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Geographic information system in assessing bruxism among school children

Sistema de informação geográfica na avaliação de bruxismo em escolares

Sistema de información geográfica en la evaluación del bruxismo en escolares

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Abstract
The aim of this study was to evaluate the distribution profile of childhood bruxism using Geographic Information System in the city of Alfenas, in southwest Brazil. The study included schoolchildren of both sex attending public schools in the city of Alfenas - Minas Gerais, Brazil. During clinical examination, the presence or absence of bruxism for each child was recorded. For statistical analysis, Chi-square test and t test was used to compare sex and age distribution according to the groups, with an established alpha of 5%. A Geographic Information System was used to perform the geoprocessing procedures. The home addresses were geocoded on a map to apply the kernel density estimator. The final sample includes 353 children, in which 44 presented signs of bruxism. Age and gender were not associated with bruxism ($p>0.05$). The spatial analysis of the distribution of childhood bruxism in the city of Alfenas indicated an occurrence of a hotspot. In conclusion, there is an intraurban differentials in childhood bruxism in the city.
Keywords: Geographic information systems; Oral health; Bruxism.

Resumo

O objetivo deste estudo foi avaliar o perfil de distribuição do bruxismo infantil utilizando um Sistema de Informação Geográfica na cidade de Alfenas, no sudoeste do Brasil. Participaram do estudo escolares de ambos os sexos de escolas públicas da cidade de Alfenas - Minas Gerais, Brasil. Durante o exame clínico, foi registrada a presença ou ausência de bruxismo para cada criança. Para a análise estatística, o teste do Qui-quadrado e o teste t foram utilizados para comparar a distribuição por sexo e idade de acordo com os grupos, com alfa estabelecido de 5%. Um Sistema de Informação Geográfica foi utilizado para realizar os procedimentos de geoprocessamento. Os endereços residenciais foram geocodificados em um mapa para aplicar o estimador de densidade dos núcleos. A amostra final incluiu 353 crianças, das quais 44 apresentavam sinais de bruxismo. Idade e sexo não foram associados ao bruxismo (p>0,05). A análise espacial da distribuição do bruxismo infantil na cidade de Alfenas indicou a ocorrência de um *hotspot*. Em conclusão, existe um diferencial intraurbano no bruxismo infantil na cidade.

Palavras-chave: Sistemas de informação geográfica; Saúde bucal; Bruxismo.

Resumen

El objetivo de este estudio fue evaluar el perfil de distribución del bruxismo infantil utilizando un Sistema de Información Geográfica en la ciudad de Alfenas, en el suroeste de Brasil. Participaron del estudio escolares de ambos sexos de escuelas públicas de la ciudad de Alfenas - Minas Gerais, Brasil. Durante el examen clínico se registró la presencia o ausencia de bruxismo de cada niño. Para el análisis estadístico se utilizó la prueba de chi-cuadrado y la prueba t para comparar la distribución por sexo y edad según los grupos, con un alfa establecido del 5%. Se utilizó un Sistema de Información Geográfica para realizar los procedimientos de geoprocesamiento. Las direcciones residenciales se geocodificaron en un mapa para aplicar el estimador de densidad central. La muestra final incluyó a 353 niños, 44 de los cuales tenían signos de bruxismo. La edad y el sexo no se asociaron con el bruxismo (p>0,05). El análisis espacial de la distribución del bruxismo infantil en la ciudad de Alfenas indicó la ocurrencia de un *hotspot*. En conclusión, existe un diferencial intraurbano del bruxismo infantil en la ciudad.

Palabras clave: Sistemas de información geográfica; Salud bucal; Bruxismo.

1. Introduction

Geographic Information Systems (GIS) is a system increasingly accepted and used in health science and epidemiological studies (Barros et al., 2020; Dias et al., 2020; Ferronato et al., 2021; Pieri et al., 2021; Macedo et al., 2021; Nayak et al., 2021; Jardine et al., 2022). Studies using this type of strategy have been increasing in dental research and showing the importance of the use of GIS also in oral health promotion (Pereira et al., 2010). GIS can provide important information regarding the geographic spatial distribution of diseases and health conditions (Graham et al., 2004; Ruankaew, 2005; Nayak et al., 2021). In fact, the knowledge regarding the geographic distribution of the diseases is necessary to decision making in epidemiological surveillance systems, (Ribeiro et al., 2014), including oral diseases (Nayak et al., 2021).

Bruxism is a movement disorder characterized by grinding and clenching of teeth. Bruxism is more common during childhood, although it is not unusual in adulthood, however, it is uncommon in the elderly (Manfredini et al., 2013). The occurrence of childhood bruxism is high and can achieve 40.6% (Lobbezoo et al., 2013). Teeth grinding is an activity particularly important in dentistry because of breakage of dental restorations, tooth damage, association with headache and temporomandibular disorders (Lavigne et al., 2008). Bruxism is a multifactorial condition in which many factors are involved, including environmental factors (Shetty et al., 2010).

Although many external factors can be involved in the occurrence of bruxism in children, many of have been poorly explored so far. According to the World Health Organization (WHO, 2021), Geospatial technology in the form of GIS allows spatial representation of data to improve public health planning and decision-making. Thus the aim of this study was to evaluate the distribution profile of childhood bruxism using Geographic Information Systems in the city of Alfenas in southwest Brazil.

2. Methodology

The present study is part of a larger project that evaluate oral and dental conditions/diseases in school children from Alfenas, Minas Gerais state – Brazil (Barbosa et al., 2020; Barbosa et al., 2021; Reis et al., 2021,a,b,c,d).

This study was previously approved by the Local Human Ethics committee (protocol: 78568217.7.0000.5142). Informed consent were obtained from all legal guardians and age appropriate assent documents were also used in agreement with the ethical norms and standards in the Declaration of Helsinki.

Schoolchildren of both sex registered in 4 public schools in the city of Alfenas-MG were included in the study. In the anamnesis and clinical examination, all biosecurity standards and institutional safety procedures were used. Patients who refused to participate, those who did not have a signed term of informed consent and those with systemic diseases were excluded from the study.

All the schoolchildren received a brush kit, containing toothbrush, toothpaste and dental floss, and were instructed during tooth brushing previously the dental examination. The schoolchildren's anamnesis and clinical examination were performed by one single examiner (dentist) trained and calibrated (Kappa intra-examiner=0.87) as previously reported[1-10].

The data collection was performed in two phases: questionnaire/anamnesis and clinical examination. The same dentist conducted the interviews, the collection of the questionnaires and clinical examination. Patients were considered with bruxism (bruxers) when showed signs and symptoms related to bruxism, such as dental wear facets (Lobbezoo et al., 2013). The schoolchildren were examined at the school while lying on desks under natural light and using a dental mirror.

2.1 Data analysis

For statistical analyses, GraphPad Prism 8.0 software (Prism version 8.0, GraphPad, LaJolla, USA) used GraphPad Prism 5.0 software to analyze data. Chi-square test was used to compare gender distribution according to bruxers and non-bruxers groups and t test was used to compare age distribution according to groups. An alpha of 5% was considered statistically significant ($p<0.05$).

GIS (Geographic Information System) was used to integrate the tabulated and spatial data and execute the geoprocessing procedures within the software QGIS (2.8.1). The software QGIS (2.8.1) created the spatial analysis and maps. Each patients' home address was geocoded, allowing 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 enables to better understand the data distribution.

3. Results and Discussion

The final sample includes 353 children age ranging between 8 and 11 years.

The prevalence of bruxism was 12.5% (n=44). The gender and age distribution according to the presence and absence of bruxism is presented in the table 1. Age and sex were not associated with bruxism (*$p>0.05$*). There was no sex preference in bruxism (Odds ratio =1.08; Confidence interval 95% 0.57 – 2.06).

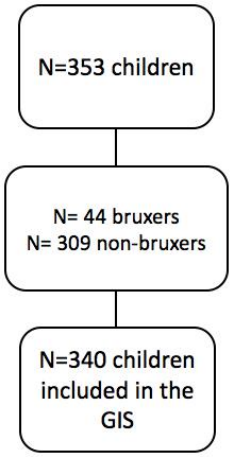
Table 1. Population characteristics according to bruxers and non-bruxers.

Variables	Bruxers	Non-bruxers	*p-value*
Age			
Minimum - maximum	8 - 10	8 - 11	*0.073**
Mean (SD)	8.9 (±0.9)	8.6 (±0.7)	
Gender			
Male n (%)	22 (50%)	148 (48%)	*0.872#*
Female n (%)	22 (50%)	161 (52%)	

Note: SD means standard deviation. *Chi-square was used. #t test was used. Source: Authors (2021).

A total of 340 from the 353 evaluated children's records were used for the geocoding process (Figure 1). Incomplete address information provided by the legal guardians during interviews and areas not officially registered with the City Hall determined the nonidentification from 13 (3.7%) addresses.

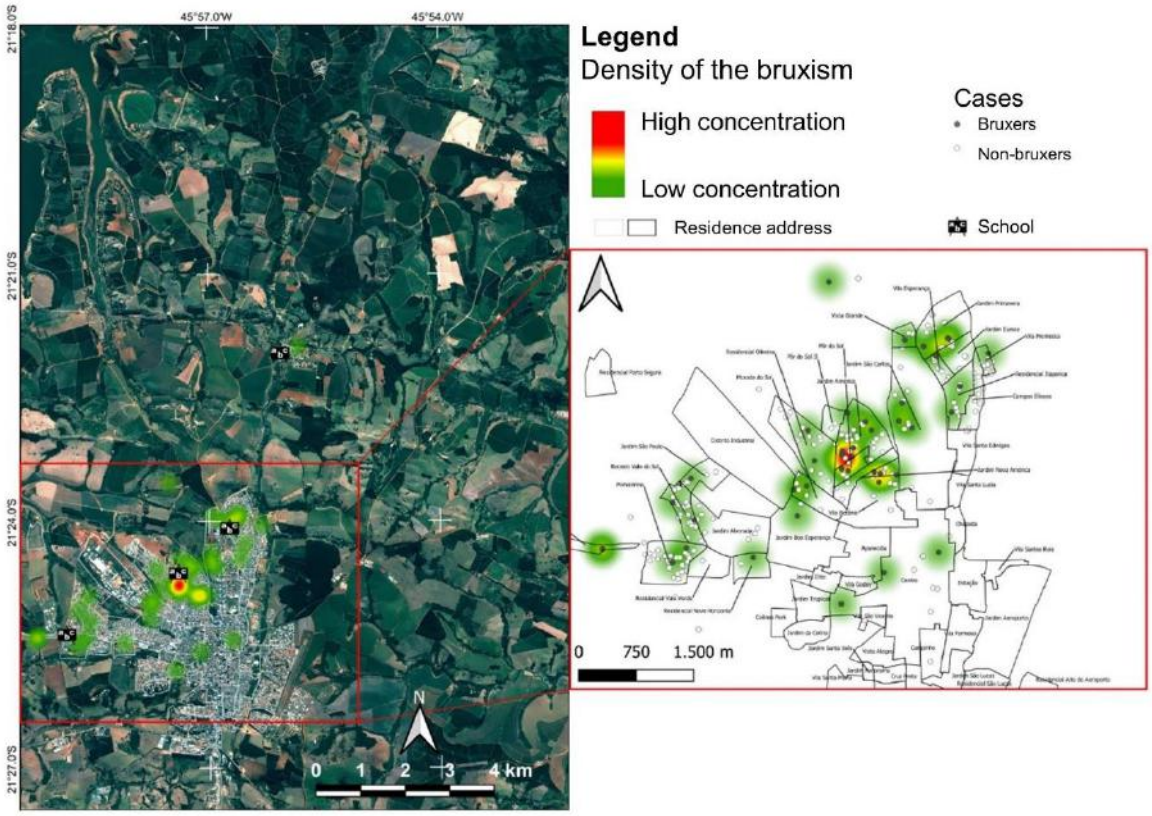
Figure 1. Flowchart of the included children.



Source: Authors (2021).

Figure 2 demonstrated the distribution of bruxism in the schoolchildren based on their residence address and a cluster was observed.

Figure 2. Residences of schoolchildren investigated in the Geographic information system stage.



Source: Produced by the authors using map base from IBGE (Brazilian Institute of Geography and statistics) and CBRS satellite Image.

4. Discussion

For a better understanding of the oral health conditions and oral disease etiological factors, it is interesting to explore the relationships between space and community oral health. Geographic space is actually understood as a receptor of social processes and an activator of these processes (Moreira et al., 2007). Although psychosocial influences such as stress or anxiety are well known involved in the etiology of childhood bruxism (Lobbezoo et al., 2013) and stress levels and anxiety can be influenced by the child's environment, to the best of our knowledge, this is the first study that investigated the special distribution of bruxism.

Detailed analysis of the spatial distribution of oral conditions, such as childhood bruxism, is fundamental for the allocation of resources to areas with the greatest social privation, leading to greater efforts to address the problems (Antunes et al., 2002), these is especially true in conditions such as bruxism, which can have different triggers involved and an inequality in the prevalence of the disease.

The childhood prevalence of bruxism in schoolchildren from public schools from Alfenas was 12.5%. This prevalence ranges according to the studies (Lobbezoo et al., 2013), it is possible that our study underrepresent the cases, once bruxism was considered only when clinical evidence was possible to observe. However, although it is possible that the true prevalence is higher, the spatial distribution should be similar to the one identified here. GIS is valuable tool to explore the inequalities and contributes to a better understanding between the environment and health (Cutchin, 2007; Nayak et al., 2021).

A sex difference was not observed in our study, in which boys and girls were similarly affected. A literature review also reported that such difference among sex does not exist (Shetty et al., 2010). Therefore, similar preventive and treatment approaches can be used for both sexes.

Although GIS is very useful in public health, it is still rarely used, and even more uncommon in dental researchers. Our study explored a common oral condition and revealed geographic differences in childhood bruxism. These information can be used to improve health services with the understanding of the locations where the problems occur more frequently, facilitating the process of planning and monitoring health services. In fact, the most adequate strategies for evaluating and intervening in the process of inequality in the distribution of many oral conditions have been discussed (Campus et al., 2003; Antunes et al., 2004; Nayak et al., 2021), with emphasis on the population approach (Carvalho & Souza-Santos, 2005).

Briefly, our study explored the special distribution of childhood bruxism in schoolchildren from public schools in Alfenas-Brazil. Geographical information system provides a broad source of tools for exploring dental health data in order to identify clusters. These systems can be defined as a set of tools for the analysis and interpretation of spatial data (Graham et al., 2004; Ruankaew, 2005). Our study has some limitations, therefore, further studies designs can also use this technology, not only to identify interurban differences, but also to the associated factors, such as social, economic and environmental factors, and pathogenic agents; once GIS allows the hierarchy of complexity and multiple interactions between the different levels studied (Moreira et al., 2007).

5. Final Considerations

Our data reinforce the hypothesis that the variables of the districts are involved in the childhood bruxism in the municipality. The visualization of the map revealed geographic differences in childhood bruxism in Alfenas - Brazil.

Future studies are necessary to identify the factors that also presents similar spatial distribution that could explain the identification of the hotspot, such as family income, socioeconomic conditions, concentration of crime and urban violence and characteristics of the family and school micro-environment. Additionally, the geographic distribution of the factors bruxism trigger factors, such as anxiety and stress levels should be explored.

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