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Association between social cohesion and food insecurity among adults living in a healthcare region in southern Brazil

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Abstract

Background Food insecurity (FI) has grown worldwide in recent years, especially in developing countries. Studies have shown that aspects of the social environment, such as social cohesion in the neighborhood, may be associated with FI; however, this topic has yet to be explored, in Brazil. This study aims to verify the association between aspects of the perceived social environment of the neighborhood (social cohesion) and FI.

Methods This is a cross-sectional study with adults and elderly individuals ($n=400$) residing in a healthcare region in Porto Alegre, Rio Grande do Sul (Brazil). The sample is selected proportionally from areas of higher and lower socioeconomic status, and data are collected through household interviews. The presence of FI is assessed using the Brazilian Food Insecurity Scale (short version). The perception of the neighborhood regarding social cohesion is obtained using a questionnaire validated for the Brazilian population. Poisson regression with robust variance was used to estimate the crude and adjusted prevalence ratios (PRs) and their respective 95% confidence intervals (95% CIs).

Results Individuals with more positive perceptions of social cohesion in the neighborhood are less likely to experience FI than those with less positive perceptions [PR = 0.73; 95% CI (0.55–0.97)], after adjustments.

Conclusions The community social environment is independently associated with FI and may have characteristics that positively influence the probability of individuals experiencing FI. Interventions at the community level are necessary to address FI.

Keywords Food insecurity, Social environment, Neighborhood features, Social cohesion

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Introduction

Food insecurity (FI) is a public health problem that persists around the world, especially in middle- and low-income countries [1]. FI is characterized by the lack of regular and permanent access to quality food in sufficient quantities to support active and healthy lifestyles [2]. The Food and Agriculture Organization (FAO) of the United Nations estimates that 828 million people faced severe levels of FI in 2021, an increase of 150 million compared to that in 2019 [1]. In 2022, FI levels remained high, with around 735 million people lacking access to food [3].

In Brazil, since 2013, national studies have shown an increase in the prevalence of FI. According to the Household Budget Survey 2017–2018, approximately 36.7% of the population lived with some level of FI in 2018 [4]. This scenario has worsened over the years, mainly due to economic and political crises, which peaked during the COVID-19 pandemic and intensified inequalities in the country [5]. Currently, more than half of the population faces FI, and approximately 33.1 million people live with severe dietary FI; that is, they are experiencing hunger [6, 7].

According to the theoretical model established by Anne Keppler and Ana Segall in 2011, food and nutrition security have both macrosocioeconomic determinants, such as environmental and geopolitical factors, and regional/local determinants that refer to the community environment, including food prices, racism, discrimination, and social cohesion relations. There are also household determinants related to education, race/color, and gender. Each level of determinants can affect the next level and influence individuals' access to food, contributing to the FI phenomenon [8].

At the regional/local level of determination, studies have suggested that aspects of the neighborhood where individuals live, including the social environment, may significantly contribute to FI [9–12]. According to Taylor et al. (1997), a neighborhood can be defined as the general area surrounding a home where individuals typically engage in routine activities, such as shopping, going to the park, or visiting neighbors [13]. Studying neighborhood characteristics enables the examination of both the physical structure of the environment and the social relationships established among community members [14]. In this context, social environment refers to the social processes and relationships that exist between individuals and groups that live in a neighborhood. This environment includes, among other factors, socially cohesive relationships in the community [9–12].

Originally, the concept of social cohesion emerged from the ideas of Émile Durkheim in his study of social relations and suicide rates [15]. In general, social cohesion reflects the level of connection and solidarity between individuals in a geographic space, such as a neighborhood. According to Kawachi and Berkman (2000), social cohesion has two components: the absence of social conflict in the neighborhood and the presence of strong social ties between individuals [16]. Thus, neighborhoods with low levels of social conflict and strong social ties are considered to have high levels of social cohesion [17–20].

Studies conducted in countries in the Global North show that low levels of social cohesion in a neighborhood have been associated with an increased risk of suffering from FI. The main hypothesis is that dense networks of collaboration between individuals increase social cohesion in the neighborhood and alleviate food shortages through various strategies, such as resource sharing, community gardens, and informal assistance like meal sharing. These networks seem to help people experiencing FI [17–20]. Despite the growing body of evidence on the subject, the relationship between FI and perceptions of social cohesion in the neighborhood is an issue that has been little explored in the countries of the Global South, which are those countries most affected by hunger and have a distinct social structure, thus, it is necessary to understand these relationships, favoring approaches in the environments where individuals live and interact. This study aims to analyze the association of self-perceived social cohesion in the neighborhood and FI among individuals from a healthcare region in the city of Porto Alegre/RS.

Materials and methods

Design and population

This study was cross-sectional and included individuals over 19 years of age residing in a territory covered by a Primary Health Unit in the central area of the city of Porto Alegre in the state of Rio Grande do Sul, Brazil. The present study is part of a research project entitled Study of the social and environmental determinants of food and nutrition: An ecosocial approach [21–23] reviewed and approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul (CAAE 46934015.3.0000.5347). This study was conducted according to the ethical standards established in the Declaration of Helsinki in 1964 [24]. All candidates eligible for the study signed informed consent forms.

Approximately 12,000 households live in the healthcare region covered by this study. Each health team is assigned a specific geographic area for service delivery, with four areas established. While these areas are similar in size, they differ in terms of vulnerability, with two being socially vulnerable, i.e., with per capita incomes of Rs 1,700.00, and two being less vulnerable, i.e., with per capita incomes of Rs 4,000.00 [25]. The higher vulnerability is also characterized by irregular occupations and impaired access to essential public services, such as

sanitary sewage services and regular garbage collection. Furthermore, urbanization presents itself with narrow circulation routes, a lack of sidewalks, or irregular alignment [26].

Data were collected at home or the health unit between October 2018 and June 2019 by a team composed of previously trained nutritionists and nutrition students using a standardized, precoded, and previously tested questionnaire.

Sample size

The sample size was calculated considering the objectives of the main study—"Study of the social and environmental determinants of food and nutrition: An ecosocial approach" [23] Thus, the calculations of the sampling powers of each exposure variable were performed *a posteriori*. Through the use of a 95% CI and 80% power, the final sample was able to detect a prevalence ratio (PR) of approximately 1.35 in the perception of social cohesion when associated with the outcome.

Sampling

We included adults and elderly individuals of both sexes (>19 years) who were eligible and agreed to participate in the study. Individuals with physical or mental disabilities that prevented the proper collection of information were excluded from the study. As the outcome of the larger study was obesity, pregnant women were also excluded because the recommendation of weight gain in this group could interfere with the results.

The same proportions of individuals from the most vulnerable and least vulnerable areas were included according to the previously described vulnerability criteria. In the most vulnerable areas, which comprised only 250 households, all households were approached, and all eligible participants were invited to participate in the study, resulting in a final total of 201 participants (i.e., a refusal rate of 16%). In the least vulnerable areas, the same number of individuals was included to maintain sample proportionality. A random sampling procedure based on their registration with the healthcare unit was applied to select the primary sampling units (households), resulting in a refusal rate of 22%.

Only one individual per household was included, and when more than one person met the inclusion criteria, only one individual was chosen. The alternation between the sexes of those participants included in each household was performed whenever possible; i.e., if a woman was included, an attempt was made to include a man in the next household to maintain sample representativeness.

Outcome variable

The study outcome was food insecurity (FI), assessed using the short version of the Brazilian Food Insecurity Scale (BFIS) [27]. This scale, validated by Santos et al. (2014), was developed based on the original Brazilian Food Insecurity Scale, which consists of 14 questions and is widely used in population surveys throughout Brazil [28, 29]. Although the short version of the BFIS cannot distinguish between different degrees of FI, it demonstrates high specificity, sensitivity, and accuracy, producing results very similar to those of the original scale while using fewer questions. This allows for more efficient tracking of individuals experiencing food insecurity [27].

The "yes/no" dichotomous scale identified the presence of FI when the participant responded affirmatively to at least one of the following five items regarding access to food in the last 3 months (1). Did you worry that the food in your house would run out before you would be able to buy, receive, or produce more food? (2) Did you run out of food before you had the money to buy more food? (3) Did you run out of money to have a healthy and varied diet? (4) Have you or any adult in your household ever reduced the amount of food at meals or skipped meals because there was not enough money to buy more food? (5) Have you ever eaten less than you thought you should because there was not enough money to buy more food?

Exposure variable

The exposure variable was the self-perceived measure of social cohesion in the community. A questionnaire, cross-culturally adapted and validated for the Brazilian population by Santos et al. (2013), was adopted to assess the perception of social cohesion. This questionnaire evaluates self-reported neighborhood characteristics across multiple domains [30]. This questionnaire was initially validated in two large studies, entitled "Project on Human Development in Chicago Neighborhoods" [13] and "Multi-Ethnic Study of Atherosclerosis" [31].

Social cohesion was assessed using the following five items. Before the questionnaire was administered, participants were instructed to think of their neighborhood as "the general area surrounding their home where you usually perform routine activities such as going shopping, going to the park or visiting neighbors" [13] (1). In your neighborhood, are people willing to help their neighbors? (2) Is your neighborhood closely knit, meaning that people are able to unite around common interests? (3) Are people in your neighborhood trustworthy? (4) In general, do people in your neighborhood get al.ong well with each other? (5) Do the people in your neighborhood share the same culture, that is, the same traditions, beliefs, and customs? Participants reported their levels of agreement using a 5-point Likert scale (1=strongly agree to 5=strongly disagree). To facilitate the response process

by participants, response cards were prepared with the alternatives available for each question. Participants were instructed to point to the card that best corresponded to their perception.

The response codes of all items were inverted so that a higher score indicated a greater degree of social cohesion. Thus, the total score of the perception of the social environment was obtained by summing the responses of each participant, with a higher score indicating a more positive perception of social cohesion; i.e., the higher the perception score was, the more social cohesion in the neighborhood as perceived by the individual. The scores were converted into quartiles of approximately equal sizes.

Covariates

A standardized questionnaire prepared by the researchers containing the following variables was used to collect data on the socioeconomic and demographic covariates: sex (observed; female or male), age (referred to in years/ 19–49 years, 50–59 years, > 60 years old), self-reported race/skin color and categorized according to age, 2010 census of the Brazilian Institute of Geography and Statistics [32] (white, black, mixed-race, yellow, or indigenous), education level (did not study, was illiterate, completed or did not complete elementary school, completed or did not complete high school, completed higher education/, or completed postgraduate degree), marital status (with partner, without a partner), monthly family income reported in minimum wage ranges (<1 minimum wage (MW up to 2 MW/ 2–3 MW / >3 MW), employment relationship (yes or no), Neighbourhood time (<10 years, 10–28 years, ≥29 years), number of residents in the household (1, 2–3, <3), receipt of benefits (does not receive, Bolsa Família, retirement or pension, continuing payment benefit - CPB, or others).

Statistical analyses

The data were double-typed into EpiData®, version 3.1. Data analyses were performed using Stata 12.0 (Stata Corp., College Station, USA) and SPSS version 18.0 (Statistical Package for the Social Sciences).

The normality of the variables was tested using the Shapiro–Wilk test. The analysis of the neighborhood perception scores and associations with the covariates were presented as the median and interquartile range and were assessed using nonparametric tests. The presence of FI and its association with the covariates was described as absolute and relative frequency, using the chi-square test of independence to detect associations. The association between FI and the exposure variable was explored using Poisson regression with robust variance, estimating crude and adjusted prevalence ratios (PRs), and the respective 95% confidence intervals (95% CIs) [33]. The adjustment variables in the multivariate analysis were included when they were associated ($p<0.20$) with FI and the exposure of interest, observing the conceptual structure, as described by Victora et al., (1997), which describes hierarchical relationships between factors [34].

The internal consistency of the perceived social cohesion scale was estimated using standardized Cronbach's alpha coefficients. The internal consistency of the BFIS was estimated using the Kuder–Richardson coefficient. The domain that assessed self-perceived social cohesion in the neighborhood showed moderate reliability (0.74), as did the EFIS (0.68) [35].

Results

Table 1 presents the sociodemographic and economic characteristics of the study participants according to the prevalence of FI and the levels of social cohesion in the participants' neighborhoods. The sample consisted of 400 participants who were predominantly female (75.0%), aged between 19 and 49 years (50.5%), had white skin color (62.3%), and had completed high school (37.0%). In addition, a large portion of the sample received between 3 and 5 monthly minimum wages (48.4%). The prevalence of FI in the sample was 51.2%, with FI being more prevalent among women (55.3%) and younger adults aged between 19 and 49 years (56.9%).

Furthermore, individuals with lower monthly incomes (71.6%), who did not receive social benefits (51.7%), residents of areas considered vulnerable (62.2%) and households with more than three (3) members (65.5%) had a higher percentage of FI. Completed higher education was also related to a higher prevalence of FI. Similarly, despite not showing significance, single individuals with black, brown, or yellow skin color and those who were unemployed were more affected by FI than were other individuals. It was observed that being an elderly individual, not having a stable relationship and receiving retirement and/or pension were associated with more positive perceptions of social cohesion in the neighborhood. Furthermore, those individuals experiencing FI had less positive perceptions of social cohesion; that is, they perceived a lesser degree of social cohesion in their neighborhood than those individuals not experiencing FI (Table 1).

The results of the association between the perception score and FI adjusted for the covariates are presented in Table 2. Individuals with more positive perceptions (Q3 and Q4) of the degree of social cohesion in the neighborhood were 35% less likely to experience FI than other individuals, in the crude model. When adjusted for confounders, the highest positive perception level remained, conferring a 27% lower probability of experiencing FI [PR=0.73; 95% CI (0.55–0.97)]. The age variable remained significant until Model 3, demonstrating that it also has an important relationship with FI.

Table 1 Sociodemographic and economic characteristics of participants according to the prevalence of food insecurity and perceptions of the degree of social cohesion in the neighborhood ($n = 400$)

		Food Insecurity		Social cohesion	
Variable	**n (%)**	**n (%)**	**p-value**	**Interquartile range**	**p-value**
Sex					
Male	100 (25.0%)	39 (39.0%)	0.007*[a]	18 (14–20)	0.849[d]
Female	300 (75.0%)	166 (55.3%)		18 (14–20)	
Age (years)					
19–49	202 (50.5%)	115 (56.9%)		17 (14–19)	
50–59	110 (27.5%)	66 (56.4%)	$p < 0.001$*[b]	18 (15–21)	$p < 0.001$*[a]
> 60	88 (22.0%)	24 (27.3%)		19 (16–22)	
Skin color					
White	249 (62.3%)	121 (48.6%)	0.207[a]	18 (15–21)	0.111[d]
Black/brown/yellow	151 (37.8%)	84 (55.6%)		17 (14–20)	
Education ($n = 395$)					
ES incomplete	73 (18.3%)	45 (37.7%)		18 (14–21)	
ES complete	73 (18.5%)	40 (54.8%)	0.004*[b]	17 (14–20)	0.328[c]
HS complete	146 (37.0%)	81 (75.4%)		18 (14–20)	
UE complete	103 (26.1%)	38 (53.2%)		18 (15–21)	
Marital Status					
With partner	149 (37.3%)	69 (46.3%)	0.156[a]	17 (14–20)	0.025*[b]
Without a partner	251 (62.7%)	136 (54.2%)		18 (15–21)	
Monthly income ($n = 399$)					
Up to 2 MW	134 (33.6%)	96 (71.6%)		17 (14–20)	
3–5 MW	193 (48.4%)	92 (47.7%)	$p < 0.001$*[b]	18 (15–21)	0.224[c]
> 5 MW	72 (18.0%)	17 (23.6%)		18 (15–21)	
Social benefit					
None	201 (50.2%)	104 (51.7%)		17 (14–19)	
BFP/CPB/others	52 (13.0%)	38 (26.7%)	0.001*[b]	18 (12–20)	$p < 0.001$*[c]
Retirement/pension	147 (36.8%)	63 (42.9%)		19 (15–21)	
Employment relationship					
Yes	245 (61.3%)	119 (48.6%)	0.213[a]	18 (14–20)	0.253[d]
No	155 (38.8%)	86 (55.5%)		18 (15–21)	
Living area					
Vulnerable	201 (51.2%)	125 (62.2%)	$p < 0.001$*[a]	18 (14–20)	0.095[d]
Not vulnerable	199 (49.8%)	80 (40.2%)		18 (15–21)	
Neighborhood time (years)					
< 10	134 (33.5%)	60 (44.8%)		18 (14–21)	
10–28	130 (32.5%)	73 (56.2%)	0.161[b]	17 (13–20)	0.281[c]
≥ 29	136 (34.0%)	72 (52.95)		18 (15–20)	
No. of residents in the household					
1					
2–3	66 (16.5%)	25 (37.9%)		17 (15–21)	
> 3	195 (48.8%)	89 (45.6%)	$p < 0.001$*[b]	18 (15–21)	0.174[c]
	139 (34.8%)	91 (65.5%)		17 (14–20)	
FI			-		
Yes	205 (51,2%)	-		17 (13–20)	$p < 0.001$[d]
No	195 (48,8%)			18 (15–21)	

n, absolute frequency; %, relative frequency; MW, minimum wage; ES, elementary school; HS, high school; UE, university education; BFP, Bolsa Família Program; CPB, Continuing Payment Benefit; FI, Food Insecurity

Superscript lowercase distinct letters: a – Yates continuity correction test; b – Pearson's Chi-square test; c – Kruskal–Wallis test for independent samples; and d – Mann–Whitney U test for independent samples

*Significance at $p \leq 0.05$

Table 2 Crude and adjusted prevalence ratio (PRs) of the association between the social cohesion score and food insecurity ($n=400$)

	Model without adjustment		Model I		Model II	
Variables	**PR (95%CI)**	**p-value**	**PR (95%CI)**	**p-value**	**PR (95%CI)**	**p-value**
Social Cohesion Score	$n=400$		$n=400$		$n=400$	
Q1 (lower perception)	1		1		1	
Q2	0.89 (0.711–1.133)		0.91 (0.725–1.155)		0.91 (0.724–1.155)	
Q3	0.67 (0.523–0.870)	$p<0.001$*	0.69 (0.543–0.899)	0.007*	0.69 (0.536–0.889)	0.005*
Q4 (greater perception)	0.65 (0.498–0.868)		0.74 (0.566–0.992)		0.73 (0.555–0.975)	
Age (years)						
19–49	1		1		1	
50–59	1.05 (0.867–1.279)	$p<0.001$*	1.09 (0.901–1.323)	0.001*	1.11 (0.917–1.346)	0.001*
>60	0.47 (0.333–0.688)		0.50 (0.351–0.730		0.52 (0.355–0.764)	
Marital Status						
With partner	1		1			
Without a partner	0.85 (0.694–1.051)	0.137	0.91 (0.748–1.117)	0.294		
Social benefit						
None	1				1	
BFP/CPB/others	1.41 (1.141–1.746)	0.154			1.42 (1.159–1.753)	0.735
Retirement/pension	0.82 (0.658–1.042)				1.04 (0.827–1.308)	

PR, prevalence ratio; 95% CI, 95% confidence interval; Q1, quartile 1; Q2, quartile 2; Q3, quartile 3; Q4, quartile 4; BFP, *Bolsa Família* Program; and CPB, Continuing Payment Benefit

Multivariate analysis was performed using Poisson regression with robust variance. *Significance at $p\leq0.05$

Variables associated with the outcome and with exposure at a significance level lower than 20% ($p<0.20$)

Model without adjustment: effect of social cohesion without adjustment; Model 1: Adjusted for marital status and age; and Model 2: Adjusted for age and social benefit

Discussion

In this study, we evaluated the relationship between perceptions of social cohesion among individuals in a neighborhood and the level of food insecurity among adult individuals living in a healthcare region in the city of Porto Alegre/RS. The results showed that half of the study sample was in a state of FI. In addition, social cohesion was associated with the outcome, and those individuals who reported more positive perceptions of social cohesion in their neighborhood were less likely to experience FI than those who did not report such perceptions.

The level of prevalence of FI in the study sample (51.2%) was higher than that found in the 2017–2018 Household Budget Survey (36.7%) [4], but was similar to that found in the 2nd National Survey on Food Insecurity in the Context of the Covid-19 Pandemic in Brazil, the prevalence rates of which were 58.7% in Brazil in general and 47.6% in the state of Rio Grande do Sul in 2022 [6, 7]. The fact that FI is more prevalent in women, in the youngest individuals, in those individuals with lower income and education levels, and in larger families is in agreement with the observations in the scientific literature, which has consistently demonstrated that these sociodemographic and economic factors are present in relation to FI in several countries around the world [6, 36, 37]. Brazil is a country with high rates of social inequalities that result in the asymmetric distribution of resources and opportunities, limiting the right to access adequate and healthy food among different societal groups. It is estimated that 6 out of 10 households whose head of household is a woman, for example, experience some degree of FI in Brazil [6]. This situation highlights the persistent gender inequities historically faced by the country. Women have predominantly been responsible for domestic work or informal jobs, and when they are paid, they receive less than men [38, 39]. Economic fragility translates into levels of social vulnerability that affect fundamental rights, such as access to food. Public policies that support women by expanding opportunities and promoting social protection are essential for combating food insecurity [39]. The Bolsa Família Program, an income transfer initiative that focuses on women and children, exemplifies inclusive policies and the protection of women. Women are responsible for receiving a financial benefit and using it for the family's welfare, which enhances their decision-making power, autonomy, and participation in the household's financial provision [40, 41]. Other policies, such as those enabling access to education for young children and professional qualifications for women, are crucial for maintaining their presence in the job market, thereby increasing family income [41, 42].

In addition, income, poverty, family composition and low levels of education are the determining factors and drivers of FI [43]. The chances of individuals or population groups experiencing FI are reduced when there is an increase in the amount of monetary resources, with education being a factor that allows for an increase in the average income of individuals, while the presence of

a larger number of individuals in the household favors a greater commitment of resources than does the presence of a smaller number of individuals in the household [44]. As in our study, individuals with lower income and education levels experience a greater degree of FI in Brazil [6]. Younger individuals and households with children under 18 years old seem to experience a higher degree of FI in studies conducted in different regions of the country [45–47]. These data reinforce the idea that larger families with children and adolescents who do not yet contribute financially to household expenses have limited resources for basic items for survival. Thus, for individuals, receiving a social benefit, whether through income transfer programs such as the Bolsa Família Program or those obtained through social assistance such as the Continuous Payment Program, which guarantees financial assistance to the elderly and those with a disability [40, 48], may contribute to weaker fluctuations in household income, being a factor protecting against FI, expanding access to food, and favoring an improvement in the quality of the diets of individuals [46, 47, 49].

We also found that individuals with more positive perceptions of social cohesion in the neighborhood were less likely to experience FI. In a study conducted with women in California, Denney et al., (2017) showed that those women with low-level perceptions of social cohesion in the neighborhood were approximately 50% more likely to experience FI than were other women [18]. Additionally, in a longitudinal study conducted in rural areas of South Carolina, a 24% higher risk of FI was identified in those individuals with lower-level perceptions of social cohesion in the neighborhood [19]. This relationship can be explained through multiple and complex social interactions. Cohesive communities result in greater social capital, that is, resources to prevent, face, and overcome situations of vulnerability [50, 51]. These resources translate into cooperative behaviors among individuals, strengthening informal networks of credit, support, and social leverage and expanding empowerment and problem-solving skills, which can act as important strategies for coping with FI [18, 19, 52].

A greater degree of social cohesion may favor the sharing of supplies among peers and the construction of resource-generating spaces, such as community gardens, which are maintained and strengthened through small efforts by each participant in the relationship network. In addition, facilitating access to food through informal help, either by sharing financial resources or by direct food donations, allows for a greater degree of stability in terms of permanent food security [53].

In our study, we also found that older individuals who received some type of social benefit, such as retirement, pension, or CPB, perceived a greater degree of cohesion in their neighborhood. This result may indicate that the older portion of the population has more established socioeconomic conditions than the younger population, as well as the fact that the individuals in this population receive social benefits, whether transitory or fixed, a factor that contributes to the financial stability of families. When investigating the contribution of social cohesion to individual well-being considering income inequality, Delhey and Dragolov (2016) showed that income inequality weakens social cohesion among individuals [54]. Furthermore, Child et al., (2020) showed that compared to lower-income individuals, those with higher income levels reported greater social cohesion among their neighbors and received greater social support [55].

Individuals with higher education and income levels seem to have greater access to connections with people from different professions, expanding their possibilities for problem-solving and social leverage [55]. These results agree with the data of our study, which, although not significant, showed that individuals with higher income levels had more positive perceptions of social cohesion in their neighborhoods. Thus, there is inequality in access to social cohesion based on socioeconomic status, which may favor lower-income individuals in terms of living in more vulnerable neighborhoods with a larger number of social conflicts, hindering the construction of strong social bonds [17–20].

The present study has some limitations. The research was conducted before the COVID-19 pandemic, and thus, the population's food conditions may have since changed. However, it is important to note that this period was also crucial for studying the topic and understanding the factors involved in FI in Brazil. The upward trend in FI observed in recent years led to Brazil's return to the Hunger Map of the Food and Agriculture Organization of the United Nations in 2019 [56]. The temporality between exposure and outcome cannot be guaranteed because this is a cross-sectional study. In addition, despite the care taken to mitigate selection bias by alternating the sexes in each household, women are represented in greater numbers in the final sample than men. There may be gender differences in the perception of social cohesion and also in the prevalence of FI. In addition, the study sample is not representative of the general population, and the associations found could be influenced by the characteristics of the healthcare region. Therefore, the results should be generalized to other population groups with caution. In addition, we use the measure of individual perception of neighborhood aspects, which may differ from reality in this community.

To the best of our knowledge, this study is unprecedented, as it is a pioneer in Brazil in attempting to understand the relationship between the community social environment and FI while contemplating individuals' self-perceptions of social cohesion. This study reinforces

the hypothesis that processes now considered strongly related to the individual component are also a reflection of the community component. We suggest future investigations relating these elements to a better understanding of the factors involved, including other population groups. In addition, the effectiveness of actions to strengthen social cohesion, for example, in the community construct, is a topic that should be further explored.

This study finds an independent association between individuals' perceptions of the degree of social cohesion in the community and FI in a population with a high prevalence of food insecurity. These findings reinforce the importance of considering environmental aspects when developing public programs and policies to combat FI, which can promote equity in health. In addition, projects that expand and strengthen social ties between individuals and groups, favoring trust, a sense of belonging, cooperation, and tolerance among its members and expanding action in the face of social injustice and the engagement of organized civil society are essential for overcoming FI and building spaces that promote both health and citizenship.

Abbreviations

95% CI	95% confidence interval
BFIS	Brazilian Food Insecurity Scale
BFP	Bolsa Família Program
PHU	Primary Health Unit
CPB	Continuing Payment Benefit
ES	Elementary school
FAO	Food and Agriculture Organization
FI	Food insecurity
HS	High school
MW	Minimum wage
PR	Prevalence ratio
UE	University education

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Author contributions
All authors contributed to the study conception and design. IS and RC recruited participants and collected data. FVPP analyzed and interpreted the data. FVVP wrote the first draft of the article. IS and RC reviewed the manuscript. All authors had unrestricted access to the data and participated in data interpretation. All authors contributed to subsequent versions and agreed to submit the article for publication.

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Data availability
The datasets used during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
All procedures were performed in accordance with the ethical standards of the institutional research committee and with the Declaration of Helsinki in 1964 and its subsequent amendments or comparable ethical standards. This study was approved by the Ethics Committee of the Federal University of Rio Grande do Sul (no. 46934015.3.0000.5347). Informed consent was obtained from all participants included in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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