

Prevalence and socio-economic disparities in fissure sealant placement among adolescents in the Limpopo Province, South Africa

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O A Ayo-Yusuf: BDS, MSc (Odont), MPH, PhD, Department of Community Dentistry, School of Dentistry, Faculty of Health Sciences, University of Pretoria, Pretoria, South Africa.

TE Okagbare: BDS, Dip Odont, MSc (Odont), Department of Community Dentistry, School of Dentistry, University of Pretoria, South Africa.

IJ Ayo-Yusuf: BDS, Dip Odont, MSc (Dent), Department of Dental Management Sciences, University of Pretoria, South Africa.

Corresponding author

O A Ayo-Yusuf: Department of Community Dentistry, School of Dentistry, University of Pretoria, P. O. Box 1266, Pretoria, 0001, South Africa, Tel: 012 319 2514, E-mail: lekan.ayoyusuf@up.ac.za.

ABSTRACT

Objectives: This study investigated socio-economic factors associated with the placement of fissure sealants in a population of South African adolescents.

Method: The study participants were high school students aged 12 to 15 years who provided baseline data during 2005 in a tobacco-use prevention trial, and consented to oral examination ($n=1103$). Information was obtained using a self-administered survey questionnaire, including demographic data, data on oral health behaviour, the employment status of parents/guardians, and the family structure of the household and on health insurance enrolment. The main outcome measure was the presence of a fissure sealant on any tooth, recorded using the WHO oral examination protocol. Data were analysed using chi-square statistics and multiple logistic regression analysis ($p<0.05$).

Results: Overall, only 3.5% ($n=37$) of the study participants had a fissure sealant, and only 31.3% ($n=345$) had ever made a dental visit. Those who had attended seeking mostly preventive care were significantly more likely to have a fissure sealant than those who had visited mostly when they were in pain (14.2% vs. 2.9%; $p<0.001$). In the multi-variable adjusted analysis, those reporting to have parents who are both employed (OR = 2.76; 2.26 – 3.38), and reporting regular preventive dental visits (OR = 3.55; 2.28 – 5.58) were positively associated with receiving fissure sealant, while those who self-identified as black (OR = 0.04; 0.01 – 0.13), were significantly less likely to present with a fissure sealant as compared with other ethnicity/race groups.

Conclusions: Higher socio-economic status and regular access to preventive care were significantly associated with the placement of fissure sealants in the studied population.

INTRODUCTION

Since the use of fluoride dentifrices has become widespread, it has been reported that the pattern of dental caries has changed to a disease affecting largely the pit and fissure surfaces (occlusal, buccal and lingual).¹⁻⁴ Importantly, this change in the pattern of dental

caries disease has been found to be similar in both fluoridated and fluoride-deficient populations.³ Studies conducted recently have indicated that the placement of occlusal fissure sealants is an effective and safe measure to prevent dental caries.^{5,6} In particular, fissure sealants can reduce caries prevalence by up to 60% over a four-year period.⁵ These observations have been cited as a justification for sealant application as the preventive measure of choice, or as an adjunct to other caries preventive procedures, as demonstrated by Van Wyk *et al.*⁶ in a school-based fissure sealant programme in South Africa. Indeed, a recent study in South Africa showed that in 98% of adolescents aged 14 years, the second molars had already erupted, and 20% had already had a caries experience.⁷ Furthermore, surveys on dental caries severity (DMFT) in South Africa have consistently demonstrated a significant increase in DMFT between the ages of 12 and 15 years.⁸ It therefore appears important to provide fissure sealants on molar teeth up to the age of 15.

Although the cost per person for a sealant programme is relatively higher than any of the more traditional preventive modalities,⁹ economic evaluation studies have reported that a hypothetical school-based sealant programme that sealed the first permanent molars would be more cost-effective than treating decaying unsealed molars.¹⁰ This argument was confirmed by a study conducted by Dasanayake *et al.*¹¹ among Alabama Medicaid children. It is the concern regarding cost and socio-economic disparities in the placement of sealants that has prompted oral public health experts to advocate for school-based programmes that provide universal pit and fissure sealant coverage to children without health insurance, and/or who are of low socio-economic status – thus, the inclusion of children who would otherwise be less likely to receive sealants.¹⁰⁻¹² However, there are no nationally organised school-based fissure sealant programmes in South Africa. Although the global oral health strategic framework proposes these programmes,¹³ there is currently only limited information on the prevalence of fissure sealant placement in resource-poor countries, including South Africa. This study therefore sought to investigate the socio-economic factors associated with the placement of fissure sealants among 12 year-

Table 1: Socio-economic and behavioural factors associated with sealant placement among adolescents who had ever attended a dental office in Limpopo Province ($n=345$)

Variables		Sealant placement %		
		Sealant(s) (n=37)	No sealant (n=308)	P-value*
Gender	Male	11.4 (n=15)	88.6 (n=117)	0.43
	Female	10.4 (n=22)	89.6 (n=189)	
Mother in the home	No	3.9 (n=3)	96.1 (n=74)	0.005
	Yes	12.7 (n=34)	87.3 (n=233)	
Both parents employed	No	4.6 (n=7)	95.4 (n=146)	<0.001
	Yes	15.3 (n=29)	84.7 (n=160)	
Ethnicity	Black	1.8 (n=4)	98.2 (n=222)	<0.001
	Others	27.7 (n=33)	72.3 (n=86)	
Mostly preventive dental visits	No	2.9 (n=3)	97.1 (n=102)	<0.001
	Yes	14.2 (n=34)	85.8 (n=206)	
Health insurance cover	No	9.8 (n=15)	90.2 (n=138)	0.39
	Yes	11.5 (n=22)	88.5 (n=170)	
Brush twice daily	No	9.8 (n=21)	90.2 (n=194)	0.33
	Yes	12.4 (n=16)	87.6 (n=113)	
Cariou tooth	No	12.9 (n=34)	87.1 (n=230)	0.02
	Yes	3.5 (n=3)	96.5 (n=82)	
Total		10.7 (n=37)	89.3 (n=308)	

*Chi-square statistics. NB: Some of the subgroup totals do not add to 345 because of some missing questionnaire responses.

to 14-year-old adolescents in South Africa, a country with wide socio-economic inequities,¹⁴ little public health subsidisation and low private health insurance coverage.¹⁵

METHOD

Setting and study participants

The participants in this study were high school pupils who provided baseline data during 2005 as part of a trial to prevent tobacco use, and at the same time to improve oral health among adolescents. That study involved 21 randomly selected schools in the most rural of all the nine provinces in South Africa – the Limpopo Province. A two-stage cluster sampling strategy was used to produce a provincially representative sample of Grade 8 pupils, who were between the ages of 12 and 19 years ($n=2,119$). However, for the purposes of the current study, only those between the ages of 12 and 14 years who had consented to oral examination, were included ($n=1107$). We restricted our analysis to the younger age group because the older participants would not normally be considered eligible for fissure sealant placement.

Measures

Demographic features

Using a self-administered survey questionnaire, consenting participants were asked to provide information about age, sex, race/ethnicity (Black or Others), the employment status of the parents or guardians, and the family structure of the household (whether the participants lived with both parents, with the mother only or with neither parent). Because of the relatively high prevalence of non-nuclear family structures, and the previously reported importance of the presence of the mother on children's oral health¹⁶⁻¹⁷, the family structure was dichotomised into those living with their mother and those who were not.

Oral health behaviour and health insurance enrolment

The oral health behaviour recorded included a history of past dental visits and the frequency of daily tooth-brushing.¹⁷ The study participants were also asked to indicate whether or not they were enrolled on their parents' or guardian's private health insurance as beneficiaries.

Measurement of dental status

The participants were also invited to undergo a dental examination conducted on the school premises, where their dental caries experience was assessed by six calibrated dentists and hygienists (intra- and inter-examiner agreement was measured by kappa statistics >0.7) using the WHO diagnostic criteria and the DMFT index.¹⁸ During the examination, fissure sealants were noted to be present or absent. Any of the participants requiring treatment were given a referral note to their regular dentist or to the public dental clinic closest to where they lived. Furthermore, all study participants were each provided a toothbrush and toothpaste at the end of the oral examination.

Statistical analysis

Taking into account the cluster sampling used, all the statistical analyses were conducted using the statistical package STATA Version 10 (Stata Corp, Texas, USA). Data were analysed using chi-square statistics and multiple logistic regression analysis ($p<0.05$).

RESULTS

The socio-economic status and dental visit history of those who consented to oral examinations were not significantly different from those of the participants who did not consent to oral examination. Of the study participants, 86.1% ($n=944$) self-identified as blacks and 60% ($n=662$) were females. The mean DMFT was 0.69 (SD = 1.60). Of the participants, 25.5% ($n=282$) presented with caries experience, of which 87.9% was untreated. Overall, 21.4% of the study participants indicated having had a dental visit for check-up or tooth cleaning in the past 12 months. However, only 31.3% ($n=345$) of the study participants had ever visited a dental office, with 51% ($n=175$) of these indicating it was mostly related to check-up or tooth-cleaning (preventive dental visits) as opposed to seeking relief from pain or other dental problems (symptomatic visits). Compared with those without health insurance coverage, those with insurance were significantly more likely to have ever visited a dental office (23.2% vs. 41.8%; $p<0.001$). Furthermore, compared with blacks, those of other ethnicity were significantly more likely to have ever visited the

Table 2: Logistic-regression model of socio-economic factors independently associated with sealant placement among adolescents who had ever attended a dental office in the Limpopo Province

Independent variables		Odds ratio	[95% CI]	P-value
Both parents employed	No	1 (reference)		
	Yes	2.76	2.26 – 3.38	<0.001
Ethnicity	Others*	1 (reference)		
	Black	0.04	0.01 – 0.13	0.002
Preventive dental visits	No	1 (reference)		
	Yes	3.55	2.28 – 5.53	0.001

* "Others" include those who self-identified as Indian, coloured or white. CI = Confidence interval.

dental office (24% vs. 77.8%; $p < 0.001$). Of the study participants, only 3.5% ($n = 39$) had had a fissure sealant placed. The mean age of those having had at least one fissure sealant placed was 13.6 years (SD 0.49).

Of all those who had ever made a dental visit, those who reported having made dental visits mostly for preventive care were significantly more likely to have a fissure sealant than those who had visited mostly when they were in pain (14.2% vs. 2.9%; $p < 0.001$). In addition, of those who had ever visited a dental office, fissure sealant placement was less prevalent among blacks than among other ethnic/race groups (1.8% vs. 27.4%; $p < 0.001$) and was more prevalent among those who presented without a decayed tooth than among those with a decayed tooth (12.9% vs. 3.5%; $p < 0.01$). There were other significant socio-economic and behavioural differences identified in those who presented with dental sealants (Table 1).

Except for having a mother in the home, all other factors statistically associated with fissure sealant placement in the bivariate analysis retained that association in a multi-variable adjusted regression model restricted to those who had ever visited a dentist (Table 2). In particular, when compared with those who had made dental visits mostly when in pain, those who had made dental visits mostly for preventive care were 3.5 times more likely to have received a dental sealant.

DISCUSSION

This study has demonstrated a very low prevalence of fissure sealant placement in Limpopo Province and showed a wide variation across socio-economic status. As expected, frequent preventive dental visits was strongly associated with having had fissure sealant placement. In particular, those with fissure sealants were less likely to present with any decayed tooth. The mean DMFT obtained in this study (0.7) is comparable with that reported for similar age groups for this province in a previous national survey.¹⁹

There have been no previously published population-based studies on the prevalence of fissure sealant placement in any other province, thus we were not able to compare our data with any other from South Africa. However, our finding of fissure sealant placement among 11.5% of those with health insurance who had ever visited a dental office was comparable with the 10% reported in an analysis of insurance dental treatment claims among those less than 20 years old who had visited private dental practices in South Africa.²⁰ Furthermore, our finding of the low utilisation of fissure sealants in this poorly resourced province is consistent with that reported in resource-constrained settings elsewhere,²¹ but is much lower than the national average of 37.4% reported for the 12- to 15-year-olds in the United States during 2002.²²

Notably, this study did not find a significant gender difference in fissure sealant placement, contrary to the findings in the studies conducted in Alabama (United States), and Puerto Rico.^{11,21}

In accord with the findings of previous surveys, this study showed that the frequency of fissure sealant placement varied with the socio-economic status of the children,¹⁰⁻¹² being more prevalent among those whose parents are both employed. Potentially greater financial constraints may be experienced by those seeking personal preventive services for children from homes where one or both parents are unemployed. Similarly, previous studies have also demonstrated that those from minority populations or of low socio-economic status were less likely to have received fissure sealants.^{10-12,23}

The chances of receiving a treatment that includes sealant placement showed wide racial disparity: respondents who identified themselves as black were less likely to have received sealants. This may be connected with the generally lower income and literacy levels of those who are classified as black in South Africa,¹⁴ who are also more likely to have no health insurance.¹⁵ It is moreover important to note that the observed racial differences persisted even after statistically controlling for health insurance coverage and socio-economic status as indicated by the employment status of participants' parents. This observation suggests that there may be other factors, such as cultural differences in the value attached to preventive care services and/or differences in caries risk perception, which may also have contributed to the differences in the placement of fissure sealants. It is conceivable that caregivers of black children are less likely to perceive a need for preventing dental caries using fissure sealants, given the relatively low level of dental caries severity in this population group in rural South Africa and in the Limpopo Province in particular.¹⁹ This highlights the need for culturally-tailored oral health promotion interventions, including the designing of educational campaigns targeted at high caries risk sub-population groups in order to raise awareness of the importance of fissure sealants in improving their oral health.

It was not surprising that better financial access to care through health insurance coverage alone was inadequate to eliminate the socio-economic differences in fissure sealant placement. After all, primary health care services in South Africa are indeed potentially accessible to many children at no fee. However, it is likely that the effect of health insurance on fissure sealant placement is mediated by a greater likelihood of making a preventive dental visit to a private practice where fissure sealants are more likely to be placed.

This possible mediating role of health insurance on making preventive dental visits supports the ongoing national debate on the merits of the introduction of universal health insurance through a national health insurance (NHI) scheme, as proposed

by the South African government.²⁴ This study supports the need for NHI to include at least benefit coverage for preventive dental services, particularly for children below the age of 18 years, as is the case in many developed countries which have enjoyed significant success in improving children's oral health.²⁵

STUDY LIMITATIONS

This is a cross-sectional study; hence, the temporal order of events is unknown. In particular, the time (age) of fissure sealant placement is not known, although it is known that fissure sealant placement after the age of 12 years is not a benefit under many health insurance contracts in South Africa. This may indeed also partly explain why health insurance coverage was not independently associated with fissure sealant placement in this population of Grade 8 adolescents (with an average age of 14 years).

Furthermore, self-reporting of parents' insurance cover by adolescents may not accurately reflect the true status of insurance cover. Moreover, we did not specifically ask whether a dental benefit was included in the insurance coverage or not. It may also not be possible to generalise the current study findings to the whole of South Africa, given the provincial differences in caries prevalence and racial/ethnic composition.

Despite these limitations, this study provides some useful and relevant information on the prevalence of fissure sealant utilisation in the Limpopo Province that can serve as a guide for similar studies in the other provinces in future, and even at the national level, to monitor progress in implementing a national strategy to increase the proportion of children with fissure sealants. In particular, it could provide a baseline for setting a more realistic goal with regard to achieving an increased proportion of adolescents of this age with fissure sealants in this population.

CONCLUSIONS

The findings of this study demonstrate a very low utilisation of fissure sealants in the population under review. However, considering the low caries severity in this province and the fact that many of those with caries did not have a fissure sealant, the study findings highlight the need for a targeted-population approach to fissure sealant placement programmes, as this is likely to be more cost-effective than a completely population-based approach. This could be accomplished through regular school screening to identify high-risk populations and the subsequent institution of a school-based programme. Such an intervention has the potential to reduce or eliminate racial and socio-economic disparities in the placement of fissure sealants associated with differences in access to dental offices. In addition, policy-makers should make an effort to increase public knowledge regarding the benefits of fissure sealants, especially among those identified as high-risk populations from the lower socio-economic class, as well as to promote fissure sealant use by dentists and oral hygienists in public health programmes. Fissure sealant placement in private practice settings among children between the ages of 12 and 15 years should be promoted by providing financial coverage for this service.

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