



# Epidemiological profile of caries and need for dental extraction in a Kaingang adult Indigenous population

## *Perfil epidemiológico de cárie e necessidade de extração dentária em uma população Indígena Kaingang adulta*

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**ABSTRACT:** *Introduction:* The epidemiological profile of dental caries for Indigenous Peoples is complex and heterogeneous. The oral health of the Kaingang people, third largest Indigenous population from Brazil, has not been investigated so far. *Objective:* The purpose of this study was to assess the prevalence and severity of dental caries, in addition to the associated factors of the need of dental extraction among Kaingang adult Indigenous. *Methods:* A cross-sectional oral health survey was conducted among Kaingang adults aged from 35 to 44 years old living in the Guarita Indigenous Land, Rio Grande do Sul. Clinical exams were performed to analyze the conditions of dental crown and treatment needs. *Results:* A total of 107 Indigenous adults were examined. Mean DMFT score was 14.45 ( $\pm$  5.80). Two-thirds of the DMFT score accounted for missing teeth. Anterior lower dentition presented the highest rates of sound teeth, whereas the lower first molars had the lowest. Need for dental extraction was observed in 34.58% and was associated with village location, time of last dental visit, and higher number of decayed teeth. *Conclusion:* The high frequencies of caries and missing teeth observed in this population indicate a lack of adequate assistance. It is essential to discuss health care models in order to combat avoidable social and health injustices.

**Keywords:** Oral health. Indigenous population. Indians, South American. Dental caries.

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**RESUMO:** *Introdução:* O perfil epidemiológico de cárie dentária dos povos indígenas é complexo e heterogêneo. A saúde bucal do povo Kaingang, terceira maior população indígena do Brasil, ainda não foi investigada. *Objetivo:* O objetivo deste estudo foi avaliar a prevalência e severidade de cárie, além dos fatores associados à necessidade de extração dentária entre adultos Indígenas Kaingang. *Métodos:* Foi realizado um inquérito de saúde bucal entre adultos Kaingang com idade entre 35 e 44 anos residentes na Terra Indígena Guarita, Rio Grande do Sul. Exames clínicos foram realizados a fim de analisar as condições da coroas dentárias e as necessidades de tratamento, seguindo os critérios e diretrizes da Organização Mundial da Saúde e da Pesquisa Nacional de Saúde Bucal SB Brasil 2010. *Resultados:* O total de 107 Indígenas Kaingang foi examinado. O índice de dentes cariados, perdidos e obturados (CPOD) médio observado foi de 14,45 ( $\pm 5,80$ ). Dois terços do escore do índice foram compostos do componente “perdidos”. A dentição inferior anterior apresentou as maiores taxas de dentes hígidos, enquanto os primeiros molares inferiores apresentaram as menores. Necessidade de extração dentária foi observada em 34,58%, sendo associada com a localização da aldeia, tempo da última consulta odontológica e maior número de dentes cariados. *Conclusão:* As altas frequências de cárie não tratada e dentes perdidos observados nessa população indicam a falta de assistência adequada. É necessário discutir modelos de atenção à saúde para combater iniquidades sociais e de saúde.

*Palavras-chave:* Saúde bucal. População Indígena. Índios sul-americanos. Cárie dentária.

## INTRODUCTION

Indigenous populations worldwide generally present a context of social and economic disadvantage in relation to their non-indigenous counterparts, with effects to their health status<sup>1,2</sup>. The oral health gap between indigenous and non-indigenous is expressive. Irrespective of country, individuals belonging to native groups present higher prevalence rates of untreated dental caries, missing teeth, inadequate dentition, periodontal disease, and fewer restored teeth<sup>3,4</sup>.

The Indigenous population from Brazil is estimated at 817 thousand individuals (0.26% of the national population) living across all regions of the national territory. Such universe comprises 305 different ethnic groups exhibiting highly diverse sociocultural characteristics and epidemiological profiles<sup>5</sup>. Most of the available information regarding the oral health status of the Brazilian Indigenous populations were obtained from cross-sectional studies conducted sporadically since the 1960s, generally in the Amazonian region<sup>6</sup>. The oral health profile of the Kaingang people, who inhabits the Southern region and represents the third largest national Indigenous population, has not been investigated so far.

The Kaingang ethnic group is estimated at 45,460 individuals distributed in more than 30 communities over four states (São Paulo, Paraná, Santa Catarina and Rio Grande do Sul). There are at least 11 Kaingang territories in the northwestern region of Rio Grande do Sul, all interconnected by paved roads and delimited by municipalities with very different socio-cultural characteristics<sup>7</sup>. Guarita is the largest Indigenous Land of Rio Grande do Sul, and is recognized as a territory historically occupied by the Kaingang people.

The Kaingang economy is based on small-scale agriculture and traditional handicraft activities. Families present a considerable dependence on government programs such as the conditional cash-transfer scheme *Bolsa Família*, public housing, and the distribution of basic-needs grocery packages. Although many aspects of the Kaingang culture and way of living have been affected by these interferences, including their epidemiological profile, this ethnic group has managed to maintain their language and most of their socio-cultural organization<sup>7,8</sup>.

The epidemiological profile of the Kaingang people is complex, presenting a coexistence of infectious and chronic conditions such as tuberculosis, cancer, malnutrition, and obesity<sup>7,9</sup>. On the other hand, the lack of epidemiological data regarding the oral health status of the Kaingang people undermines the construction of culturally adapted preventive strategies and adequate levels of comprehensive care for this population.

Data from the 2010 National Oral Health Survey shows that Brazilian urban Indigenous adults present a mean Decayed, Missing and Filled teeth (DMFT) index of 17.1, similar to the non-indigenous urban population (16.9)<sup>10</sup>. Nevertheless, recent studies conducted with Indigenous adults living in traditional territories demonstrate a rather heterogeneous situation, with DMFT ranging from 13.4 to 20.2<sup>11,12</sup>. Additionally, vulnerable groups tend to be significantly affected by tooth loss, a strong manifestation of oral health inequalities<sup>13,14</sup>. Although it is not usually investigated in surveys conducted with Indigenous populations, assessing the need for dental extraction might provide important parameters to evaluate the oral health status and efficiency of the health care delivered for these populations.

Thus, the aim of this study was to assess the prevalence and severity of caries, in addition to the associated factors of the need of dental extraction among Kaingang adult Indigenous living at the Guarita Indigenous Land.

## **METHODS**

This study was conducted at the Guarita Indigenous Land, situated in the state of Rio Grande do Sul, Southern region of Brazil.

## **ETHICAL ASPECTS**

The research project was previously presented to the local indigenous leaders, who agreed to its realization. Human ethics research approval was granted by the National Research Ethics Committee.

## **LOCAL SETTING**

The Guarita Indigenous Land encompasses an area of 23,406 hectares belonging to three different municipalities (Tenente Portela, Redentora e Erval Seco). The population

is estimated by the Indigenous Health Special Secretary (SESAI) at five thousand people distributed in a total of 12 villages. The adult population aged 35 to 44 years is estimated at 300 people. The infrastructure of all 12 villages includes a Basic Health Unit, electric energy network, and an elementary public school. Available drinking water is extracted from local drilled wells and does not receive the addition of fluoride. Access to all villages is carried out by land, and the distances to the Indigenous Health Office vary between 2 and 40 kilometers.

## STUDY DESIGN

An oral health survey was conducted among Kaingang adults living in all villages of the Guarita Indigenous Land between February and August 2017. As recommended by the World Health Organization (WHO) as the age bracket to evaluate the oral health status of adults, only individuals aged from 35 to 44 years old were included in the study. All households were visited and individuals within the selected age group were invited to take part in the research by signing a written consent form. Fourteen individuals refused to participate. In addition to their native languages, all participants were Portuguese speakers. Oral examinations were performed by a single examiner (GHS) previously trained in outdoor areas near the houses of the participants, under indirect natural daylight, and using sterilized clinical instruments (flat mouth mirror and community periodontal index probe) and individual protection equipment. Examiner calibration was conducted in a sub-sample of 10 participants in order to obtain the intra-examiner agreement coefficient (Kappa = 0.817). After examinations, participants answered a structured questionnaire in order to characterize the population regarding the use of dental services, and socio-demographic aspects.

## VARIABLES

Conditions of dental crowns were assessed through DMFT index accordingly the methodology recommended by WHO to oral health surveys<sup>15</sup>. Treatment need was evaluated based on the guidelines established for the 2010 Brazilian National Oral Health Survey, which included the need of fillings (one and two or more surfaces), endodontic treatment, dental extraction, and sealants<sup>16</sup>.

The frequency of consumption of soft drinks, sweets, pasta, and canned food was measured on a numerical scale ranging from 0 (never) to 3 (every day). Scores 0 and 1 (never and rarely, respectively) were classified as scant consumption, and scores 2 and 3 (often and every day, respectively) were classified as regular consumption. When two or more food groups were categorized as regular consumption, the overall frequency of industrialized food was categorized as high. When only one or none food group was

classified as regular consumption, the overall consumption of industrialized food was categorized as low.

Age was the only continuous variable analyzed. Education was classified as up to 4 years of schooling or more than four years. Half of the 2017 Brazilian minimum wage, converted in US Dollars (mean exchange rate in August 2017: R\$ 3.15 = US\$ 1.00), was adopted as the cutoff point to classify the monthly household income. Time of last dental visit was categorized either as within the previous two years or in three or more years. Village location was classified as Tenente Portela or Redentora/Erval Seco. This division is due to the fact that the municipality of Tenente Portela provides a Center of Dental Specialties (*CEO — Centro de Especialidades Odontológicas*) in the public healthcare network, whereas Indigenous living in the villages located in Redentora and Erval Seco are referred for specialized dental treatment in a municipality located 116 km away from the Indigenous Land. Participants were also classified according to gender, whether they received the *Bolsa Família* cash transfer program benefit, and history of dental pain in the previous six months. Clinical variables were dichotomized based on the observed means for the population.

The dependent variable analyzed was the need for dental extraction, assessed as the presence of one or more teeth with indication of extraction<sup>16</sup>.

## STATISTICAL ANALYSIS

The Shapiro-Wilk test was employed to assess data normality. Descriptive analyses were performed in order to obtain mean  $\pm$  standard deviation (SD) of the DMFT components and total scores. Frequencies of sound teeth were calculated for each dental element. Poisson regressions with robust variance were employed to verify whether the selected variables (age, gender, municipality, education, income, *Bolsa Família* cash transfer program, industrialized food consumption, and clinical parameters) were significantly associated with the need for dental extraction. Variables with a level of significance lower than 0.20 in the bivariate analysis were included in the final model. Associations were considered statistically significant in the multivariate analysis at the 5% probability level ( $p \leq 0.05$ ). All analyses were performed using STATA 12.0 software (StataCorp, College Station, Texas, USA).

## RESULTS

A total of 107 individuals was examined, corresponding to approximately 35.7% of the universe of individuals aged 35–44 years old living in the Guarita Indigenous Land. The distribution of the participants regarding sociodemographic characteristics is presented in Table 1.

Prevalence of dental caries was 91.6% ( $n = 98$ ). Mean DMFT score of 14.45 ( $\pm 5.80$ ) was observed. There was no participant with DMFT = 0. The mean number of missing teeth corresponded to 65% of the total score, whereas the filled component accounted for only 5.6% (Table 2). When considering restored teeth that present carious lesions, primarily categorized

as decayed, the filled component reaches a mean number of 1.21 ( $\pm$  1.56). The need for at least one type of treatment was observed in 92.5% of the participants ( $n = 99$ ). Frequency of need for dental extraction was 34.6%, need for one surface filling was 71%, need for two or more surfaces filling was 57.9%, and need for endodontic treatment was 13.01%.

The distribution of sound teeth (excluding those decayed, missing and filled) is shown in Figure 1. Lower anterior teeth presented the higher rates of healthy dental elements, ranging from 88 to 94%, in contrast with the lower first molars, with frequencies ranging from 11 to 15%. Greater differences were observed between lower and upper central incisors.

Regular consumption of soft drinks was observed in 34.6%, sweets in 30.8%, pasta in 54.2%, and canned food in 9.4%. The overall industrialized food consumption was classified as high in 35.5% of the participants.

Table 3 shows the associations between the need for dental extraction and the independent variables. In the bivariate analysis, gender, village location, time of the last dental visit, and number of decayed teeth presented a probability level lower than 20% ( $p \leq 0.20$ ), and were included in the final model. After adjustment for the other selected variables, need for dental extraction

Table 1. Sociodemographic characteristics of Kaingang adults from the Guarita Indigenous Land.

Variable	Category	N	%	DMFT ( $\pm$ SD)
Age	Mean $\pm$ SD	39.43 $\pm$ 3.32	100.00	14.45 ( $\pm$ 5.80)
Gender	Female	81	75.70	15.18 ( $\pm$ 5.91)
	Male	26	24.30	12.31 ( $\pm$ 5.05)
Village Location	Redentora/Erval Seco	73	68.22	14.52 ( $\pm$ 6.28)
	Tenente Portela	34	31.78	14.41 ( $\pm$ 4.77)
Schooling	Up to four years	51	47.66	13.96 ( $\pm$ 5.53)
	Five or more years	56	52.34	14.98 ( $\pm$ 6.09)
Household Income	Up to US\$ 147	44	51.16	14.89 ( $\pm$ 6.07)
	US\$ 148 or more	42	48.84	14.93 ( $\pm$ 5.65)
Bolsa Família*	No	28	26.17	12.82 ( $\pm$ 4.94)
	Yes	79	73.83	15.07 ( $\pm$ 6.02)
Last dental visit	Within last two years	78	72.90	14.63 ( $\pm$ 5.19)
	Three or more years	29	27.10	14.10 ( $\pm$ 7.35)
Dental Pain	No	36	33.64	14.50 ( $\pm$ 6.49)
	Yes	71	66.36	14.48 ( $\pm$ 5.82)
Industrialized food	Low consumption	69	64.49	13.88 ( $\pm$ 5.64)
	High consumption	38	35.51	15.58 ( $\pm$ 6.06)

SD: standard deviation; DMFT: Decayed, Missing and Filled teeth; \*cash transfer program.

remained statistically associated with longer time of the last dental visit (PR = 1.47; 95%CI 1.18–1.66), higher number of teeth affected by dental caries (PR = 3.21; 95%CI 1.91–5.36), and

Table 2. Distribution of the Decayed, Missing and Filled teeth (DMFT) index composition and treatment needs of Kaingang adults from the Guarita Indigenous Land.

	Mean (%)	SD	Median	95%CI	Min.	Max.
<b>Index</b>						
Decayed	4.25 (29.4%)	3.04	4	3.67–4.82	0	17
Missing	9.38 (65%)	6.13	9	8.22–10.54	0	26
Filled	0.82 (5.6%)	1.35	0	0.56–1.07	0	7
DMFT*	14.45 (100%)	5.80	14	13.35–15.55	3	29
<b>Treatment needs</b>						
1 surface filling	1.97	1.99	2	1.61–2.37	0	11
2+ surfaces filling	1.15	1.37	1	0.89–1.42	0	6
Endodontic treatment	0.17	0.47	0	0.08–0.24	0	2
Extraction	0.87	1.97	0	0.50–1.26	0	14

Mean: mean number of teeth affected; SD: standard deviation; 95%CI: confidence interval of 95%; Min.: Minimum; Max.: Maximum; \*normally distributed (Shapiro-Wilk p = 0.482).

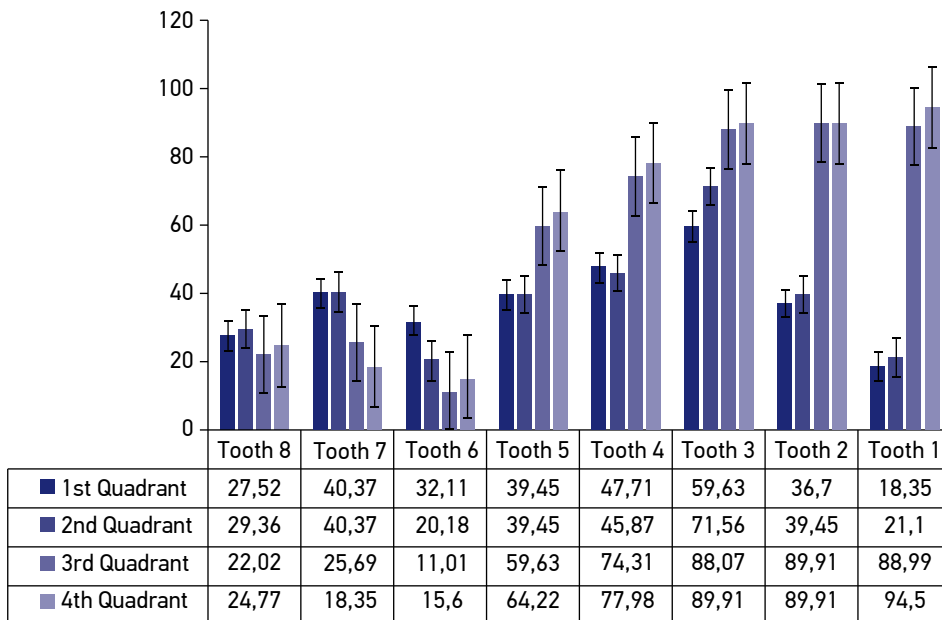


Figure 1. Frequency of sound teeth according to quadrants and dental elements.

villages located in *Tenente Portela* (PR = 0.51; 95%CI 0.28–0.93). The association of need for dental extraction and gender was attenuated and lost statistical significance ( $p = 0.104$ ).

Table 3. Unadjusted and adjusted analyses for need of dental extraction need and associated factors according to multiple Poisson regression.

Variables	Categories	Bivariate			Multivariate		
		PR	95%CI	p	PR	95%CI	p
Age	Years	0.95	0.88–1.03	0.217			
Gender	Female	1		0.002	1		0.104
	Male	2.12	1.30–3.46		1.46	0.92–2.32	
Villages	Redentora/ Erval Seco	1		0.059	1		0.029
	Tenente Portela	0.50	0.24–1.03		0.51	0.28–0.93	
Schooling (years)	≤ 4	1		0.510			
	≥ 5	0.84	0.49–1.42				
Income	≤ US\$ 147	1		0.332			
	≥ US\$ 148	0.74	0.40–1.36				
<i>Bolsa Família</i>	No	1		0.301			
	Yes	1.53	0.05–1.88				
Last dental visit (years)	1–2	1		0.018	1		0.004
	≥ 3	1.45	1.10–1.67		1.47	1.18–1.66	
Dental pain	No	1		0.848			
	Yes	1.06	0.60–1.85				
Industrialized food	Low consumption	1		0.419			
	High consumption	1.80	0.43–7.50				
Decayed (teeth)	≤ 4	1		0.000	1		0.000
	≥ 5	3.22	1.86–5.58		3.21	1.91–5.36	
Missing (teeth)	≤ 9	1		0.773			
	≥ 10	1.25	0.28–5.68				
Filled	None	1		0.249			
	≥ 1	0.71	0.40–1.26				
DMFT	≤ 14	1		0.500			
	≥ 15	1.20	0.71–2.03				

PR: prevalence ratio; 95%CI: confidence interval of 95%; DMFT: Decayed, Missing and Filled teeth.



## DISCUSSION

To the best of our knowledge, this was the first study to analyze the epidemiological profile of dental caries for the Kaingang indigenous people. Nearly all individuals were affected by untreated dental caries. Need for dental extraction was associated with village location, time of the last dental visit, and higher number of decayed teeth.

This study presented limitations inherent to the cross-sectional methodology such as the impossibility of drawing conclusions regarding cause and effect. Additionally, the normative assessment of need of dental extraction does not consider aspects of perceived health needs and subjective issues related to physical and social wellbeing. Conducting health surveys with hard-to-reach populations such as Indigenous communities imposes significant methodological challenges to sampling strategies traditionally employed in epidemiological research. The great dispersion of the Kaingang population throughout the territory and the adversities related to locating eligible participants might have affected the final sample size of this study. The relatively few numbers of observations in some of the variables investigated could have influenced the statistical significance of the associations. Even though the epidemiological data for Indigenous population might lack precision, their presentation and cautious discussion justifies their use in a critical analysis<sup>7</sup>. Although the number of participants in this study is relatively small, it is safe to infer that the presented data is representative of the adult population of the Guarita Indigenous Land. It also offers the first opportunity to analyze the epidemiological pattern of dental caries in this ethnic group.

The severity of dental caries observed in this study, expressed by the DMFT index, is close to the mean scores reported to the Indigenous peoples Guarani (13.9) and Xavante (14.25) in the 35–44 age bracket<sup>17,18</sup>. A study conducted with Sateré-Mawé and Tikuna Indigenous peoples from Brazil observed mean DMFT of 13.4 for adults aged 40 to 49 years old<sup>11</sup>. Higher DMFT scores were previously described among the Potiguara (16.43), Indigenous adults from the Xingu National Park (20.2), and non-Indigenous adults in Brazil (16.75)<sup>12,19,20</sup>.

Although the DMFT score observed for the Brazilian adult population in the 2010 National Oral Health Survey (*SB Brasil 2010*) is higher than the mean reported in the present study, non-Indigenous presented a balanced proportion of missing and filled teeth (46 and 45% of the total DMFT, respectively)<sup>20</sup>. Moreover, the decayed component of the DMFT index was significantly lower in the national sample (1.48), implicating in an expressively higher burden of the disease for the Indigenous from the Guarita Indigenous Land. These differences represent inequalities in the experience of dental caries most likely related to accessing adequate oral health care<sup>21</sup>.

The high missing:filled ratio observed in this study suggests that dental extraction was the main, if not the only, dental care practice available for this population for decades. It reflects the cumulative effect of dental caries and lack of adequate assistance throughout the lifespan. The reorientation of dental professional practices is crucial in order to treat

satisfactorily the substantial frequency of carious lesions and to develop preventive strategies to reduce the need for dental extractions. Mean number of teeth requiring dental extraction have been reported for the Brazilian adult population (0.32) and Indigenous adults from the Potiguara people (1.02)<sup>19,22</sup>.

The considerably low frequencies of sound teeth in the upper anterior dentition and posterior dentition (first and second molars) observed in Figure 1 suggest the occurrence of both aesthetic and functional oral impairments. In this study, dental caries presented a widespread distribution in the Kaingang adult population. Similarly high prevalence rates have been observed among South American native populations such as the Panares from Venezuela (71.4%), and the Mapuche-Huilliche from Chile (100%)<sup>23,24</sup>. Conversely, extremely low frequencies of dental caries were described in the 1960s and 1970s among the Indigenous populations from the Brazilian Amazon basin<sup>25,26</sup>. The Xavante group from the state of Mato Grosso, for instance, represents a classic case of well documented epidemiological transition towards a profile of increased experience of dental caries during the late 20<sup>th</sup> Century<sup>27</sup>.

The shift in the experience of dental caries and nutritional disorders in many Indigenous communities has been primarily attributed to changes in dietary patterns, with the progressive inclusion of industrialized and sugar-rich products in their food systems<sup>26,27</sup>. Actually, this phenomenon seems to be the result of the reduction of Indigenous territories, the destruction of traditional socio-political arrangements, and the decline of the biodiversity in the villages, rather than a presumed process of acculturation<sup>28,29</sup>. In this study, higher consumption of industrialized foods was not statistically associated with the need for dental extractions.

The lack of fluoride in the community water available at the Guarita Reservation may partially explain the morbidity of dental caries reported for this population. The majority of the households of the Guarita Indigenous Land receive water extracted from local drills. The water treatment is conducted by SESAI and is limited to the chlorination process. Hence, the addition of fluoride to the drinking water could be an important and feasible population-based strategy to prevent dental caries. Interventions that implemented community water fluoridation have been successful in reducing the incidence of the disease in Indigenous peoples, especially among children<sup>30,31</sup>. Yet, evidence points out that these measures are not sufficient to remove disparities in caries levels between Indigenous and non-Indigenous<sup>32,33</sup>.

Dental caries remains the main cause of tooth loss in most populations<sup>34</sup>. As expected, Indigenous with a higher number of decayed teeth, in addition to those which have not attended a dental appointment in the last two years, presented a greater prevalence of need of dental extraction. Whereas the lack of recent dental visits might contribute to aggravate the oral conditions, participants with need of dental extractions might also be prone to avoid dental appointments. A previous study conducted with the ethnic groups Kaiwoiá, Kadiwéu, Terêna, and Guarani observed a statistically significant association of need of dental extraction and poor self-evaluation of oral health<sup>35</sup>.

The primary health care (PHC) is the fundamental basis for the Indigenous Health Subsystem, operationalized mainly through the Family Health Strategy<sup>36</sup>. The participants examined in this study rely heavily on the dental services offered at the public health care facilities in each community due to financial restraints and geographic barriers. The lower frequency of need of dental extraction observed in the villages situated in the municipality of *Tenente Portela* indicates regional differences in the access to specialized dental treatment in the public health system. Individuals living in villages from Redentora / Erval Seco seem to face a heavier burden of financial and geographic barriers to access the CEO due to its distance from the Indigenous territory. An ecological study conducted with data of 48 Indigenous peoples from Brazil observed regional differences in the caries distribution regarding villages located in the Amazon region and availability of infrastructure<sup>37</sup>.

Accessing primary or secondary care services is far more complex than merely locating a facility within or close to the Indigenous villages<sup>38</sup>. Focusing exclusively on the spatial aspects of access, which are clearly relevant, tend to overlook many other important issues to Indigenous health such as the ability of the service to incorporate social and cultural demands, the provision of care by Indigenous staff, the promotion of spaces free of discrimination, the inclusion of the communities and families in the care process, and the type of care provided to the identified health needs<sup>39</sup>.

## CONCLUSION

Kaingang adult Indigenous presented high prevalence of dental caries and unmet treatment needs. Higher frequency of need of dental extraction was associated with regional differences in the access to specialized oral care, time of the last dental visit, and a higher number of decayed teeth. The development of policies and actions designed to tackle the structural factors associated with the occurrence of caries and tooth loss in Indigenous populations is paramount, otherwise, social and health inequalities will remain mostly unchanged.

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