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Preschool children dietary patterns and associated factors

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Abstract

Objectives: To identify dietary patterns in pre-school children and to investigate its determinants.

Methods: Cross-sectional study nested in a cohort born between 2004 and 2005 in the municipality of Diamantina, state of Minas Gerais, Brazil. The instrument used to explore the dietary patterns was a frequency questionnaire for food consumption. Factor analysis was used for the identification of the dietary patterns. The study also assessed personal and socioeconomic data and anthropometric measurements of 232 preschoolers in the period between July 2009 and July 2010. The determinants of food patterns were identified by logistic regression.

Results: Three patterns were obtained, which were called: "mixed diet," "snack," and "unhealthy." The children of mothers with low education are more likely (odds ratio – OR = 3.80; confidence interval 95% – 95%CI = 1.90-7.60) to consume food from the "mixed diet" pattern, and less likely (OR = 0.31; 95%CI = 0.15-0.61) to consume food from the "snack" pattern, while those with higher *per capita* income are more likely to consume food from the "unhealthy" pattern (OR = 2.43; 95%CI = 1.13-5.24).

Conclusion: Three dietary patterns were identified in the studied population, which were determined by the level of maternal education and *per capita* income.

J Pediatr (Rio J). 2012;88(2):129-36: Dietary patterns, preschoolers, factor analysis, cross-sectional studies.

Introduction

Dietary patterns (DP) represent a general profile of food and nutrient consumption, characterized on the basis of the usual eating habits. Thus, the analysis of dietary patterns may better predict the risk of diseases than the analysis of isolated nutrients or foods, once the joint effect of various nutrients involved in a DP would be better identified.[1]

DPs can be defined as *a priori* or *a posteriori*. When foods are grouped on the basis of previous knowledge of the combination with healthy outcomes, according to the constitution of a healthy diet or nutritional recommendations, it is said that the pattern was established *a priori*.[2] Diet variables are normally quantified and added with the aim to compose a level to assess the quality of the diet.

The dietary patterns defined *a posteriori* are obtained by statistical analysis, according to the correlations between the variables of the food questionnaires. Factor analysis

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and cluster analysis are the most common methods to empirically derive patterns. Factorial analysis converts data into patterns, based on the correlations among the food items, while the cluster analysis employs different individual intake means to perform this transformation.[2] For the extraction of factors performed in the first analysis, a score is calculated for each subject in the various factors.[3]

With increased income, the growth of the food industry and the expansion of unhealthy food advertisements in the media, diets rich in complex carbohydrates and fiber are being replaced by diets with higher energy density, rich in sugars and lipids.[4] According to Millen et al.,[5] modern industrialized societies seem to adhere to this dietary pattern, which, combined with a sedentary lifestyle, has resulted in increased obesity and non-communicable chronic diseases.

Some researches have identified this type of DP in children[6-9] and adolescents,[10,11] which has been associated to the following characteristics: lower level of maternal education,[6,9] longer period spent watching Television,[9,11] white-skinned children, larger number of siblings,[6] smoking parents, single parents and, conversely, with families of higher income.[11] Oellinggrath et al.[8] observed that this kind of pattern, besides more frequent among children of less educated mothers, it was also more prevalent among children of overweight mothers.

Considering the above aspects, the present study aimed to identify preschoolers' DPs in the municipality of Diamantina, state of Minas Gerais (MG), and to investigate its determinants.

Methods

Type and location of the study

Cross-sectional study nested in a cohort of children born alive between September 2004 and July 2005 and living in the municipality of Diamantina, which had as an objective the growth and development follow-up in the first years of life.[12] The newborns were contacted in their first weeks of life at their homes. The recruitment was conducted based on records of Born Alive Declarations of two hospitals in the municipality of Diamantina.

The seat of a municipality represents the urban area where the municipal government is established, i.e. the City Hall and the City Council.[13]

Diamantina is a municipality located at the top of Alto Vale do Jequitinhonha, in the state of Minas Gerais, Brazil. It presents a mortality rate among children younger than 1 year of 32.8/1,000, literacy rate of 83,4%, human development index (HDI) of 0.748 and HDI income of 0.752. Among households, 90.76% are supplied with clean water, 70.7% with sanitary sewer and 69.67% with garbage collection.[14]

The flowchart about the formation of the cohort and the follow-up of children is shown in Figure 1. For this research, preschoolers were recruited from the addresses used in the above cohort. The exclusion criteria were previously defined (Figure 1); to be included in this study, preschoolers had to be eligible for the cohort study and have the permission of the parents.

Subjects

The study included children from the cohort mentioned above. Data collection occurred in households of children and in the premises of the Universidade Federal dos Vales do Jequitinhonha e Mucuri (UFVJM) in the period of 2009 to July 2010 and was conducted by four nutritionists and a student from the Course of Nutrition at UFVJM.

For the identification of a DP, it is recommended that the number of individuals should be equal or greater than five for each food/food group on the frequency questionnaire of Food Consumption (FFQ).[15] In this study, 24 food groups were identified; thus, 120 individuals would be necessary (5 x 24 groups). As 232 preschoolers were studied, the sample was considered satisfactory for the present research.

Anthropometric indicator

Weight was measured using a portable electronic digital scale, with a maximum capacity of 150 kg and divisions of 50 g; and height, on a stadiometer with accuracy of 0.1 cm. These measurements were taken according to protocols recommended by Jelliffe,[16] in a lab of the Department of Nursing of UFVJM, in the morning, with fasting children.

The cutoff z-score ≥ 1 identified overweight children according to body mass index (BMI)/age.[17] The softwares WHO Antro 2005 version 2.0.1 and WHO Antro Plus 2009 version 3 were used to identify the z-score of children.

Mothers of the preschoolers were also assessed for weight and height to obtain the BMI and the body fat measured by bioelectrical impedance analysis (BIA). These evaluations were performed in the morning, in one only occasion, and were measured according to the standardization of Lohman et al.[18] and of the manufacturer of the BIA appliance. Value of BMI ≥ 25 kg/m^2 and percentage of body fat (%BF) greater than 32% were considered high, respectively.[18,19] Classification as overweight occurred when BMI and %BF were simultaneously high.

Dietary pattern

The DP of this research were identified *a posteriori* through a FFQ developed by Sales et al.[20] and adapted to the food habits of the region of the preschoolers studied. For the analysis, the FFQ items were grouped in 24 categories, according to the similarity of nutrient content (Table 1).

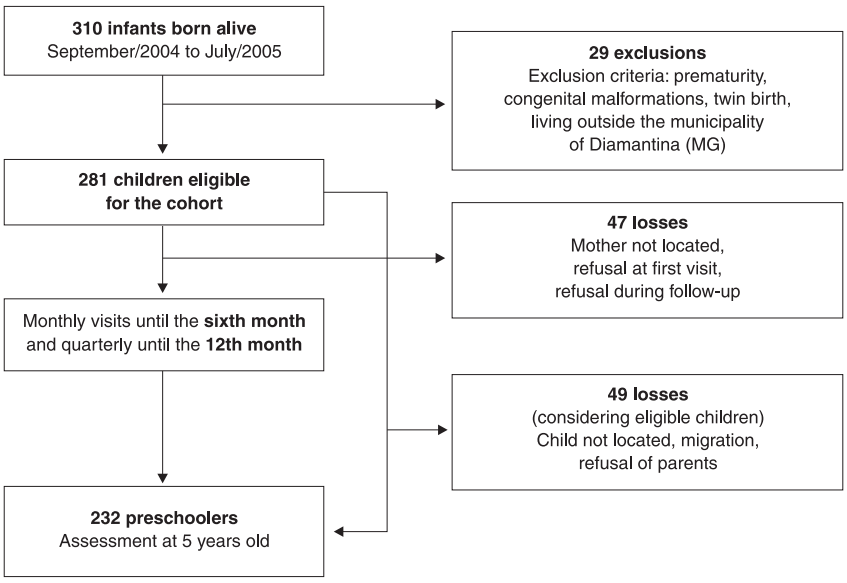

Figure 1 - Flowchart of the cohort formation and follow-up until 5 years old – Diamantina, state of Minas Gerais, 2011

The frequency of consumption of the foods or food groups were summarized in a single value for each preschooler, according to the methodology used by Neumann et al.,[21] whose formula for obtaining this measure is:

(Σ of frequency of consumption of foods contained in the food group) / Number of foods from the group * maximum frequency of consumption in the FFQ used

The DPs were presented as a discrete variable, which was obtained by the sum of the frequencies of consumption of foods contained in each DP, and, then, were categorized in dichotomous variable (0 and 1), using the categories of high (1) and low consumption (0) to values above or below the first quartile, respectively.

Other information

It was also collected information about monthly family income, maternal education and time spent by the child watching television. To this end, a questionnaire was applied to the mother or caretaker of the preschoolers in their homes.

Statistical analysis

For identification of the DPs, the factor analysis methodology of principal components analysis (PCA) was applied in the answers obtained from the FFQ. Before the calculation of factor analysis, the coefficient of Kaiser-Mayer-Olkin (KMO) was estimated, and the Bartlett's test of sphericity was applied to assess the quality of the correlations between variables. The PCA, followed by Varimax orthogonal rotation, was performed to assess the exploratory factorial structure of the FFQ, in which were considered the factor loadings above 0.30. The number of factors to extract was defined according to the screen plot variance of the number of components, in which the points, in the steepest decline, indicated the appropriate number of components (DP) to retain.[22] The internal consistency of the dimensions of the FFQ was also evaluated, and a level of Cronbach's alpha ≥ 0.60 was considered acceptable.[22]

The analysis of logistic regression was used to assess the determinants of the DP. The variables that presented value $p < 0.2$ in bivariate analysis were included in the multivariate analysis, and those with p-value < 0.05 in multivariate analysis were considered to be associated with the DP. The database was built in Excel and analyzed in the Statistical Package for Social Sciences software version 19.0 for Windows.

The protocol of this study was approved by the Research Ethics Committee on Human Research of the UFVJM and of the Universidade Federal de Minas Gerais, whose protocol numbers are 039/08 and Etic 545/08, respectively.

Table 1 - Grouping of foods used in the analysis of dietary patterns according to nutritional similarity - Diamantina (MG), 2009-2010

Group or food	Food present in the food frequency questionnaire
Beef and Pork	Meatball, cooked beef, pork/chicken sausage, steak and ground beef
Chicken and Fish	Roasted chicken, stewed chicken, fried or baked fish
Eggs	Boiled or fried eggs
Baked beans	Baked beans
Milk and derivatives	Cow milk, liquid and powder, mozzarella, Minas cheese, liquid chocolate milk and yogurt
Rice and roots	Angu, rice, boiled yam, boiled manioc, fried manioc, pasta and manioc flour
Farinaceous	Neston, Farinha láctea cereal and cereal
Pasta and pastry	Pizza, lasagna, chicken croquettes and meat pastry
Sweet and savory biscuits	Cream cracker, manioc flour biscuit, maizena biscuits and clube social
Cakes	Corn flour cake, basic cake and chocolate cake
Stuffed cookies	Stuffed cookies
Breads	Cheese bread, French bread and bred loaf
Leafy	Lettuce, steamed cabbage
Vegetables	Eggplant, tomato, pumpkin, cooked carrots, boiled beetroot, steamed green beans, cooked chayote, grated raw carrot, potato, fried sweet potato, sweet potato mash, baked sweet potato, vegetable salad with mayonnaise, vegetable salad without mayonnaise
Fruits	Watermelon, guava, tangerine, orange, pineapple, banana, apple, papaya, pear and grape
Sweets/desserts	Candy, little cashew, dulce de leche/piece, gelatin and guava jelly
Coffee/infusions	Teas, coffee
Sodas	Soda
Natural juices	Juice concentrates and natural juices
Artificial juices	Package artificial juices
Margarine	Butter, margarine
Chocolate powder	Nescau/Toddy
High-Fat snacks	Potato chips, salted popcorn, Cheetos
Sweets	Lollipop, candy, gum, sweet popcorn (package)

Results

It can be observed from Figure 1, that there was a loss of 49 preschoolers. To avoid significant losses that could invalidate the present study, the choice was to study the preschoolers eligible for the cohort and not only those who were followed in the follow-up study in their first years of life, since some children were lost during follow-up.

The values of tests to evaluate the correlation between food items and the appropriateness of using factor analysis to identify the DP were satisfactory and appropriate for the PCA (KMO = 0.697, Bartlett's test of sphericity = χ^2 (276) = 888.06 and p = 0.000, determining the correlation matrix = 0.018).

The PCA extracted eight factors with latent roots greater than 1, which explained 56.26% of the variance. However, considering that the screen plot identified three plot points in the steepest decline, the appropriate number of components to retain was three, which were those which presented largest combined variance. The extraction of these components explained 30.30% of the variance after the rotation of factors. Of the 24 food items tested, 20 are valid and with saturation values exceeding 0.30 (Table 2).

The indexes relating to the internal consistency (Cronbach's alpha ≥ 0.6) show that, for the first two patterns, it was guaranteed an acceptable level of accuracy of measurement of these DPs, thereby confirming, an internal consistence of the FFQ used. The Cronbach's alpha value for the third pattern, however, was lower than 0.6, what demonstrates that it was not possible to guarantee the internal consistence for this pattern.

It can also be observed from Table 2, that the "mixed diet" pattern consists of foods/groups typical of Brazilian diet; the "snack" pattern, by foods/bakery groups and that, usually, do not require preparation for consumption; while the "unhealthy" pattern is composed of sweets rich in lipid and carbohydrates. The "mixed diet" pattern presented

Table 2 - Distribution of factor loadings for dietary patterns of preschool children – Diamantina (MG), 2009-2010

Foods	Dietary patterns			h_2*
	Mixed diet	Snack	Unhealthy	
Beef and pork	0.542			0.363
Baked beans	0.364			0.229
Milk and milk products	0.342	0.548		0.434
Rice and roots	0.404	-0.438		0.405
Farinaceous	0.437			0.191
Sweet and savory biscuits	0.302	0.374		0.235
Cakes	0.380			0.191
Pastries	0.656			0.342
Fruits	0.618	0.382		0.549
Juices	0.373	0.369		0.313
Breads		0.648		0.464
Margarine		0.627		0.405
Nescau/Toddy		0.556		0.343
Fat snacks			0.614	0.457
Sweet treats			0.599	0.361
Artificial Juices			0.510	0.300
Soft drinks			0.433	0.284
Sweets/desserts			0.462	0.252
Stuffed cookies			0.463	0.260
Fired or boiled eggs			0.426	0.193
Number of items	10	7	7	
Cumulative variance (%)	15.41	23.87	30.29	
Cronbach's alpha	0.63	0.63	0.53	

Absolute values lower than 0.30 have been removed for simplification.
* h_2 = commonality is the measure of how much variance is explained by the factors derived by factor analysis.

higher percentage of variance explanation, and was considered the one that best represented the food intake of the sample analyzed.

Table 3 presents the result of the bivariate and multivariate analysis of factors associated with the DPs identified in this study. In bivariate analysis, children of mothers of lower education and *per capita* income greater than 1/2 minimum wage presented 4-fold higher chance of consuming more often foods from the "mixed diet" pattern. The permanence of the preschoolers for 4 hours in schools was a protective factor of the "mixed diet" pattern and a risk factor for the consumption of "snack." In relation to the "unhealthy" pattern, the higher chance of consumption occurred among children with *per capita* income greater than 1/2 the minimum wage.

Even after controlling the multivariate analysis, the risk effect of higher frequency of consumption of "mixed diet" DP remained among the children of mothers with low education. Due to the inconsistence of this result with the scientific literature, it was preferred to perform an analysis stratified by income and considering whether or not the child attends school.

In the analysis stratified by income, it was verified the presence of effective modification in this variable with the "mixed diet" DP, and the lower education only maintained risk effect for more frequency of consumption of this DP among the preschoolers with lower *per capita* income. (OR = 3.56; 95%CI = 1.66-7.62; p = 0.001). A similar result occurred in the stratification for the variable "child attends school," being verified presence of effect modification of this variable with the "mixed diet" DP; lower maternal education only kept the risk effect for higher frequency of consumption of this pattern among the preschoolers that attended schools (OR = 4.27; 95%CI = 2.08-8.75; p = 0.0001).

On the "snack" pattern, preschool children of mothers with less education consumed foods from this DP less frequently. As for the "unhealthy" DP, preschoolers children of families with *per capita* income exceeding 1/2 the minimum wage presented a 2-fold higher chance of consuming more frequently foods from this DP, when compared to the preschoolers of lower income.

Discussion

The results of this research identified that the DP of preschoolers assessed is consistent with the global trend, i.e., they are consuming food rich in lipids, refined carbohydrates, bread products, products of animal origin and products rich in sugar, such as sodas, stuffed cookies and sweets.[23]

Table 3 - Gross and adjusted odds ratio and respective confidence intervals according to variables associated to the different types of dietary patterns of preschoolers – Diamantina (MG), 2009-2010

	Dietary patterns					
	Mixed diet*		Snack[‖]		Unhealthy[†]	
Variable	OR	95%CI	OR	95%CI	OR	95%CI
			Bivariate analysis			
Gender						
Male	1		1		1	
Female	1.22	0.67-2.23	0.79	0.44-1.42	1.01	0.55-1.87
BMI						
Not high	1		1		1	
High	0.57	0.24-1.37	1.29	0.59-2.83	0.97	0.44-2.14
Time spent watching TV						
< 2 hours	1		1		1	
≥ 2 hours	1.06	0.58-1.95	1.26	0.71-2.24	1.35	0.74-2.47
Child attends school						
Yes	1		1		1	
No	0.86	0.33-2.27	0.62	0.26-1.46	0.70	0.28-1.71
Mother schooling years[‡]						
> 9 years	1		1		1	
≤ 9 years	3.93*	1.98-7.78	0.24*	0.12-0.46	1.38	0.76-2.52
Overweight mother						
No	1		1		1	
Yes	0.52**	0.25-1.05	1.75**	0.90-3.39	1.15	0.59-2.23
Mother works outside						
No	1		1		1	
Yes	0.63**	0.34-1.15	1.62**	0.91-2.87	1.29	0.70-2.37
Per capita income[§]						
< 1/2 MW	1		1		1	
≥ 1/2 MW	4.07*	1.19-13.87	0.19*	0.05-0.67	2.52*	1.18-5.40
People living at home						
≤ 4 people	1		1		1	
> 4 people	1.05	0.58-1.89	1.25	0.71-2.21	1.69**	0.92-3.13
			Multivariate analysis			
Years of maternal study[‡]						
> 9 years	1		1			
≤ 9 years	3.80	1.90-7.60	0.31	0.15-0.61	–	
Per capita income[§]						
< 1/2 MW	–		–		1	
≥ 1/2 MW					2.43	1.13-5.24

‡ Value refers to the median years of schooling.
§ Value refers to the minimum wage of R$ 510.00.
*,** Significant, respectively, of levels of 5 and 20% of probability of the chi-square test.

Multivariate analysis:

*,‖ Analysis adjusted for child's time in school, excessive maternal weight, maternal work outside the household and *per capita* income.
† Analysis adjusted to the number of household members.

95%CI = 95% confidence interval; BMI = body mass index; MW = minimum wage; OR = odds ratio.

This trend was observed considering that, among the three dietary patterns identified in this research, one was classified as "snack" and the other as "unhealthy", both with foods rich in lipids and sugars.

Among the Brazilian publications on identification of infant-juvenile DPs, based on the application of statistical models, only two were found.[7,10] The first[7] involved preschoolers treated at a basic health care unit in Rio de Janeiro, state of Rio de Janeiro and aimed to asses consumption pattern and risk factors for cardiovascular diseases (CVD). Six groups (DP) were identified, five classified as risk patterns for CVD. The second[10] used the PCA to identify DP of adolescent in the municipality of São Paulo, state of São Paulo, and assess their metabolic consequences. Authors identified three patterns: traditional, in transition and fast food. The three DP were considered obesogenic, but the fast food seems to be more atherogenic and to promote arterial hypertension.

Some international publications about this theme were developed with children,[6,8] adolescents[11] and with people at different stages of life.[9] Northstone & Emmett[6] studied English children aged 4 and 7 and identified three dietary patterns: unhealthy, traditional and conscious healthy. Oellingrath et al.[8] identified four among Norwegian children aged 9 and 10: snack, sweets/processed foods, Norwegian variety and diet food.

Ambrosini et al.[11] identified two DP among adolescents, which were called "western" – consisting of foods such as sodas, candy, French fries, refined grains, whole dairy products and processed meats – and "healthy" – characterized by high consumption of whole grains, fruits, vegetables, and fish.

Five DPs of children, adolescents and young adults in Spain were identified by Aranceta et al.,[9] which were called: rich in meet, rich in protein, snacks, healthy and little nutritive. The "snack" pattern was characterized by a more frequent and higher consumption of products such as breads, cakes, and biscuits, sweets, snacks and soft drinks. The "healthy" pattern was characterized by a more frequent consumption of fruits, vegetables and fish.

It is observed that the DPs identified in this study are similar to the mentioned researches. This result is in line with the study of Caetano et al.,[24] which identified high frequency of inappropriate eating practices and dietary intake in young infants; and with the research on household budget of 2002,[25] which found an increase in the consumption of sugar, total and saturated fats, processed products such as cookies and soda, a reduction in the consumption of rice and beans and insufficient consumption of fruits and vegetables. The unhealthy foods present in the "unhealthy" DP in this research are relatively inexpensive and very accepted by children; they may; still, represent social status, and that may be fostering their consumption.

On the determinants of the "unhealthy" patterns, they have been associated to the lower level of education of mothers,[6,8,9] to a longer period of time watching television,[9,11,26] to male children,[26] to white-skinned children, to a greater number of siblings,[6] to children of overweight mothers,[8] to smoking parents, to single parents and, inversely, to families of higher income.[11]

The traditional pattern, similar to the typically Brazilian pattern of "mixed diet," was associated to the female sex,[6,9,11] to children with non vegetarian families and whose mothers had a partner,[8] to higher maternal education,[9,10,26] to well-structured families, with married parents, and inversely, associated with the time spent watching television[11] and to the longer duration of sleep.[26]

The performance of the stratified analysis, aiming to better understand why in this research, the low maternal education was a determinant factor of higher frequency of consumption of the "mixed diet" dietary pattern, showed that income and the school attendance have a modification effect in this variable, i.e., it is not exactly the low level of maternal education that has this effect. This result is consistent with a research,[27] which identified that lower income reduces the access to processed foods, often unhealthy and costly, and that attending schools favors the consumption of foods from the different dietary groups and sometimes with a better energy distribution.[28] Out of preschoolers that attend schools, 89.89% study in municipal schools, which are establishments that offer healthy meals planned by nutritionists. These factors, together, may also justify why children of mothers with lower education consume less often foods from the "snack" DP.

The fact that a higher *per capita* income was a determinant of the "unhealthy" DP denotes that families with such characteristics are acquiring more often less healthy foods, refined and ready for consumption, which may influence the medium and long-term development of disorders such as excessive weight, anemia, and dyslipidemia.

It is important to highlight that the DP better express the complexity involved in the act of eating, since people do not eat isolated foods or nutrients; besides, they can better support proposals of effective measures to promote health through feeding.[29] Sichieri et al.[30] also mention that the pattern of food consumption, more than the absence of specific nutrients in the diet, express real situations of food availability and different conditions of inclusion or not of the people in different social settings.

It should be mentioned, however, some limitations of the present study. The most important refers to the assessment of usual diet of preschoolers and the time spent on sedentary activities. Obtaining accurate information about these topics is not simple, because most mothers work outside (62.5%) and their children attend schools (88.79%).

In conclusion, three DP were identified among the preschoolers studied, and two were identified as inadequate. Maternal education and *per capita* income were determinants of the patterns "mixed diet"/ "snack" and "unhealthy", respectively. This result shows the need to encourage behavioral changes, which require public policies to fight inadequate DP, and the need for prevention of illnesses that come with such practices. Children should be the target group of such policies, since eating habits are formed in childhood, and poor habits embedded in this phase and maintained throughout life may foster the development of diseases in adulthood.

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