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# Changes in the frequency of food consumption by adults/elderly according to food insecurity: evidence from a longitudinal study in the northeastern semi-arid region, Brazil, 2011-2014

*Mudanças na frequência do consumo alimentar de adultos/idosos segundo a situação de insegurança alimentar: evidências a partir de um estudo longitudinal no semiárido nordestino, Brasil, 2011-2014*

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## ABSTRACT

### Objective

To prospectively analyze changes in the frequency of individual food consumption of adults/elderly people according to different food insecurity outcomes over time.

### Methods

Population-based longitudinal study carried out in 2011 (358 individuals) and 2014 (301 individuals) in a municipality in the northeastern semi-arid region. The frequency of food consumption of 37 foods in adults/elderly was assessed using the Food Frequency Questionnaire and food insecurity using the Brazilian Food Insecurity Scale. Differences in the proportion of frequency of consumption of each food at baseline (2011) and follow-up (2014) were calculated according to longitudinal categories of change in food insecurity. The McNemar test for paired samples was applied to estimate differences between 2011 and 2014.

### Results

Among the individuals studied, 38.9% and 30.6% were classified in food security and food insecurity in the two periods (2011 and 2014), respectively, and 23.2% changed from food

insecurity in 2011 to food security in 2014. Increase in the frequency of food consumed in the three groups of food insecurity outcomes. Only in the food insecurity group at both times, an increase in the consumption frequency of soft drinks and industrialized juices was observed. In the three groups, when comparing 2011 and 2014, there was an increase in the consumption of local agricultural foods, such as mangoes, sweet potatoes and a decrease in the consumption of pumpkin.

### Conclusion

Overcoming food insecurity results in positive changes in food consumption, and seasonality is a factor that promotes and limits food consumption.

**Keywords:** Food intake. Food security. Seasonality.

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## RESUMO

### Objetivo

Analisar prospectivamente mudanças na frequência do consumo alimentar individual de adultos/idosos segundo diferentes desfechos de insegurança alimentar no tempo.

### Métodos

Estudo longitudinal de base populacional realizado em 2011 (358 indivíduos) e 2014 (301 indivíduos) em um município do semiárido nordestino. Foi avaliada a frequência de consumo alimentar de 37 alimentos em adultos/idosos por Questionário de Frequência Alimentar e a insegurança alimentar pela Escala Brasileira de Insegurança Alimentar. Foram calculadas as diferenças na proporção da frequência de consumo de cada alimento no baseline (2011) e follow-up (2014) segundo categorias longitudinais de mudança na insegurança alimentar. Foi aplicado o teste de McNemar para amostras pareadas para estimar diferenças entre 2011 e 2014.

### Resultados

Dentre os indivíduos estudados, 38,9% e 30,6% foram classificados em segurança e insegurança alimentar nos dois tempos (2011 e 2014), respectivamente, e 23,2% mudaram da insegurança alimentar em 2011 para segurança alimentar em 2014. Houve aumento na frequência dos alimentos consumidos nos três grupos de desfechos da insegurança alimentar. Apenas no grupo insegurança alimentar nos dois tempos, observou-se aumento na frequência alimentar de refrigerantes e sucos industrializados. Nos três grupos, ao comparar 2011 e 2014, houve aumento no consumo de alimentos da vocação agrícola local, como manga, batata-doce e diminuição do consumo de jerimum/abóbora.

### Conclusão

A superação da insegurança alimentar resulta em mudanças positivas no consumo de alimentos, e a sazonalidade é um fator promotor e limitante do consumo de alimentos.

**Palavras-chave:** Consumo de alimentos. Segurança alimentar. Sazonalidade.

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## INTRODUCTION

Food Insecurity (FI) is expressed by uncertainty, concern or deprivation of access to sufficient and quality food to maintain a healthy life, being one of the most serious social and public health problems to be faced today [1-4].

The *Pesquisa de Orçamentos Familiares* (POF, Consumer Expenditure Survey) carried out by the *Instituto Brasileiro de Geografia e Estatística* (IBGE, Brazilian Institute of Geography and Statistics) in 2017-2018 estimated that 36.7% of Brazilian families were facing FI, a higher percentage than those observed by the *Pesquisa Nacional por Amostra de Domicílios* (National Household Sample Survey) in 2013-2014 (22.9%) and 2003-2004 (35.2%) [5,6]. In the Northeast region, the results revealed in the 2017-2018 POF were even more expressive, as half of the households were classified as facing some degree of FI (49.7%) [5]. In 2022, the *Rede Brasileira de Pesquisa em Soberania e Segurança Alimentar e Nutricional* (Brazilian Research Network on Food and Nutrition Sovereignty and Security) revealed the return of a serious condition of hunger in Brazil, highlighting the necessary urgency in the implementation of public policies for Food and Nutritional Security (FNS) [7].

In Brazil, the main tool for measuring FI is the *Escala Brasileira de Insegurança Alimentar* (EBIA, Brazilian Food Insecurity Scale), which captures the dimension of access to food [8] measuring FI experiences as a progressive phenomenon and experienced in the psychological, social spheres and/or compromising the quantity and quality of food, at home and individually. In this direction, studies that evaluate food consumption in FI scenarios contribute to characterize the diet of families that experience FI.

Studies have shown an association between FI, measured by EBIA, and the adoption of monotonous diets and excessive consumption of low-cost meals which are rich in calories and with low nutritional value [9-12]. Researchers have also reported that exposure to FI experiences can result in compensatory behaviors such as lower fruit and vegetable intake [13], reduced portion sizes of consumed foods or skipping meals [14] and lower overall quality of the diet [15].

Thus, deprivation of access to food, in addition to representing a violation of the human right to adequate food, compromises the adequate intake of nutrients [16,17], configuring a risk for the development and treatment of Chronic Non-Communicable Diseases [18], mainly for the adult and elderly population [19]. Despite this, there are still few longitudinal studies on the subject that contribute to analyzing the food consumption of individuals in situations of persistent and overcoming FI, especially in the populations most affected by chronic non-communicable diseases, such as adults and the elderly [20].

Therefore, the aim of this study was to prospectively analyze changes in the frequency of individual food consumption by adults/elderly people according to different FI outcomes over time, based on a longitudinal study carried out with families in the northeastern semi-arid region.

## METHODS

This is a longitudinal cohort study conducted with families living in the municipality of Cuité, located in the State of Paraíba (PB) Brazil, in the northeastern semi-arid region. The town has approximately 20,000 inhabitants and a low Human Development Index.

Baseline data were collected in 2011 (May-June), when a representative cross-sectional study was conducted for families in the urban and rural areas of the municipality. The sample was calculated using the Stratified Random Sampling technique, considering the expected FI estimate of 50%, aiming to maximize the sample size. A maximum sampling error of 5% was used, under a confidence level of 95%. Based on these parameters and the estimate of private households from the 2010 Population Census (5869 households), a sample of 360 households was estimated, proportionally subdivided according to the area of residence (urban and rural). Households to be surveyed in the urban area were drawn from the municipal registry of Property Tax. In the rural area, a Cartesian plan was built on the cartographic map of the municipality and 12 random points were drawn to be surveyed, reaching 16 rural locations. Thus, 358 families were investigated at baseline (2011) and 326 at follow-up (2014), resulting in a sample loss of 8.9% and an error of 0.054.

In each investigated family, an adult or elderly resident was surveyed regarding food consumption, in both investigation periods, with 358 individuals surveyed at baseline and 301 interviewed again at follow-up, composing the sample of this study. Data collection occurred in households and was performed by previously trained nutrition undergraduate students. More details about the cohort can be consulted in Palmeira et al. [21].

Food consumption was assessed in 2011 and 2014 using a qualitative Food Frequency Questionnaire (FFQ) consisting of 83 foods, referring to the last three months, considering the following food frequency categories: Never; <1 time/month; 1-3 times/month; 1 time/week; 2-3 times/week; 4-5 times/week; 1 time/day; 2 or more times/day [22].

Studies have described a diet with low nutritional value and the presence of ultra-processed foods in households facing FI [10-12]. Therefore, for this study, the food frequency of 37 foods belonging to the groups of fruits, vegetables/legumes, milk and dairy products, meat, eggs, ultra-processed products such as sausages and sugary drinks was used. In addition, foods that are part of the local agricultural vocation were selected: mango, cassava, guava, sweet potato and pumpkin, given their relevance to the debate on FNS policies.

For analysis, food frequency categories were regrouped. For most foods, the frequency category “weekly-daily” was adopted (Weekly-daily: when there was consumption from 1 time/week to 2 or more times/day, in the last three months). For fruits and vegetables/legumes, considering the low frequency of consumption observed in the sample, the following category was adopted: “Consumed in the last three months” (when consumption in the last three months was mentioned – that is, between <1 time /month to 2 or more times/day).

The FI was measured using the EBIA in both evaluation periods. The EBIA is a psychometric scale validated for the Brazilian population and used in national surveys by IBGE since 2004 [6]. The scale is composed of questions with “yes” or “no” answers about the family’s experience regarding access to food in the last 90 days. The details of the EBIA questions were described by Segall-Corrêa et al. [8].

With 14 items, EBIA consists of eight questions asked for households without the presence of children under 18 years old and 14 questions for those with children and/or adolescents under 18 years old. From the sum of affirmative responses, cutoff points are applied to classify the household in terms of “food security (FS)” (score=0) or “FI” (score >=1) [8].

In this study, three groups of FS/FI outcomes over time were constituted: (i) FS at both periods, for families classified in 2011 and 2014 (n=117); (ii) FI at both periods, when families were classified in 2011 and 2014 (n=92); and (iii) changed to FS, when families classified in some degree of FI at baseline and FS at follow-up (n=70). Only 22 families were classified as FS at baseline and worsened this condition to FI at follow-up, this group was not included in the analysis due to the small sample size.

For data analysis, descriptive analyzes of the population were carried out considering socioeconomic and demographic variables (gender, age, area of residence, schooling and family income) and calculated the proportions of food consumption frequency at baseline (2011) and follow-up (2014), stratified according to groups of FS/FI outcomes over time. For the analysis of the change in frequency of consumption, the differences ( $\Delta$ ) in the proportion of each food item between 2011 and 2014 were calculated. The McNemar test for paired samples was used to estimate differences between 2011 and 2014 in the total sample and in the groups of outcomes of FI. Values of  $p < 0.05$  and  $p < 0.001$  were considered for statistical significance. The analyzes were performed using the Stata IC 15.0 program [23].

The Research Ethics Committee of the State University of Paraíba and the University Hospital Alcides Carneiros of the Federal University of Campina Grande approved the research in 2011 (Certificate of Ethical Appreciation Presentation: 0102.0.133.000-11) and 2014 (Certificate of Ethical Appreciation Presentation: 30919314.6.0000.5182), respectively. All interviewees signed an informed consent form.

## RESULTS

Most subjects were female (86.3%), mean age was  $44.6 \pm 0.98$  years at baseline (2011) and  $47.6 \pm 0.97$  at follow-up (2014). More than half of the population studied lived in the urban area (2011: 68.1%; 2014: 68.8%) with less than 8 years of schooling (incomplete elementary school), both in 2011 (71.4%) and in 2014 (70.4%). In 2011, 39.9% of individuals lived in families with an income of up to  $\frac{1}{4}$  minimum wage and in 2014 this percentage reduced to 33.2%. Regarding the prevalence of FI, 30.6% of the investigated population was facing FI at both periods of the study, 23.2% changed from FI to FS, 38.9% remained in FS at both periods, and 7.3% changed from FS to FI.

When comparing the baseline and follow-up results, a significant difference was observed in the frequency of food consumption over time, with an increase in the frequency of consumption of milk and dairy (whole and skimmed milk, yogurt, *requeijão* cheese), chicken meat, eggs and ham-type meat (cold-pressed canned meat), bread, tubers (cassava and sweet potatoes), vegetables/legumes (beetroot, carrots, cabbage, potatoes, tomatoes) and all fruits, and a decrease in the frequency of consumption of pumpkin (Table 1).

**Table 1** – Frequency of food consumption in the two study periods (n=301). Cuité (PB), Brazil, 2011-2014.

Foods	Periods		$\Delta$
	2011 ( <i>baseline</i> )	2014 ( <i>follow-up</i> )	
	Weekly-daily (%)	Weekly-daily (%)	
Whole Milk	47.6	58.5	+10.9*
Skimmed Milk	10.4	15.7	+5.3*
Yogurt	26.1	33.2	+7.1*
Cheese	45.5	43.2	-2.3
<i>Requeijão</i> cheese	7.1	12.0	+4.9*
Meat, beef	82.7	83.1	+0.4
Meat, chicken	76.8	86.4	+9.6**
Meat, ham-type	5.4	12.0	+6.6*
Chicken nuggets	5.0	8.0	+3.0
Hot dogs	18.4	19.3	+0.9
Sausages	20.8	24.3	+3.5
Ham or bologna	30.1	33.6	+3.5
Eggs	60.2	71.1	+10.9*
Bread	76.1	87.4	+11.3**
Carbonated drinks	38.0	35.9	-2.1
Industrialized juices	43.4	42.2	-1.2
Cassava	28.0	34.2	+6.2*
Sweet potato	33.3	53.2	+19.9**
Foods	2011 ( <i>baseline</i> )	2014 ( <i>follow-up</i> )	$\Delta$
	Consumed in the last 3 months (%)	Consumed in the last 3 months (%)	
<b>Fruits</b>			
Avocado	19.1	30.7	+11.6*
Pineapple	48.0	59.0	+11.0**
Banana	87.7	91.4	+3.7*
Guava	48.8	57.3	+8.5*
Orange	64.7	74.7	+10.0*
Apple	61.8	71.3	+9.5*

**Table 1** – Frequency of food consumption in the two study periods (n=301). Cuité (PB), Brazil, 2011-2014.

Foods	2011 ( <i>baseline</i> )		2014 ( <i>follow-up</i> )		Δ
	Consumed in the last 3 months (%)		Consumed in the last 3 months (%)		
Papaya	56.4		65.1		+8.7*
Melon/Watermelon	34.7		49.3		+14.6**
Mango	17.2		51.5		+34.3**
Grape	46.8		58.7		+11.9*
Legumes/Vegetables					
Lettuce	71.9		72.7		+0.8
Beet	30.0		40.5		+10.5*
Carrot	53.4		79.3		+25.9**
Kale	19.1		33.3		+14.2**
Pumpkin	76.6		49.5		-27.1**
Cucumber	18.9		21.7		+2.8
Cabbage	27.9		31.0		+3.1
Potato	58.9		76.3		+17.4**
Tomato	85.3		91.3		+6.0*

Note: McNemar test: \* $p < 0.05$  and \*\* $p < 0.001$ . Meat, ham-type: cold-pressed canned meat. Weekly-daily: Consumption between 1 time a week and 2 or more times a day.

Tables 2, 3 and 4 present food frequency according to categories of change in FS/FI at baseline and follow-up. In 2011, when comparing the three groups of changes in FS/FI over time, there was a higher frequency for foods: milk and dairy items, meats and eggs, bread, soft drinks and most fruits and vegetables among individuals from families classified as FS at both periods, when compared to the other groups of families who started the study as FI. At follow-up, an increase in consumption was noted in the three comparison groups investigated, based on the initial and final classification of the families' FS/FI situation.

**Table 2** – Frequency of food consumption among individuals from families classified in food security in the two study periods (n=117). Cuité (PB), Brazil, 2011-2014.

Foods	Food security in both periods		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Whole Milk	54.3	60.7	+6.4
Skimmed Milk	14.5	23.3	+8.8*
Yogurt	37.6	50.4	+12.8*
Cheese	66.7	64.1	-2.6
Requeijão cheese	13.8	21.4	+7.6
Meat, beef	90.6	85.5	-5.1
Meat, chicken	82.6	85.5	+2.9
Meat, ham-type	5.8	8.6	+2.8
Chicken nuggets	6.8	6.8	-
Hot dogs	18	11.1	-6.9
Sausages	23.1	25.6	+2.5
Ham or bologna	31.9	35	+3.1
Eggs	62.4	76.9	+14.5*
Bread	82.1	90.6	+8.5*
Carbonated drinks	44.4	38.5	-5.9

**Table 2** – Frequency of food consumption among individuals from families classified in food security in the two study periods (n=117). Cuité (PB), Brazil, 2011-2014.

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Foods	Food security in both periods		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Industrialized juices	35.6	28.2	-7.4
Cassava	37.6	44.4	+6.8
Sweet potato	36.8	55.6	+18.8**
Foods	2011	2014	Δ
	Consumed in the last 3 months (%)	Consumed in the last 3 months (%)	
Fruits			
Avocado	22.6	35.9	+13.3*
Pineapple	61.5	67.5	+6.0
Banana	89.7	93.2	+3.5
Guava	51.5	57.3	+5.8
Orange	70.9	81.2	+10.3*
Apple	73.5	76.1	+2.6
Papaya	63.8	77.8	+14.0*
Melon/Watermelon	44.4	63.3	+18.9**
Mango	21.6	60.3	+38.7**
Grape	59	71.8	+12.8*
Legumes/Vegetables			
Lettuce	82.9	82.9	-
Beet	40.2	46.2	+6.0
Carrot	65.5	83.8	+18.3**
Kale	30.8	47	+16.2**
Pumpkin	78.6	59.8	-18.8*
Cucumber	31.6	32.5	+0.9
Cabbage	39.3	43.6	+4.3
Potato	63.8	76.9	+13.1*
Tomato	88.9	90.6	+1.7

Note: McNemar test: \* $p < 0.05$  and \*\* $p < 0.001$ . Meat, ham-type: cold-pressed canned meat. Weekly-daily: consumption between 1 time a week and 2 or more times a day.

**Table 3** – Frequency of food consumption among individuals from families classified as food insecure at both periods (n=92). Cuité (PB), Brazil, 2011-2014.

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Foods	Food insecurity in both periods		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Whole Milk	42.7	54.4	+11.7
Skimmed Milk	7.9	4.3	-3.6
Yogurt	14.4	13	-1.4
Cheese	25.6	22.8	-2.8
Requeijão cheese	2.22	4.35	+2.1
Meat, beef	76.9	81.5	+4.6
Meat, chicken	68.1	90.2	+22.1**
Meat, ham-type	4.5	14.1	+9.6*
Chicken nuggets	4.4	8.7	+4.3
Hot dogs	22.2	30.4	+8.2
Sausages	17.8	26.1	+8.3

**Table 3** – Frequency of food consumption among individuals from families classified as food insecure at both periods (n=92). Cuité (PB), Brazil, 2011-2014.

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Foods	Food insecurity in both periods		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Ham or bologna	32.8	38.0	+5.2
Eggs	56.7	63.0	+6.3
Bread	68.5	82.6	+14.1*
Carbonated drinks	28.6	38	+ 9.4
Industrialized juices	28.6	38	+9.4
Cassava	56.0	60.9	+4.9
Sweet potato	30.8	52.2	+21.4**
Foods	2011	2014	Δ
	Consumed in the last 3 months (%)	Consumed in the last 3 months (%)	
<b>Fruits</b>			
Avocado	17.6	27.2	+9.6
Pineapple	35.6	48.9	+13.3*
Banana	87.0	89.1	+2.1
Guava	50.0	60.9	+10.9
Orange	59.8	69.6	+9.8*
Apple	58.7	64.1	+5.4
Papaya	46.7	55.4	+8.7
Melon/Watermelon	23.1	39.1	+16.0*
Mango	10.0	42.4	+32.4**
Grape	36.7	45.7	+9.0
<b>Legumes/Vegetables</b>			
Lettuce	65.6	64.8	-0.8
Beet	21.3	36.3	+15.0*
Carrot	45.6	75.8	+30.2**
Kale	5.6	23.1	+17.5**
Pumpkin	77.8	34.8	-43.0**
Cucumber	4.55	13.2	+8.65
Cabbage	15.7	19.8	+4.1
Potato	52.7	76.9	+24.2**
Tomato	81.1	90.1	+9.0*

Note: McNemar test: \* $p < 0.05$  and \*\* $p < 0.001$ . Meat, ham-type: cold-pressed canned meat. Weekly-daily: Consumption between 1 time a week and 2 or more times a day.

**Table 4** – Frequency of food consumption among individuals from families classified as food insecure at baseline and food secure at follow-up (n=70). Cuité (PB), Brazil, 2011-2014.

1 of 2

Foods	Changed to food security at follow-up		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Whole Milk	44.9	62.9	+18.0*
Skimmed Milk	7.1	15.7	+8.6
Yogurt	20	31.4	+11.4
Cheese	40.4	41.4	+1.0
Requeijão cheese	1.45	8.6	+7.15
Meat, beef	78.6	84.3	+5.7
Meat, chicken	79.7	84.3	+4.6
Meat, ham-type	5.8	11.4	+5.6



**Table 4** – Frequency of food consumption among individuals from families classified as food insecure at baseline and food secure at follow-up (n=70). Cuité (PB), Brazil, 2011-2014.

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Foods	Changed to food security at follow-up		Δ
	2011	2014	
	Weekly-daily (%)	Weekly-daily (%)	
Chicken nuggets	2.9	8.6	+5.7
Hot dogs	15.7	20	+4.3
Sausages	18.8	15.7	-3.1
Ham or bologna	25.7	21.4	-4.3
Eggs	57.1	72.9	+15.8*
Bread	80	90	+10
Carbonated drinks	37.1	28.6	-8.5
Industrialized juices	41.1	35.7	-5.4
Cassava	18.6	30	+11.4
Sweet potato	34.3	50	+15.7*
Foods	2011	2014	Δ
	Consumed in the last 3 months (%)	Consumed in the last 3 months (%)	
<b>Fruits</b>			
Avocado	17.1	29	+11.9
Pineapple	44.9	56.5	+11.6
Banana	85.7	90	+4.3
Guava	47.4	56.5	+9.1
Orange	62.3	72.5	+10.2
Apple	50	75.4	+25.4**
Papaya	55.7	60	+4.3
Melon/Watermelon	35.7	42	+6.3
Mango	19.1	47.8	+28.7**
Grape	44.3	60.9	+16.6*
<b>Legumes/Vegetables</b>			
Lettuce	68.6	62.9	-5.7
Beet	24.6	39.1	+14.5*
Carrot	45.7	74.3	+28.6**
Kale	17.4	25.7	+8.3
Pumpkin	72.9	51.4	-21.5*
Cucumber	14.3	17.4	+3.1
Cabbage	30	28.6	-1.4
Potato	55.7	75.7	+20.0*
Tomato	82.9	92.9	+10.0*

Note: McNemar test: \* $p < 0.05$  and \*\* $p < 0.001$ . Meat, ham-type: cold-pressed canned meat. Weekly-daily: Consumption between 1 time a week and 2 or more times a day.

In the group of FS residents at the two investigated periods (baseline and follow-up) (Table 2), in the “weekly-daily” category, there was a significant increase in the consumption frequency of sweet potato (+18.8%), eggs (+14.5%), yogurt (+12.8%), skimmed milk (+8.8%) and bread (+8.5%), and in the category of “consumed in the last three months” for mango (+38.7%), watermelon (+18.9%), carrot (+18.3%), kale (+16.2%), papaya (+14.0%), avocado (+13.3%), potato (+13.1%), grape (+12.8%) and orange (+10.9%).

Among the individuals facing FI at the two investigated periods (Table 3), there was a significant increase in the “weekly-daily” food frequency of chicken (+22.1%), sweet potato (+21.4%), bread (+14.1%) and ham-type meat (+9.6%). In fruits, the increase in frequency was observed for mango (+32.4%), watermelon (+16.0%), pineapple (+13.3%) and orange (+9.8%) and in vegetables for carrot (+30.2%), potato (+24.2%), cabbage (+17.5%), beet (+15.0%) and tomato (+9.0%).

Among individuals in FI at baseline and in FS at follow-up (Table 4), there was a significant increase in the consumption of eggs (+15.8%), sweet potato (+15.7) and whole milk (+18.0%); as well as mango (+28.7%), apple (+25.4%) and grape (+16.6%) and vegetables such as carrot (+28.6%), potato (+20%), beet (+14.5%) and tomato (+10%).

## DISCUSSION

The results of this study showed an increase in the frequency of food consumption in the three groups of FS/FI outcomes studied, expressing an improvement in access to food between 2011 and 2014. This improvement was also observed among individuals from families classified as facing some level of FI in both stages, which corroborates the reduction in the prevalence and severity of FI in this population, revealed in a previous study [21]. The improvement in the FI situation occurred in a period marked by the federal government's investment in governmental initiatives to promote FNS, with an agenda focused on income redistribution, strengthening the minimum wage and encouraging family-farming agricultural production [24].

According to the POF, using the budget methodology to assess food consumption, *in natura* or minimally processed foods made a significant contribution to the food consumption of Brazilians between 2017 and 2018 [25]. Among these foods, beans, rice, pasta, fruits, vegetables, legumes, meats, milk, roots and tubers made the greatest contribution to this consumption. Concerning processed foods, the ones with the greatest contribution to Brazilian consumption were bread and cheese, while among the ultra-processed foods, the greatest contribution was from sausages and cold cuts, sweets and biscuits, savory crackers, margarine, cakes and pies, sweets in general, chocolate and carbonated drinks [25].

Fresh or minimally processed foods had a greater share in consumption in the Northeast and North, while the share of ultra-processed foods was higher in the Southeast and South, and lower in the Northeast and North [25]. When comparing the last three POF surveys (2002-2003, 2008-2009 and 2017-2018), one can observe a decrease in the contribution of food consumption referring to *in natura* or minimally processed foods and processed culinary ingredients. On the other hand, surveys indicated an increase in the percentage of processed and ultra-processed foods [25].

The literature points out that the levels of FS/FI of families influence the frequency of consumption of food by their members so that in situations of FI, where access to quality and quantity of food is impaired, the food choices of residents have repercussions also in the frequency of purchased foods [26]. So far, longitudinal studies on food consumption and FI with the Brazilian adult/elderly population are not yet available. In a longitudinal study of pregnant women in Bangladesh, South Asia, Na et al. [27] reported that maternal dietary diversity, as assessed by FFQ, mainly intake of animal source foods (meat, dairy products, fish, and eggs), fruits (yellow and orange ones), vegetables, nuts and legumes decreased with FI worsening.

As for cross-sectional studies, national studies showed a lower frequency of milk and dairy, vegetables, meat and soft drinks in Campinas (SP) [11]. It was observed in a cross-sectional study carried out in Belo Horizonte (MG), Araújo et al. [17] lower consumption of vegetables and fruits, and higher consumption of beans and tubers among families facing FI compared to families in FS; still, according to the authors, there was no association between FI and the consumption of ultra-processed foods in the study. In the Federal District, Dos Santos et al. [28] reported a negative association between FI and the consumption of beans, vegetables and fruits. In agreement, Franco et al. [29] investigating the population of Palmeira das Missões (RS), observed that the presence

of FS showed a relationship between fruit consumption and the habit of eating breakfast. In the population evaluated in this study, which was located in the semi-arid region of Paraíba, an increase in the frequency of consumption of some ultra-processed foods was observed in the group facing FI at both periods, which did not occur in the other groups.

Food consumption is defined by individual choices and also by cultural characteristics, availability, access, taste, food prices and income [30]. Family income, an important determinant of FI [31], is associated with increased consumption of some foods in the diet, especially those sources of animal protein, fruits and vegetables, indicating a strong relationship in the qualitative and quantitative choices of foods [32,33].

In this sense, 17.5% of the average monthly family expenditure of the Brazilian population was on food between 2017 and 2018. In Brazil, the average family expenditure on food was R\$ 658,23, with an average of R\$ 587,11 in the Northeast. The minimum monthly family income *per capita* of the Brazilian population was higher in the Southeast (R\$ 671,73), falling to R\$ 215,54 in the South, R\$ 250,33 in the Northeast, R\$ 76,86 in the North and R\$ 117,12 in the Midwest [25]. In the 2017/2018 POF, when comparing the food and transportation groups, it was observed that food weighed more for individuals with incomplete/complete primary education and incomplete high school education [25].

Facchini et al. [34] state that insufficient purchasing power, aggravated by high food prices, is a decisive factor in the maintenance of FS. In this way, the increase in purchasing power is as important as the availability of food for overcoming FI situations. Suggesting that overcoming FI and changes in the frequency of food consumption are strongly mediated by family income.

Among the foods considered to be of local agricultural vocation there was a significant reduction in the frequency of consumption of pumpkin and a significant increase in the frequency of mangoes and sweet potatoes, in the three investigated FS/FI outcomes [35]. Thus, another important factor for the discussion of food consumption and FI is the seasonality of food production – that is, the time when food availability, such as fruits and vegetables, is greater and at a lower cost when compared to the off-season period, expressing the importance of seasonality and family food production for access to food, especially among vulnerable families [36]. On the other hand, the low capacity for food production in the region, given the challenges inherent to the semi-arid region, can also be a factor that compromises access to food.

The low consumption of *in natura* and minimally processed foods, such as fruits and vegetables, and the consumption of ultra-processed foods are dietary risk factors for the development of chronic non-communicable diseases and exposes FI individuals to chronic non-communicable diseases [37]. The FI, in addition to being a violation of rights, is also a risk factor for health.

This study has limitations that must be considered. The sample size made it impossible to statistically analyze all FI outcomes over time, as well as to analyze food consumption from a greater number of frequency categories, thus differentiating daily, weekly, or monthly consumption. Another limitation is related to the use of the FFQ, an instrument that is less accurate in describing food consumption because it uses standardized measures and a pre-established list of foods. Thus, caution is needed in generalizing the results presented. Despite this, the robust longitudinal design and the use of longitudinal categories of FI change, still little applied in research in Brazil, are strengths of the study, and these results encourage debate and future research on the subject, especially given the lack of studies of the type in the area.

## CONCLUSION

The results describe distinct changes in the frequency of food consumption among adults and elderly people from families in different food security situations over time, showing an improvement in access to food. Overcoming FI results in positive changes in the food consumption profile, as well as the persistence of FI is an exposure factor for the consumption of industrialized foods with low nutritional value.

Food seasonality is also a promoting and limiting factor in food consumption, essentially among families facing FI, which strengthens the importance of public policies that stimulate the local agricultural vocation for overcoming and minimizing FI. More studies that seek to investigate the relationship between food consumption and FI in a longitudinal manner should be encouraged.

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## CONTRIBUTORS

PA PALMEIRA coordinated data collection, analyzed the results, and wrote the manuscript. JSL LAURENTINO and CCS CHEROL analyzed the data and wrote the article. R SALLES-COSTA revised the manuscript.