Original article

Food insecurity in a city in the extreme south of Rio Grande do Sul, Brazil, 2016: a population-based study*

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Mariane da Silva Dias[1] – orcid.org/0000-0003-4995-4748
Samuel de Carvalho Dumith[1] – orcid.org/0000-0002-5994-735X
Juliana dos Santos Vaz[2] – orcid.org/0000-0002-2880-767X
Lulie Rosane Odeh Susin[1] – orcid.org/0000-0002-9404-0577

[1]Universidade Federal do Rio Grande, Faculdade de Medicina, Rio Grande, RS, Brazil
[2]Universidade Federal de Pelotas, Faculdade de Nutrição , Pelotas, RS, Brazil

Abstract

Objective: to analyze the occurrence of food insecurity and associated factors in Rio Grande, Rio Grande do Sul, Brazil, in 2016. **Methods:** this was a cross-sectional population-based study using data obtained by interviewing heads of household; Poisson regression with robust variance adjustment was used. **Results:** 675 households were included; food insecurity prevalence was 35.2% (95%CI31.6;39.0) and its occurrence was associated with heads of household being female (PR=1.49 – 95%CI1.17;1.90), not being white-skinned (PR=1.49 – 95%CI1.18;1.88), being younger, unmarried (PR=1.39 – 95%CI 1.07;1.81), belonging to the lowest education bracket (PR=1.58; 95%CI 1.17;2,12), belonging to the first and second assets index tertiles, having insufficient money to meet expenses (PR=2.22 – 95%CI 1.76;2.80), being obese (PR=1.39 – 95%CI 1.13;1.71), and being a smoker (PR=1.28 – 95%CI 1.05;1.56). **Conclusion:** food insecurity was associated with all factors studied except alcohol abuse.

Keywords: Food and Nutrition Security; Socioeconomic Factors; Social Vulnerability; Health Surveys; Cross-Sectional Studies.

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Correspondence:
Mariane da Silva Dias – Rua Visconde de Paranaguá, No 102, Rio Grande, RS, Brasil. CEP: 96203-900
E-mail: marianedias.md@gmail.com

Introduction

Food and nutrition safety consists of guaranteed regular and permanent access to food of sufficient quality and in sufficient quantities, without compromising access to other essential needs.[1] To this end, governments should adopt policies and actions that take into consideration environmental, cultural, economic, regional and social factors, with the aim of ensuring that people can realize this right.[2]

Despite food being considered a fundamental right, and despite hunger being recognized as humankind's biggest solvable problem, the number of hungry people in the world continues to be high.[3,4] Brazil has achieved positive prominence in reducing extreme poverty and hunger, by implementing successful social inclusion policies and income transfer programs since the 2000s.[5] Notwithstanding this progress, food insecurity (FI) continues to be an important issue in Brazil.[5]

FI prevalence rates show great variation, arising from social and economic differences between the country's regions.[6,7] According to data from the National Household Sample Survey (PNAD), conducted by the Brazilian Institute of Geography and Statistics (IBGE) in 2013, FI occurrence varied between over 36.0% in the North and Northeast regions and under 15.0% in the South and Southeast regions.[8]

> *Food and nutrition safety consists of guaranteed regular and permanent access to food of sufficient quality and in sufficient quantities, without compromising access to other essential needs*

A study conducted using PNAD data, aimed at evaluating FI trends and associated factors in Brazil, found a reduction in its prevalence in the period 2004-2013, principally with regard to moderate and severe FI, from 17.0% (95%CI15.7;18.4) to 7.9% (95%CI7.2;8.7). However, this reduction was found to be greater in municipalities that had lower prevalence in 2004, demonstrating that FI-related disparities continue to exist.[7] Another study, which also used PNAD data, estimated prevalence of moderate or severe FI for the Brazilian municipalities, highlighting their great heterogeneity, especially the significant difference between the average for municipalities in the Northeast region (14.5%) and the Southern region (3.6%).[6]

Food security status has been monitored in Brazil since 2004, by means of the PNAD, with the purpose of classifying households according to their food security status and producing basic information about the country's socio-economic development.[8] However, the information generated by PNAD may not portray the reality of a municipality or microregion, since the survey presents mean FI results for a defined region. Brazil has great interregional and intraregional diversity and as such specific FI monitoring in municipalities or microregions is necessary in order to inform public policies that are more adequate for the respective contexts.

Furthermore, FI is a complex phenomenon that is hard to measure based solely on the Brazilian Food Insecurity Scale (EBIA), which is incapable of revealing a more comprehensive panorama of the conditions that lead to FI or which, together, contribute to it.[9] Other instruments need to be used along with the EBIA that enable households and/or their dwellers to be classified according to social indicators. These indicators enable identification of households with a higher level of social vulneraiblity.[10,11]

Despite the importance of obtaining data on food insecurity by region for planning and implementing public policies on access to food in sufficient and necessary quantities, there are few studies with data on FI in municipalities in the southern part of the state of Rio Grande do Sul (RS). An example is the city of Rio Grande, RS, which in recent years has undergone a period of great economic instability, with the unemployment rate increasing considerably as a result of lay-offs related to the production of platforms at the Naval Base. The increased financial instability faced by the population results in increased uncertainty and difficulty in accessing food as a consequence of the drop in family income.[12]

The objective of this article was to analyze the occurrence of food insecurity and associated factors in the municipality of Rio Grande, RS, Brazil.

Methods

This was a cross-sectional population-based study conducted in the municipality of Rio Grande. Located on the south coast of the state of Rio Grande do Sul, at 317 kilometers from the state capital Porto Alegre, Rio Grande has a population of 207,036 inhabitants and 66,554 households in its urban area.[13] For the most part the local economy is concentrated on seaport activities.[6]

This study is part of a research consortium entitled 'Health of the Population of Rio Grande', the objective of which was to evaluate different health outcomes among the population aged 18 or over and resident in the city in 2016. Further information about the methods used is available in an article about the methodology.[14]

Individuals aged 18 or more and resident in the urban area of Rio Grande were eligible to take part in the study. Individuals institutionalized in nursing homes, hospitals and prisons, as well as those physically or mentally unable to answer the questionnaire administered by the interviewers were not considered to be eligible.

The sample size calculation used a prevalence rate of 14.9% for the outcome,[6] a 95% confidence level, 80% statistical power and an margin of error of 3.0 percentage points. This resulted in an initial sample size of 541 households, for which a design effect (deff) of 1.3 was then calculated which increased the sample size to 703 households. A further 10% was added for possible losses and refusals, so that the preliminary sample therefore consisted of 773 households.

The sampling process took place in two stages. The census tracts were selected first and then the households and individuals. In this way, 72 census tracts were systematically selected out of the 293 eligible tracts, accounting for 25% of them. This resulted in an average of ten households per tract. At the end of this process, 711 households were selected.

The study's unit of analysis was the household. The questions relating to the household and to the 'food insecurity' outcome were asked only of the individual considered by its dwellers to be the head of the household. Taking as a reference the classification adopted by the Brazilian Institute of Geography and Statistics (IBGE),[14] the study considered the head of household to be the person who had knowledge of the household food and financial dynamics, i.e. the person involved in buying food for the family to consume.

FI was measured using the Brazilian Food Insecurity Scale (EBIA).[6] It should be mentioned that this is an instrument adapted from the food insecurity scale proposed by the United States Department of Agriculture (USDA).[1] The EBIA measures families' perception of their access to food in the 90 days prior to the interview. It has been adapted and validated to correspond better to the characteristics of the Brazilian population.[15]

FI can be mild, moderate or severe, depending on the total score for positive answers on the EBIA. A household is classified as having food security when its score is equal to zero on the scale, meaning that the household has access to food in sufficient quantity and of sufficient quality for its family consumption. A household is classified as having mild FI when its score on the scale is from 1 to 3, moderate FI when it scores 4 to 5, and severe FI when its score is between 6 and 8 on the EBIA.[6] The four FI categories were kept in the analysis in order to verify the prevalence of each of them. When analyzing associated factors, the FI variable was dichotomized: yes or no.

The independent variables used were:

a) sex (male; female);
b) race/skin color (White; non-White);
c) age group (in years: 18-39; 40-59; 60 or over);
d) schooling (in years of study: 0-8; 9-11; 12 or more);
e) assets index (categorized in tertiles);
f) number of dwellers in the household (up to 3; 4 or more);
g) sufficient money to pay expenses (no; yes);
h) marital status (married; single/widowed/separated);
i) currently smokes tobacco (no; yes);
j) alcohol abuse (no; yes); and
k) nutritional status (low weight; normal weight; overweight; obese).[16]

The 'assets index' variable was generated to be a proxy variable for family income, given that the 'income' variable may not be very reliable: there is the possibility of the head of household refusing to answer about their income or even not knowing what the income of the other dwellers in the household is.[17,18] As such, the 'assets index' variable was built by analyzing main components based on 11 variables, (origin of drinking water, number of rooms in the household used for sleeping in, number of bathrooms, ownership of a car, ownership of a computer, access to the internet, existence of a landline telephone, presence of a microwave oven, washing machine, tumble drier, and DVD). The score was divided into tertiles, whereby the first tertile was the worst assets index and the third was the best assets index. The first component that had an eingenvalue of 3.3 was extracted, explaining 30% of the variability of all the indicators; the indicators had a covariance coefficient above 0.20.

Nutritional status was characterized based self-reported information regarding current weight and height by applying the body mass index formula (BMI: kg/m^2); it was classified according to the cut-off points

established by the World Health Organization (WHO).

Alcohol abuse was defined as follows: intake of five or more measures of alcoholic beverage for men and four or more measures for women, on a single occasion in the 30 days prior to the interview.[19]

Data quality control was done by means of a second interview carried out in 10% of the households visited, selected at random. Eleven key questions were asked again, about age, race/skin color, smoking status in the household, existence of a landline telephone, hypertension, asthma, influenza vaccine, whether there were household dwellers under 18 years old, number of days walking/week, whether the respondent likes living in the neighborhood and tooth brushing frequency. The second interview was conducted by telephone and agreement between the first and the second interviews was tested using the Kappa statistic. Its mean value of 0.80 showed excellent data consistency.

The data were analyzed using Stata version 14.1 (Stata Corp. College Station, United States). The analyses were performed using the *svy* module, which takes the sample design into consideration. The sample was initially described in percentages and absolute numbers; multivariate analysis was then performed using Poisson regression with robust adjustment for variance.

Household-related analyses were performed, and included sociodemographic variables and variables relating to heads of household, namely behavioral and nutritional status variables.

The household-related analyses followed the order of the analysis model: demographic variables (sex, race/skin color, age and marital status) on the first level; socio-economic variables (schooling, number of dwellers in the household, assets index and sufficient money) on the second level; and behavioral variables (nutritional status, currently smokes tobacco and alcohol abuse) on the third level.

This analysis strategy assumes that adjustment of all the variables being studied is included in the model, using the backward inclusion method in accordance with the previously determined analysis model. Adjustment was made on each level and variables with $p>0.20$ were identified; these were excluded from the model and were not part of the adjustment on the following levels. The analysis strategy, as well as keeping variables with $p<0.20$, have been recommended to achieve better adjustment of confounding factors. Level of significance was estimated using the Wald heterogeneity test; associations with a p value ≤ 0.05 were considered to be statistically significant.

The research project was approved by the Federal University of Rio Grande Health Research Ethics Committee, as per Letter No. 20/2016 issued in March 2016; all interviewees signed a Free and Informed Consent form.

Results

The final sample was comprised of 675 houses in view of 5.1% losses and refusals. Losses were higher in census tracts in the center of Rio Grande city (20.0%), as well as among males (12.0% versus 6.5% among females). With regard to heads of household, 61.6% were female, 83.2% stated that their race/skin color was White and 41.2% were in the 40-59 years age group (Table 1).

FI occurrence Rio Grande households was 35.2% (95%CI 31.6%;39.0%), of which 26.3% were mild FI (95%CI 29.8%;23.0%), 6.1% were moderate FI (95%CI 8.2%;4.4%) and 2.8% were severe FI (95%CI 4.4%;1.7%).

Table 2 shows the measurements of crude and adjusted association between the variables and the FI outcome. Following adjustment all the variables, with the exception of alcohol abuse, had statistically significant association with the outcome. In households headed by a female FI prevalence was FI 49% greater, compared to those that had a male head of household (PR=1.49 – 95%CI 1.17;1.90), as did those with heads of household who stated that their race/skin color was non-White, in relation to those with heads of household of White race/skin color (PR=1.49; 95%CI1.18;1.88).

Households headed by people aged 18-39 years and 40-59 years had greater probability of FI when compared to those headed by people in the 60 years or over age group (PR=1.93 – 95%CI 1.42;2.62 and PR=1.38 – 95%CI 1.33;2.44, respectively). A linear trend was therefore found, whereby the older the age group, the greater the probability of FI being lower. FI prevalence was higher in households with unmarried heads of household (PR=1.39 – 95%CI 1.07;1.81), in relation to married heads of households.

There was greater probability of FI in households with heads of households who had up to eight years of schooling (PR=1.58 – 95%CI 1.17;2.12), compared to those who had 12 years or more of schooling. Similarly, belonging to the lower asset tertiles was associated with

Table 1 – Sample description according to socio-economic, demographic and behavioral characteristics and nutritional status (n=675), Rio Grande, Rio Grande do Sul, 2016

Variables	n	%
Sex		
Male	259	38.4
Female	416	61.6
Race/skin color[a]		
White	561	83.2
Black. brown and other	113	16.8
Age group (in years)		
18-39	191	28.3
40-59	278	41.2
≥60	206	30.5
Schooling (in years of study)[a]		
0-8	301	44.6
9-11	196	29.1
≥12	177	26.3
Number of dwellers in the household		
Up to 3	487	72.2
4 or more	188	27.8
Assets index		
1st (worst situation)	273	40.5
2nd	208	30.8
3rd (best situation)	194	28.7
Sufficient money to pay expenses[b]		
No/partly	258	38.4
Yes	414	61.6
Marital status		
Married	247	36.6
Single	264	39.1
Widowed/separated	164	24.3
Nutritional status[c]		
Low weight	11	1.7
Normal weight	246	37.9
Overweight	244	37.7
Obese	147	22.7
Currently smokes tobacco		
Non-smoker	533	79.0
Smoker	142	21.0
Alcohol abuse[a]		
No	599	88.9
Yes	75	11.1

a) 1 *missing* na variável.
b) 3 *missings* na variável.
c) 27 *missings* na variável.

greater probability of FI (PR=2.40 – 95%CI 1.66;3.46 [1st tertile] and PR=2.13 – 95%CI 1.49;3.05 [2nd tertile]), when compared with belonging to the highest tertile.

Households with four or more dwellers had greater probability of FI (PR=1.32 – 95%CI 1.12;1.56), when compared to households with fewer dwellers. Households with heads of household who stated not having sufficient money to pay expenses also had greater probability of FI (PR=2.22 – 95%CI 1.76;2.80) in relation to those who stated having enough money to pay their expenses.

With regard to nutritional status, households headed by obese individuals had higher probability of FI (PR=1.39 – 95%CI 1.13;1.71), compared to individuals with normal weight. Finally, households headed by smokers also had greater probability of FI (PR=1.28 – 95%CI 1.05;1.56) in relation to non-smokers.

Discussion

This study found high prevalence of FI in the municipality of Rio Grande, affecting over one third of households. Around one in every ten of those households had moderate or severe FI. Considering that according to the most recent IBGE census there are 66,554 households in the city of Rio Grande,[13] and given that FI prevalence was found to be just over 35.0%, it is estimated that some 23,427 of the city's households were in a situation of FI, with 4,060 of them having moderate FI and 1,864 having severe FI.

FI prevalence in Rio Grande was greater than that found for Southern Brazil as a whole in 2013 (14.9%)[6] and 2010 (27.3%).[16] Another population-based urban study conducted in Pelotas, RS, a municipality near to Rio Grande, found 11.0% FI prevalence (95%CI 9.0;13.0) in 2007.[9]

8.9% prevalence of moderate or severe FI was also considered to be high when compared to the findings of the Southern region studies cited above: 4.4%[6] and 7.5%.[14] In the study conducted in Pelotas, FI prevalence where hunger was present, which can be compared to severe FI, was 3.0%.[20]

The high FI prevalence found can be explained by the economic crisis faced by Brazil which caused mass job dismissals at the municipality's port and oil refinery complex. A country's economic instability implies a variety of upsets in the lives of its citizens, such as increased concern or uncertainty about the future and access to food.[12] Increased FI prevalence in times of crisis was found in some regions of Portugal in a study using temporal data for the period 2011-2013.[12]

The variables associated with FI in Rio Grande, such as, for instance, being female, being of non-White race/skin color, having little schooling, belonging to the lowest assets tertile, being obese, being a smoker and consuming alcohol abusively, tend to be factors related to poorer health outcomes. These findings were also revealed by another study using PNAD data[6] and by other national and international studies,[21-25] making evident the need to continue with and improve income transfer programs for individuals with the aim of increasing access to income, with greater employment opportunities, given that adequate access to income increases access to food.

Households with a higher number of dwellers have been shown to be a factor related to situations of FI.[26] This finding was also highlighted in data presented regarding the most recent PNAD,[8] when it could be seen that as the number of dwellers per household increased, the probability of FI occurring also increased.

With regard to age group, the study showed that households headed by younger people had greater probability of FI, compared to those headed by older individuals, similarly to the evidence of the study of trends and factors associated with FI prevalence cited above.[7] This association can be explained by the fact of individuals in older age groups usually having greater financial stability.

We also found that the fact of the head of household being married was a factor that reduced the probability of FI. We believe that this happens because individuals living with each other tend to have greater economic stability, given the greater probability of more than one individual being economically active.

As for the analysis of the behavioral variables, tobacco use was associated with greater occurrence of FI. It is believed that habits such as tobacco smoking may affect the financial resources of families and, consequently, increase the occurrence of FI. A study conducted in Korea covering the period 2012-2013, concluded that being a smoker and consuming alcohol abusively were associated with greater occurrence of FI.[27] Similarly, a study conducted in California, United States, in 2011 and 2012, demonstrated that tobacco smoking prevalence is higher in households characterized by food insecurity.[28]

With regard to nutritional status, this study found associations between head of household obesity and greater occurrence of FI. This fact was also identified in a study using data from the 2006 National Demography and Health Survey, which demonstrated FI association with obesity in females.[29] It is believed that in Brazil the process of nutritional transition may have reduced the deleterious effect of FI on the accumulation of body fat.[29] Families with lower purchasing power have turned to buying food with high energy density, rich in sugars and fats, because they cost less, even though their nutritional quality is poorer. The process of nutritional transition in Brazil is therefore related to reduced undernourishment and increased obesity in low-income families.[30]

Standing out among the limitations of this study is the fact of losses having been greater in households located in census tracts in the city center, as well as among males. However, the overall percentage of losses and refusals was low. Nevertheless, it is possible that

Table 2 – Crude and adjusted prevalence ratios of associations between food insecurity and sociodemographic and behavioral variables (n=675), Rio Grande, Rio Grande do Sul, 2016

Variables	Prevalence %	Crude PR[a] (95%CI[b])	p-value[c]	Adjusted PR[a] (95%CIb)	p-value.[c]
Sex			0.001		0.002
Male	26.7	1.00		1.00	
Female	40.5	1.51(1.20;1.91)		1.49(1.17;1.90)	
Race/skin color			<0.001		0.001
White	32.2	1.00		1.00	
Non-White	50.4	1.57(1.25;1.96)		1.49(1.18;1.88)	
Age group (in years)			<0.001		<0.001
18-39	45.6	2.11(1.54;2.90)		1.93(1.42;2.62)	
40-59	38.1	1.77(1.29;2.42)		1.38(1.33;2.44)	
≥60	21.6	1.00		1.00	
Marital status			<0.001		0.021
Married	25.6	1.00		1.00	
Single/widowed/separated	40.8	1.59(1.25;2.03)		1.39(1.07;1.81)	
Schooling (in years of study)			<0.001		0.012
0-8	44.8	2.20(1.60;3.03)		1.58(1.17;2.12)	
9-11	34.2	1.68(1.18;2.39)		1.33(1.00;1.78)	
≥12	20.3	1.00		1.00	
Assets index			<0.001		<0.001
1st tertile (worst situation)	49.1	3.97(2.79;5.64)		2.40(1.66;3.46)	
2nd tertile	38.5	3.11(2.13;4.53)		2.13(1.49;3.05)	
3rd tertile (best situation)	12.4	1.00		1.00	
Number of dwellers in the household			<0.001		0.001
Up to 3	29.1	1.00		1.00	
4 or more	51.1	1.76(1.46;2.11)		1.32(1.12;1.56)	
Sufficient money to pay expenses			<0.001		<0.001
No	59.9	3.02(2.37;3.85)		2.22(1.76;2.80)	
Yes	19.9	1.00		1.00	
Nutritional status			0.146		0.031
Low weight	45.5	1.47(0.75;2.87)		1.17(0.74;1.85)	
Normal weight	31.4	1.00		1.00	
Overweight	34.8	1.12(0.88;1.44)		1.24(1.00;1.53)	
Obese	41.5	1.34(1.03;1.73)		1.39(1.13;1.71)	
Currently smokes tobacco			0.002		0.021
No	31.8	1.00		1.00	
Yes	47.9	1.50(1.17;1.93)		1.28(1.05;1.56)	
Alcohol abuse			0.890		0.063
No	35.2	1.00		1.00	
Yes	36.0	1.01(0.63;1.62)		1.11(0.73;1.67)	

a) PR: prevalence ratio.

b) 95%CI: 95% confidence interval.

c) Wald heterogeneity test.

Note:

The analyses took the design effect (*svy*) into consideration.

greater loss of households headed by males leads to measurement of its occurrence and impact on the study being overestimated, given that households headed by males were found to have greater probability of having FI. In relation to FI occurrence in census tracts in the central area of the city of Rio Grande, prevalence was found to be 19.6% (95%CI 10.2;32.4), which is lower than the overall prevalence found by the study.

With regard to the study's strong points, it is a population-based study and this enables investigation of the population's health conditions and their determinants. By obtaining data on FI in Rio Grande, it was possible to gain better knowledge of citizens in this situation and also to demonstrate the existence of differences between FI prevalence rates in Brazil's Southern region and prevalence found in the municipality

in question. FI prevalence in Rio Grande was similar to that estimated for Brazil's Northeast region which has the country's highest FI levels. Another strong point of this study was the use of the EBIA to measure the outcome, since this scale, which is widely used in Brazil, enables comparison with national studies and is a validated instrument.

Perception of lack of money to meet expenses, the current economic situation of the country and especially that of Rio Grande may be exacerbating access to adequate quantities and quality of food. These factors need to be taken into consideration in order to identify more vulnerable households and, consequently, direct public policies focused on this priority. Maintaining income transfer programs, reducing unemployment, increasing income and schooling, as well as other actions in this direction, will minimize occurrence of FI.

The results presented differ from those of other studies conducted in Southern Brazil, revealing considerable heterogeneity between the region's municipalities which have not been detected by the average estimates generated. It is therefore important to conduct studies aimed at better elucidation of the panorama of food insecurity in localized realities. Finally, it should be emphasized that the results of this study have been used in formulating the food and nutrition security policy of the municipality of Rio Grande.

Authors' contributions

Dias MS contributed to the conception and design of the study, analysis and interpretation of the results and writing the manuscript. Dumith SC contributed to the conception and design of the study, critical review of the analyses and the contents of the manuscript. Vaz JS contributed to writing and critically reviewing the manuscript. Susin LRO contributed to the conception and design of the study and critical review of the manuscript. All the authors have approved the final version of the manuscript and are responsible for all its aspects, including guaranteeing its accuracy and integrity.

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