

## ORIGINAL ARTICLE

# Sociodemographic factors and overweight in children participating in a government program for fortified milk distribution



Fernanda Martins Dias Escaldelai<sup>1</sup>, Rosangela Aparecida Augusto<sup>1</sup>, José Maria Pacheco de Souza<sup>2</sup>

<sup>1</sup>Faculdade de Saúde Pública da Universidade de São Paulo.  
Endereço: Av. Dr. Arnaldo, 715 - São Paulo - SP - Brasil.

<sup>2</sup>Professor Titular (aposentado) e Professor Sênior do Departamento de Epidemiologia da Faculdade de Saúde Pública da Universidade de São Paulo

**Corresponding author:**  
fernandamartins@usp.br

*Manuscript received: January 2018*  
*Manuscript accepted: April 2018*  
*Version of record online: June 2018*

## Abstract

**Introduction:** Previous studies have shown the effectiveness of the VIVALEITE Project for promoting weight gain in children under two years old. Given the program's effectiveness, children whose weight on entry was close to the normal limit for age may have become overweight during their participation.

**Objective:** To analyze the association between sociodemographic factors and overweight in participants of the VIVALEITE Project.

**Methods:** A cohort study with data on 1,039 infants from low-income families in the state of São Paulo enrolled on the VIVALEITE Program at six months of age with a weight near the upper limit of adequacy between January 2003 and September 2008 was conducted. The proportion of children that became overweight during participation in the program and associations with sociodemographic conditions of each child (breastfeeding at six months, sex and birth weight) and mother/guardian (marital status, age, employment status and education) were investigated. Modeling was performed using multilevel logistic regression of socioeconomic variables and ages at weighing. The Stata program version 10.1 was used for analysis.

**Results:** On multilevel analysis, the "yes" category of breastfeeding at six months (OR = 0.29,  $p = 0.001$ ) and maternal employment (OR = 0.36,  $p = 0.012$ ) were significantly associated with overweight in the children. The variables birth weight, sex, marital status, maternal age and education were not statistically associated with overweight.

**Conclusions:** The sociodemographic factors "not breastfeeding at six months" and "maternal unemployment" were positively associated with overweight among the infants participating in the program.

**Keywords:** fortified milk distribution program, nutrition programs and policies, infant, weight gain.

**Suggested citation:** Escaldelai FMD, Augusto RA, de Souza JMP. Sociodemographic factors and overweight in children participating in a government program for fortified milk distribution. *J Hum Growth Dev.* 2018; 28(2):129-138. DOI: <http://dx.doi.org/10.7322/jhgd.115676>

## INTRODUCTION

The prevalence of childhood obesity has risen in recent decades and become a global public health problem. The worldwide prevalence of overweight in infants under five, defined as weight-for-height (W/H)  $> +2$  Z-scores, rose by 4.2% in 1990 to 6.7% in 2010, representing a relative increase of 60%. The estimated prevalence of overweight is expected to reach 9.1% in 2020. The number of children at risk of overweight, defined as W/H  $> +1$  Z-score and  $\leq +2$  Z-scores, is also cause for concern. In 2010, an estimated 92 million children were in this situation, double the number of overweight children. The prevalence of children at risk of overweight was estimated at 21.4% and 13.6% in developed and developing countries, respectively<sup>1</sup>

In Brazil, data from the National Demography and Health Survey of Children and Women (PNDS 2006) revealed an overall prevalence of overweight in children under five of 6.6%, a rate of 6.7% in infants aged 0-11 months and 6.0% in children aged 12-23 months<sup>1</sup>.

Obesity has negative effects on child health in the short term, such as bone, joint and muscle problems<sup>2</sup>, breathing difficulties, and increased risk of fractures, hypertension and cardiovascular diseases, insulin resistance and psychological effects. Childhood overweight is associated with greater risk of obesity, disability and premature death in adulthood<sup>3</sup>. In the first months of life, excessive weight gain can predict obesity in later phases of life. Children obese at nine months are more predisposed to remaining overweight at four years of age compared to non-obese individuals<sup>4</sup>. Given the harmful effects posed by overweight for both child and adult health, preventive measures to control behaviors that lead to obesity should be implemented during the pre-natal period and early infancy<sup>5</sup>.

In 2008, a series of articles published in "The Lancet" addressed the importance of the period spanning from pregnancy to two years of age for child growth in deprived settings. This period, corresponding to the first 1000 days of life of the child, is considered one of great nutritional vulnerability. Good quality nutrition, including the availability of fortified foods and access to healthy foods to promote adequate growth in early infancy, can confer lifelong benefits, with prevention of undernutrition

<sup>1</sup>Brazil. Brazilian Center of Analysis and Planning. National Demography and Health Survey of Children and Women: PNDS 2006: final report. Brasilia: Ministry of Health; 2008.

## METHODS

### Study design, population and site

A dynamic cohort study was conducted involving children of both sexes enrolled at six months on the VIVALEITE program between January 2003 and September 2008. All children with weight-for-age (W/A) of between  $+1$  Z-score and  $\leq +2$  Z-scores, deemed adequate but bordering overweight, were followed until the age of 23 months. The children were from low-income families living in interior of São Paulo State.

### Data source

A sample of 1,039 children was drawn from the database of 25,433 participants in the study by AUGUSTO and SOUZA (2010)<sup>15</sup>. The children were participants in

and overweight<sup>6,7</sup>.

Up to the age of two, the factors most predominantly affecting weight gain are nutritional and social conditions<sup>8</sup>. Tracking weight gain is recommended as a means of monitoring nutritional status.

The sociodemographic factors generally associated with overweight in the first two years of life include those related to the infants, such as birth weight<sup>7,9</sup>, sex<sup>10</sup>, maternal breastfeeding<sup>11</sup>, and maternal factors such as age<sup>12</sup>, education<sup>13</sup>, employment status<sup>14</sup> and marital status<sup>12</sup>.

### Government fortified milk distribution program

In São Paulo, VIVALEITE, the State Milk Project has, since 1999, served children aged from six months to six years whose families have a monthly income of under two minimum wage<sup>ii</sup>. Under the program, each beneficiary receives 15 liters of fortified milk per month. In the interior of São Paulo state, the children are weighed and measured every four months, overseen by a healthcare professional. This information is sent to the Secretariat of Social Development to help track the anthropometric trajectory of the children during their participation in the program<sup>iii</sup>.

A survey carried out in 2009 demonstrated the effectiveness of the VIVALEITE program for promoting weight gain in children under two<sup>15</sup>. Given the program's proven effectiveness for weight gain, some children enrolling at a weight near the upper limit of normality for age may have become overweight during their participation. Therefore, the magnitude of this situation and sociodemographic variables associated with this excess weight gain were determined allowing actions to be taken by program managers.

Thus, the study objective was to determine the proportion of children that became overweight during the government milk distribution program and identify associations between sociodemographic factors and overweight status.

<sup>ii</sup>São Paulo (State). Decree n° 45.014, of 28th of June, 2000. Amending Decree n° 44.569, of 22 of December 1999, which enacted the State "Vivaleite" Milk Project. São Paulo State Gazette. 2000;110(123):4.

<sup>iii</sup>São Paulo (State). Decree n° 57.225, of 11th of August, 2011. Amends provisions of Decree n° 44.569, of 22nd of December 1999, which enacted the State "Vivaleite" Milk Project, and provides related measures. São Paulo State Gazette. 2011;121(152):1.

the VIVALEITE program, a social project for distribution of free liquid pasteurized milk containing at least 3% fat, enriched with iron and vitamins A and D. In January 2011, management of the program was transferred from the Secretariat of Agriculture to the Secretariat of Social Development.

In the study of Augusto and Souza<sup>15</sup>, the database comprised children enrolled on the program aged 6-21 months; with at least two weight measurements; non twins; healthy; and with complete enrollment records that included information on the child, their mother or guardian, and respective families. The enrolment of children on the program was independent of nutritional status and therefore beneficiaries with adequate and inadequate W/A were

included. The database contained 835 (3.3%) children with low W/A ( $< -2$  Z-scores), 23,689 (93.1%) with adequate W/A ( $-2$  Z-scores  $\leq$  to  $\leq +2$  Z-scores) and 909 (3.6%) with high W/A ( $> +2$  Z-scores) at first weighing session.

### Sample

In the original study<sup>15</sup>, the data of interest was collected using registration forms and spreadsheets for anthropometric follow-up, performed every four months as a routine part of the service.

Weight measurements of the children were taken at basic health units by trained professionals using appropriate calibrated weighing scales on entry, and every four months throughout their participation in the program. These measurements were converted into W/A and expressed as Z-scores, adopting the child growth standards of the World Health Organization (WHO) as a reference<sup>16</sup>. Children with  $< -5$  Z-scores or  $> +5$  Z-scores were excluded<sup>iv</sup>.

The completed records were keyed into an on-line system developed specifically for the program and held on a computerized database used to produce information for managers of the cities. The system incorporates filters to prevent inclusion of children that had incomplete records. The system allowed changes in W/A to be followed. At time of data collection, no filter was available for entering body length data. Thus, the consistency of length measurements could not be validated and this data was therefore not used in this study.

The inclusion criteria of the present study were:

- Program entry at six months of age. Inclusion of children of the same age was to avoid a possible confounding effect, given that intense growth occurs in infants during the first two years of life.
- Enrolment with a Z-score in the range  $+1 < z \leq 2$ , representing greater risk of overweight during subsequent weighing sessions<sup>v</sup>.
- Having data for at least two weighing sessions, the

first at entry and the others scheduled every four months up to the age of 23 months.

This gave a final sample of 1,039 children. Of the 23,689 children enrolled on the program with adequate W/A (Z-score in the range  $-2 \leq z \leq +2$ ), 8,147 (34.4%) were six months of age. Of this total, 1,386 (17.0%) had initial W/A in the range  $-2 \leq z < -1$ ; 5,722 (70.2%)  $-1 \leq z \leq 1$ ; and 1,039 (12.8%) had initial W/A of  $1 < z \leq 2$ , thereby satisfying the inclusion criteria.

Given the study involved a dynamic cohort, losses occurred over time. Overall, each child in the sample had between 2 and 5 weighing sessions. Out of the 1,039 children, 254 (24.5%) had two weighing sessions, 184 (17.7%) had three, 230 (22.1%) had four and 371 (35.7%) had data for five weighing sessions. In addition, scheduled four-monthly weighing sessions, i.e. at 10, 14, 18 and 22 months, were not always carried out, giving rise to unscheduled weighing sessions at 9, 11, 13, 15, 17, 19, 21 and 23 months.

Grouping ages at unscheduled weighing sessions with closest scheduled ages, revealed that 881 (84.8% of total sample of 1,039) had the second weighing session at 9-11 months, 729 (70.2%) had the third at 13-15 meses, 645 (62.1%) had the fourth at 17-19 months, and 541 (52.1%) had the fifth weighing session at 21-23 months. The majority of children underwent weighing sessions at the scheduled age.

### Variables

The response variable was “overweight” and dichotomous (yes/no). The “yes” category (code 1) corresponded to anthropometric classification of overweight ( $> 2$  Z-scores) children. The “no” category” (code 0) corresponded to normal weight, with Z-score in the range  $+1 < z \leq +2$ . Initially, all children had normal weight-for-age and during the course of their participation in the program, some of the children became overweight.

Explanatory variables were selected pertaining to the sociodemographic status of each child (age, sex, birth weight and breastfeeding at six months) and of their respective guardian (marital status, age, maternal employment status and education) (See table 1).

<sup>iv</sup>World Health Organization (WHO). Physical status: the use and interpretation of anthropometry. Report. Geneva: World Health Organization; 1995. (Technical Reports Series, 854).

<sup>v</sup>Brazil. Ministry of Health. Secretariat of Health Care. Department of Basic Care. Guidelines for collection and analysis of anthropometric data in health services: Technical Standard of the Nutritional and Food Surveillance System – SISVAN. Brasília: Ministry of Health; 2011.

**Table 1:** Variable, meaning and variable coding

Variable	Meaning	Code	
Response:		0	1
Overweight	Elevated weight status at the different weighing ages, in Z-scores	no ( $1 < z\text{-score} \leq 2$ )	yes ( $z\text{-score} > 2$ )
Explanatory:			
Breastfeeding at six months	Breastfeeding status at program entry	no	yes
Birth weight	Weight of infant at birth, in grams	$< 3000\text{g}$	$\geq 3000\text{g}$
Sex	Sex of child	male	female
Marital status	Marital status of mother or guardian	Without partner	With partner
Age of mother or guardian	Age of mother or guardian, by age bracket: 10-19 years (adolescent) and $\geq 19$ years (non-adolescent)	$\leq 19$ years	$> 19$ years
Employment status	Employment status of mother or guardian	Unemployed	Employed
Education	Years of education of mother or guardian	$\leq 8$ years	$> 8$ years
Child age at weighing	Child age at weighing, in months	6, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21, 22, 23	
Interaction	Interaction of child age variable, in months, with each explanatory variable	6, 9, 10, 11, 13, 14, 15, 17, 18, 19, 21, 22, 23	
Child identifier	Child identifier	5, ..., 182.872	

**Statistical Analysis**

The explanatory variables were analyzed in conjunction and for each age. The dichotomous response variable was employed to build logistic regression models. The effect measure was odds ratio (OR).

The sample is described at each age in terms of percentage. Graphs depict the percentage overweight and the modelled mean probabilities of becoming overweight for the variable of child age and for the explanatory variables in the final model, age by age at weighing. On graph plots, interactions of each explanatory variable with child age were disregarded when these had a descriptive p-value > 5% (significance level  $\alpha=5\%$ ).

Models were built for the group of ages at weighing using multi-level logistic regression, enabling adjustment for repeated observations in the same child by using the identification variable, for group of ages from 9 to 23 months.

The complete modelling sequence was performed via the following steps, where “overweight” was the response variable:

1) Multi-level multiple logistic regression with the following variables: child age at weighing, explanatory variables (breastfeeding at six months, birth weight, sex, marital status, age of mother or guardian, maternal employment status, and education) and the respective interactions (age at weighing X explanatory variable  $\iota$ ).

2) Multi-level multiple logistic regression with child age and explanatory variables, without interactions, when descriptive p-values of interactions > 5% in step 1.

3) Multi-level multiple logistic regression with child age and sociodemographic variables that had descriptive p-values  $\leq 5\%$  in step 2. Possible interaction among explanatory variables selected in this step (explanatory variable  $\iota$  X explanatory variable  $\iota'$ ) were analyzed.

4) Multi-level multiple logistic regression (final model) with child age and explanatory variables that had descriptive p-values  $\leq 5\%$  in step 3. Confounding effect was examined by comparing step 2 results with those of step 4.

Statistical analyses were performed using the Stata 10.1. statistical package.

**Ethical considerations**

The study was approved by the Research Ethics Committee. The ethics permit (CAAE) number for the study was 13543413.5.0000.5421. The study was based on analysis of the VIVALEITE program database, formally approved by the Secretariat for Agriculture and Supply of the State of São Paulo. The study was conducted in accordance with the ethical requirements set forth in resolution 196 of 10/10/1996 of the National Health Council.

**RESULTS**

The sociodemographic factors “not breastfeeding at six months” and “maternal unemployment” were positively associated with a greater prevalence of overweight. Length of time on the program was not associated with overweight of the children.

The prevalences of overweight found among program participants that enrolled at six months of age with W/A of  $1 < z \leq 2$  are shown in Table 2.

Multi-level analysis with child age alone indicated that the likelihood of being overweight at each age was, on average, 0.97 times the likelihood of being overweight at the preceding age, and was not statistically significant ( $p=0.457$ ). The prevalences and mean probabilities of overweight by child age at weighing in the models are depicted in Figure 1.

**Table 2:** Number and percentage of children that became overweight, and odds ratio (OR) relative to preceding age, by child age (months) at weighing.

Age (months)	Overweight		Total	OR
	No n	Yes n (%)		
9	121	44 (26.67)	165	1
10	457	109 (19.26)	566	0.66 #
11	131	19 (12.67)	150	0.61
13	94	33 (25.98)	127	2.42
14	387	82 (17.48)	469	0.60
15	110	23 (17.29)	133	0.99
17	83	21 (20.19)	104	1.21
18	339	87 (20.42)	426	1.01
19	91	24 (20.87)	115	1.03
21	72	26 (26.53)	98	1.37
22	272	78 (22.29)	350	0.79
23	76	17 (18.28)	93	0.78
Total	3,272	563 (14.68)	3,835	0.97 ##

# Example:  $(109 \times 121) / (44 \times 457) = 0.66$ ; ## At each age, on average, 0.97 times the odds ( $p=0,457$ ).

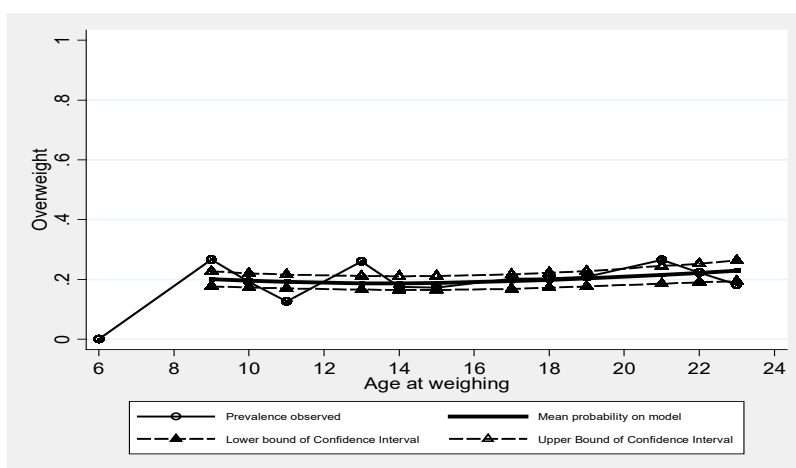


Figure 1: Prevalence and mean probabilities of overweight on model with confidence interval, according to child age (months) at weighing

### Child age and explanatory variables

Of the 1,039 enrollers on the program at six months of age with W/A of  $+1 < z \leq +2$ , 540 (52.0%) were being breastfed, 885 (85.2%) had birth weight  $\geq 3,000g$ , 542 (52.2%) were male, 783 (75.4%) had mothers with partner, 800 (77.0%) had mothers or guardians aged  $> 19$  years (non-adolescents), 859 (82.7%) had unemployed mothers, and 542 (52.2%) had mothers whose educational level was  $\leq 8$  years.

The multi-level analysis (Table 3) showed no statistically significant interaction ( $p > 0.05$ ) between child age and any of the explanatory variables. Interactions were not included in the subsequent models. Only the explanatory variables “breastfeeding at six months” (OR=0.28;  $p=0.001$ ) and “maternal employment status” (OR=0.37;  $p=0.015$ ) had a statistically significant association with overweight and were selected for step 3.

Table 3: Multi-level multiple logistic regression with child age (months) and the explanatory variables sex, birth weight, breastfeeding at six months, maternal age, education, marital status, employment status and respective interactions with child age (step 1) and without interactions (step 2).

Variables	Step 1 With interaction			Step 2 Without interaction		
	OR	p	CI (95%)	OR	p	CI (95%)
Child age (months)	0.98	0.838	0.81-1.18	0.96	0.317	0.88-1.04
Sex						
Male	1			1		
Female	0.46	0.270	0.12-1.82	0.57	0.054	0.32-1.01
Interaction of child age X sex	1.02	0.743	0.93-1.11			
Birth weight						
< 3,000g	1			1		
$\geq 3,000g$	3.16	0.254	0.44-22.8	1.22	0.633	0.54-2.77
Interaction of child age X birth weight	0.93	0.296	0.82-1.06			
Breastfeeding at six months						
No	1			1		
Yes	0.33	0.117	0.08-1.32	0.28	0.001	0.16-0.52
Interaction of child age X breastfeeding	0.99	0.834	0.90-1.09			
Maternal Age						
$\leq 19$ years	1			1		
$> 19$ years	0.30	0.132	0.06-1.43	0.86	0.666	0.44-1.69
Interaction of child age X maternal age	1.08	0.142	0.97-1.20			
Education						
$\leq 8$ years	1			1		
$> 8$ years	1.36	0.661	0.35-5.30	0.46	0.194	0.82-2.60
Interaction of child age X maternal education	1.00	0.903	0.92-1.01			
Marital status						
Without partner	1			1		
With partner	1.64	0.534	0.34-7.81	1.06	0.855	0.55-2.06
Interaction of child age X marital status	0.97	0.548	0.87-1.07			
Employment status						
Unemployed	1			1		
Employed	0.32	0.256	0.45-2.29	0.37	0.015	0.16-0.83
Interaction of child age X employment status	1.01	0.870	0.89-1.15			

OR: odds ratio; p: descriptive level of test; CI: interval of OR with 95% confidence.

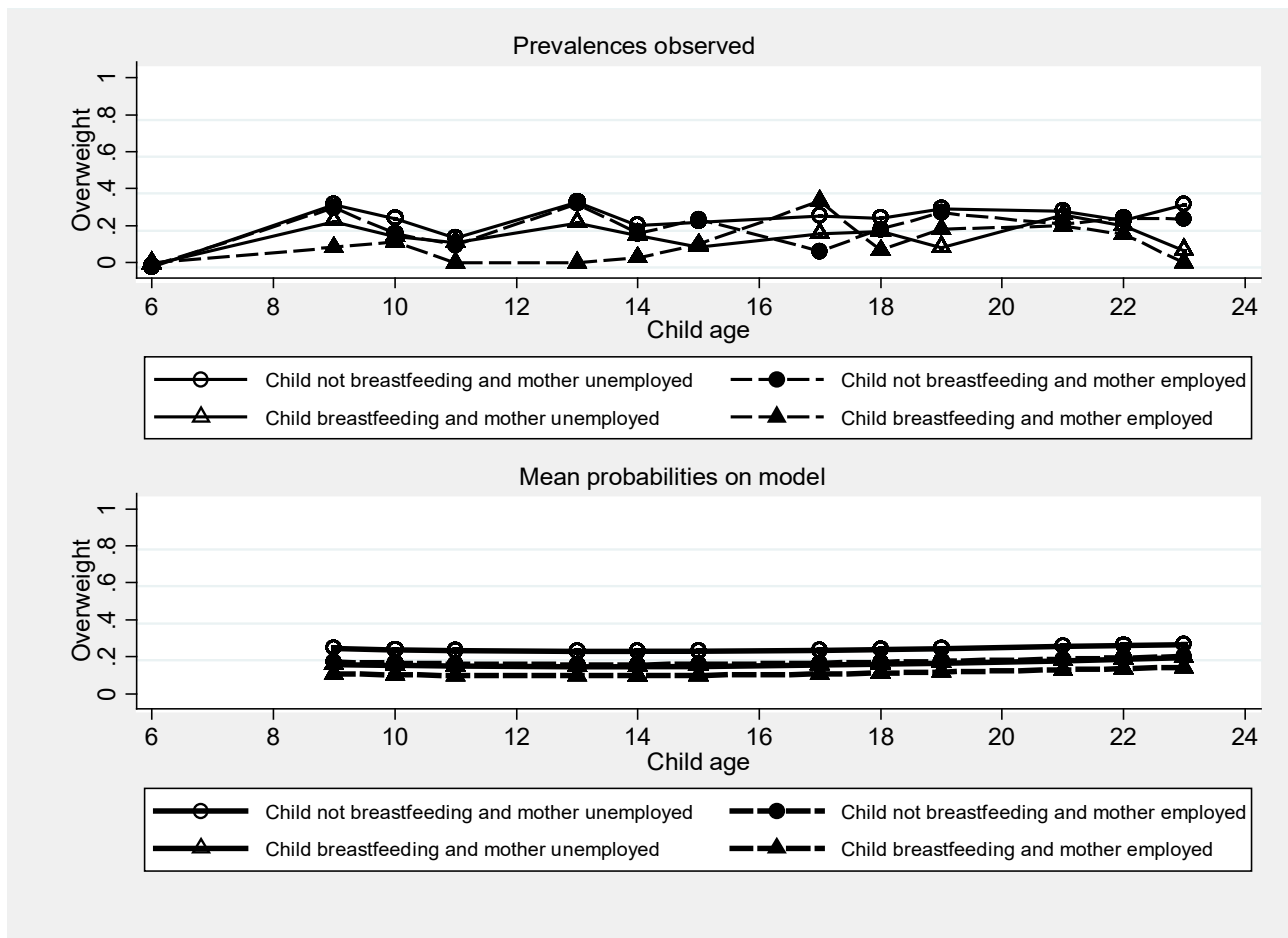
In step 3 (Table 4), interaction among the explanatory variables was not significant ( $p > 0.05$ ). Therefore, interaction was not included in the subsequent step. The independent variables “breastfeeding at six months” and “maternal employment status” had a descriptive  $p$ -value  $\leq 5\%$ , step 3 represented the final model (step 4). No confounding effect was evident on comparison of results for step 2 and for steps 3 and 4.

The prevalences observed and mean probabilities of overweight, according to breastfeeding at six months, employment status and child age on models, are given in Figure 2. The curves plotted show that the mean probabilities of being overweight remained stable throughout participation in the program.

**Table 4:** Multi-level multiple logistic regression with child age (months) for breastfeeding at six months and employment status, with and without interaction (step 3).

Variables Step 3	With interaction			Without interaction		
	OR	p	CI (95%)	OR	p	CI (95%)
Breastfeeding at six months						
No	1			1		
Yes	0.32	0.001	0.17-0.60	0.29	0.001	0.16-0.53
Employment status						
Unemployed	1			1		
Employed	0.46	0.128	0.17-1.25	0.36	0.012	0.16-0.80
Child age (months)	0.97	0.393	0.89-1.05	0.97	0.407	0.89-1.05
Interaction breastfeeding X employment status	0.53	0.441	0.10-2.69			

OR: odds ratio; p: descriptive level of test; CI: interval of OR with 95% confidence.



**Figure 2:** Prevalence and mean probabilities of overweight, according to breastfeeding at six months, employment status and child age (months) on models.

## DISCUSSION

The factors associated with a greater prevalence of overweight were the child not breastfeeding at six months and the absence of paid maternal employment. This result corroborates the conclusions of previous studies in which breastfed infants had a lower likelihood of being obese<sup>11,17</sup>. However, this finding differs to the results of other studies concluding that infant overweight was associated with maternal employment outside the home<sup>14,18</sup>.

In Brazil, a study of secondary data on 2,209 children, predominantly from families with a low socioeconomic level living in a semi-arid region, found that those infants exclusively breastfeeding for at least six months had lower risk of being overweight at 12 and 24 months of life compared to infants breastfed for less than six months<sup>19</sup>. By contrast, a study of 764 children from Viçosa, Minas Gerais state, failed to find a significant association between breastfeeding and obesity in school children, nor a dose-response effect of duration of breastfeeding, even after adjusting for confounding factors<sup>20</sup>.

In the present study, a protective effect of maternal breastfeeding against overweight was found, most likely due to the characteristics of maternal milk, such as leptin levels<sup>21</sup>, and greater satiety responsiveness among breastfed children<sup>22</sup>. However, the relationship between maternal breastfeeding and lower risk of obesity in childhood is controversial, where one study suggests that strategies for increasing the duration of maternal breastfeeding are insufficient to contain the increase in the prevalence of obesity<sup>23</sup>. Confounding factors can exist in observational studies, such as social, behavioral and biological differences between breastfeeding and non-breastfeeding mothers, where these factors which may be difficult to control for<sup>24</sup>.

It is believed that the protective effect of maternal employment outside the home against child overweight might be due to the increase in family income and its use for purchasing more adequate foods for the children. In addition, one study has reported no adverse effects of maternal employment outside the home on child health when the individual receives adequate care from caregivers<sup>25</sup>.

In the present study, the odds ratios for overweight among categories of the variables “breastfeeding at six months” and “employment status” remained stable throughout the period, after the initial advance.

The explanatory variables birth weight, child age, marital status and maternal age were not statistically associated with overweight of the children during their participation in the program. This result may be due to the uniform socioeconomic conditions of the population participating in the VIVALEITE program from the interior of São Paulo State, suggesting there were no significant differences across the categories studied when enrolling on the program.

Previous studies assessing milk distribution programs have tended to involve populations of underweight children and report weight gain among the participants<sup>26,27</sup>. The focus of the present study was

children that enrolled at six months of age and had a W/A nearing the upper limit of adequacy. As expected, after three-months’ participation on the program, cases of overweight were observed. However, the results of multi-level analysis revealed that the incidence of overweight remained stable over the observation period, with no further major weight gains up to 23 months of age.

Knowledge on the sociodemographic factors associated with overweight can help guide actions by program managers. Nevertheless, it is important to highlight that none of these factors can be modified by the program, whether associated with child overweight or otherwise. These situations preceded program entry, such as access to prenatal care and mothers’ decision to breastfeed their newborn infant. Under the program, interventions involving maternal and biological characteristics of the child are not possible. The goal of the VIVALEITE program is to distribute fortified milk to under-privileged families as opposed to integrating intersectoral intervention action to improve social conditions of the families.

The program included the running of courses promoting food security and dietary education for guardians of the children<sup>vi</sup>, although encouragement to breastfeed should be given during prenatal care. Increasing the proportion of children being breastfed prior to enrolment on the VIVALEITE requires action through other public policies.

Breast milk is the best food in the first months of life, providing essential antibodies and nutrients for healthy growth and development of the infant<sup>28</sup>. It also helps prevent infant morbidity due to diarrhea, respiratory infections and otitis media. To yield its full benefit, breastfeeding should be continued up to two years of age<sup>29</sup>. When it is not possible to extend the breastfeeding period, the option of enrolling on the milk program allows the intake of a nutritious food, enriched with vitamins and minerals. Besides helping to prevent micronutrient deficiencies, the milk serves as a source of sustenance for low-income children.

This study has several limitations. First, reliable length measurements were not available, preventing the use of body mass index-for-age and classification of children as obese, according to WHO recommendations<sup>16</sup>. However, the use of the W/A index met the study objective, constituting a sensitive measure of nutritional status<sup>15</sup>, particularly up to two years of age.

Another limitation was the absence of dietary intake data, because food records for the children were not collected under the program. However, analysis of maternal breastfeeding on program entry found a protective effect against overweight, irrespective of food given to the infants during the first six months of life.

Inclusion of only children enrolling on the program at aged six months controlled for the potential confounding effect of other ages. Conversely, the inclusion of children enrolled at different ages would have

Viçosa (State). Decree nº 55.053, of 17th of November, 2009. São Paulo State Gazette. 2009;119(215):3.

introduced a confounding effect and created the need for more complex statistical analysis. Another positive aspect was the selection of only children that were healthy on program entry, given that child morbidities often impact nutritional status over time.

The study results should be interpreted with caution for the general population because the sample

comprised only children enrolled on the program from low-income families with two minimum wages or less. However, comparable results can be expected in studies involving populations with similar sociodemographic and environmental characteristics to those of participants of the VIVALEITE program from the interior of São Paulo State.

## ■ CONCLUSION

The program goal was attained and should continue to serve its target audience, irrespective of their nutritional status at time of enrollment. Courses and talks on food education and security should also continue, along with regular anthropometric assessments based on height and weight measurements taken using standardized techniques.

### Contributions to field of public health

The number of children at risk of overweight is cause for concern, corresponding to roughly double the number of obese children. Child obesity is associated with morbidities that can persist into childhood and adult life, representing a high economic and social burden. Continued assessment of nutrition programs and monitoring of growth in the first 1,000 days of life can help prevent obesity in early childhood.

The results of the present study showed that the factors “not breastfeeding at six months” and “absence of paid maternal employment” were positively associated

with a greater prevalence of overweight in children participating in the program. These factors point to the importance of interventions aimed at improving socioeconomic conditions, health and child nutrition. These actions should center on maternal care with an emphasis on information and motivation for practicing exclusive maternal breastfeeding up to the seventh month, with subsequent introduction of adequate complementary solid food.

### Acknowledgements

The authors would like to extend their thanks to Prof. MD. Cassia Maria Buchala of the Department of Epidemiology of the School of Public Health of the University of São Paulo (USP) for her contributions during the course of this study.

### Conflicts of interest

The authors declare no conflicts of interest.

## ■ REFERENCES

1. Onis M, Blossner M, Borghi E. Global prevalence and trends of overweight and obesity among preschool children. *Am J Clin Nutr.* 2010;92(5):1257-64. DOI: <http://dx.doi.org/10.3945/ajcn.2010.29786>
2. Halfon N, Larson K, Slusser W. Associations between obesity and comorbid mental health, developmental, and physical health conditions in a nationally representative sample of US children aged 10 to 17. *Acad Pediatr.* 2013;13(1):6-13. DOI: <http://dx.doi.org/10.1016/j.acap.2012.10.007>
3. World Health Organization (WHO). Obesity and overweight. [cited 2016 Jul 03] Available from: <http://www.who.int/en/news-room/fact-sheets/detail/obesity-and-overweight>.
4. Moss BG, Yeaton WH. U.S. childrens preschool weight status trajectories: patterns from 9-month, 2-year, and 4-year Early Childhood Longitudinal Study-Birth cohort data. *Am J Health Promot.* 2012;26(3):172-5. DOI: <http://dx.doi.org/10.4278/ajhp.100304-ARB-73>
5. Paul IM, Bartok CJ, Downs DS, Stifter CA, Ventura AK, Birch LL. Opportunities for the primary prevention of obesity during infancy. *Adv Pediatr.* 2009;56(1):107-33. DOI: <http://dx.doi.org/10.1016/j.yapd.2009.08.012>
6. Adair LS, Fall CH, Osmond C, Stein AD, Martorell R, Ramirez-Zea M, et al. Associations of linear growth and relative weight gain during early life with adult health and human capital in countries of low and middle income: findings from five birth cohort studies. *Lancet.* 2013; 382(9891):525-34. DOI: [http://dx.doi.org/10.1016/S0140-6736\(13\)60103-8](http://dx.doi.org/10.1016/S0140-6736(13)60103-8)
7. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet.* 2013;382(9890):427-51. DOI: [http://dx.doi.org/10.1016/S0140-6736\(13\)60937-X](http://dx.doi.org/10.1016/S0140-6736(13)60937-X)
8. Spyrides MHC, Struchiner CJ, Barbosa MTS, Kac G. Efeito das práticas alimentares sobre o crescimento infantil. *Rev Bras Saude Mater. Infant.* 2005;5(2):145-53. DOI: <http://dx.doi.org/10.1590/S1519-38292005000200002>
9. Rooney BL, Mathiason MA, Schauburger CW. Predictors of Obesity in Childhood, Adolescence, and Adulthood in a Birth Cohort. *Matern Child Health J.* 2011;15(8):1166-75. DOI: <http://dx.doi.org/10.1007/s10995-010-0689-1>



10. Muller RM, Tomasi E, Facchinilli LA, Piccini RX, Silveira DS, Siqueira FV, et al. Excesso de peso e fatores associados em menores de cinco anos em populações urbanas no Brasil. *Rev Bras Epidemiol.* 2014;17(2):285-96. DOI: <http://dx.doi.org/10.1590/1809-4503201400020001ENG>
11. Anderson A, Hayes D, Chock L. Characteristics of Overweight and Obesity at Age Two and the Association with Breastfeeding in Hawai'i Women, Infants, and Children (WIC) Participants. *Matern Child Health J.* 2014;18(10):2323-31. DOI: <http://dx.doi.org/10.1007/s10995-013-1392-9>
12. Schuch I, Castro TG, Vasconcelos FAG, Dutra CLC, Goldani MZ. Excess weight in preschoolers: prevalence and associated factors. *J Pediatr (Rio J).* 2013;89(2):179-88. DOI: <http://dx.doi.org/10.1016/j.jped.2013.03.003>
13. Ruel MT, Alderman H; Maternal and Child Nutrition Study Group. Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition? *Lancet.* 2013;382(9891):536-51. DOI: [http://dx.doi.org/10.1016/S0140-6736\(13\)60843-0](http://dx.doi.org/10.1016/S0140-6736(13)60843-0)
14. Hawkins SS, Cole TJ, Law C; Millennium Cohort Study Child Health Group. Maternal employment and early childhood overweight: findings from the UK Millennium Cohort Study. *Int J Obes.* 2008;32(1):30-8. DOI: <http://dx.doi.org/10.1038/sj.ijo.0803682>
15. Augusto RA, Souza JMP. Efetividade de programa de suplementação alimentar no ganho ponderal de crianças. *Rev Saude Publica.* 2010;44(5):793-802. DOI: <http://dx.doi.org/10.1590/S0034-89102010000500004>
16. World Health Organization (WHO). WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development. Geneva: World Health Organization; 2006.
17. Zheng JS, Liu H, Li J, Chen Y, Wei C, Shen G, et al. Exclusive Breastfeeding Was Inversely Associated with Risk of Childhood Overweight in a Large Chinese Cohort. *J Nutr.* 2014;144(9):1454-9. DOI: <http://dx.doi.org/10.3945/jn.114.193664>
18. Mindlin M, Jenkins R, Law C. Maternal employment and indicators of child health: a systematic review in pre-school children in OECD countries. *J Epidemiol Community Health.* 2009;63(5):340-50. DOI: <http://dx.doi.org/10.1136/jech.2008.077073>
19. Assunção ML, Ferreira HS, Coutinho SB, Santos LMP, Horta BL. Protective Effect of Breastfeeding against Overweight Can Be Detected as Early as the Second Year of Life: A Study of Children from One of the Most Socially-deprived Areas of Brazil. *J Health Popul Nutr.* 2015;33(1):85-91.
20. Novaes JF, Lamounier JA, Colosimo EA, Franceschini SC, Priore SE. Breastfeeding and obesity in Brazilian children. *Eur J Public Health.* 2012;22(3):383-9. DOI: <http://dx.doi.org/10.1093/eurpub/ckr067>
21. Schuster S, Hechler C, Gebauer C, Kiess W, Kratzsch J. Leptin in maternal serum and breast milk: association with infants' body weight gain in a longitudinal study over 6 months of lactation. *Pediatr Res.* 2011;70(6):633-7. DOI: <http://dx.doi.org/10.1203/PDR.0b013e31823214ea>
22. Brown A, Lee M. Breastfeeding during the first year promotes satiety responsiveness in children aged 18-24 months. *Pediatr Obes.* 2012;7(5):382-90. DOI: <http://dx.doi.org/10.1111/j.2047-6310.2012.00071.x>
23. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *Lancet.* 2013;382(9890):452-77. DOI: [http://dx.doi.org/10.1016/S0140-6736\(13\)60996-4](http://dx.doi.org/10.1016/S0140-6736(13)60996-4)
24. Druet C, Ong KK. Early childhood predictors of adult body composition. *Best Pract Res Clin Endocrinol Metab.* 2008;22(3):489-502. DOI: <http://dx.doi.org/10.1016/j.beem.2008.02.002>
25. Pierre-Louis JN, Sanjur D, Nesheim MC, Bowman DD, Mohammed HO. Maternal income-generating activities, child care, and child nutrition in Mali. *Food Nutr Bull.* 2007;28(1):67-75. DOI: <http://dx.doi.org/10.1177/156482650702800108>
26. Castro IRR, Monteiro CA. Avaliação do impacto do programa "Leite é Saúde" na recuperação de crianças desnutridas no Município do Rio de Janeiro. *Rev Bras Epidemiol.* 2002;5(1):52-62. DOI: <http://dx.doi.org/10.1590/S1415-790X2002000100007>
27. Goulart RMM, França Junior I, Souza MFM. Fatores associados à recuperação nutricional de crianças em programa de suplementação alimentar. *Rev Bras Epidemiol.* 2009;12(2):180-94. DOI: <http://dx.doi.org/10.1590/S1415-790X2009000200008>
28. Martin CR, Ling PR, Blackburn GL. Review of Infant Feeding: Key Features of Breast Milk and Infant Formula. *Nutrients.* 2016;8(5):279. DOI: <http://dx.doi.org/10.3390/nu8050279>
29. Victora CG, Bahl R, Barros AJ, França GV, Horton S, Krasevec J, et al. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *Lancet.* 2016;387(10017):475-90. DOI: [http://dx.doi.org/10.1016/S0140-6736\(15\)01024-7](http://dx.doi.org/10.1016/S0140-6736(15)01024-7)

## Resumo

**Introdução:** Estudos anteriores mostraram a efetividade do programa VIVALEITE para o ganho de peso de crianças menores de dois anos. Como o programa é efetivo, é possível que crianças ingressantes com peso próximo ao limite considerado adequado para idade o ultrapassem no decorrer de sua participação.

**Objetivo:** Analisar a associação entre fatores sociodemográficos e excesso de peso em participantes do programa VIVALEITE.

**Método:** Estudo de coorte com dados de 1.039 crianças de famílias de baixa renda do interior do Estado de São Paulo, ingressantes no programa com seis meses de idade e peso próximo ao limite superior de adequação, entre janeiro/2003 e setembro/2008. Investigou-se a proporção de crianças que ficam com excesso de peso durante a participação no programa e associações com as condições sociodemográficas de cada criança (amamentação aos seis meses, sexo, peso ao nascer) e dos respectivos responsáveis (condição conjugal, idade, situação de trabalho, escolaridade). A modelagem foi feita por meio de regressão logística multinível das variáveis socioeconômicas e o conjunto das idades de pesagem. O processamento foi feito com o pacote estatístico Stata 10.1.

**Resultados:** Conforme análise multinível, a categoria sim da variável aleitamento materno aos seis meses (OR=0,29,  $p=0,001$ ) e a categoria trabalha da variável situação de trabalho materno (OR=0,36,  $p=0,012$ ) foram associadas significativamente ao excesso de peso das crianças. As demais variáveis não foram associadas estatisticamente a excesso de peso.

**Conclusão:** Não amamentação aos seis meses e ausência de trabalho materno são fatores sociodemográficos positivamente associados ao excesso de peso das crianças participantes do programa.

**Palavras-chave:** programa de distribuição de leite fortificado, programas e políticas de nutrição e alimentação, lactente, ganho de peso.

©The authors (2018), this article is distributed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated.