RSBO

ISSN:
Electronic version: 1984-5685
RSBO. 2025 Jan-Jun;22(1):5-12

Original Research Article

Differential diagnosis of developmental defects of enamel and associated factors: a cross-sectional study conducted with dentists in Southern Brazil

Paula Dresch Portella[1]
Gabriela Fonseca de Souza[1]
Juliana Feltrin de Souza[1]
Luciana Reichert da Silva Assunção[1]

Corresponding author:
Paula Dresch Portella
Avenida Prefeito Lothário Meissner, 632 – Jardim Botânico
CEP 80210-170 – Curitiba – PR – Brasil
E-mail: pauladresch@hotmail.com

[1] Department of Stomatology, Federal University of Paraná – Curitiba – PR – Brazil.

Received for publication: July 31, 2024. Accepted for publication: August 1st, 2024.

Keywords:
dental enamel hypoplasia; fluorosis, dental; amelogenesis imperfecta; diagnosis; health knowledge, attitudes, practice.

Abstract

Introduction: Enamel development defects (EDD) encompass diverse dental anomalies affecting deciduous and permanent dentition, posing diagnostic challenges crucial for effective clinical management. **Objective:** Assessing Southern Brazilian dental surgeons' (DS) knowledge about, and factors associated with, differential diagnosis of EDD. **Material and methods:** Cross-sectional study utilized an online, anonymous and self-administered questionnaire distributed to actively registered professionals at the Regional Dentistry Council, Paraná State, Brazil, from January to August 2020. Participants were presented with images of different types of EDD and were asked to provide corresponding diagnosis for each defect. Univariate and multivariate Poisson regression analyses with robust variance was employed to assess correlation among factors associated with professionals' performance in differential diagnosis of EDD. **Results:** A total of 613 DSs participated in the study, 76.5% of them were women; their mean age was 37.74 years (standard deviation; SD=11.027). The mean number of correct diagnoses was 1.93 (SD=1.121); with only 11.4% of participants achieving 100% accuracy. The frequencies of correct diagnoses were: fluorosis (73.1%), amelogenesis imperfecta (64.4%), hypoplasia (29.7%) and demarcated opacity (25.9%). Holding a Master's and/or Doctorate degree was associated with larger number of correct diagnoses for all EDD types, except for fluorosis. Participants' age was associated with higher frequency of correct

diagnoses for demarcated opacity and fluorosis. Training in the field of Pediatric Dentistry was associated with a higher number of correct diagnoses for all EDD subtypes($P<0.05$). **Conclusion:** Dental surgeons demonstrated limited knowledge regarding the differential diagnosis of EDD, particularly concerning hypoplasia and demarcated opacity. The findings of this study underscore the necessity of providing specific and continuous training in the differential diagnosis of various EDD types, particularly focusing on demarcated opacity and hypoplasia.

Introduction

Enamel development defects (EDD) result from disorders occurring during the secretion and maturation phases of amelogenesis, and they can affect deciduous or permanent dentition [1, 22]. Studies have reported EDD prevalence in children ranging from 5.32% [25] to 74.2% [15].

The term EDD (enamel development defects) encompasses distinct dental alterations regarding etiology and clinical characteristics, with the primary clinical criterion for classifying these defects was established by Fédération Dentaire Internationale [World Dental Federation] in 1989 and updated in 1992. The modified EDD suggested a classification criterion based on visual and tactile features of different EDD types, namely: demarcated opacity, fluorosis (diffuse opacity), hypoplasia, among other defects, such as amelogenesis imperfecta [29].

Opacities are qualitative enamel defects clinically featured by varying-color patches, smooth surface and normal enamel thickness; they can be either demarcated or diffuse [22]. Demarcated opacities present well-defined edges whose color ranges from white and yellow to brown [10]. On the other hand, diffuse opacities, also known as fluorosis, present white striations with undefined edges and affect homologous teeth [22]. Hypoplasias, in their turn, are quantitative defects; therefore, they present thinner enamel with regular edges [21]. Amelogenesis imperfecta is another defect type, although it is not as common as the other types. It can be of the hypomineralized or hypoplastic type and, given its hereditary origin, it affects both dentitions [6].

The correct diagnosis of different EDD types can be challenging for dental surgeons due to its clinical complexity [2, 19] besides influencing the adoption of appropriate clinical management strategies, since each defect has different symptoms and therapeutic demands [28]. Furthermore, difficulties in performing differential EDD diagnosis can hinder the anamnesis process carried out to find ethological factors and to establish likely groups at risk of presenting these changes [11].

Studies focused on assessing dental surgeons' knowledge about differential diagnosis of EDD types remain scarce in the literature [2, 11]. A study carried out in Sweden with dental surgeons, oral health technicians and oral health assistants observed professionals' poor ability to recognize demarcated opacity, fluorosis and hypoplasia, without receiving specific training [11]. A study conducted in Brazil assessed the knowledge of 23 and 98 Dentistry professors and students, respectively, about hypoplasia, fluorosis and amelogenesis imperfecta diagnosis and treatment. The aforementioned study only reported students' difficulty in recognizing different EDD types, mainly amelogenesis imperfecta and hypoplasia [2].

It is essential assessing dental surgeons' knowledge about the diagnosis of different EDD types to establish training strategies to be provided to these professionals [5, 11]. This factor not only benefits patients who receive accurate and effective treatment, but it also contributes to Dentistry advancement, in general. The aim of the current study was to assess Southern Brazilian dental surgeons' knowledge about differential diagnosis of different EDD types and their associated factors.

Material and methods

Ethical aspects

The current project was approved by the Human Research Ethics Committee of the Health Sciences Sector of Federal University of Paraná (UFPR) (1509919.7.0000.0102). All volunteers provided written informed consent to participate in the study.

Study design and participants' features

Cross-sectional study conducted with dental surgeons in Paraná State, Southern Brazil, from January to August 2020. Paraná State's population comprises 11,597,484 inhabitants and, according to the United Nations Development Program (UNDP, 2022), Human Development Index (HDI) is 0.749.

All dental professionals actively registered at Paraná State's Regional Dentistry Council (also known as CRO-PR), Brazil, were invited to participate in the current study via email. Only participants who signed the free and informed consent form were included in the study.

Online questionnaire

Professionals who agreed to participate in the study received, via e-mail, a brief explanation about the study, as well as the link to complete the online questionnaire, which was developed on the Google Forms platform.

The questionnaire was structured in three different parts: I – personal data, II – professional data, and III – knowledge about different EDD types. Personal data (Part I) comprised participants' age, gender and city of birth. Part II assessed professional information such as undergraduate institution (institution's name and completion year), specialization (if any, including number of specializations, subfield, and completion years), area of expertise (public service, private, or both), teaching activity (yes or no), possession of a Master's and/or Doctorate degree (yes or no), acting zone (rural or urban), years of clinical practice, and information about care provided to children (yes or no, and frequency).

Part III assessed DSs' knowledge about the different EDD types. Four dental pictures of each EDD subtype (demarcated opacity, fluorosis, amelogenesis imperfecta and hypoplasia) [4] (figure 1) were included in this section. Each picture was followed by a multiple-choice question: "What is the diagnosis of the condition presented in this picture?". Participants were required to select one of the following answer options for each question: Healthy tooth, Dental cavity, Amelogenesis imperfecta, Fluorosis (diffuse opacity), Hypoplasia and Demarcated opacity. The number of correct diagnoses observed for each participant ranged from 0 to 4.

Figure 1 – Pictures used in the online questionnaire for visual diagnosis purposes. A1, A2 and A3) Demarcated opacity (hypomineralization); B) Fluorosis (diffuse opacity); C) Amelogenesis Imperfecta; D1 and D2) Hypoplasia

Pilot study

A pilot study was conducted from August to September 2019 to assess the applicability of the adopted instrument in collecting data to meet the aims of the current study. A preliminary form was developed and applied to 15 dental surgeons who graduated at Federal University of Paraná, Curitiba City, Southern Brazil, in the previous six years. Participants in the pilot study were not included in the main study. Some words and questions in the questionnaire were reformulated to assist participants in better understanding the form.

Statistical analysis

The number of correct diagnoses was expressed as mean and standard deviation, based on the total number of questions. The frequency of correct diagnoses observed for each assessed condition was expressed as absolute and percentage values.

The prevalence ratio of correct diagnoses in all four visual diagnostic questions about the covered EDD types (demarcated opacity, fluorosis, amelogenesis imperfecta and hypoplasia) was taken as dependent variable. Independent variables taken into consideration in the aforementioned analysis

comprised gender (male and female), specialization (yes or no), specialization in Pediatric Dentistry (yes or no), teaching activity (yes or no), Master's and/or Doctorate degree (yes or no), and whether participants provided dental care to children (yes or no). Quantitative independent variables were dichotomized, based on the median value recorded for age (≤ 37 years and > 37 years) and years of professional performance (≤ 12 years and > 12 years). Univariate and multivariate Poisson regression analysis with robust variance was used to assess the factors associated with professionals' performance in the differential diagnosis of different EDD types. All independent variables showing $p < 0.20$ in the univariate analysis were selected and those that remained significant ($p < 0.05$) after their adjustment, or that allowed the best model adjustments, remained in the final model.

Data were tabulated and statistically analyzed in SPSS software (version 20.0, IBM, Brazil).

Results

In total, 613 DSs completed the online form. The mean age of the professionals was 37.74 years (minimum = 21 years, maximum = 72 years), with 23.5% of participants identifying as female. The majority of professionals did not possess a Master's and/or Doctorate degree (75%), but 70.6% of them had some form of specialization. Additionally, 14.4% of participants were experts in Dentistry. Most participants reported providing dental care to children (74.6%), working in the private sector (63.6%), and practicing in urban areas (89.5%), as shown in table I.

Table I – Socioeconomic and demographic variables of the sample

Variables	Frequencies
Age (mean, min-max)	37.74 (21-72)
Gender (N, %)	
Male	144 (23.5)
Female	469 (76.5)
Years of practice (N, %)	
>12 years	305 (49.7)
≤ 12 years	308 (50.3)
Specialization (N, %)	
Yes	433 (70.6)
No	180 (29.4)
Specialization in Pediatric Dentistry (N, %)	
Yes	88 (14.4)
No	525 (85.6)
Teaching activity (N, %)	
Yes	98 (16.0)
No	515 (84.0)
Master's and/or Doctorate (N, %)	
Yes	153 (25.0)
No	460 (75.0)
Children's care (N, %)	
Yes	457 (74.6)
No	156 (25.4)

The mean number of correct diagnoses among participants was 1.93 (SD = 1.12); only 11.4% (n = 70) of professionals correctly identified all answers. The frequency of correct diagnoses in descending order comprised fluorosis (73.1%), amelogenesis imperfecta (64.4%), hypoplasia (29.7%), and demarcated opacity (25.9%), as shown in table II.

Table II – Descriptive analysis of correct and incorrect responses to each question presented to dentists

EDD Type	Correct diagnoses (N, %)	Incorrect diagnoses (N, %)
Demarcated opacity	159 (25.9)	454 (74.1)
Fluorosis	448 (73.1)	165 (26.9)
Amelogenesis	395 (64.4)	218 (35.6)
Hypoplasia	182 (29.7)	431 (70.3)

Poisson multivariate regression analysis evidenced that age younger than or equal to 37 years old was associated with a larger number of correct diagnoses in fluorosis ($p = 0.002$) and demarcated opacity ($p = 0.001$) diagnosis. Having a Master's and/or Doctorate degree was associated with the highest prevalence of correct diagnoses for all EDD types ($p < 0.05$) except for fluorosis. Similarly, having specialization in Pediatric Dentistry was associated with the highest prevalence of correct diagnoses for all EDD types compared to other specializations ($p < 0.05$). Factors such as years of professional performance, providing dental care to children, participants' gender, having specialization and teaching activity were not associated with the frequency of correct diagnoses in the diagnosis of different EDD types ($p > 0.05$) (table III).

Table III – Multivariate analysis for association between variables of interest and prevalence of correct responses by dentists regarding types of enamel development defects in a sample of dentists

Variables	Demarcated opacity		Fluorosis		Amelogenesis imperfecta		Hypoplasia	
	PRb (IC 95%)	PRa (IC 95%)	PRb (IC 95%)	PRa (IC 95%)	PRb (IC 95%)	PRa (IC 95%)	PRb (IC 95%)	PRa (IC 95%)
Age								
>37 years (N=292)	1	1	1	1	1	-	1	-
≤37 years (N=321)	1.50 (1.14-1.98)	1.57 (1.21-2.05)	1.10 (0.97-1.24)	1.16 (1.06-1.28)	1.10 (0.97-1.24)		1.27 (0.99-1.63)	
P value*	**0.004**	**0.001**	**0.006**	**0.002**	0.12	-	0.06	-
Gender								
Male (N=144)	1	-	1	-	1	-	1	-
Female (N=469)	1.06 (0.78-1.44)		0.92 (0.82-1.04)		1.02 (0.89-1.17)		1.07 (0.81-1.42)	
P value*	0.72	-	0.20	-	0.81	-	0.64	-
Years of practice		-		-				
>12 years (N=305)	1		1		1		1	
≤12 years (N=308)	1.43 (1.09-1.88)		1.09 (0.99-1.20)		1.07 (0.95-1.20)		1.21 (0.94-1.54)	
P value*	**0.010**	-	0.07	-	0.27		0.13	
Specialization								
No (N=180)	1		1		1	-	1	-
Yes (N=433)	0.91 (0.68-1.21)	-	1.05 (0.90-1.12)	-	1.24 (1.07-1.44)		1.13 (0.85-1.49)	
P value*	0.54	-	0.92	-	**0.002**	-	0.44	-
Specialization in Pediatric Dentistry								
No (N=525)	1	1	1	1	1	1	1	1
Yes (N=88)	2.43 (1.88-2.35)	2.35 (1.82-3.02)	1.24 (1.12-1.36)	1.26 (1.14-1.39)	1.40 (1.25-1.56)	1.34 (1.20-1.50)	2.20 (1.73-2.79)	1.34 (1.20-1.50)
P value*	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**
Teaching activity								
No (N=515)	1	-	1	-	1	-	1	-
Yes (N=98)	1.77 (1.33-2.35)		1.06 (0.94-1.19)		1.42 (1.28-1.58)		1.68 (1.29-2.18)	
P value*	**<0.001**	-	0.38	-	**<0.001**	-	**<0.001**	-
Master's and/ or Doctorate								
No (N=460)	1	1	1	-	1	1	1	1
Yes (N=153)	1.92 (1.48-2.50)	1.74 (1.35-2.26)	1.10 (0.99-1.22)		1.10 (0.99-1.22)	1.37 (1.23-1.53)	1.63 (1.28-2.08)	1.27 (1.23-1.53)
P value*	**<0.001**	**<0.001**	0.07	-	0.07	**<0.001**	**<0.001**	**<0.001**
Children's care								
No (N=156)	1	-	1	-	1	-	1	-
Yes (N=457)	1.13 (0.82-1.55)		1.09 (0.97-1.23)		0.99 (0.87-1.14)		1.12 (1.02-1.24)	
P value*	0.47	-	0.16	-	0.93	-	**0.002**	-

* P value calculated through Poisson Regression. Significant results are highlighted in bold.

Abbreviations: PRb = Crude Prevalence Ratio; PRa = Adjusted Prevalence Ratio; CI = Confidence Interval.

Discussion

Results in the current study have indicated a low frequency of correct diagnoses in the differential diagnosis of EDD, with particular emphasis on demarcated opacity and hypoplasia. Studies focused on assessing the performance of dental surgeons in EDD diagnosis remain scarce in the literature, making comparisons challenging. However, a study conducted in Sweden with dental care teams examined the effect of training on the differential diagnosis of EDD, with a focus on demarcated and diffuse opacities, as well as hypoplasia. The experimental group comprised 43 professionals, while the control group comprised 60 professionals who did not receive training [11]. The group without previous training performed correct diagnosis in only 42% of dental surfaces with EDD, whereas the experimental group recorded 85% of correct diagnoses. Results from the current study highlight the need for providing specific and continuous training for dentistry professionals to enable more assertive clinical practices [11].

Some factors can contribute to professionals' low assertiveness in the visual diagnosing EEDs, with an emphasis on successive changes in nomenclatures and recategorizations of these defects. The EDD classification was proposed in 1992 [28], however, for a long time, demarcated opacities, also referred to as hypomineralizations, were termed as internal enamel hypoplasia or enamel aplasia [4]. Hence, the absence of standardized terms for various EDD types may impede the learning process of dental surgeons during training and exacerbate their challenges in diagnosing these defects, as evidenced in the present study.

Participants evaluated in the current study exhibited a lower frequency of correct diagnoses in identifying demarcated opacities and hypoplasias. This impairment in visual identification may be linked to the clinical characteristics of the lesions under assessment. Despite demarcated opacities being qualitative defects of tooth enamel, they are frequently accompanied by post-eruptive structural losses resulting from masticatory forces [23]. This fact often makes it hard to visualize the stains and it can also induce professionals to misidentify them as quantitative defects like hypoplasia [13]. Furthermore, teeth presenting demarcated opacity and hypoplasia are more susceptible to have dental cavities [24, 27]. Therefore, dental surgeons frequently encounter teeth displaying significant levels of damage during consultations, which can impede the diagnosis of demarcated opacity and hypoplasia, as well as diminish Dentistry professionals' familiarity with these alterations [8, 13, 20].

On the other hand, the investigated professionals excelled in diagnosing fluorosis and amelogenesis imperfecta. Fluorosis is the most prevalent EDD in Brazil [3], with milder lesions without structural being the most frequently diagnosed in the population [12]. These aspects may contribute to dental surgeons' greater experience in diagnosing these lesions, as they often encounter fluorosis during consultations. Additionally, although amelogenesis imperfecta is rarely observed in patients' teeth [6], it can be easily differentiated from other EDDs due to its association with specific signs such as anterior open bite and compromise of all teeth in both dentitions, stemming from its genetic origin [18].

Based on the diverse profiles of the assessed professionals, higher assertiveness was observed among pediatric dentists and those with a Master's and/or Doctorate degree. Pediatric dentists demonstrated superior performance in providing a differential diagnosis of all EDD types. EDDs are changes taking place at tooth enamel formation time; thus, they can be detected as soon as individuals' teeth erupt [16]. Consequently, professionals specialized in providing dental care for children are often the ones who first diagnose these changes. Furthermore, this topic is often included in the discipline matrix of different specialization courses in Pediatric Dentistry in Brazil. It is essential providing specific training in differential diagnosis of different EDD types, mainly the one based on dental pictures, to help improving Dentistry professionals' performance and skills to identify these changes [11].

It is worth emphasizing that individuals in the age group 37 years or younger performed better at the time to diagnose dental fluorosis and demarcated opacities. These findings can be attributed to a decline in the severity of dental cavities over time [3], potentially making EDD detection easier, as well as to updates in scientific evidence on this topic [17]. There has been increased inclusion of this topic in undergraduate courses' discipline matrices in recent years, and it may have contributed to improve both the familiarity and knowledge of recently graduated professionals. This trend is corroborated by previous studies focused on assessing dental surgeons' perception about molar and incisor teeth hypomineralization (MIH), which reported findings similar to those in the current study. Both studies have evidenced

that the most experienced professionals tend to diagnose these defects less often in their clinical practice [7, 26]. In addition, the limited number of correct diagnoses by professionals who graduated a long time ago may be associated with the fact that all EDDs were previously treated as hypoplasia, which may have hindered the ability of this specific group to distinguish between different defect types, mainly due to a lack of updates on this topic [11].

Having Master's and/or Doctorate degree was associated with the highest prevalence of correct diagnoses in hypoplasia, amelogenesis imperfecta and demarcated opacities' diagnosis. There has been significant increase in the number of studies published in specialized literature focused on addressing different EDD aspects, in recent years [17]. The systematized training, along with critical reading and analysis of scientific articles during Master's and/or Doctoral courses, make professionals with this level of academic education more likely to base their clinical practice on evidence [9, 14]. This aspect contributes to professionals' familiarity with both the classification and differential diagnosis of these changes, which may justify this finding.

The current study had some limitations. One of them was the low response rate, as the questionnaire was sent to approximately 24,000 professionals actively registered in the Regional Council of Dentistry of Paraná State. However, the sample assessed in this study was significantly larger than that in other studies on the same topic [2, 11, 19, 28]. Another limitation was the focus solely on a specific Brazilian region. Future studies should include other regions of Brazil to identify potential differences among professionals from different locations within the country.

Conclusion

Based on the current findings, it was evident that Dentistry professionals have poor knowledge about the differential diagnosis of EDD, particularly emphasizing hypoplasia and demarcated opacity. Therefore, it is crucial to include specific training and improvement strategies to aid in detecting different EDD subtypes in the curriculum of Dentistry undergraduate courses. Additionally, these professionals should undergo continuous updates to ensure the provision of the best clinical treatment for patients presenting these changes. Continuing education and professional improvement are essential pillars for maintaining the quality of dental services provided to society.

References

1. Anthonappa R, King N. Enamel defects in the permanent dentition: prevalence and etiology. Pediatr Restorative Dent. 2015;Springer:15-30.

2. Barzotto I, Rigo L. Clinical decision making for diagnosis and treatment of dental enamel injuries. J Hum Growth Dev. 2018;28(2):189-98.

3. Brasil. Ministério da Saúde. SB Brasil 2010: Pesquisa Nacional de Saúde Bucal: resultados principais. Brasília, DF; 2012. Available from: URL:https://bvsms.saude.gov.br/bvs/publicacoes/pesquisa_nacional_saude_bucal.pdf.

4. Clarkson J. Review of terminology, classifications, and indices of developmental defects of enamel. Adv Dent Res. 1989;3:104-9.

5. Dabiri D, Eckert GJ, Li Y, Seow S, Schroth, RJ, Warren J et al. Diagnosing developmental defects of enamel: pilot study of online training and accuracy. Pediatr Dent. 2018;40(2):105-9.

6. Gadhia K, McDonald S, Arkutu N, Malik K. Amelogenesis imperfecta: an introduction. Br Dent J. 2012 Apr 27;212(8):377-9.

7. Gamboa GCS, Lee GHM, Ekambaram M, Yiu CKY. Knowledge, perceptions, and clinical experiences on molar incisor hypomineralization among dental care providers in Hong Kong. BMC Oral Health. 2018;18:217.

8. Hanlin S, Burbridge L, Drummond B. Restorative management of permanent teeth enamel defects in children and adolescents. Pediatr Restorative Dent. 2015;Springer:139-55.

9. Isett KR, Doshi AM, Rosenblum S, Eller W, Hicks D, Melkers J et al. Temporal search persistence, certainty, and source preference in dentistry: Results from the National Dental PBRN. PLoS One. 2022;17:e0264913.

10. Jälevik B, Norén J. Enamel hypomineralization of permanent first molars: a morphological study and survey of possible aetiological factors. Int J Paediatr Dent. 2000;10(4):278-89.

11. Jälevik B, Szigyarto-Matei A, Robertson A. Difficulties in identifying developmental defects of the enamel: a BITA study. Eur Arch Paediatr Dent. 2019 Oct;20(5):481-8.

12. Lima I, Nóbrega D, Cericato G, Ziegelmann P, Paranhos L. Prevalence of dental fluorosis in regions supplied with non-fluoridated water in the Brazilian territory: a systematic review and meta-analysis. Ciênc Saúde Colet. 2019;24:2909-22.

13. Lo E, Zheng C, King N. Relationship between the presence of demarcated opacities and hypoplasia in permanent teeth and caries in their primary predecessors. Caries Res. 2003;37:456-61.

14. Oliveira BH, Hyppolito IMD, Malheiros Z, Stewart B, Pannuti CM. Information-seeking behaviors and barriers to the incorporation of scientific evidence into clinical practice: a survey with Brazilian dentists. PLoS One. 2021;16:e0249260.

15. Osorio-Tovar JP, Naranjo-Sierra MC, Rodríguez-Godoy M. Prevalence of developmental defects of the enamel in primary dentition in a bogotan population. Rev Salud Publica. 2016;18(6):963-75.

16. Palma-Portaro C, Casian J, Cabrera-Matta A, Rocca F, Fuks A. Atypical Developmental defects of enamel in primary incisors versus preeruptive intracoronal resorption (PEIR): case reports. Pediatr Dent. 2020;42:146-9.

17. Perazzo MF, Otoni ALC, Costa MS, Granville-Granville AF, Paiva SM, Martins-Júnior PA. The top 100 most-cited papers in Paediatric Dentistry journals: a bibliometric analysis. Int J Paediatr Dent. 2019;29:692-711.

18. Poulsen S, Gjørup H, Haubek D. Amelogenesis imperfecta – a systematic literature review of associated dental and oro-facial abnormalities and their impact on patients. Acta Odontol Scand. 2008;66:193-9.

19. Rigo L, Lodi L, Garbin RR. Differential diagnosis of dental fluorosis made by undergraduate dental students. Einstein. 2015 Oct-Dec;13(4):547-54.

20. Ruschel H, Vargas-Ferreira F, Tovo M, Kramer P, Feldens C. Developmental defects of enamel in primary teeth: highly prevalent, unevenly distributed in the oral cavity and not associated with birth weight. Eur Arch Paediatr Dent. 2019;20:241-8.

21. Sabel N, Klingberg G, Dietz W, Nietzsche S, Norén J. Polarized light and scanning electron microscopic investigation of enamel hypoplasia in primary teeth. Int J Paediatr Dent. 2010;20(1):31-6.

22. Seow WK. Clinical diagnosis of enamel defects: pitfalls and practical guidelines. Int Dent J. 1997 Jun;47(3):173-82.

23. Soviero V, Haubek D, Trindade C, Matta T, Poulsen S. Prevalence and distribution of demarcated opacities and their sequelae in permanent 1st molars and incisors in 7 to 13-year-old Brazilian children. Acta Odontol Scand. 2009;67:170-5.

24. Vargas-Ferreira F, Ardenghi TM. Developmental enamel defects and their impact on child oral health-related quality of life. Braz Oral Res. 2011 Nov;25(6):531-7.

25. Wagner Y. Developmental defects of enamel in primary teeth – findings of a regional German birth cohort study. BMC Oral Health. 2017;17:10.

26. Wall A, Leith R. A questionnaire study on perception and clinical management of molar incisor hypomineralisation (MIH) by Irish dentists. Eur Arch Paediatr Dent. 2020;21:703-10.

27. Wong H, McGrath C, King N. Dental practitioners' views on the need to treat developmental defects of enamel. Community Dent Oral Epidemiol. 2007;35(2):130-9.

28. World Dental Federation. A review of the developmental defects of enamel index (DDE Index). Commission on Oral Health, Research & Epidemiology. Report of an FDI Working Group. Int Dent J. 1992 Dec;42(6):411-26.