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Original/*Pediatría*

Energy consumption, the distribution of macronutrients and BMI in mothers and their Mexican schoolchildren

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Abstract

Objective: **to identify the association between the percentage of adequacy of energy and protein and the distribution of macronutrients and sugar in the diets of mothers and schoolchildren with their respective BMI.**

Methods: **in a cross-sectional study, 174 5-12-year-old schoolchildren and their mothers were randomly selected. BMI was measured, and 24-hour dietary surveys were administered on weekdays and weekends. The associations between the dietetic indicators in the mothers and their children and the BMI of the mothers and their children were assessed. The chi-square test, linear regression and odds ratio were used for analysis.**

Results: **excessive energy consumption in the mothers increased the risk of excessive energy consumption in their daughters by 11-fold (p=0.04). Maternal lipid intake was associated with the consumption of lipids in their sons and daughters (p<0.001 and p=0.005, respectively), and mothers' carbohydrate consumption was associated with their daughters' consumption (p=0.004). Mothers' excessive sugar consumption increased the risk of excessive sugar consumption in their sons and daughters by 4- to 5-fold. Obese mothers had higher proportions of obese children [RM 15.5 (95% CI 1.8, 132), p=0.003].**

Conclusions: **the excessive energy consumption of mothers is a risk for excessive energy consumption in their children, differentiated by gender. Maternal obesity reflects an obesogenic environment and represents a risk factor for obesity in their children.**

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Key words: *Mother-child diet. Percentage of energy adequacy. Macronutrient distribution. BMI.*

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CONSUMO ENERGÉTICO, DISTRIBUCIÓN DE MACRONUTRIENTES E ÍNDICE DE MASA CORPORAL EN MADRES MEXICANAS Y SUS HIJOS ESCOLARES

Resumen

Objetivo: **identificar la asociación entre el porcentaje de adecuación de energía y proteína y la distribución de macronutrientes y azúcar en la dieta de madres e hijos con sus respectivos índices de masa corporal.**

Material y métodos: **en estudio transversal se seleccionaron de forma aleatoria 174 escolares de 5 a 12 años y sus madres. Se obtuvo el IMC y se aplicaron encuestas dietéticas por recordatorio de 24 h entre semana y en fin de semana. Se identificó la asociación de indicadores dietéticos en la díada madre-hijo y de los mismos con el IMC de madres e hijos. Se utilizó la prueba de ji cuadrada, regresión linear y razón de momios.**

Resultados: **el consumo excesivo de energía en las madres incrementó 11 veces el riesgo de consumo excesivo de energía en sus hijas (p=0,04). El consumo materno de lípidos se asoció al consumo de estos en sus hijos e hijas (p<0,001 y p<0,005) y el de hidratos de carbono al consumo de lípidos de sus hijas (p=0,004). El consumo excesivo de azúcar de las madres incrementó 4-5 veces el riesgo de consumo excesivo de hidratos de carbono en sus hijos e hijas. Las madres con obesidad tuvieron mayor proporción de niños con obesidad [RM 15,5 (IC 95% 1,8, 132), p=0,003].**

Conclusiones: **el consumo excesivo de energía en la madre constituyó un riesgo de consumo excesivo de energía en sus hijos de manera diferenciada por género. La obesidad materna reflejaría un ambiente obesogénico y representaría un factor de riesgo de obesidad en sus hijos.**

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Palabras clave: *Dieta madres e hijos. Consumo de energía. Distribución de macronutrientes. Índice de masa corporal.*

Introduction

According to scientific evidence, the food preferences of mothers exert a biological effect on the food preferences of their children from pregnancy and after birth when they receive exclusive breastfeeding [1]. This influence continues during the first years of life and decreases gradually as children grow [2, 3]. Several researchers have shown that parents are role models for young children in behaviors related to the selection and consumption of food [3, 4]. According to Rozin [5], one of the main factors in the selection of food is its availability at home, and this depends directly on what the parents provide [6]. There are relatively few studies on this issue, and the vast majority have been conducted in developed countries [3]. In Mexico, a nationally representative survey (ENSANUT-06) [7] identified three dietary patterns in the adult population [8]: "traditional" diet, which corresponds to traditional Mexican food culture (little food variety and corn and its derivatives account for nearly 50% of energy intake); the "refined and sweet" diet, which is high in "refined products and simple carbohydrates"; and finally, the "different" diet, which is high in animal products, saturated fats and with the highest proportion of fruits and vegetables of the three diets. [6.]

The latter two patterns represent approximately 60% of the study population and were associated with overweight and obesity. If these dietary patterns characterize the Mexican adult population, who influence the feeding of the pediatric population, this situation would represent an important risk factor for the development of overweight and obesity in Mexican children.

Therefore, the purpose of this paper is to explore the association of the diet of the mother and schoolchildren (sons and daughters) in terms of the percentage of adequacy and the balance of macronutrients and its association with body mass index (BMI).

Material and methods

A cross-sectional study involving 172 children, ages 5-12 years, of both gender and their mothers was conducted. The children were selected by random sampling of public primary schools in the municipality of Arandas Jalisco from May 2010 to May 2011. Dietary surveys were administered by 24-hour recall (EDR24h) on weekdays and weekends to the mother-child dyads by trained personnel and were analyzed by the program Nutrikcal.vo® (CONSINFO, SC, Mexico City). The percentage of adequacy [9] energy consumption according to the recommendations of the FAO/WHO/UNU [10], protein intake according to the recommended reference [11] and the percentage of energy distribution from macronutrient intake [11] were determined. Weight and height were measured according to the method of Habitch [12] to determine body mass index. BMI was classified as normal weight, overweight and obese according to the WHO recommendations. In mothers, the weight categories corresponded to the following BMIs[13]: normal weight, 18.5 to 24.99 kg/m^2; overweight 25 to 29.99 kg/m^2, and obesity ≥30 kg/m^2. In children, the weight categories corresponded to the following DE [14]: normal weight, -2 to 1 DE; overweight > 1 to <2 DE, and obesity ≥2 DE.

The statistical analysis was performed in SPSS version 18 (IBM®). The distribution of the data was determined by the Kolmogorov-Smirnov test. The frequencies of the following categories were obtained: sufficient, insufficient and excessive percentages of adequacy in energy and protein as well as the percentages of energy distribution from lipids, carbohydrates and sugar in the diets of mothers and children. The difference in proportions of each category was determined by the chi-square test between the following:

a) the diet during the week compared to the weekend; b) by gender between boys vs. girls; c) between mothers of girls vs. mothers of boys; and, d) between the group of mothers vs. the group of children (boys and girls).

- Linear regression, including the percentages of adequate energy and protein and the energy distribution percentages of lipids, carbohydrates and sugar in the weekday and weekend diet of schoolchildren as the dependent variable; and these same parameters in the mothers' diets as the independent variables (the correlation coefficients and determination were obtained).
- The association (chi-square) and the possibility of occurrence (odds ratio) of the frequency of the "excessive" category in the percentage of adequacy of energy and protein, and the percentage distribution of lipids, carbohydrates and sugar in the diet of mother-child dyads were determined.
- The association (chi-square) and the possibility of occurrence (odds ratio) of the presence of normal weight, overweight and obesity in the mothers and boys/girls were investigated.
- The difference in proportions (chi-square) and the possibility of occurrence (odds ratio) of the "excessive" category in the percentage of adequacy in energy and protein intake, as well as the percentage distribution of lipids, carbohydrates and sugar in the weekday and weekend diet according to the presence of normal weight, overweight and obesity in the group of children and their mothers were assessed.

Ethical considerations

The protocol was applied after obtaining informed consent. It was approved by the bioethics and research committees at the University of Guadalajara, opinion CI-13609.

Results

Table I presents the general characteristics of the population. Table II presents the percentage of adequacy in energy and protein in the weekday and weekend diet of mothers and children.

Energy

For the weekday diet, insufficient energy consumption was more common in mothers of boys than in boys, p = 0.02, as well as mothers of girls than girls, p <0.01, while excessive energy consumption was more common in boys and girls than in the mothers of boys and mothers of girls, p <0.01. For the weekend diet, mothers of girls had higher frequencies of inadequate energy than girls, p = 0.049, while the diets of boys were more frequently excessive in energy consumption than in the mothers of boys, p <0.01.

Protein

In the midweek diet, insufficient protein intake was more frequent in mothers of boys and mothers of girls than in boys and girls, p <0.01. Excessive consumption was more common in boys and girls than in mothers of boys and mothers of girls, p <0.01. In the weekend diet, the same trend was observed but only when compared to girls and mothers of girls, p <0.01.

Energy distribution percentage of lipids in the diet

In mothers, the excessive consumption of lipids was more common on weekends (47%, 33/70) than weekdays (21%, 27/128), p <0.01. This trend only persisted in the mothers of boys when stratifying the mothers according to the sex of their children [weekend (58% 29/50) and weekday (21% 15/70) lipid consumption], p <0.01. When comparing mothers and their children, only weekend excessive consumption of lipids was more common in the mothers of boys (58% 29/50) than in boys (30% 13/43), p = 0.007.

Table III shows the correlation coefficients and determination obtained by comparing the percentage of adequacy of energy and protein as well as the energy distribution of lipids, carbohydrates and sugar in the weekday and weekend diets of children with their respective mothers. In both the weekday and weekend diets, approximately 20% of the variability in the percentage of adequacy of energy in the diet of boys was explained by the percentage of adequacy in the energy consumption of their mothers (p <0.001 and p = 0.039, respectively). In girls, both in the weekday and weekend diets, 30-40% of the variability in the percentage of energy distribution of lipids was explained by the percentage of energy adequacy of lipids in the diet of their mothers (p <0.001 and p = 0.005, respectively). In boys, 20% of this variable was explained by the diet of their mothers during weekends only, p = 0.023.

Eleven percent and 40% of the variability in the percentage of energy distribution of carbohydrates (HC) in the weekday and weekend diets of girls was explained by the percentage of energy distribution of HC in the diet of their mothers (p = 0.013 and p = 0.004, respectively). In boys, 15% and 34% of the variability in the percentage of energy distribution of sugar in weekday and weekend diet was explained by the percentage of energy distribution of sugar in the diet of their mothers (p = 0.002 and p = 0.003, respectively).

Table IV presents the odds ratios obtained by comparing the occurrence of the excessive category in the percentage of adequacy of energy and protein, as well as the energy distribution of lipids, carbohydrates and sugar in the weekday and weekend diets of children and their mothers. Excessive consumption of dietary energy over the weekend in mothers was associated with their daughters' excessive consumption of dietary energy, p = 0.04. Excessive consumption of dietary lipids over the weekend was more common in boys when their mothers overconsumed as well, p = 0.02. A similar trend was observed in girls (p = 0.04). Excessive consumption of sugar during the week was more common in boys (p = 0.02) and girls (p = 0.01) when their mothers had excessive sugar intake. On weekends, this association was observed only in boys, p = 0.05.

Table V shows the association between BMI in the mother-child dyad. There is a significant association between maternal obesity and obesity in daughters and sons [RM 15.5 (1.8, 132), p = 0.003]. No association between maternal overweight status and obesity in children was observed, and when integrated into a single group, cases of overweight and obese mothers were not significantly associated with overweight and obesity in daughters and sons.

Table VI shows the statistically significant odds ratios that were obtained by comparing the percentage of adequacy of energy and protein, as well as the energy distribution of lipids, carbohydrates and sugar, in the weekday and weekend diets of boys and girls according to their own BMI. In obese girls and boys, the excessive consumption of protein in the diet during the week was less frequent than in their peers with normal weight [OR 0.12, 95% CI 0.02, 0.62, p = 0.02]. Excessive consumption of dietary lipids on weekends was seven times more common in obese children than in those with normal weight (p = 0.014), while in the weekday diet, it was nearly four times more common in overweight boys than in those with normal weight (p = 0.028). Excessive consumption of carbohydrates over the weekend was less frequent in obese children [OR 1.13, 95% CI 0.014, 1.1, p = 0.03] than in children of normal weight, while this situation was 10 times more common in overweight boys (p = 0.02) than their peers of normal weight during the week.

Table I
General Characteristics of the Population

Variable		*Boys*		*Girls*		
		n	*Median±SD*	*n*	*Median±SD*	*p**
Children´s age (years)		99	8.3±2.4	75	7.7±2.1	0.087
Mother´s age (years)		99	38.2±11.2	74	37.1±8.2	0.459
Monthly family income (Mexican pesos)		99	6259±4202	72	6280±6416	0.980
Per capita income (Mexican pesos)		98	39.8±30.0	72	42.0±39.0	0.685
Monthly family expenditure on food (Mexican pesos)		96	2836±1533	70	2448±1103	0.073
Per capita expenditure on food (Mexican pesos)		95	17.5±10.1	70	16.2±7.9	0.376
		n	*%*	*n*	*%*	*p***
Mothers' occupation	Home	69	55.2	56	44.8	0.500
	Other	30	61.2	19	38.8	
Mothers' education	≤3 years of elementary school	16	64.0	9	36.0	0.824
	Complete elementary school or more	77	59.7	52	40.3	
Family composition	Nuclear	79	57.2	59	42.8	0.845
	Other	20	60.6	13	39.4	
Marital status of mothers	Married	94	59.1	65	40.9	0.364
	Separated/Divorced/Widow/Single mother	5	41.7	7	58.3	

*Student's T test; ** Chi-square test

Table II
Percentage of adequacy of energy and protein in the diet of the mother-child dyad

Variable			Children						Mothers of					
			Boys		Girls		Total		Boys		Girls		Total	
			n	%	*n*	%	*N*	%	*n*	%	*n*	%	*N*	%
Energy (Kilocalories)	Weekdays	Inadequate[1]	26	34	13	23	39	29	37	54	32	56	69	55
		Enough[2]	18	23	14	25	32	24	21	30	13	23	34	27
		Excessive[3]	33	43	29	52	62	47	12	17	12	21	24	19
		Total	77	100	56	100	133	100	70	101	57	100	127	101
	Weekend	Inadequate[1]	13	30	9	28	22	29	15	54	11	55	26	54
		Enough[2]	8	19	11	34	19	25	8	29	3	15	11	23
		Excessive[3]	22	51	12	38	34	45	5	18	6	30	11	23
		Total	43	100	32	100	75	100	28	100	20	100	48	100
Proteins	Weekdays	Inadequate[1]	3	4	2	4	5	4	20	29	12	21	32	25
		Enough[2]	2	3	1	2	3	2	12	17	10	18	22	17
		Excessive[3]	72	94	54	95	126	94	38	55	35	61	73	58
		Total	77	100	57	100	134	100	70	101	57	100	127	101
	Weekend	Inadequate[1]	1	2	0	0	1	1	3	11	3	15	6	13
		Enough[2]	2	5	0	0	2	3	2	7	5	25	7	15
		Excessive[3]	40	93	32	100	72	96	23	82	12	60	35	73
		Total	43	100	32	100	75	100	28	100	20	100	48	100

[1]<90% of the estimated requirement [2]90-110% of the estimated requirement; [3]>110% of the estimated requirement.

Table III
The relationship between the percentage of adequacy and distribution of macronutrients in the diet of the mother-child dyad

Variable		Mother/son dyad				Mother/daughter dyad			
		n	*r*	R^2 +	*p*	*n*	*R*	R^2	*p*
Percentage of adequacy									
Energy	Weekdays	68	0.42	0.177	<0.001	53	0.214	0.046	0.124
	Weekends	22	0.443	0.196	0.039	19	0.165	0.027	0.5
Proteins	Weekdays	68	0.085	0.007	0.486	54	0.233	0.054	0.09
	Weekends	26	0.368	0.136	0.064	19	0.358	0.128	0.133
Percentage of distribution									
Lipids	Weekdays	70	0.115	0.013	0.345	56	0.517	0.267	<0.001
	Weekends	27	0.436	0.19	0.023	19	0.619	0.383	0.005
Carbohydrates	Weekdays	68	0.096	0.009	0.434	54	0.337	0.113	0.013
	Weekends	27	0.262	0.069	0.187	19	0.622	0.386	0.004
Sugar	Weekdays	61	0.387	0.15	0.002	51	0.117	0.014	0.415
	Weekends	23	0.586	0.344	0.003	16	0.301	0.091	0.258

+ R^2: Coefficient of determination

Table VII shows the statistically significant odds ratios that were obtained by comparing the percentage of adequacy of energy and protein, as well as the energy distribution of lipids, carbohydrates and sugar, in the weekday diets of mothers according to their own BMI. The excessive consumption of protein during the week was less common in overweight mothers than in mothers of normal weight [OR 0.33, 95% CI 0.13, 0.81, p = 0.013].

Discussion

The mother-child diet relationship

Energy

The diet of boys and girls during the week generally included an excess in the percentage of adequacy in energy consumption (> 110% of the estimated requirement). In contrast, most of the mothers had insufficient energy consumption during the week (<90% of the estimated requirement). Monday through Friday, the daughters and sons spent about six hours in school, so food intake was not supervised by their mothers. It is likely that this circumstance favors snacking (not covered as part of the family diet) and is conducive to excessive energy consumption. The influence of maternal energy consumption on the total energy consumption of their respective sons (analyzed by linear regression) was low (~20%) and had a distinct gender difference, as this relationship was not significant between daughters and their mothers. However, when stratifying energy consumption according to the percentage of adequacy in excess vs. non-excess, we observed that when the energy in the diet of the mothers was excessive, the risk of excessive energy consumption in girls but not boys increased by 11-fold over the weekend. One might assume that mothers with excessive energy intake in their diet would favor excessive energy intake in the diet of different family members (as they are responsible for preparing food). However, this finding occurred only in girls over the weekend. One could speculate that over the weekend, girls spend more time at home with their mothers, unlike boys, which may favor a stronger influence of the energy consumption of mothers on the energy consumption of their daughters.

Lipids

The percentage of energy distribution of lipids in the maternal diet explained 30-40% of the percentage distribution of lipids in the diet of their sons and daughters. In girls, this relationship was observed both during the week and over the weekend, while in boys, this relationship was only present over the weekend. These findings may reflect a greater tendency for girls to consume food provided by their mothers during the week, so despite spending time in school, they largely retain

Table IV

Percentage of adequacy of energy and protein and energy distribution of lipids, carbohydrates and sugar in the diet of the mother/child dyad

		Mothers	Boys							Girls						
			Excessive		Not excessive		OR	CI 95%	p*	Excessive		Not excessive		OR	CI 95%	p*
			n/N	%	n/N	%				n/N	%	n/N	%			
Energy	Weekdays	Excessive[1]	8/12	67	4/12	33	3.2	0.86-12	0.14	7/11	64	4/11	36	1.9	0.5-7.6	0.54
		Not excessive[2]	22/57	39	35/57	61				20/42	48	22/42	52			
	Weekends	Excessive	3/5	60	2/5	40	1.7	0.23-12	1.00	5/6	83	1/6	17	11.3	0.97-130	0.04
		Not excessive	10/21	48	11/21	52				4/14	29	9/14	64			
Proteins	Weekdays	Excessive[1]	36/38	95	2/38	5.3	1.2	0.16-9	0.75	31/33	94	2/33	6	0.8	0.1-9.1	0.68
		Not excessive[2]	29/31	94	2/31	6.5				20/21	95	1/21	5			
	Weekends	Excessive	20/21	95	1/21	4.8	5.0	0.26-98	0.83	12/12	100	0/12	0	1.8	0.1-35	0.71
		Not excessive	5/5	100	0/5	0				7/7	100	0/7	0			
Lipids	Weekdays	Excessive[3]	7/15	47	8/15	53	2.3	0.7-7	0.28	5/11	45	6/11	55	3.3	0.87-13	0.15
		Not excessive[4]	15/54	28	39/54	72				10/43	23	33/43	77			
	Weekends	Excessive	6/8	75	2/8	25	8.4	1.3-56	0.02	3/4	75	1/4	25	12.0	0.89-160	0.04
		Not excessive	5/19	26	14/19	74				3/15	20	12/15	80			
Carbohydrates	Weekdays	Excessive[5]	16/30	53	14/30	47	2.0	0.77-5	0.23	12/26	46	14/26	54	2.6	0.81-8	0.18
		Not excessive[6]	14/39	36	25/39	64				7/28	25	21/28	75			
	Weekends	Excessive	3/9	33	6/9	67	1.8	0.3-10	0.88	4/6	67	2/6	33	6.7	0.8-56	0.18
		Not excessive	4/18	22	14/18	78				3/13	23	10/13	77			
Sugar	Weekdays	Excessive[7]	7/14	50	7/14	50	4.3	1.2-16	0.02	7/13	54	6/13	46	5.2	1.3-20	0.01
		Not excessive[8]	9/48	19	39/48	81				7/38	18	31/38	82			
	Weekends	Excessive	4/10	40	6/10	60	2.2	0.36-14	0.68	4/6	67	2/6	33	9.0	0.91-89	0.05
		Not excessive	3/13	23	10/13	77				2/11	18	9/11	82			

[1]>110% of the estimated requirement; [2]≤110% of the estimated requirement; [3]>30% of total energy consumption; [4]≤30% of total energy consumption; [5]>60% of total energy consumption [6]≤60% of total energy consumption; [7]>10% of total energy consumption; [8]≤10% of total energy consumption. * Chi-square test.

Table V
Association between the BMI of children and maternal BMI

Children	Mothers															
	Normal weight [a]				Overweight [b]				Obesity *[c]				Overweight and obesity			
	Boys		Girls		Boys		Girls		Boys		Girls		Boys		Girls	
	n	%	*n*	%	*N*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Thinness (<-2 SD)	3	10	1	3	0	0	1	4	0	0	0	0	0	0	1	3
Normal weight (-2 a +1 SD)	17	57	22	73	28	78	19	70	13	57	8	67	41	69	27	69
Overweight (>+1 SD)	10	33	7	23	6	17	6	22	3	13	3	25	9	15	9	23
Obesity (>+2 SD)	0	0	0	0	2	6	1	4	7	30	1	8	9	15	2	5
Total	30	100	30	100	36	100	27	100	23	100	12	100	59	100	39	100

[a] 18.5 to 24.9 kg/m^2; [b] 25 to 29.9 kg/m^2; [c] ≥30 kg/m^2; * There was a higher risk of obesity in children (boys and girls) whose mothers were obese [OR 15.5 CI 95% (1.8, 132), p=0.003]

the proportion of macronutrients from their mothers' diets, and similarly, girls spend more time at home with their mothers over the weekend, which would increase the attachment of their diets to their mothers' diets.

However, using a qualitative approach, when lipid consumption is stratified as excessive vs. not excessive, the excessive intake of lipids by the mothers on weekends increased the risk of the excessive intake of lipids in the diets of their sons by 8-fold, while only a trend with respect to this behavior was observed in girls. Apparently, the sample size was insufficient to show a significant finding in girls. The weekend diet of families tends to vary from the diet during the week. This is likely due to the feeding habits in Mexico[15], where eating high-fat foods is more common over the weekend (through the increased consumption of fast food and high-energy snacks and poor nutritional content).

Carbohydrates

Similar to the energy and lipid consumption findings, the proportion of carbohydrates consumed in the maternal diet significantly explained the variability in the proportion of carbohydrates in the diets of their daughters. This finding was significantly higher during the weekend but was not observed among boys and their mothers.

Sugar

The percentage of energy distribution of sugar in the mothers' diets explained the variability of the energy distribution of sugar in the diets of their sons, especially over the weekend. Boys tended to more frequently consume foods rich in simple carbohydrates (sugar), as did their mothers (r = 0.4, p = 0.002, and r = 0.6, p = 0.003 on weekdays and weekends, respectively), while this trend did not occur in girls. However, when stratifying excessive consumption of sugar vs. non-excessive, excessive sugar intake (> 10% of total energy consumption) in the maternal diet increased the risk of excessive consumption of sugar in the diets of their sons and daughters (4 and 5 times, respectively), especially on weekdays. This finding confirms that mothers with excessive consumption of sugar favor the excess consumption of sugar in the diets of their children. Women have very important roles in the food intake of their families: it is the mother who teaches children how, what, and when to eat [15]. It is essential to take this into consideration when developing strategies for addressing and preventing overweight and obesity in pediatric populations.

BMI of the mother-child dyad

According to several authors [16-18], the weight of children is closely linked to the weight of their parents.

Table VI
Percentage of adequacy of protein and the energy distribution of lipids and carbohydrates in the diet of schoolchildren according to their BMI

			Excessive		*Not excessive*		*OR*	*CI 95%*	*p**
			n/N	*%*	*n/N*	*%*			
Proteins		**Boys/girls**							
	Weekdays diet	OB	8/98	8.2	3/7	42.8	0.12	0.02, 0.62	0.02
		NW	90/98	91.8	4/7	57.1			
		Boys/girls							
	Weekends diet	OB	5/16	31.2	3/43	7.0	7.42	1.54, 35.8	0.014
		NW	11/16	68.7	40/43	93			
Lipids		**Boys**							
	Weekdays diet	OW	9/20	45	9/48	18.8	3.55	1.13,11.1	0.026
		NW	11/20	55	39/48	81.2			
		Boys/girls							
	Weekends diet	OW	0/26	0	8/33	24.2	0.13	0.01, 1.1	0.03
		NW	26/26	100	25/33	75.7			
Carbohydrates		**Boys/girls**							
	Weekdays diet	OW	1/27	3.7	15/40	37.5	0.06	0.008, 0.52	0.001
		NW	26/27	96.3	25/40	62.5			
		Boys							
	Weekdays diet	OW	14/14	100	13/33	56.5	10.0	1.11, 89.8	0.02
		NW	0/14	0	10/33	43.5			

[1]OB= Obesity (BMI>2 DE), [2]NW= Normal weight (BMI -2-1 DE), [3]OW=Overweight (BMI ≥1 DE). * Chi-square test.

In 2012, Freeman [19] showed that the body mass index (BMI) of mothers was correlated with the BMI of their daughters and sons (r = 0.31 and r = 0.29, respectively). In our study population, obese mothers had a significantly higher proportion of obese children compared with normal weight or overweight mothers [RM 15.5 (95% CI 1.8, 132), p = 0.003]. It is common to collapse the prevalence of overweight and obesity in the analysis of BMI (in women of reproductive age and in schoolchildren) and to consider them as a single entity within the disease spectrum associated with body weight [20]. However, our results provided evidence that maternal obesity is a high epidemiological risk factor for obesity in their children, although this was not the case for maternal overweight status, or when overweight and obesity were collapsed into a single group. Therefore, we believe that in the analysis of the association between BMI among mothers and their children, it is necessary to make a distinction between obesity and overweight, as these entities have different associations with various health risk factors. The studies by Da-Silva [21] and Cali [22] present data suggesting that differences in the concentration of C-reactive protein sensitivity [21] and in systolic blood pressure, glucose, triglycerides, insulin, HDL-cholesterol density factors and insulin-like factors [22] are independently associated with overweight or obesity in children and adolescents.

The association between diet and BMI in the mother-child dyad

Overweight and obesity in children

A first interesting finding was that the excessive consumption of carbohydrates and lipids during the week was more common in overweight children than their normal weight peers, which could represent an early manifestation of imbalance in their diets. On the other hand, the excessive consumption of protein during the week was less frequent among obese boys and

Table VII
Percentage of adequacy of protein and the energy distribution of carbohydrates and sugars in the diet of mothers according to their BMI

			Excessive		Not excessive		OR	CI95%	p*
			n/N	%	n/N	%			
		Total mothers group							
Proteins	**Weekdays diet**	OW[1]	20/45	44.4	27/38	71.1	0.33	0.13, 0.81	0.013
		NW[2]	25/45	55.6	11/38	28.9			
		Mothers of boys							
		OB[3]	15/33	65.2	5/18	27.8	4.9	1.3,18.6	0.019
		NW	8/33	37.8	13/18	72.2			
		Total mothers group							
		OW	30/40	75	17/43	39.5	4.6	1.8, 11.8	0.001
		NW	10/40	25	26/43	60.5			
Carbohydrates	**Weekdays diet**	**Mothers of boys**							
		OW	18/21	85.7	11/22	50	6	1.37, 26.4	0.014
		NW	3/21	14.3	11/22	50			
		Mothers of girls							
		OW	12/19	63.2	6/21	28.6	4.3	1.13, 16.2	0.029
		NW	7/19	36.8	15/21	71.4			
		Mothers of boys							
		OW	1/7	14.3	19/31	61.3	0.10	0.01, 0.99	0.032
Sugar	**Weekdays diet**	NW	6/7	85.7	12/31	38.7			
		Mothers of girls							
		OW	5/7	71.4	5/26	19.2	10.5	1.56, 70.8	0.016
		NW	2/7	28.6	21/26	80.8			

[1]OW= Overweight (BMI 25 to 29.9 Kg/m^2); [2]NW= Normal weight (BMI 18.5 to 24.9 kg/m^2); [3]OB= Obesity (BMI ≥30 kg/m^2). * Chi-square test.

girls than their peers of normal weight. The main sources of protein in the diet were foods of animal origin, including meat, dairy products and legumes [23].

However, in low-income families, foods with high biological quality protein are often replaced by cheaper food that has poor-quality protein and is rich in fat and carbohydrates [24]. It is likely that because of their increased adiposity, obese children have a greater appetite [25], which they satiate by consuming foods with high levels of fat and carbohydrates. The occurrence of this situation on weekdays (Monday to Friday) may be because the children are outside the supervision of their mothers. Obesity in boys and girls was associated with the excessive consumption of dietary lipids over the weekend, while obese boys presented with lower levels of carbohydrate consumption than their normal-weight peers. It is likely that the mothers of children who are obese try to promote weight loss by restricting food because they consider their children to be "feeders". This is especially likely for high energy density foods with high levels of carbohydrates. This situation would lead to the low consumption of carbohydrates over the weekend among obese children, whereas this attitude did not seem to occur with respect to the proportion of fat in the diet.

In the general population, there is a misperception of what a "healthy" dish is. For example, salads are considered healthy because of their high vegetable content. However, in an analysis of salad preparation, mothers are likely to use dressings and cheeses with high fat contents to promote the taste and acceptance of the salad, which leads to the "healthy" dish becoming "very high energy" due to its high fat content. This scenario could explain the finding of excessive fat consumption, but not carbohydrate consumption, in the diet of these children during the weekend.

The percentage of adequacy of energy consumption was not associated with BMI, while the excessive consumption of carbohydrates was higher in overweight women than in their normal-weight peers. The increased consumption of carbohydrates (because of its effect on postprandial blood glucose and insulin levels) [26] would favor increased energy storage in the form of adipose tissue, which would cause increased weight in these women. Excessive protein intake during the week was more common in women of normal weight than in those who were overweight. Excessive protein consumption, especially when paired with low energy consumption, is associated with a reduction in body weight because the metabolic cost of energy production from protein (which represents the main energy source in the diet) is high compared to the metabolic cost of energy production from carbohydrates or lipids. This finding could be related to the more frequent excessive consumption of protein in women of normal weight.

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Conflict of interest

None.

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