




## Short Communication

# Food insecurity and weight status of socially vulnerable child beneficiaries of a food assistance programme in Maceió, Northeast Brazil

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### Abstract

**Objective:** To evaluate the association between weight status and food insecurity of children living in social vulnerability who are beneficiaries of a food assistance programme (FAP).

**Design:** Cross-sectional study.

**Setting:** From all children benefiting from the FAP in the municipality, 30 % were mapped in forty-seven distribution points. Their weight status was evaluated using BMI-for-age and food insecurity was determined with the Brazilian Food Insecurity Scale. Socio-economic data of the participants were collected using regular questionnaires. The main outcome measure was obesity.

**Participants:** To be a beneficiary of the FAP, a family must have a child aged 24–96 months and receive less than half a minimum wage per capita. Participating families receive 1 litre of whole milk per day.

**Results:** In all, 1487 children had BMI-for-age and food insecurity data. Of these children, 376 (25.3 %) had excess weight, of whom 164 (11.0 %) presented with obesity, and only twenty-seven (1.8 %) were underweight; 76 % of the families had some degree of food insecurity. Multivariable analysis revealed no overall association between household food insecurity and weight status. In the specific comparison, children living in severe food insecurity were less likely to present obesity than those children living in food security (prevalence ratio = 0.60; 95 % CI 0.38, 0.96;  $P = 0.03$ ).

**Conclusions:** In a socially vulnerable population that participates in a FAP, there was no overall association between food insecurity and weight status in children, a result which is similar to what is observed in more developed contexts.

### Keywords

Undernutrition

Obesity

Food insecurity

Social vulnerability

Food assistance programme

The relationship between food insecurity and the weight status of populations is quite heterogeneous, depending on the socio-economic situation and age group of the studied population<sup>(1–3)</sup>. Evidence shows that in vulnerable populations in developed countries, there is a positive relationship between food insecurity and obesity, particularly in adult women<sup>(4,5)</sup>. This relationship seems to be less clear with regard to children<sup>(6,7)</sup>. Moreover, there is evidence that participation in government food-supply programmes, such as

food assistance programmes (FAP), seems to be a possible confounding factor in this relationship<sup>(8)</sup>. Investigations in adults demonstrate that participation in these programmes is associated with increased BMI in food-insecure households<sup>(9)</sup>, but longitudinal evidence does not corroborate these findings<sup>(10)</sup>. Although more scarce, studies in children indicate that participation in such programmes seems to reduce the risk of obesity in those children living in food-insecure households, at least in developed countries<sup>(11,12)</sup>.

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In Brazil, several national and local policies and programmes converge to improve the food security of the population<sup>(13,14)</sup>. The sample from the present study participates in a FAP, referred to as the Milk Program, which aims to encourage family farming and to promote food access to poor families. The government purchases milk produced by local farmers and donates 1 litre of whole milk per day to families in social vulnerability with at least one child aged 24–96 months, with the aim to improve child development during this crucial stage. In Maceió, Alagoas, the municipality of the present study, about 20% of the population is considered poor and/or extremely poor, and the Milk Program benefits about 15 000 families<sup>(15,16)</sup>. Among families that were beneficiaries of a cash-transfer programme in Maceió, 33% were in severe food insecurity and only 6.5% of the children had excess weight<sup>(17)</sup>. Considering that individuals in cash-transfer programmes do not necessarily use the financial resources received to buy food, the crosstalk between food security status and weight status among families in FAP, in this setting, remains unclear. The present study aimed to determine the association between household food insecurity and the weight status of children who are beneficiaries of the Milk Program in the municipality of Maceió, Alagoas, Northeast Brazil.

## Methods

### *Experimental design*

Cross-sectional study. The data collected for the present analysis arise from an initiative of the local government to independently assess the effectiveness of the Milk Program in reducing food insecurity and undernutrition in the participating population. All data were collected by individuals who are part of the research team of the authors. The study was approved by the local institutional review board and the head of each included family gave written informed consent.

### *Location and sample selection*

Children aged 24–96 months who belonged to beneficiary families of the Milk Program of the municipality of Maceió were included. To be eligible for this programme, the family must present a monthly income of less than half a minimum wage per capita.

At the time of collection, there were 106 milk distribution points in Maceió. For the study, the forty-seven points that had the longest participation time in the Program were identified. After selecting each point and quantifying the people, it was defined for convenience to use 30% of the beneficiaries of the forty-seven distribution points, totalling 3426 children in 2036 households. Because 1390 households had more than one child, the youngest child from each of these households was evaluated, totalling 2036 children. From these children, 538 (26.4%) did not

have complete anthropometric data and eleven (0.5%) presented a BMI-for-age Z-score (BAZ) that was  $<-5$  or  $>+5$ , and/or a height-for-age Z-score (HAZ) that was  $<-6$  or  $>+6$ , and were excluded, totalling 1487 children initially included in the analysis.

### *Variables*

The anthropometric variables were weight and height. The socio-economic variables were: sex of the child; sex, education (illiterate/literate) and labour status (work/not working) of the household's responsible adult; and household crowding index (i.e. the number of resident individuals divided by the number of rooms in the household). These socio-economic data were collected through a previously tested questionnaire. The questionnaire of the Brazilian Food Insecurity Scale was used to evaluate the food security situation of the families<sup>(18)</sup>. The questionnaires were reviewed and tabulated in the Epi Info™ version 7.0 software (Centers for Disease Control and Prevention, Atlanta, GA, USA, 2013).

### *Anthropometry*

The children, wearing light clothes, barefoot and without diapers, were weighed using a portable digital scale with a precision of 100 g. Height was measured using a portable stadiometer, with a precision of 1 mm. The children were measured barefoot, positioned with their feet parallel, arms relaxed and palms facing the body.

The children's weight and height obtained in the collection were used to calculate their HAZ and BAZ with the aid of the WHO Anthro and AnthroPlus software. Children were considered stunted when they presented a HAZ  $<-2$ . Regarding body weight, those children with a BAZ  $<-2$  were considered underweight; those with a BAZ between  $-2$  and  $+1$  as normal weight; those with a BAZ between  $+1$  and  $+2$  as overweight; and those children with a BAZ  $\geq +2$  as presenting with obesity.

### *Food security*

Based on the questionnaire of the Brazilian Food Insecurity Scale with fourteen questions, the food security level of each household was classified into four categories: (i) food security, when the household has regular and permanent access to quality food; (ii) mild food insecurity, when the household is concerned or uncertain about the future availability of food in quantity or quality; (iii) moderate food insecurity, when there is a quantitative reduction of food and/or a break in eating patterns among adults; and (iv) severe food insecurity, when quantitative reduction and/or rupture occurs among children, or when there is food deprivation and hunger<sup>(18)</sup>.

### *Statistical analysis*

The main outcome was obesity (BAZ  $\geq +2$ ). The main exposure was the four household food security classes. The following variables were investigated as confounding factors: age, sex and stunting of the child; sex, literacy and



labour status of the person in charge of the household; and the household crowding index. Univariable associations between exposure and outcomes and between exposure and confounding factors were measured using the  $\chi^2$  test. Poisson regression models with robust estimates of variances were constructed to estimate the prevalence ratio of the outcomes among the four classes of food insecurity, adjusted for the confounding factors<sup>(19)</sup>. These factors were selected because they were at the most distal hierarchical level in relation to the outcomes, thus avoiding problems of multicollinearity in the model, because many of the socio-economic variables are associated with each other. To compare the length of participation in the programme among the four classes of food insecurity, ANOVA was used. To better explore the relationship between food security and overweight/obesity, and to avoid aggregation of underweight children with normal-weight children, the former class of children were excluded from the inferential analysis, resulting in 1460 children. In all cases, a significance level of 5 % was adopted. Statistical analysis was performed using the software R version 3.5.1 (R Foundation for Statistical Computing, Vienna, Austria), with the packages 'Rcmdr' and 'sandwich'.

## Results

Table 1 shows the characteristics of the studied sample. Regarding food insecurity classification, 357 (24.0 %) of

the families were in food security, and 407 (27.4 %) were in mild, 402 (27.0 %) in moderate and 321 (21.6 %) were in severe food insecurity. The families were participating in the Milk Program for a mean time of 26.7 (SD 19.0) months, a result which was similar among the four categories of food insecurity ( $F=0.108$ ,  $df=1486$ ,  $P=0.95$ ). There were only two significant differences between the included children and those children excluded from the analysis because of insufficient or inadequate anthropometric data ( $n=549$ ). The head of the families of the included children had a lower unemployment rate (46.6 *v.* 39.3 %;  $P<0.01$ ) and lower illiteracy (34.2 *v.* 28.9 %;  $P=0.02$ ).

The multivariable association between food insecurity and weight status in the 1460 children without underweight is provided in Table 2. No overall association was found. In the specific comparison, children living in a household with severe food insecurity were less likely to present obesity than those children living in a food-secure household (prevalence ratio = 0.60; 95 % CI 0.38, 0.96;  $P=0.03$ ).

## Discussion

The present study demonstrated that, in a highly socially vulnerable population participating in a FAP with the direct donation of whole milk, there was no overall association between food insecurity and weight status of children aged 24–96 months. Nevertheless, children who lived in a severely food-insecure household were less likely to

**Table 1** Socio-economic characteristics of the families and weight status of the child beneficiaries of the Milk Program in Maceió, Alagoas, Northeast Brazil ( $n=1487$ )

Variable	Category	Brazilian Food Insecurity Scale										<i>P</i> *
		Overall ( $n=1487$ )		Food security ( $n=357$ )		Mild food insecurity ( $n=407$ )		Moderate food insecurity ( $n=402$ )		Severe food insecurity ( $n=321$ )		
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	
Sex of the child	Female	760	51.1	178	49.9	204	50.1	208	51.7	170	53.0	0.82
	Male	727	48.9	179	50.1	203	49.9	194	48.3	151	47.0	
Age of the child	24–60 months	824	55.4	194	54.3	241	59.2	223	55.5	166	51.7	0.22
	60–96 months	663	44.6	163	45.7	166	40.8	179	44.5	155	48.3	
Sex of the responsible adult	Female	794	53.4	206	57.7	226	55.5	199	49.5	163	50.8	0.08
	Male	693	46.6	151	42.3	181	44.5	203	50.5	158	49.2	
Responsible adult illiterate	Yes	429	28.9	84	23.5	95	23.3	113	28.1	137	42.7	<0.01
	No	1058	71.1	276	76.5	312	76.7	289	71.9	184	57.3	
Responsible adult employed	Yes	903	60.7	243	68.1	249	61.2	237	59.0	174	54.2	<0.01
	No	584	39.3	114	31.9	158	38.8	165	41.0	147	45.8	
HCI	<0.9	203	13.7	58	16.2	65	16.0	58	14.4	22	6.9	<0.01
	1.0 ≤ HCI < 2.0	889	59.8	237	66.4	260	63.9	231	57.5	161	50.2	
	>2.0	395	26.6	62	17.4	82	20.1	113	28.1	138	43.0	
Height-for-age	Normal	1397	93.9	337	94.4	383	94.1	383	95.3	294	91.6	0.21
	With stunting	90	6.1	20	5.6	24	5.9	19	4.7	27	8.4	
BMI-for-age	Underweight	27	1.8	7	2.0	9	2.2	9	2.2	2	0.6	0.21
	Normal weight	1084	72.9	247	69.2	288	70.8	297	73.9	252	78.5	
	Overweight	212	14.3	56	15.7	60	14.7	54	13.4	42	13.1	
	With obesity	164	11.0	47	13.2	50	12.3	42	10.4	25	7.8	

HCI, household crowding index.  
\**P* value for the  $\chi^2$  test.

**Table 2** Association between food insecurity, measured by the Brazilian Food Insecurity Scale (BFIS), and overweight or obesity status, measured by BMI-for-age Z-score (BAZ), of the child beneficiaries of the Milk Program in Maceió, Alagoas, Northeast Brazil (*n* 1460). Underweight children (*n* 27) were excluded from this analysis

Exposure	BAZ status				PR*	95 % CI	P value
	Normal weight (−2 < BAZ < +1) ( <i>n</i> 1084)		With obesity (BAZ ≥ +2) ( <i>n</i> 164)				
	<i>n</i>	%	<i>n</i>	%			
BFIS							0.17†
Food security	247	84.0	47	16.0	1.00	Ref.	–
Mild food insecurity	288	85.2	50	14.8	0.92	0.64, 1.33	0.66
Moderate food insecurity	297	87.6	42	12.4	0.80	0.54, 1.19	0.28
Severe food insecurity	252	91.0	25	9.0	0.60	0.38, 0.96	0.03
Exposure	BAZ status				PR*	95 % CI	P value
	Normal weight (−2 < BAZ < +1) ( <i>n</i> 1084)		With overweight (+1 < BAZ < +2) ( <i>n</i> 212)				
	<i>n</i>	%	<i>n</i>	%			
BFIS							0.68†
Food security	247	84.0	56	18.5	1.00	Ref.	–
Mild food insecurity	288	85.2	60	17.2	0.91	0.65, 1.26	0.58
Moderate food insecurity	297	87.6	54	15.4	0.84	0.60, 1.18	0.32
Severe food insecurity	252	91.0	42	14.3	0.81	0.56, 1.18	0.28

PR, prevalence ratio; ref., reference category.

\*Prevalence ratio of the individual living in a mildly, moderately or severely food-insecure household to present obesity (BAZ ≥ +2) or overweight (BAZ between +1 and +2), compared with the reference category. Analyses adjusted for the age, sex and height-for-age status of the children, illiteracy, occupation and sex of the responsible adult and household crowding index.

†P value for the omnibus test between BFIS status and BAZ status.

present with obesity compared with those children living in a food-secure household. In addition, the prevalence of food insecurity in the present population (76 %) was higher than that found in the state of Alagoas (58 %) (20) and in Brazil (22 %) (13).

The association between food insecurity and weight status in Brazilian children has not been explored to a significant degree. Different authors have investigated a national representative sample of children derived from the 2006 Brazilian Demographic and Health Survey, using various inclusion criteria and statistical approaches (21–23). Most of the authors did not report any significant association between food insecurity and weight status in this national representative sample (21,22), a result which is in accordance with the overall finding of our study. Nevertheless, one of the studies affirmed that household food insecurity was associated with worse anthropometric measures (23), which is in disagreement with the specific comparison presented in our study that showed that children living in severe food insecurity were actually less likely to present with obesity than those children living in food security. This result may possibly be because, as stated, the sample from the present study arises from a poorer population when compared with the national population.

The interaction among FAP participation, food security status and children's weight status is less clear (24). Nguyen *et al.* (11) studied 4–17-year-old Americans and did not find significant associations between household food security

and BAZ in the sub-sample of families participating in the Supplemental Nutrition Assistance Program. The authors affirmed the presence of a non-significant trend towards increasing BMI percentile with decreasing household food security in those participating in the National School Lunch Program. It is important to emphasize that these programmes differ from the Milk Program because they offer an increased variety of foods for their participants, subsequently contributing to increasing the dietary diversity and quality of the beneficiary families. In turn, the Milk Program provides only whole milk for the beneficiary families, thus substantially increasing the energy and protein intakes of the children. This impact can be seen in the lower prevalence of underweight and stunting found in this population in relation to the Brazilian population. However, in those families that remained in severe food insecurity, the prevalence of obesity was significantly lower than in food-secure families, indicating that in this population in extreme social vulnerability, the participation in a FAP with direct milk donation does not appear to result in increased obesity levels, in contrast to observations in other studies' contexts (12).

The present study has some limitations. First, the measure of food security used was at the household level, and not at the level of the child; and the Brazilian Food Insecurity Scale is a measure of the perceived food insecurity of the head of the family, an approach which may introduce bias in the results (25). Second, the measure of obesity used was





exclusively BAZ, with no additional measures of adiposity. Alone, BAZ may not be sufficiently sensitive to detect differences in adiposity in children, particularly in the leaner ones<sup>(26)</sup>. Third, it is common for longitudinal studies to present association estimates that differ from those estimates presented by cross-sectional studies<sup>(27,28)</sup>. Fourth, the absence of a control group prevented the formal analysis of the interaction between the participation in a FAP and the association between household food insecurity and obesity. Finally, we could not measure children's dietary intake and were therefore not able to assess its role as an effect modifier of the association between food insecurity and weight status. All families participating in this programme are formally instructed to give the milk received to their youngest children. Still, we are not able to state that the included children are receiving the donated milk. Hence, considering these limitations and the nature of the study, which used a convenience sampling and a cross-sectional design, conclusions must be taken cautiously. Nevertheless, the present work contributes in an important way to the discussion of the current theme because it brings a little-explored investigation since the population studied here is beneficiary of a FAP and resides in a place of extreme social vulnerability, thereby presenting another facet of the association between food insecurity and obesity. In addition, considering the sample size, the present study has adequate statistical power to detect significant differences, which increases the confidence in the estimates encountered.

### Conclusion

In conclusion, in a population that is extremely socially vulnerable and is beneficiary of a FAP, there were no overall associations between the household food security status and the weight status of children. Hence, even in a context of extreme social vulnerability, the association between these two variables is similar to what is observed in more developed contexts.

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This study was conducted according to the guidelines laid down in the Declaration of Helsinki and all procedures involving human subjects were approved by the Research Ethics Committee of the Federal University of Alagoas (protocol number 1,393,366). Written informed consent was obtained from all subjects.

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