Long-term Effectiveness of Maternal Dietary Counseling in a Low-Income Population: A Randomized Field Trial

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KEY WORDS

intervention studies, counseling, food habits, infant, child

ABBREVIATIONS

BMIz—BMI-for-age *z* score
CI—confidence interval
HDL—high-density lipoprotein
LDL—low-density lipoprotein
RR—relative risk
TC—total cholesterol

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WHAT'S KNOWN ON THIS SUBJECT: Recent systematic reviews revealed that educational dietary interventions were effective in improving nutritional status and food consumption in the first year after birth. We are not aware, however, of studies in developing countries that have evaluated their long-term effectiveness.

WHAT THIS STUDY ADDS: This randomized trial revealed that, in a low-income population, the delivery of home-based maternal counseling focusing on breastfeeding and complementary feeding during the first year of children's lives significantly improved the lipid profile at 7 to 8 years old.

abstract

OBJECTIVE: To assess the impact of dietary counseling given to mothers during the first year of infants' lives on food consumption, nutritional status, and lipid profile of the children up to 7 to 8 years old.

METHODS: The randomized trial was conducted with 500 mothers who gave birth to full-term infants with birth weight ≥2500 g between October 2001 and June 2002 in São Leopoldo, Brazil. Mothers were randomly assigned to intervention (n = 200) and control groups (n = 300) and those in the intervention group received counseling on breastfeeding and complementary feeding by 12 fieldworkers on 10 home visits during the first year of children's lives. Blinded fieldworkers assessed dietary and anthropometric data at 12 to 16 months, 3 to 4 years, and 7 to 8 years and lipid profiles at 3 to 4 years and 7 to 8 years old. The lipid profile was the primary outcome.

RESULTS: Of the 500 recruited children, 397 underwent the 12- to 16-month, 354 the 3- to 4-year, and 315 the 7- to 8-year assessment. The energy-dense foods intake was significantly lower in the intervention group at 12 to 16 months and 3 to 4 years old. At 3 to 4 years, serum lipid levels did not differ between groups. At 7 to 8 years, high-density lipoprotein levels were 0.11 mmol/L higher (0.00 to 0.20), and triglycerides concentration was 0.13 mmol/L lower (−0.25 to −0.01) in intervention children but only among the girls. Overweight/obesity rates did not differ between groups.

CONCLUSIONS: Dietary counseling for mothers during infancy decreased the energy-dense foods consumption and improved lipid profile. *Pediatrics* 2012;129:e1477–e1484

A growing body of evidence suggests that feeding practices during the first year after birth provide the basis for food habits in childhood and tend to track later in life.[1–3] Therefore, the establishment of unhealthy food habits is of great public health concern because poor diet quality can promote both micronutrient deficiency[4] and overweight in children[5] and may be related to the future occurrence of chronic diseases.[6] Interventions to promote healthy diets in early life may therefore have the potential to influence health patterns throughout one's lifetime.

Systematic reviews have revealed that educational interventions focusing on complementary feeding practices were effective in improving nutritional status and food consumption in the first year after birth.[7,8] We are not aware, however, of studies in developing countries that have evaluated their long-term effectiveness. Our objective for this study was to assess the impact of dietary counseling given to mothers during the first year of infants' lives on food consumption, nutritional status, and lipid profiles of children up to 7 to 8 years old. Furthermore, we aimed to verify whether the intervention influenced boys and girls differently, considering biological differences in relation to the outcomes and the evidence that there are different responses to dietary interventions between genders.[9]

METHODS

The main hypothesis was that the intervention would improve lipid profile at 3 to 4 and 7 to 8 years old. Secondary hypotheses were that the intervention would (1) reduce sugar- and lipid-dense foods consumption and improve fruits and vegetables intake and (2) decrease overweight/obesity rates up to 7 to 8 years old in both genders.

This trial was conducted with mothers who gave birth to full-term (≥37 weeks) infants with birth weight ≥2500 g between October 2001 and June 2002 in São Leopoldo, Brazil. HIV-positive mothers and infants with congenital malformation were not eligible for the study. Study protocol was approved by the Ethics Committee of the Universidade Federal de Ciências da Saúde de Porto Alegre, and informed consent was obtained at study entry.

Fieldworkers recruited the mothers at the maternity wards in a hospital that attends to low-income populations. A total of 500 participants were recruited, which constituted 89.5% of all invited mothers. An investigator not involved in the recruitment conducted the randomization procedure. Mothers who agreed to participate were sequentially included in a list based on their time of delivery, grouped in blocks of 5, and their names were separated in opaque, sealed envelopes. Two mothers from each block were randomly assigned to the intervention group, whereas other 3 mothers were allocated to the control group. The fieldworkers received 8 hours of practical training.

Intervention

The intervention consisted of dietary advice about breastfeeding and complementary feeding based on the "Ten steps for healthy feeding for Brazilian children from birth to 2 years of age" (Table 1).[10] The counseling was carried out by 6 couples of undergraduate students in nutritional sciences in home visits to the mothers within 10 days of the child's birth, monthly up to 6 months, and with subsequent visits at 8, 10, and 12 months. Each visit addressed 1 of the "Ten Steps" and lasted ~40 minutes.

Mothers from the control group were interviewed twice during the first year of children's lives for data collection only. The study did not interfere in the routines of pediatric visits of both groups.

Data Collection

Fieldworkers not involved in the intervention and unaware of group allocation collected data at 6 months, 12 to 16 months, 3 to 4 years, and 7 to 8 years after birth in home visits. The second interview was planned to be carried out when each child reached 12 months of age but was extended up to 16 months for logistical reasons; nevertheless, 82% of the children were assessed between 12 and 13.9 months old. Monthly, 10% of the questionnaires were selected randomly and followed up with telephone calls to the mothers to verify the authenticity of the data.

Identification and data required for locating the family in the community were collected at the time of recruitment. Gender, birth weight, and length were obtained from hospital records. Socioeconomic characteristics were assessed when the children had reached an age of 6 months by face-to-face interviews with mothers. When the children were 12 to 16 months, the mothers were asked if their infants had received regular health care services during the first year after birth. At that time, measurements of mothers' weight and height were taken to gauge the prevalence of maternal overweight.[11]

Dietary Data

Fruits, vegetables, and lipid- and sugar-dense foods consumption was assessed through dietary recalls. At 12 to 16 months, one 24-hour dietary recall was collected for each child. At 3 to 4 and 7 to 8 years old, two 24-hour dietary recalls were collected on 2 nonconsecutive days, and the mean values were used in the analyses. To quantify food portion size, pictures were used to illustrate standard household measurements, such as teaspoons, tablespoons, and cups. The Nutrition Support software (Nutwin 1.5 [Federal University of São Paulo, São Paulo/Brazil]) was used to convert average sizes in grams to different measurements and to estimate energy intake from the selected foods.

The grams of intake of all fresh, dried, canned, and cooked fruits and vegetables

TABLE 1 Dietary Intervention Summary: The "Ten Steps for Healthy Feeding for Brazilian Children From Birth to 2 Years of Age" and the Main Counseling Strategies Applied During Each Home Visit

Ten Steps for Healthy Feeding for Brazilian Children From Birth to 2 Years of Age	Main Counseling Strategies Applied During Each Home Visit
Step 1: Exclusive breastfeeding up to 6 mo.	Mothers were advised to guarantee the posterior milk during the breastfeeding meals and not to give tea, water, or pacifiers.
Step 2: After 6 mo, mothers should gradually introduce complementary foods and continue breastfeeding up to 2 y or more.	The mothers were informed that infants change their responses to new foods because their familiarity with the food increases with repeated exposure (8 to 10 exposures).
Step 3: Complementary foods should be given 3 times a day (cereals, beans, fruits, and vegetables) if the child is breastfed, and 5 times a day if not.	Mothers received a list with all the most common foods of each of the 3 group sources: (1) carbohydrate; (2) protein, and (3) vitamins and minerals. They received different recipes to the preparation of meals with 1 food of each group. Mothers were advised not to use bottles.
Step 4: The mealtimes should be adjusted to the children's internal cues of hunger and satiety.	Mothers were advised that snacks between main meals should be avoided, even juices or others common sugar sweetened beverages, and that caregivers should be aware of child's appetite.
Step 5: New foods should gradually get thicker up to the time when the child is able to eat a family meal. Complementary foods should not be liquefied like a soup.	Mothers were advised to smash properly the cooked meal and to offer it in a thick consistency, allowing infants the opportunity to a varied sensory taste in each meal.
Step 6: A large variety of healthy foods should be given daily to guarantee the intake of different nutrients.	Mothers were counseled to choose different foods of the same food groups in each meal and to stimulate the consumption of table foods.
Step 7: The consumption of different fruits and vegetables should be stimulated daily.	Mothers were counseled to take into account the season to purchase fruits and vegetables and to avoid giving fruit juices.
Step 8: Sugar, sweets, soft drinks, salty snacks, cookies, and processed and fried foods must be avoided.	Mothers were advised against the addition of sugars (sugarcane, honey) in fruits, porridge, juices, milk, or other liquids and against offering soft drinks, sweets, and salty snacks.
Step 9: Good hygiene practices in food preparation and handling.	Mothers were advised to wash their hands before meal preparation and to properly preserve foods before giving to infants.
Step 10: Adequate feeding patterns during child illness.	Mothers were advised to offer easily accepted foods for infants during the sickness to prevent malnutrition.

were analyzed in 1 continuous variable. Fruits and vegetables juices and potatoes were not included in the analyses.

The energy intake of foods with high contents of lipids and sugar in the composition was analyzed in 2 continuous variables. Highly processed meat (ham, mortadella, salami, sausage), fried snacks (such as French fries), chips, filled cookies, and chocolate were defined as lipid-dense foods. Gelatin, candies, fruit-flavored juice powder, and soft drinks were classified as sugar-dense foods. These foods were chosen based on the results of a study conducted in Brazil, which indicated which foods were most commonly present in the dietary habits of children.[10] Two children were excluded from the analyses at 12 to 16 months and 1 at 3 to 4 years after being flagged as outliers (converted standard scores of the energy intake of +5 or beyond).

Anthropometric Measurements

At 12 to 16 months, children were weighed naked by using a portable digital scale (Techline, São Paulo, Brazil), and length was measured by using an infant stadiometer (Serwital Inc, Porto Alegre, Brazil). At 3 to 4 and 7 to 8 years, children were directly weighted barefoot and wearing light clothes by using a digital scale (Techline) to the nearest 0.1 kg, and height was measured with the children standing straight by using a stadiometer (SECA, Hamburg, Germany) to the nearest 0.1 cm. BMI-for-age *z* scores (BMIzs) were estimated based on the World Health Organization standards.[12,13] Two children with BMIz $> +5$ were excluded from the analyses. Children were classified as overweight and obese when BMIz was $>+1$ and $>+2$, respectively.

Lipid Profile

Venous blood samples were obtained from the right arm after an overnight fast at 3 to 4 and 7 to 8 years old. Analyses were performed at the laboratory of Cardiology Institute of Rio Grande do Sul by blinded technicians. Total cholesterol (TC), high-density lipoprotein (HDL), and triglyceride concentrations were measured with an automatic analyzer (Cobas Integra, São Paulo, Brazil). Low-density lipoprotein (LDL) was calculated according to Friedewald's formula (all triglyceride concentrations were <4.52 mmol/L).[14]

The sample size was previously calculated to estimate the impact of the intervention on the exclusive breastfeeding duration. A sample of 363 infants was estimated to detect a 65% increase in the frequency of exclusive breastfeeding up to 4 months in the intervention group (80% power and α of .05), considering a 21.5% frequency of exclusive breastfeeding up to 4 months in the control group. Although the sample size was not based on the outcomes of this study, we calculated that a sample of 128 children would allow the detection of a difference in HDL levels between groups of 0.15 mmol/L (effect size of 0.50), considering an SD of 0.3, with power of 80% and statistical significance of 5%.

Statistical Analyses

Analyses were performed by intention to treat and by gender and using SPSS 16.0 (SPSS Inc, Chicago, IL). Student's *t* test was used to evaluate the effect of the intervention on independent continuous variables. Nonnormally distributed variables were log-transformed. If the distribution remained nonnormal after the transformation, Mann-Whitney tests were used with the nontransformed values. Despite the use of log-transformed variables in the analyses, untransformed values were presented in tables for clinical interpretation. The result was expressed through mean differences and 95% confidence intervals (95% CIs). Frequencies were compared by using χ^2 tests, and the effect size was expressed by relative risks (RRs) with 95% CI. A *P* value of <.05 was considered significant.

RESULTS

Among the 500 initially recruited children, 397 underwent the 12- to 16-month, 354 the 3- to 4-year, and 315 the 7- to 8-year assessment (Fig 1). No difference was found between children who were lost in the follow-up and those who remained at 7 to 8 years of age regarding weight at birth (3349.6 ± 493.7 g versus 3366.9 ± 457.7 g, *P* = .75), length at birth (48.9 ± 2.1 cm versus 48.7 ± 2.0 cm, *P* = .47), maternal age at child's birth (25.2 ± 5.7 years versus 26.1 ± 6.8 years, *P* = .28), maternal level of education (6.7 ± 2.6 years versus 6.8 ± 2.7 years, *P* = .81), and annual family income (US$ 3505.3 ± 2574.7 versus US$ 3743.1 ± 2478.9, *P* = .44).

We noted an even balance between intervention and control groups in the distribution of the baseline characteristics (Table 2). Differences in the sample of some variables were due to factors such as incomplete information, incorrect dietary recall, and refusal for blood sampling.

At 12 to 16 months, the lipid-dense foods energy intake was lower in the intervention than in the control group for both genders, and the consumption of sugar-dense foods was lower in the intervention children but only among girls (Table 3). At 3 to 4 years, the energy intake from sugar-dense and lipid-dense foods was lower in the boys from

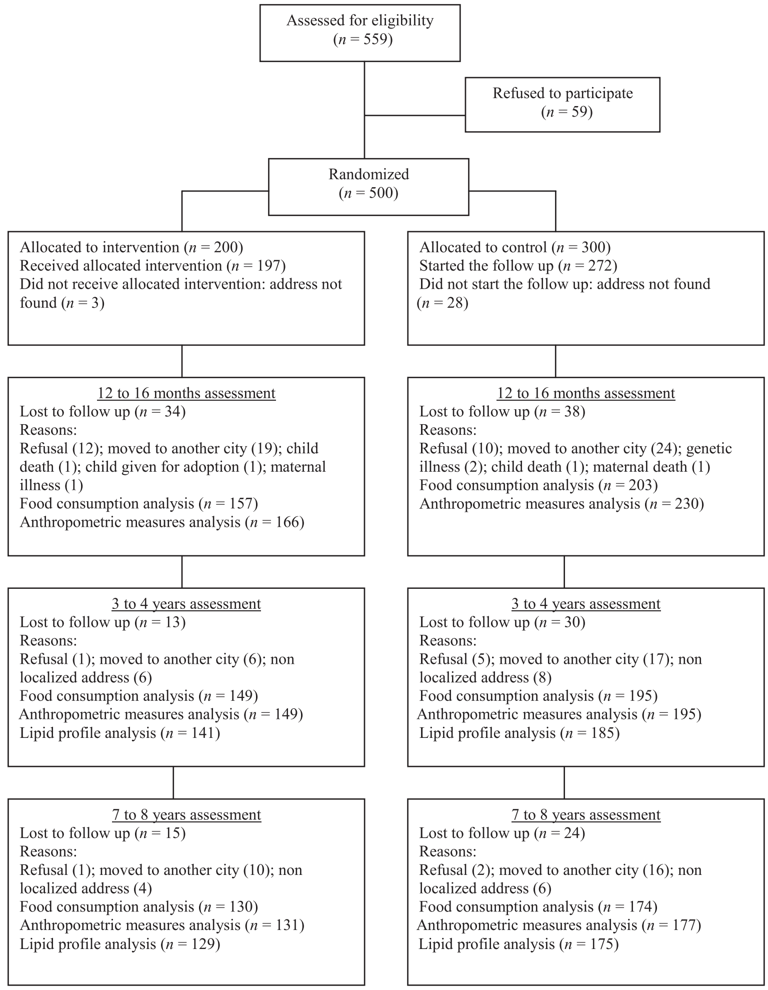

FIGURE 1
Trial profile of participation in the randomized controlled trial from recruitment of mother–child pairs through the assessment at 7 to 8 years of age.

TABLE 2 Family and Child Characteristics According to the Group

Characteristics	Total *N* [a]	Intervention Group	Control Group
Birth weight in g, mean (SD)	390	3380.6 (471.7)	3350.1 (461.1)
Maternal schooling, mean (SD)	396	6.6 (2.7)	6.8 (2.7)
Annual family income in US$, mean (SD)	395	3451.8 (2346.6)	3796.2 (2595.6)
Boys, *n* (%)	397	93 (56.0)	130 (56.3)
Maternal employment, *n* (%)	391	59 (35.8)	75 (33.2)
Maternal overweight, *n* (%)[b]	377	83 (52.5)	91 (41.6)
Health care follow-up at first year after birth, *n* (%)	393	85 (51.8)	103 (45.0)

[a] Total *N* indicates the number of responses recorded for each characteristic.
[b] BMI ≥ 25.

TABLE 3 Intervention Effect on Food Consumption at 12 to 16 mo, 3 to 4 y, and 7 to 8 y

	12 to 16 mo					3 to 4 y					7 to 8 y				
	Intervention		Control		Difference (95% CI)	Intervention		Control		Difference (95% CI)	Intervention		Control		Difference (95% CI)
Boys	*n* = 210					*n* = 195					*n* = 174				
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Lipid-dense foods, kJ[a]	95.4	200.8	196.2	375.3	−100.8 (−153.0 to −23.1)[b]	605.0	770.2	817.5	923.4	−212.5 (−492.5 to −45.3)[b]	870.2	760.6	999.9	863.9	−129.7 (−353.5 to 178.0)
Sugar-dense foods, kJ[a]	53.5	169.4	60.2	130.5	−6.7 (−47.6 to 33.8)	364.8	256.0	499.9	405.4	−135.1 (−235.2 to −33.9)[b]	306.8	271.3	371.2	359.8	−64.4 (−163.8 to 41.8)
Fruits and vegetables, g[a]	81.2	66.5	90.6	82.5	−9.4 (−33.5 to 11.4)	145.9	136.6	152.0	132.8	−6.1 (−44.8 to 32.7)	126.4	102.3	112.9	97.3	13.5 (−16.5 to 43.5)
Girls	*n* = 150					*n* = 149					*n* = 130				
	Mean	SD	Mean	SD		Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Lipid-dense foods, kJ[a]	51.8	152.2	180.7	368.6	−128.9 (−222.2 to −34.0)[b]	681.5	745.5	760.6	803.3	−79.1 (−333.0 to 175.0)	780.3	728.0	943.5	845.1	−163.2 (−424.9 to 121.2)
Sugar-dense foods, kJ[a]	36.8	86.2	74.4	151.0	−37.6 (−80.6 to −5.7)[b]	454.8	415.0	446.4	321.7	8.4 (−110.9 to 127.4)	318.8	219.6	384.5	396.2	−65.7 (−176.2 to 56.7)
Fruits and vegetables, g[a]	96.2	64.1	94.8	86.7	1.4 (23.6 to 26.4)	146.6	106.1	164.0	158.8	−17.4 (−62.8 to 28.0)	137.7	98.0	135.2	111.5	2.5 (−34.9 to 39.8)

[a] Mann-Whitney test was used.
[b] Values from intervention group were significantly different from those of the control group ($P < .05$).

the intervention group, as compared with those from control, without differences among the girls (Table 3). The impact of the intervention on food consumption was not sustained up to 7 to 8 years old. Fruits and vegetables intake did not differ significantly between groups (Table 3).

There were no significant differences between groups in overweight and obesity rates during the entire trial (Table 4). At 3 to 4 years, serum lipid levels did not differ between groups for both genders. At 7 to 8 years, HDL levels were 0.11 mmol/L higher, and triglycerides concentration was 0.13 mmol/L lower in the intervention children, as compared with the control children but only among the girls (Table 5).

DISCUSSION

Our findings revealed that home-based dietary counseling given to mothers during the first year of infants' lives was effective in reducing children's energy-dense food consumption in the first years after birth and in improving girls' lipid profiles at 7 to 8 years of age.

The findings support the assumption that providing counseling to mothers can modify their choices regarding the foods they offer to their children. Although there are numerous factors linked to eating behavior (including income, food costs and advertising[15,16]) mounting evidence demonstrates that maternal attitudes and beliefs have a direct effect on a child's food intake.[17] Decreasing the consumption of energy-dense foods could yield tremendous public health benefits as studies indicate such food's association with micronutrient deficiencies, overweight, and risk factors for cardiovascular diseases.[18–21] An unexpected finding was that boys from the intervention group significantly lowered their intake of sugar-dense foods, as compared with boys from the control group at 3 to 4 years but not at 12 to 16 months. We

TABLE 4 Intervention Effect on Overweight and Obesity at 12 to 16 mo, 3 to 4 y, and 7 to 8 y

	12 to 16 mo					3 to 4 y					7 to 8 y				
	Intervention		Control			Intervention		Control			Intervention		Control		
Boys	*n* = 223					*n* = 192					*n* = 175				
	n	%	*n*	%	RR (95% CI)	*n*	%	*n*	%	RR (95% CI)	*n*	%	*n*	%	RR (95%CI)
Overweight[a,b]	30	32.3	44	33.8	0.95 (0.65 to 1.39)	16	19.3	20	18.3	1.05 (0.58 to 1.89)	24	31.6	26	26.3	1.20 (0.75 to 1.91)
Obesity[b,c]	6	6.5	10	7.7	0.84 (0.31 to 2.22)	4	4.8	4	3.7	1.31 (0.33 to 5.09)	12	15.8	9	9.1	1.73 (0.77 to 3.90)
Girls	*n* = 173					*n* = 152					*n* = 133				
Overweight[a,b]	29	39.7	40	40.0	0.99 (0.68 to 1.43)	17	25.8	18	20.9	1.23 (0.68 to 2.19)	16	29.1	19	24.4	1.19 (0.67 to 2.10)
Obesity[b,c]	10	13.7	11	11.0	1.24 (0.55 to 2.77)	7	10.6	3	3.5	3.04 (0.81 to 11.31)	7	12.7	8	10.3	1.24 (0.47 to 3.22)

There were no differences between intervention and control groups.
[a] BMIz > +1.
[b] χ^2 test was used.
[c] BMIz > +2.

TABLE 5 Intervention Effect on Lipid Profile at 3 to 4 y and 7 to 8 y

	3 to 4 y				Difference (95% CI)	7 to 8 y				Difference (95% CI)
	Intervention		Control			Intervention		Control		
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
Boys	*n* = 185					*n* = 172				
TC, mmol/L[a]	3.23[b]	0.67	3.37[b]	0.68	−0.14 (−0.32 to 0.07)	4.16	0.72	4.22	0.67	−0.04 (−0.27 to 0.14)
LDL, mmol/L[a]	1.76[b]	0.61	1.87[b]	0.59	−0.11 (−0.28 to 0.06)	2.55	0.63	2.57	0.57	−0.02 (−0.19 to 0.17)
HDL, mmol/L[a]	1.16	0.25	1.20	0.29	−0.04 (−0.12 to 0.03)	1.24	0.27	1.30	0.29	−0.06 (−0.14 to 0.03)
TC/HDL[a]	2.89[b]	0.81	2.92[b]	0.89	−0.03 (−0.28 to 0.21)	3.46	0.84	3.35	0.65	0.11 (−0.11 to 0.34)
Triglycerides, mmol/L[a]	0.65[b]	0.23	0.61[b]	0.23	0.04 (−0.02 to 0.10)	0.75[b]	0.29	0.74[b]	0.31	0.01 (−0.07 to 9.10)
Girls	*n* = 141					*n* = 132				
TC, mmol/L[a]	3.48[b]	0.65	3.44[b]	0.67	0.04 (−0.19 to 0.26)	4.41	0.76	4.28	0.69	0.13 (−0.11 to 0.39)
LDL, mmol/L[a]	1.91[b]	0.60	1.91[b]	0.61	0.00 (−0.20 to 0.20)	2.78	0.66	2.68	0.60	0.10 (−0.32 to 0.11)
HDL, mmol/L[a]	1.18	0.28	1.16	0.26	0.02 (−0.07 to 0.11)	1.30	0.31	1.19	0.27	0.11 (0.00 to 0.20)[c]
TC/HDL[a]	3.02[b]	0.66	3.04[b]	0.71	−0.02 (−0.07 to 0.11)	3.53	0.75	3.69	0.87	−0.16 (−0.44 to 0.13)
Triglycerides, mmol/L[a]	0.65[b]	0.23	0.69[b]	0.38	−0.04 (−0.15 to 0.06)	0.69[b]	0.24	0.82[b]	0.42	−0.13 (−0.25 to −0.01)[c]

TC/HDL, total-to-HDL cholesterol ratio.
[a] Student's *t* test was used.
[b] These variables were log-transformed for the analyses.
[c] Values from intervention group were significantly different from those of the control group ($P < .05$).

believe that the effect observed in preschool-aged children indicates that the improvement in feeding habits started in the first year after birth but that bias in data collection, small amount of change, or type II β error may have prevented us from finding a statistically significant result.

The impact of the intervention on energy-dense food consumption was not observed at 7 to 8 years. This finding may be related to the increased autonomy of older children regarding their food choices. School children have many opportunities to eat without parental supervision and can more easily access foods in their social environment.[22] Although studies emphasize the importance of promoting health during early childhood,[23,24] training older children in self-regulatory skills regarding their food choices and conducting interventions that penetrate school settings may be of equal importance to the maintenance of healthy feeding habits throughout one's lifetime.

The intervention was not effective in enhancing the consumption of fruits and vegetables. There are 2 potential explanations for this result. First, encouraging the intake of fruits and vegetables may be a more difficult guideline to be followed by mothers because toddlers have a genetically determined predisposition to dislike bitter and sour tastes and present a tendency to avoid novel foods, especially fruits and vegetables.[25] Secondly, qualitative studies have revealed that the relatively high cost of fruits and vegetables may be a barrier to the consumption of these foods in economically disadvantaged populations such as the ones that live where this study was conducted and therefore can limit the scope of interventions.[26,27]

The intervention's lack of impact on overweight rates is not surprising. The Ten Steps were drawn up, and the study's design was planned ~10 years ago. At that time, despite the fact that undernutrition rates had already fallen,[28] national guidelines were still focused on the prevention of insufficient weight gain and micronutrient deficiencies during infancy. As the prevalence of childhood obesity in Brazil has significantly increased in recent years[29] and its importance for the development of cardiovascular diseases has been acknowledged, population-based preventive strategies focused on energy balance and weight control have begun to be developed and implemented in the country's primary health care services. Nevertheless, girls in the intervention group presented lower serum triglyceride levels and higher HDL values than girls in the control group at 7 to 8 years of age. These changes may be at least partly explained by the effects of the intervention on breastfeeding practices and food consumption in the first year after birth, as shown by our previous[30] and current studies. Although they were controversial, studies that examined associations between infant feeding and risk factors for cardiovascular diseases revealed that breastfeeding duration had an effect on blood cholesterol levels later in life, but few assessed the influence of diet quality.[31–33] Although modest, the magnitude of the difference in HDL and triglyceride levels between groups may have important clinical implications. In adults, a 1% increase in HDL is associated with a 2% to 3% decrease in coronary heart disease risk.[34] RR for cardiovascular disease (with respect to a 1 mmol/L increase in serum triglycerides) was reported as 1.14 (95% CI: 1.05–1.28).[35]

The same effect was not observed among boys, suggesting that different causal pathways may operate among boys and girls.[36] This difference between genders cannot be explained by different adherence to the dietary counseling because energy-dense food intake was significantly lower in both boys and girls in the intervention group compared with those in the control group. Hence, differences in body composition, physical activity patterns, and divergent hormonal status already presented by school-aged children should be considered to be additional explanations for the different serum lipid responses to the intervention.[9]

Our study has some limitations. First, the large rate of loss during follow-up draws attention. Our losses, mainly due to families moving to an unknown address, are similar to those of studies involving follow-up of people living in large low-income urban areas and were almost always beyond our control. The similarity in baseline characteristics between the people who were lost and those who remained in the trial as well as the similar proportion of losses in each group, though, suggest that selection bias is unlikely to be a problem. The greater initial loss of controls was foreseen during the study's conception, most likely being attributable to the longer period between hospital discharge and their first home contact. Secondly, we are not aware of other possible dietary advice that the mothers could have received during the trial; however, we showed that the proportion of infants who received regular health care services in the first year after birth was similar between groups. Thirdly, mothers may have been aware of the group to which they belonged and this may have posed a threat to internal validity due to social desirability bias because it is not possible to blind patients in studies that evaluate dietary advice. To minimize such bias, the assessments were carried out by fieldworkers who were not involved with the intervention. Furthermore, this intervention was carried out during home visits, and it was impossible to separate the effect of the counseling from the influence of the visits themselves.

Because this trial evaluated many outcomes related to feeding practices and health, a final potential problem is that our findings may be due to chance within the context of multiple hypothesis testing. Because the hypotheses were defined a priori, the results were biologically plausible, and the impact on feeding practices was consistent with our previous findings,[30] this possibility appears remote. It is also important to note that the sample size was not calculated based on the current study's outcomes, and our sample may not be sufficiently able to detect smaller effect sizes. The Ten Steps guidelines are culturally sensitive, and the effectiveness of this intervention should be evaluated in the context of the low-income populations in which it was tested.

This trial revealed that the promotion of healthy eating in the first year after birth through the delivery of dietary counseling during home visits to mothers was effective in improving some early feeding practices and lipid profiles at 7 to 8 years of age. The result provides evidence supporting the assumption that interventions that disclose appropriate knowledge and information are essential in altering inappropriate feeding behaviors, and it highlights the importance of the first year after birth as a critical window for the establishment of habits that will influence health patterns throughout one's lifetime. Subsequent follow-up of this cohort will be relevant in evaluating whether the beneficial effects of the intervention persist over a longer period of time. Further studies are warranted to determine what types of educational programs could be beneficial in helping to reduce obesity rates.

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REFERENCES

1. Fiorito LM, Marini M, Mitchell DC, Smiciklas-Wright H, Birch LL. Girls' early sweetened carbonated beverage intake predicts different patterns of beverage and nutrient intake across childhood and adolescence. *J Am Diet Assoc*. 2010;110(4):543–550
2. Mikkilä V, Räsänen L, Raitakari OT, Pietinen P, Viikari J. Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study. *Br J Nutr*. 2005;93(6):923–931
3. Northstone K, Emmett PM. Are dietary patterns stable throughout early and mid-childhood? A birth cohort study. *Br J Nutr*. 2008;100(5):1069–1076
4. Jiang JX, Lin LM, Lian GL, Greiner T. Vitamin A deficiency and child feeding in Beijing and Guizhou, China. *World J Pediatr*. 2008;4(1):20–25
5. Jennings A, Welch A, van Sluijs EM, Griffin SJ, Cassidy A. Diet quality is independently associated with weight status in children aged 9-10 years. *J Nutr*. 2011;141(3):453–459
6. Lanigan J, Singhal A. Early nutrition and long-term health: a practical approach. *Proc Nutr Soc*. 2009;68(4):422–429
7. Shi L, Zhang J. Recent evidence of the effectiveness of educational interventions for improving complementary feeding practices in developing countries. *J Trop Pediatr*. 2011;57(2):91–98
8. Imdad A, Yakoob MY, Bhutta ZA. Impact of maternal education about complementary feeding and provision of complementary foods on child growth in developing countries. *BMC Public Health*. 2011;11(suppl 3):S25
9. Niinikoski H, Lagström H, Jokinen E, et al. Impact of repeated dietary counseling between infancy and 14 years of age on dietary intakes and serum lipids and lipoproteins: the STRIP study. *Circulation*. 2007;116(9):1032–1040
10. Ministry of Health. *Dez passos para uma alimentação saudável: guia alimentar para menores de dois anos* [in Portuguese]. Brasília, Brazil: Ministry of Health; 2002
11. World Health Organization. *Obesity: Preventing and Managing the Global Epidemic*. Geneva, Switzerland: World Health Organization; 2000
12. World Health Organization. *Methods and Development: Length/Height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age*. Geneva, Switzerland: World Health Organization; 2006
13. de Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. *Bull World Health Organ*. 2007;85(9):660–667
14. Friedewald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem*. 1972;18(6):499–502
15. Taylor JP, Evers S, McKenna M. Determinants of healthy eating in children and youth. *Can J Public Health*. 2005;96(suppl 3):S20–S26, S22–S29
16. Claro RM, Monteiro CA. Family income, food prices, and household purchases of fruits and vegetables in Brazil. *Rev Saude Publica*. 2010;44(6):1014–1020
17. Ventura AK, Birch LL. Does parenting affect children's eating and weight status? *Int J Behav Nutr Phys Act*. 2008;5:15
18. O'Neil CE, Fulgoni VL, Nicklas TA. Association of candy consumption with body weight measures, other health risk factors for cardiovascular disease, and diet quality in US children and adolescents: NHANES 1999-2004. *Food Nutr Res*; 2011:55
19. Kranz S, Smiciklas-Wright H, Siega-Riz AM, Mitchell D. Adverse effect of high added sugar consumption on dietary intake in American preschoolers. *J Pediatr*. 2005;146(1):105–111
20. Pereira MA, Kartashov AI, Ebbeling CB, et al. Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. *Lancet*. 2005;365(9453):36–42
21. Receveur O, Morou K, Gray-Donald K, Macaulay AC. Consumption of key food items is associated with excess weight among elementary-school-aged children in a Canadian first nations community. *J Am Diet Assoc*. 2008;108(2):362–366
22. Briefel RR, Crepinsek MK, Cabili C, Wilson A, Gleason PM. School food environments and practices affect dietary behaviors of US public school children. *J Am Diet Assoc*. 2009;109(suppl 2):S91–S107
23. Birch LL, Ventura AK. Preventing childhood obesity: what works? *Int J Obes (Lond)*. 2009;33(suppl 1):S74–S81
24. Victora CG, de Onis M, Hallal PC, Blössner M, Shrimpton R. Worldwide timing of growth faltering: revisiting implications for interventions. *Pediatrics*. 2010;125(3). Available at: www.pediatrics.org/cgi/content/full/125/3/e473
25. Birch LL. Development of food acceptance patterns in the first years of life. *Proc Nutr Soc*. 1998;57(4):617–624
26. John JH, Ziebland S. Reported barriers to eating more fruit and vegetables before and after participation in a randomized controlled trial: a qualitative study. *Health Educ Res*. 2004;19(2):165–174
27. Evans A, Chow S, Jennings R, et al. Traditional foods and practices of Spanish-speaking Latina mothers influence the home food environment: implications for future interventions. *J Am Diet Assoc*. 2011;111(7):1031–1038
28. Monteiro CA. The decline in child malnutrition in Brazil. *Cad Saude Publica*. 2009;25(5):950–951
29. Brazilian Institute of Geography and Statistics. *Pesquisa de Orçamentos Familiares 2008–2009* [in Portuguese]. Rio de Janeiro, Brazil: Brazilian Institute of Geography and Statistics; 2010
30. Vitolo MR, Bortolini GA, Feldens CA, Drachler ML. [Impacts of the 10 Steps to Healthy Feeding in Infants: a randomized field trial]. *Cad Saude Publica*. 2005;21(5):1448–1457
31. Plagemann A, Harder T. Breast feeding and the risk of obesity and related metabolic diseases in the child. *Metab Syndr Relat Disord*. 2005;3(3):222–232
32. Owen CG, Whincup PH, Kaye SJ, et al. Does initial breastfeeding lead to lower blood cholesterol in adult life? A quantitative review of the evidence. *Am J Clin Nutr*. 2008;88(2):305–314
33. Owen CG, Whincup PH, Odoki K, Gilg JA, Cook DG. Infant feeding and blood cholesterol: a study in adolescents and a systematic review. *Pediatrics*. 2002;110(3):597–608
34. Gordon DJ, Probstfield JL, Garrison RJ, et al. High-density lipoprotein cholesterol and cardiovascular disease. Four prospective American studies. *Circulation*. 1989;79(1):8–15
35. Hokanson JE, Austin MA. Plasma triglyceride level is a risk factor for cardiovascular disease independent of high-density lipoprotein cholesterol level: a meta-analysis of population-based prospective studies. *J Cardiovasc Risk*. 1996;3(2):213–219
36. Gortmaker SL, Peterson K, Wiecha J, et al. Reducing obesity via a school-based interdisciplinary intervention among youth: Planet Health. *Arch Pediatr Adolesc Med*. 1999;153(4):409–418