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Dental caries in 5-year-old children attending multi-ethnic schools in Greater Glasgow – the impact of ethnic background and levels of deprivation

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Objective To examine levels of dental caries of 5-year-olds attending multi-ethnic schools in Greater Glasgow and to explore the effects of deprived backgrounds and ethnic identity on their dental health. ***Design*** Between October 2001 and February 2002 a cross-sectional dental epidemiology survey of a sample of 721 5-year-olds was undertaken in schools having at least 25 per cent of pupils from black or minority ethnic groups. Background data on participating children were obtained from school records, including: ethnic origin, mothers' ability to speak English, religion, and demographics. Statistical analyses included two way analysis of variance to determine the effect of ethnicity after adjusting for socio-economic factors. ***Results*** Complete data were available for 649 (90%) children. The sample broadly divided into white (52%), Pakistani (33%), and other minority ethnic groups (15%). Based on repeat observations, diagnosis reliability was good (Kappa = 0.77). The caries experience of Pakistani children ($d_3$mft = 4.1; 95%CI 3.6 to 4.6) was significantly higher ($p < 0.001$) than the white children ($d_3$mft = 2.3; 95%CI 1.9 to 2.6). Only 25% (95% CI 17 to 34) of the Pakistani children had no obvious decay, significantly lower ($p < 0.001$) than their white contemporaries (48%, 95% CI 39 to 58). Pakistani ethnic origin was associated with significantly higher levels of dental caries ($p < 0.001$), after adjusting for socio-economic deprivation. ***Conclusion*** Children from deprived backgrounds have worse dental caries levels than their affluent counterparts and, over and above this effect, minority ethnic children of Pakistani background have higher levels than their white peers.

Key words: Caries prevalence, children, ethnicity, inequalities, oral health

Introduction

Determining the oral health of children is important for planning and developing services orientated to meeting the needs of the population (Pitts *et al*., 1998). The oral health of children can also be used to predict adult oral health and oral health needs (Pearce *et al*., 2004).

The oral health of children in Greater Glasgow and Scotland as a whole is well documented through the Scottish Health Boards' Dental Epidemiology Programme (SHBDEP) now known as the National Dental Inspection Programme (NDIP) (SDECC, 2004).

Despite a wealth of information, there are, however, sparse data on the current oral health status of black and minority ethnic groups. Ethnic origin is not a routinely collected category in UK and Scottish oral health surveys. Similarly, there is no specific information on levels of dental registration, service usage and treatment of minority ethnic patients.

In Scotland, the largest minority ethnic group have their origins in the Indian subcontinent and China, with smaller numbers from Africa, the Caribbean, and elsewhere. Together they comprise only 2% of Scotland's population. However, the population of the Greater Glasgow NHS Board area has approximately 5% black and minority ethnic (BME) groups, more than half (53%) of whom are Pakistani in origin, with 17% Indian, 12% Chinese and 18% from other BME groups (ISD, 2004).

Ethnicity has been identified as a factor for consideration when examining inequalities in oral health, with higher levels of dental caries having been found in some ethnic minority groups and 'at risk' ethnic groups. These include children of Asian Muslim backgrounds with a non-English speaking mother (Bedi, 1989). However, the importance of ethnicity compared to socio-economic status in explaining such dental health inequalities has been challenged (Bedi and Uppal, 1995; Watt and Sheiham, 1999).

It has also to be recognised that ethnic groups are heterogenous, with wide variation within groups as well as between groups (Bedi and Uppal, 1995). Previous studies undertaken in Glasgow have shown that inequalities in levels of dental caries between Asian and white children exist in 5-year-olds (Bedi and Elton, 1991), but these findings are not observed in 10-year-olds (Bedi *et al*., 1991). Additionally, recent UK studies found higher caries rates in 5-year old South Asian children compared with white children of equal (low) deprivation and water fluoridation exposure levels (Prendergast *et al*., 1997;

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Gray *et al*., 2000).

An exploration of the two-way confounding of poverty and ethnic origin with regard to oral health has not previously been undertaken in Scotland. Thus, a specific study was required to investigate this issue, to model the effects of these factors and also to provide follow-up data to that previously presented in the early 1990s.

Materials and methods

The study took place between October 2001 and February 2002, as a discrete part of the SHBDEP survey of 5 year olds in Greater Glasgow (Pitts *et al*., 2002). Prior to commencing the survey, permission was obtained from the Education Department of Glasgow City Council. A written agreement was drawn up between the Greater Glasgow Primary Care Trust and the Education Department to ensure that data protection was guaranteed. The Education Department supplied a list of all schools (n = 21) in Greater Glasgow with a minority ethnic population of 25% and over. A letter explaining the purpose and nature of the study was sent to the head teachers of the 21 schools, with an accompanying letter from the Education Department. Each head teacher was requested to forward a list detailing the names, dates of birth and addresses, with postcode, of all Primary 1 children within their establishment.

In keeping with standard procedures for SHBDEP, letters were sent out to parents explaining the nature of the survey and requesting written withdrawal of the child if the parent did not wish them to participate. For the purposes of this study, head teachers and class teachers of the children were asked to detail the child's religion, ethnic background and the ability of the mother to speak and understand English from their school records. Ethnicity details are a requirement for schools to report to Local Authority Education Departments.

The dentist examiner underwent SHBDEP training and calibration (Pine *et al*., 1997). The children were all examined by a single calibrated dentist (IQ) in their schools, under standardised examination and lighting conditions, as per the diagnostic criteria applied in dental caries epidemiological surveys of children by BASCD (Pitts *et al*., 1997). A random 5% sample of the children was selected by the dental nurse for re-examination to permit intra-examiner consistency assessment.

Following BASCD guidelines and international epidemiological conventions, figures presented for "decay" only relate to dental caries which clinically appears to have penetrated into dentine (d_3). Less severe manifestations of decay, such as that which appeared to be confined to enamel, were recorded as "sound", as no radiographs were taken.

Data analysis

The information from the paper examination form was linked to the previously provided children's details. This included the child's home postcode from which the deprivation category (DEPCAT) score was obtained – the measure of material deprivation commonly used in Scotland (Carstairs and Morris, 1991; McLoone, 1994).

The data were exported into Microsoft Excel and analysed using Minitab (release 13.2) statistical software package. Descriptive statistics and contingency table analyses including Chi-square tests were performed. Cohen's Kappa was used to measure intra-examiner agreement (Landis and Koch, 1997). A General Linear Model was used to estimate the effects of ethnic group and socio-economic deprivation on $d_3$mft, and an interaction term was included to assess whether the effect of ethnic group differed between socio-economic groups.

Results

All 21 schools approached returned the requested lists. However, two schools were excluded as they had no minority ethnic children within the Primary 1 classes. This gave a sample of 721 children, which represented 7.3% of the Primary 1 population in Greater Glasgow. However, only 649 (90%) children were examined, the difference being due to children being absent from school on the day of the examination visit. Summary information on the sample is shown in Table 1. For the clinical examinations, the intra-examiner agreement was excellent for determination of caries presence (100% agreement, Kappa = 1.0) and good for detection of caries at the d_3 level (86% agreement, Kappa = 0.77).

Full details of the reported ethnic origin of the children are shown in Table 2. This demonstrates that the vast majority of children had either white (52%) or Pakistani (33%) ethnic backgrounds. The remaining (15%) children were from a variety of ethnic minority backgrounds, and include 4% of unknown origin.

In those for whom a religion was documented, there was a high correlation between reported Pakistani ethnic origin and Muslim religion, with 211 (98%) of the Pakistani children reported as being Muslim. There was a strong association between having a non-English speaking mother and being of Pakistani origin ($p < 0.001$), with 22 of those having mothers who reportedly couldn't speak English being Pakistani, and the remaining 14 being distributed between the other BME groups. The numbers were too small to permit valid comparison between non-English speaking mothers and English speaking mothers, either within the Pakistani children or across the other groups as a whole.

When combining all of the black and minority ethnic groups together (n = 288), there was a significantly ($p < 0.001$) higher severity of caries in the BME children (mean $d_3$mft = 3.8) compared with their white counterparts (mean $d_3$mft = 2.3). Correspondingly there was a significantly ($p < 0.001$) lower proportion of BME children (30%) who had no obvious decay compared to the white children (48%).

The number of children in most minority ethnic groups was too small to allow comparisons to be made between groups. Therefore, analyses were focused on comparisons between Pakistani and white children. There was a significantly ($p < 0.001$) higher severity of caries ($d_3$mft) when comparing Pakistani children (mean $d_3$mft = 4.1) with white children (mean $d_3$mft = 2.3). Similarly, significantly ($p < 0.001$) more white (48%) than Pakistani (25%) children had no obvious caries.

The influence of deprivation and ethnic origin was explored, with the DEPCAT categories split into three broad groups: affluent (DEPCAT 1, 2), heterogenous (DEPCAT 3, 4, 5) and deprived (DEPCAT 6, 7). The

Table 1. Sample details

Sample	721
Examined	649 (90%)
Gender distribution	343 (53%) males 306 (47%) females
Mean age	5.4 years (range 4.9 – 5.8)
Reported religion	333 (54%) Christian 240 (39%) Muslim 18 (3%) Sikh 4 (0.6%) Hindu 1 Buddhist 3 (0.5%) No religion 53 (6.8%) Unknown
Non-English speaking mother	36 (6%)

Table 2. 5- year-old school children attending Greater Glasgow schools – the average number of decayed, missing and filled teeth ($d_3$mft) by ethnic background (with 95% confidence interval)

Ethnic origin	*n (%)*	*Decayed*	*Missing*	*Filled*	*$d_3$mft*	*% no obvious decay*
White	335 (51.6%)	1.75 (1.45-2.05)	0.34 (0.22-0.47)	0.19 (0.13-0.25)	2.28 (1.93-2.62)	48.1% (38.6-57.8)
Pakistani	215 (33.1%)	3.2 (2.72-3.68)	0.46 (0.30-0.63)	0.41 (0.27-0.55)	4.07 (3.56-4.58)	24.7% (17.3-34.0)
Indian	24 (3.7%)	1.50(0.11-2.89)	0 *	0.33 *	1.83 (0.38-3.29)	62.5% (52.7-71.4)
Chinese *	7 (1.1%)	3.43	0.14	0.86	4.43	42.9%
Other Asian *	2 (0.2%)	3.00	0	0	3.00	50%
African *	5 (0.8%)	2.40	0	1.2	3.6	0%
Arab *	7 (1.1%)	4.57	1.71	0.29	6.57	28.6%
Mixed origin	28 (4.3%)	1.86 (0.76-2.95)	0.29 *	0.39 (0.01-0.78)	2.54 (1.28-3.80)	46.4% (36.9-56.1)
Unknown	26 (4.0%)	1.89 (0.67-3.10)	0.08 *	0.23 *	2.19 (0.93-3.45)	46.2% (36.8-55.9)
Total	649 (100%)	2.29 (2.04-2.53)	0.36 (0.28-0.45)	0.29 (0.23-0.36)	2.95 (2.67-3.22)	40.1% (31.0-49.9)

* Numbers insufficient to calculate valid confidence intervals

Table 3. The mean number of decayed, missing and filled teeth (unadjusted) within broad deprivation categories by white or Pakistani origin **

Deprivation Category (DEPCAT)	*Ethnic origin*	*Number of children*	*Mean $d_3$mft (Standard deviation)*
1 - 2	White	34	1.50 (2.68)
	Pakistani	15	4.60 (3.70)
3 - 5	White	116	2.05 (1.73)
	Pakistani	35	4.09 (4.08)
6 - 7	White	185	2.56 (3.49)
	Pakistani	165	4.02 (3.78)

** General Linear Model: interaction $p = 0.31$; after removing interaction, deprivation $p = 0.48$, ethnicity $p < 0.001$

results are shown in Table 3.

A General Linear Model was used to assess the effects of ethnicity and deprivation on caries levels. The mean $d_3$mft was higher in Pakistani children compared to their white contempories at all levels of deprivation. There was no significant interaction between deprivation category and ethnic group ($p = 0.31$), indicating that the effect of ethnic group on $d_3$mft does not differ significantly between deprivation categories. When the interaction term was removed, it was found that the effect of deprivation category was not significant after adjusting for ethnic group ($p = 0.48$), but that ethnic origin was highly significant ($p < 0.001$), whether or not adjusted for deprivation category. After adjusting for deprivation category, the mean $d_3$mft of Pakistani children was 1.7 higher than for white children (95% CI: 1.1 to 2.3).

Discussion

The study assessed the impact of ethnicity on the dental caries levels of 5-year-olds in the Greater Glasgow NHS Board area. The response rate was good with 90% of the sampled children in Glasgow being examined. Schools with a BME population of 25% or more were selected for convenience and to provide consistency in methodology to that used in previous surveys. Additionally, to promote the validity of comparison, the method of collecting the data relating to ethnicity, religion and mother's ability to speak English, i.e. via school records, was the same as that used previously in Glasgow (Bedi and Elton, 1991; Bedi *et al*., 1991).

The original aim of simply exploring levels of dental caries of the different minority ethnic groups in Glasgow and comparing these levels to the white population was refined to look specifically at the differences between Pakistani and white children and the inequalities between these groups. This avoided generalisations about a heterogenous group, of whom the vast majority were Pakistani.

The findings are consistent with previous UK studies which have found oral health inequalities linked to ethnicity (Bedi and Elton, 1991; Bedi *et al.,* 1991; Pine *et al.,* 2003).

In the Glasgow study carried out in 1989, Asian 5-year-olds were found to have higher caries experience than their white counterparts. The possible risk factors which accounted for these differences were: mothers' inability to speak English and Muslim religion. However, this earlier study did not explore the potential major confounder of material or socio-economic deprivation (Bedi and Elton, 1991).

Since then a number of UK studies have found socio-economic deprivation to be the most important factor in dental health inequalities (Sweeney *et al.,* 1996; ; Prendergast *et al*., 1997; Gray *et al.,* 2000; Pine *et al.,* 2004) mediated through behaviours and lifestyle factors that predispose to ill health (Verrips *et al.,* 1992; Hinds and Gregory, 1995; Pine *et al*., 2004). It is also well recognised that socio-economic circumstances are correlated to minority ethnic background (Saxena *et al*., 2002). The prevalence of certain diseases vary, generally towards disadvantage, in different socio-economic or ethnic groups, and differentials exist in service use and provision (Newton *et al*., 2001). While it is recognised that there are difficulties using an area-based measure for deprivation (e.g. DEPCAT or Townsend Index) on one hand and an individual measure of ethnicity on the other, similar comparisons have previously been reported (Pine *et al*., 2003).

However, this study has shown that within inequalities associated with deprivation, there lies further inequalities in levels of dental caries related to ethnic background. Specifically, in this case, 5-year-old Pakistani children are far more disadvantaged in terms of oral health than their white counterparts, independent of their socio-economic background. The previous high risk association with being Muslim (Bedi and Elton, 1991) could still be a possible explanation. However, it was impossible in the study sample to differentiate between Pakistani ethnic origin and Muslim religion as the latter is almost universal in the former. Furthermore, due to the small numbers of non-English speaking mothers, analysis could not be undertaken to assess this factors' impact. Other potential explanatory factors (e.g. diet and oral health behaviours) or confounders (e.g. gender) require further exploration.

There are only a limited number of studies in the dental literature which describe the exploration of the 2-way-confounding of poverty and ethnic origin. Furthermore, earlier analyses generally fall short of determining whether there is an effect of ethnicity independent of deprivation (Pine *et al*., 2003).

The previous Glasgow studies showed that the differences in caries experience between white and ethnic minority groups seen in 5-year-olds (Bedi and Elton, 1991) were not present in 10-year-olds (Bedi *et al.,* 1991). However, these studies were carried out around the same time and therefore a cohort effect could not be examined. It would be beneficial to conduct a follow-up when the present study 5-year-olds are 10-years-old in 2006/07.

These findings have implications on policy and practice. The headline national target is that by 2010, 60% of 5-year-olds in Scotland should have no experience of dental decay (SEHD, 2005). The current approach of targeting dental services and oral health promotion activities to deprived communities, schools and pre-school establishments should now be broadened in scope to ensure that inequalities as a result of ethnic differences are taken into account.

In conclusion, the data have shown that 5-year-old children of Pakistani origin have significantly poorer dental health than their white peers and this is a major health inequality which exists over and above that due to material deprivation. Further work is required to explain these inequalities, and could involve assessing similar data using an individual measure of socio-economic status, and exploring the different groups' infant experiences.

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