Differences in Oral Health Among Italian Adolescents Related to the Type of Secondary School Attended

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Purpose: The aim of the present study was to evaluate the possible interaction between the type of secondary school attended, oral clinical data and self-perceived oral health (SPOH) behaviour among Italian adolescents.

Materials and Methods: A total of 913 adolescents living in Milan (Italy), attending two different types of secondary schools, grammar and technical secondary schools, were examined regarding dental caries and gingival conditions. Oral health behaviour data were collected using an anonymous questionnaire. The presence of caries was recorded using the decayed missed filled tooth (DMFT) index, gingival conditions with community periodontal index (CPI) following World Health Organization recommendations. Stepwise logistic regression was applied to determine whether the type of school attended was associated with the clinical outcome variables and subjects' SPOH and with oral health or lifestyle behaviour.

Results: The prevalence of caries was 59.8% (95% CI = 41.3 to 76.8); a third of participants showed a CPI = 0, whereas 34.9% had bleeding at probing and 37.9% had calculus. Caries distribution was significantly related to the type of school attended in each score of the DMFT categorisation (P < 0.01). Experience of tooth discomfort was claimed by 23.6% of subjects from grammar schools and 35.3% from technical schools (P < 0.01). In males, CPI ≥ 1 was associated with the type of school, OR = 1.6 (95% CI = 1.1 to 2.5), the highest DMFT score and experience of self-perceived tooth discomfort, OR = 1.6 (95% CI = 1.2 to 2.0) and OR = 1.2 (95% CI = 1.4 to 2.6), respectively. In females, only CPI ≥ 1 and highest DMFT score were associated with the type of school, OR = 2.1 (95% CI = 1.3 to 3.3) and OR = 1.6 (95% CI = 1.2 to 2.0), respectively.

Conclusions: The type of school is a sensitive indicator of oral health status among adolescents.

Key words: adolescents, cross-sectional studies, epidemiology, oral health, socioeconomic status

Oral Health Prev Dent 2009; 7: xxx-xxx.

Submitted for publication: 05.02.08; accepted for publication: 20.07.08.

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Vol 7, No 4, 2009

detected and analysed in many health conditions, such as mortality, surviving childhood, the proportion of chronic health problems, risk factors during childhood and adolescence, and the subjective perception of health status, including oral disease (Okullo et al, 2004). Social class is an important tool for measuring the 'social impact' of most variables that characterise the social environment, such as greater consumption of cariogenic food and soft drinks (high and frequent sugar intake) and poor oral hygiene habits for caries disease. As reported in the literature (Zurriaga et al, 2004), it is not easy to assess the socioeconomic level, because it is not a directly measurable feature. It is usually assessed as the

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highest occupational class and/or the highest education level of parents, the market price of the property where the family resides and the type of school attended (Geckova et al, 2002). The type of school, in particular, contributes significantly to differences among adolescents in health-risk behaviour, mental health, health complaints experienced, use of prescribed and non-prescribed drugs, self-reported health and self-perceived vulnerability to illness (Geckova et al, 2002).

Adolescents, in contrast to children (van der Lucht and Groothoff, 1995) or adults (Power and Matthews, 1997), appear to be characterised more by the absence than by the presence of class gradients in health.

Very few data are available on the oral health status of Italian adolescents. In 2002, a mean decayed missing filled teeth (DMFT) index of 3 was found (Arcella et al, 2002); recently, DMFT > 3 was observed in 58.8% of 15-year-olds living in the north of Italy (Guadagni et al, 2005). For comparison, DMFT values in other countries in 2000 were 1.6 among Swiss adolescents (Marthaler et al, 2005), 2.1 among 15-year-olds in Denmark (Poulsen, 1996) and 1.5 among 14-year-olds in the United Kingdom (Pitts et al. 2004). Mild and moderate forms of gingival inflammation are found almost universally among adolescents (Cohen and Jago, 1976; Albandar et al, 1997; Gjermo et al, 2002). Clinical measures, such as DMFT index or community periodontal index (CPI), were used for systematic epidemiological recording of oral health status in children and in adolescents in several countries (Östberg et al. 2003). However, the need to include the patient's self-perceived oral health (SPOH) and behaviour for a comprehensive epidemiological evaluation in a specific population has been highlighted by several authors (Locker, 1988; Payne and Locker, 1996; Hobdell et al, 2003). Standardised questionnaires are the most commonly used method for evaluating a patient's SPOH and behaviour (Schafer et al, 1992; Locker, 1996; Östberg et al, 2003).

Oral health behaviour is often associated with gender and SES (Brunswick and Nikias, 1975; Locker, 1988; Schou et al, 1990; Schafer et al, 1992; Ronis et al, 1993; Locker, 1996; Payne and Locker, 1996; Corson et al, 1999). Few studies have revealed that daily toothbrushing is more common among individuals with higher education levels and income (Ronis et al, 1993; Sakki et al, 1995). Furthermore, many other factors may influence oral health behaviour including smoking, alcohol consumption, physical activity and dietary habits (Schafer et al, 1992; Sakki et al, 1995, 1998).



The aim of the present study was to evaluate in adolescents the possible interaction between the type of secondary school attended, which is used as a proxy for SES, clinical findings SPOH and behaviour, assessed using a self-completed questionnaire.

MATERIALS AND METHODS

Sample

The present survey was carried out as a crosssectional study from January to April 2006. Milan, with a population of 1,308,735 (Italian National Statistical Institute [ISTAT], 2004), is the second biggest city in Italy. It is an industrial and administrative city situated in north of the country. There are 59 public secondary schools in the city. The city council stratified the schools according to SES, based on the cost of household per square metre in the nine different districts of the town (http://www.comunemilano.it). Of the 59 secondary schools in Milan, 36 were stratified as schools located in areas with an average-low SES (with houses having a mean price within 3000 euros per square metre), whereas 23 secondary schools were stratified as schools located in areas with an average-high SES (with houses having a mean price of > 3000 euros per square meter). Information about the total number of adolescents (13- to 18-year-olds) resident in Milan was derived from the National Statistical Institute (ISTAT, 2004) (48,697 total: 8282 individuals in each age group, approximately). The sample size was calculated on the basis of the prevalence of caries reported in the literature (Arcella et al. 2002), augmented by 25%. Consequently, the estimates were safeguarded at an optimal level of precision (5%) against the possible effects of (a) disease reduction and (b) numbers of nonresponders.

Adolescents were recruited using systematic cluster sampling. Each class cluster was compiled from a list of students attending all classes in the two types of secondary schools in Milan. The two types of secondary schools selected were 'grammar and technical schools'. Grammar school can be defined as a school providing secondary education, and these schools trace their origins back to medieval Europe, as schools in which university preparatory subjects, such as Latin and Greek, were emphasized. Technical school is a general term used for 2-year college that provides mostly employmentpreparation skills for trained labour, such as welding, culinary arts and office management. The first cluster on the list was randomly chosen, whereas the others were selected at systematic intervals from three classes. The number of subjects in each class was approximately the same. In all, 1124 subjects (677 females and 447 males) were invited to participate in the survey.

The concentration of fluoride in tap water in Milan is low (i.e. 0.2 ppm of fluoride) (Brambilla et al, 1999).

Study design

The present research was ethically conducted in accordance with the Declaration of Helsinki. This study was approved by the Research and Ethics Committee of the University of Milan. The data were collected using a standardised questionnaire and through a dental examination. Parents or guardians were given an information leaflet explaining the aim of this study and requesting their child's participation. Only adolescents with informed signed consent by their parents were enrolled as participants (n = 1113); 163 of them were absent on the school day of the clinical examination and 37 refused the examination; hence, this study reports data on 913 subjects (492 females and 421 males), 547 in grammar schools (198 males [36.2%] and 349 females [63.8%]) and 366 in technical schools (223 males [60.9%] and 143 females [39.1%]). Statistically significant differences were observed in the sample distribution by gender and age groups, with a higher percentage of females in the younger groups $(\gamma^2 = 14.73; P < 0.01)$ (data are not given in the tables).

Questionnaire (construction and development)

The questionnaire (Fig 1) was pretested and validated by the same research group in a previous study on Italian adolescents (Campus et al, 2006). After the validation process, six items were modified. It was highly structured and divided into four domains: (1) personal data (age and gender); (2) self-assessed oral health status (i.e. dental and gingival status); (3) oral health behaviour (i.e. toothbrushing and frequency of dental checkups); and (4) lifestyle behaviour (i.e. smoking and dietary habits). The data in Table 1 summarise the main items in the questionnaire. This questionnaire was completed in the classrooms under the supervision of one of the examiners.

Clinical examination

Clinical data on dental caries were recorded using the DMFT index (World Health Organization [WHO], 1997). Clinical data on the gingival health status were catalogued using CPI, whereby participants were categorised by maximum CPI score. In view of the age range of the sample being examined, and following WHO (1997) recommendations, only scores of 0, 1 and 2 were recorded, so probing depths were not considered. Data were collected by three calibrated examiners: Cohen's kappa values for DMFT and CPI were at least 0.82 for interexaminer reliability and 0.74 for intraexaminer reliability. The students were seated on school chairs, and lighting was provided by a handheld halogen diving light. A sterile mouth mirror and a probe were used for the examination. An educational course on oral health topics was given immediately after the visit.

Data analysis

The Wald test was used to compare the mean estimates between gender in the type of schools. The Kruskal-Wallis test was used to evaluate differences among means. Bivariate analyses in terms of type of schools and answers to the questionnaire were performed by frequency distribution and chi-square test. The reference group included those individuals with the most favourable exposure level (i.e. group A: medium-high SES, toothbrushing more than twice a day and no daily snacks). Linear trends in proportion were tested using chi-square test (Mantel, 1963). The 95% confidence interval (CI) on the prevalence of caries was calculated assuming a binomial distribution. Residence area of subjects coded as urban, suburban and rural was used to control potential confounding variables (Chen and Andersen, 1997).

A linear regression model was created using mean DMFT as the dependent variable and the number of sextants with calculus as a proxy variable for low oral hygiene status.

The DMFT index was used as an ordinal score derived by categorisation of the DMFT score into four classes (Lesaffre et al, 2004).

The stepwise logistic regression method was applied to determine whether the type of school attended was associated with the clinical outcome variables, the DMFT index as an ordinal score (Lesaffre et al, 2004) and CPI \geq 1 with subjects' SPOH and with oral health or lifestyle behaviour. Statistical significance was accepted when the 95% CI for the parameters was different from 1.0.

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DATE
                                         ORAL HEALTH HABITS AND BEHAVIOUR
                                                                                                                              (mm/dd/yy)
EXAMINER
                Did you have had some kind of toothache or discomfort during the last year?
            1.
                 Yes
                            No
                                   Don't know
                How do you consider the level of your oral health ?
            2.
                 П
                            п
                                       п
                Not good Good
                                     Excellent
                Are you satisfied with the appereance of your teeth?
            3.
                п
                            No
                         Sufficiently
                                     Enough
                                                 Verv much
                Do you use other oral hygiene instruments, apart from toothbrushing and toothpaste?
           4.
                П
                            П
                 Yes
                            No
           5.
                How often do you eat sweet food (cookies, candies, etc.) outside of main meals?
                Once a week
                                       More than once a week
                                                              Once a day
                                                                         More than once a day
                Never
                Have you had some kind of fluoride supplementation (fluoride tablets, fluoride gels,
           6.
                fluoride mouthrinses)?
                           П
                                       П
                                   Don't know
                No
                           Yes
                How many times do you brush your teeth?
           7.
                Once a day
                              Twice a day
                                            More than twice a day
           8.
                Do you smoke? How many cigarettes a day?
                П
                                         Yes
                            No
                                      Less than five
                                                   6-10 a day More than 10 cigarettes a day
                How often do you have snacks outside of main meals?
           9.
                                       Once a week or less Once a day or more
           10.
                How often do you drink soft beverages (coke, fruit juice, etc.) outside of main meals?
                                            п
                 П
                            П
                                                                П
                Never
                          Once a week
                                       More than once a week
                                                              Once a day
                                                                          More than once a day
                                        Thanks for your collaboration!
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Fig 1 Questionnaire.

The possible modifying effects of covariates on the outcomes were tested using an interaction model (likelihood ratio test statistic).

RESULTS

The prevalence of caries was 59.8% (95% CI = 41.3 to 76.8); about a third of participants showed a CPI = 0, whereas 34.9% had bleeding at probing and 37.9% had calculus. Subjects from technical schools showed an odds ratio (OR) of 2.3 (95% CI = 1.8 to 2.9) for DMFT > 0 and a lower risk of gingivitis OR = 0.5 (95% CI = 0.3 to 0.79) (data are not given in the tables). The estimation of mean values

and 95% CI of DMFT and components was 1.9 (95% CI = 1.7 to 2.1) for DMFT, 1.2 (95% CI = 0.9 to 1.5) for DT, 0.2 (95% CI = 0.03 to 0.4) for MT and 0.5 (95% CI = 0.3 to 0.8) for FT. The D component of the caries index was dominant. The Kruskal-Wallis test showed significant differences between the two types of schools for DT (P < 0.01), FT (P < 0.01) and DMFT (P < 0.01). The DMFT values that are recorded in the two types of schools showed statistically significant differences of 1.6 (95% CI = 1.4 to 1.8) for grammar schools and 2.4 (95% CI = 2.2 to 2.7) for technical schools (P < 0.01). The distribution of the DMFT index was highly skewed (Fisher $\gamma^1 = 1.55$), and the caries distribution was significantly related to the type of

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| Table 1 Answers to questionnaire items stratified by type of school | | | | |
|---|---------------|-----------------|---------------------------------|--|
| | Grammar n (%) | Technical n (%) | χ^2 ; <i>P</i> value | |
| EDT: Experience of tooth discomfort | | | ^o ssen ^{co} | |
| No | 367 (67.1) | 212 (57.9) | | |
| Yes | 129 (23.6) | 129 (35.3) | | |
| Don't know | 43 (7.9) | 22 (6.0) | | |
| No answer | 8 (1.4) | 3 (0.8) | 15.3; < 0.01 | |
| SPOH: Self-perceived oral health | | | | |
| Not good | 4 (0.7) | 6 (1.6) | | |
| Good | 20 (3.7) | 15 (4.1) | | |
| Excellent | 513 (93.8) | 333 (91.0) | | |
| No answer | 10 (1.8) | 12 (3.3) | 3.8; = 0.31 | |
| SAT: Satisfied with appearance of the teeth | | | | |
| Not satisfied | 65 (11.9) | 47 (12.8) | | |
| Sufficiently | 73 (13.3) | 61 (16.7) | | |
| Enough | 275 (50.3) | 186 (50.8) | | |
| Very much | 128 (23.4) | 71 (19.4) | | |
| No answer | 6 (1.1) | 1 (0.3) | 5.4; = 0.31 | |
| OOHI: Other oral hygiene instruments | | | | |
| No | 392 (71.7) | 204 (55.7) | | |
| Yes | 86 (15.7) | 122 (33.3) | | |
| No answer | 69 (12.6) | 40 (10.9) | 38.9; < 0.01 | |
| SF: Sweet frequency | (), | × , | | |
| Never | 52 (9.5) | 48 (13.1) | | |
| Once a week | 55 (10.1) | 51 (13.9) | | |
| > Once a week | 90 (16.4) | 41 (11.2) | | |
| Once a day | 161 (29.4) | 109 (29.8) | | |
| > Once a day | 188 (34.4) | 110 (30.1) | | |
| No answer | 1 (0.2) | 7 (1.9) | 11.5; = 0.02 | |
| FS: Fluoride supplementation | | | | |
| No | 32 (5.8) | 6 (1.6) | | |
| Yes | 287 (52.5) | 210 (57.4) | | |
| Don't know | 209 (38.2) | 132 (36.1) | | |
| No answer | 19 (3.5) | 18 (4.9) | 11.7; < 0.01 | |
| TF: Toothbrushing frequency | | | | |
| Once a day | 26 (4.7) | 20 (5.56) | | |
| Twice a day | 72 (13.2) | 70 (19.1) | | |
| > Twice a day | 438 (80.1) | 261 (71.3) | | |
| No answer | 11 (2.0) | 15 (4.1) | 10.8; < 0.01 | |
| SH: Smoking habits | | | | |
| No smoking | 287 (52.5) | 213 (58.2) | | |
| < 5 a day | 61 (11.2) | 25 (6.8) | | |
| 6–10 a day | 46 (8.4) | 19 (5.2) | | |
| > 10 a day | 131 (23.9) | 99 (27.1) | | |
| No answer | 22 (4.0) | 10 (2.7) | 10.7; = 0.03 | |
| SOM: Snacks outside of meal | | | | |
| \leq Once a week | 255 (46.6) | 117 (32.0) | | |
| \geq Once a day | 290 (53.0) | 244 (66.7) | | |
| No answer | 2 (0.4) | 5 (1.3) | 21.4; < 0.01 | |
| SDF: Soft drink frequency | | | | |
| Never | 100 (18.3) | 30 (8.2) | | |
| Once a week | 103 (18.8) | 35 (9.6) | | |
| > Once a week | 214 (39.1) | 125 (34.1) | | |
| Once a day | 66 (12.1) | 79 (21.6) | | |
| > Once a day | 63 (11.5) | 90 (24.6) | | |
| No answer | 1 (0.2) | 7 (1.9) | 71.9; < 0.01 | |

school attended in each score of the DMFT categorisation (P < 0.01). A significant inverse relationship was observed between the presence of calculus and the experience of caries ($R^2 = 0.8$; P < 0.01). The data in Table 1 show the adolescents' answers to the different questionnaire items stratified by the type of school. Experience of tooth discomfort (ETD) was claimed by 23.6% of subjects from grammar schools and 35.3% from technical schools (P < 0.01). Excellent SPOH was reported by the entire sample (93.8% in grammar schools and 91.0% in technical schools, P = 0.31). Satisfied with appearance of the teeth (SAT) was found in > 70% of the sample, with a slightly higher percentage from grammar schools. Toothbrushing more than twice a day was reported by 80.1% of grammar school students and 71.3% of technical school students (P < 0.01). Frequent consumption of soft drinks and snacks outside main mealtimes were greater among the technical school adolescents (P < 0.01); finally, no smoking was reported by 52.5% of subjects in grammar schools versus 58.2% in technical schools (P = 0.03). The item about frequency of dental checkups showed several missing data, and hence it was excluded from the analysis. The data in Table 2 report the results of the logistic regression models using the type of school as the outcome variable. Gender (female), CPI (> 1) and the highest DMFT score gave a significant contribution to the logistic regression model with an OR (95% CI) of 0.4 (0.3 to 0.5), 1.8 (1.3 to 2.5) and 1.6 (1.3 to 1.9), respectively. During the process of assessing the model, it was found that gender was an effect modifier, and the effect was tested using an interaction model (likelihood ratio test statistic, G = 5.1; P = 0.02). Hence, two logistic regression models were created for males and for females separately. The data in Table 3 present the crude OR estimates and the associated 95%

| Table 2 Logistic estimates of the model (forwardstepwise logistic regression) for type of school | | | | |
|--|-----|---------|--|--|
| Variable | OR | 95% CI | | |
| Gender (female) | 0.4 | 0.3–0.5 | | |
| CPI (CPI = 1 or higher) | 1.8 | 1.3–2.5 | | |
| DMFT score | 1.6 | 1.3–1.9 | | |
| EDT (yes) | 1.2 | 0.9–1.5 | | |
| TF (once a day) | 1.0 | 0.7–1.3 | | |
| SF (> once a day) | 0.9 | 0.8–1.1 | | |
| Log likelihood = -480.9 , no. of observations = 870, $P < 0.01$. | | | | |



Table 3 Logistic regressions: estimates of the model using type of school as the outcome, stratified by gender

| Variable | OR | 95% CI | | |
|--|-----|---------|--|--|
| Gender: male ^a | | | | |
| CPI (CPI = 1 or higher) | 1.6 | 1.1–2.5 | | |
| DMFT score | 1.6 | 1.2-2.0 | | |
| EDT (yes) | 1.2 | 1.4–2.6 | | |
| TF (once a day) | 0.9 | 0.6–1.2 | | |
| SF (> once a day) | 1.0 | 0.8–1.2 | | |
| Gender: female ^b | | | | |
| CPI (CPI = 1 or higher) | 2.1 | 1.3–3.3 | | |
| DMFT score | 1.6 | 1.2-2.0 | | |
| EDT (yes) | 1.1 | 0.8–1.6 | | |
| TF (once a day) | 1.3 | 0.8–2.3 | | |
| SF (> once a day) | 0.8 | 0.6-1.1 | | |
| ^a Log likelihood = -229.7 , no. of observations = 394, $P < 0.01$. ^b Log likelihood = -248.7 , no. of observations = 476, $P < 0.01$. | | | | |

confidence intervals via the two forward procedures in logistic regression by gender. In males, CPI \geq 1 was positively associated with the type of school, OR = 1.6 (95% CI = 1.1 to 2.5), the highest DMFT score and the experience of self-perceived tooth discomfort, OR = 1.6 (95% CI = 1.2 to 2.0) and OR = 1.2 (95% CI = 1.4 to 2.6), respectively. However in females, only CPI \geq 1 and the highest DMFT score were associated with the type of school, OR = 2.1 (95% CI = 1.3 to 3.3) and OR = 1.6 (95% CI = 1.2 to 2.0), respectively.

DISCUSSION

In the present study, the possible relationship between the type of secondary school attended, which was used as a proxy for SES, oral clinical data, SPOH and behaviour in adolescents was evaluated. Based on the type of school attended, the findings showed that the occurrence of caries, behaviour towards caries and oral health were strongly related to SES.

The proportion of smokers in the lower SES group was less than that in the grammar school. However in the literature, smoking habits have been linked to low SES level (Fagan et al, 2007), although education is independent of initiation and exposure (Watson et al, 2003). Overall, the data might suggest interactions between the gender and the smoking habit factor. However, the fact that the gender-related factor has the potential to interact, and that it might be distributed differently among samples (in grammar schools, females were a higher percentage than males) may result in one behaviour factor having more weight in some populations than in others.

Several socioeconomic indicators based on both adolescents and their parents were used to investigate health-risk behaviour and health status. In the present study, the type of secondary school was chosen as proxy for SES; this SES determinant seems to be a very sensitive socioeconomic indicator in adolescents (Geckova et al, 2002). The type of school is strongly correlated with life orientation, skills and knowledge (Hobdell et al, 2003).

The association between low SES background and caries disease was extensively studied and described (Watson et al, 2001; Hobdell et al, 2003; Johnson, 2004; Okullo et al, 2004; Enjary et al, 2006; Selwitz et al, 2007); however, information about SES and caries among adolescents was fairly limited. In 2003, an association between socioeconomic factors and the level of caries in Brazilian adolescents was described. The authors hypothesised that an adverse socioeconomic environment increases the risk of having high levels of caries, reduces the chances of a healthy diet, access to dental care and the likelihood to adopting healthy caries-related behaviour (Nicolau et al, 2003). In Chilean adolescents, poor socioeconomic and behavioural factors showed a strong correlation with infrequent dental visits and symptoms such as dental pain, gum bleeding and infection (Lopez & Baelum, 2007). Among European adolescents, significant socioeconomic health differences were found in Slovak adolescents: subjects with parents of a lower occupational class and who attended a school of lower socioeconomic status showed significantly poorer health (Geckova et al, 2004).

When dental caries rates are reported by gender, females were typically found to exhibit higher prevalence rates than males. In the present study, this finding might also be related to the higher percentage of females attending grammar schools than those attending the other schools.

A number of advantages and limitations should also be considered when interpreting the findings of the present study. Clinical examinations were conducted by three calibrated examiners; the high value of interexaminer and intraexaminer reliability, associated with the response rate, ensured good reliability to the study design. Furthermore, methods used for caries diagnosis (visual inspection with probe and mirror) may be considered a limitation, but these methods showed excellent reliability (Bolin et al, 2004). Moreover, the present study was crosssectional and, consequently, no information is available regarding lesion progression. Furthermore, the present sample, enrolled in schools located in a northern area of the country, cannot be a representative of the entire Italian adolescent population, but the distribution of these two types of schools in the country and a similar SES of the subjects who attended them made this SES indicator useful and simple for oral health in adolescents.

The present study has documented a correlation between the type of secondary school attended by adolescents and their oral health status and behaviour. Adolescents attending the technical secondary schools showed more experience of caries and poorer behaviour related to oral diseases than their coevals attending grammar schools. The type of school is a sensitive oral health indicator and contributes significantly to differences in oral health, self-reported health and oral health-related behaviour.

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