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Household food insecurity, dental caries and oral-health-related quality of life in Brazilian Indigenous adults

Insegurança alimentar domiciliar, cárie dentária e qualidade de vida relacionada à saúde bucal em Indígenas adultos brasileiros

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Abstract *Food insecurity is a complex phenomenon that affects the health and wellbeing of vulnerable families. The aim of this study was to investigate the relationship between household food insecurity, dental caries, oral health-related quality of life, and social determinants of health among Indigenous adults. A cross-sectional study was conducted among Kaingang adults aged 35-44 years old from the Guarita Indigenous Land, Brazil. Food insecurity was assessed through the EBIA scale. Dental caries was assessed using the DMFT index. Participants answered the OHIP-14 questionnaire and a structured interview. Descriptive and multivariate analyzes using Poisson regression models were performed. The final sample included 107 adults from 97 households. Approximately 95% lived in food insecure families. Severe food insecurity was present in 58% of the households. The phenomenon was associated to the Bolsa Família benefit, household size, and greater perception of oral health impacts on quality of life. The high number of families affected by food insecurity reveals the social vulnerability of the Kaingang people. Food insecurity in Kaingangs adults is associated to oral health perception and social determinants of health.*

Key words *Food deprivation, Indigenous population, Food security, Dental caries, Oral-health -related quality of life*

Resumo *Insegurança alimentar é um fenômeno complexo que afeta a saúde e o bem-estar de famílias vulneráveis. Este estudo objetivou investigar a relação entre insegurança alimentar domiciliar, cárie dentária, qualidade de vida relacionada à saúde bucal, e determinantes sociais de saúde entre indígenas adultos. Foi conduzido um estudo transversal com adultos Kaingang entre 35-44 anos da Terra Indígena Guarita, Brasil. Insegurança alimentar foi avaliada pela escala EBIA. Cárie dentária foi avaliada pelo índice CPOD. Participantes responderam o questionário OHIP-14 e uma entrevista estruturada. Foram realizadas análises descritivas e multivariadas usando modelos de regressão de Poisson. A amostra incluiu 107 adultos Kaingang de 97 domicílios. Aproximadamente 95% dos participantes viviam em famílias com insegurança alimentar. Insegurança alimentar grave esteve presente em 58% dos domicílios. O fenômeno foi associado ao Bolsa Família, densidade familiar e percepção dos impactos da saúde bucal na qualidade de vida. O alto número de famílias afetadas pela insegurança alimentar revela a vulnerabilidade social do povo Kaingang. Insegurança alimentar em adultos Kaingang está associada à percepção da saúde bucal e determinantes sociais da saúde.*

Palavras-chave *Privação de alimentos, População indígenas, Segurança alimentar, Cárie dentária, Qualidade de vida relacionada à saúde bucal*

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Introduction

Food access is essential to human life and consequently, food security is considered an important social determinant of health[1]. Food and Agriculture Organization of the United Nations[2] defines food security as a "situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life"[2]. Based on this definition, four dimensions of food security can be identified: food availability, economic and physical access to food, food utilization and stability over time. Food insecurity is a phenomenon that has been increasing worldwide in recent years and affects the most vulnerable populations, such as Indigenous peoples[2].

The guarantee of the human right to adequate food and freedom from hunger incorporates aspects of food security and food sovereignty, the fight against hunger, poverty, and social inequalities, and the realization of other human rights[3,4]. Despite international efforts to meet the Millennium Development Goal of eradicating extreme poverty and hunger, the first increase in the world hunger was registered in 2017 after more than a decade of continuous decline[2,5]. In Brazil, social protection policies conducted in recent decades allowed the country to be withdrawn in 2014 from the so-called Hunger Map, the list of nations presenting more than 5% of their population with calorie intake deficit[6]. Nevertheless, the prospect of Brazil's return to the Hunger Map due to austerity measures challenges the solidity of the advances accomplished globally and in the Latin America[7]. Vulnerable subgroups and Indigenous peoples seem particularly sensitive to these setbacks.

Multiple determinants of historical, social, economic and environmental order affect the food security status of Indigenous peoples[8]. The increasing erosion of Indigenous food systems, associated with the decline of biodiversity and the reduction of traditional territories, threatens the existence of alternative models of ethnodevelopment and Indigenous food sovereignty[9,10]. The food transition observed in many Indigenous populations has dramatically affected sociodiversity, food security levels, and health conditions[11-17].

The relationship between food security, food sovereignty and health equity has a particularly relevant role for Indigenous communities due to the cultural importance of food practices and the high burden of diseases attributed to changes in food habits[18]. Household food insecurity in Indigenous communities has been associated with increased frequency of smoking, reduced sense of belonging to the community, occurrence of mental disorders, chronic diseases, child growth deficit, and recent hospitalization[19,20].

Studies conducted in Brazil, Canada and the United States with non-Indigenous populations have observed that individuals in situation of food insecurity present higher frequencies of untreated dental caries, use of dental prostheses, history of dental pain, and negative self-perception of oral health[21-25]. So far, the association between food insecurity and oral health in Indigenous populations has not been investigated, nor between household food insecurity and oral health-related quality of life (OHRQoL). In addition, exploring the relationship between dental outcomes and food security promotes a more comprehensive perspective of the oral health of Indigenous peoples, in line with their holistic understanding of health.

The aim of this study was to investigate the relationship between household food insecurity, dental caries, oral health-related quality of life, and social determinants of health among Kaingang Indigenous adults. We hypothesize that Indigenous adults living in food insecure households present worse oral health status due to social vulnerability.

Methods

This is an exploratory, population-based, cross-sectional study which is part of a larger mixed-methods project conducted between January and August 2017 with Kaingang Indigenous adults in the South of Brazil.

Setting

The Guarita Indigenous Land is the largest Indigenous territory of the state of Rio Grande do Sul, Southernmost region of Brazil. The area comprises 23.406 hectares and is historically occupied by the Kaingang people, third most populous Indigenous people in Brazil.

The population at the Guarita Indigenous Land is estimated by the Indigenous Health Special Secretary (SESAI) at 5867 people distributed in 12 villages. Access to all villages is carried out by land, and the distances to the Indigenous Health Office range from 2 to 40 kilometers. The

territory occupies areas of three municipalities (*Tenente Portela*, *Redentora*, and *Erval Seco*). The number of inhabitants in each community varies from 181 to 744 people.

Study design

In order to obtain a representative sample and identify eligible participants, a census-based sampling strategy was employed. Selection criteria adopted was individuals ethnically self-identified as Kaingang, aged from 35 to 44 years old, living in all villages of the Guarita Indigenous Land. The World Health Organization recommends targeting the 35-44 age bracket to assess the oral health status of adults[26]. All households were visited and individuals who met the inclusion criteria were invited to take part in the research by signing a written informed consent form. Individuals who lacked capacity to give informed consent were excluded. In addition to their native language, all participants were Portuguese speakers. The 35-44 years old local population is estimated at approximately 300 individuals.

Household Food Security (HFS) was assessed through the Brazilian Food Insecurity Scale (EBIA), a Portuguese version validated for the Brazilian population based on an instrument created by the United States Department of Agriculture[27]. A focus group was conducted with 9 participants previously selected by the Indigenous leader to analyze whether the Kaingang community understand the concepts assessed by the EBIA instrument. In order to reflect the diversity within the Kaingang population, researchers asked the Indigenous leaders to invite a heterogeneous group of locals, comprising young adults, midlife adults and elders of both genders involved in different occupations and social roles (such as agriculture, food preparation, handcrafting, and health workers). The EBIA scale comprises a 14-item questionnaire on the family experience of inadequate access to food during the previous three months. Affirmative responses for each question were recorded as 1 point, resulting in a score ranging from 0 to 14 (Chart 1). In cases that more than one participant from the same household was included in the study, only the participant involved in the food preparation answered the EBIA questionnaire. The resulting score was then attributed to the respective household and, consequently, to the other family members.

Oral examinations were performed by a single examiner (GHS) following the World Health Organization guidelines to oral health surveys[26]. Prior to the study, the examiner calibration process comprised 20 hours of theoretical discussions, clinical examinations, and calibration exercises. A sub-sample of 10 participants was reexamined, with an interval of 5 to 7 days between the two assessments, in order to obtain the intra-examiner agreement coefficient (Kappa=0.817). Conditions of dental crowns were assessed through the decayed, missing or filled teeth index (DMFT). Participants also answered the validated Brazilian short version of the Oral Health Impact Profile (OHIP-14) questionnaire, which is intended to assess the OHRQoL, i.e., the impacts of oral health conditions on the individual's quality of life[28]. A structured interview was used to collect sociodemographic data related to social determinants of health. The OHIP-14 questionnaire and the sociodemographic interview were administered individually to each participant by the researcher. Data was processed and analyzed by an experienced biostatistician who was blind to the identity of the participants (EMC).

Variables

Participants were classified regarding whether they live in a household which receives the *Bolsa Família* benefit ("beneficiary" or "non-beneficiary"). The *Bolsa Família* program is a federal policy created in 2003 aiming to combat poverty, improve health outcomes, and increase food security through direct income transfers to families in situation of social vulnerability[29].

Village location was classified as *Tenente Portela* or *Redentora/Erval Seco*. These subareas belong to different health regions within the public healthcare network, which may interfere in the access and utilization of health services. For instance, while Indigenous people living in the villages located in *Tenente Portela* have access to a local Center of Dental Specialties (*Centro de Especialidades Odontológicas*), the Indigenous communities from *Redentora* and *Erval Seco* are referred for specialized dental care in another Center located more than 100 kilometers away from the Indigenous Land.

Oral health clinical outcomes, household size, age, and years of formal schooling were dichotomized based on the mean values observed. OHRQoL was the only factor analyzed as a continuous variable (score from 0 to 56). Household monthly income was classified based on half of the 2017 Brazilian minimum wage converted in

Chart 1. Household food security classification according to the Brazilian Food Insecurity Scale (EBIA)[27].

Level	Score		Definition
	Families with no children	Families with children	
Food security	0	0	Access to good food in adequate quantity
Mild food insecurity	1-3	1-5	Concern about possibility of lack of food; impairment of food quality
Moderate food insecurity	4-6	6-9	Experience of quantitative food restriction
Severe food insecurity	7-8	10-14	Food deprivation affects the children; presence of hunger

US Dollars (mean exchange rate in August 2017: R$3.15=US$1.00).

The dependent variable "food insecurity" was analyzed both quantitatively, through the final score obtained by the EBIA questionnaire, and adopting severe food insecurity as a cut-off point. For the latter, participants were classified either as living in households "not severe food insecure" (scores from 0 to 9), or in households "severe food insecure" (scores from 10 to 14). Since the classification of the food insecurity level for families with no children is different (range from 0 to 8), households with no children were classified as "not severe food insecure" when presenting scores from 0 to 6, and as "severe food insecure" when presenting scores from 7 to 8. This approach follows the EBIA classification system (Chart 1).

Statistical analysis

Prevalence rates were calculated for each level of food security/insecurity. Bivariate analyzes were performed using the Mann-Whitney U test, Spearman's correlation, and robust Poisson regression, according to the nature of the outcome and the associated factor. Poisson regression models with robust variance were used for multivariate analyzes. Associations were considered statistically significant at the 5% probability level. All analyzes were performed using the STATA 14.0 software (StataCorp, College Station, Texas, USA).

Ethical Standards

The research project was previously presented and approved by the local indigenous leaders. All subjects gave their informed consent for inclusion before they participated in the study. This study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of the Dentistry School of the University of São Paulo and by the Brazilian National Research Ethics Committee.

Results

The focus group discussion revealed that Kaingang adults understand the main concepts related to food insecurity assessed by the Household Food Insecurity Scale (EBIA). Few minor modifications were applied to the questionnaire, such as replacing "quality food" for "good food".

A total of 107 participants from 97 households were included in the study, approximately 36% of the total population aged 35-44 years. The sample presented a mean age of 39.3 (SD 3.32). Average years of schooling was 4.8 (SD 3.85), and mean household monthly income was U$135.50. Nevertheless, 19 participants presented missing data on household monthly income, as they did not know or declined to answer the question. Mean number of people per household was 5.45 (SD 1.62). Only four families did not include any children. Mean number of affirmative responses to EBIA was 8.90 (SD 4.81, Min 0, Max 14). According to the EBIA scores, approximately 95.3% of the participants live in food insecure families. The distribution of individuals according to their household food insecurity status is presented in Table 1.

In the bivariate analysis, participants with up to 4 years of schooling (p=0.007), beneficiaries of the *Bolsa Família* program (p=0.001) and those living in households with more than 5 members (p=0.041) had significantly higher food insecurity scores than their corresponding peers (Table 2). Those living in severe food insecure house-

holds presented a statistically significant association with up to 4 years of schooling (PR 1.35; 95%CI: 1,08-1.55), in addition to higher scores on the impact of oral health on quality of life (PR 1.01; 95%CI: 1.00-1.01). A positive correlation was observed between the OHIP-14 and EBIA scores (rs=0.311; p=0.001) (Figure 1).

The *Bolsa Família* benefit remained associated with higher scores of food insecurity after adjustment for the other variables (PR 1.47; 95%CI: 1.03-2.08). Households with more than 5 members (PR 1.26; 95%CI: 1.02-1.57) and higher oral health impact scores on quality of life (PR 1.02; 95%CI: 1.01-1.03) were also associated with higher scores of the EBIA instrument in the multivariate analysis. Prevalence of severe food insecurity was 55% higher among participants living in households with more than 5 members (p=0.048). Higher oral health impacts on quality of life were also associated with the presence of severe food insecurity (PR 1.02; 95%CI: 1.01-1.04). Clinical outcomes related to dental caries were not associated to household food insecurity (Table 3).

Table 1. Household food insecurity distribution of Kaingang adults, Guarita Indigenous Land, Rio Grande do Sul, Brazil, 2017.

Status	N	%
Not Severe Food Insecure	45	42.06
Food security	5	4.67
Mild food insecurity	21	19.63
Moderate food insecurity	19	17.76
Severe Food Insecure	62	57.94

Discussion

In this study, food insecurity affected a significant proportion of households with Indigenous Kaingang adults aged between 35 and 44 years. More than half of the participants presented the most serious form of food insecurity, which includes the manifestation of hunger among the family members. The phenomenon was associated to the *Bolsa Família* cash transfer benefit, households with more than 5 members, and adults with higher impacts of oral health on quality of life.

Few studies have reported the household food insecurity situation experienced by Indigenous peoples. Surveys carried out with the Teréna and Guarani-Kaiowá ethnic groups, both from the State of Mato Grosso do Sul in Brazil, observed food insecurity in 76% and 100% of the households investigated, respectively[30,31]. Canadian

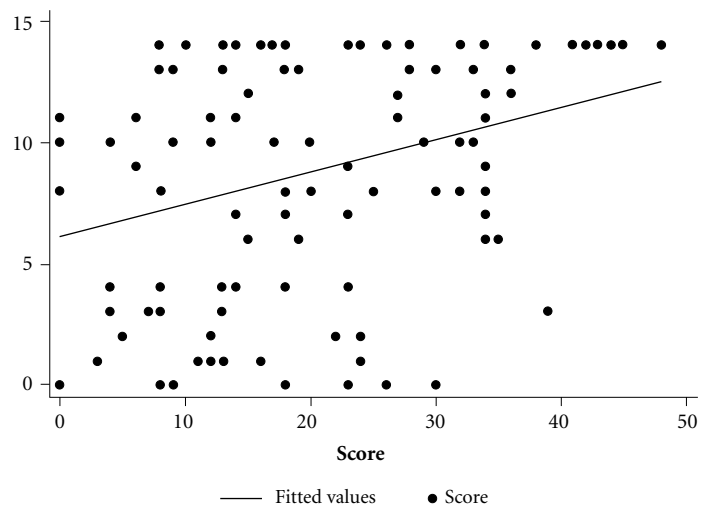

Figure 1. Correlation between the oral health-related quality of life and household food insecurity, Guarita Indigenous Land, Brazil, 2017.

Table 2. Unadjusted analyses for household food insecurity and associated factors, Guarita Indigenous Land, Brazil, 2017.

Factor	n.	%	EBIA score			Severe food insecure		
			Mean	SD	p-value	PR	95%CI	p-value
Total	107	100	8,90	4,81				
Village location								
Redentora/Erval Seco	73	68.2	8.85	4.75		1		
Tenente Portela	34	31.8	9.03	5.01	0.701†	0.97	0.68-1.39	0.889¶
Gender								
Female	81	75.7	8.92	4.88		1		
Male	26	24.3	8.84	4.67	0.919†	1.11	0.77-1.59	0.570¶
Age								
35-39	56	52.4	8.96	4.54		1		
40-44	51	47.6	8.84	5.14	0.943†	1.13	0.82-1.58	0.441¶
Schooling								
≥5 years	50	46.7	7.77	4.65		1		
≤4 years	57	53.3	9.95	4.77	0.007†	1.35	1.08-1.55	0.016¶
Household monthly income								
≤US$147.00	46	42.9	9.76	4.56		1		
≥US$148.00	42	39.5	8.17	5.19	0.184†	0.69	0.47-1.03	0.070¶
Bolsa Família								
Non-beneficiary	28	26.2	6.40	4.99		1		
Beneficiary	79	73.8	9.78	4.46	0.001†	1.60	0.98-2.62	0.060¶
Household size								
≤5 residents	49	45.8	8.08	4.63		1		
≥6 residents	58	54.2	9.58	4.89	0.041†	1.38	0.97-1.97	0.070¶
Decayed teeth								
≤4	68	64.2	8.94	4.70		1		
≥5	39	35.8	8.84	5.06	0.820†	1.05	0.76-1.48	0.740¶
Missing teeth								
≤8	61	57.0	8.88	4.81		1		
≥9	46	43.0	8.93	4.85	0.874†	1.13	0.81-1.56	0.470¶
Filled teeth								
None	66	61.7	8.62	5.08		1		
≥1	41	38.3	9.35	4.39	0.631†	0.90	0.64-1.28	0.572¶
DMFT index								
≤14	54	50.5	8.65	4.84		1		
≥15	53	49.5	9.16	4.81	0.602†	1.16	0.83-1.61	0.381
OHIP-14								
Score (0-46)	107	100		ρ=0.311*	0.001‡	1.01	1.00-1.01	0.003¶

SD - Standard Deviation; PR - Prevalence ratio; 95%CI - 95% Confidence Interval. †Mann-Whitney U Test; *Spearman's rank correlation coefficient; ‡Spearman correlation; ¶Poisson Regression.

researchers, using a questionnaire equivalent to EBIA, found a 70% prevalence rate of household food insecurity in a First Nation community[32].

The severe food insecurity status observed among adults from the Guarita Indigenous Land (57.94%) presents a large discrepancy in relation to other Indigenous peoples (ranging from 17% to 28%), and the non-Indigenous population in Brazil (3.2%)[30-33]. These findings suggest that hunger represents a marked manifestation of health and social inequalities between indigenous and non-indigenous. The high frequency of severe food insecurity observed among the Indigenous from the Guarita Indigenous Land highlights the social vulnerability experienced by this population. Experience of hunger is, arguably, the most obvious and immediate form of violation of the human right to adequate food.

Table 3. Adjusted analyses for household food insecurity and associated factors according to Poisson regression, Guarita Indigenous Land, Brazil, 2017.

Factor	EBIA score			Severe food insecure		
	PR_{un}	95%CI	p-value	PR_{ad}	95%CI	p-value
Village location						
Redentora/Erval Seco	1			1		
Tenente Portela	1.10	0.89-1.34	0.371	1.05	0.74-1.50	0.778
Gender						
Female	1			1		
Male	1.23	0.95-1.59	0.112	1.27	0.79-2.05	0.315
Age						
35-39	1			1		
40-44	0.97	0.80-1.19	0.808	1.18	0.82-1.70	0.368
Schooling						
≥5 years	1			1		
≤4 years	1.13	0.91-1.30	0.238	1.15	0.72 – 1.44	0.429
Household monthly income						
≤ US$147.00	1			1		
≥US$148.00	0.92	0.74-1.12	0.414	0.80	0.55-1.15	0.222
Bolsa Família						
Non-beneficiary	1			1		
Beneficiary	1.47	1.03-2.08	0.032	1.78	0.83-3.79	0.137
Houlsehold size						
≤5 residents	1			1		
≥6 residents	1.26	1.02-1.57	0.035	1.55	1.01-2.39	0.048
Decayed teeth						
≤4	1			1		
≥5	0.80	0.62-1.04	0.098	0.86	0.56-1.32	0.497
Missing teeth						
≤8	1			1		
≥9	1.01	0.77-1.33	0.951	1.12	0.67-1.89	0.660
Filled teeth						
None	1			1		
≥1	1.06	0.88-1.29	0.529	0.99	0.71-1.41	0.995
DMFT index						
≤14	1			1		
≥15	0.99	0.75-1.31	0.977	1.01	0.60-1.68	0.976
OHIP-14						
Score (0-46)	1.02	1.01-1.03	0.000	1.02	1.01-1.04	0.004

PR - Prevalence ratio; 95%CI - 95% Confidence Interval.

Given the interdependence and indivisibility of human rights, it also represents a serious violation of rights to the territory, cultural identity, health, housing, education, water, justice and human dignity[31].

The existence of hunger in the Guarita Indigenous Land is directly associated with the complex land issue faced by native peoples in Brazil. Although the Federal Constitution recognizes the traditional rights of occupation of Indigenous communities over their territories, the current political and institutional dismantling of the National Indian Foundation (*Fundação Nacional do Índio - FUNAI*), an institution responsible for protecting and promoting Indigenous rights, has relativized such constitutional prerogative[34]. The reduction of ancestral territories, unjustified slowness in land demarcation processes, and

the violence engendered by the agribusiness are factors that undermine the food sovereignty of Indigenous peoples[4,31]. Even though the Guarita Indigenous Land is legally recognized by the Brazilian Federation as an Indigenous territory, the illicit exploitation of the Kaingang land by non-Indigenous is a phenomenon that occurs for decades and deprive the Indigenous families from their traditional ways of subsistence[35].

Emerged among small producers from the *Via Campesina* movement around 1993, the concept of food sovereignty considers the democratic distribution of food production resources at all scales, with their fair application to different social and ecological contexts[36]. In relation to Indigenous peoples, food sovereignty also refers to the collective ability to make decisions about healthy and culturally appropriate food practices[37]. In this context, the Kaingang people from the Guarita Indigenous Land was the first Indigenous community to receive the food production label "*Indígenas do Brasil*" granted in 2015 by the Brazilian Ministry of Agrarian Development. The label indicates the origin of products grown or collected on Indigenous lands, adding market value to traditional food systems. Further studies are needed to understand the real effects of this type of measure on food security of Indigenous populations.

The high prevalence of severe food insecurity among *Bolsa Família* beneficiaries demonstrates the ability of the program in identifying households in situation of extreme poverty and greater need. On the other hand, evidence indicate that *Bolsa Família*, when isolated from other public policies, has limited effects on the household food security status, not being able to significantly change the context of families living in situation of moderate and severe food insecurity[38]. As a result, families living in contexts of greater vulnerability may remain food insecure even when receiving the cash transfer benefit, which partially explains the association of food insecurity and the *Bolsa Família* program reported in this study.

The effects of the *Bolsa Família* program on the dietary pattern of beneficiaries seem to be heterogeneous. Researchers have observed positive impacts of the cash transfer benefit on families' food purchases and diet quality, including increased household expenditures on food, higher caloric intake, and higher consumption of fresh or minimally processed items[39,40]. Other studies indicate that the increased purchasing power of vulnerable families is associated with unhealthy food choices, higher consumption of soft drinks and sugar, and lower intake of fruits and vegetables[41-43].

On general, the *Bolsa Família* program seems to be effective in increasing the variety and quantities of the food items consumed through the promotion of the families's access to food markets, although households frequently adopt a high-calorie and low-nutrient diet[44]. The unhealthy food choices made by groups in situation of food insecurity might not be simply a matter of lack of information, but rather an actual strategy employed by families to cope with the food-resource inadequacy[45]. Families experiencing financial constraints are likely to reduce diet costs by prioritizing the purchase of energy-dense foods, which often leads to lower overall diet quality[46].

The high intake of sugar-rich foods has been long established as the major dietary factor in the development of dental caries[47]. Furthermore, micro and macronutrients deficiencies potentially compromise the oral health in individuals with poor dietary patterns[48]. Due to the cumulative burden of dental caries through the lifespan and the lifelong effects of sugars on the dentition, individuals living in a context of food insecurity might experience high prevalence rates of carious lesions and tooth loss[22]. Studies conducted in Canada and the United States observed that adults in situation of food insecurity present higher frequencies of use of dental prostheses, experience of dental pain, and negative self-perception of oral health[24,25]. Nevertheless, household food insecurity was not associated to any clinical variable related to dental caries among Kaingang families. The positive association observed in this study between household food insecurity and the OHRQoL scores suggests a higher perception of oral disorders by individuals in a context of greater vulnerability.

In addition to contributing at some level to improve the food consumption quality, the *Bolsa Família* may positively impact the oral health status of families in situation of food insecurity by allowing the acquisition of oral hygiene kits[49]. Underserved families who receive the benefit also tend to experience improved access to health care services, especially vaccination, check-ups and growth monitoring[50]. Yet, oral health check-ups are not included as a conditionality of the program.

Cash-transfer programs contributes to increase families' autonomy and empower the most vulnerable subgroups of society[51]. The benefit also impacts the family structure by increasing the female decision-making power regarding

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contraception, which in turn may have positive implications for the household food security status[52]. In this study, severe food insecurity was associated with higher household size, similarly to the findings reported for the Teréna Indigenous people from Brazil[30]. A systematic review assessed the food security status in different socio-demographic contexts in Brazil and reported that number of members living in the household was one of the main factors associated to food insecurity, as well as income and type of housing[53].

Few studies have assessed the impact of the *Bolsa Família* program on Indigenous populations. On general, the benefit is well accepted by the communities, perceived as a form of assistance specially targeting the children needs, and mostly used for direct expenditures on food or acquisition of resources for food production[54]. In many Indigenous communities the benefit has become the main source of income[55].

In order to enhance the repercussions of *Bolsa Família* on HFS status is mandatory its expansion and association with public policies focused on common issues faced by Indigenous peoples such as lack of basic sanitation, food production, and food sovereignty. Our findings highlight the need to formulate culturally-appropriate policies addressing the serious situation of social vulnerability and violation of the human right to adequate food in Indigenous populations.

Our study describes the first investigation on the association between HFS and oral health outcomes in Indigenous peoples. The Kaingang communities constitute vulnerable, hard to reach populations with scant information available regarding their oral health profile. In this manner, this report contributes with original perspectives related to the phenomenon and the population investigated. Conducting studies with Indigenous peoples impose significant challenges to epidemiological research. Geographic and social characteristics of the Kaingang population such as the disperse distribution over a large territory influenced the final sample size of the study. The number of participants was also affected by a seasonal flow of Indigenous adult workers, specially men, during the period of the study, to outside of the Indigenous Land. Even though the final sample was relatively small, it is safe to assume that the findings of this study are representative of a segment of the Guarita's Kaingang community, particularly of families led by young adults. Due to the paucity of available epidemiological data for Indigenous peoples, the cautious discussion of the findings justifies their use in a critical analysis, despite eventual low external validity or precision[35].

Although the calibration process undertaken by the examiner was an intensive training directly supervised by an experienced researcher and clinician, the interexaminer agreement was not estimated in this phase. Another limitation of this study was the inability to blind the examiner, as the data collection for each participant was conducted in sequence (oral examinations followed by interviews) by the same researcher, which may have exposed observations to some degree of bias. Subgroups susceptible to food insecurity, such as families composed exclusively of the elderly, were not evaluated. The cross-sectional design prevented the establishment of inferences of cause and effect. years. The instrument used for the measurement of household food insecurity does not consider cultural aspects of indigenous food practices such as the importance of food exchanges, collectivity, and environment.

To the best of our knowledge, this was the first assessment of the oral health-related quality of life in an Indigenous population from Brazil. Therefore, the use of the OHIP-14 questionnaire in this study was essentially exploratory. The instrument was not previously validated to the study population and, as a result, it may have not been fully understood by all participants. We used the version validated by Oliveira and Nadanovski[28] for the Brazilian population. All participants were Portuguese speakers and no interpreter was required during the interviews.

This exploratory, population-based, cross-sectional, study conducted with Kaingang adults from the South of Brazil demonstrated that household food insecurity in Indigenous families is associated with worse oral health-related quality of life, higher household size and the benefit of the *Bolsa Família* program. The vulnerability of Kaingang Indigenous families is accentuated by the disproportionately high frequency of food insecure families and, more specifically, by the number of those living with severe food insecurity. The importance of these findings for public health underlies the need to address structural determinants related to housing, oral health care, health inequalities, social welfare policies, and food production through inter-sectorial, culturally-sensitive approaches. Further studies should assess the association of HFS and oral health in Indigenous communities with different sociocultural characteristics, as well as to attempt to develop explanatory pathways to the investigated association.

Collaborations

GH Soares participated in concept and design of the study, data collection, and writing the manuscript. JMS Mota participated in interpretation and relevant critical review of the manuscript's intellectual content. FL Mialhe participated in the interpretation of data, and relevant critical review of the manuscript's intellectual content. MGH Biazevic participated in the manuscript concept, interpretation of data, and relevant critical review of the manuscript's intellectual content. ME Araújo participated in the interpretation of data, and relevant critical review of the manuscript's intellectual content. E Michel-Crosato performed the fundraising, participated in the concept and design of the study, coordination and supervision of the data collection, statistical analysis, and writing and revising the manuscript.

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