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Association Between Presence of Enamel Defects, Dental Caries and Socioeconomic Conditions on Brazilian Children

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Abstract

Objective: To verify the relationship between developmental enamel defects (DED) in permanent incisors and socioeconomic conditions and dental caries in children within the life course context. **Material and Methods:** A total of 350 children aged 9-11 years from 13 public schools in the city of Bauru, Brazil were examined. Clinical exams were performed to observe the presence of caries and developmental enamel defects using the DMFT and DED indexes, respectively. In addition, information about family income and parental schooling was collected. Statistical analysis used the Spearman Correlation Coefficient and the Chi-square test to verify the association between DED, socioeconomic conditions and dental caries. The significance level adopted was 5%. **Results:** Association between presence of dental caries and DED (p=0.04), delimited opacity (p=0.02) and opacity (p=0.01) was observed. Inverse correlation for the decayed component with maternal schooling and family income was also verified. Regarding the types of development enamel defect (DED), correlation between delimited opacity, opacity and DED with the DMFT index was observed. **Conclusion:** The results of this study indicated association between enamel defects and caries, as well as correlation between income and parental schooling and dental caries.

Keywords: Epidemiology; Oral Health; Dental enamel; Dental Caries.

Introduction

Dental caries is considered an important disease that affects children and young people and has repercussions in adult life [1]. The use of the life course approach in the context of this disease seeks to promote a better understanding of its etiology, risk factors and living conditions that influence the oral condition of children.

Recent studies point to the decline of caries disease along with its polarization in disadvantaged groups. It is expected that the prevalence of the disease is high in low-income populations [2,3]. The decrease in DMFT values can be explained by the fluoridation of the public water supply, use of fluoridated dentifrices and the development of oral health care programs [4]. Oral diseases are more present in less egalitarian societies and socially disadvantaged groups [5], a phenomenon known as social gradient in health.

Therefore, assuming that oral diseases, such as dental caries, share the same risk factors as other chronic diseases, it could be inferred that explanatory theories for chronic diseases can be applied to oral health [6]. Thus, in order to contextualize dental caries and socioeconomic condition in the child's life, the life course approach will be applied [7]. This theory states that exposures and aggressions are accumulated throughout life, affecting health later, so there is a causal relationship between exposures and outcomes, taking into account the importance of time (duration) and timing of disease development.

Thus, the influence of early life may be considered one of the explanations for health inequities that occur in adult life [1]. Among the various life course models developed [8] aimed at understanding how exposure and its effects are related to health, risk accumulation and critical period models were adopted in this study. The first concerns beneficial or harmful exposures that accumulate during the life course, affecting health (dental caries) and the second deals about exposures during an important developmental period, producing a condition in adult life (enamel defects) [7].

In relation to dental enamel, it could be inferred that it is an unusual tissue that, once formed, does not undergo remodeling like other hard tissues. Due to its non-remodeling nature, changes during its formation are permanently recorded on the tooth surface [9,10]. Thus, developmental enamel defects may play an important role in increasing the susceptibility to caries development. According to the life course theory, aggressions and injuries in the enamel occurred in the intrauterine phase may result in opacities and hypoplasias that can later facilitate the development of caries disease. The relationship between social gradient and developmental enamel defects is not yet conclusive in literature [11]. Therefore, the association between oral health and socioeconomic conditions remains uncertain, requiring further studies to clarify this possible relationship.

Studies on the life course in the field of oral health are relatively recent [11-14] and have been contributing to a better understanding of related risk factors and conditions since the dawn of life. Although still controversial, several studies have confirmed the association between caries and enamel defects [15-18]. In a cohort study carried out in Australia, the impact of enamel defects in

the first permanent molar on caries experience and quality of life was observed, and the presence of diffuse opacity was associated with lower chance of caries [19]. A positive association was found between caries experience and enamel defects, considered as a potential predictor for dental caries and the possibility of sharing with DED the same risk factors [20].

The aim of this study was to evaluate the relationship between developmental enamel defects in permanent incisors and molars and socioeconomic conditions in the oral health of children within the life course context.

Material and Methods

Study Design

This cross-sectional study was carried out in 13 public schools, 6 municipal and 7 state, with children aged 9-11 years from the municipality of Bauru, Brazil during the year 2016 (March to June). The city of Bauru is considered of medium size (337,094 inhabitants), with Human Development Index (HDI) of 0.82.

Sample

The population comprised a total of 7988 schoolchildren enrolled in 25 schools. The study sample was probabilistic with simple draw among schools (geographical location) with systematic sampling among schoolchildren. Correlation coefficient (r) of 0.15 was used to calculate the sample size, using alpha of 5% and statistical power of 80%. Thus, the minimum sample size required corresponded to 347 children [Sample calculation = N = [(Zα + Zβ) / C] 2 + 3 = 347]. Those who agreed to participate and had consent form signed by parents were examined. Therefore, 350 children participated in the study.

As exposure factors, enamel defects were evaluated using the Modified Development Enamel Defects Index (Modified DED Index) proposed by the FDI - *Federation Dentaire International*. Its classification is based on the appearance, varying with extension, position and distribution in the teeth [21]. For dental caries examination, the DMFT index was used according to World Health Organization (WHO) criteria [22]. Socioeconomic information was obtained using a questionnaire on family income and paternal and maternal schooling sent together with the informed consent form to the families of children. For family income, the variable was collected in a continuous form and then categorized into more or less than 2 minimum wages. In relation to parental schooling, information year of schooling was collected. Subsequently, the variable was categorized into less than or more than 8 years of study concerning complete elementary school.

The calibration of the team consisting of two examiners and two annotators was initially performed through a theoretical discussion aiming to present and discuss the codes and criteria of dental caries and enamel defect indexes. Clinical evaluation was performed with the gold standard investigator and the examiner. The intra-examiner agreement for both indexes (dental caries and DED) was 0.80.

Epidemiological examination was carried out in the school environment, in an area with natural light and with the help of WHO Millennium - probe and oral mirror No. 5 (Golgran Ind. Com. Instr. Odontológicos, São Caetano do Sul, SP, Brazil) and examiner in the sitting position. Enamel defects were observed in upper and lower incisors and in molars. Regarding the DMFT index, all teeth were examined and after this procedure, SiC (Significant Caries Index) was calculated, that is, the average DMFT for the third of the group with the highest levels of the disease. In the same way, the Care Index was also calculated, which is calculated from the ratio of filled teeth by DMFT multiplied by 100.

Statistical Analysis

Data were submitted to the normality test using the Kolgomorov-Smirnov test. As there was no normal distribution of results, the Spearman Correlation Coefficient was performed, adopting significance level of 5%. The Chi-square test was also performed to verify association between DED and dental caries.

Ethical Aspects

The research was approved by the Research Ethics Committee of the Faculty of Dentistry of Bauru (CAAE 37046714.1.0000.5417). All parents / guardians were informed of the study objectives and signed the Informed Consent Form

Results

A total of 350 children aged 9-11 years participated in the study, with predominance of females (191; 54.57%). Socioeconomic data and oral conditions are presented in Table 1. The prevalence of DED was 22.29% (n=78). The most common type of DED was delimited opacity (20.57%) followed by diffuse opacity (0.57%) and hypoplasia (2%). The Care Index was 30%, while caries-free teeth consisted of 57% (n=199) and DMFT of 0.92 (± 1.32). Dental caries was significantly associated with DED (p=0.04), delimited opacity (p=0.02) and opacity (p=0.01).

Table 1. Socioeconomic and oral characteristics of children.

Variables	N (%)	Dental Caries		OR	p-value
		Absent N (%)	Present N (%)		
Sex					
Male	159 (45.43)	92 (57.86)	67 (42.14)	-	0.81
Female	191 (54.57)	107 (56.02)	84 (43.98)		
Income					
> 2 minimum wages	89 (25.43)	54 (60.67)	35 (39.33)	-	0.47
< 2 minimum wages	261 (74.57)	145 (55.56)	116 (44.44)		
Paternal Schooling					
> 8 years	195 (55.71)	115 (58.97)	80 (41.03)	-	0.43
< 8 years	155 (44.29)	84 (54.19)	71 (45.81)		

Maternal Schooling					
> 8 years	235 (67.14)	139 (59.15)	96 (40.85)		0.26
< 8 years	115 (32.86)	60 (52.17)	55 (47.83)		
DED					
Absent	272 (77.71)	163 (59.93)	109 (40.07)	1.74 (1.05-2.89)	0.04*
Present	78 (22.29)	36 (46.15)	42 (53.85)		
Delimited Opacity					
Absent	276 (79.43)	166 (60.14)	110 (39.86)	1.87 (1.11-3.14)	0.02*
Present	74 (20.57)	33 (44.59)	41 (44.41)		
Diffuse Opacity					
Absent	348 (99.43)	199 (57.18)	149 (42.82)	-	0.36
Present	2 (0.57)	0 (0.0)	2 (100.0)		
Opacity					
Absent	275 (78.57)	166 (60.36)	109 (39.64)	1.87 (1.12-3.12)	0.01*
Present	75 (21.43)	33 (44.0)	42 (56.0)		
Hypoplasia					
Absent	343 (98.0)	194 (56.56)	149 (43.44)	-	0.69
Present	7 (2.0)	5 (71.43)	2 (28.57)		

OR = Odds Ratio; *Qui-square test; **Minimum wage: R$ 880,00 (US$ 281.22).

Table 2 presents the Spearman correlation coefficients between DMFT and its components with socioeconomic characteristics and enamel defects. There was an inversely proportional correlation between dental carried in children and maternal schooling and family income. In relation to the types of developmental enamel defects (DED), correlation of delimited opacity, opacity and DED with the DMFT index was observed.

Table 2. Correlation between DMFT and its components with socioeconomic characteristics and developmental enamel defects in children.

Variables	Decayed Tooth	Missing Tooth	Filled Tooth	DMFT
Income	-0.11*	-0.09	-0.03	-0.06
Paternal Schooling	-0.09	-0.12*	-0.10	-0.08
Maternal Schooling	-0.16*	-0.01	0.10	-0.10
Delimited Opacity	0.06	-0.04	0.05	0.12*
Diffuse Opacity	0.03	-0.01	-0.01	0.07
Opacity	0.06	-0.04	0.05	0.12*
Hypoplasia	-0.09	-0.01	-0.01	-0.04
DED	0.04	-0.04	0.05	0.10*

*$p < 0.05$.

Discussion

The present study investigated the relationship between dental caries and presence of developmental enamel defects (DED) and socioeconomic conditions of the participating children's family (income and schooling). The results were consistent with previous studies that suggested that DED increased the risk of dental caries, since the influence of enamel defects in the development of caries was observed. Likewise, the relationship between socioeconomic conditions and oral health was verified.

Despite the evident decline in caries experience in the last decades in Brazil, this disease remains a public health problem. Along with its decline, the polarization phenomenon was observed

in a small part of the population, which due to social exclusion presents caries risk at higher levels [4]. The SiC (Significant Caries Index – average distribution of the third with the highest DMFT index) was found to be 2.46, a much lower value when compared to another Brazilian study carried out in the city of Itaí (polarization of dental caries in adolescents) in 178 children [23]. On the other hand, it was observed that 30% of children had no caries experience, lower than 57% found in this study [15].

Regarding variable sex, higher prevalence of dental caries was observed in females, although the difference was not statistically significant in the present study, unlike previous studies [24,25]. This result may be justified by the eruption of permanent teeth that occurs earlier in girls and due to the longer exposure time to caries risk, higher DMFT is understandable in this group of individuals.

In the present study, significant association (p=0.05) between developmental enamel defects and dental caries experience was also found. Some researchers found that children with developmental enamel defects were fifteen times more likely to have caries [26]. In this study, children were twice as likely to develop dental caries compared to those with no defects. Developmental enamel defects are disorders that occur during the dental enamel formation process, being common both in deciduous and permanent dentition and classified as hypomineralization and hypoplasia [27].

The literature shows that hypoplastic areas are more prone to retention of dental biofilm, increasing susceptibility to dental caries. As previously described, children with some enamel defects were more likely to develop the disease [10]. Associations between presence of these enamel defects and dental caries were also observed [10].

There was a correlation between maternal schooling and dental caries in children, and it was observed that the low education level of mothers (less than 8 years old) had a relation with the caries component in children. As in this study, associations between socioeconomic status and oral health were also reported in previous studies [14,24,28]. The educational level is a socioeconomic position marker, since high educational levels are associated with better living conditions and this may influence oral health [29]. The following caries indicators can be considered: not being a student, studying in public schools and income less than 5 minimum wages. Social deprivation may be related to dental caries experience, since unfavorable conditions are related to worse oral conditions [28]. Although somewhat controversial, literature shows that students from public schools present higher level of dental caries experience when compared to private school students [30]. Another study points out a relationship between family income and dental caries [31]. The correlation between family income and dental caries found in this study demonstrates the importance of the economic condition in the individual's health, especially in early life, corroborating the life course theory, in which there is accumulation of exposure of risk factors, contributing to the development of chronic diseases, such as dental caries.

The cross-sectional observational epidemiological design is a limitation because it does not allow concluding about the causal relationship among biological variables under study; however, it

should be emphasized that a significant change in the social determination of these biological variables hardly occurs, since social mobility occurs slowly and gradually [25].

This study contributes to the relationship between developmental enamel defects and dental caries, since the defect may precede the development of caries. Thus, individuals with developmental enamel defects should be monitored in order to prevent the development of the disease. In addition, a relationship between socioeconomic condition and dental caries was also observed, demonstrating the importance of the life course theory in the social condition and its consequent influence on oral health.

Conclusion

Association between developmental enamel defects and dental caries was observed in schoolchildren, as well as correlation between income and parental schooling and dental caries. In the life course context, further studies with longitudinal designs using life course models should be carried out in order to understand in a deeper way the impact of social and biological factors on the oral health of children

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