the oral health/SES relationship helps reveal areas important for

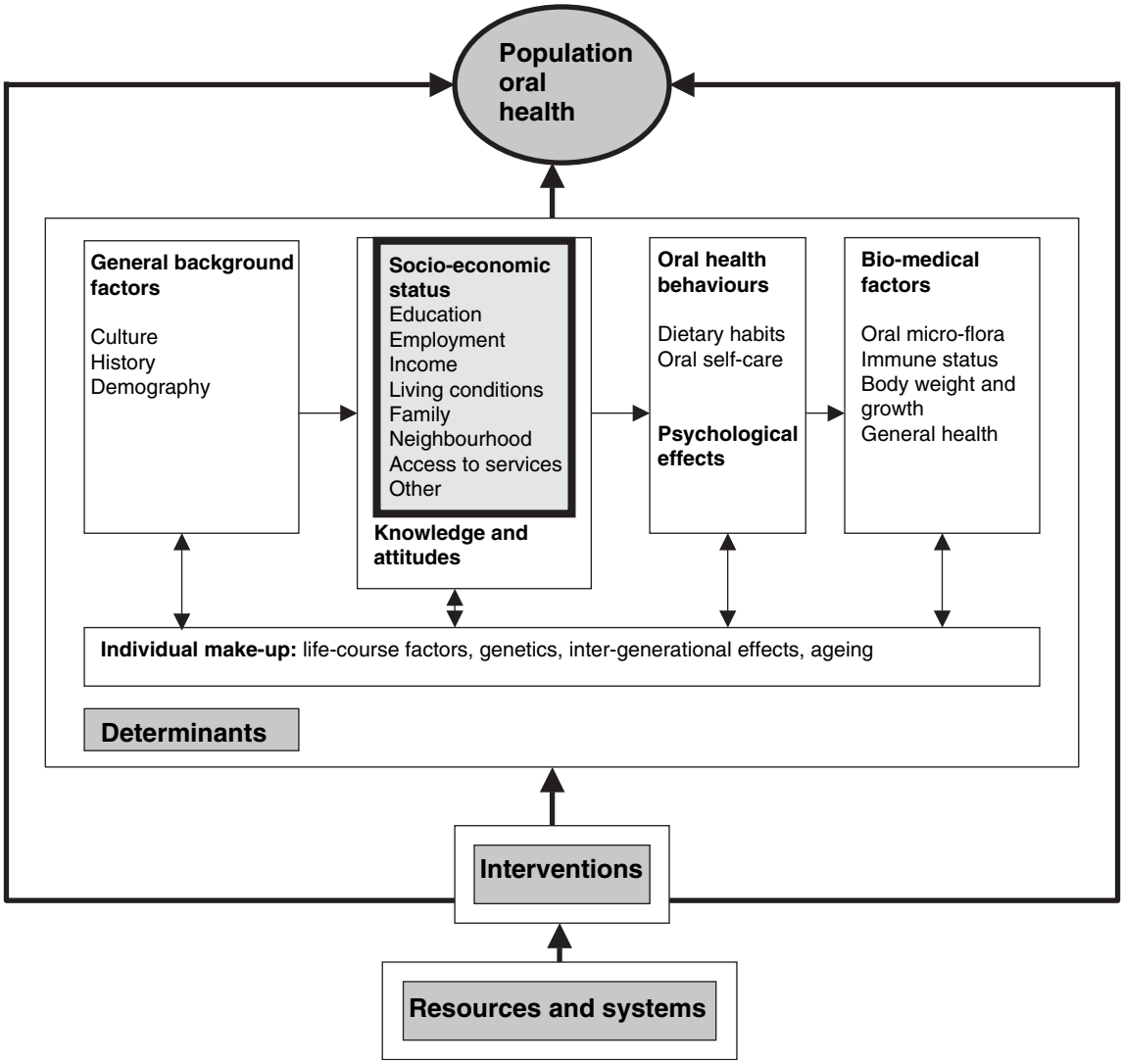


Fig. 1. Conceptual framework for population oral health [modified from AIHW (8)].

clinical intervention, epidemiological measurement and public policy (4).

At the time of the 2001 census there were approximately 4 million children (aged 0–14 years) in Australia (7), a country comprising of six states and two territories. Indigenous children are those who identify as Aboriginal, Torres Strait Islander or both, and represent 4.7% of the child population (7). Such children live in a wide range of locations, speak a multitude of languages and belong to hundreds of distinct descent groups (8). While this paper focuses on indigenous children as a group, it is important to acknowledge this diversity. Most indigenous children live in metropolitan areas (52%), where they constitute 2% of the metropolitan child population (7). The indigenous proportion in total child population increases with rising geographic remoteness, with 25% of indigenous children living in 'remote' or 'very remote' areas compared with 3% of the nonindigenous child population (9). Approximately 40% of children in the Northern Territory are indigenous (8).

Prior to the 1980s, indigenous children in Australia were recognized as having better oral health than their nonindigenous counterparts (10–13). Recent evidence suggests, however, that indigenous children have, on average, twice as much (and in some communities, up to five times as much) tooth decay as nonindigenous children (14–17). In one study of remote indigenous children, more than 90% of child dmfs was found to be made up of either decayed or missing surfaces, and less than 10% of tooth surfaces with experience of decay had been treated with a filling (14). Literature shows that indigenous children in countries such as New Zealand, Canada and the United

States also experience poorer oral health than their nonindigenous counterparts (18–20).

In the past, oral health investigations pertaining to SES relied largely upon individual (household-level) measures (21, 22). However, Macintyre et al. (23) suggested that neighborhood conditions influenced oral health behaviors, promoted diffusion of oral health-related information and increased adoption of healthy normative behaviors; all of which contributed to the prevention of dental diseases. They also contended that a neighborhood's conditions, such as the number of dental providers and clinics, facilitated promotion of healthy behaviors including regular oral health checkups and dissemination of oral health-related information to community members (23). For these reasons, and because of their ability to better capture contextual factors involved in the etiology of oral health disparities among certain population groups, the utility of area-based SES tools in the measure of oral health inequalities has increased in recent years (3).

Dental public health researchers are becoming increasingly interested in how inequality and variation in social context affect oral health outcomes (24, 25). This is particularly so in regards to indigenous populations. Indigenous groups, by definition, exist naturally in a particular country, region or environment; they are 'native' (26). However, in many nations, including Australia, such groups have been victims of colonization, discrimination and marginalization, with policies often focusing on assimilation and, in some cases, cultural annihilation (27). Such historical legacy has had marked impacts on all aspects of indigenous health, including oral health. It is important that the indigenous situation is considered to be separate and unique to that of other ethnic minority groups when exploring oral health outcomes and reasons for disparities so that the goals outlined in the Geneva Declaration on the Health and Survival of Indigenous Populations might be met (28, 29).

The aim of this study was to describe oral health inequalities among indigenous and nonindigenous children in an Australian territory using an area-based SES measure. The hypotheses were that: (i) indigenous children would have worse oral health than nonindigenous children; (ii) consistent gradients would occur between high and low SES groups in indigenous and nonindigenous child oral health outcomes, respectively; and (iii) when SES factors were taken into account, the magnitude of oral health disparities between indigenous and nonindigenous children would lessen.

Methods

Data for this study were collected as part of the Child Dental Health Survey, a monitoring survey of the oral health status of children enrolled in the government-funded School Dental Service (SDS) in each state and territory of Australia. Data are obtained each year from routine dental examinations conducted by noncalibrated dental health professionals within the service. Dental examiners are not calibrated but receive similar professional training and use standardized procedures. Children are enrolled from both public and private schools. The SDSs provide care essentially to primary school-aged children, with service provision typically including dental examinations, preventive services and restorative treatment as required. Children enrolled in the Northern Territory SDS served as participants in this study due to the very high percentage of indigenous children in this Australian region. In 2001, indigenous children represented 40.1% of the 4–14-year olds in the Northern Territory (8). Children enrolled in the Northern Territory SDS represent about 86% of the total Northern Territory child population (30).

A random sampling procedure was used to select approximately one in two (1:1.9) children residing in the capital city of Darwin. This was achieved by selecting those children whose birthday was between the 1st and 16th (inclusive) of any given month. All children residing outside Darwin were included in the sampling frame. Data were weighted on the basis of 'area of sampling' and 'sampling fraction' to provide a more representative result, and by 'time since last dental examination' so that children on longer recall intervals were not under-represented (children with good oral health may be placed on recall intervals of 15–18 months). Ethical approval for the study was obtained from the Australian Institute of Health and Welfare and the University of Adelaide.

SES measure

The Socio-Economic Indices For Areas (SEIFA) were used to determine socioeconomic relationships with dental disease experience. The indices were developed by the Australian Bureau of Statistics (ABS) using data derived from the 2001 Census of Population and Housing (31), and use a

range of measures to rank areas based on their relative social and economic well-being. For purposes of this report, the SEIFA Index of Disadvantage (category 2) was used. This index takes into account variables relating to income, educational attainment, unemployment and dwellings without motor vehicles. In particular it focuses on low-income earners, relatively lower educational attainment and high unemployment. The SEIFA Index has been validated against house-hold measures of SES (31) and is a standardized instrument frequently used in the measurement of SES at a population level in Australia. In the figures, '1' denotes the most disadvantaged areas and '4' denotes the least disadvantaged areas.

Oral health indices

The dmft (sum of decayed, missing and filled teeth in the deciduous dentition) and DMFT (sum of decayed, missing and filled teeth in the permanent dentition) indices were used to assess oral health outcomes. The indices include a record of the presence/absence of all teeth including presumptive cause of tooth loss and are a cumulative measure of caries experience. Both measures were used for children aged 6–10 years because in such age-groups children have a mixed dentition (both primary and permanent teeth are present). Permanent teeth usually begin erupting around the age of 6 years.

Indices of caries experience were calculated from data collected over a 12-month period in 2002–2003. When children received more than one examination during this period, information derived from the first examination only was included. Data were analyzed using SPSS 12.0 and 95% confidence intervals were generated for each age-group and SEIFA score in relation to mean dmft/DMFT.

Results

The sample comprised 12,584 children aged 4–13 years, of whom 35.1% (n = 4414) were indigenous. Indigenous and nonindigenous child distribution by age is presented in Table 1. The age-group with the highest proportion of indigenous children was 13 years (43.4%), while the age-group with the lowest proportion of indigenous children was 4 years (27.5%).

The mean dmft for 4–10-year-old children by indigenous status is presented in Fig. 2. The mean dmft for indigenous children was greater than for nonindigenous children across all age-groups, with the differential being greatest in the younger age-groups. Five-year-old indigenous children had the highest mean dmft levels and this was 3.0 times that of nonindigenous 5-year olds.

Table 1. Number of indigenous and nonindigenous children by age (row percentages in brackets)

Age (years)	Indigenous	Nonindigenous
4	365 (27.5)	961 (72.5)
5	476 (33.0)	967 (67.0)
6	426 (30.3)	981 (69.7)
7	514 (35.7)	924 (64.3)
8	556 (38.5)	890 (61.5)
9	542 (37.3)	913 (62.7)
10	534 (37.8)	880 (62.2)
11	503 (37.3)	847 (62.7)
12	377 (36.7)	649 (63.3)
13	121 (43.4)	158 (56.6)
Total	4414 (35.1)	8170 (64.9)

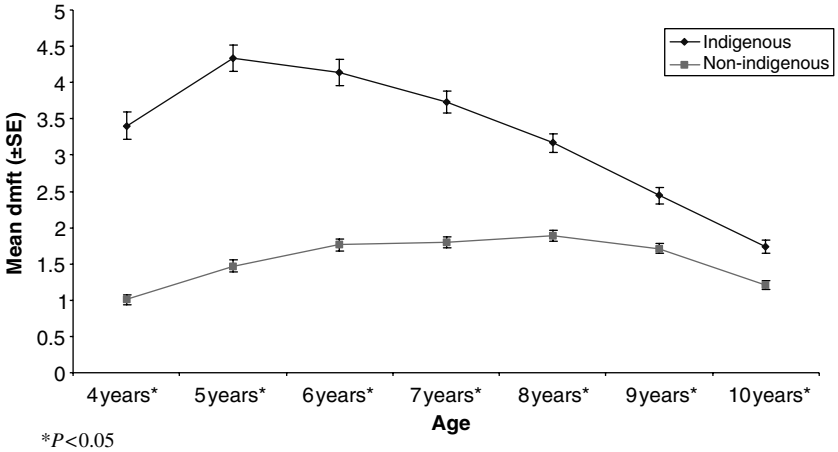
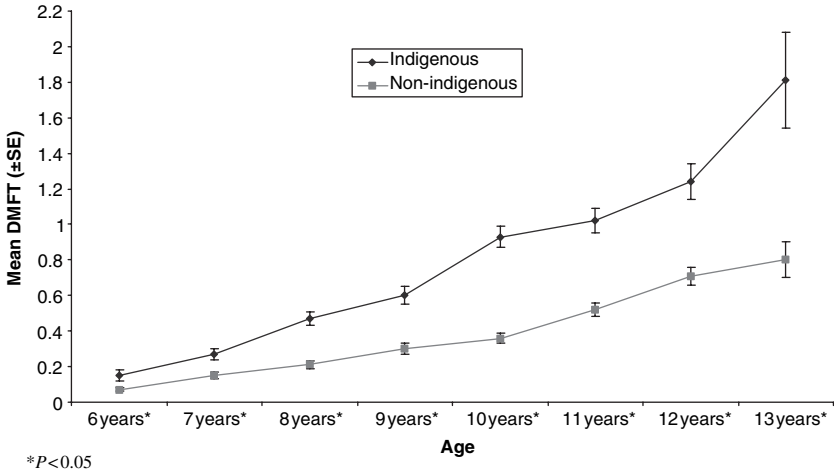
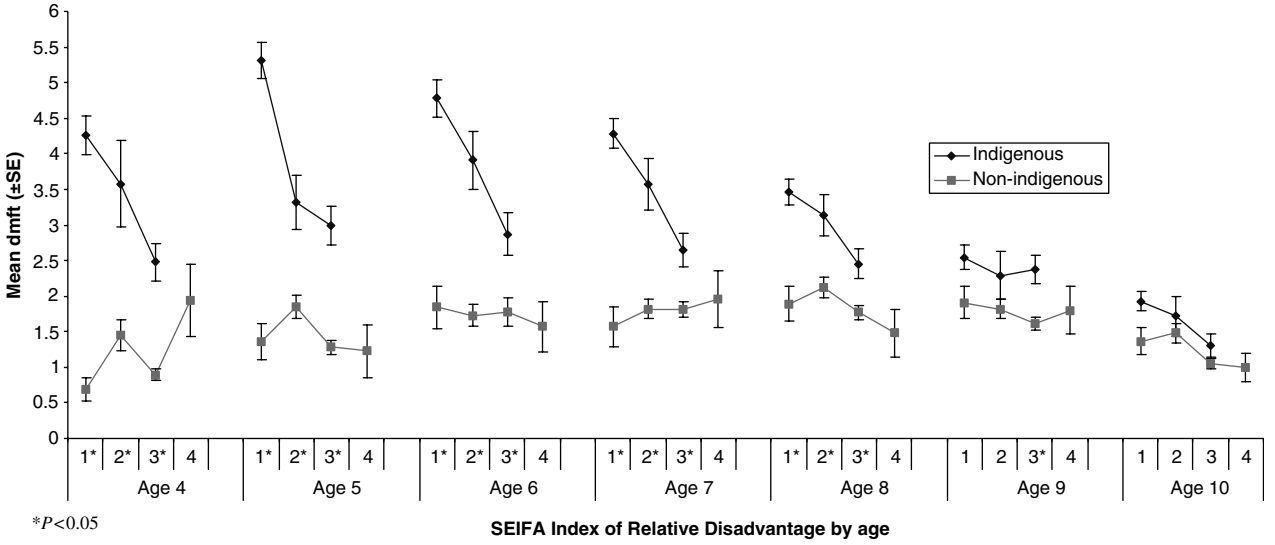


Fig. 2. Mean dmft by indigenous status and age.



*$P<0.05$

Fig. 3. Mean DMFT by indigenous status and age.



*$P<0.05$

Fig. 4. Mean dmft for 4–10-year-old children by SEIFA Index of Relative Socio-Economic Disadvantage.

The mean DMFT for 6–13-year-old children by indigenous status is presented in Fig. 3. Across all age-groups, the mean DMFT of indigenous children was greater than that of nonindigenous children, with the magnitude of the disparity increasing with increasing age. Thirteen-year-old indigenous children had the highest mean DMFT and this was 2.3 times that of nonindigenous children.

The mean dmft for 4–10-year-old children by the SEIFA Index of Relative Socio-Economic Disadvantage is presented in Fig. 4. Note that for indigenous children, no cases fell into the least disadvantaged category. Across all ages and disadvantage categories, indigenous children had higher dmft scores than their nonindigenous counterparts. Indigenous children aged 5 years had the highest mean dmft score and this was 3.9 times the dmft of nonindigenous children in the same disadvantage category. The highest dmft among nonindigenous children was observed among 8-year olds, with 8-year-old indigenous children in the same disadvantage category having 1.5 times this score. Among indigenous children aged 4–8 years, dmft levels fell steeply with increasing socioeconomic advantage. This was less marked among indigenous children aged 9–10 years, but an overall decrease was still observed. The dmft differential between indigenous and nonindigenous children was greater in the 4–8-year age-groups, but was reduced considerably in the 9–10-year age-groups. Across all ages (except age 10) the lowest dmft score among indigenous children was higher than the highest dmft score of nonindigenous children, irrespective of disadvantage category. The mean dmft of 4- and 7-year-old nonindigenous children increased with decreasing social disadvantage, but these changes were not statistically significant.

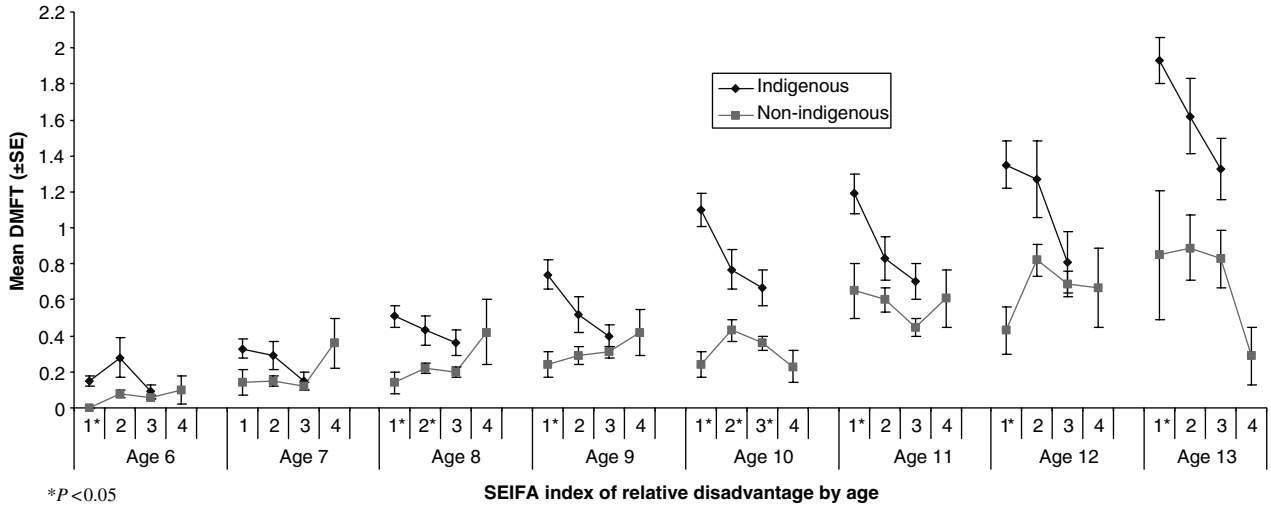


Fig. 5. Mean DMFT for 6–13-year-old children by SEIFA Index of Relative Socio-Economic Disadvantage.

The mean DMFT for 6–13-year-old children by the SEIFA Index of Relative Socio-Economic Disadvantage is presented in Fig. 5. There were no indigenous children in the least disadvantaged category. Indigenous children had higher DMFT levels than nonindigenous children across all ages and disadvantage categories. Thirteen-year old indigenous children experienced the highest mean DMFT levels and this was 2.3 times the DMFT score of their nonindigenous counterparts in the same disadvantage group. The greatest differential was observed among 10-year olds, with the most disadvantaged indigenous children having 4.6 times the DMFT of nonindigenous children in the same disadvantage category. While DMFT increased with increasing age across both child samples, the trend was more pronounced among indigenous children (for example; the DMFT of the most disadvantaged indigenous 6- and 13-year olds were 0.15 and 1.93, respectively, while for similarly aged and disadvantaged nonindigenous children, DMFT levels of 0.0 and 0.85, respectively, were observed). Across all age-groups (except age 6), the DMFT differential between indigenous and nonindigenous children was widest among the most disadvantaged groups. The lowest DMFT score of indigenous children was equal to or higher than the highest DMFT score of nonindigenous children across all ages (except ages 7 and 8), irrespective of disadvantage category. The mean DMFT of 6–9-year-old nonindigenous children in the least disadvantaged category was greater than their most disadvantaged counterparts, although these differences were not significant.

Discussion

This cross-sectional investigation of a child sample in an Australian territory has showed that social inequalities were present with respect to indigenous status when an area-based SES measure was used to assess oral health outcomes. Across all age-groups, indigenous children had worse oral health than nonindigenous children, and the most disadvantaged indigenous children had poorer oral health than their less-deprived indigenous counterparts (with the downward trend in dmft/DMFT score against increasing social advantage generally being linear). The differentials between indigenous and nonindigenous dental disease experience were marked, with indigenous children in the least disadvantaged categories frequently having worse oral health than nonindigenous children in the most disadvantaged categories. While the magnitude of oral health disparities between indigenous and nonindigenous children generally lessened with increasing SES advantage, a differential still remained and suggests that the oral health disparities observed cannot be explained by SES factors alone.

There may be a number of explanations for our findings. One obvious reason is that the SEIFA Index of Relative Disadvantage may not have been a sensitive enough measure of SES for the purposes of our study; that is, the parameters of the tool did not adequately encompass the multitude of complex and inter-related SES factors unique to the indigenous situation. This may have been overcome by using the index in conjunction with other

SES measures, for example, individual or household-level SES instruments, or by using more culturally specific SES tools such as household size, number of children for whom income-earners are financially responsible and access to dental services. However, the importance of using area-based measures of SES when assessing the health outcomes of indigenous groups has been stressed by Durie (27), who states that individual-level analyses of SES (particularly those pertaining to occupation) fail to capture the complex, diverse and multi-faceted factors that contribute to socio-economic disadvantage among indigenous groups.

Consideration of the 'life course' model may offer further explanation for the oral health disparities observed in the deciduous dentition among indigenous and nonindigenous 4–8-year olds, and in the permanent dentition among indigenous and nonindigenous 8–13-year olds. This paradigm suggests that cumulative lifetime exposure to 'oral health-promoting' or 'oral health-damaging' environments are the most accurate explanations for observed oral health differences between population groups, with poor growth and development, and adverse environmental conditions at a young age being associated with high risk of dental diseases in later life (32). Examples include preterm low-birth-weight babies being more likely to have enamel hypoplasia leading to increased risk of dental decay in the primary and permanent dentition (33–35), and people who experience poor systemic health at a younger age being more likely to encounter rapidly progressive periodontitis in later life (21, 36). There were no specific measures of life-course factors in our study, but data from the 2001 census pertaining to the Northern Territory reveal that the proportion of low birthweight indigenous children is 2.2 times that of nonindigenous children and that such indigenous children have 2.5 times the burden of disease (higher risk of disease, injury and mortality, and more likely to be hospitalized for most diseases and conditions) (8) of nonindigenous children (37). In addition, Northern Territory indigenous children are 5.5 times more likely to be the subject of child abuse and 2.6 times more likely to be placed in out-of-home care than nonindigenous children (37). Such life-course factors may impact on oral health outcomes (35) and thus may have influenced the oral health disparities observed.

Location may have been an additional factor influencing our findings. Some 80.1% of indigenous children in the Northern Territory reside in remote or very remote locations compared with 32.4% of nonindigenous children (7). Endean et al. (16) found that remote indigenous children had much higher dental disease levels than the general Australian child population, and in both Canada and the United States rural-dwelling indigenous children have been consistently found to have poorer oral health than their counterparts in urban areas (18, 19). The provision of dental services in the Northern Territory varies from community to community depending on location, logistical challenges and staff availability. For example, indigenous children living in remote communities in the Top End of the Northern Territory (the area directly north of Darwin) receive dental service provision fortnightly/monthly, while the remaining 83% of the Northern Territory remote-living indigenous child population (7) receive dental service provision less frequently (written personal communication; Jill Davis, Director, Oral Health Services, Department of Health and Community Services, Northern Territory Government). The provision of oral health education and promotion initiatives in these communities is also limited. Remoteness additionally impinges on indigenous children's general health which, following the life-course model, may have long-term impacts on oral health. Physical height and weight measures of indigenous children in remote areas fall far short of average urban indigenous children measures, and the prevalence of anemia and other nutrient-deficient conditions among expecting mothers in such locations is high (38–41). People in remote communities also have limited access to fresh food produce and, in areas where healthy food is available, competing priorities for limited family incomes, lack of nutritional knowledge by caregivers and lack of culturally appropriate information on healthy food may contribute to dietary choices that are not conducive to generating or maintaining health (8).

The efficacy of fluoride in the prevention of dental caries is incontrovertible (42–45). Fluoride exposure (or lack thereof) may thus have been a further contributing factor in the oral health disparities observed. Water fluoride levels (natural or otherwise) are known for around 10% of remote indigenous communities in the Northern Territory. There are large variances in water fluoride levels between such communities, for example, many communities in the Top End have negligible fluoride levels while some areas in central Australia have natural water fluoride levels that are too

high (46). The city of Darwin has water fluoridation of 0.6 ppm. Some 67.6% of the nonindigenous Northern Territory child population live in Darwin, compared with 14.5% of the indigenous child population (9). Given the representativeness of our sample, more of those exposed to the benefits of water fluoridation may have been nonindigenous. In contrast to metropolitan areas, the availability of fluoridated toothpaste in remote communities is also inconsistent, and if available, may be three times the cost in urban stores (46).

Another element that may have influenced our findings concern the upstream factors that have shaped present-day indigenous Australian society. It is becoming increasingly evident that the separatism and disempowerment that has occurred among indigenous Australian groups since cohabitation with nonindigenous people some 200-odd years ago has had deeper implications than previously acknowledged; with accumulation of such grievances being manifest in the widespread indigenous social and health problems witnessed today (47). On a world scale, Australia boasts one of the finest records of general and oral health, yet the health status of its indigenous groups are on par with inhabitants of the poorest developing countries (47). Wooldridge (48) acknowledged that 'our single most spectacular failure as a nation has been in the area of Aboriginal and Torres Strait Islander health', which was suggested by Thomson (47) as being due (in part) to the lack of social resources in indigenous communities and to partnerships between indigenous groups and government health services being frequently 'set up to fail'. High welfare dependence (in the Northern Territory, 85% of indigenous adults are dependent upon welfare) (7) is also recognized as being socially destructive and as having a major negative influence on a community's morale, which may be expressed in certain 'down stream' factors including child oral health outcomes (49, 50).

In summary, our findings suggest that SES alone (as measured by the SEIFA Index) does not account for observed oral health disparities among indigenous and nonindigenous children in an Australian territory. The findings add to the collective knowledge of indigenous oral health issues and, as such, may enable policy makers to implement more effective and relevant indigenous oral health strategies, including initiatives that address 'upstream' factors as well as those more directly related to dental service provision, and oral health education and promotion. The findings provide some insight into the complex relationship between SES, indigenous status and oral health, and may be useful in the design of investigations that aim to further explore indigenous child oral health inequalities. Although our investigation focused on indigenous children in one Australian territory, the findings have international relevance as the global community becomes increasingly aware of their role in addressing the social, economic and health disadvantages experienced by indigenous groups throughout the world.

Acknowledgements

The authors are grateful to the Northern Territory dental authorities and School Dental Service for their assistance and support in the collection of this research data.

References

1. Provart SJ, Carmichael CL. The use of an index of material deprivation to identify groups of children at risk to dental caries in County Durham. Community Dent Health 1995;12:138–42.
2. Vanobbergen JN, Martens LC, Lesaffre E, Declerck D. Parental occupational status related to dental caries experience in 7-year-old children in Flanders (Belgium). Community Dent Health 2001;18:256–62.
3. Gillcrist JA, Brumley DE, Blackford JU. Community socioeconomic status and children's dental health. J Am Dent Assoc 2001;132:216–22.
4. Oakes JM, Rossi PH. The measurement of SES in health research: current practice and steps toward a new approach. Soc Sci Med 2003;56:769–84.
5. Blane D. Social determinants of health—socioeconomic status, social class, and ethnicity. Am J Public Health 1995;85:903–5.
6. Kaplan GA. People and places: contrasting perspectives on the association between social class and health. Int J Health Serv 1996;26:507–19.
7. Australian Bureau of Statistics. Indigenous profile 2001 census of population and housing. Canberra: Australian Government; 2001.
8. Australian Institute of Health and Welfare. Australia's health 2004. Canberra: AIHW; 2004.
9. Trewin D, Madden R. The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples, 2003. Canberra: Australian Bureau of Statistics; 2003.
10. Barrett MJ. Dental observations on Australian Aborigines, Yuendumu, Central Australia, 1951–52. Aust J Dent 1953;57:27–38.
11. Kailis DG. Dental conditions observed in Australian Aboriginal children resident in Warburton and Cundeelee mission, Western Australia. Aust Dent J 1971;16:44–52.
12. Kailis DG. Prevalence of dental caries in Australian Aboriginal children resident in Carnarvon, Western Australia. Aust Dent J 1971;16:109–15.

13. Barrett MJ, Williamson JJ. Oral health of Australian Aborigines: survey methods and prevalence of dental caries. Aust Dent J 1972;32:37–50.
14. Bourke C, Baima D, Allister J, Spencer AJ. Caries experience of aboriginal children in South Australia. J Dent Res 1999;78:951.
15. Tennant M, Namjoshi D, Silva D, Codde J. Oral health and hospitalisation in Western Australian children. Aust Dent J 2000;45:204–7.
16. Endean C, Roberts-Thomson K, Wooley S. Anangu oral health: the status of the Indigenous population of the Anangu Pitjantjatjara lands. Aust J Rural Health 2004;12:99–103.
17. Schamschula RG, Cooper MH, Adkins BL, Barmes DE, Agus HM. Oral conditions in Australian children of Aboriginal and Caucasian descent. Community Dent Oral Epidemiol 1980;8:365–9.
18. Peressini S, Leake JL, Mayhall JT, Maar M, Trudeau R. Prevalence of early childhood caries among First Nations children, District of Manitoulin, Ontario. Int J Paediatr Dent 2004;14:101–10.
19. Jones DB, Schlife CM, Phipps KR. An oral health survey of Head Start children in Alaska: oral health status, treatment needs, and cost of treatment. J Public Health Dent 1992;52:86–93.
20. Thomson WM. Ethnicity and child dental health status in the Manuwatu-Wanganui Area Health Board. N Z Dent J 1993;89:12–4.
21. Thomson WM, Poulton R, Milne BJ, Caspi A, Broughton JR, Ayers KM. Socioeconomic inequalities in oral health in childhood and adulthood in a birth cohort. Community Dent Oral Epidemiol 2004; 32:345–53.
22. Heft MW, Gilbert GH, Shelton BJ, Duncan RP. Relationship of dental status, sociodemographic status, and oral symptoms to perceived need for dental care. Community Dent Oral Epidemiol 2003;31:351–60.
23. Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure them? Soc Sci Med 2002;55:125–39.
24. Newton JT, Corrigan M, Gibbons DE, Locker D. The self-assessed oral health status of individuals from White, Indian, Chinese and Black Caribbean communities in South-east England. Community Dent Oral Epidemiol 2003;31:192–9.
25. Borrell LN, Taylor GW, Borgnakke WS, Woolfolk MW, Nyquist LV. Perception of general and oral health in White and African American adults: assessing the effect of neighborhood socioeconomic conditions. Community Dent Oral Epidemiol 2004;32:363–73.
26. Webster's Reference Library. Concise edition dictionary and thesaurus. Scotland: Geddes and Grosset; 2002. p. 169.
27. Durie M. Understanding health and illness: research at the interface between science and indigenous knowledge. Int J Epidemiol 2004;33:1138–43.
28. Thomson N. The need for indigenous health information. In: Thomson N, editor. The health of indigenous Australians. Victoria: Oxford University Press; 2000. p. 1–24.
29. Committee on Indigenous Health. The Geneva declaration on the health and survival of indigenous peoples. New York: United Nations Permanent Forum on Indigenous Issues; 2002.
30. Armfield JM, Roberts-Thomson KF, Slade GD, Spencer AJ. Child dental health survey, Northern Territory 2000. Adelaide: The University of Adelaide; 2003.
31. Australian Bureau of Statistics. Census of population and housing – socio-economic indexes for areas. Canberra, Australia: Australian Government; 2001.
32. Kuh D, Ben Shlomo Y. A life course approach to chronic disease epidemiology. Oxford: Oxford University Press; 1997. p. 3–14.
33. Lukacs JR, Walimbe SR, Floyd B. Epidemiology of enamel hypoplasia in deciduous teeth: explaining variation in prevalence in western India. Am J Hum Biol 2001;13:788–807.
34. Aine L, Backstrom MC, Maki R, Kuusela AL, Koivisto AM, Ikonen RS et al. Enamel defects in primary and permanent teeth of children born prematurely. J Oral Pathol Med 2000;29:403–9.
35. Nicolau B, Marcenes W, Bartley M, Sheiham A. A life course approach to assessing causes of dental caries experience: the relationship between biological, behavioural, socio-economic and psychological conditions and caries in adolescents. Caries Res 2003;37:319–26.
36. Nicolau B, Marcenes W, Hardy R, Sheiham A. A life-course approach to assess the relationship between social and psychological circumstances and gingival status in adolescents. J Clin Periodontol 2003;30:1038–45.
37. Northern Territory Government Department of Health and Community Services. Aboriginal Health in the Northern Territory in DHCS Annual Report 2003/2004. Darwin: Northern Territory Government; 2004.
38. Hitchcock NE, Gracey M, Maller RA, Spargo RM. Physical size of 1887 aboriginal schoolchildren in the Kimberley region. Med J Aust 1987;146:415–9.
39. Dugdale AE, Muller M, Alsop-Shields L. Patterns of weight growth in aboriginal children on Queensland communities. J Paediatr Child Health 1994;30:55–8.
40. Mackerras DE, Reid A, Sayers SM, Singh GR, Bucens IK, Flynn KA. Growth and morbidity in children in the Aboriginal Birth Cohort Study: the urban-remote differential. Med J Aust 2003;178:56–60.
41. Gracey M. Historical, cultural, political, and social influences on dietary patterns and nutrition in Australian Aboriginal children. Am J Clin Nutr 2000;72:1361–7.
42. Mitchell L, Mitchell DA. Oxford handbook of clinical dentistry. New York: Oxford University Press; 1991. p. 24–5, 200–1.
43. Chestnutt IG, Gibson J. Churchill's pocketbook of clinical dentistry. New York: Churchill Livingston; 1998. p. 136–7.
44. Singh KA, Spencer AJ. Relative effects of pre- and post-eruption water fluoride on caries experience by surface type of permanent first molars. Community Dent Oral Epidemiol 2004;32:435–46.
45. Stookey GK, Mau MS, Isaacs RL, Gonzalez-Gierbolini C, Bartizek RD, Biesbrock AR. The relative anti-caries effectiveness of three fluoride-containing dentifrices in Puerto Rico. Caries Res 2004;38:542–50.
46. Nganampa Health Council. Dentistry in remote aboriginal communities. Alice Springs: Nganampa Health Council; 2001.

47. Thomson N. Responding to our spectacular failure. In: Thomson N, editor. The health of indigenous Australians. Victoria: Oxford University Press; 2000. p. 488–505.
48. Wooldridge M. Launch of Australia's health 2000 (media release). http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-mediarel-yr2000-mw-mwsp200622.htm. Cited 25 February, 2005.
49. Chavez R, Kemp L, Harris E. The social capital:health relationship in two disadvantaged neighbourhoods. J Health Serv Res Policy 2004;9:29–34.
50. Ziersch AM, Baum FE, Macdougall C, Putland C. Neighbourhood life and social capital: the implications for health. Soc Sci Med 2005;60:71–86.