

Socio-economic Inequities in Dental Caries Experience of 12-year-old South Africans: Policy Implications for Prevention.

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ABSTRACT

Objectives: To examine the socio-economic inequities in dental caries experience of 12-year-olds, in order to inform policy actions for caries prevention in South Africa.

Methods: Secondary analysis of the 1999-2002 national survey data of 12-year-olds (N=5411), available from 37 regions in 7 of the 9 provinces, was carried out. Logistic regression was used to determine risks for caries experience among 12-year-olds in each province, using parental occupation and racial group as independent variables. Regression curve-estimation was used to examine the spatial relationship between mean DMFT and caries prevalence.

Results: The mean DMFT (\pm SD) for the study population was 1.19 (\pm 2.13), significant caries index was 3.35 and caries prevalence was 40.1%. The highest mean DMFT was among the Coloured population (2.14 \pm 2.50). Compared to children in the highest occupational class, the risk for children of the unemployed to experience caries was lower in the North West province (Odds ratio [OR]=0.47; p <0.01), but significantly higher in the coastal provinces - KwaZulu-Natal and Northern Cape, with OR of 1.32 and 1.52 respectively. The regression curve derived demonstrated that a unit increase in caries experience in low-level caries populations would generate more cases than similar increase in high-level caries populations.

Conclusions: DMFT alone provided an incomplete picture of the impact of caries in South Africa, thus the need to monitor inequities as part of policy impact. The distribution of caries suggests that 'high-risk' approach to prevention in the presence of existing social gaps may inadvertently reinforce inequities in caries-burden and supports the concurrent implementation of population-approach, such as water fluoridation.

Keyword: Inequities; Caries Prevalence; Prevention; Mean DMFT; Risk.

INTRODUCTION

A recently published report described caries levels among South African children to be low.¹ However, the World Health Organisation's (WHO) World Health Report for the year 2000 emphasised the importance of assessing health not only by the level of disease, but also by examining its distribution.² In many countries, oral health is persistently associated with social disadvantage³⁻⁵ and reducing social inequities in health has become a political priority, especially so in South Africa.⁶ Equity in health has been defined as the absence of systematic disparities in health (or in the major social determinants of health) between social groups who have different levels of underlying social advantage/disadvantage – that is, different positions in a social hierarchy.⁷ Inequities in health, therefore, systematically put groups of people who are already socially disadvantaged (for example, by virtue of being poor, female, and/or members of a disen-

franchised racial, ethnic, or religious group) at further disadvantage with respect to their health. The concept of health equity is distinctly different from that of health equality. Health equity focuses on the distribution of resources and other processes that drive a particular kind of health inequality between the more and less advantaged social groups. Health inequity is a health inequality or disparity that is deemed to be unjust or unfair.⁷

During the Apartheid years, all South Africans were classified by race under the repealed Population Registration Act of 1950. The following classification system was used and is referred to in this paper: Asians, mainly people of Indian descent. Blacks, descendants of African people. Coloureds, people of mixed parentage, mainly descendants of the indigenous Khoikhoi people, the Malayan slaves and the White settlers and, Whites, descendants of the European settlers, mainly Dutch, British, German, French, Portuguese, etc.⁸ The provision of services occurred along these racially segregated lines. Information is still collected by government along these 'racial' divisions in order to redress the inequities that have resulted from the apartheid system.⁹ Of South Africa's 44.8 million population, 79% are classified as Black/Africans, 8.9% Coloureds, 2.5% Indians/Asians and 9.6% Whites.¹⁰ The 1998 Poverty and Inequality report,⁹ identified race as one of the most significant indicators of poverty, with 61% of Black Africans, 38% of the Coloured, 5% of Indian, and only 1% of the White population

categorised as being poor – assessed against consumption-based income poverty lines. Other identified indicators of poverty included female-headed households, unemployment, rural residence and provincial residence. The nine provinces listed in descending order according to poverty rates are; Eastern Cape (71% of residents are poor), Free State (63%), North West (62%), Limpopo (formerly Northern Province) (59%), Mpumalanga (57%), Northern Cape (55%), KwaZulu-Natal (52%), Western Cape (28%) and Gauteng (17%).⁹ With equity in focus, the use of the traditional expression of caries severity by the mean DMFT has recently been complemented with the introduction of the Significant Caries Index (SiC). The SiC index (the mean DMFT for one-third of the population with the highest DMFT), brings attention to those children with highest caries scores in each population.¹¹ A SiC of 4.3 was reported for South African 12-year olds during 1988/89 survey.¹¹ The recent national children’s oral health survey indicates a decline in caries severity (DMFT) in South Africa,¹ therefore the ‘high risk’ approach to prevention may seem an attractive option for consideration. However, it has been suggested that because changes in caries experience occurs throughout the population and not limited to ‘at risk’ individuals, the high-risk approach may fail to deal with majority of new lesions.¹² In deciding upon the choice of caries preventive strategy it is fundamental to consider whether or not, a large number of people exposed to a small risk will generate many more cases than a small number of people exposed to a high risk.¹³

With equity issues emerging in the mainstream of public oral health and as part of an effort to improve the effectiveness of health actions within a context of an overall decline of caries prevalence and severity in children, the objectives of this study were set as follows;

1. To determine the differential risk for caries experience among South African children across social groups reflected by self-reported racial identification and parental occupational class.
2. To determine the spatial (regional-level) relationship between the mean caries scores (DMFT) and the caries prevalence.
3. To examine the implications of the above findings for the high-risk prevention approach in South Africa.

MATERIALS AND METHODS

Secondary analysis of caries data of 5411,12-year-olds, from 37 regions in seven of the nine provinces, was carried out. The data set used was obtained from the 1999-2002 national children oral health survey.¹ The sampling strategy and survey methods employed are as previously described by Van Wyk, Louw and Du Plessis.¹ Data collected in two provinces did not include parental occupational class and this study was therefore restricted to analysis of data from seven provinces. Caries prevalence, mean DMFT and SiC index for each social group was determined. Data obtained were weighted and weighting was performed in two stages. In stage 1, within a particular province, the figures were

adjusted to correct for differences in the proportions of the different population groups in the realised sample and the general population. In stage 2, population figures were adjusted to correct for differences in the proportions of children per age group per province in the realised sample and in the general population. For SiC index calculation, an online spreadsheet provided by the WHO Collaborating Center in Malmo University, Sweden was used.¹⁴

Following an approach similar to that previously suggested by Braveman *et al.*¹⁵ for studying social disparities in health, logistic regression analysis was used to determine risks for caries experience in the overall sample, using the broad categories of occupation (skilled, semi-skilled/manual workers and the unemployed) reported for breadwinners in the household of children examined and self-reported racial/ethnic identification as independent variables. Specific occu-

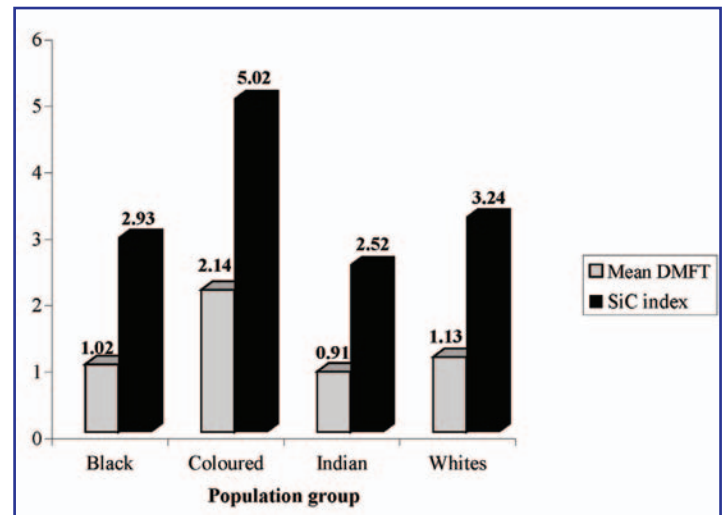


Figure 1: Caries severity across racial/ethnic groups

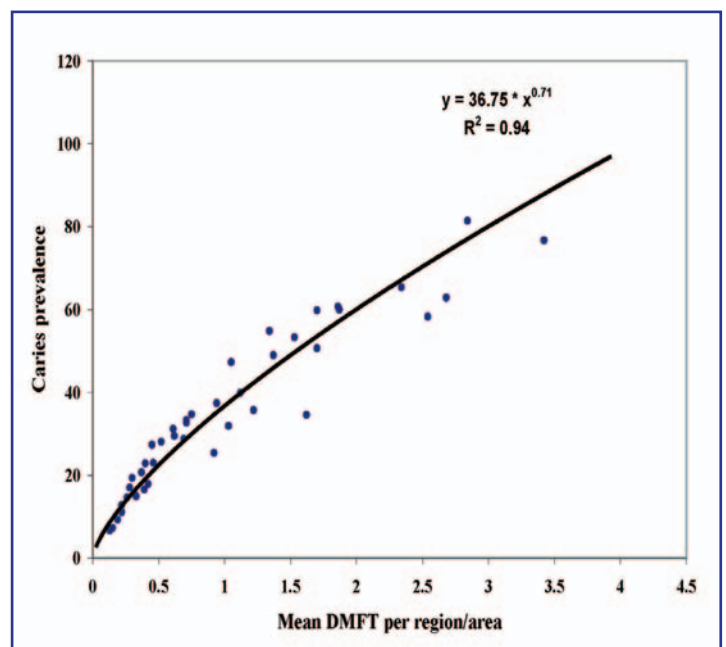


Figure 2: Relationship between DMFT and caries prevalence in 12- year-olds

pational classes recorded were similar to that used for the South African National Census.¹⁰ Odd ratios (OR) and confidence intervals (CI) were used to indicate effect size and statistical significance. OR estimates whose 95% CI excluded 1.0 were interpreted as indicating a statistically significant degree of association. Adjustments were made to control for potential confounders such as areas of residence (urban/farm/rural) and gender. Those categorised within skilled occupations, and white population (most-advantaged groups) served as referent categories (OR=1). Separate models were also run for each province. Statistical analyses were conducted with SPSS software for Windows Release 12.0 (SPSS Inc., Chicago, IL, USA). Regression curve-estimation was used to examine the relationship between mean DMFT and caries prevalence as described by Batchelor and Sheiham.¹²

RESULTS

Table I shows that although the mean DMFT for all of the seven provinces was low (DMFT < 2), the SiC index was high (> 3) especially in the relatively affluent coastal provinces (Table I). The findings in this study confirm the skewed distribution of DMFT (Table II), and showed that a significant number of individuals could be experiencing high levels of caries even when the mean DMFT for their population group is low. The highest level of caries was observed among the Coloured population (Fig. 1). Generally, the Black/Africans have significantly less risk of having caries compared to the Whites, except in the MP and WC provinces (Table III).

Table III, also shows that while being on the lowest end of the economic gradient (unemployed) in the NW, FS and MP provinces seem to be protective of caries, the relative risk for this group to experience caries was significantly higher in WC, KZN and NC provinces, when compared to caries experience of children of skilled workers. Although not displayed in the tables urban residents had a higher risk for caries than those resident in the rural and farm areas, except in the KwaZulu-Natal and

Province	Mean DMFT (±SD)	SiC index	%Caries (95% CI)
Eastern Cape (EC)	1.37 (2.23)	3.31	49.0 (39.9-58.2)
North West (NW)	0.71 (1.57)	2.31	27.6 (22.8-33.0)
Free State (FS)	0.94 (1.65)	2.49	35.5 (28.0-43.8)
Mpumalanga (MP)	1.0 (2.65)	2.71	30.9 (24.7-38.0)
Northern Cape (NC)	1.36 (1.86)	4.09	48.6 (34.2-63.2)
KwaZulu - Natal (KZN)	1.15 (1.99)	3.17	38.8 (34.3-43.4)
Western Cape (WC)	1.99 (2.45)	5.11	61.7 (55.8-67.2)
Total weighted mean	1.19 (2.13)	3.35	40.1 (37.5-42.7)

Western Cape provinces where farm residents had a significantly higher risk for caries - odd ratio (95% CI) of 1.14 (1.09-1.99) and 2.32 (1.77-3.05) respectively.

Fig. 2 shows a mathematical relationship between prevalence of dental caries and mean DMFT, which indicates that at the lower end of the curve (towards DMFT of <1) - the case with the majority of the provinces/population in South Africa - a small increase in DMFT would result in a greater or steep increase in prevalence (cases) of dental caries.

DISCUSSION

Although caries levels have decreased over the years,¹ this study suggest that the decline may not have been experienced equitably across all South African social classes. There is demonstrable evidence of socio-economic inequity in dental caries in South Africa.

Caries severity in the general population of 12-year-olds is well below the WHO's target of 3 for this age group, but the mean SiC is greater than 3. The implication is that more efforts need to be made to achieve the WHO's 2015 target of SiC < 3, set for countries that have already achieved a DMFT < 3.¹¹ The finding from this study, which demonstrated socio-economic equity in caries experience in only three provinces with SiC of less than 3, also supports setting such a target for South Africa.

This study confirmed a previous report of dental caries being highest among the Coloured population in South Africa.¹⁶ The particularly high caries-risk observed among the Black/African

and Coloured children in Mpumalanga province, when compared to their White counterparts and other comparable provinces require further investigation. However, this may be related to the fact that the Mpumalanga province occupies the mid-point along the poverty trend across the nine provinces in the country.⁹ Therefore, the effect of the non-white population now being relatively better socio-economically positioned - with increase access to urban/sugar diet - may be more prominent in this province. This is in addition to the fact that parts of the Lowveld region of this province also pass through the 'sugar belt' that extends from KwaZulu-Natal to Swaziland. Similarly, the observation of higher caries risk among farm residents in KwaZulu-Natal and Western Cape provinces may be related to more access to sugar diet.

Health and by implication oral health, are a product of environmental, social, and economic determinants, not just genetics, individual behaviour and a well functioning health service.¹⁷ The observation of the relatively strong protection of children of the unemployed from caries in the North West province may be related to the relatively high levels of natural fluoride in drinking water in many parts of this largely rural province especially in areas of socio-economic deprivation.¹⁸ This contrast the situation in the coastal provinces - EC, KZN, WC and NC - where fluoride levels have been reported to be mostly lower than in the interior provinces/regions.^{1,19-20} The view that the differences in the natural fluoride levels may be contributory to the differential risk observed in the current study is further supported by a recent literature review, which provided evidence that

fluoridation reduces socio-economic based disparities in dental caries.²¹ Furthermore, the observation of greater disparities in the relatively affluent provinces (NC, KZN and WC) is consistent with findings from other similar studies.²²⁻²³ The relative equity observed in the North West province might also be a reflection of a closer gap between the rich and the poor compared to the situation that may be obtained in the relatively more affluent provinces of WC and KZN. Patussi, Marceles and Croucher²⁴ previously reported a direct correlation between dental caries experience among Brazilian school children and measures of social inequality and social cohesion in their respective communities. Social capital or cohesion – an important feature of social organisation of a community - have indeed been reported to be negatively affected by the growing gap between the rich and the poor with resultant negative impact on public's general health.²⁵

It is conceivable that with decreasing social cohesion or social capital, there would be lower capacity for caregivers within a community to cope with environmental stress to the extent that it may consequently result in neglect of children's oral hygiene and/or dietary habits. Furthermore, low social capital may also lead to adoption of maladaptive behaviours such as smoking and excessive drinking as stress-coping methods. It is pertinent to note that two recent studies have shown a significant increase in primary tooth caries risk among chil-

dren exposed to environmental tobacco smoke²⁶ and in permanent teeth caries among teenagers who smoke and have irregular eating habits, even after controlling for tooth brushing frequency.²⁷ These factors may well be contributory risk factors to higher caries risk among the Coloured population considering the fact that numerous studies have consistently shown smoking prevalence is highest among the Coloured population in South Africa.²⁸⁻²⁹ While the role of these factors still require further investigations, the findings of socio-economic inequity in caries-risk, support the use of the common-risk factors approach to oral health promotion,³⁰ and in particular, the adoption of a primary health care strategy in promoting oral health in South Africa.

The mathematical relationship between

mean DMFT and caries prevalence obtained in this study is comparable to that previously reported for British and American children of comparable age.¹² As observed from the caries distribution, about 75% of caries experience involves just about 20% of the population (Table II). However, because changes in caries experience occurs throughout the population and not limited to 'at risk' (e.g. high DMFT) population, the high-risk approach may fail to deal with majority of new lesions that may develop among the high proportion of 'low risk' individuals to the extent that total number of cases generated may become higher than that generated by the relatively smaller number of high risk individuals. This view is also supported by a previous local report of the evaluation of impact of a mobile dental system focused on

Table II: Frequency distribution of the DMFT for 12-year-old South Africans

DMFT	n (weighted)	Percentage	Cumulative Percentage	Caries Experience	Percentage of total caries
0	296767	60.1	60.1	0	0
1	63550	12.9	72.9	63550	10.84
2	49350	10	82.9	98700	16.83
3	25504	5.2	88.1	76512	13.05
4	23037	4.7	92.7	92148	15.71
5	10143	2.1	94.8	50715	8.65
6	7794	1.6	96.4	46764	7.98
7	6893	1.4	97.8	48251	8.23
8	5282	1.1	98.8	42256	7.21
9	1701	0.3	99.2	15309	2.61
10	877	0.2	99.4	8770	1.50
11	726	0.1	99.5	7986	1.36
12	1217	0.2	99.8	14604	2.49
13	276	0.1	99.8	3588	0.61
14	297	0.1	99.9	4158	0.71
15	57	0	99.9	855	0.15
16 - 26	592	0.1	100	12204	2.08
Total	494063			586370	

Table III : Association between parental employment status, race/ethnicity and risk for dental caries across the provinces.

	Referent group; White (OR=1)*			Referent group; Skilled -professionals/administrative officers (OR=1)*	
	Black/Africans	Coloured	Indian	Less skilled/manual labourers	Unemployed
Eastern Cape (n=209)	0.93 (0.87 – 1.0)	2.52 (2.33 – 2.71)	-	0.89 (0.84 – 0.95)	1.08 (1.0 – 1.15)
Free State (n=889)	0.71 (0.66 – 0.75)	0.98 (0.89 – 1.07)	0.37 (0.23 – 0.58)	0.95 (0.91 – 0.99)	0.73 (0.70 – 0.77)
NorthWest (n=1038)	0.52 (0.48 – 0.56)	0.02 (0.01 – 0.06)	0.25 (0.22 – 0.30)	0.64 (0.61 – 0.66)	0.47 (0.45 – 0.49)
Mpumalanga (n=606)	3.14 (2.94 – 3.35)	7.97 (6.68 – 9.51)	2.67 (2.28 – 3.13)	0.74 (0.71 – 0.77)	0.71 (0.68 – 0.75)
Northern Cape** (n=161)	0.73 (0.65 – 0.83)	Referent	-	0.87 (0.72 – 1.06)	1.52 (1.17 – 1.97)
Kwazulu Natal (n=1634)	0.56 (0.54 – 0.59)	1.39 (1.30 – 1.49)	0.88 (0.83 – 0.93)	1.28 (1.25 – 1.32)	1.32 (1.29 – 1.36)
Western Cape (n=889)	2.08 (1.98 – 2.20)	4.09 (3.90 – 4.29)	1.03 (0.92 – 1.15)	1.28 (1.24 – 1.33)	1.12 (1.08 – 1.18)
Aggregate data (n=5411)	0.97 (0.94 – 0.99)	3.32 (3.23 – 3.40)	1.23 (1.18 – 1.27)	1.10 (1.09 – 1.12)	1.07 (1.05 – 1.09)

*Reported Odd ratios (OR) were already adjusted for potential differences in gender and urban/rural residence.

** Referent group was the coloured population as the number of Whites and Indians in the sample was too small for analysis.

providing preventive care to schoolchildren whose parents were not covered by medical aid ('at risk' individuals), which demonstrated the limitation of the service in preventing or controlling the development of new carious lesions among the studied population, irrespective of their socio-economic status.³¹ This observation, together with existing socio-economic inequities in caries experience shown in most provinces, challenges adopting only the high-risk approach and supports the inclusion of population strategy for prevention of dental caries, within the framework of an integrated primary health care strategy.

The findings from the current study is arguably limited by the fact that the study cannot claim to be truly nationally representative because of missing data from two provinces and some regions within the Eastern Cape and Northern Cape provinces. Nevertheless, the aggregate data presented may not be significantly different from the national picture considering that the caries prevalence data reported here was not significantly different to that previously reported nationally, which included data from the two missing provinces.¹ The strength of the current study lies in the large sample size used and the fact that it represents one of the first attempts to begin to analyse national dental caries data along the lines of social equity.

CONCLUSIONS AND POLICY IMPLICATIONS

- The mean DMFT alone is not a good indicator of caries impact in South Africa. There is a need for monitoring inequities. In particular, effectiveness of interventions, which has focused on achieving overall improvement in oral health, will need to begin to evaluate the differential effectiveness of interventions in different social groups. It is hoped that this study will generate discussion leading to more systematic and comprehensive approach to studying and monitoring of regional-level social inequities in oral health.
- The 'high-risk' approach alone to caries prevention may inadvertently reinforce present inequities in car-

ies-burden. If it is to be utilised, then it should be in addition to a population-based approach such as water fluoridation.

- These study findings highlight the need to set priorities for policy directions differently across the provinces. Specifically, it also provides support for the implementation of water fluoridation particularly in the provinces with demonstrable inequity in dental caries.
- There is need for future research on determinants of racial disparities in caries levels in South Africa.

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