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Assessing the oral health of school-age children and the current school-based dental screening programme in Freiburg (Germany)

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Sagheri D, Hahn P, Hellwig E. Assessing the oral health of school-age children and the current school-based dental screening programme in Freiburg (Germany).

Abstract: Germany has a three-tiered system of education at secondary school level, divided into the school types 'Hauptschule', Realschule' and 'Gymnasium'. All students receive, when aged 6–12 years, a uniform annual dental examination and oral health education programme. *Objectives:* The aim of this cross-sectional study was to report on the dental caries levels of school-age children stratified into these three different school types at secondary school level to enable oral healthcare personnel to administer a focused, school-based dental screening and education programme according to patients' needs rather than a uniform dental examination. *Methods:* A representative, random sample of 12-year-old school children in Freiburg (Germany) was examined and dental caries was recorded using WHO criteria. *Results:* A total of 322 12-year-old children participated. The mean DMFT was 0.69. An examination of the distribution of the DMFT score revealed that its distribution is positively skewed. For this reason, this study provides summary analyses based on medians and a non-parametric rank sum test. The non-parametric Kruskal-Wallis H-test showed a highly significant difference between median scores across the different school types (*P*-value = 0.004). The significance was a result of the 'Gymnasium' distribution of DMFT scores which differed markedly from the other two school types. *Conclusions:* The finding of the present study suggests that it may be useful to stratify the school dental screening and education programme according to school type and to prioritize children who attend 'Realschule' and

'Hauptschule'. This shift should systematically target children with the greatest need for dental care.

Key words: children; dental caries; fluoride; Freiburg; Germany; oral health; oral health education; oral health promotion; preventive dentistry; school screening

Introduction

In Germany, responsibilities for health and education are held by the 16 German states and therefore may vary from state to state. However, in general, state salaried dentists perform uniform annual dental examination on all schoolchildren aged 6–12 years and may provide oral health education in a team together with other professionals, such as dental hygienists and dental nurses. These programmes may include the application of fluoride varnish or gel with a concentration of 23 600 ppm and are provided by the public dental health service at city or county level in all state maintained primary and secondary schools.

The first survey which provided information on oral health of 12-year-old children in Germany was a representative survey conducted on behalf of the 'Deutsche Arbeitsgemeinschaft für Jugendzahnpflege, DAJ' (German working-group for children's dental care) by the University of Marburg in 1994 (1). The survey collected data about dental caries in the different German states and discussed the results for each state. The diagnostic criteria for dental caries were based on the WHO diagnostic criteria (2). However, there were no epidemiological data available that focused only on Freiburg city or its county and the smallest unit reported on is the State of Baden-Württemberg (population: 10.2 million).

The 1994 survey reported a mean DMFT of 2.4 in 12-year-old children. A second survey conducted by DAJ in 1996 (3) showed a mean DMFT of 1.43. The methods and criteria for this second survey was a duplication of those used in the 1994 survey. In 2000, the Landesgesundheitsamt Baden-Württemberg (State Health Authority of Baden-Württemberg) conducted a survey to report on children's dental health using the same criteria as in the DAJ 1994 survey and DAJ 1997 survey. The 2000 survey showed a mean DMFT of 1.03 for the 12-year olds (4). A fourth survey conducted by Landesgesundheitsamt Baden-Württemberg in 2004 (5), which used the same examination criteria as in the previous three surveys, showed a mean DMFT of 0.71. The surveys conducted in 1994, 1996, 2000 and 2004 demonstrated that the oral health in 12-year olds has improved substantially. However, these surveys provided no applicable information or strategy on how to identify children with the greatest need for dental care.

The German education system provides different paths for students based on individual ability. Mandatory attendance starts at age 6 and ends at age 18. All children attend primary school until fourth standard (i.e. up to 10 years of age). After that they can take one of three school paths ('Hauptschule', 'Realschule' and 'Gymnasium') based on their school performance at primary school level. 'Hauptschule' is supposed to prepare mainly practically oriented students for craft professions. 'Realschule' is supposed to prepare mainly practically and theoretically oriented students for trade, technical and administrative professions. 'Gymnasium' caters mainly to theoretically oriented students, who are to be prepared for various studies at universities. The aim of this study was to report on the oral health of school-age children stratified into the three different school types at secondary school level in Freiburg (Germany) to assist oral healthcare professionals to develop the current uniform school-based dental screening and education programme for all state maintained schools further to a focused, patient-centred programme.

Methods

Sample

Selection for age in the sample was carried out on the basis of the children's standard (class) in school. Second standard secondary school was selected to represent 12-year olds in Freiburg. Children aged 12 years were selected as the study population because this age group is comparable with earlier German studies and with studies conducted internationally as this age group was recommended for study by the World Health Organization (WHO). The District Education Department in Freiburg [total population of approximately 205 000, had a population of 12-year olds of approximately 1600 (6)] provided information on numbers of children in the classes and schools. This permitted determination of the sample size and the random selection of schools for inclusion in the study. The total target sample size required, based on a confidence

level of 95%, margin of error of 5%, was 310 children. The study included all state-maintained schools with 12-year olds on the school roll. The primary sampling unit was the school. The second stage of the sampling process was then the selection of one class. If a school had more than one class available each class had an equal probability of being randomly selected. All children within a class were included in the sample. A list of children in each class was obtained from the selected schools. This selection process continued until sufficient numbers of children were obtained.

Ethical approval and consent

The Joint Hospitals Research Ethics Committee (JHREC) reviewed the protocols for training and calibration of the examiner and for the main study. The committee approved the study in December 2001. All parents of participating children were fully informed regarding the nature of the study and the benefits of participating. Parental consent forms were given to the teacher responsible for the class selected who issued them to the children to forward them to the parents together with parental questionnaires one week before the examination. Questionnaire items were adapted from previous international surveys to ensure their validity (7–9). The development and validation of the various items have been reported elsewhere (7). The questionnaire included 15 items regarding the child's current oral hygiene practices and the consumption of different fluoride-containing products. Clinical examinations were only carried out on the children with completed consent forms (Positive Consent) and questionnaire.

Training and calibration of the examiner

The examiner (DS) and recorder (dental surgery assistant) were trained and calibrated prior to the commencement of the fieldwork to ensure reliability on the measurement indices following WHO guidelines (10, 11). The trainer, a senior lecturer in public dental health at the WHO Collaborating Centre for International Collaboration in Dental Education with extensive experience in oral health surveys, provided the standard against which the examiner (DS) was calibrated. The initial training and calibration programme took place over a 3-day period at WHO Collaborating Centre for Dental Education and in a primary healthcare centre. The first part of the training exercise consisted of a series of seminars and exercises on the measurement indices used with standardized slides from previous dental health surveys (7, 12). The second part of the training exercise consisted of the examination of 25 12-year-old children in a primary care setting. These children had been preselected to allow the examiner to examine a full range of the oral conditions included in the study. The level of agreement between the examiner and the gold standard was assessed by use of the Kappa statistic, as described by Fleiss and Chilton (13). A validation exercise was conducted during the fieldwork (re-examination of 10% of the subjects) to monitor examiner agreement and consistency during the course of the survey.

Fieldwork and data processing

Dental caries was recorded at DMFT level, i.e. when clinically detectable lesions in dentine and lesions into the pulp were evident and children's CPI scores were recorded as an indicator for their oral hygiene levels using WHO criteria (10). All children were examined in their schools under the same standardized conditions. A transportable halogen lamp (Daray Versatile Medical Light with halogen bulb, 12 volts and 20 watts) was used to illuminate the mouth and clamped to the table in a position that enabled it to be angled towards the mouth. All children were supplied with tinted protective eyewear. The teeth were examined visually for dental caries. The teeth were examined wet and a CPITN probe was only used to confirm a diagnosis of cavitation or to remove food debris. A strict cross infection protocol was followed. Data were collected on schematized charts and processed using the Statistical Package for the Social Sciences, SPSS 12 (SPSS Inc., Chicago, IL, USA).

Results

In all, 13 secondary schools in Freiburg were included in the sample, and 378 consent forms and questionnaires were issued. A total of 322 (85% response) completed consent forms were returned and subsequently the same number of children were examined. The difference between the numbers of issued consent forms and questionnaires and the examined children is mostly made up of children who were not present even at the second visit or who forgot to return the consent forms. Out of these 164 females (50.9%) and 158 males (49.1%) were examined. The mean age of the children on the day of examination in Freiburg was 11.66.

Examiner and recorder were calibrated to ensure reliability on the measurement indices used prior to the commencement of the fieldwork. The level of agreement between the examiner and the gold standard was calculated and showed an agreement of Kappa 0.87. A validation exercise was conducted

Table 1. **Mean number of decayed, missing and filled permanent teeth (DMFT) for the total sample and mean numbers and mean rank for each school type in Freiburg**

	Freiburg		
n	322		
Mean DMFT	0.69		
SD	1.19		
Caries free (%)	66.1		
School type	Gymnasium	Realschule	Hauptschule
n	139	101	82
Mean DMFT	0.4	0.89	0.93
SD	0.78	1.4	1.38
Caries free (%)	74.8	59.4	59.8
Kruskal-Wallis Rank	145.05	173.28	174.87

during the fieldwork (re-examination of 10% of the subjects) to monitor examiner agreement and consistency during the course of the survey (intra-examiner Kappa 0.89).

The data (Table 1) are presented as the mean values of decayed, missing and filled permanent teeth (DMFT). The mean DMFT for the sample was 0.69 (1.19 SD). The proportion of children with caries-free dentition (DMFT = 0) was 66.1% in Freiburg.

Germany's school system divides the students into three different types of schools ('Hauptschule', 'Realschule' and 'Gymnasium'). To get a further insight into the distribution of dental caries in the child population in Freiburg, the DMFT scores were stratified into the different school types. Table 1 shows the DMFT mean values for each school type in Freiburg. The mean DMFT for 'Gymnasium' was 0.4, for 'Realschule' it was 0.89 and for 'Hauptschule' it was 0.93. As it is typical in low caries populations, the DMFT values are not normally distributed but are positively skewed with the result that reporting the mean DMFT of the sample population gives an incomplete picture of the distribution of dental caries in that population. For this reason, this study provides summary analyses based on medians and inter-quartile range and non-parametric rank sum tests (Table 1). The non-parametric Kruskal-Wallis H-test showed a highly significant difference between median scores across the different school types in Freiburg. The association between the DMFT scores and the different school types in Freiburg is considered to be statistically highly significant (the one-way $\chi^2 = 10.827$; the *P*-value = 0.004). To make these differences between the DMFT distribution in the different school types visible, a boxplot was used. Boxplots allows comparing the different median scores (or median lines) for the three social classes and their variation (length of the box, which represents the middle 50% of the DMFT scores, and whiskers, which represents the range

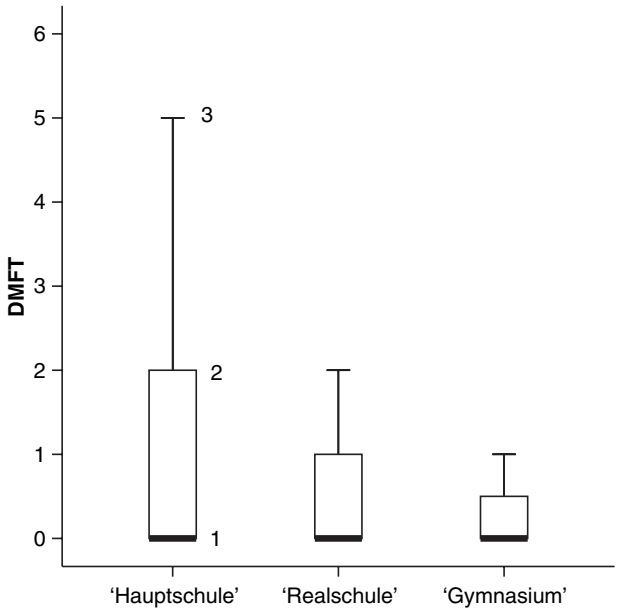

Fig. 1. Boxplot of the DMFT distribution for each school type in Freiburg. [1]Median score (median line), [2]Length of the box and [3]Length of the whiskers.

of the DMFT scores). The boxplot for the sample (Fig. 1) demonstrates that the significance between median scores (median lines) and spread (length of the boxes or whis kers) across the different school types is due to 'Gymnasium' distribution differing markedly from 'Realschule' and 'Hauptschule'.

The levels of chronic gingivitis in children can be seen as an indicator for the effectiveness of oral hygiene habits. The Community Periodontal Index (CPI) was used to report on children's periodontal status. The percentages of children with one or more sextants scored as 'Healthy', 'Bleeding' or 'Calculus' as a maximum score for each school type are shown in Table 2. In total, 45.7% of the children had a maximum score

Table 2. **Children's maximum Community Periodontal Index (CPI) score for each school type in Freiburg**

	Gymnasium		Realschule		Hauptschule	
	n	%	*n*	%	*n*	%
Healthy (score 0)	75	54.0	44	43.6	28	34.1
Bleeding (score 1)	56	40.3	51	50.5	48	58.5
Calculus (score 2)	8	5.8	6	5.9	6	7.3
Total*	139	100.0	101	100.0	82	100.0

The scores of the CPI index are the following: health periodontal conditions (score 0), gingival bleedings (score 1), calculus and bleeding (score 2), shallow periodontal pockets, 4–5 mm (score 3) and deep periodontal pockets, 6 mm or more (score 4).
*Shallow periodontal pockets (score 3) and deep periodontal pockets (score 4) were not found in the sample population.

Table 3. **Reported consumption of different fluoride products for each school type in Freiburg**

	Fluoride toothpaste		Fluoridated salt		Fluoride tablets		Fluoride gel		Fluoride mouthrinse	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%
Gymnasium	132	95.0	102	73.4	55	39.6	32	23.0	6	4.3
Realschule	93	92.1	57	56.4	34	33.7	19	18.8	10	9.9
Hauptschule	77	93.9	43	52.4	24	29.3	17	20.7	14	17.1
Total	302	93.8	202	62.7	113	35.1	68	21.1	30	9.3

of 'healthy' in Freiburg. From Table 2, it can be seen that there was a decreasing proportion of children in the 'Healthy' category from 'Gymnasium' to 'Hauptschule' with a similar increasing trend in the 'Bleeding' category from 'Gymnasium' to 'Hauptschule'.

The use of freely available (non-prescription) fluoride containing oral healthcare products, in particular the use of fluoridated salt, is considered as a cornerstone in the strategy to prevent dental caries in Freiburg. It was for this reason that the use of these products was recorded to report on their consumption patters. The results of this study revealed that approximately 93.8% of the parents reported that their children use fluoride toothpaste, approximately 62.7% reported using fluoridated salt, approximately 35.1% reported using fluoride tablets, approximately 21.1% reported using fluoride gel and approximately 9.3% reported using fluoride mouthrinse (Table 3). The main source of fluoride, apart from the use of fluoridated toothpaste, is fluoridated salt. Table 3 revealed that a considerably higher proportion of children attending 'Gymnasium' use fluoridated salt when compared with children attending 'Realschule' and 'Hauptschule'. In Freiburg 73.4% of parents of children attending 'Gymnasium', 56.4% of children attending 'Realschule' and 52.4% of children attending 'Hauptschule' reported using fluoridated salt.

Discussion

It was decided to use school type at secondary school level as a proxy for social stratification because Germany's school system divides the students into three different levels of schools ('Hauptschule', 'Realschule and 'Gymnasium') from an early age. This stratification revealed the existence of social gradients in oral health status in Freiburg. Comparisons of the mean numbers of decayed, missing and filled permanent teeth (DMFT) showed that dental caries levels of children attending 'Gymnasium' were considerably lower when compared with the other two school types. The association between the DMFT scores and the different school types was considered to be statistically very significant. The significance was due to the distribution DMFT scores at 'Gymnasium' level which differed markedly from 'Realschule' and 'Hauptschule'. Klemme *et al.* (14) found in their study on the relationship between caries prevalence and fissure sealants among 12-year olds in Heidelberg (Germany) that there was an unequal fissure sealant prevalence and dental caries experience throughout the different school types. Reasons for this variation in oral health experience and dental caries levels in different social groups are complex and multifactorial. One factor that influences dental caries levels is the exposure of a population to fluoride. The World Health Organization (WHO) concluded in its report on 'Fluorides and Oral Health' (15) that there is 'clear evidence that regular, low-level exposure of a population to fluoride can reduce caries prevalence'. The current study showed that the vast majority of children use fluoridated toothpaste. However, an obvious gradient in the use of fluoride gel, tablets and fluoridated salt was observed in Freiburg. The number of parents who reported that their children regularly use fluoridated salt, fluoride tablets and fluoride gel increased for all three products from 'Hauptschule' to 'Realschule' and was the highest in 'Gymnasium' which underpins the need for a targeted approach in oral health promotion. The findings demonstrated that about 62.7% of the parents in Freiburg reported using fluoridated salt regularly. This level of fluoridated salt use is considerably lower than the 84% reported for Switzerland (16) and suggests the opportunity to increase the uptake to similar levels in Freiburg through an oral health promotion programme on the use of fluoridated salt. Schulte *et al.* (17) found in their comparative study on caries experience in 12-year-old children in Heidelberg (Germany) and Montpellier (France) that approximately 40% of their German sample consumed fluoridated salt. They concluded that a decrease in the caries experience may well be obtainable by increasing the use of fluoridated salt. To achieve the wanted broad reduction of dental caries on population level, all groups of the society need to consume fluoridated salt (16) or a sufficient amount of alternative fluoride containing products. This requires a comprehensive oral health promotion programme on the use of fluoride, which should target parents and children. The finding of the present study suggests that it may be useful to stratify school screenings and oral health promotion programmes

according to whether children attend 'Gymnasium' or other types of school in Freiburg and to prioritize children who attend 'Realschule' and 'Hauptschule'. This shift within the provision of the school dental programme will help to systematically target children with the greatest need of dental care who can then be referred for treatment, advised of the service available and provided with targeted oral health education in their schools. Locker *et al.* (18) found in their evaluation of a targeted school-based dental screening programme that a targeted programme was the most effective at identifying children with dental care needs and that it can maximize the cost effectiveness of oral health promotion programmes. The authors suggest that dental hygienists should play a leading role within the dental team in applying such an oral health programme. A programme tailored to parents and needs of children, who attend 'Hauptschule' and 'Realschule' may well then lead to a reduction in dental health inequalities in Freiburg. Further research is desirable to test such a need-focused oral health promotion programme.

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