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The prevalence of enamel opacities in permanent teeth of 11-12 year-old school children in Kuala Lumpur, Malaysia.

N. Yusoff[1], N. Jaafar[1], I.A. Razak[1], Y.Y Chew[2], N. Ismail[2] and A.M. Bulgiba[3]

[1] Dept. of Community Dentistry, University of Malaya, Kuala Lumpur; [2] Oral Health Division , Ministry of Health Malaysia, [3] Dept. of Social & Preventive Medicine, University of Malaya, Kuala Lumpur, Malaysia.

Objective To determine the prevalence, distribution, severity and treatment need of enamel opacities among 11-12 year-old school children in a fluoridated urban community. ***Design*** A cross-sectional descriptive survey of enamel opacities in 11-12 year-old schoolchildren. ***Clinical setting*** A questionnaire survey and a clinical examination of erupted teeth using the Modified DDE Index was conducted on schoolchildren in randomly selected schools. ***Participants*** 957 schoolchildren from government schools in Kuala Lumpur comprising the three major ethnic groups of Malay, Chinese and Indian children. ***Main outcome measures*** The severity of enamel opacities was assessed by the extent of buccal surface involvement. Normative treatment need was based on severity of opacities. ***Results*** Enamel opacities were found in 90.7 % of subjects and 47.2 % of teeth .Malays have the highest prevalence with Chinese the least. Although ethnic differences is statistically significant ($p<0.01$), the differences in prevalence between ethnicity is small. The most common type of defect was "diffuse opacities" (88.6% of subjects). Most subjects (70%) showed bilateral distribution of diffuse opacities indicating a systemic disturbance. Posterior teeth were twice more commonly affected ($p<0.05$). The majority of opacities in anterior teeth (66.7%) were minor, involving less than 1/3 of the labial surface. Only 0.6% of the whole sample required some form of aesthetic intervention. ***Conclusion*** Despite the high prevalence of enamel opacities, the degree of severity is very mild with only minimal aesthetic and public health concern.

Key words: Dental epidemiology, enamel opacities, fluorosis

Introduction

The population of Federal Territory Kuala Lumpur (FTKL) has received the benefits of water fluoridation since the early 1970's, with the implementation of nationwide fluoridation policy as a public health measure to control dental caries. In addition to fluoridation, the use of fluoridated toothpaste is widespread in the community. Other sources of fluoride may come from the dietary intake.

The three major ethnic groups in Kuala Lumpur are Malays, Chinese and Indians. Each ethnic group has its own cultural, religious and unique dietary practices. This may influence their fluoride intake through the different fluoride content in the diet. These major ethnic groups are also reflected in the population of schoolchildren attending government schools in FTKL. All government schools in FTKL are being given comprehensive oral health care under the School Dental Service from the Dental Department of FTKL.

The relationship between fluorosis and fluoride intake has been well established. In addition to caries decline, there appears to be an increasingly common occurrence of enamel opacities among schoolchildren as seen during the annual screening in the primary schools in Kuala Lumpur. However no study has been done locally to quantify these casual observations. A study of enamel opacities among 12-year-old schoolchildren in the neighbouring state of Selangor, which also received fluoridated water supply, reported a prevalence of 72.5% (Razak and Hussein, 1986). It is not known whether these opacities are directly attributed to fluorosis.

In the last national survey of 16-year-old schoolchildren, it was noted that although the prevalence of enamel opacities was high (56% of subjects), there was an inverse relationship between the dental caries experience and the mean number of teeth with diffuse opacities (Oral Health Division Ministry of Health Malaysia, 1998).

In view of the perceived widespread prevalence of enamel opacities among school children as observed during the annual school oral health examination under the school dental service, it is thus necessary to monitor the prevalence of enamel opacities, allay public concern and to make provision for any treatment needs.

Therefore the aim of the present study was to assess the: (i) prevalence of enamel opacities by ethnicity and type of defect, (ii) extent of opacity and (iii) normative treatment need among 12-year-old schoolchildren in Kuala Lumpur.

Method

The total enrolment of Primary Six schoolchildren aged 11-12 years old in Kuala Lumpur was 15,371. Of these, 95% (n=14,602) consented to be treated under the School Dental Service (SDS) programme and they formed the sampling frame for this study. Their ethnic composition was Malays (45%), Chinese (44.6%) and Indians (10.4%). A list of all the three main types of government schools with their primary six enrolment was obtained from the

Correspondence to: Dr. Noriah Hj Yusoff, Department of Community Dentistry, Faculty of Dentistry, University of Malaya, 50603 Kuala Lumpur, Malaysia. E-mail: noriahyu@um.edu.my

Education Ministry. There were a total of 168 schools in the following proportions: 112 National schools; 40 Chinese schools; 16 Tamil schools. The sampling units were first stratified according to the three main types of schools in Kuala Lumpur, that is National, Chinese and Tamil schools to ensure the three major ethnic groups were included in the sampling frame. The schools from each category were selected in a random sequence of numbering given to the schools from each listing. A total of eight schools were selected for the survey. Based on the enamel defect prevalence of 72.5% in the neighbouring area (Razak and Hussein, 1986) it was calculated that a minimum sample size of 300 for each ethnic group was needed to ensure a sampling error of less than 5%. All the subjects in the selected schools were examined until more than the required sample was obtained. A total of 957 subjects made up the final sample.

The three examiners were trained and calibrated in the use of the modified DDE Index (FDI, 1992). Each examiner was assisted by a trained recorder. Percentage agreement between the three examiners was used to check for consistency. Since the prevalence of the condition is high, the researchers feel that the use of percentage agreement instead of Kappa statistics would not compromise the accuracy (WHO, 1997). The percentage agreement for inter examiner agreement was at least 80% which is considered acceptable for the survey. Ten percent of subjects were re-examined at the end of each day to check for examiner consistency. At least 85% agreement was achieved.

The subjects were asked to brush their teeth before the clinical examination to remove oral debris. The subjects were seated on a portable dental chair. Illumination was provided by a standard Waldman 100W portable light. The teeth were not dried prior to examination.

The clinical examination excluded canines, second premolars, second molars, partially erupted teeth and teeth with fixed orthodontic appliances. A tooth was also excluded if more than half of the tooth has fractured or more than half of the surface was carious or restored and if calculus covered more than two thirds of the tooth surface. The tooth surfaces examined were the buccal/labial, occlusal and lingual/palatal, using a disposable mouth mirror. However, the severity of enamel opacities was assessed by the extent of involvement on the buccal/labial surfaces only.

Normative treatment need was assessed based on the severity of opacities on the anterior/buccal aspects of tooth surfaces using the modified DDE Index for use in the general purpose epidemiological studies (FDI,1992). Treatment was indicated for severe opacities (severe staining/hypoplasia) on the anterior/buccal aspects corresponding to codes 6-9 of the modified DDE Index whilst mild opacities corresponding to codes 1-5 was not indicated for treatment.

Data analysis was done using Epi- Info Version 6 software. The significance level was taken at 0.05.

Results

The final sample consisted of 957 subjects with almost equal distribution of Malay, Chinese and Indian children. About 60% were males (Table1). Overall prevalence was high. The mouth prevalence of enamel opacities for the sample was 90.7% (weighted population prevalence by ethnicity=90.5%) while the tooth prevalence was 47.2%. Malays had the highest prevalence (94.5%), followed by Indians (90.9%) and Chinese the least, (86.6%) (Table 2). There was a statistically significant difference between ethnic groups ($p<0.05$) in the mouth prevalence of enamel opacities, however the absolute difference is small.

Table 3 shows the distribution of types of enamel defect. Overall, the most common was "diffuse opacities" which affected 88.6% of subjects, followed by "demarcated opacities" (20.3%) or a combination of the above (13.1%). The "hypoplastic" type (5.2%) and "other opacities" (0.3%) were very few. Of those with opacities (n=868), it was found that the majority (77.3%, n=671), showed a bilateral distribution (homologous pairs) of diffuse patchy opacities which indicates that the disturbance was probably of systemic origin.

Table 4 shows the distribution of the severity of enamel opacities by the extent of buccal/labial involvement for anterior and posterior teeth. Overall, the majority of the opacities (57.1%) in both anterior and posterior teeth involved only less than one-third of the tooth surfaces.

The more severe opacities such as confluent opacities with staining and hypoplasia occurs less frequently (only 1.3%) and then also mainly on posterior teeth (30.6% of buccal opacities). The more extensive involvement affecting more than two-thirds of the buccal surfaces were twice more likely to be found in the posterior teeth as compared to anterior. The difference in distribution between anterior and posterior teeth is statistically significant ($p< 0.05$).

Treatment need among those with opacities is very low. Overall, very few children (0.6%, n=6) were diagnosed by the examiners to require some form of aesthetic intervention to improve their tooth appearance. This represents only 1.8% of those with enamel opacities.

Discussion

The overall prevalence of enamel opacities was high (90.7%) irrespective of ethnicity. The high prevalence observed also agrees with the observation made by King and Wei (1986) among 12 year–old children in Hong Kong which reported a 99.6% prevalence. The slightly lower prevalence in this study might be because the present study did not dry the teeth prior to examination.

The present study found significant although small differences in prevalence between ethnic groups , which was contrary to previous local studies. The national study NOHSS'97 (Oral Health Division, MoH,1998) reported the highest prevalence among Chinese (64.6%) as compared to Malays (57.5%), while the reverse is reported in this study in Kuala Lumpur with Malays(94.5%) having highest prevalence and Chinese (86.6%) lowest. An earlier study in Johore in 1986 found no significant difference (Dental Division, Ministry of Health, 1986). Since lifelong water fluoridation and the use of fluoridated toothpaste is a common factor for all subjects in all the study populations, the variations could be attributed to other factors such as cultural variations in diet, nutrition, lifestyle and socioeconomic factors. However it should

Table 1. Socio-demographic characteristics of the sample

	Distribution of sample by gender and ethnic group			
	Gender		*Total*	
Ethnic group	*Male*	*Female*	*n*	*(%)*
Malay	199	129	328	(34.3)
Chinese	182	139	321	(33.5)
Indian	188	120	308	(32.2)
Total	569 (59.5%)	388 (40.5%)	957	(100%)

Table 2. Prevalence of enamel opacities according to ethnic groups

	With Opacities		*No Opacities*		*Total*	
*Ethnic Groups**	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*
Malay	310	(94.5)	18	(5.5)	328	(100)
Chinese	278	(86.6)	43	(13.4)	321	(100)
Indian	280	(90.9)	28	(9.1)	308	(100)
Total	868	(90.7)	89	(9.3)	957	(100)

*Chi-squared test (p = 0.002)
Weighted population prevalence = 90.5%

Table 3. Distribution of types of enamel opacities by number of subjects and teeth affected

Type Of Opacities	*No. Of Subjects Affected*		*No. of teeth affected*	
	n	*(%)**	*n*	*(%)**
Demarcated	194	(20.3)	272	(1.8)
Diffuse	849	(88.6)	6686	(45.1)
Hypoplastic	50	(5.2)	57	(0.4)
Combination	125	(13.1)	178	(1.2)
Other Opacities	3	(0.3)	13	(0.1)
Total	1221	*	7206	*

* Total does not tally to 100 % because a subject or tooth may be counted more than once depending on number of defect types

Table 4. Distribution of the severity of enamel defect by the extent of buccal/labial involvement for anterior and posterior teeth

Buccal / labial surface involvement	*Less than one-third*		*Between 1/3 to 2/3*		*More > 2/3*		*Total*	
	n	*(%)*	*n*	*(%)*	*n*	*(%)*	*n*	*(%)*
Anterior teeth	1696	(66.7)	530	(20.8)	316	(12.4)	2542	(100)
Posterior teeth	1932	(50.6)	921	(24.2)	961	(25.2)	3814	(100)
Total	3628	(57.1)	1451	(22.8)	977	(20.1)	6356	(100)

be noted that the differences between Malay, Chinese and Indian children was rather small (less than 8%). Therefore ethnicity does not seem to be an important factor in the distribution of enamel opacities.

The modified DDE Index records all types of enamel opacities without presuming aetiology (FDI, 1992). Hence we cannot assume that all opacities are fluorosis. However, fluorosis has certain traits. The WHO (1997) criteria for dental fluorosis stated that fluorotic lesions are usually bilateral and symmetrical, tend to show horizontal striae across the tooth and are usually found on the premolars, secondmolars and upper incisors, in that order of frequency. Bilateral distribution of diffuse patchy opacities in paired homologous teeth has been suggested to be associated with systemic effects of fluoride ingestion (Moller, 1982). Other reports stated that a bilateral distribution of enamel opacities was more evident for diffuse type of opacities than for other types of opacities with the prevalence of symmetrical distribution more than double in fluoridated areas (Suckling et al, 1985). In addition, Clarkson & O'Mullane (1989) suggested that the prevalence of diffuse patchy opacities is the distinguishing factor between fluoride and non-fluoride aetiology of enamel opacities.

The present and previous studies (Razak and Hussein, 1986; Oral Health Division, 1998) confirmed that the majority of opacities were "diffuse opacities" with "bilateral distribution" implying a systemic aetiology. These observations strongly suggest that the opacities are most probably associated with "fluorosis".

A recent local study on fluorosis prevalence among Malaysian schoolchildren (Tan et al, 2005) using the Dean's index reported 58.7% had fluorosis ranging from very mild (35.6%), mild (14.6%), moderate (7.6%) severe (0.9%) and no fluorosis (41.3%). Fluorosis is caused by exposure to fluoride during tooth development (Beltran & Burt, 1988) and is dependent on the duration of fluoride exposure (Riordan, 1993). In view of the high prevalence of fluorosis in the population (Tan et al ,2005) the Oral Health Division, Ministry of Health in Malaysia has since 2005 made a downward adjustment of the level of fluoride in the community water supply to an "optimal level" of 0.5ppmF. However the water supply in Kuala Lumpur has been fluoridated since early 1970's and monitored at an "optimal level" of 0.7 ppmF previously. Thus most of the children in this study would have been continuously exposed to fluoridated water at that level since birth.

In addition, the majority of Malaysian children also used fluoride toothpaste (Amdah, 2000). Early use of fluoride toothpaste may explain for the high prevalence of enamel opacities. The most vulnerable period for fluorosis due to accidental swallowing of fluoridated toothpaste is between two and six years old. Although currently there is no data to show any differences in practice among ethnic groups, a local study on fluoride toothpaste usage among 6-year-old Malay preschool children in Malaysia found that the majority (73%) used fluoridated toothpaste and 52% were not supervised by any adult during tooth brushing. The mean age when they started tooth brushing was 3.1 years (Amdah, 2000) and the age when they started using toothpaste is 3.9 years. Only 20% used the recommended pea-sized toothpaste (Tan 2003).

Even though the prevalence of enamel opacities in the present study seems to be very high, the majority has very little aesthetic impact. In most cases (57.1%), only one-third or less of the crown were affected and the severe ones (1.3%) were mainly found in posterior teeth which have less aesthetic implications. This perception was further confirmed by the clinical examiners who found that the normative treatment need for aesthetic intervention was very low (only 0.6%).

In conclusion, despite the very high prevalence of enamel opacities in Kuala Lumpur (90.7%), the majority were not severe so as to need professional aesthetic intervention. Since it has been proven that there is an inverse relationship between the prevalence of mild enamel opacities and dental caries (Oral Health Division, 1998), the dental profession as a responsible organization has the obligation to continue periodic monitoring to ensure that the benefits of fluoridation and fluoride use outweigh the risks involved.

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