

# Esthetic perception and psychosocial impact of developmental enamel defects among Malaysian adolescents

Sharol Lail Sujak<sup>§</sup>, Rahimah Abdul Kadir<sup>†</sup> and Tuti Ningseh Mohd Dom<sup>‡</sup>

<sup>§</sup>Kuala Lumpur Dental Division, Ministry of Health Malaysia,

<sup>†</sup>Department of Community Dentistry, Faculty of Dentistry, University of Malaya, and

<sup>‡</sup>Department of Preventive Dentistry, Faculty of Dentistry, National University of Malaysia, Kuala Lumpur, Malaysia

(Received 15 January and 9 September 2004)

**Abstract:** The aim of this study was to investigate the prevalence and psychosocial impact of enamel defects among 16-year-old school children on the island of Penang. The data were collected through a self-administered questionnaire survey and an oral examination, using the Modified Developmental Defects of Enamel Index (FDI, 1992). In all, 1024 subjects were selected using a multistage random sampling technique. About two-thirds of the sample (67.1%) had at least one tooth affected by enamel defects. Enamel opacities accounted for 85.6% of the total condition. Diffuse-type opacity predominated (63.5%). Among subjects who expressed dissatisfaction, 18.8% reported covering their mouths when smiling, 8.7% avoided going out with friends and 39.1% had consulted their dentists. About 17% of the subjects reported that their parents had complained about the color of their front teeth but only 5.7% had experienced being teased by their friends about the problem. Two-thirds of the subjects were affected by enamel defects involving at least one tooth; however, the esthetic perception and psychosocial impact of those affected were minor. (*J. Oral Sci.* 46, 221-226, 2004)

**Key words:** developmental enamel defect; prevalence; esthetic perception; psychosocial impact; adolescent.

Correspondence to Dr. Sharol Lail Sujak, 41, USJ 9/5G, 47600 Subang Jaya, Selangor, Malaysia  
Tel: +60 19 3548028  
Fax: +60 37 9673474  
E-mail: slsujak@pd.jaring.my

---

---

## Introduction

Enamel defects are defined as disturbances in dental hard tissue matrices and their mineralization during the period of odontogenesis (1). No reference is made to any causative factors or associated histology that would include enamel opacities, enamel hypoplasia or discolored enamel, and dental fluorosis.

Traditionally, dental health professionals have not regarded this as being of public health importance. However, a review by Szpunar and Burt (2), observed an increase in the prevalence of enamel defects in the United States in spite of no appreciable increase in severity. Although Burt and Eklund (3) did not justify classifying enamel defects as a public health problem, they recognized that the public's concern about esthetics could increase the potential for enamel defects to become a problem. In an effort to look at the potential links between enamel defects and esthetic concerns, a number of researchers have attempted to record lay perceptions and opinions of the appearance of teeth with such defects (4-7). These studies suggested that both lay and dental observers can distinguish between different levels of enamel defects, and that as severity increases, concern about esthetics also increases.

In Malaysia, the fluoridation of water supplies was introduced some 40 years ago. Penang was one of the earliest states fluoridated at that time (8). Until now, there has been a general lack of information about enamel defects, in particular in relation to the perceptions of the Malaysian population towards the condition. Of late, there has been increasing concern about enamel defects among the public in Malaysia. Available data are limited to one

study conducted in Johore (9) which started fluoridation at about the same time as Penang. In this study, enamel defects were measured using the Developmental Defects of Enamel Index. Results of the survey indicated that prevalence of enamel defects among 12-year-old children ranged from 73% to 89% in non-fluoridated and fluoridated areas, respectively.

Given this high prevalence of enamel defects and in light of the increased awareness of the Malaysian public towards “whitish” teeth, it was considered important to study the public health implications of the condition by measuring whether enamel defects have any psychosocial impact. We decided to use the descriptive Modified Developmental Defects of Enamel Index as the measure. The choice was made in an effort to increase the national data bank and also to enable comparison with available data.

## Materials and Methods

### Sampling and sample size

This was a cross-sectional study involving a questionnaire survey and clinical examination. The target population was 16-year-old students attending government schools in Penang. An additional requirement was that all subjects must have lived in Penang since birth. A multistage, stratified random sampling technique was used in the selection of schools. These schools were assessed by examining school category and ethnic and gender composition. Calculation of the sample size used available information about the prevalence of enamel defects in Johore. The consent rate was 100%, with all 1024 subjects constituting the sampling frame coming from seven selected schools.

### Survey procedure

The study was undertaken in two stages comprising a questionnaire survey and an intra-oral examination (Fig. 1). The index used for the oral examination was the Modified Developmental Defects of Enamel Index (10). Calibration of oral examinations and pre-testing of the questionnaire survey forms were carried out by the principal examiners on 30 similar age students at a private college in Kuala Lumpur. The calculated intra-examiner agreement was 85.8%.

### Questionnaire survey

All 1024 subjects were first subjected to the self-administered, structured questionnaire, which was based on a review of the literature, and was modified and piloted as mentioned earlier. It was designed to elicit information on the perception of subjects concerning their overall health, the general appearance of their teeth, the appearance

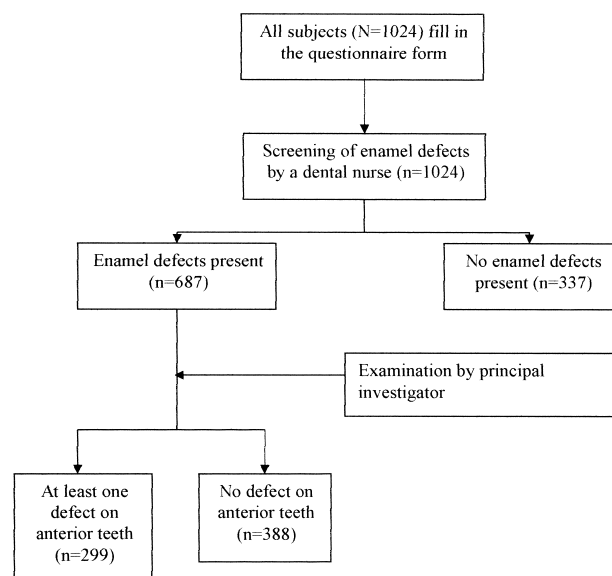


Fig. 1 Chart to illustrate flow of survey procedure.

of their anterior teeth and whether these factors affected their social activities and psychological well-being. Questions relating to parents’ and peers’ reactions to the appearance of the subjects’ anterior teeth were included. No discussion was permitted between researchers and respondents. Socio-demographic data included age, gender, ethnicity and water source. The latter gauged variation in fluoride levels in the different water plants.

### Intra-oral examination

Prior to examination, the teeth were cleaned of debris using gauze, but were not dried. The intra-oral examination was carried out in two stages using a fiber optic light. The first examination was to screen for the presence of any enamel defects on any single tooth. This was done by an experienced dental nurse (an operating auxiliary) who had been trained and calibrated with the principal examiner (95.3% inter-examiner agreement). If enamel defects were present, the subjects were examined thoroughly by the principal examiner and scored for the types of enamel defects present. If no enamel defects were detected, subjects were dismissed. A random sample of 10% of the subjects was called for re-examination at the end of the day to ascertain intra-examiner consistency. Intra-examiner agreement was 87.8%.

### Data analysis

Both questionnaire and oral examination forms were manually checked for completion of data input. Analysis was carried out using the Statistical Package for Social

Sciences version 10.0 (SPSS). Hypothesis testing was carried out using Pearson's chi-squared test for proportions at a significance level at  $P = 0.05$ . Logistic regression analysis looked into predictor variability of the subjects' esthetic perception.

## Results

### Socio-demographic profile of the sample

The subjects who participated in the study (Table 1) were Malays (48.4%), Chinese (40.5%) and Indians (11.1%). These groups represent the major ethnic composition in Peninsular Malaysia and the proportion was comparable to that of the main population at this age. The proportion of male and female subjects was almost equal. The mean age of the sample was  $16.4 \pm 0.4$  years. All the water treatment plants from where the subjects received their water supply had had fluoride feeders for more than 16 years, and the average level of fluoride concentration maintained in the last year was between 0.61 to 0.86 ppm.

### Prevalence of enamel defects in the sample

The results (Table 2) indicated that about two-thirds (67.1%) of the sample were affected by enamel defects. Of these, 299 subjects (43.5%) had at least one defect on their anterior teeth. Enamel opacities seemed to be the most common defect observed (85.5%), followed by hypoplasia (6.7%) and a combination of defects (5.2%). Diffuse opacities were observed in 63.5% of the subjects while demarcated opacities affected 22%.

### Esthetic perception of enamel defects

A majority of the subjects were satisfied with the condition ( $n = 888$ , 86.7%) as well as the color of their front teeth ( $n = 839$ , 81.9%). More subjects in the group with enamel defects on their anterior teeth were not satisfied with the condition of their teeth but this difference was not significant ( $P = 0.084$ ) (Table 3). Among reasons given for dissatisfaction with the condition of their teeth were caries, protruding teeth and irregularities in appearance of the teeth. However, when it came to the color of their anterior teeth, the proportion of subjects who were not satisfied in the affected group ( $n = 69$ , 22.9%) was significantly greater than those not affected ( $n = 120$ , 16.3) ( $P = 0.014$ ). Among reasons given for dissatisfaction with the color of their teeth, a majority cited that it was because of the whiteness of the teeth ( $n = 66$ , 95.7%). Both groups gave similar responses when asked about the impact of the enamel defects, such as covering their mouth when smiling, avoiding going out with friends, consulting a dentist, worrying about the condition and lacking confidence when socializing. There were also no significant

Table 1 Socio-demographic profile of the sample ( $n = 1024$ )

Items	n (%)
<b>Ethnicity</b>	
Malay	496 (48.4%)
Chinese	415 (40.5%)
Indian	113 (11.1%)
<b>Gender</b>	
Male	528 (51.6%)
Female	496 (48.4%)
<b>Mean age of sample = <math>16.4 \pm 0.4</math> years</b>	

Table 2 Prevalence, location and types of enamel defects

Items	Subjects	
	n	%
<b>Prevalence of enamel defects (N=1024)</b>		
No enamel defect	337	32.9%
Presence of at least one enamel defect	687	67.1%
<b>Location of enamel defects (N=687)</b>		
At least one on anterior teeth	299	43.5%
Posterior teeth only (i.e. none on anterior teeth)	388	56.5%
<b>Types of enamel defect (N=687)</b>		
Demarcated opacities	132	22.0%
Diffuse opacities	437	63.5%
Hypoplasia	46	6.7%
Any other defects	17	2.5%
Combination	36	5.2%

differences between the reactions of parents and schoolmates regarding this condition.

### Dissatisfaction with color of anterior teeth

Several bivariate analyses were attempted to see if there was any evidence to suggest that the dissatisfaction expressed by the subjects was associated with other variables such as ethnicity, gender, perceived general health, perceived condition of teeth and the reactions of parents and peers. All the variables were significantly associated, except ethnicity (Table 4).

Table 3 Demographic characteristics of subjects and esthetic perceptions of enamel defects shown by location of enamel defects

Socio-demographic characteristic of subjects and psychological impact of enamel defects	Subjects with anterior teeth affected by enamel defects (N=299)		Subjects with anterior teeth unaffected by enamel defects (N=725)		p-value
	n	%	n	%	
<b>Ethnicity</b>					
Malay	145	48.5	351	48.4	0.258
Chinese	121	40.5	294	40.6	
Indian	33	11.0	71	9.8	
<b>Gender</b>					
Male	162	54.2	366	50.5	0.302
Female	137	45.8	359	49.5	
<b>Dissatisfied with condition of teeth</b>	50	16.7	77	10.6	0.084
Reasons:					
Orthodontic reasons	27	9.0	37	5.2	
Dental caries	14	4.7	27	3.7	
Other reasons	11	3.7	19	2.6	
<b>Dissatisfied with color of front teeth</b>	69	22.9	120	16.3	0.014
Reason:					
Whiteness of teeth	66	95.7	116	96.7	
Others	3	4.2	4	3.3	
<b>Consequences relating to the color of front teeth:</b>					
Covering mouth when smiling	13	18.8	29	23.8	0.472
Avoiding going out with friends	6	8.7	9	7.4	0.783
Consulted dentist	25	36.2	41	33.9	0.754
<b>Experience of the following because of color of front teeth:</b>					
Worried about color	46	66.7	80	65.6	1.000
Not confident in socializing	22	31.9	32	27.1	0.600
<b>Parent complaining about color of front teeth</b>	51	17.1	104	14.4	0.291
<b>Schoolmates teasing about color of front teeth</b>	17	5.1	31	4.3	0.333

## Results of logistic regression

Variables that had been observed to demonstrate significant differences regarding whether subjects felt dissatisfied with the appearance of their anterior teeth were considered and entered in the logistic regression model. The outcome variable was measured as "Dissatisfied" or "Satisfied".

The regression results (Table 5) suggested that a 16-year-old adolescent in Penang is more likely to express dissatisfaction with the color of the anterior teeth if the subject is female, has enamel defects on the anterior teeth, is dissatisfied with her overall health, is satisfied with the general condition of the teeth and has been subjected to some complaints by parents or teasing by friends regarding the state of the anterior teeth.

The regression results indicated that having enamel defects alone does not necessarily predict that the subject would feel dissatisfied with the condition. In fact, after

Table 4 Variables associated with dissatisfaction with color of anterior teeth

Variables	Satisfied		Not satisfied		p-value
	n	%	n	%	
<b>Ethnicity</b>					
Malay	408	49.2	83	44.9	0.137
Chinese	330	39.8	81	43.8	
Indian	86	10.4	17	9.2	
<b>Gender</b>					
Male	441	53.2	78	42.2	0.007
Female	388	46.8	107	57.8	
<b>Perceived general health</b>					
Satisfied	188	22.7	15	8.1	0.000
Not satisfied	628	75.8	155	83.8	
<b>Perceived condition of teeth</b>					
Satisfied	125	15.1	5	2.7	0.000
Not satisfied	639	77.1	118	63.8	
<b>Perceived parent concern</b>					
Yes	88	10.6	65	35.1	0.000
No	740	89.4	120	64.9	
<b>Perceived peer reaction</b>					
Yes	21	2.5	27	14.6	0.000
No	805	97.5	158	85.4	

Table 5 Logistic regression results

Variable	$\beta$	p-value	Exp ( $\beta$ )
Gender (male)	-0.2482	0.0074	0.78
Enamel defects on anterior teeth	0.3638	0.0544	1.20
Perceived general health	-0.5988	0.0065	0.55
Perceived condition of teeth	0.7082	0.0000	4.12
Perceived parent opinion	0.6396	0.0000	1.89
Perceived peer opinion	0.5271	0.0036	1.69

adjusting for the effects of covariates, the significance of having enamel defects on anterior teeth in predicting dissatisfaction became less ( $P = 0.05$ ). Subjects can feel dissatisfied with the color of the anterior teeth even in the absence of enamel defects.

## Discussion and Recommendations

### Prevalence of developmental defects of dental enamel

The prevalence of enamel defects (67.1%) was higher than the 54% reported by Suckling and Pearce (11) and the 69% reported by Cutress et al. (12) for 9 to 14-year-old children in New Zealand. An even higher prevalence of 94 – 99% was observed by King and Brook (1984) in 20-year-old subjects in Hong Kong (13). This higher prevalence of enamel defects among Asians when compared to Europeans was confirmed by Cutress et al. (12). Possible explanations include frequent consumption of tea and dried fish among Asians (14,15) and a larger intake of fluids

due to higher climatic temperatures.

While the prevalence of enamel defects observed in this study was relatively lower than those found in other local studies, it can still be considered as generally high. Reports of increased prevalence of fluorosis in other countries have led to the condition being considered a public health concern, and there has been some pressure to restrict the use of fluorides in dentistry. In Malaysia there has been a dawning of concern about fluorosis, albeit not documented, mainly for cosmetic or esthetic reasons. The present research should be seen as a baseline study in its attempt to gather such data.

It is recommended that more refined studies be carried out to look into the general population's esthetic perceptions relating to enamel defects, including fluorosis. It seems appropriate to suggest that similar studies be carried out in other states that have been fluoridated for more than ten years.

It also appears that Penang can learn from the Hong Kong experience and must find an optimal dose level to provide maximum dental caries protection with minimal enamel defects (16).

### Psychological impact of developmental defects of dental enamel

Although about two-thirds of the sample had enamel defects, only 12.5% expressed dissatisfaction with the condition of their teeth. Moreover, less than 10% of those affected indicated that they were not satisfied with the color of their anterior teeth. This suggests that very few subjects were concerned about the appearance of their teeth or were not aware of their teeth being different.

The general perception towards the color of anterior teeth is in line with results reported by Riordan: that the appearance of the teeth in relation to their color was not considered by most people to be a factor in grooming (5). Of those with enamel defects on their anterior teeth who voiced dissatisfaction, the reported social and psychological impacts were low. A bivariate analysis was done to assess the differences in the dissatisfaction between groups with enamel defects and those without. Chi-squared Yates' correction revealed that a higher proportion of subjects with enamel defects felt dissatisfied with the color of their anterior teeth ( $P = 0.02$ ). Further stratification of our data seems desirable to ascertain whether or not such a primary relationship could be accepted. The logistic regression approach with anterior teeth is particularly helpful because factors such as gender, ethnicity, perceived general health, perceived condition of teeth, and parents' and peers' opinions may be associated with the subject's satisfaction or dissatisfaction with their teeth.

These findings, however, are not conclusive since not all possible covariates were included or even considered. Possible confounding factors are numerous, ranging from dental health knowledge and oral health status to socio-cultural variables such as satisfaction with facial appearance, as well as accepted cultural beliefs and norms. Further investigations to fill gaps in this area are indicated.

### Conclusion

Although the psychological impact of enamel defects on the subjects was found to be generally low, it is to be expected that this issue will eventually be raised by the public. Therefore this research should be seen as a baseline study. More studies should be undertaken to look at the general population's cosmetic or esthetic perceptions relating to enamel defects, including fluorosis.

### References

1. Clarkson J (1989) Review of terminology, classifications, and indices of developmental defects of enamel. *Adv Dent Res* 3, 104-109
2. Szpunar SM, Burt BA (1987) Trends in the prevalence of dental fluorosis in the United States: a review. *J Public Health Dent* 47, 71-79
3. Burt BA, Eklund SA (1992) *Dentistry, dental practice, and the community*. 4th ed, WB Saunders, Philadelphia, 149
4. Clark DC, Hann HJ, Williamson MF, Berkowitz J (1993) Aesthetic concerns of children and parents in relation to different classifications of the Tooth Surface Index of Fluorosis. *Community Dent Oral Epidemiol* 21, 360-364
5. Riordan PJ (1993) Perceptions of dental fluorosis. *J Dent Res* 72, 1268-1274
6. Clark DC (1995) Evaluation of aesthetics for the different classifications of the Tooth Surface Index of Fluorosis. *Community Dent Oral Epidemiol* 23, 80-83
7. Lalumandier JA, Rozier RG (1998) Parents' satisfaction with children's tooth color: fluorosis as a contributing factor. *J Am Dent Assoc* 129, 1000-1006
8. Dental Division Ministry of Health, Malaysia (1971) Report of the committee appointed to inquire into and report upon the fluoridation of public water supplies in West Malaysia. Kuala Lumpur
9. Dental Division Johore, Malaysia (1986) Epidemiological survey of developmental defects of dental enamel in Johore. Johore Bahru
10. Commission on oral Health, Research & Epidemiology (1992) A review of the developmental

- defects of enamel index (DDE Index). Report of an FDI Working Group. *Int Dent J* 42, 411-426
11. Suckling GW, Pearce EIF (1984) Developmental defects of enamel in a group of New Zealand children: their prevalence and some associated etiological factors. *Community Dent Oral Epidemiol* 12, 177-184
  12. Cutress TW, Suckling GW, Pearce EIF, Ball ME (1985) Defects of tooth enamel in children in fluoridated and non-fluoridated water areas of the Auckland Region. *NZ Dent J* 81, 12-19
  13. King NM, Brook AH (1984) A prevalence study of enamel defects among young adults in Hong Kong: use of the FDI Index. *NZ Dent J* 80, 47-49
  14. Kula K, Wei SHY (1985) Fluoride supplements and dietary sources of fluoride. In *Clinical use of fluorides*, Wei SHY ed, Lea & Febiger, Philadelphia, 57-74
  15. Rao GS (1984) Dietary intake and bioavailability of fluoride. *Annu Rev Nutr* 4, 115-136
  16. Evans RW (1989) Changes in dental fluorosis following an adjustment to the fluoride concentration on Hong Kong's water supplies. *Adv Dent Res* 3, 154-160