

## Complementary feeding: inappropriate practices in infants

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### Abstract

**Objective:** To assess feeding practices and dietary intake of healthy infants in three Brazilian municipalities.

**Methods:** By means of a prospective study, we analyzed the food record of 7 consecutive days of an intentional sample (quota and weighted sampling) of 179 healthy infants, aged between 4 and 12 months, from the municipalities of Curitiba, São Paulo, and Recife, who were not being exclusively breastfed. Mothers received oral and written information provided by a nutritionist with the purpose of standardizing the feeding data. The computer program NutWin was used to calculate the dietary intake.

**Results:** The median of the infants' age was 6.8 months (4.0-12.6 months). We found that 50.3% of the infants were no longer being exclusively breastfed. Of these, 12.0 and 6.7% among the infants younger and older than 6 months, respectively, were fed with infant formulae instead of breast milk. Therefore, most infants received whole cow's milk. Infant formula dilution was correct in only 23.8 and 34.7% of the infants younger and older than 6 months old, respectively. With regards to complementary feeding, we found that the median age was 4 months for its introduction and 5.5 months for the introduction of family diet. There was high quantitative inappropriateness of micronutrient intake for infants between 6 and 12 months old who were not exclusively breastfed, mainly in terms of zinc (75%) and iron (45%).

**Conclusion:** The present study showed a high frequency of inappropriate feeding practices and dietary intake in very young infants. These practices may lead to an increased risk of development of chronic diseases in the future.

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### Introduction

There is strong evidence in the literature, based on epidemiological studies, animal models and clinical trials, highlighting that the initial phases of life (intra-uterine period and first year of life) are sensitive to nutritional and metabolic factors that may determine short- and long-term effects on the individual's health and well-being until adulthood. The developmental origins of health and disease suggest that induction, deletion or harm in the development of a permanent somatic structure or adjustment of a physiologic system, by means of stimulation or aggression, which takes

place during a susceptible period (early phases of life), would result in long-term consequences for the physiologic functions.<sup>1</sup>

Exclusive breastfeeding up to 6 months, with breastfeeding lasting up to 2 years or longer in combination with the introduction of balanced complementary feeding (CF) are emphasized by the World Health Organization (WHO) as important measures of public health with effective impact on the reduction in the risk of developing this type of disease.<sup>2</sup> Nevertheless, current data show

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that chronic diseases affect 30% of the Brazilian adult population.<sup>3</sup> Several studies have emphasized that the recommendations on healthy feeding practices during the first year of life have not been totally incorporated yet, not only in Brazil, but also in other countries, in spite of the permanently updated guidelines aimed at health professionals who provide care to the pediatric age group.<sup>4-6</sup>

The appropriate CF must include a balanced composition of foods containing an adequate amount of macro and micronutrients (with special attention to iron, zinc, calcium, vitamin A, vitamin C and folic acid), contamination-free (biologic, chemical or physical) food, which can be easily digested and accepted, at reasonable cost and prepared using food usually consumed by the family.<sup>4,7</sup>

Recent studies conducted by the Brazilian Ministry of Health have emphasized the high frequency of inadequate CF during the first year of life.<sup>3</sup> Even though total breastfeeding duration has shown an increase by comparing the population surveys of 1996 and 2006, the median of exclusive breastfeeding is still very low (1.8 months).<sup>3</sup> With regard to CF, it is important to highlight the early introduction of inappropriate food such as, for instance, whole cow's milk; inappropriate consistency and low density and bioavailability of micronutrients (diluted soups); low amount of fruits and vegetables; contamination during food preparation and storage; addition of simple carbohydrates to the feeding bottle; and offer of manufactured foods rich in simple carbohydrates, lipids, and salt, often consumed by the family.<sup>4</sup>

In Brazil, several studies have been published on the introduction of CF to children; however, it is worth mentioning that these studies were based on semi-structured questionnaires based on the interviewee's memory and related to the food consumed on the day previous to the interview, usually carried out during vaccination campaigns.<sup>8-13</sup> There are not any studies available regarding the dietary intake of infants using the 7-day food diary as the instrument of data collection.

Therefore, the objective of the present study was to assess the feeding practices and dietary intake of infants between 4 and 12 months who lived in São Paulo, Curitiba, and Recife.

## Methods

Our sample included a representative subsample of infants younger than 1 year old who were randomly selected from a consumption study conducted in 2005 involving 1,800 mothers of children between 4 and 36 months old, belonging to socioeconomic classes A, B, C, and D, from the municipalities of São Paulo, Recife, and Curitiba. This initial sample was a non-probabilistic, intentional (quota and weighted) sampling based on the data from the

Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística, IBGE).

We analyzed the 7-day food diary of 179 healthy infants from Curitiba, São Paulo, and Recife, Brazil, aged between 4 and 12 months, who were not being exclusively breastfed. By means of structured and pre-codified questionnaires, we collected sociodemographic data and information on feeding practices.

The mothers received oral and written information from trained nutritionists before they completed the 7-day food diary with the purpose of standardizing data collection. In order to increase the accuracy of the data, the mothers were offered scales with capacity of 1 kg and graduation of 100 g, measuring jug with graduation of 10 mL and capacity for 50 mL, and set of measuring spoons for different types of food.

Data were recorded by the mothers in grams, mL, or home measures and they included: food offered and preparation mode, mentioning all ingredients used and the leftovers.

Next, the qualitative and quantitative analyses of food records were carried out by nutritionists, researchers, and the authors of the present study. For the quantitative analysis, we used the computer program NutWin of Universidade Federal de São Paulo. The 1989 Recommended Dietary Allowance (RDA)<sup>14</sup> was used as the reference values, considering the intake of micronutrients and energy lower than 80% as inappropriate.

Due to the wide variation in the preparation of infant formulae or powder cow's milk (with regard to the dilution and addition of simple carbohydrates), each preparation was individually assessed.

All data were double entered (independent typewriters) and validated using the statistical package Epi Info 6.04 (validate duplicate entry). The statistical package SPSS 13.0 was used to build the tables of results, which, for the qualitative and dichotomic data, were presented by means of frequency tables (absolute number and percentage) and, for the continuous variables, were presented by means of measurement of central tendency (median) and dispersion (minimum and maximum values).

## Results

The median of the infants' age was 6.8 months (4.0-12.6 months). Table 1 shows the sociodemographic characteristics and the related feeding practices of this population.

The mothers reported that the feeding practices used were predominantly based on their own and their family's life experience (67.6%). Pediatricians and the media ranked second and third place, respectively (data not provided).

Among the questionnaires evaluated, we found that 50.3% of the infants were no longer being exclusively

**Table 1** - Distribution of infants (number and percentage) regarding the sociodemographic variables related to the feeding practices of infants up to 12 months old who were not being exclusively breastfed

Variable	n (%)
Municipality	
Curitiba	65 (36.3)
São Paulo	59 (33.0)
Recife	55 (30.7)
Sex	
Male	94 (52.5)
Female	85 (47.5)
Age	
< 6 months	67 (37.4)
≥ 6 months	112 (62.5)
Median (minimum-maximum)	179-6.8 (4.0-12.6) months
Mother's marital status	
Single	31 (17.9)
Married	138 (79.7)
Separated	4 (2.3)
Family income	
≤ 1 minimum salary	56 (32.4)
1-5	83 (48.0)
5-10	12 (6.9)
10-20	3 (1.7)
> 20	1 (0.6)
Mother's age	
< 20 years old	21 (12.1)
≥ 20 years old	156 (90.2)
Median (minimum-maximum)	25 (18-50) years
Mother's occupation	
Housewife or unemployed	128 (74.0)
Has a job or is a part-time student	41 (23.7)
Has a full-time job	4 (2.3)
Mother's educational level	
< 4 years	6 (3.5)
4-8 years	46 (26.6)
8-12 years	45 (26.0)
> 12 years	76 (43.9)
Internet access	
Yes	38 (21.9)
No	135 (78.1)
Child's caregiver	
Mother	169 (97.7)
Father or baby sitter	4 (2.3)
Breastfeeding*	
< 6 months (n = 67)	39 (58.2)
≥ 6 months (n = 112)	50 (44.6)
Infant formula	
< 6 months (n = 67)	13 (19.4)
≥ 6 months (n = 112)	21 (18.7)
Whole cow's milk	
< 6 months (n = 67)	51 (76.1)
≥ 6 months (n = 112)	87 (77.7)
Other	
< 6 months (n = 67)	3 (4.5)
≥ 6 months (n = 112)	4 (3.7)

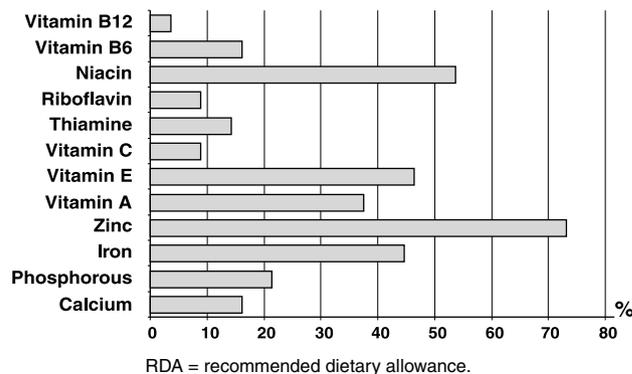
\* Frequency of infants according to the number of times each child is breastfed/day (median): four times (1-8).

breastfed. Of these, 12.0 and 6.7% among the infants younger and older than 6 months, respectively, were fed with infant formulae instead of breast milk. Therefore, most infants received whole cow's milk. The most frequent reasons mentioned by the mothers for the interruption of exclusive breastfeeding were: low milk production (17.7%) and child's refusal to be breastfed (8.4%) (data not provided).

The median age for introduction of feeding bottle was 3 months (0.0-10 months). We found a high percentage of inadequate preparation of infant formulae and milk bottles (Table 2). Infant formula dilution was adequate in only 23.8 and 34.7% of the infants younger and older than 6 months old, respectively (Table 2). We found a high frequency of addition of sugar, cereals, and chocolate powder in the preparation of feeding bottles, even for children younger than 6 months (Table 2).

With regards to CF, we found that the median age was 4 months for its introduction and 5.5 months for the introduction of the family diet (data not provided). The analysis of the frequency of the weekly intake demonstrated high percentage of consumption of manufactured foods, soft drinks, and artificial juices among the children assessed (Table 3).

Figure 1 shows high quantitative inappropriateness in the micronutrient intake for infants from 6 to 12 months who were no longer being breastfed. It is important to highlight the specific deficits of zinc (75%) and iron (45%).

**Figure 1** - Quantitative inappropriateness of dietary micronutrients based on the 7-day evaluation according to the RDA in children older than 6 months who received complementary feeding

## Discussion

The present study warns about the evident nutritional risk of infants in the first year of life with potential short- and long-term implications considering: short duration of breastfeeding, use of whole cow's milk, early introduction of manufactured foods rich in lipids (including trans fat), sugar,

**Table 2** - Frequency and percentage of the appropriateness of dilution and addition of simple carbohydrates to infant formula and whole cow's milk consumed by infants up to 12 months old who were no longer being exclusively breastfed

	< 6 months, n (%)	≥ 6 months, n (%)
Infant formula dilution		
Adequate	16 (23.8)	26 (34.7)
Diluted	21 (29.2)	20 (26.7)
Concentrated	35 (48.6)	29 (38.7)
Infant formula additions		
Sugar, cereals, and powder chocolate	0	0
Sugar and cereals	0	0
Sugar and powder chocolate	0	8 (10.7)
Sugar	5 (6.9)	1 (1.3)
Cereals and powder chocolate	0	1 (1.3)
Cereals	0	1 (1.3)
Powder chocolate	21 (29.2)	30 (40)
No additions	46 (63.9)	34 (45.3)
Cow's milk dilution		
Adequate	8 (3.9)	52 (15.3)
Diluted	107 (51.9)	166 (49.0)
Concentrated	91 (44.2)	121 (35.7)
Powder whole cow's milk additions		
Sugar, cereals, and powder chocolate	3 (1.5)	3 (0.9)
Sugar and cereals	0	1 (0.3)
Sugar and powder chocolate	82 (40.4)	151 (44.5)
Sugar	23 (11.3)	35 (10.3)
Cereals and powder chocolate	0	8 (2.3)
Cereals	0	13 (3.8)
Powder chocolate	46 (22.7)	95 (28)
No additions	49 (24.1)	33 (9.6)
Liquid whole cow's milk additions		
Sugar, cereals, and powder chocolate	2 (1.3)	8 (2.5)
Sugar and cereals	5 (3.3)	9 (2.9)
Sugar and powder chocolate	30 (19.9)	92 (29.3)
Sugar	25 (16.6)	25 (8.0)
Cereals and powder chocolate	0	6 (2.0)
Cereals	0	22 (7.0)
Powder chocolate	60 (39.7)	96 (30.6)
No additions	29 (19.2)	56 (17.8)

and salt. Combined with the inappropriate consumption of macronutrients, the low intake of micronutrients is also a reason for concern, mainly related to the antioxidant defense, which may potentiate the risk of developing diseases such as cardiovascular disorders.

Li et al., in a recent study involving US mothers, suggested several reasons for the early interruption of breastfeeding, highlighting the mothers' low educational level and young age, short maternity leave, use of feeding bottles in neonatal intensive care units, and families' desire of offering manufactured foods rich in fat, simple carbohydrates, and salt, often consumed by parents.<sup>15</sup>

In our study, we found that the most frequent reasons reported by the mothers for early interruption of breastfeeding (little production of milk and child's refusal to be breastfed) are in agreement with data published by the Brazilian Ministry of Health. We also did not find association between the interruption of breastfeeding and mother's educational level.<sup>3</sup>

Siqueira & Monteiro found a two-fold higher risk of obesity in children who had never been breastfed when compared to other children's risk. They did not find dose-response effect in the association between duration of breastfeeding and obesity at schoolage.<sup>16</sup>

**Table 3** - Frequency of weekly intake of some types of foods according to age group, in absolute number, percentage, and median of consumption

	< 6 months		≥ 6 months	
	n (%)	Median	n (%)	Median
<i>Petit-suisse</i>	19 (29.2)	3 (1-7)	57 (51.3)	2 (1-7)
Meat	22 (33.8)	3 (1-7)	87 (78.3)	4 (1-7)
Fried food	0	0	10 (9.0)	1 (1-2)
Cold cuts	0	0	6 (5.4)	1 (1-2)
Cookies	25 (38.5)	2 (1-7)	88 (79.3)	3.5 (1-7)
Snacks	1 (1.5)	1 (1-1)	6 (5.4)	2 (1-4)
Instant noodles	8 (12.3)	2 (1-4)	18 (16.2)	2 (1-5)
Sweets	1 (1.5)	1 (1-1)	29 (26.1)	1 (1-5)
Ready-to-eat foods*	13 (20)	3 (1-7)	33 (29.7)	2 (1-7)
Soft drink	0	0	10 (9.0)	1 (1-4)
Artificial juice	1 (1.5)	1 (1-1)	23 (20.7)	1 (1-3)
Fruits	55 (84.6)	6 (1-7)	108 (97.3)	6 (1-7)
Vegetables	41 (63)	4 (1-7)	90 (81.1)	3 (1-7)

\* Manufactured convenience foods.

A surprising result was the high percentage of children in the first year of life who consumed whole cow's milk, with or without addition of simple carbohydrates, instead of breast milk. The use of whole cow's milk is an independent risk factor for the development of iron deficiency anemia; for each month of use of cow's milk there is a reduction of 0.2 g/dL in the hemoglobin levels.<sup>17</sup> It is also worth highlighting that iron deficit and iron deficiency anemia cause severe sequelae in children's cognitive and emotional development, impairing their development during adulthood.<sup>18,19</sup> Another important aspect is related to the excessive consumption of proteins associated with the early use of cow's milk in the first year of life and the development of chronic diseases such as obesity and type 2 diabetes. Larnkjaer et al., comparing the intake of infants from 9 to 12 months who consumed infant formula and whole cow's milk, emphasized the risk of the excessive consumption of proteins associated with the early use of whole cow's milk with consequences in the IgF1 levels.<sup>20</sup>

A cohort study recently published by Koletzko et al., comparing the body mass index (BMI) at 2 years old of children receiving infant formulae with higher or lower protein content in the first year of life within the limits recommended by the Codex Alimentarius, reported significantly higher values of BMI in the group who received infant formulae containing higher protein content when compared to those children who were still being breastfed and those who received infant formulae containing lower amounts of protein.<sup>21</sup> The suggested mechanism was the increase in the adipogenesis and resistance to insulin associated with

increase in the circulating levels of IgF1 in children whose protein intake was higher.<sup>22</sup>

With regard to those children fed with infant formulae, there was high percentage of dilution error. A study conducted by Labiner-Wolfe et al. highlighted that the incorrect dilution of infant formulae was often found, increasing the risk of diarrhea, dehydration, as well as inappropriate offer of energy and protein.<sup>23</sup>

Healthy and diversified CF is an opportunity for the child to be exposed to a wide variety of foods that will serve as the basis for healthy dietary habits in the future. The definition of the feeding preferences based on the feeding practices during the first years of life has been broadly approached in the literature.<sup>24,25</sup> It is important to highlight that the breast milk contains several smells/flavors directly related to the foods, spices, and liquids consumed and inhaled by the mother. Breastfeeding exposes the infant to a wide sensorial experience, making it easier the full acceptance of a balanced CF.<sup>25</sup>

With regard to the quantitative analysis, we found several inappropriate aspects. The inadequate intake of iron, zinc, and vitamin A, previously described in other Brazilian studies, is surprising.<sup>3</sup> Recently, the National Survey on Demography and Health of Children and Women (Pesquisa Nacional de Demografia e Saúde da Criança e da Mulher, PNDS) provided results regarding biomarkers and reported that there was anemia and vitamin A deficit in 20.5 and 17.4%, respectively, of the children younger than 5 years old, which once again corroborates the need of nutritional education interventions in the scope of public health.<sup>26</sup> It

is important to emphasize that approximately 70% of the iron and zinc needs of infants after 6 months of life must be supplied by complementary feeding.

In our sample, we found that children started to be fed very early with inappropriate foods such as manufactured sweets, sandwich cookies, instant noodles, frozen convenience foods, soft drinks, and artificial juices. Recently published population-based studies, assessing the dietary intake of US and European infants (Germany, Poland, Italy, Spain, and Belgium), evidenced early introduction of CF (before 4 months of life) and frequent use of inappropriate foods for this age group, such as foods with high fat and sugar content.<sup>4,5</sup>

There are some limitations in the present study: need to estimate the addition of oil and sugar, lack of children's anthropometric data, and cross-sectional study design that makes it only possible to find associations between the events studied, not allowing to demonstrate a cause-effect relationship between such events.

## Conclusion

The present study showed a high frequency of inappropriate feeding practices and dietary intake in very young infants. These practices may lead to increased risk of development of chronic diseases in the future.

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