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Relationship between Overweight and Dietary Patterns in Brazilian Preschoolers

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Abstract

Background/Objectives: The prevalence of overweight in children is a growing health problem. The aim of this study was to investigate the relationship between overweight and dietary patterns in preschoolers. **Methods:** In total, 232 preschoolers (age 5) residing in the city of Diamantina, Brazil, were evaluated. Dietary intake from a food frequency questionnaire, anthropometric parameters and socioeconomic/behavioral information from a questionnaire were evaluated using a cross-sectional design. Dietary patterns were identified using principal component analysis, and the relationship between overweight and dietary patterns was examined by logistic regression analysis. **Results:** "Mixed diet", "snack" and "unhealthy" dietary patterns were identified. Children daughters of obese mothers, and those who had higher average weight gain in the first four months of life had a significantly higher chance of being overweight (respective values: OR = 3.81; $p = 0.002$; and OR = 2.97; $p = 0.009$). Higher levels of maternal education were associated with higher "mixed diet" scores ($p < 0.001$), whereas lower levels of maternal education ($p < 0.001$), higher per capita income ($p < 0.001$) and higher average weight gain from 0 to 4 months ($p = 0.002$) were associated with higher "snack" scores. Higher per capita income was also associated with lower "unhealthy" scores ($p < 0.001$). Dietary patterns no associated with overweight. **Conclusions:** In the present study, overweight was not associated with dietary pattern. However, unhealthy eating habits are known to be risk factors for overweight, and considering that eating habits are formed in childhood, it is very important that healthy eating be encouraged in the family environment and in other spaces like childcare and school.

Keywords

Dietary Patterns, Nutritional Assessment, Overweight, Childhood, Dietary Intake

1. Introduction

Recent reports on the global prevalence and trends of childhood overweight have presented alarming statistics: in 2010, 43 million children—35 million of them residents in developing countries and 8.1 million living in developed countries—were overweight or obese. The global prevalence has increased, from 4.2% in 1990 to 6.7% in 2010, and the predicted prevalence of childhood obesity in 2020 is 9.1% (60 million) [1]. This problem is due to many factors, including genetic predisposition, physical inactivity, food availability, and unhealthy dietary patterns [2].

However, despite considerable research on the nutritional etiology of childhood obesity, the roles of macronutrient intake and individual foods remain controversial [3]. Inconsistent findings may be due to the traditional single-nutrient or single-food approaches commonly used in dietary epidemiological research, which do not examine the combined effect of dietary components [4].

Considering the difficulty of identifying an association between the intake of specific nutrients and the onset of disease, the most recent research has focused on the overall effect of diet on the genesis of certain diseases. Dietary patterns represent the general profile of food and nutrient intake with typical eating habits and can predict disease risk better than assessment of single foods or nutrients because dietary patterns document the cumulative effect of various nutrients on health [5].

The failure to identify a positive relationship between overweight and unhealthy foods in cross-sectional studies is partly explained by changes in dietary habits and food restrictions due to childhood weight gain [6] [7]. It is not known whether this is a general phenomenon or a phenomenon is dependent on other characteristics. Several studies have linked healthy dietary patterns among children with high parental education levels [6] [8], female sex [8], and increased physical activity [9].

Principal component analysis (PCA) is the statistical method most commonly used to describe overall dietary patterns. This approach specifically assesses the correlations between the frequencies of foods typically eaten together. This method may provide a better indicator of disease risk. Some research has identified an association between unhealthy dietary patterns and overweight [10] [11] [12], whereas other studies have found no consistent association [9] [13] [14].

Considering the increased prevalence of overweight in Brazilian children, the aim of this study is to investigate the association between dietary patterns derived from PCA and overweight in preschoolers from Diamantina, Minas Gerais Brazil.

2. Methods

2.1. Study Design, Subjects and Location

This study had a nested cross-sectional design in a cohort of children born and living in Diamantina, Minas Gerais, Brazil [15]. As in most Brazilian cities, the children in this study were mostly (73.8%) mixed race [16]. The details of the formation of the cohort are described elsewhere [17]. In this study the children were 5 years old (±5 months). For this research, preschoolers were recruited from the addresses used in the cohort cited above. The exclusion criteria were previously defined in the cohort study (prematurity, congenital malformations, twin birth, living outside the municipality Diamantina); to be included in this study, preschoolers had to be eligible for the cohort study and have the permission of the parents.

According to Pestano and Gageiro [18] to identify dietary patterns based on the number of food groups listed on a food frequency questionnaire (FFQ), 120 subjects would be necessary. We obtained data from 232 preschoolers; therefore, the sample size was satisfactory.

The data collection for the present study occurred from July 2009 to July 2010. The data were collected by four nutritionists and one student in a nutrition course at the Universidade Federal dos Vales do Jequitinhonha e Mucuri-FUVJM. Before the start of the study, the researchers were trained in data collection to avoid measurement error. Each preschooler was then visited at his or her home.

Diamantina is a city located in the northwest region of Minas Gerais state in Brazil, also known as the Jequitinhonha Valley. Currently, in this area, the mortality rate among children aged 1 year or less is 32.8/1000 children, the literacy rate is 83.4%, the human development index (HDI) is 0.748, and the HDI-income is 0.752 [19]. The HDI aims to be a general summary measure of human development and thus evaluates the quality of health, education and income in cities, states and countries.

The research protocol was approved by the Ethics Committee of the Universidade Federal de Minas Gerais (ref. no ETIC 545/08), and informed written consent was obtained from the parents/guardians of all participating preschoolers.

2.2. Anthropometry and Other Evaluations

The nutritional status of the children was evaluated by measuring their weight and height to obtain their body mass index (BMI). Weight was determined utilizing a portable digital scale with a maximum capacity of 150 kg and increments of 50 g, and height was measured using a portable stadiometer with a scale accuracy of 0.1 cm. The procedures were followed according to the protocols recommended by Jelliffe [20].

The classification of nutritional status was performed using z-scores and the WHO criteria [21]. According to BMI/age, a z-score < +1 identified children with deficit/eutrophy, and a z-score ≥ +1 identified overweight children. To calculate the z-scores, we used the software WHO Anthro and WHO AnthroPlus versions 3.0.1 and 1.0.3, respectively (Antho, WHO, Geneva, Switzerland).

The children's mothers also underwent anthropometric assessments: their weights and heights were evaluated to obtain their BMIs. These measures were performed according to the protocol of Lohman *et al.* [22]. BMI values ≥30 kg/m^2 were classified as indicating obesity [23]. These assessments occurred in the morning. All of the measurements of preschoolers and their mothers were performed on a single occasion and occurred at the FUVJM.

Additional information about the determinants of overweight was obtained using a questionnaire that was administered to each child's mother or caregiver. Data were collected about the family's monthly income, maternal education, and the amount of time spent on children's games and watching TV. Information about the duration of breastfeeding and about weight at birth and during the first four months of life was obtained from the Lessa study database [24], which is part of a PhD thesis.

2.3. Dietary Intake

Dietary intake was evaluated by semi-quantitative FFQ created by Sales *et al.* [25]. A pilot test was conducted to assess the adequacy of the FFQ for this research; any foods not mentioned by the preschoolers' families were excluded, and other foods were added to the FFQ.

We assessed the possibility of under- or over-reporting dietary intake in our sample using the Burrows *et al.* method [26]. This method divides the value for the energy intake (EI) by the estimated energy requirement (EER) (EI/EER). An EI/EER ratio less than 0.84 indicates under-reporting, an EI/EER greater than 1.16 indicates over-reporting, and an EI/EER between 0.85 and 1.16 indicates accurate reporting. The evaluation of the IE and EER was performed using the energy requirement estimated according to the National Research Council's formula [27].

The evaluation of EI was performed using the EER, which is the energy needed to meet the energy balance compatible with good health [28]. The physical activity factor used was 1.16 for girls and 1.13 for boys. We used a low activity factor because the children spent an average of 3 hours/day on sedentary children's games, and only nine participated in scheduled physical activities (e.g., swimming, soccer, and ballet). The adequacy of the relative distribution of macronutrients in the diet compared with the total energy value (TEV) was evaluated using the recommended acceptable macronutrient distribution ranges (AMDRs) as reference values: carbohydrates, 45% to 65% of the TEV; proteins, 10% to 30%; and lipids, 25% to 35% [28].

2.4. Dietary Patterns

Dietary patterns were identified using dietary information collected from a FFQ listed above [25], and were extracted by principal component analysis. Before the analysis, the coefficient of Kaiser-Mayer-Olkin was estimated, and the Bartlett's test of sphericity was applied to assess the quality of the correlations between variables. The components factor analysis, followed by orthogonal varimax 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 to retain. The internal consistency of the dimensions of the FFQ was also evaluated, and a level of Cronbach's alpha ≥ 0.60 was considered acceptable. More methodological details of the dietary patterns have been published elsewhere [17]. Each component (dietary pattern) has been labeled, although these labels do not perfectly describe each underlying pattern, but rather aid in the reporting and discussion of the results [17].

The dietary patterns were used as a discrete variable calculated by multiplying the factor loadings by the corresponding standardized value for each food and by the food's frequency of intake in each dietary pattern. The participants were then categorized using a dichotomous variable (0 or 1) according to a high (1) or low (0) frequency of consumption of each food group, considering values above (1) or below (0) the second tertile.

2.5. Statistical Analysis

A score was created for each preschooler for each dietary pattern identified. These scores were calculated by multiplying the factor loadings by the corresponding standardized value for each food and summing across the food types.

Each score had a mean of zero, and a higher score indicated that the diet was closer to that dietary pattern. Foods with loadings above 0.3 on a pattern were considered to have a strong association with that pattern and were deemed to be most informative in describing the dietary pattern.

Differences between group factor scores (dietary pattern) were tested using a t test. We used logistic regression analysis to calculate the odds ratio (OR) for overweight in relation to socioeconomic, maternal, behavioral and early life characteristics. Variables with a p-value < 0.2 in the crude analysis were used in the adjusted analysis. Finally, we considered the factors associated with overweight as significant at a p-value < 0.05.

Another multivariate logistic regression was used to compare overweight status (dependent variable) and dietary pattern, controlling for potential confounding factors (socioeconomic, maternal, previous and behavioral characteristics). Four models were tested: Model 1 included the socioeconomic and maternal variables, Model 2 included sex and the maternal and previous variables, Model 3 included the variables related to the children's lifestyle, and Model 4 included alltudied variables.

Statistical analysis was performed using the PASW software system (version 19.0) for Windows (SPSS Inc., Chicago, IL, USA).

3. Results

In this research, 232 children were studied, including 142 boys (61.2%) and 90 girls (38.79%). The percentages of eutrophic and overweight children were 82.8% (n = 192) and 17.3% (n = 40), respectively. We included underweight children in the normal weight group because of the small number of individuals involved (n = 7). The prevalence of overweight in boys was 16.2% (n = 23), and in girls, it was 18.9% (n = 17).

Three dietary patterns were obtained. The "mixed diet" consisted of foods/ food groups typical of a Brazilian diet, *i.e.*, bovine and pork meat; milk and dairy products, rice and tubers, farina, sweet and savory biscuits, cakes, leafy vegetables, fruit and natural juices. The "snack" pattern consisted of bakery foods/food groups that usually do not require preparation for consumption, *i.e.*, milk and dairy products, sweet and savory biscuits, fruit, natural juices, bread, margarine and Nescau®/Toddy® (powdered chocolate drink). In addition, the "unhealthy" pattern consisted of sweets and foods rich in lipids and carbohydrates, *i.e.*, fatty and sweet goodies, artificial juices, soft drinks, sweets/desserts, stuffed cookie and fried or boiled eggs.

The pattern of "mixed diet" explained the high percentage of variance and was considered as the pattern that best represented the food intake of the sample analyzed. This pattern represents a traditional Brazilian diet close to that recommended by the national nutrition authorities.

It is worth mentioning that children who belonged to a given pattern did not necessarily eat only foods that made up that pattern. Therefore, adherence to a pattern did not preclude engagement in another dietary pattern.

It is also worth noting that for the "mixed diet" pattern, which may be protective against overweight, "low intake" was categorized as 1, *i.e.*, indicating risk. For the other intake patterns, which may increase the risk of overweight, "high intake" was categorized as 1.

Table 1 shows the crude and adjusted ORs for overweight by socioeconomic, anthropometric, and behavioral characteristics and dietary patterns. In the crude analysis, children with higher mean weight gain in the first months of life (OR = 3.11; $p = 0.003$), obese mothers (OR = 3.66; $p = 0.001$), and a higher frequency consumption in the "snack" dietary pattern (OR = 2.09; $p = 0.03$) had an increased risk of overweight. Families with lower per capita income (OR = 0.48; $p = 0.03$) had a decreased risk. In the adjusted analysis, only weight gain in the first months of life (OR = 2.97; $p = 0.009$) and maternal obesity (OR = 3.81; $p = 0.002$) remained associated with the presence of overweight in the children studied.

Higher levels of maternal education ($p < 0.001$) were associated with higher "mixed diet" scores, whereas lower levels of maternal education ($p < 0.001$), higher per capita income ($p < 0.001$) and higher average weight gain from 0 to 4 months ($p = 0.002$) were associated with higher "snack" scores. Higher per capita income was also associated with lower "unhealthy" scores ($p < 0.001$) (Table 2).

An analysis of the relationship between dietary patterns and overweight, adjusted for various potential confounders, is presented in Table 3. Four models were constructed. Only one of them – the Model 3, was associated with overweight after adjustment for the time spent on children's games and watching TV. Children who most frequently consumed foods in the "snack" pattern had a twofold higher chance of being overweight (OR = 2.10; $p = 0.03$). The fourth model, which was adjusted for all potential confounding factors presented in Table 1 and Table 2, did not identify association between overweight and dietary patterns.

Table 1. Association (with crude and adjusted ORs) between socioeconomic, maternal, previous and current characteristics and overweight in 5-year-old children.

Variable	Overweight n	Overweight %	Crude OR	*p*-value	Adjusted[a] OR	*p*-value (95% CI)
Per capita family income (US$)§						
<144.1 MW	18	45.0	1		1	
≥144.1 MW	22	55.0	0.48	**0.03**	1.08	0.85 (0.49, 2.34)
Maternal years of education‡						
≤9	21	52.5	0.88	0.71	-	
>9	19	47.5	1			
Maternal employment						
No	12	30.0	1.49	0.28	-	
Yes	28	70.0	1			
Maternal obesity						
Yes	14	35.0	3.66	**0.001**	3.81	**0.002** (1.66, 8.79)
No	26	65.0	1		1	
Time spent watching TV†						
<2 hours	17	42.5	1			
≥2 hours	23	57.5	0.88	0.73	-	
Time spent playing (hours/day)						
<3	16	40.0	1.62	**0.17**	1.55	0.25 (0.73, 3.32)
≥3	24	60.0	1		1	
Sex						
Female	17	42.5	1.21	0.59	-	
Male	23	57.5	1			
Duration of breastfeeding						
<6 months	13	32.5	1.44	0.33	-	
≥6 months	27	67.5	1			
Average weight gain from 0 to 4 months						
<0.85 kg/month	10	25.0	1		1	
≥0.85 kg/month	29	75.0	3.11	**0.003**	2.97	**0.009** (1.31, 6.75)
Mixed diet dietary pattern#						
≤2nd tertile	27	67.5	1.04	0.91	-	
>2nd tertile	13	32.5	1			
Snack dietary pattern						
≤2nd tertile	21	52.5	1		1	
>2nd tertile	19	47.5	2.09	**0.03**	1.64	0.19 (0.77, 3.46)
Unhealthy dietary patterns						
≤2nd tertile	29	72.5	1		-	
>2nd tertile	11	27.5	0.72	0.40		

§Value refers to the minimum wage (MW) of US$288.1; ‡Value refers to the median number of full years of schooling, †Value refers to the median time spent watching TV; #High and low intake was considered in the upper or lower second tertile, respectively; [a]Adjusted for variables with a *p*-value < 0.2 in the bivariate analysis.

Table 2. Dietary patterns by maternal, socioeconomic, behavioral and anthropometric characteristics among 5-year-old children.

Variable	Dietary patterns		
	“Mixed diet”	“Snack”	“Unhealthy”
Mother’s obesity			
Yes	−0.03	0.16	−0.06
No	−0.01	−0.03	0.01
p-value[a]	0.951	0.559	0.804
95% CI	−0.36, 0.39	−0.86, 0.46	−0.56, 0.72
Mother’s years of study‡			
≥9 years	0.34	−0.63	0.07
<9 years	−0.28	0.79	0.09
p-value	**<0.001***	**<0.001***	0.472
95% CI	0.35, 0.88	0.97, 1.88	−0.64, 0.29
Mother’s work			
No	0.07	0.14	0.08
Yes	−0.13	−0.22	−0.13
p-value[a]	0.146**	0.150**	0.368
95% CI	−0.49, 0.07	−0.87, 0.13	−0.70, 0.26
Per capita family income§			
<1/2 MW	−0.04	−0.17	0.17
≥1/2 MW	0.21	1.05	−1.03
p-value[a]	0.198**	**<0.001***	**<0.001***
95% CI	−0.13, 0.65	0.56, 1.91	−1.85, −0.57
Duration of breastfeeding			
<6 months	0.08	−0.01	0.18
≥6 months	−0.03	0.01	−0.06
p-value	0.471	0.960	0.350
95% CI	−0.43, 0.19	−0.54, 0.57	−0.78, 0.28
Average weight gain from 0 to 4 months#			
<0.85 kg/month	−0.13	−0.40	−0.12
≥0.85 kg/month	0.09	0.39	0.18
p-value[a]	0.103**	**0.002***	0.202
95% CI	−0.51, 0.05	−1.29, −0.31	−0.78, 0.16
Sex			
Male	0.05	0.16	0.09
Female	−0.09	−0.25	−0.13
p-value[a]	0.315	0.094**	0.344
95% CI	−0.14, 0.43	−0.07, 0.93	−0.24, 0.71
Time spent watching TV†			
<2 hours	0.00	−0.23	−0.10
≥2 hours	−0.01	0.16	0.07
p-value[a]	0.964	0.098**	0.459

Continued

95% CI	−0.28, 0.29	−0.89, 0.08	−0.66, 0.29
Time spent playing»			
<3 hours	−0.04	−0.09	−0.13
≥3 hours	0.01	0.22	0.31
p-value[a]	0.661	0.235	0.075**
95% CI	−0.23, 0.37	−0.85, 0.21	0.96, 0.04
Overweight			
Yes	0.14	0.43	0.01
No	−0.03	−0.08	0.00
p-value[a]	0.329	0.116**	0.957
95% CI	−0.55, 0.18	−1.16, 0.13	−0.64, 0.60

‡Value refers to the median years of schooling; §Value refers to the minimum wage of US $288.1; #Value refers to the median average weight gain from 0 to 4 months; †Value refers to the median time spent watching TV; »Value refers to the median time spent playing; *Significant at a *p*-value < 0.05; **Significant at a *p*-value < 0.2; [a]t test. A score for each pattern identified was created for each preschooler. These scores were calculated by multiplying the factor loadings by the corresponding standardized value for each food and summing across the food types. Each score has a mean of zero, and a higher score indicates that the diet is closer to that dietary pattern.

Table 3. Multivariate analyses of dietary patterns by overweight adjusted for socioeconomic, maternal, previous, and behavioral characteristics among 5-year-old children.

Variable	Dietary patterns								
	"Mixed diet"			"Snack"			"Unhealthy"		
	OR	*p*-value	95% CI	OR	*p*-value	95% CI	OR	*p*-value	95% CI
Overweight									
Model 1‡	1.23	0.60	0.56, 2.67	2.04	0.07	0.95, 4.39	0.77	0.49	0.36, 1.65
Model 2§	0.95	0.91	0.44, 2.08	1.69	0.17	0.80, 3.59	0.79	0.57	0.36, 1.77
Model 3#	0.99	0.98	0.47, 2.06	2.10	**0.03**	1.04, 4.23	0.72	0.40	0.34, 1.54
Model 4†	1.04	0.93	0.46, 2.35	1.54	0.31	0.66, 3.56	0.82	0.64	0.36, 1.87

‡Adjusted for maternal years of education/maternal employment/per capita family income, §Adjusted for average weight gain from 0 to 4 months/mother's obesity/sex, #Adjusted for time spent playing/time spent watching TV, †Adjusted for all variables.

Among the eutrophic preschoolers, the rates of under-reporting (n = 64; 33.3%), true reporting (n = 62; 32.3%), and over-reporting (n = 66; 34.4%) were similar. Among the overweight preschoolers (n = 40), under-reporting occurred in 19 cases (47.5%); true reporting, in 10 (25.0%); and over-reporting, in 11 (27.5%).

Of the 281 children in the original cohort, 232 (82.6%) were included in this study. The 17.3% loss was due to families moving away from the city (n = 37; 75.5%), incorrect addresses (n = 8; 16.3%) or family refusal to participate (n = 4; 8.2%).

4. Discussion

The results of this research show that the pediatric population has been affected by overweight in Brazil [28]-[33], as in other countries [9] [10] [11] [12] [13]. Nevertheless, unhealthy eating habits is recognized as a risk factor for overweight, and healthy eating should be a family practice and public policy object. Of note, the prevalence of overweight found in the present study remains consistent with the Brazilian statistics [29] [30] [31] [32] [33] but is much lower than values in earlier national survey reports [28], which showed rates of overweight ranging from 9.5% to 34.4% or 35.5%.

According to the Brazilian Institute of Geography and Statistics [28], one in every three Brazilian children aged 5 to 9 years is overweight. Moreover, the prevalence of obesity is 16.6% among boys and 11.8% in girls. Indeed, the southeast region (where the city of Diamantina is located) stands out, with 40.3% of boys and 38% of girls being overweight in that age group. The survey also found a rise in obesity in the low-income population, increasing from 8.9% in 1989 to 26.5% in 2008 to 2009. However, the highest prevalence remains in the high-income population.

The dietary pattern results identified in this study are comparable to those in several studies that also found healthy and unhealthy dietary patterns among children [8] [9] [10] [12] [14] [33] [35] [36] [37] [38] [39] and adolescents [11] [13] [33] [34] [37].

Nonetheless, there are still few publications about dietary patterns in Brazilian children and adolescents defined a posteriori [33]-[39]. Differences in dietary assessments and the population specificity of dietary patterns make a direct comparison difficult [40], but several similarities can be observed. Most dietary pattern studies have included one pattern featuring a mixture of processed foods and convenience/junk foods [8] [9] [37] [38] [39] [40] and one pattern characterized by traditional national foods [8] [9] [35] [36] [38] [39].

The results presented in **Table 1** showed that maternal obesity and high average weight gain during the first months of life were associated with overweight among the assessed children. These results are in agreement with other studies that have found that in children, this problem is associated with maternal obesity [41] [42] [43] and high weight gain during the first months of life [43]. The familial characteristic of obesity, as reflected by the co-occurrence of obesity in schoolchildren and their parents, has been documented in the literature [41] [42] [43]. Thus, parents who have this problem must be more attentive when feeding their children and encouraging physical activity.

The association observed between the "mixed diet" dietary pattern and higher maternal schooling corroborates the similar results of other studies [33] [35]. Mothers with more education may be better prepared to make healthy food choices for their children. Higher consumption of the "snack" pattern occurred among the children of mothers with low education and higher income, a situation that appears contradictory. In this sense, we evaluated the distribution of maternal schooling according to income levels. It was noted that schooling was distributed equally between the two income levels, *i.e.*, the proportion of mothers with low schooling was approximately 55.0% for both levels. This fact could be explained by the relatively low income in the population evaluated, which was dissociated from education.

The families with the highest-income per capita were associated with lower scores for the "unhealthy" pattern. This result indicates that families with better purchasing power should be prioritizing healthy foods such as fruit, vegetables, meat, milk and dairy products for their children. Based on these results, it is speculated that subjective issues such as the social representation of food in society permeate food choices.

In evaluating the relationship between dietary patterns and overweight, a higher frequency of food consumption according to the "snack" dietary pattern was associated with overweight the third model. Certain foods contained in this AP may be favoring this problem, such as bread, margarine, Nescau®/Toddy® (powdered chocolate drink), milk and dairy products. The consumption of bread (r = 0.648), margarine (r = 0.627), Nescau®/Toddy® (r = 0.556) and milk and dairy products (r = 0.548) showed higher correlations with this AP, which probably explains why more frequent consumption of foods in this dietary pattern was significantly associated with increased odds of being overweight. Other research conducted with Portuguese [10] and Mexican [12] children and Australian [11] adolescents also observed an association between "unhealthy" dietary patterns and overweight.

However, is worth mentioning that this association was observed when adjusted for behavioral variables, *i.e*. time spent playing and time spent watching TV. When adjusted for all variables with potential confusion this association was not maintained (fourth model). One explanation for our results may be the small variability in children's diets, a situation that difficult to identify this relationship.

Research about relationship between unhealthy dietary patterns and overweight in infantojuvenil group have shown contradictory results. Some studies [9] [10] [13] not identified this association while others found a positive association [11] [12]. According to Perozzo *et al*. [44], is likely to parents of overweight children are modifying the diet of their children during the search. In transversal study, this type of problem is common, which is termed of reverse causality, in this case the mothers of children with overweight could be offering healthier foods for their children compared to their usual offerings.

Furthermore, it is known that people with overweight/obesity tend to underestimate the amount of food consumed. In addition, in this study, we observed that the mothers of overweight children under-reporting the consumption of their children (47.5%). These factors together can explain the results this search. Thus, further research especially with longitudinal design and use of more precise methods to assess food intake may help elucidate this relationship, and reduce chance of occurrence of reverse causality.

There are certain limitations to the present study. One limitation is the cross-sectional design, which eliminates the possibility of identifying causal relationships between dietary patterns and the risk of being overweight. Despite the under reporting among overweight preschoolers, which may have initially been a limit, the food frequency questionnaire used in the present study registered dietary intakes for less than a month; thus, this limited range could be more sensitive to the effect of reverse causality.

5. Conclusion

The present study, overweight was not associated with dietary pattern. Nevertheless, unhealthy eating habits are recognizably risk factor for overweight, and healthy eating should be a family practice and public policy object. The study indicates the complexity of the association between dietary patterns and overweight. New studies are needed to further clarify the subject.

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Conflicts of Interest

The authors declare no conflict of interest.

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