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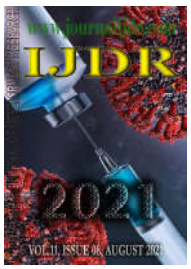

RESEARCH ARTICLE OPEN ACCESS

SPATIAL DISTRIBUTION OF DENTAL FLUOROSIS AMONG PRESCHOOL CHILDREN FROM PUBLIC SCHOOLS IN ALFENAS, SOUTHWEST REGION, BRAZIL

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ABSTRACT

Dental fluorosis is a common developmental dental alteration and highly prevalent in many Brazilian cities. The aim of the present study was to investigate the spatial distribution of dental fluorosis among schoolchildren in the city of Alfenas,Southwest Region, Brazil. The study included schoolchildren of both genders, age ranging between 8 and 11 years, enrolled in 4 public schools in the city. The children's examination and data collection were performed by a dentist and dental fluorosis was assessed using the Dean index. For statistical analyses, chi-square test was used to compare gender distribution according to fluorosis subtype (alpha=0.05).A Geographic Information System was builtto perform the geoprocessing procedures. Each child's home address was geocoded on a map and later applied the kernel density estimator. The final sample includes 353 children. Two hundred ninety children (82.15%)did not present dental fluorosis. None of the children presented moderate or severe subtypes of dental fluorosis. The spatial analysis of the distribution of very mild and mild cases of dental fluorosis among preschool children in the city of Alfenas indicated an occurrence of intraurban differentials. The prevalence of dental fluorosis is low in schoolchildren from Alfenas and thespatial analysis revealed geographic differences.

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INTRODUCTION

Dental fluorosis is a common developmental dental alteration characterized by hypomineralization of tooth enamel. This alteration is caused by ingestion of excessive fluoride during enamel formation (Den Besten and Li, 2011). The excessive systemic fluoride ingestion is mainly due to the fluoridation of thewater supply (Aoba and Fejerskov, 2002). The artificial water fluoridation strategy was proposed with the main goal of reducing the incidence and severity of dental caries disease (Spencer *et al*., 2018), which is the most frequent chronic disease during childhood and represents anenormous cost in public health (Kro and Nedley, 2007; Prathap *et al*., 2018). It is estimated that the exposure to fluoridated water reducesup to 35% of the experience of dental caries experience, in both primary and permanent teeth. In addition, fluoridated watercan increase 15% in the proportion of caries-free children in primary dentition and 14% in permanent dentition (Iheozor-Ejiofor *et al*., 2015; Rugg-Gunn *et al*., 2016). On the other hand, when exposure to fluoride leads to dental fluorosis, the susceptibility to dental caries increases (Cunha-Cruz and Nadanovsky, 2005; Nilchian *et al*., 2018). In Brazil, the coverage of the water supply system extends to 76% of the population (Frazão and Narvai, 2017). The fluoride concentrations ranges from 0.6 to 0.9 ppm according to the region, depending on the average daily temperatures (Frazão *et al*., 2011). A previous study performed a literature review on the prevalence of dental fluorosis in Brazil and observed that the prevalence widely ranges according to the region and the highest values were found in the Southeast and South of the country (approximately 12%) while the lowest in the Central-West and Northeast (approximately 4%) (Cunha and Tomita, 2006). Understanding the geographic distribution of health conditions is necessary to decision making in epidemiological surveillance

systems. The Geographic Information System (GIS) is a well-known tool in studies that evaluate the geographic distribution of many diseases, enablingthe collection, storage, visualization and analysis of spatial data (Ribeiro *et al*., 2014). Therefore, the aim of the present study was to investigate the spatial distribution of dental fluorosis amongschoolchildren in the Alfenas, a city located in Minas Gerais, state of southwest region of Brazil.

METHODS

This cross-sectional study is part of a larger project that evaluate oral conditions in preschool children from Alfenas. This study was approved by the Local Human Ethics committee (protocol: 78568217.7.0000.5142). The study recruitedschoolchildren of both genders, age ranging between 8 and 11 years, enrolled in 4 public schools in the city of Alfenas-MG. Parents/legal guardians agreed to participate in written informed consent and an assent document was applied for children. All standard biosecurity and institutional safety procedures have been used in this study during clinical examination. The characteristics of these children were previously described (Barbosa *et al*., 2020; Barbosa *et al*., 2021a; Reis *et al*., 2020a; Reis *et al*., 2021b; Reis *et al*., 2021c; Reis *et al*., 2021d). The children's examination and data collection were performed in 2018 by one single examiner (dentist) trained and calibrated (Kappa intra-examiner=0.87). Children were examined at the preschool while lying on desks under natural light and using a dental mirror. Dental fluorosis was assessed using the Modified Dean's fluorosis index (Dean, 1942).

DATA ANALYSIS

For statistical analyses, GraphPad Prism 8.0 software (GraphPad, LaJolla, USA) was to analyze data. Chi-square test was applied to compare gender distribution according to fluorosis subtypes and an alpha of 5% ($p<0.05$) was considered statistically significant. Geographic Information System was used to integrate the tabulated and spatial data and perform the geoprocessing procedures through the software QGIS (2.8.1), which was used to create the spatial analysis and maps. Each child's home address was geocoded, enabling the construction of a base of points on a map of the municipality. On the geocoded points, a kernel density estimation was applied, as this probability density function technique allows the user to better understand the data distribution.

RESULTS

The final sample includes 353 children, in which 170 were boys (48.2%) and 183 were girls (51.8%). Two hundred ninety children did not present dental fluorosis. The dental fluorosis subtypes distribution is presented in Table 1.

Table 1. Dental Fluorosis subtypes distribution among the evaluated children

Dental fluorosis subtypes	n	%
Normal (no clinical dental fluorosis)	200	82.1
Questionable	36	10.2
Very mild	26	7.3
Mild	1	0.3
Moderate	0	0
Severe	0	0

None of the children presented moderate or severe subtypes of dental fluorosis. Figure 1 shows non-fluorosis and fluorosis distribution among the gender. There was no statistical difference among males and females (p=0.302). A total of 340 children's records were evaluated and used for the geocoding process. Incomplete information provided by the parents/guardians during interviews and areas not officially registered with the City Hall determined the non-identification from13 (3.7%) addresses.

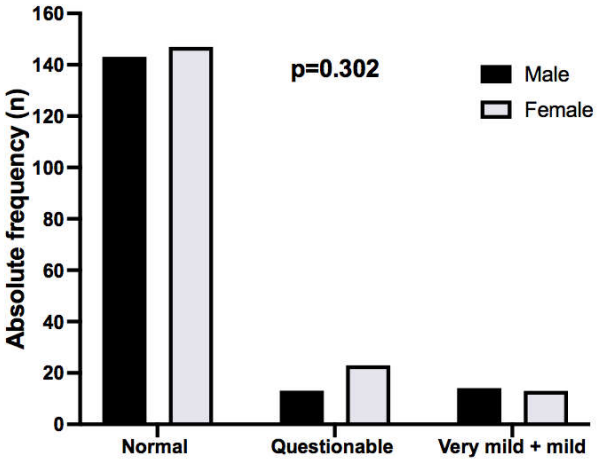

Figure 1. Fluorosis distribution among genders. Note: Chi-square was used. p>0.05 means not statistically significant

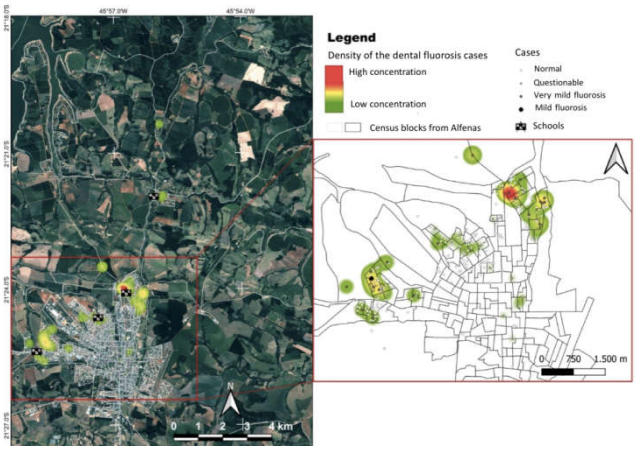

Figure 2. Residences of children analyzed in the geographic information system stage. Note: Produced by the authors using map base from IBGE (Brazilian Institute of Geography and statistics) and CBRS satellite Image

Figure 2 shows the distribution of the children based on their residence address and dental fluorosis subtypes. A cluster was observed in the northeast of the city.

DISCUSSION

Dental fluorosis is a health condition that results from adevelopmental disturbances of enamel due to an excessive exposure to fluoride. The duration of exposure, specific body response factors, weight, activity, diet, bone growth and genetics are directly proportional to the severity of presentation of these enamel defects (Aoba and Fejerskov, 2002; Nagata et al., 2016). Dental fluorosis is now a days commonly seen among pediatric patients (Gupta et al., 2017). In our studied population we were able to note that the prevalence of dental fluorosis in school children from Alfenas was low. Only 7.6% of the children presented dental fluorosis. Additionally, all the affected children presented only mild forms of the condition. Therefore, although dental fluorosis manifestations were observed in these children, the clinical presentation may not raise a concern as a public health problem. The scenario of dental fluorosis prevalence in Brazilian different regions range according to the studied region. A study performed by Cunha and Tomita, (2006) revised the prevalence of dental fluorosis in Brazilian regions from 1993 to 2004. The authors concluded that the prevalence widely ranges according to the evaluated region. They also reported that the highest values were observed in the Southeast and South of Brazil (approximately 12%). Alfenas is a city located in the Southeastof Braziland the prevalence observed in our study is similar to those ones observed in other

regions in the vicinity. In the others epidemiological studies evaluating children in the Southeast of Brazil, the occurrence of moderate and severe cases of dental fluorosis were also extremely uncommon (Cunha and Tomita, 2006), as observed in the present study. It is important to highlight that Alfenas has an artificially fluoridated water (Aguiar, 2019), which the controlled adjustment of fluoride to a public water supply aims to reduce the incidence and severity of dental caries. The heterocontrol, which is the monitoring of fluoride concentration in supply water, should be done periodically to ensure the effectiveness and safety of fluoridation. Dental fluorosis mostly affects families living in high-fluoride belt areas with excessive amount of fluoride present in drinking water (Gupta *et al.,* 2017), therefore, we also decided to analyze if there was a distribution pattern of dental fluorosis and evaluate it spatially. The spatial analysis of the distribution of dental fluorosis among preschool children in the city of Alfenas indicated an occurrence of intraurban differentials. However, it is important to emphasize that this cluster presents only very mild cases. Although this finding should not raise a concern for the evaluated children, a close monitoring of younger children living in this area should be performed. This is the first study to investigate dental fluorosis in this population and its spatial distribution.

The use of spatial analysis allows to identifyif there is a polarization process of this dental conditions to identify vulnerable populations and target group of patients. Additionally, to identify spatial inequalities and visualize them on maps enables more efficient organization of health services. In addition to optimizing the allocation of financial and human resources based on the characteristics of each geographic area, this process is essential for guiding preventive and interventional programs to reduce inequalities (Ribeiro *et al.,* 2014; Pereira *et al.,* 2010). Briefly, our study explored the prevalence and the special distribution of dental fluorosis in school children from Alfenas. Geographical information system provides a broad source of tools for exploring oral health data. These systems can be defined as a set of tools for the analysis and interpretation of spatial data (Graham *et al.,* 2004; Ruankaew, 2005). In conclusion, the prevalence of dental fluorosis is low in school children from Alfenas and the results from the spatial analysis revealed geographic differences.

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