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An Epidemiological Study of Developmental Defects of Enamel in a Group of Nigerian School Children

Estudo Epidemiológico dos Defeitos de Desenvolvimento do Esmalte em um Grupo de Escolares Nigerianos

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RESUMO

Objetivo: Este estudo epidemiológico analisou a prevalência, distribuição e associação dos fatores eiológicos no desenvolvimento de defeitos do esmalte em crianças nigerianas.
Método: A amostra compreendeu a análise de 2.015 escolares (1.088 meninos e 927 meninas) com idades entre 4 a 16 anos, selecionadas aleatoriamente de 6 escolas em Lagos, Nigeria. O exame intra-oral para o diagnóstico dos defeitos do esmalte foi feito com o uso método modificado proposto pela Federação Dentária Internacional (FDI). As mães das crianças foram entrevistadas a respeito dos fatores etiológicos.
Resultados: Um total de 226 (11,2%) das crianças examinadas apresentavam defeitos do esmalte. A hipoplasia do esmalte foi o defeito mais prevalente (7,5%), e o tipo de distribuição mais comum foi a difusa (61,5%). Não se observou diferença estatisticamente significante na distribuição dos defeitos entre os sexos (p>0,05). A maioria dos defeitos localizavam-se nas faces vestibulares dos dentes afetados (40,26%). A diferença observada na localização dos defeitos dos dentes entre meninos e meninas foi estatisticamente significante (p<0,05).
Conclusão: Estes defeitos de esmalte não estéticos são prevalentes nas crianças nigerianas e estão, principalmente, associados com doenças da infância, uso de tetraciclina e baixa condição sócio-econômica.

DESCRITORES

Hipoplasia do esmalte dentário; Prevalência; Etiologia.

ABSTRACT

Objective: This epidemiological study of dental enamel defects in a group of Nigerian school children assessed the prevalence, distribution and associated etiological factors of developmental defects of enamel.
Method: The study subjects consisting of 2015 school children, (1088 males and 927 females) in the age range 4 to 16 years were randomly selected from 6 schools in Lagos, Nigeria. Intra-oral examination for dental enamel defects was carried out on all the children using a modification of the "Federation Dentaire Internationale" system. The mothers of the children were interviewed on relevant associated etiological factors.
Results: A total of 226 (11.22%) of the children examined had dental enamel defects. The most prevalent dental enamel defect seen was chronologic enamel hypoplasia (7.5%), and most common type of distribution was the diffuse patchy type (61.5%). No statistically significant difference in distribution of defects between males and females. (p>0.05.) Most of the defects were on the buccal surfaces of the affected teeth (40.26%). The difference observed in the location of defects on the teeth between males and females was statistically significant (p<0.05).
Conclusion: These unaesthetic enamel defects are prevalent in Nigeria children and mainly associated with childhood illnesses, use of tetracycline and poor socio-economic conditions.

KEYWORDS

Dental enamel hypoplasia; Prevalence; Etiology,

INTRODUCTION

A number of studies have reported prevalence values for selected dental anomalies including congenitally missing teeth, supernumerary teeth, peg-shaped lateral incisors, fusion, gemination and non-carious defects of enamel[1-5]. However, there is little information on any West African population. The purpose of the present study was to collect data on a defined population in Nigeria. The study assessed in particular the non-carious structural defects of enamel. Three primary schools and three secondary schools in Lagos were randomly selected for the study. Lagos a major commercial center and former capital city of Nigeria is suited for such a study because of its population of over 7 million and out of which approximately 39.4% are children between ages 4 to 16 years[6]. Lagos is also made up of diverse ethnic groups from all over the country.

Developmental defects of enamel may be defined as disturbances in hard tissue matrices and in their mineralization during odontogenesis[7]. When this complex sequence of cytological and physico-chemical events is disrupted by genetic or environmental factors, the function of the ameloblast may be disrupted permanently or temporarily[7,8]. This results in the formation of enamel exhibiting qualitative or quantitative defects that may range from a complete absence of enamel to a normal thickness or no change in structure except for a slight abnormality in colour[7,9]. The type of defect is dependent on the stage of amelogenesis at the time of the disturbance[1,7,9].

Over the last 55 years, a number of surveys have reported on the prevalence of developmental defects of enamel in a variety of populations[4,5,7-11]. Unfortunately, most of the studies used different terminologies and classifications as a result of which direct comparisons have been inappropriate. More recently, as a result of the need for uniform nomenclature, a working group of the Commission on Oral Health Research and Epidemiology of the ''Federation Dentaire Internationale'' has produced an Epidemiological index of developmental defects of enamel (DDE Index)[12,13].

Studies conducted in different parts of the world revealed a prevalence of developmental defects of enamel varying from 0%-60%[3-5,9-11,14-18]. The differences observed are dependent on the population studied, the teeth examined and the criteria used to diagnose enamel defects; such as whether enamel opacities were included in the diagnosis. Children from developing countries are generally found to display a high incidence of enamel defects while a lower incidence is found in children from developed countries[14-21]. In the literature, a prevalence of approximately 4% has been reported for developmental defects of enamel in the primary teeth of Nigerian children[22,23]. In the permanent teeth of Nigerian children, 6%-11.7% prevalence has been reported[18,20,21].

The present study assessed the prevalence and distribution of developmental defects of enamel in a group of Nigerian children aged 3 to 16 years from different socioeconomic status. It also explored the association between enamel defects and some systemic conditions.

MATERIALS AND METHODS

The study sample consisted of a total of 2015 children (1088 males and 927 females) aged 4 to 16 years attending 6 different schools in Lagos, Nigeria. Schools and children were selected through a random sampling technique and use of appropriate school registers. Approval for the study was obtained from the ethical committee of the Lagos University Teaching Hospital and informed consent obtained for eligible children through the school authorities. Information on age, sex, place of birth, ethnic group, parents' occupation was obtained by means of school records and or verbal questioning. The children examined were from various socioeconomic groups. Only children whose parents gave their consent were recruited into the study.

Intra-oral examination was carried out by one examiner (O.O.O). Each child was examined in a well-lit classroom or playground in the school compound. The child was seated on a classroom chair, illumination was provided under reflected light but avoiding direct sunlight, the teeth being wet and unclean by the examiner except in a few subjects whose gross plaque accumulations prevented inspection of the gingival third of the crown. In such cases, the examiner cleaned the teeth before the examination. Instruments used during the examination were disposable dental mouth mirror, dental probe and excavator.

The defects of enamel were classified using a modification of the ''Federation Dentaire Internationale'' system, which is based solely on the clinical appearance of the tooth, using a descriptive criteria[12,13]. The following criteria were adopted: the enamel defect were classified in terms of: type of defect, number and demarcation of defect and location of the defect on the tooth.

Type of defect- this includes hypoplasia, opacity, and, discolored enamel. Number and demarcation of defect- describes the main groups of defects, which can occur in a number of ways on each tooth surface.

The DDE Index also allows the location of the defects to be recorded for each tooth surface. In this study, a modification of the DDE Index on the location of defect was used.

Whilst recording the data, a recording chart was used with each defect coded according to type, number and location of defect on the tooth. Unerupted, missing, heavily restored, badly decayed, fractured tooth or tooth surfaces, which for any reason could not be classified for defects, were excluded from statistical evaluation. Permanent teeth were number coded and primary teeth were letter coded. The codes were recorded on charts using the format of the DDE Index[12,13].

The mothers were interviewed for information regarding clinical episodes in their children's lives, family history of similar conditions in other members of the immediate family. Maternal illnesses during pregnancy were noted. Data obtained was recorded on a prepared questionnaire by the examiner.

Descriptive analysis was carried out for prevalence of enamel defects, distribution of defects and etiology of defect. Data was validated visually and checked by examination of frequency tables and charts generated. Distributions of all the continuous variables were assessed. Cross-tabulations were done on selected categorical variables. Associations were subjected to the chi-square test and significance was defined as $p<0.05$.

RESULTS

A total of 2015 children were examined, 1088(54%) males and 927 (46%) females. A total of 226 (11.22%) children presented with enamel defects; 120 (11.03%) males and 106(11.43%) females (Table 1).

Table 1. Distribution of children studied by sex.

	Male		Female		Total	
	n	%	n	%	n	%
No. of Children	1088	54.00	927	46.00	2015	100.0
Total With Defects	120	11.03	106	11.43	226	11.22

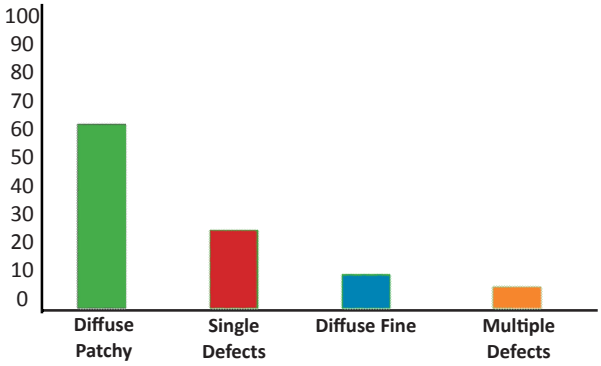
Discolored enamel unassociated with opacity (chronological enamel hypoplasia-CEH) was the most prevalent enamel defect seen, with a prevalence of 7.5%. There were no cases of Amelogenesis Imperfecta. No statistically significant difference in the distribution of defects between males and females (Table 2).

Figure 1 shows that the commonest type of distribution of enamel defect was diffuse patchy 61.5%. This was followed by single defects seen in 26.54% of the children. Diffuse fine white lines, multiple defects were seen in 8.84% and 5.53% of the children respectively. The distribution was not statistically significant.

Table 2. Distribution of prevalence of type of enamel defects in the total sample of 2015 children studied.

Type of Enamel Defect	Male		Female		Total	
	n	%	n	%	n	%
enamel defects absent	968	88.97	821	88.57	1789	88.78
opacity	21	1.9	31	3.3	52	2.6
hypoplasia	10	0.9	13	1.4	23	1.1
discolored enamel (ceh)	89	8.2	62	6.7	151	7.5

X2=5.99, df=2 and p=0.05.



X2=18.38, df=3 and p>0.05. The association was not statistically significant.

Figure 1. Distribution of nature of defect on tooth surfaces (n=226).

Figure 2 shows that discolored enamel unassociated with opacity was the most common type of enamel defect seen. It was recorded in 64.61% of the children. A combination of defects was seen in 5 (2.21%) of the children. There was no statistically significant difference in the distribution of the specific defects between males and females.

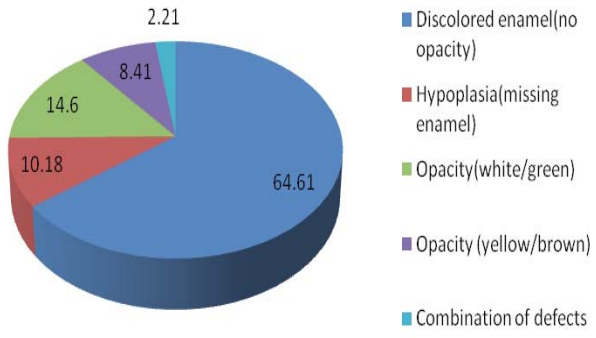
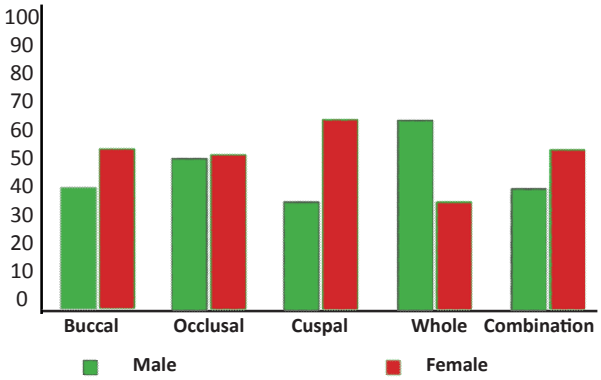


Figure 2. Distribution of specific type of enamel defect (n=226).

Figure 3 shows the distribution of the location of enamel defects. Cuspal lesions were recorded mostly in females and lesions affecting the whole surface of the tooth more prevalent in males. The differences seen in the location of defects on the tooth surface between males and females was statistically significant.

Table 3 shows that out of the 226 children with enamel defects, 128 (56.64%) had an episode of childhood illness. Only 10 (4.43%) were reported has having had metabolic disease. History of dental trauma was reported in 18(7.97%) of the children.However, a total of 180 (79.65%) of the children had no relevant information in their dental history that could be associated with the existence of enamel defect.

Majority of the enamel defects seen was associated with the occurrence of neonatal disturbances, 40.27%. This was closely followed by the administration of tetracycline in 84 (37.17%) of the children.The least contributing factor was fluorosis reported in 3 (1.33%) of the children. The difference seen between males and females was not statistically significant (Figure 4).

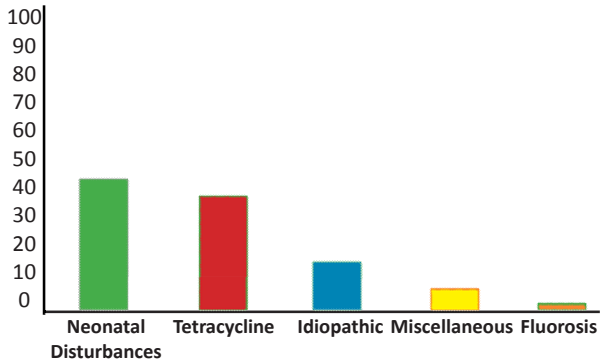


X2=4.21, df=4 and p<0.05. Association is statistically significant.

Figure 3. Distribution of location of enamel defects on tooth surfaces (n=226).

Table 3. Distribution of relevant factors in medical and dental history.

Medical Condition	Male		Female		Total		Dental Condition	Male		Female		Total	
	n	%	n	%	n	%		n	%	n	%	n	%
Metabolic disease	6	5.00	4	3.77	10	4.43	Dental infection	1	4.72	5	4.72	6	2.66
Drugs	7	5.83	7	6.60	14	6.20	Extraction	10	9.43	10	9.43	14	6.2
Childhood illness	68	56.66	60	56.60	128	56.64	Trauma	7	6.60	7	6.60	18	7.97
Combination	8	6.66	6	5.66	14	6.20	Combination	6	5.66	6	5.66	8	3.54
Idiopathic	31	25.83	29	27.36	60	26.55	None	78	73.58	78	73.58	180	79.65



X2=14.25, df=4 and p>0.05. No differences between males and females in the possible aetiological factors.

Figure 4. Distribution of possible aetiological factors for enamel defects in children with defects (n=226).

DISCUSSION

Using the modified index for Developmental Defects in Enamel[13] the results from the present study show that the prevalence of all types of developmental defects of enamel including hypoplasia and opacity among this group of Nigerian children was 11.22% (Table 1). The prevalence of enamel hypoplasia in primary dentition was 0.9%. Earlier reports in Nigerian children have reported a prevalence of 4% in primary dentition and 0.13% in primary and permanent dentition of children examined in a hospital based study[18,22,23]. A survey on oral anomalies in Nigerian children also reported amelogenesis imperfecta (0.2%) and localized enamel hypoplasia (11.7%)[22].

Despite the fact that the DDE Index gives information on a wide range of defects, their location and distribution, direct comparisons with other studies are still a little difficult. This is because the large amount of data generated has caused difficulties in presenting data in a meaningful fashion for interpretation and comparison of results. This is further hampered by the method of assessment in the different studies, either photographic or clinical[13]. Reports in the literature on developmental defects of enamel from developed countries[11,16,17,24,25] show much higher values than those reported in developing countries[3,10,14,18,20-23] in recent times. A review of the reports of recently published studies have shown that the prevalence of enamel defects varies from 20-77%[3-5,9-11,14-31]. All the reports give higher values for enamel defect when compared with the present study.

They also indicate a significant increase in the prevalence of enamel defects when compared with earlier reports in developed countries.

In the present study 11.3% of the children had enamel defects. Reports on enamel defects in 2 New Zealand studies were 63% and 64.1% respectively[24,25]. A similar study in London on British[27] children reported a prevalence of 68% and a Hong Kong[10] study a remarkable 99.5%. The result of the present study on the prevalence of enamel defect would at first appear to be very low when compared with these studies. It should however be noted that the area selected for the New Zealand study was known to have unusually high prevalence of enamel defect, probably due to the diagnostic criteria used, whilst the other study included children who had received fluoride supplements.

The technical fluoridation of drinking water supplies and the increase in use of various fluoride preparations in the prevention of caries may account for the significant differences seen between reports from the developed countries and the developing countries. There is presently no technical fluoridation of the drinking water supplies in Lagos[32]. No cases of fluorosis were observed in the present study.

In the present study the defects were predominantly in the permanent dentition (10.4%). This could be due to the fact that the study sample was predominantly children aged 6 to 12 years old and by which age majority of the defective primary teeth would have been shed.

Localized enamel hypoplasia of the primary canine occurring on the labial surface at the junction of the middle and gingival thirds was noted. This defect accounted for 0.9% of the total enamel defects seen. This suggests a disturbance in the matrix formation at about 4 to 5 months in-utero during the period of calcification of the primary canine[35]. Similar reports have been reported in developed countries[33,34].

Observations within the present study showed that the most frequent type of distribution was diffuse patchy (61.5%) followed by single (26.54%), diffuse single (8.84%) and multiple (7.8%) and differs from that reported for children from South Wales[9]: the most prevalent distribution was single defects (26.4%) followed by diffuse patchy (9.9%), multiple (7.8%) and diffuse single (4.2%). The type of classifications used in other reports hampered further comparisons.

In this study, the teeth most frequently affected in the permanent dentition were the mandibular, maxillary incisors (34.1%) and the mandibular first permanent molars (34.7%). This is similar to reports from South Wales[9] and investigations on Chinese children[3] where the maxillary and mandibular incisors were found to be the most frequently affected teeth with a prevalence of 18.7% and 40.8% respectively. There was involvement of the premolars in only 10 children (4.42%) in the present study.

Observation in this study that discolored enamel unassociated with opacity occurred in 64.4% of teeth, white opacity in 14.6%, hypoplasia-missing enamel in 10.18% and yellow opacity in 8.42% of teeth is generally higher when compared with figures of New Zealand study 0.3%, 4.17%, 0.57%, and 1.04%[24].

The trends in the prevalence of defects on the various tooth types and tooth surfaces conform closely to those previously reported[9-11,14,18,28-30]. Observations in the present study show that the buccal surfaces were affected more frequently than the occlusal and lingual surfaces.

In this study the etiological factors associated with enamel defects were neonatal disturbances, tetracycline staining, fluorosis and local infection (8.2%), while 4.8% of the defects were idiopathic in origin. In this environment, the other main etiological factors associated with enamel defect are measles, juvenile gastroenteritis, chromosomal abnormalities and kidney disorders[18].

Observations in this study that tetracycline staining accounted for 3.7% of the etiological factors associated with enamel defects in the teeth of the children investigated should be interpreted with caution, as use of tetracycline drug alone may not have been the exclusive cause. It should be noted that conditions such as exanthematous fevers, which necessitated the use of tetracycline drug, might by itself give rise to enamel defect.

Previous study in children from Nigeria reported a strong association between socioeconomic status and prevalence of developmental defects of enamel[20]. Similar findings have been reported in Ghana and Guatemala[35]. Other studies[21,26] have also suggested that children from higher socioeconomic groups tend to have more diffuse mottling than children from low socioeconomic group. Studies on Nigerian and Guatemalan children have also reported a strong association between the prevalence of enamel hypoplasia and low socio-economic status[18,35]. However a similar study from Birmingham found no difference in the mouth prevalence and tooth prevalence of enamel defects in 2 fluoridated areas of Birmingham with marked social class differences[36]. The present study found no statistically significant association between enamel hypoplasia and socio-economic status ($p<0.05$).

The significant finding of childhood illness in the medical history of 56.6% of the children with enamel defects is a relevant factor. Reports have also associated the presence of enamel defects with existing medical

conditions in the patient[18,27,37].

Results from the present study show that differences occur in the prevalence and distribution of enamel defects between developing countries and developed countries. There are also differences in the possible etiological factors associated with the condition. For studies in developing countries, the history of childhood illness, use of tetracycline and poverty were significant factors in the etiology of defects[14,18,20,22]. In the developed countries, low birth weight and exposure to high levels of fluoride were more important etiological factors[4,5,17,24,36-38].

However, a recent study has also reported that environmental contamination from dioxin or dioxin-like compounds may interfere with tooth development. The study found a correlation between prolonged breastfeeding and hypomineralization of first permanent molars[37].

Studies that have used photographic assessments, revealed more lesions than studies based on visual assessments[29,30]. In the developed countries cosmetic considerations to improve the appearance of teeth with enamel defects is of major public health concern.

However, cosmetic consideration in developing countries is still low as a lot of these unaesthetic lesions are left untreated. Some authors[24] established that 23(1%) of children studied had poor appearance from a sample of 1758 as a result of defects other than fluoride. Observations from other studies have also given similar reports[36,39]. However, observations from the present study showed that 4.8% of the children studied had a cosmetic problem (Figure 5). The high figure reported in the present study implies that there is a need for improvement of the oral health awareness in Nigeria. Parents should be encouraged to bring their children and wards early and regularly for treatment for maximum benefits especially on preventive oral health care.

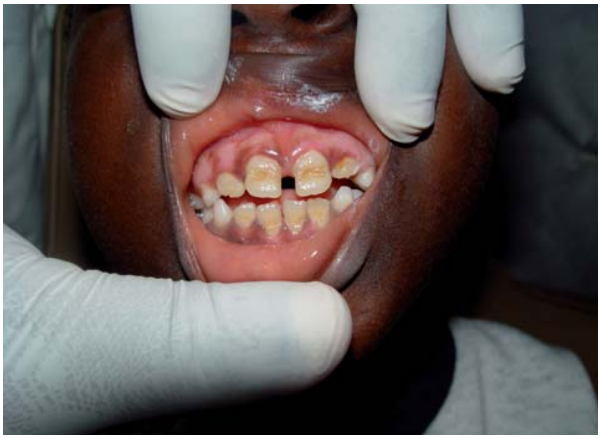


Figure 5. Clinical photograph of 8 year old child showing chronologic enamel hypoplasia on maxillary and mandibular incisors.

CONCLUSION

The principal findings from this study show that the unaesthetic enamel defects are prevalent in Nigerian children. They occur mostly on the buccal and lingual surfaces of affected teeth and are mainly associated with childhood illnesses, use of tetracycline in children less than 12 years old and poor socioeconomic conditions. A number of the defects have been left untreated due to low level of oral health awareness and poverty.

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