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Parental perception of fluorosis among 8-year-old children living in three communities in Iceland, Ireland and England

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Abstract – *Objectives:* To assess the impact of enamel fluorosis in three of the communities examined in 'Project FLINT', it was decided to conduct a structured telephone interview with the parents of some of the children who took part in the study. *Methods:* Three communities involved in this project were able to conduct this investigation: Reykjavik (Iceland), Cork (Ireland) and Knowsley (England). The aim was to interview the parents of children with a range of Thylstrup and Fejerskov (TF) index grades selected from each participating centre with respect to the appearance of their child's permanent maxillary central incisors. Interviewers were blinded as to the TF grade of the subject. *Results:* Interviews were conducted with parents of 215 children: 69 with TF grade 0; 70 with TF grade 1; 60 with TF grade 2 and 16 with TF grade 3 or greater. There was a trend towards more parents being unhappy with the appearance of their child's teeth with increasing TF grade. However, the main reasons given by parents for being unhappy with the appearance of their child's teeth was tooth alignment followed by the more yellow colour of permanent compared with primary teeth. Only with a TF grade of 3 was any appreciable concern expressed about fluorosis. *Conclusion:* It would appear that there is a public awareness of both developmental defects and enamel fluorosis although this is not always expressed as dissatisfaction. Further research is required into the clinical impact of both fluorosis and other developmental defects of enamel.

Key words: aesthetics; dental fluorosis

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Enamel fluorosis is seen as a lack of lustre of the enamel and may show the appearance of white lines that sometimes coalesce into enamel opacities. More severe forms of fluorosis appear as a brown discoloration that occurs posteruptively and as alterations in tooth morphology (1). In some countries, such as Tanzania, India and South Africa, there are cases of skeletal fluorosis attributable to the high levels of fluoride in some sources of drinking water. This is clearly a public-health problem where it occurs. In countries with good control over their drinking water, the levels of fluorosis observed are considerably milder. Although indices exist for measuring the degree of dental fluorosis they do not measure the impact that fluorosis of any particular degree might have for the subject, his or her family, or the casual observer. A study in Tanzania (2) showed, however, that only severe enamel fluorosis [Thylstrup and Fejerskov (TF) index grade >4] was perceived as an aesthetic problem.

Clearly the more severe levels of fluorosis are unaesthetic to any observer but it is unclear if mild fluorosis is perceived as an aesthetic problem by the lay person. It has been suggested that the sense of dental aesthetics has changed since the original observations of fluorosis by Dean (3) and it is

possible that the problem of dental fluorosis may be increasing as the prevalence of even mild or very mild fluorosis rises in any community (4). The benefits of fluoride use in reducing caries prevalence and incidence need to be weighed against the drawback of causing enamel fluorosis. This evaluation may differ in different communities. It needs to take into account not only the appearance of mild fluorosis but also the cost of treating caries, pain and discomfort to the patient and the poor aesthetics of decayed and even restored teeth.

The project 'FLINT' was an investigation of the prevalence of fluorosis and fluoride ingestion from toothpaste conducted among children living in communities in seven European countries (1, 5). To assess the impact of enamel fluorosis in the populations studied in 'Project FLINT' (5) a structured telephone interview was conducted with a sample of parents of the 8-year-olds who participated. The aim was to discover the views of the responding parent concerning the appearance and colour of their child's permanent maxillary central incisors.

Materials and methods

It proved possible to conduct this investigation in only three of the communities involved in the 'Project FLINT' (5): Reykjavik (Iceland), Cork (Ireland) and Knowsley (England). An optimal level of fluoride was present in the drinking water in Cork but only very low levels of fluoride were present in the drinking water in the other two communities. It was not possible to involve the other centres in the FLINT project in the telephone interview because either telephone numbers were not available for the subjects or because permission could not be obtained from the relevant authorities for a telephone questionnaire to be conducted. A questionnaire that formed the basis for the structured telephone interview was written in English for the two English-speaking communities and then translated into Icelandic. The Icelandic version was then back-translated into English by an independent investigator to discover inconsistencies in translation that were then corrected.

All children who had their permanent maxillary central incisors (teeth 11 and 21) photographed and graded for fluorosis, where grades showed symmetry (6, 7), formed the sample of children from which a subsample was selected. Symmetry of grading scores was thought necessary to exclude demarcated enamel opacities that were unlikely to be a manifestation of fluorosis (6, 7). The aim was to interview the parents of 120 children over the telephone from each participating centre with respect to the appearance of their child's central permanent maxillary incisor teeth without asking leading questions. Thirty children from each of the fluorosis groups (TF grades 0, 1, 2 and $\geq$3) per study site were randomly selected. As the number of children in the group with TF grade $\geq$3 was very small, all children in this group were included in the subsample for each study site. For this reason it was also decided to carry out the statistical analysis using pooled data from all three study sites although the results from the individual study sites are also given separately (Table 1).

Table 1. Numbers of parents contacted and distribution of TF scores in each of the three participating sites

	TF grade for incisors 11 and 21				
	0	1	2	3	6
Cork ($n = 96$)	29	28	27	11	1
Reykjavik ($n = 87$)	28	29	26	4	
Knowsley ($n = 32$)	12	13	7	0	0
Total	69	70	60	15	1

Sub-samples of children were formed for each site by randomly generating subject numbers. The telephone numbers were obtained from the school records but for cases where a telephone number could not be obtained a second list of randomly generated subject numbers was formed. One dentally qualified telephone interviewer was chosen for each participating centre and was blinded with respect to the TF grade for the subjects in question. The questionnaire is given in Table 2. Relevant permission was obtained for the survey in each centre from the appropriate ethical and data protection bodies. If question 1 produced a response of 'yes' the respondent was thanked and the interview was ended. A response of 'no' led to the remaining two questions, with the interviewer taking care not to prompt the respondent about the colour of the teeth until the end of the interview if the matter had not been raised. Results from the questionnaire were entered on a spreadsheet and the data from all three participating centres were combined for analysis.

Table 2. Questionnaire used to determine parents' opinions of their children's upper front teeth

Questions
1. Are you happy with the appearance of your child's upper front teeth?
2. What is it you do not like, if anything, about the appearance of your child's teeth?
3. In what way are you unhappy with the colour?

Table 3. The number (percentage) of parents who were happy ('yes') or not ('no') with the appearance of their child's upper front teeth according to TF score

TF score	*n*	Yes	No
0	69	43 (62%)	26 (38%)
1	70	42 (60%)	28 (40%)
2	60	32 (53%)	28 (47%)
3	15	7 (47%)	8 (53%)
6	1	1 (100%)	0
Total	215	125	90

Results

Interviews were conducted with the parents of 215 children. Table 1 shows the distribution of TF grades for the incisors amongst the children whose parents were interviewed. Results are given for the individual study sites and combined for the whole group.

The main reason for the inability to interview 30 subjects in each category in each centre was the failure to find telephone numbers for all the subjects. This was a particular problem in Knowsley where a new cable network was being installed for which there was no telephone directory. The total numbers interviewed for each centre were: Reykjavik, 87 (94% of the subsamples for whom telephone numbers were found); Cork, 96 (79% of the subsamples for whom telephone numbers were found); Knowsley, 32 (63% of the subsamples for whom telephone numbers were found).

Tables 3–5 give the results of the responses to questions concerning the appearance of the children's teeth. There was a steady rise in the proportion of parents interviewed that were unhappy with the appearance of their child's teeth with increasing TF grade (Table 3). Results for the children with TF grade 3 or more are difficult to interpret because of the small numbers. When the responses were grouped by comparing TF grades 0 and 1 with TF grades 2 and 3, there was no significant difference in the proportion of respondents unhappy with the appearance of their child's teeth ($\chi^2 = 1.674$; 1 d.f. $P = 0.196$).

There were however, differences in their reasons for being unhappy for the appearance of the teeth. Table 4 shows that the main reasons given by parents for being unhappy with the appearance of their child's teeth was tooth alignment. The second most common reason for being unhappy was the colour of the child's teeth. Seven out of 15 (47%) parents whose children had a TF grade of three or more were unhappy with the colour of the teeth and this was statistically a very significant difference from responses for children with lower TF grades ($\chi^2 = 7.881$; 1 d.f.; $P = 0.005$). However, 11 out of the 69 parents (15.9%) whose children had a TF grade of 0 were also unhappy with the colour of their children's teeth.

When further questioned about the colour of the child's teeth, 18 of 41 parents (44%) that had mentioned the colour of their child's teeth felt that the teeth were a darker yellow than the primary teeth had been. This proportion was similar for all TF grades (Table 5).

Manifestations of fluorosis, such as white lines or patches and pits were of concern to parents of 11 out

Table 4. Reasons for not being happy with the appearance of the child's front teeth [number (%)]

			Reason not happy				
TF score	*n*	No. of parents not happy	Caries/ restoration	Orthodontic	Trauma	Periodontal	Colour
0	69	26 (38%)	0	18 (26%)	1 (1%)	1 (1%)	11 (16%)
1	70	28 (40%)	2 (3%)	17 (24%)	3 (4%)	0	12 (17%)
2	60	28 (47%)	0	20 (33%)	2 (3%)	2 (3%)	11 (18%)
3	15	8 (53%)	0	3 (20%)	0	0	7 (47%)
Total	214	90	2	58	6	3	41

Table 5. Reasons for not being happy with the colour of the child's front teeth [number (%)]

			Reason not happy with colour				
TF score	*n*	No. parents not happy with colour	Dark grey	Dark yellow	Stain	Pits	White line/patches
0	69	11 (16%)	0	6 (9%)	2 (3%)	0	4 (6%)
1	70	12 (17%)	0	6 (9%)	3 (4%)	0	4 (6%)
2	60	11 (18%)	1 (2%)	5 (8%)	3 (5%)	1 (2%)	5 (8%)
3	15	7 (47%)	0	1 (7%)	3 (20%)	3 (20%)	2 (13%)
Total	214	41	1	18	11	4	15

of 75 children (15%) with TF grades 2 and 3 but in the case of children with TF grades 0 and 1 only eight of 139 (6%) were concerned about white lines, patches, or pits ($\chi^2 = 5.587$; 1 d.f.; $P = 0.018$). Although more parents were concerned about white patches in the anterior teeth of their children when the TF grades were 2 or more, four parents of children with TF grade 0 mentioned white lines or patches on their child's teeth.

Discussion

The relatively simple telephone questionnaire used in this study was assumed to be an adequate means of determining parental concern about the appearance of their child's teeth given that all parents had previously given their informed consent to the photographic investigation for fluorosis (6, 7). This study has shown that the mild level of fluorosis found in these subjects (6) is of little concern to their parents. There was a clear trend for parents to be more concerned about white lines, patches, or enamel pits in those children who were recorded as TF grade 3 and these results were statistically significantly, despite the small numbers involved. Some concern was expressed by parents concerning white markings in children with a TF grade of 0. The perception of what is aesthetically acceptable is, of course, subjective and this perception may change with time and circumstances. For example, following the marked decline in dental caries prevalence in developed countries over the last 30 years, a much keener awareness of dental aesthetics has developed among society in general and especially among the many 'role models' in society.

Using the Tooth Surface Index of Fluorosis (TSIF) index (8), Woodward et al. (9) measured a number of characteristics of oral health including fluorosis. Parents were contacted by telephone and asked about their satisfaction with the appearance of their child's teeth. TSIF grades of less than 2 were much more likely to be found in children whose parents were satisfied with their child's appearance than was the case if the child had a TSIF grade greater than 2. Parents are perhaps more likely than children themselves to appreciate an aesthetic problem concerning their teeth. Clark et al. (10) showed an increasing level of dissatisfaction by both parents and children with appearance as the child's TSIF index grade rose. There may well be a threshold level of fluorosis that is unacceptable to parents or children but below this threshold there is an acceptable level of fluorosis in society where the benefits of fluoride outweigh the slight levels of fluorosis (11).

While van Palenstein Helderman and Mkasabuni (2) in Tanzania found dissatisfaction with the appearance of teeth only with a TF grade of 4 or more, Riordan (12) found only 22.5% of professional and lay observers to agree with a statement that teeth of TF grade 3 were pleasing in appearance. That study, moreover, found that dentists would be prepared to offer treatment for teeth that had been given a TF grade of 3. In the present study only relatively few cases of TF grade 3 were found but there was evidence that this level of fluorosis was unacceptable to the parents and similar observations were made by adolescents in Manchester (13). Increasing TSIF scores have similarly been associated with increasing dissatisfaction about the appearance of the teeth (14). Only 7% of parents in the present study, however, perceived any problem that could be attributed to fluorosis. This level of concern clearly does not represent a public-health problem (11), although individual cases will be of concern to the child and parents involved. Far more concern was expressed about tooth alignment or, if colour was a perceived problem, about the natural darker colour of permanent teeth compared with their deciduous predecessors. A similar observation was made by Lalumandier and Rozier (14). Although such factors may be of concern, McKnight et al. (15) also found that indeed fluorosis was noticeable and was regarded as unaesthetic.

Further research is needed into the impact of a probable increasing prevalence of mild fluorosis in populations with low levels of dental caries. This should be linked to differentiating fluorosis from other developmental defects of enamel and assessing the impact of these separate factors on the subjects' perception of his or her appearance. The clear drawback to this is that of raising the level of consciousness regarding even very mild deviations from what is regarded as an ideal dental appearance.

It is not known how fluorosis present in the permanent central incisors will change over the years, nor how the appearance will be perceived by the subject concerned and others with the passing of time. As the photographic records from the 'FLINT' project have been stored it should be possible to review some of the subjects in the future, re-examine the fluorosis and re-score the degree and then compare the results with those obtained at the 'baseline' examination at 8 years of age.

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