

# Dietary Patterns of Pre-Schoolers and Their Relationship with Food Insecurity

ORIGINAL

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## Abstract

**Introduction:** Dietary patterns (DPs) represent the consumption of food and nutrients of a population. Research in this area is very important to evaluate eating habits, especially during the critical period of growth and development in childhood.

**Objective:** Analyse the dietary patterns of pre-school children in a city with a Human Development Index (HDI) of 0.800, their relationship to socio-economic conditions, household FI and overweight children.

**Methods:** A cross-sectional study was undertaken of 308 children between 24 and 48 months of age enrolled at municipal day care centres in a city with a Human Development Index (HDI) of 0.800. Dietary intake was assessed using a food frequency questionnaire and interpreted through principal components analysis (PCA). Nutritional condition was assessed by the indicator BMI/age and food insecurity (FI) was classified by the score on the Brazilian Food Insecurity Scale.

**Results:** Five DPs were identified: "Western", "Fruits and vegetables", "Prudent", "Dairy" and "Traditional". Pre-schoolers with "Western" food standards are less likely (OR: 0.51; 95% CI: 0.27–0.98) to be in moderate or severe FI; however, food quality is compromised, featuring light FI. Children in the "Traditional" category are strongly linked to families receiving social benefits and childhood overweight ( $p < 0.05$ ).

**Conclusion:** Western and Traditional DPs are qualitatively and quantitatively inadequate, regardless of family income condition and maternal education. Thus, public actions to combat unfavourable DPs and deleterious effects on health are important and indispensable to prevent chronic diseases.

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Dietary Patterns; Food Security; Overweight; Preschool; Food Consumption.

## Introduction

Inappropriate eating habits formed in early childhood can be retained in the next stages of life, providing greater risk of the development of chronic diseases [1], as in the case of overweight/obesity. The economic consequences in terms of the increase in health costs in the private and public sector, in addition to dramatic implications for the survival of the individual, justify the epidemiological value of research to public health.

The investigation of dietary patterns (DPs) in different regions and cultures is necessary for the evaluation of eating habits and their short- and long-term outcomes in the health of the population, these being a better predictor of disease risk than the isolated effect of nutrients or foods [2].

Some studies have linked obesity and socioeconomic conditions [3, 4] and others have investigated the DPs of pre-school children [1, 5, 6], but few have attempted to discuss these variables in conjunction with household food insecurity (FI) in pre-schoolers, an important population group as an indicator of the quality of life and health of a country.

Therefore, this objective is analyse the dietary patterns of pre-school children in a city with a Human Development Index (HDI) of 0.800, their relationship to socio-economic conditions, household FI and overweight children.

## Methods

This is a cross-sectional study with children enrolled in public day care centres in the city of Taubaté, State of São Paulo, Brazil, in 2014. The probabilistic sample was based on the total number of children enrolled in public service education, which corresponds to approximately 80% of the total population of children with less than five years of age. For the sample calculation, a prevalence of 22.6% of food insecurity was taken from a national survey [7], were adopted  $\alpha = 5\%$ ,  $\beta=20\%$  (80% statistical power) and an increment of 10% for possible

losses, resulting in a sample of 291 children. The sample for the analysis of DPs was made up of data from 308 children who completed all the activities planned for the project.

Socioeconomic information was obtained through a questionnaire sent by the day care centres to parents. It consisted of the following information: age and gender of the child, maternal education in complete years of schooling, receipt and value of social benefits through conditional income transfer (Programa Bolsa Família – PBF) and monthly family income, converted into minimum wages considering the value of the time (2014) of R\$ 724.00.

Household food insecurity (FI) was evaluated using the Brazilian Food Insecurity Scale (Escala Brasileira de Insegurança Alimentar – EBIA), which classifies the families into four categories according to scores of ranging from 0 to 15 in families with children under 18 years, as follows: 0 points – food security (FS); 1 to 5 points – mild FI (when there is the worry of running out of food to ensure the immediate future, or qualitative impairment in terms of financial limitations on diet); 6 to 10 points – moderate FI (with qualitative and quantitative restrictions on diet among adults); 11 to 15 points – severe FI (the restriction in the diet is qualitative and quantitative for adults and children) [8].

The anthropometric assessment used measures of weight and height, according to the technical standards of the World Health Organization (WHO), adopted by the Brazilian Health Ministry [9]. The nutritional condition was evaluated by body mass index/age (BMI/A) and for the determination of excess weight (overweight/obesity), z scores  $\geq +2.00$  [10] were considered.

Food consumption was obtained using a food frequency questionnaire developed to assess the usual diet of children [11], containing a frequency of consumption presented in 7 categories: never; less than 1 time per month; 1 to 3 times per month; 1 time per week; 2 to 4 times a week; 1 time per

day; 2 or more times per day. This corresponded to the children's food consumption over the previous 6 months.

To obtain the DPs, exploratory factor analysis (EFA) was used, with the extraction of factors being undertaken through principal components analysis (PCA). In this way, from the list of 57 food items in the Food Frequency Questionnaire, 26 food groups were built, based on criteria concerning nutritional composition and cultural aspects (**Table 1**). Items consumed with less than 20% weekly frequency were excluded; foods with a weekly consumption of more than 80% (rice, beans, chicken, fish, eggs, milk, chips, cake, instant noodles and coffee) were added individually to allow better analysis of children's food consumption habits. For the factor analysis, Kaiser–Meyer–Olkin (KMO)  $\geq 0.600$  and Barlett's test of sphericity (BTS)  $p > 0.05$  were considered to indicate the suitability of the sample.

Sequentially, orthogonal rotation was carried out to optimize the configuration of DPs, considering factor loadings greater than 0.40 to be acceptable. The number of extracted factors explained around 40% of total variance, confirming the observations of the Cattell graph (scree plot). Cronbach's alpha was calculated to analyse internal consistency, attaining acceptable values  $\geq 0.60$ .

After obtaining the DPs, the scores were categorized according to the 50 percentile (P50), where  $< P50$  represented low consumption and  $\geq P50$  high consumption. The cut-off point given by the median for each food pattern was 0.010 (default 1), 0.018 (default 2), 0.137 (default 3), 0.168 (default 4) and 0.082 (default 5).

Logistic regression analysis was used to assess the socioeconomic determinants of FI and the nutritional status of all DPs. First, the independent variables that presented values of  $p < 0.2$  in the Chi-square test were included in the model, taking into account the calculation of the odds ratio (OR) and adjusted with their respective 95% confidence intervals (CI: 95%) and considering values of  $p < 0.05$  to be sta-

**Table 1.** Food groups and items from the food frequency questionnaire used in the factorial assessment of the main components.

Group or food	Food present in the food frequency questionnaire
Rice	Boiled rice
Beans	Boiled beans
Pasta	Boiled noodles, pasta with tomato sauce
Instant noodles	Miojo® instant noodles
Vegetables	Lettuce, tomato, chard, arugula and cabbage
Legumes	Pumpkin, carrots, chayote, soups with legumes
Tubers	Boiled potato or puree, manioc
Fruits	Banana, apple, pear, orange, orange juice, fruit juice (passion fruit, pineapple, lemon...)
Meats	Boiled beef (cooking or minced)
Chicken	Boiled, fried, grilled or roasted chicken
Fish	Boiled or fried fish
Eggs	Boiled or fried eggs, omelette with one egg
Sausages	Sausage, ham, mortadella
Milk	Whole milk, whole powdered milk
Dairy products	Yoghurts; prato cheese, mozzarella and white; cream cheese
Breads and cookies	Bread, french bread; Maisena®, Maria®, milk, water and salt cookies
Cake	Regular cake or chocolate with no icing
Cereal and starchy	Sucrilhos® and Nescau ball® cereals; Maizena®, Farinha Láctea®, Mucilon® and Cremogema® thickeners
French fries	French fries
Fatty lunches	Chips, cheese bread, pastry, drumstick, esfirra, pizza, sandwiches, hamburger
Cookies	Cookie, wafer
Chocolate	Chocolate bar, bonbon
Soda/artificial juice	Soda; Tang® artificial juice
Sugar	Nescau® and Toddy® instant chocolate powder; sugar
Butter	Butter
Coffee	Coffee with sugar

tistically significant. The analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 20.0.

The research was approved by the Research Ethics Committee of the College of Public Health, University of São Paulo (n° 773287, 2014). The person responsible authorized the participation of children in the data collection by signing the free consent form.

## Results

The sample was characterized by children whose mothers had over 9 years of formal education, with a income of 1 to 2 minimum wages and with almost 30% of households in receipt of PBF, receiving approximately 1/5 of the minimum wage (R\$ 133; 95% CI: 121-170). As for FI, 26% of households were classified as having mild FI, 13.3% with moderate FI and 1.9% as having severe FI, demonstrating that almost 60% were in household FS. It was verified that overweight/obesity was present in 6.8% of pre-schoolers (**Table 2**).

**Table 2.** Pre-school distribution according to demographic, socioeconomic, food insecurity and nutritional condition, Taubaté, São Paulo, Brazil, 2014.

Variable	n	%
Gender		
Male	140	45.5
Female	168	54.5
Age		
24 to 35 months	109	35.4
36 to 48 months	199	64.6
Maternal schooling		
≤ 5 years of study	38	12.4
6 to 8 years of study	62	20.2
9 to 11 years of study	119	38.8
≥ 12 years of study	88	28.7

Variable	n	%
Family Income		
< 1 minimum wage	36	12.0
1 to 2 minimum wages	117	38.9
2 to 3 minimum wages	87	28.9
≥ 3 minimum wages	61	20.3
Programa Bolsa Família beneficiaries		
Yes	90	29.2
No	218	70.8
Food Insecurity Scale		
Food and nutritional safety	181	58.8
Light food insecurity	80	26.0
Moderate food insecurity	41	13.3
Severe food insecurity	6	1.9
BMI/Age		
< +2.00 z-scores	289	93.8
≥ +2.00 z-scores	19	6.2
<b>Source:</b> Research data		

From the habitual consumption of the population, it was possible to determine five DPs, named according to their highest factor, which explained 39.5% of the total variance of the data, with a KMO of 0.675 and a BTS  $p \leq 0.001$ . The “Western” pattern was composed of fatty and/or sugary foods, with a predominance of ultra-processed foods. The “Fruits and Vegetables” pattern consisted of a diet high in fruits, vegetables, fish, cereals and tubers. The “Prudent” pattern was composed of meats, pasta and vegetables. The pattern predominantly rich in milk and sugary ingredients for the preparation of bottles was termed “Dairy”. Finally, the “Traditional” eating pattern included typical Brazilian foods, such as rice, coffee and beans (**Table 3**).

The factors associated with DPs in the bivariate analysis are presented in **Table 3**. It should be noted that the model for the “Western” pattern includes children in FS/mild FI; the “Fruits and Vegetables” DP is associated with high-income families and FS;

**Table 3.** Distribution of factor loadings for the five identified food standards for pre-school. Taubaté. São Paulo. Brazil. 2014.

Food groups and items	Food Pattern				
	Western	FV*	Prudent	Dairy	Traditional
Fatty lunches	0.690				
Sausages	0.587				
French-fries	0.567				
Chocolate	0.545				
Dairy products	0.529	0.402			
Soda/Artificial juice	0.502				
Cookies	0.494				
Fruits		0.689			
Vegetables		0.613			
Legumes		0.556	0.406		
Cereal e starchy		0.493			
Fish		0.468			

no association was found between the “Prudent” DP and the variables studied; the “Dairy” DP is associated with low-income families, moderate/severe FI and with low-schooled mothers; finally, the “Traditional” pattern includes children with overweight/obesity, low-educated mothers, low family income, benefiting from the income transfer programme, i.e. PBF, and moderate/severe FI.

In logistic regression analysis (**Table 4**), after adjusting each DP in relation to independent varia-

Food groups and items	Food Pattern				
	Western	FV*	Prudent	Dairy	Traditional
Meats			0.682		
Tubers		0.422	0.477		
Pasta			0.460		
Chicken			0.427		
Sugars				0.691	
Milk				0.666	
Instant noodles				0.434	
Rice					0.601
Coffee					0.543
Beans					0.515
Total of items	7	7	5	3	3
Eigenvalue	2.55	2.44	1.71	1.65	1.51
Variance (%)	10.20	9.77	6.84	6.61	6.05
Accumulated variance (%)	10.20	19.97	26.81	33.42	39.47

\* Fruits and Vegetables. Principal Component Analysis - Rotation Method: Varimax with Kaiser normalization. KMO: 0.675; BTS ≤ 0.001; Cronbach's alpha ≥ 0.60

bles and the other DPs, significant associations only remained for the “Western” DP with a protective effect against moderate/severe FI (OR: 0.46; 95% CI 0.23 -0.9; p = 0.02) and for the “Traditional” DP, for which there was a significant relationship with families that have the benefit of PBF, in addition to a greater risk of children being overweight/obese (OR: 3.68; 95% CI: 1.14–11.86; p = 0.03).

**Table 4.** Pre-school distribution by scores categorized feeding patterns in medians and demographic, socioeconomic, food insecurity and nutritional condition characteristics. Taubaté. São Paulo. Brazil. 2014.

Variables	Western		FV		Prudent		Dairy		Traditional	
	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50
Gender		p=1.0		p=0.49		p=0.82		p=0.11		p=0.89
Male	50.0	50.0	52.1	47.9	49.3	50.7	45.0	55.0	50.7	49.3
Female	50.0	50.0	48.2	51.8	50.6	49.4	54.2	45.8	49.4	50.6

Variables	Western		FV		Prudent		Dairy		Traditional	
	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50	< P50	≥ P50
Age		p=0.07		p=0.91		p=0.91		p=0.12		p=0.28
24 a 35 months	56.9	43.1	49.5	50.5	49.5	50.5	56.0	44.0	54.1	45.9
36 a 48 months	46.2	53.8	50.3	49.7	50.3	49.7	46.7	53.3	47.7	52.3
Maternal schooling		p=0.31		p=0.24		p=0.84		p=0.01		p=0.02
< 9 school years	46.0	54.0	55.0	45.0	51.0	49.0	40.0	60.0	40.0	60.0
≥ 9 school years	52.2	47.8	47.8	52.2	49.8	50.2	55.1	44.9	54.6	45.4
Family income		p=0.61		p=0.14		p=0.98		p=0.16		p=0.08
< 1 M.W.	52.8	47.2	61.1	38.9	50.0	50.0	38.9	61.1	36.1	63.9
≥ 1 M.W.	48.3	51.7	47.9	52.1	50.2	49.8	51.3	48.7	51.7	48.3
PBF Beneficiaries		p=0.21		p=0.62		p=0.80		p=0.21		p=0.001
Yes	44.4	55.6	52.2	47.8	48.9	51.1	44.4	55.6	35.6	64.4
No	52.3	47.7	49.1	50.9	50.5	49.5	52.3	47.7	56.0	44.0
Food Insecurity Scale		p=0.04		p=0.08		p=0.87		p=0.15		p=0.02
FS and mild FI	47.5	52.5	47.9	52.1	49.8	50.2	51.7	48.3	52.9	47.1
Moderate and severe FI	63.8	36.2	61.7	38.3	51.1	48.9	40.4	59.6	34.0	66.0
BMI/Age		p=0.24		p=0.24		p=0.81		p=0.24		p=0.01
< +2.00 z-scores	49.1	50.9	49.1	50.9	49.8	50.2	50.9	49.1	51.9	48.1
≥ +2.00 z-scores	63.2	36.8	63.2	36.8	52.6	47.4	36.8	63.2	21.1	78.9

Qui-Square assess; <P50: below the percentile 50; ≥ P50: above the percentile 50. FV: Fruits and Vegetables; M.W.: Minimum wage of R\$724.00 (in 2014); PBF: Programa Bolsa Família; FHS: Family Health Strategy. FS: Food Security; FI: Food Insecurity; BMI: Body Mass Index

## Discussion

The socioeconomic indicators of the sample (Table 2) confirm the official data of the city of Taubaté, which is part of the metropolitan region of the Paraíba Valley and the North Coast, in the State of São Paulo, Brazil. More years of maternal schooling and a higher income of the families investigated were associated with a low rate of illiteracy. In addition, the population has good basic sanitation

indicators in terms of appropriate coverage of garbage collection (99.78%), water supply (98.60%) and sewerage (95.93%), justifying the HDI value of 0.800, which is greater than that observed in Brazil as a whole and in São Paulo State more broadly. Thus, this investigation of food consumption habits, nutritional condition and food and nutritional security refers to a population with favourable living conditions.

The food consumption described indicates that the most common pattern in pre-school nutrition in this study is the “Western” DP, given that the percentage value of variance explains the highest percentage of items and food groups aggregated in this factor (**Table 3**). This DP features high consumption of ultra-processed foods in preference to fresh or minimally processed foods in the population [12]. This means greater energy intake, involving a higher content of saturated and trans fats and sugar [13]. Other researchers have found the same trend among pre-schoolers [1, 5, 6], children over five years and adolescents [14, 15], albeit using different terms such as “unhealthy food”, “snacks”, “goodies” or “fast food”.

In general, the food consumption patterns of children suffer from the direct influences of their life experiences in terms of families, health professionals and the media, who often have considerable power over food preferences during infancy, such as a short duration of breastfeeding, the use of cow’s milk and the consumption of processed foods [16]. These choices of unhealthy foods are widely accepted by children, both owing to their flavour and the power of the media selling “pseudo-healthy” products [15]. The latter exploit social relations involving the act of eating, namely that obtaining food can be hindered or facilitated by the social context [6, 14]. This becomes evident when analysing the early introduction of fast food, sausages and sweets in baby food, this being a reflection of the urban way of life and a globalized perspective, in which fresh food is replaced with industrialized products [17].

Compatible with the analysis, the value  $p < 0.20$  (**Table 4**) indicates that it is important and feasible to consider associations between DPs and FI in a more detailed manner as families in a state of FS/mildFI constitute “Western” and “Fruits and Vegetables” DPs, demonstrating a conceptual contradiction, where FS is associated with unhealthy foods and mild FI with healthy foods. However, this relationship may indicate a socioeconomic character-

istic. Thus, this discussion will not be settled only through statistically significant associations, which involve the loss of some nuances of food consumption and its relationship with FI. It can be assumed from the data and theoretical knowledge that families in FS appear to correspond to the pattern “Fruits and Vegetables”, with the “Western” pattern being related to mild FI and the “Traditional” and “Dairy” patterns with moderate/severe FI.

As observed in the “Western” pattern, there is in mild FI a loss in the nutritional quality of food, as well as a reduced consumption of foods rich in proteins of high biological value, in addition to the high consumption of high-calorie foods [18]. Even in situations of FS, some families with access to food are not guaranteed a healthy diet [19]. In particular, perhaps due to lack of information, those families in favourable circumstances, which should have the status of FS, are actually in mild household FI, unable to choose good quality food and buying food that is nutritionally poorer or foods that represent social status [1].

In counterpoint, the beneficiaries of the PBF, who are individuals in high socioeconomic vulnerability and dependent on income transfer from the government to improve their conditions of life, are almost twice as likely to have the “Traditional” DP (**Table 4**), such as rice, coffee and beans, consumed by the Brazilian population, often due to cultural aspects, cost and availability, together with the consumption of ultra-processed food, such as instant noodles.

These findings concerning the “Traditional” DP are in line with the consumption presented in a survey conducted in Brazil [19] and United States [20], which also observed a less varied and unhealthy diet among families in the most severe situations of FI. Reinforcing this fact, other authors have noted that children in moderate/severe FI, exhibiting monotony in food consumption or the “Traditional” DP, are predominantly from low-income families, with basic maternal schooling [1, 5, 14]. These findings corroborate with Canadian study that correlates the food

insecurity a lower mean number of different food items [21] and with the national surveys in South Africa, that show the a trend in poorer households in low mean scores for diversity and variety dietary [22].

The consumption of traditional foods mixed with other foods from a globalized, highly industrialized culture, such as instant noodles, can be understood from the perspective of poor families in which there is a convergence between purchasing power and their children's preferences for certain foods. This may lead to inappropriate children's food consumption practices, resulting in the need to include in the context of discussions concerning DPs broader reflections on social and emotional aspects in the obtainment and consumption of food by families by children and adolescents, especially those in socio-economic vulnerability, were more likely to eat some less healthful types of food [20, 23].

Regardless of the degree of FI, families exhibit more inclusion of foods with high energy content and reductions in food of nutritional value, such as fruits, vegetables and legumes<sup>19</sup>, leading to a lack of the complex carbohydrates, fibres, minerals and vitamins that are important in the prevention of chronic non-communicable diseases, such as obesity [24].

Thus, the results strongly suggest a real and high risk for pre-schoolers consuming the "Traditional" and "Western" DPs. In particular, they may present cardiovascular complications that persist into adulthood, such as hypertension, dyslipidaemia and diabetes [15].

One of the main limitations in identifying food standards derives from the subjectivity that must be assumed by the researcher, who makes arbitrary decisions in the phase of analysis, the formation of food groups, the number of factors retained, the type of rotation and especially the assigning of food standards. However, the detailing of the methodology mitigates possible errors in interpretation, clarifying the decisions taken and their justifi-

cations. Thus, we have to list the advantages of the data collection approach used: in the case of the food frequency questionnaire, this is an instrument which has low requirements in terms of cost and is applied by trained and experienced researchers; it is a relatively simple tool and allows the collection and analysis of data, requiring little time to gain knowledge of the feeding habits of a population.

As children's eating habits are formed and incorporated on a long-term basis, depending on the phase of development and growth, maintaining inadequate dietary patterns can lead to the emergence of health complications in later life<sup>1</sup>, such as excess weight and other chronic diseases that are a great social and financial burden on the country.

## Conclusion

Western and Traditional DPs are qualitatively and quantitatively inadequate, regardless of family income condition and maternal education. Thus, public actions to combat unfavourable DPs and deleterious effects on health are important and indispensable to prevent chronic diseases.

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## Conflict of interest

The authors declare that they have no conflict of interest.

## Author Contributions

Conceived and designed the experiments: Rocha EMB, Abreu LC, Vieira PD, Sorpreso ICE, Szarfarc

SC. Performed the experiments: Rocha EMB, Szarfarc SC. Analyzed the data: Rocha EMB, Abreu LC, Vieira PD, Sorpreso ICE, Szarfarc SC. Contributed analysis tools: Rocha EMB, Abreu LC, Vieira PD, Sorpreso ICE, Szarfarc SC. Wrote the paper: Rocha EMB, Abreu LC, Vieira PD, Sorpreso ICE, Szarfarc SC. Read and approved the last version of the manuscripts: Rocha EMB, Abreu LC, Vieira PD, Sorpreso ICE, Szarfarc SC

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