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Association between different stages of dental caries in preschoolers and familial socioeconomic factors

Izabella Barbosa FERNANDES[a]
Joana RAMOS-JORGE[a]
Valéria Silveira COELHO[a]
Ana Clara Sá PINTO[b]
Isabela Almeida PORDEUS[a]
Saul Martins PAIVA[a]
Maria Letícia RAMOS-JORGE[b]

[a]Universidade Federal de Minas Gerais - UFMG, Dapartment of Pediatric Dentistry, Belo Horizonte, MG, Brazil.

[b]Universidade Federal dos Vales do Jequitinhonha e Mucuri - UFVJM, Department of Pediatric Dentistry, Diamantina, MG, Brazil.

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Corresponding Author:
Izabella Barbosa Fernandes
E-mail: bellahfernandes@hotmail.com

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Abstract: This study evaluated the association between socioeconomic factors and stages of dental caries in children one to five years of age. A cross-sectional study was conducted involving 759 children enrolled in preschools in Diamantina, Brazil. The parents/caregivers filled out a form addressing socioeconomic factors. Add to the end of this sentence: and categorized in caries free (code 0 and 1), no obvious decay (code 2 and 3) and obvious decay (code 4, 5 and 6). Statistical analysis was performed using the Mann-Whitney test and multinomial regression. The prevalence of "no obvious decay" was higher among children from families with a larger number of income-dependent individuals (OR: 2.47; 95%CI: 1.41–4.31). The higher prevalence of "obvious decay" was associated with the child's age (OR: 1.36; 95%CI: 1.16–1.58), attending a public preschool (OR: 2.38; 95%CI: 1.31–4.34), a larger number of income-dependent individuals (four to five individuals: OR: 1.71; 95%CI: 1.09–2.74; more than five individuals: OR: 3.41; 95%CI: 1.95–5.94), no access to a dentist (OR: 2.14; 95%CI: 1.48-3.09), and lower income (OR: 1.72; 95%CI: 1.19–-2.49). It was concluded that the variable of a larger number of income-dependent individuals was associated with both no obvious decay and obvious decay. Child's age, type of preschool, access to a dentist, and income were associated with obvious decay.

Keywords: Dental Caries; Socioeconomic Factors; Child, Preschool; Oral Health.

Introduction

Dental caries is a considerable public health problem that exerts a substantial impact on the lives of individuals, families and communities.[1] Caries can interfere with important aspects of child development, such as eating, learning and leisure.[2] Socioeconomic inequalities in oral health outcomes, and high levels of disease in the socioeconomically underprivileged minority have been reported across many societies.[1,3-7] Inequalities in oral health are deep-rooted, and affect the general health and quality of life of millions of people throughout the world.[8] Studies have shown that families with a low socioeconomic status tend to adopt inadequate health behaviors (such as unfavorable hygiene practices and dietary habits), and have less access to healthcare services and

information on oral healthcare,[9-13] thus favoring the onset and progression of dental caries.

Modern caries management has become increasingly conservative, and involves the early identification of lesions and risk factors,[14] which can be used to introduce intervention strategies focused on controlling the carious process.[15] In epidemiological examinations, untreated dental caries has been traditionally diagnosed based on the presence of a cavity. In the last ten years, however, the inclusion of non-cavitated lesions in the diagnosis of the disease has drawn the interest of researchers, based on the high prevalence of these lesions, especially in the early years of life.[4,5,16]

Although caries surveys offer support for outlining oral health strategies, the results of these surveys enable only identification of more advanced stages of the disease.[17] Use of an index to evaluate different stages of dental caries, and the investigation of factors associated with each stage of this disease can provide important information to help guide preventive actions, and allocate public and private funds to children at risk of disease progression. Ideally, the disease should be controlled in its early stages, so that children at risk of progression do not suffer the consequences of tooth decay.[18] However, few studies have tested the socioeconomic/demographic profile of the preschool child in relation to the stage of progression of dental caries.

The key role of funding health services is to minimize the consequences of oral health diseases and oral health inequalities,[19] and funds must be allocated to the population that needs them most. Thus, this study evaluated the association between socioeconomic factors and different stages of dental caries (dichotomized as not obvious decay and obvious decay) in children one to five years of age, detected using the ICDAS criteria.

Methodology

Ethics

The children's parents signed a statement of informed consent after receiving an explanation regarding the objectives of the study. The Human Research Ethics Committee of the Universidade Federal de Minas Gerais approved this study.

Population

A population-based, cross-sectional study was conducted with preschoolers in the city of Diamantina, Minas Gerais, Brazil, during 2014. Diamantina has a population of 45,880 inhabitants and 1260 preschoolers distributed across 21 institutions.[20] Children between one and five years old, who were enrolled in a preschool/daycare center, were included in this study. Children with a systemic disorder, such as cerebral palsy or Down syndrome, were excluded.

The sample size was calculated using the OpenEpi (Open Source Epidemiologic Statistics for Public Health),[21] and the simple proportion formula was adopted. A 64.3% prevalence rate of dental caries,[22] a 95% confidence interval, and 5% standard error were considered. Afterwards, a correction factor of 2 was applied, leading to the inclusion of 706 children in the study. One hundred and forty-two children (20%) were added to compensate for possible loss. A total of 848 child/mother dyads were recruited. To ensure representativeness, the sample was stratified based on the type of preschool. The distribution of the sample was proportional to the total population enrolled in private and public preschools in the city, and the child was included through a drawing.

Pilot study

This study was conducted with 46 children from a public preschool, and their parents/caregivers. The results showed that the methods were appropriate, and that the parents/caregivers understood the questionnaires.

Socioeconomic and demographic information

Parents/caregivers filled out a form containing socioeconomic and demographic information, such as child's age and sex, family income (using the Brazilian monthly minimum wage = US$245.05 at the time of the study, dichotomized as < two times the BMMW or ≥ two times the BMMW), number of individuals who live on the same family income (categorized as

1 to 3, 4 to 5 or > 5 individuals), mother's schooling (categorized as >12, 9 to 11 or ≤8 years of study) and family access to a dentist at the time of the study (categorized as yes or no). The type of preschool (categorized as private or public) was recorded during the recruitment process.

Oral examination

The oral cavity of the children was examined by a single, calibrated dentist at a preschool. The intra- and interexaminer kappa values (≥ 0.8) were satisfactory for the oral condition evaluated. The exam was performed with the children lying on a portable cot, with mouth mirrors (Prisma, São Paulo, Brazil), WHO probes (Golgran, Sao Paulo, Brazil) and a head lamp (PETZL, Tikka XP, Crolles, France). Dental caries was detected by the ICDAS (International Caries Detection and Assessment System) criteria,[23] and classified according to the worst condition in the child's oral cavity. Thus, if a child had one tooth surface with an initial lesion, and another with distinct cavitation exposing visible dentine, only the latter was recorded. The first visually detected change in enamel (ICDAS code 1) was excluded, because, at this stage, the change is detected only after drying the tooth with compressed air, whereas the drying in this study was performed with dental gauze.

Dental caries was categorized into "no obvious decay" and "obvious decay." This classification was based on a cut-off ICDAS score.[24] The children without dental caries (codes 0 and 1 of the ICDAS) were the control group in the statistical analysis. Thus, the no obvious decay group included code 2 (distinct visual change in enamel) and code 3 (localized enamel breakdown due to caries with no visible dentin). Obvious decay included code 4 (underlying dark shadow from dentin), code 5 (distinct cavity with visible dentin) and code 6 (extensive distinct cavity with visible dentin).

Statistical analysis

The SPSS 22.0 program for Windows (SPSS, Chicago, IL, USA) was adopted to perform the statistical analysis. The occurrence of no obvious decay and obvious decay were the dependent variables.[24] Descriptive statistics were performed and multinomial regression was used to associate the stage of dental caries with the independent variables. Explanatory variables with a p-value ≤ 0.20 were selected for the multivariate analysis, and those having a p-value < 0.05 after making the adjustments for variables on the same and previous levels, were maintained in the final model. The odds ratio (OR) and 95% confidence intervals (CI) were calculated.

Results

The final sample was composed of 759 preschoolers (response rate = 89.5 percent). The reasons for dropouts were incomplete answers on the questionnaires, and lack of cooperation by the child during the examination. The mean age of the preschoolers was 3.51 (standard deviation = 1.23) years; 54.3% were female; and 85.8% attended public preschools. The prevalence of dental caries was 55.6%. A total of 32.4% (n = 246) of the children had obvious decay, and 23.2% (n = 176) had no obvious decay as the worst condition.

The majority of parents/caregivers reported that they received an income less than twice the Brazilian minimum wage (55.7%), and that four to five individuals lived on the same family income (56.0%). Table 1 shows the descriptive analysis of the socioeconomic and demographic variables according to the stage of caries.

Table 2 shows the unadjusted and adjusted model by multinomial logistic regression, showing the association of stage of caries (caries-free versus no obvious decay, and caries-free versus obvious decay) with the characteristics of preschoolers and socioeconomic/demographic factors. In the final model, no obvious decay was associated with a larger number of individuals dependent on the family income, and obvious decay was associated with public school, no family access to a dentist, a larger number of individuals dependent on the family income, child's growth in age, and low family income.

Discussion

This study evaluated the association between demographic/socioeconomic factors and different

Table 1. Descriptive analysis of independent variables according to caries stage (n = 759).

Covariables	Caries free	No obvious decay	Sample power	Obvious decay	Sample power
	n (%)	n (%)	(%)	n (%)	(%)
Sex					
Female	177 (43.0)	101 (24.5)	18.1	134 (32.5)	6.5
Male	160 (46.1)	75 (21.6)		112 (32.3)	
Age (years) - Mean (SD)	3.45 (1.3)	3.22 (1.1)	55.7	3.79 (1.1)	91.8
Type of preschool					
Private	59 (54.6)	33 (30.6)	4.9	16 (14.8)	97.7
Public	278 (42.7)	143 (22.0)		230 (35.3)	
Family income					
> 2 x BMMW	171 (50.9)	81 (24.1)	17.2	84 (25.0)	98.1
≤ 2 x BMMW	166 (39.2)	95 (22.5)		162 (38.3)	
Number of individuals living on family income					
1 to 3	85 (55.9)	29 (19.1)	89.9	38 (25.0)	90.9
4 to 5	189 (44.5)	94 (22.1)	65.2	142 (33.4)	35.9
> 5	63 (34.6)	53 (29.1)		66 (36.3)	
Mother's schooling					
> 12 years	43 (47.3)	18 (19.8)	3.1	30 (33.0)	10.3
9–11 years	166 (44.3)	101 (26.9)	33.6	108 (28.8)	30.4
≤ 8 years	128 (43.7)	57 (19.5)		108 (36.9)	
Access to dentist					
Yes	189 (52.9)	87 (24.4)	29.7	81 (22.7)	99.9
No	148 (36.8)	89 (22.1)		165 (41.0)	

SD: standard deviation; BMMW: Brazilian monthly minimum wage.

stages of caries in preschoolers. Although this association is well established in the literature, previous studies have not shown the influence of these variables on the different stages of caries. This investigation is of utmost importance to determining the profile of the population for which oral health actions should be prioritized.

Since the present study identified the early stages of caries, the prevalence of the disease was high, as could be expected. Studies that have used more sensitive indices for caries detection, such as the ICDAS, have also identified high frequencies of this disease.[4,25] However, determining the prevalence of the disease does not determine which individuals actually require an intervention, since the disease does not progress according to a set portion of the children.

No association was found between socioeconomic indicators, such as family income and type of school, and no obvious decay. However, an association was found between these indicators and obvious decay. These findings suggest that, although children from different social classes have the potential to develop caries, those from families with a poorer socioeconomic position have greater susceptibility to disease progression toward severe stages. Ideally, the disease should be controlled at the no obvious decay stage in children with a higher risk of progression, so that they do not ultimately suffer from tooth decay.[18] Thus, the professional approach to managing the no obvious decay carious lesions may not necessary be adopted by the population that has better socioeconomic indicators. Socioeconomic position is an important factor for maintaining health

Table 2. Unadjusted and adjusted model by multinomial logistic regression, showing the association of caries stage with other independent variables.

Variable	n	Caries free vs. No obvious decay						Caries free vs. Obvious decay					
		Unadjusted			Adjusted			Unadjusted			Adjusted		
		OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value	OR	95%CI	p-value
Sex													
Male	347	1											
Female	412	0.82	0.57-1.19	0.294				0.92	0.66-1.29	0.641			
Age (years) - Mean (SD)	759	0.86	0.71-0.99	0.473	0.91	0.78-1.07	0.262	1.27	1.10-1.46	0.001	1.36	1.16-1.58	0.000
Type of preschool													
Private	108	1			1			1			1		
Public	651	0.92	0.57–1.47	0.728	0.89	0.55–1.44	0.634	3.05	1.71–5.45	0.000	2.38	1.31–4.34	0.005
Family income													
> 2 x BMMW	336	1			1			1			1		
≤ 2 x BMMW	423	1.21	0.84–1.74	0.310	1.07	0.73–1.57	0.736	1.99	1.41–2.79	0.000	1.72	1.19–2.49	0.004
Number of individuals living on family income													
1 to 3	152	1			1			1			1		
4 to 5	425	1.46	0.89–2.38	0.131	1.34	0.81–2.21	0.251	1.68	1.08–2.61	0.021	1.71	1.09–2.74	0.020
> 5	182	2.47	1.41–4.31	0.002	2.31	1.28–4.15	0.005	2.34	1.40–3.92	0.001	3.41	1.95–5.94	0.000
Mother's schooling													
> 12 years	91	1											
9–11 years	375	1.45	0.79–2.66					0.93	0.55–1.58	0.794			
≤ 8 years	293	1.06	0.56–2.00					1.21	0.71–2.06	0.484			
Access to dentist													
Yes	357	1			1			1			1		
No	402	1.31	0.91–1.88	0.152	1.42	0.73–1.57	0.736	2.61	1.85–3.66	0.000	2.14	1.48–3.09	0.004

OR: odds ratio; CI: confidence interval; BMMW: Brazilian monthly minimum wage.

in its broadest sense,[6,26,27] and has been considered a determinant of the oral health of children.[1,3,4,5,6] The lack of a socioeconomic position may reflect less access of the family to health services and to healthcare information, as well as less funds to adopt health-minded practices.[8,28] Moreover, socioeconomic status can influence food choices.[29]

The distribution of income contributed more toward the occurrence of no obvious decay than family income. A larger number of family-income-dependent individuals can lead to poorer monitoring of dietary habits and hygiene practices, because of the divided attention of the caregivers.[30] In the analysis of obvious decay, both family income and the number of income-dependent individuals remained in the final model, indicating that each variable contributed to the outcome independently of the other. This finding demonstrates that the segmentation of income in families that receive two or more times the Brazilian monthly minimum wage is as important as that of a lower family income.

A mother's schooling determines the family income,[31,32] and these two variables together are associated with the presence of caries.[4,6] However, in the present study, maternal schooling was not associated with any of the stages of caries. In recent years, the Brazilian Ministry of Education's policy (education report) has prioritized the improvement in the educational level of economically unprivileged individuals, both at the high school and the university levels, by offering student funding programs, and expanding public universities into deprived regions of the country. This enhancement in the educational level may not have had an immediate impact on improving income, since inclusion in the job market depends on the job offer. Thus, mothers with higher education and lower income may have to make adaptations with regard to their expenses, such as restricting access of the family to health services, and opting for cheaper and more carbohydrate-rich foods. Furthermore, a mother's knowledge and values regarding health may not be represented by her educational level.

No access to a dentist and the presence of obvious decay were associated. This outcome underscores the importance of access to dental services in the early years of life. Regular visits to the dentist are one of the main ways of ensuring good oral health, by offering an opportunity for prevention, and by enabling dentists to counsel parents with regard to oral hygiene and health-minded dietary practices.[33] Families who had no access to a dentist in the present study, likely did not receive any advice regarding the oral hygiene of their children, and did not have the opportunity to adopt health-minded practices, factors that may have contributed to the greater occurrence of advanced stages of dental caries.

The child's age was connected to obvious decay. Indeed, dental caries is a cumulative process that tends to progress over the years if no intervention is performed.[33] Thus, the prevalence of obvious decay is expected with the growth in age. It is also expected that a child who remains exposed to a certain risk factor for a longer period of time will experience a progression in the disease. It is evident that only longitudinal studies can confirm the hypothesis that socioeconomic factors are indicative of caries progression. However, cross-sectional studies are important, because they detect exposure at a given time in life, and enable observation and reflection concerning the frequency of health problems and associated factors. The life course theory explores the importance of exposure at a particular point in an individual's life. According to this theory, exposure to a factor at one stage of life is likely to be related to exposure to other similar factors at other stages of life, and these exposures are likely to accumulate over the individual's lifetime.[34] Therefore, the results of this study, which encompasses a representative sample of the population, can be considered an important tool for public administrators.

The major limitation of this study was the sample size needed to assess some of the associations between independent and dependent variables. The power analysis showed low power in some associations. This is an indication that future research should minimize this limitation, and that a larger sample size may be called for. Early interventions and prevention programs directed at individuals in need are essential to reducing disparities in oral health. These interventions should be environmentally, socially and culturally appropriate, and should

prioritize early prevention, behavioral intervention, and the collaborative involvement of healthcare providers.[35,36] The findings of the present study can make a significant contribution to establishing public health priorities. Children from families with a poorer socioeconomic status require greater care and greater preventive and curative efforts on the part of public healthcare services. Moreover, the parents/caregivers of children belonging to different socioeconomic classes should receive information on dental caries and its determinants, in order to enable them to prevent this disease from emerging and progressing in their children.

Conclusions

In conclusion, a larger number of income-dependent individuals was associated with both no obvious decay and obvious decay. A child's growth in age, public preschool, no access to a dentist, and low income were associated with obvious decay. Thus, oral health actions should be prioritized for children with this risk profile.

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