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# Oral health inequality: characterization of the indigenous people Xukuru do Ororubá, Pernambuco, Brazil

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**Abstract** *This article aims to characterize Indigenous people aged 18-23 of the Xukuru do Ororubá ethnic group, Pernambuco state, Brazil, regarding the use of dental services, self-perceived oral health, oral hygiene practices and caries experience, and socioeconomic and demographic aspects. This population-based cross-sectional study is nested in a cohort study that started in 2010 and was conducted in the Indigenous territory in 2018. Oral examinations and questionnaires were conducted with 131 Indigenous people. Data were collected using Epi Info software and the SPSS 20.0 statistical program was used for descriptive statistics. R software was adopted to compare the caries experience results obtained with the National Oral Health Survey (SB Brasil 2010). The caries experience verified by the DMFT Index had a mean of 7.4, with the mean Index components corresponding to 22.8 for healthy teeth, 2.4 for decayed teeth, 0.2 for filled/carious teeth, 3.5 for filled teeth, and 1.4 for missing teeth. The oral health condition of Indigenous people is characterized by significant inequality when compared to the results of epidemiological surveys conducted in the country involving other population groups.*

**Key word** *South American indigenous, Health of indigenous peoples, Health status disparities, Oral health, DMFT index*

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## Introduction

Oral diseases can significantly affect health, well-being, and quality of life, especially when resources for prevention, diagnosis, and treatment are limited.[1] Since 1971, the World Health Organization (WHO) has standardized the conduct of epidemiological surveys in oral health and the measurement of caries experience using the DMFT Index. Measured by oral examinations, the Index expresses the count of Decayed, Missing, or Filled permanent teeth, ranging from zero (no caries) to 32 (total number of decayed, missing, and filled teeth), and its result can express disease severity[2].

Results from the application of this method have proven that caries and its severity are associated with a negative impact on quality of life. Untreated carious lesions affect daily activities such as chewing/eating and sleeping[3,4]. In characterizing oral health among Indigenous peoples, following WHO's established criteria ensures an international result comparability standard, which underpins the knowledge of the health profile of these peoples and underscores the magnitude of inequalities between Indigenous and non-Indigenous populations.

Caries remains a significant public health problem among Indigenous peoples in South America. Indigenous populations in Brazil, Chile, Uruguay, and Venezuela have shown higher average DMFT Index scores in all age groups studied than the general population of their respective countries. Among Indigenous people aged 15-19, results point to significant heterogeneous values, with a mean DMFT Index of 5.53 (2.97-8.09). The fourth national epidemiological survey on oral health in Brazil, SB Brasil 2010, was conducted in 2010. The survey found a mean DMFT Index of 4.25 (3.86-4.65) in the same age group[5] when examining the general Brazilian population without ethnicity/skin color criteria representation.

The Xukuru do Ororubá people, one of the largest Indigenous populations in northeastern Brazil and the largest in Pernambuco[6], were assessed for their oral health condition for the first time through an epidemiological survey conducted in 2010. Among those aged 10-14, the mean DMFT Index found was 2.38 (2.04-2.72), with about 27% of the caries experience-free group associated with contextual and individual aspects of the group[7].

To meet the WHO recommendation for regular epidemiological surveys every five or six years in the same community[2] and measure oral health inequalities, this study aimed to develop a new epidemiological survey with the Xukuru do Ororubá ethnic group to characterize individuals aged 18-23 regarding the use of dental services, self-perceived oral health, oral hygiene practices, caries experience, and socioeconomic and demographic aspects.

## Methods

### Study design

This observational, cross-sectional, population-based study is nested in a cohort initiated in 2010[7], conducted in the Xukuru do Ororubá Indigenous Land in Pesqueira, Pernambuco, Brazil. In 2018, the Xukuru do Ororubá ethnicity consisted of 7,857 people[8] distributed over 27,550 hectares of Indigenous Territory, organized into three socio-environmental regions (Serra, Ribeira, and Agreste) and 24 villages[9].

The target population was Indigenous residents of the Territory who were part of the baseline study sample conducted in 2010[7] when participants were aged 10-14. At that time, the age group was selected based on the population distribution's compatibility with the 12-year index age established by the World Health Organization (WHO) for caries monitoring[2]. The sample calculation aimed to represent 871 individuals aged 10-14, assuming a 20% caries prevalence, 5% precision, and 95% confidence interval (95% CI), with a 20% increase to mitigate losses and refusals. The sample obtained for the 2010 study was 233 participants. This investigation aimed to recruit the same participants, now aged 18-23, using residence in the Indigenous Territory as the inclusion criterion.

### Data collection

Using a search strategy in the Indigenous Health Care Information System (SIASI), the professional team of the Xukuru do Ororubá Base Hub identified the current location of the 2010 study participants and provided this information to the research team. With the location data and support from Indigenous Health Workers (AIS), the research team started data collection in December 2018, involving the application of questionnaires and oral examinations.

The closed-ended digital questionnaire, built on the Epi Info version 3.4 (2007) platform, en-

abled data collection using tablets (Samsung Galaxy Tab3). Field team training was required, followed by a pilot study in the Indigenous Territory involving 11 participants not included in the sample for data collection development. Data collection instruments and the work process were adjusted from the pilot study.

The fieldwork team consisted of two dental undergraduate students and two dentists working in pairs, each composed of an examiner and a recorder. Oral examinations followed WHO guidelines. The research relied on the sterilization center of the University of Pernambuco, Arcoverde campus, for washing and sterilizing instruments to comply with biosafety standards.

Calibration training was conducted before fieldwork for the oral examinations to have acceptable internal and external consistency parameters among the examiners. This theoretical and practical training method is employed to determine the level of agreement achieved (intra/inter-examiner) during data collection[2]. The agreement of the results obtained was verified using the Kappa Coefficient (k)[10]. Inter-examiner calibration achieved a mean of 0.84, with values ranging from 0.80 to 0.89, allowing the classification of optimal agreement among examiners. Intra-examiner calibration achieved a mean of 0.92, with values ranging from 0.85 to 1.00, also classified as optimal agreement, allowing the development of the epidemiological survey.

As the Xukuru do Ororubá Indigenous people use the Portuguese language in their daily routines, it was not necessary to adapt the questionnaire and the Informed Consent Form to a specific dialect. However, they were adjusted to cultural peculiarities, using clear and objective language. The field team conducted the examination and interview in a private location within the household to minimize the risk of participant embarrassment.

Before the oral examinations, participants received an oral hygiene kit associated with fluoride application and guidance on oral hygiene and diet. Fieldwork was coordinated with health services provided by the Indigenous Territory's Special Indigenous Health Secretariat (SESAI). Participants were referred to the nearest health service in cases of identified emergencies.

**Study variables**

The study's primary outcome was investigated using the DMFT Index, calculated from the oral examination, using standardized criteria and codes for the Index. The mean DMFT Index value was considered in the data analysis.

The other variables investigated were organized into three categories: individual, household, and oral health. Individual variables included age, gender, ethnicity/skin color, marital status, literacy, highest education level completed, principal occupation, availability of workers/employees, household income, participation in the *Bolsa Família* (Family Aid) Program, and lifestyle (tobacco, alcohol, and sugar consumption).

Household variables investigated included socioenvironmental region, village, housing conditions (floor material, roof, and external walls), number of rooms in the home, number of rooms used as bedrooms, number of residents per household, distribution of residents per room, water source, water treatment method, availability of a bathroom in the home, waste disposal, availability of electric lighting, and cooking method.

Oral health variables aimed to identify the use of dental services (dental appointments, last visit's characteristics, such as period, place, reason, scheduling method, waiting time between scheduling and care, prescription, and access to medications and tests, appointment evaluation, and dentist location in the Indigenous Territory), and self-perceived health and oral hygiene (need for dental treatment, toothache in the last six months, pain intensity, need for prosthesis, and oral hygiene practices with brush, fluoride toothpaste, and dental floss).

**Data analysis**

Data were reviewed to correct errors in the data collection instruments. Data analysis included descriptive statistics using IBM Statistical Package for the Social Sciences (IBM SPSS 20.0), with frequency distribution and description of central tendency and dispersion measures. Analyses were presented through graphs and tables. Inequalities between the verified oral health condition and results provided by SB Brazil 2010[11] for Brazil, the Northeast region, the Northeast inland region, and Recife (capital of Pernambuco) were measured using constructed graphs with R software.

**Ethical aspects**

The study was authorized by the Xukuru do Ororubá ethnicity through its Indigenous Health Council (CISXO) and the District Indigenous

Health Council (CONDISI), approved by the Research Ethics Committee (CEP) of IAM/FIOCRUZ under Opinion nº 2.839.310/2018 and the National Research Ethics Commission (CONEP) under Opinion nº 3.050.331/2018.

## Results

One hundred seventy-four of the 233 participants in the 2010 baseline study remained in the Territory in 2018, resulting in a sample of 131 Indigenous individuals, a 24.7% loss compared to the number of Indigenous people still living in the Indigenous Land. The results obtained from these participants are shown in three sections: Individual Characterization, Household Characterization, and Oral Health Characterization.

### Individual characterization

The research involved a sample of 131 participants distributed across the three socioenvironmental regions of the Indigenous Territory. The highest percentage of the sample was from the Serra region (39.7%), the most populous region, followed by the Agreste (38.9%) and Ribeira (21.4%) regions.

All participants self-identified as Indigenous of the Xukuru do Ororubá ethnic group. They were between 18 and 23 years of age, equally distributed between genders, with 50.4% female. The predominant marital status was single (55.7%), with all participants stating that they knew how to read and write and 80.2% reporting that they no longer studied. The highest schooling level completed by those who no longer studied was the third year of high school (45.8%).

Most participants worked in agriculture and animal husbandry (36.6%). All stated that they did not have workers or employees. The mean household income recorded the month before the interview was BRL 821.12 (SD = 651.5), and 73.3% of participants had a household family member who was a Bolsa Família Program beneficiary. When looking at the lifestyle of Indigenous people, most do not smoke (93.9%), do not consume alcoholic beverages (54.2%), and report consuming a regular amount of sugar (45%).

### Household characterization

The total number of residents per household corresponds to a mean of 4.5 inhabitants (SD = 2.0), with households characterized by 5.7 rooms on average (SD = 1.7), with 2.3 rooms on average used as bedrooms (SD = 0.9). The household residents' distribution per room obtained a mean of 0.8 (SD = 0.4).

The predominant physical structure among the households is formed by external masonry walls (88.5%), cement floors (74.0%), and clay roofs (93.9%). Most participants do not access tap water in their homes (59.5%) and mostly resort to water from wells, with or without a pump (29.0%), mainly applying treatment with sodium hypochlorite (87.0%) to drinking water. Most households have a bathroom (77.9%) inside the home (64.1%), with a septic tank for waste disposal (59.5%). Those without a bathroom in their homes predominantly use the bush (19.1%). Garbage collection is still not a reality for most of them, and most garbage is disposed of by burning (65.6%). Almost the entire population has electricity (99.2%) and the main form of cooking is by combining gas, coal, or firewood (51.9%).

### Oral health characterization

Oral health characterization was developed from four axes: "use of dental services", "self-perceived oral health", "oral hygiene practices", and "caries experience". The results of the first three axes are shown in Tables 1 and 2, constructed from the questionnaires applied, while the last axis refers to the results obtained in the oral examinations performed. Oral examinations among the Xukuru measured the caries experience using the DMFT Index, obtaining a mean of 7.4 (SD = 5.1), with a minimum value of 0 and a maximum of 27. In Graph 1, the Index distribution is presented similarly regarding gender, based on the median and quartiles, with three cases of discrepant values.

The mean number of permanent upper teeth was 14.5, and of permanent lower teeth, 14.4. Regarding prostheses, three participants (2.3%) said they used upper dentures, while no one reported using lower dentures. Graph 2 shows the distribution of the mean components of the DMFT Index (decayed, missing, and filled) of the healthy and decayed/filled elements of the current Indigenous epidemiological survey, together with the results for the 15-19 years age group examined by SB Brasil 2010. Recife clearly has the best oral health situation by place of residence, with the lowest mean DMFT Index (3.9) and decayed elements (1.3) and the highest mean of healthy teeth (25.0). Decayed/filled elements, which at some point received treatment but needed new

treatment, expressed the same value of 0.2 in all locations investigated.

## Discussion

"Health inequalities are systematic, avoidable and unfair differences in health outcomes that can be observed between populations, social groups within the same population or as a gradient in a population classified by social position"[12]. Since health inequalities are considered from a value judgment, researchers should initially produce knowledge capable of evidencing the inequalities between population subgroups[13].

Oral diseases knowingly affect the more impoverished and most marginalized groups in society unequally and are associated with socioeconomic status and social determinants of health[14]. However, since inequality is a central and constitutive characteristic of societies, studying it to promote understanding and overcome this reality[15] is still necessary.

This study focused on measuring oral health inequalities grounded on caries experience and ethnicity. Although reducing such inequalities has been established as a global objective[16], the characterization of the caries experience among the Xukuru do Ororubá in the 18-23 years age group classifies the disease's severity as very high based on the mean result obtained for the DMFT Index[17].

When applying methods to measure inequalities, a relevant aspect is data availability and comparability between different studies.[13] In this sense, data from SB Brasil 2010 were used as a reference. Compared with the age group studied here, the most similar group is adolescents aged 15-19 examined in 2010. Among the results compared by place of residence, the average DMFT Index in the Northeast inland region was the closest to that of Indigenous people, corresponding to 6.22[11]. Even so, Indigenous people still have worse results.

Another relevant issue in this process is the analysis of the DMFT Index based on its components. The inequality observed in the distribution of the decayed component, with almost twice as many decayed teeth per Indigenous person against the population of Recife, is likely a reflection of the difficulty of Indigenous people in accessing health services.

Sampaio *et al.*[18] studied the Potiguara, an Indigenous people in Northeastern Brazil, with results similar to those of the Xukuru. Among the

**Table 1.** Absolute and relative frequency of variables for the use of dental services. Pesqueira, 2018.

| Variables in the use of dental services | n | % |
|---|---|---|
| Have you had a dental appointment? (n = 131) | | |
| Yes | 129 | 98.5 |
| No | 2 | 1.5 |
| Period of last appointment (n = 129) | | |
| Less than one year | 105 | 81.4 |
| One to two years | 19 | 14.7 |
| Three years or more | 5 | 3.9 |
| Place of last appointment (n = 129) | | |
| Public service | 102 | 79.1 |
| Private service | 27 | 20.9 |
| Last appointment scheduling (n = 129) | | |
| Indigenous Health Worker | 83 | 64.3 |
| In person | 40 | 31.0 |
| Telephone/Internet | 6 | 4.7 |
| Waiting time between scheduling and care (n = 129) | | |
| 1-2 weeks | 115 | 89.1 |
| 3-4 weeks | 7 | 5.4 |
| 1-2 months | 4 | 3.1 |
| More than 2 months | 3 | 2.3 |
| Reason for last appointment (n = 129) | | |
| Treatment | 80 | 62.0 |
| Exodontia | 22 | 17.1 |
| Pain | 16 | 12.4 |
| Revision, prevention, or check-up | 11 | 8.5 |
| Medication prescribed in the appointment (n=129) | | |
| Yes | 25 | 19.4 |
| No | 104 | 80.6 |
| Access to medication prescribed by the SUS (n=25) | | |
| Yes | 21 | 84.0 |
| No | 4 | 16.0 |
| Tests prescribed in the appointment (n=129) | | |
| Yes | 8 | 6.2 |
| No | 121 | 93.8 |
| Access to tests prescribed by the SUS (n=8) | | |
| Yes | 4 | 50.0 |
| No | 4 | 50.0 |
| Appointment assessment (n=131) | | |
| Excellent / Good | 109 | 84.5 |
| Fair | 18 | 14.0 |
| Poor / Very poor | 2 | 1.6 |
| Knows where to find the dentist in the Indigenous Territory (n=131) | | |
| Yes | 130 | 99.2 |
| No | 1 | 0.8 |

Source: Authors.

**Table 2.** Absolute and relative frequency of self-perception and oral hygiene variables. Pesqueira, 2018.

| Self-perception and oral hygiene variables | n | % |
|---|---|---|
| Needs dental treatment (n = 131) | | |
| Yes | 102 | 77.9 |
| No | 29 | 22.1 |
| Toothache in the last 6 months (n = 131) | | |
| Yes | 32 | 24.4 |
| No | 99 | 75.6 |
| Pain intensity (n = 131) | | |
| 1-7 (up to median) | 21 | 16.0 |
| 8-10 (above the median) | 11 | 8.4 |
| No toothache | 99 | 75.6 |
| Satisfaction with teeth/mouth (n = 130) | | |
| Very satisfied/satisfied | 40 | 30.5 |
| Neither satisfied nor dissatisfied | 51 | 38.9 |
| Very dissatisfied/dissatisfied | 39 | 29.8 |
| Thinks that a prosthesis should be used or that the one being used should be replaced (n = 131) | | |
| Yes | 16 | 12.2 |
| No | 113 | 86.3 |
| Unknown | 2 | 1.5 |
| Performs oral hygiene (n = 131) | | |
| Yes | 131 | 100.0 |
| No | 0 | 0.0 |
| Brushes teeth (n = 131) | | |
| Yes | 131 | 100.0 |
| No | 0 | 0.0 |
| Uses toothpaste with fluoride (n = 131) | | |
| Yes | 131 | 100.0 |
| No | 0 | 0.0 |
| Uses dental floss (n = 131) | | |
| Yes | 65 | 49.6 |
| No | 66 | 50.4 |
| Frequency of daily brushing in the last month (n = 131) | | |
| 1 | 14 | 10.7 |
| 2 | 49 | 37.4 |
| 3 or more | 68 | 51.9 |

Source: Authors.

1,461 oral examinations performed, 507 were in the 15-19 age group, with a mean DMFT Index of 7.13, and 6.11% had a DMFT Index equal to zero. The mean number of healthy teeth was 21.83, decayed teeth 3.47, missing teeth 1.44, and filled teeth 1.94.

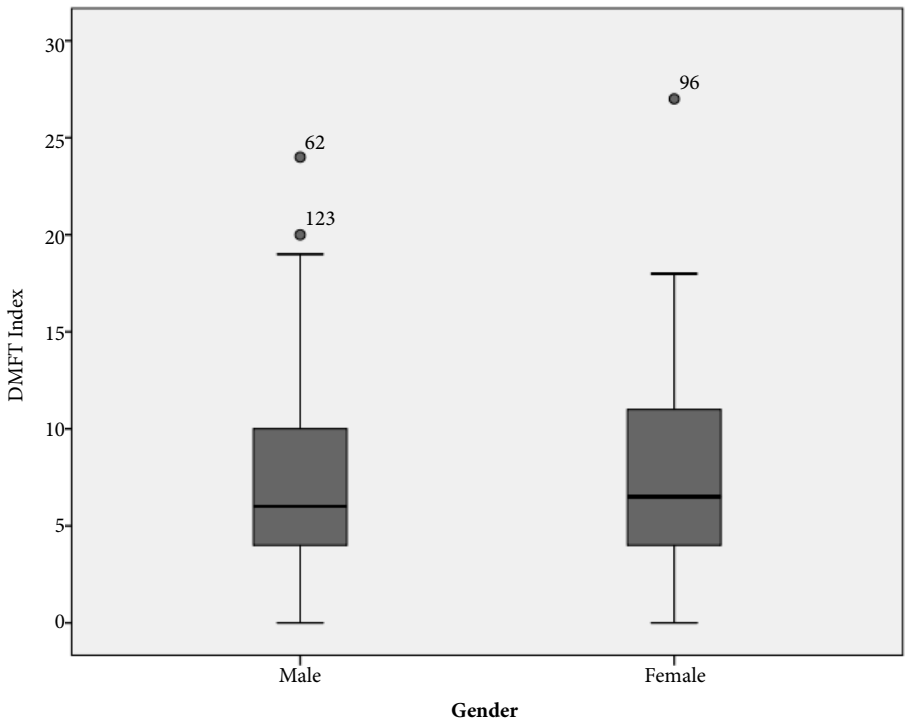
Oral disease among Indigenous people is complex and diverse[19]. The plurality of languages, customs, and cultures is also expressed in the relationship with oral health. The mean DMFT Index in the 15-19 years age group was 3.4[20] among the Guarani living in the Brazilian South. A much more favorable condition than that identified among the Xukuru can be explained by the Guarani's good access to treated water, whether through their supply network (artesian wells) or public supply, the use and availability of fluoridated toothbrushes and toothpaste, healthy eating habits, and the provision of specialized healthcare.

The Xukuru do Ororubá self-perceive their oral health condition as requiring dental treatment. This perception is very likely due to oral disease signs and symptoms. Aday and Forthofer[21] found that seeking health services among different social groups has different reasons: while ethnic-racial minorities and population groups with lower schooling levels visit the dentist in response to self-perceived oral problems, white individuals with higher schooling levels do so for preventive or follow-up appointments.

Among oral hygiene practices, dental floss use is not a consolidated habit among Indigenous people. In a study developed by Smith *et al*.[22] to identify perceptions, barriers, patient oral health education, and the effect on motivation to control interdental biofilm, participants were uncertain about the correct technique for using dental floss, believing that it causes aesthetic or health problems and pain and discomfort when using it. This characterization reveals the need for Oral Health Teams to reinforce their actions aimed at health education to incorporate demonstrations on the use of dental floss into traditional oral hygiene practices and motivational approaches that are easy for Indigenous people to understand.

Most dental services were used in the public sector, scheduled by the Indigenous Health Worker, and with available medications and tests, showing the relevance of primary health care (PHC) provided by SESAI. This setting includes the positive evaluation for the dental appointment, which shows a perceived quality in the care received. The results reveal that the Indigenous people feel comfortable regarding healthcare in this network of services, formed by professionals who know the Territory and the cultural specificities of these people.

Health behavior is a hybrid event built on a specific social and cultural framework. Multidisciplinary Indigenous Health Teams (EMSI) must understand it to influence Indigenous people's access to health services[23] positively. Health service providers discriminating against ethnic




**Graph 1.** Boxplot of the DMFT Index concerning the gender of the population studied. Pesqueira, 2018.

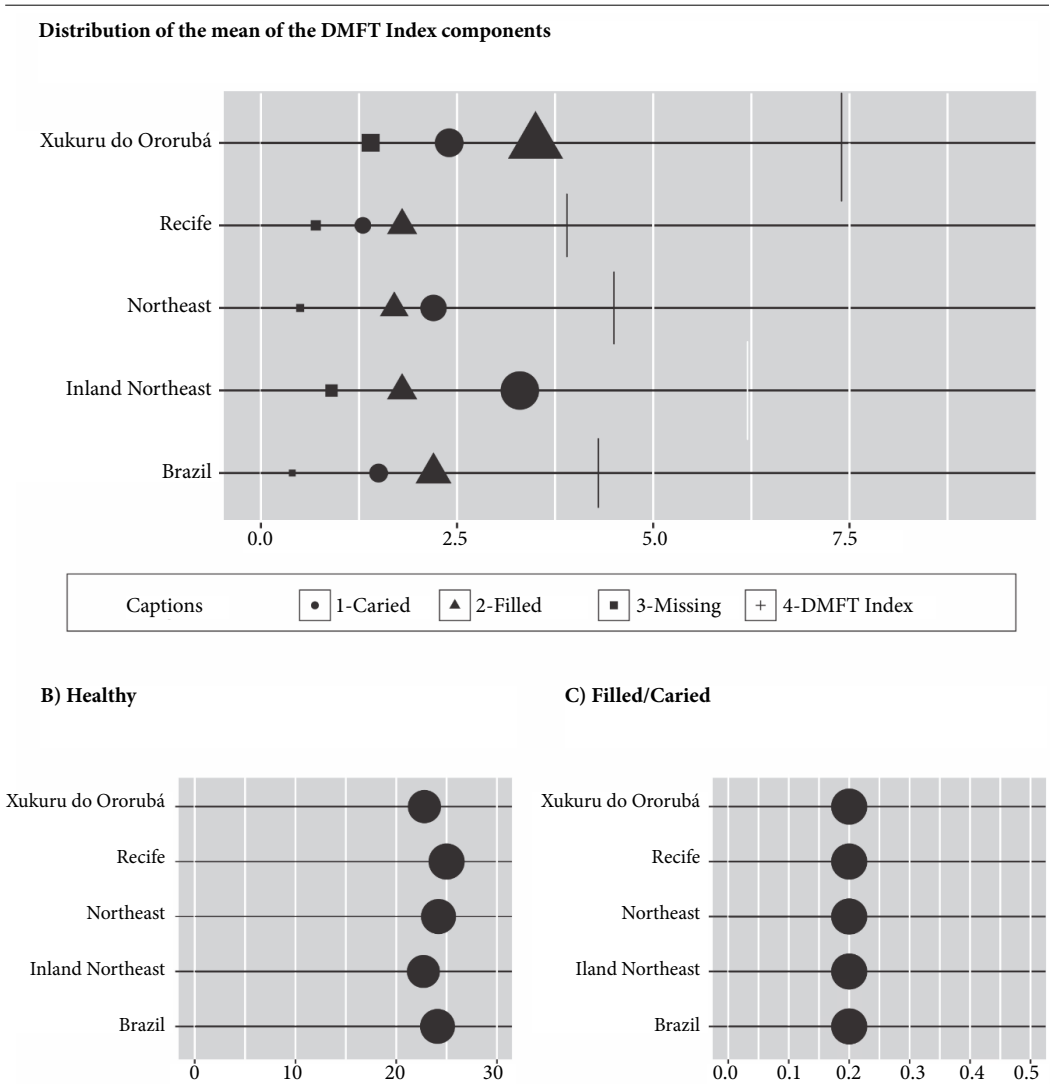
Source: Authors.

minorities is a primary barrier to access to quality healthcare in Latin America. These practices can dissuade people from seeking healthcare.[24] Therefore, a differentiated approach by health professionals, based on intercultural practices, needs to be implemented in the practices of those who provide healthcare to Indigenous peoples[25].

The mean number of decayed teeth that need treatment (2.4) and the self-perceived need for dental treatment reported by 77.9% of participants are normative and subjective measures that confirm barriers to access to dental care for the Xukuru people. Despite this, positive aspects are observed in the organization of this care network, with most respondents having already had a dental appointment (98.5%), the last appointment being less than a year ago (81.4%), and waiting time between the appointment and the service being one to two weeks (89.1%).

The performance of services in 2017 and 2018 involving all age groups living in the Xukuru do Ororubá territory was also analyzed based on indicators constructed with secondary data extracted from SIASI. The results revealed an increase in coverage of first dental appointments and supervised tooth brushing, besides an increase in the mean number of procedures per capita, corroborating an outlook of progress. Regarding the obstacles that permeate this access to Indigenous oral health, we observed a decrease in the rate of completed dental treatments and an increase in the proportion of tooth extractions performed[26]. The proportion of tooth extractions confirms the high mean of lost elements among the Xukuru shown in Graph 2, which, despite being a form of access to dental services, occurs at a late stage, with advanced damage to the tooth element, besides contributing to a higher DMFT Index value and implying negative consequences for mutilated individuals, such as shame, eating difficulty, harmed social relationships, and a feeling of incompleteness[27].

The profile is similar to rural communities in the Brazilian Northeast regarding housing conditions. A troubling result regarding this characterization is the health conditions of these residences. Many of the population do not have bathrooms and have difficulty accessing running water, and garbage collection services do not cover the entire population. This context requires




**Graph 2.** Distribution of the mean of the DMFT Index components by place of residence. Brazil, 2010-2018.

Source: Authors.

EMSI to pay special attention to preventing waterborne diseases and strengthening health education actions.

The Indigenous people studied are characterized by positive results regarding their schooling level. Many Indigenous people had completed their third year of high school. Understanding the educational process is essential to understanding their people and their needs better; this level of education will promote greater healthcare.

With a mean monthly household income of less than one minimum wage, 73.3% of participants reported having a family member in their household who is a beneficiary of the *Bolsa Família* Program (PBF). Implemented in 2003, this Program is a conditional cash transfer strategy targeting impoverished families that meet specific health and education conditions, which can positively impact health conditions[28]. Results by Arantes and Frazão[29] indicated that Indigenous families not selected as PBF beneficiaries because they had incomes above the Program criteria had 40% lower tooth decay rates. The role of income as a protective factor for oral health conditions suggests inequalities among Indigenous people as well.

Initiatives to reduce inequalities in Indigenous oral health have been documented in Aus-

tralia, Canada, the United States, and Brazil[30]. An oral health program was implemented with the Xavante people, based on incorporating three components: education, prevention, and clinical care, promoting a significant reduction in the experience of caries[19]. Thus, we can now indicate that confronting this outlook involves initiatives sensitive to local specificities and guaranteed sustainability[31].

Although the unprecedented presentation of data on the condition of oral health inequality for an Indigenous population in the Brazilian Northeast justifies the relevance of the present study, we should underscore some limitations, such as the number of participants and age group investigated (the study was not conducted in the WHO monitoring index age group). These limitations were due to the methodological option of prioritizing the monitoring of the same individuals in a study previously developed with the ethnic group, preventing the results presented here from being extrapolated to other Indigenous age groups.

The oral health condition observed among Indigenous people is characterized by significant inequality when compared to the results of an epidemiological survey conducted in the country involving other population groups.

## Collaborations

HA Mauricio conceived the article, collected, processed, and analyzed data, and drafted the text. TR Fávaro and RS Moreira analyzed the data and critically reviewed the text. All authors approved the manuscript's final version.

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