Research Article

Association between exclusive breastfeeding duration and the quality of complementary feeding at 12 months of age

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Abstract

Objective: To assess the association between exclusive breastfeeding duration and the quality of complementary feeding at 12 months of age. **Methods:** This cohort study was nested in a randomized clinical trial designed to assess the effect of a pro-breastfeeding, pro-healthy complementary feeding intervention aimed at adolescent mothers and maternal grandmothers on the prevalence of breastfeeding and the intake of a healthy diet in the first year of life. Data on infant feeding in the first year of life were obtained monthly in the first 6 months and bimonthly thereafter up to 12 months via telephone interviews with the caretaker or home visits. A healthy, diverse diet was defined as the intake of fruits/vegetables, meat, beans, and cereals/tubers at least four times weekly and a low consumption (once weekly maximum) of foods rich in fat, salt, and sugar. The association between exclusive breastfeeding duration, expressed in absolute values, and intake of a healthy, diverse diet was tested using Poisson regression analysis. **Results:** The likelihood of the infant being on a healthy, diverse diet at 12 months of age increased by 28% for each additional month of exclusive breastfeeding (relative risk [RR] 1.28; 95% confidence interval [95%CI] 1.19-1.38). **Conclusions:** This study reinforces the hypothesis of a positive association between the longer duration of exclusive breastfeeding and the intake of a healthier diet in infants.

Keywords: breastfeeding, dietary behaviors, adolescent

1 Introduction

The World Health Organization (WHO) recommends healthy feeding for infants and young children, starting with breastfeeding for 2 years or more. Specifically, breastfeeding should be started in the first hour of life, maintained exclusively for the first six months of the child's life, and complemented with healthy foods thereafter [1]. There is strong evidence of the benefits of breastfeeding and healthy complementary feeding for the growth and development of children throughout their lives [2].

As the prevalence of overweight and obesity increases worldwide, including in the pediatric population [3], we see a growing interest in studies investigating dietary habits and associated factors in children. Several factors involved in food choices and intake among children have been identified, e.g., culture, socioeconomic level, mother's working status,

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lifestyle, media influence, excessive screen time, mother's age, and influence of the social network surrounding the mother [4, 5]. There are reports that low maternal age and grandmothers' influence on infant feeding (especially from the maternal grandmother) may have a negative effect on the infant's food consumption [6].

Even though the relationship between genetic and environmental factors in the establishment of dietary habits in childhood is complex, there is evidence suggesting that this process starts in utero, where flavors and the aroma present in the mother's diet are transmitted to the amniotic fluid and thus come into contact with the fetus. The fetus can detect chemosensory stimuli present in the amniotic fluid, and repeated exposure to these stimuli influences neonates' later behavioral responses to those same stimuli [7].

More recently, an association between duration of breastfeeding, especially exclusive breastfeeding, and dietary habits in children has also been speculated [8, 9]. Nevertheless, some studies have failed to confirm that association when assessing preschool children and adolescents [10].

Taking into consideration the importance of broadening our knowledge of the factors that facilitate and hinder the adoption of healthy dietary practices in children, as well as the lack of consensus on the possible association between exclusive breastfeeding duration and the consumption of foods in infants, the objective of this study was to investigate the association between exclusive breastfeeding duration and quality of complementary feeding in the first year of life of children of adolescent mothers.

2 Materials and methods

This was a cohort study nested in a randomized clinical trial designed to assess the effect of a pro-breastfeeding, pro-healthy complementary feeding intervention aimed at adolescent mothers and maternal grandmothers on the prevalence of breastfeeding and the intake of a healthy diet in the first year of life. Adolescent mothers, their children, and their mothers (the infants' maternal grandmothers), when cohabiting, were included. Participants were recruited at the maternity ward of Hospital de Clinicas de Porto Alegre, southern Brazil, taking into consideration the following inclusion criteria: adolescent mothers aged $\leq$ 19 years, residing in the city where the study was conducted, having given birth to a healthy, term, singleton newborn with a birth weight $\geq$ 2,500 g, and having breastfed during her stay in the ward.

Details of the methodology and intervention employed are described elsewhere [11]. Briefly, data on infant feeding in the first year of life were obtained monthly in the first 6 months and bimonthly thereafter up to 12 months via telephone interviews with the caretaker or home visits whenever telephone contact failed. During the interviews, mothers/caretakers were asked to inform whether the infant was being breastfed; for those receiving complementary feeding, details on their weekly consumption of different foods were obtained.

Infants were considered to be on exclusive breastfeeding when they received breast milk only, with no other food, liquid, or solid, including water, teas, or juices. The quality of the infants' diet was assessed based on the Dietary Guidelines for Children under Two Years issued by the Brazilian Ministry of Health, which follows the recommendations of the WHO

[12]. Healthy, diverse diet was defined as the intake of fruits/vegetables, meat, beans, and cereals/tubers at least four times weekly, combined with a low consumption (once weekly maximum) of foods rich in fat, salt, and sugar (candy, soft drinks, processed snacks, fried foods).

The sample size was based on the primary objective of the randomized clinical trial (prevalence rates of breastfeeding and exclusive breastfeeding in the first year of life). Therefore, for the scope of the present study, a standardized effect size was estimated to allow assessment of complementary feeding among the participants that completed the follow-up period, with $\alpha = 5\%$ and $\beta = 20\%$. This calculation resulted in a standardized effect of ≥ 0.6.

The association between exclusive breastfeeding duration, expressed in continuous values, and intake of a healthy, diverse diet was tested using multivariate Poisson regression analysis. First, an unadjusted model was tested (model 1), followed by two cumulative models: model 2 considered the groups (control or intervention), and model 3 further included covariates that, according to the literature, could influence the infants' diet, e.g., maternal education level, number of children, infant's sex and age, and cohabitation with maternal grandmother [4, 5]. Finally, odds ratios and respective confidence intervals were calculated. Data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 23.0. Significance was set at 5%.

The study was approved by the Research Ethics Committee of Hospital de Clinicas de Porto Alegre. The trial is registered at ClinicalTrials.gov under protocol no. NCT00910377. All mothers were informed of the study objectives and signed an informed consent form before being included in the sample.

3 Results

Of the 323 mother/infant dyads assessed in the randomized clinical trial, 242 (74.9%) were included in the present cohort study. Losses were due to failure to locate mothers/families during follow-up (n=48), refusals to remain in the study (n=14), mother-infant separation (n=3), and unavailability of data for analysis (n=16). Table 1 shows the characteristics of the 242 individuals assessed.

There was an even distribution of the characteristics of participants who completed the study and of those who were lost to follow-up. No significant differences were observed in maternal characteristics (mother's skin color, age, income, education level, and number of children), infant characteristics (infant's sex, birth weight, and type of delivery), or cohabitation status (cohabiting with grandmother or partner).

The median exclusive breastfeeding duration was 69 days, and only 25% (n = 57) of the infants were exclusively breastfed for 4 months or more. Concerning food consumption, 67% of the infants consumed healthy foods at least four times weekly, and approximately 60% of them consumed unhealthy foods once weekly at the most. Conversely, only 44% of the infants met the criteria for the intake of a healthy, diverse diet at 12 months of age. Figure 1 shows data on the intake of a healthy diet stratified according to exclusive breastfeeding duration.

The multivariate analysis revealed a positive association between exclusive breastfeeding

duration and the intake of a healthy, diverse diet (Table 2). The likelihood of an infant being on a healthy diet at 12 months of age increased by 28% for each additional month of exclusive breastfeeding.

Table 1: Characteristics of the mothers and children assessed

Variable	n=242
Mother's age, years – mean ± SD	17.5 ± 1.4
Mother's skin color, white – n (%)	148 (62.7)
Mother's education level, ≥ 8 years – n (%)	131 (55.5)
Mother's income, minimum wages* – median (P25-P75)	2.5 (1.5-8.6)
Mother lives with partner – n (%)	143 (60.6)
Vaginal delivery – n (%)	183 (77.5)
Primiparous – n (%)	199 (84.3)
Infant's birth weight, g – mean ± SD	3242 ± 388
Infant's sex, male – n (%)	122 (51.6)
SD = standard deviation; P25-P75 = 25th and 75th percentiles. Equivalent to US$ 195.00/ month (mean value according to exchange rate at the time).	

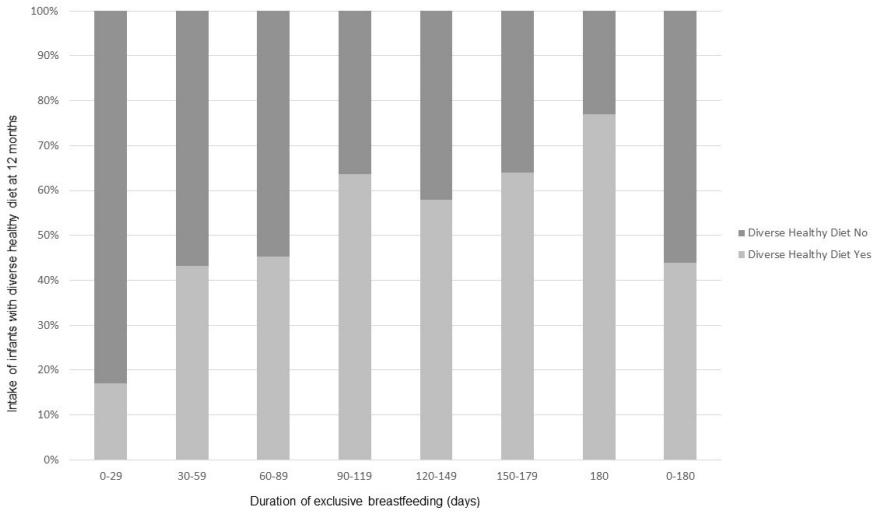

Figure 1: Exclusive breastfeeding duration and intake of a healthy, diverse diet at 12 months of age

Table 2: Poisson regression model to estimate the association between exclusive breastfeeding duration and intake of a healthy, diverse diet at 12 months of age

Model	RR (95%CI)	p
Model 1 - unadjusted	1.24 (1.16-1.32)	0.000
Model 2 - adjusted for intervention	1.24 (1.16-1.33)	0.000
Model 3 - adjusted for intervention, infant's sex, mother's education level, cohabitation with maternal grandmother and number of children	1.28 (1.19-1.38)	0.000
RR = relative risk; 95%CI = 95% confidence interval		

4 Discussion

This study corroborates the hypothesis that a longer duration of exclusive breastfeeding is associated with better dietary patterns in infants towards the end of their first year of life. This finding confirms those of two previous investigations involving infants aged 12 months or younger: one conducted in the United States reporting that infants who were exclusively breastfed showed a higher intake of vegetables between 4 and 6 months of age when compared with formula-fed infants [13]; and another carried out in the United Kingdom and involving 19,848 infants, which reported a positive association between exclusive breastfeeding for $\geq$ 3 months and greater acceptance of fruits and vegetables at 8-10 months [14].

Other studies have described an association between exclusive breastfeeding duration and dietary patterns in older children. Möller et al. observed that children who had never been exclusively breastfed showed a lower intake of vegetables at 5 years compared with their counterparts exclusively breastfed for 6 months [15]. Perrine et al. were able to demonstrate that American children who were exclusively breastfed for 3 months or more showed a higher intake of fruits and vegetables at 6 years [16]. Still in the same line, Skugarevsky et al. analyzed the effect of an intervention involving 17,046 Belarusian infants during their first year of life and found higher rates of exclusive breastfeeding at 3 months of age as well as longer breastfeeding duration in the intervention group. In addition, those authors observed that the group exposed to the intervention showed less problematic eating attitudes at 11.5 years of age. The authors speculated that the higher rates of exclusive breastfeeding may have contributed to this association [17]. These findings may be explained by the fact that infants who are breastfed are probably exposed to a wide variety of flavors and aromas present in the mother's diet, differently from formula-fed infants, who are always exposed to same constant flavor [18].

Dietary preferences do not depend exclusively on genetic predisposition and biological factors; they are also shaped and changed throughout one's lifetime. Food intake is influenced by appetite, hedonic stimuli, dietary preferences, and the social environment [18]. Breastfeeding seems to play an important role in several of these factors. In addition to its role in food acceptance, already mentioned, breastfeeding also contributes to the development of satiety/hunger mechanisms, with the infants learning to self-regulate their intake [18]. Moreover, we cannot discard the possibility that mothers who breastfeed for longer periods may have a greater awareness of healthy eating standards and thus offer healthy foods

more frequently to their children. In addition, these women may have healthier lifestyles and eating patterns, and consequently, tend to offer the healthy foods they eat to their children as well.

The decision to include grandmothers in the study was based on the fact that, in some cultures, grandmothers play an important role in choosing the foods that their grandchildren eat, as well as in preparing meals [6]. However, in our sample, the multivariate analysis showed that cohabiting with grandmothers did not influence the final result.

Regarding food consumption, although more than 60% of infants screened had eaten healthy foods four or more times a week and had eaten unhealthy foods once a week or less, only 44% qualified for the consumption of a healthy, varied diet at age 12 months. Even when there is exposure to the intervention, which has proven to positively affect the quality of complementary feeding [11], this situation is far from perfect and in harmony with food intake data across the globe. As per the WHO, fewer than one-third of infants up to 2 years old achieve the lowest standards for dietary diversity, and 50% receive only the minimum number of meals [19]. In recent times, findings from a Brazilian survey indicated that more than half of the children had eaten the recommended foods, 78% ate sugar-rich, fat-rich, and salty foods, and merely 3.4% ate a healthy diverse diet. The breastfed children who did not have non-human milks were nearly five times more likely to be on a healthy varied diet and were 19% less likely to eat food that was high in sugar, fat, and salt compared to the breastfed children who also drank non-human milk and the non-breastfed children [20].

To our knowledge, this is the first study to evaluate feeding habits in children of adolescent mothers, a population that has been shown to be at risk with regard to healthy eating habits. However, some of the limitations in this current study need to be stated. First, we had a significant number of lost follow-up participants. This is a built-in shortcoming in follow-up studies, particularly when the subjects are young adults residing in urban peripheries of developing nations. However, the fact that there were no differences in the profile of the lost-to-follow-up and the complete study participants reduces the effect of this flaw.

A further limitation is reliance on a questionnaire that only asks about weekly frequency of eating of various foods, i.e., not how much eaten. This data would undoubtedly give more precise data of the outcome measured. A third shortcoming is that the data gathered do not enable to apply the WHO suggestion for the assessment of minimal dietary variety in infants 6-23 months old, using the intake or consumption of four or more of the following food groups on the previous day: grains/roots/tubers; legumes/nuts; milk/dairy foods; flesh foods; eggs; vitamin A rich fruits and vegetables; and other fruits and vegetables. This indicator was put forward in 2010, when the data collection process for the current study was finished. We thus chose to employ an indicator of healthy, varied diet made of a mix of foods regarded as healthy at the minimum recommended frequency, and low consumption of foods regarded as unhealthy, according to official Brazilian guidelines for infant feeding of those under < 2 years of age.

Even though the original randomized clinical trial was not designed to pursue the objective of the present cohort study, the statistical analysis was planned so as to deal with this limitation (i.e., multivariate analysis with a model that included exposure to the intervention and cohabitation with grandmothers).

It is important to emphasize that this study exclusively assessed adolescent mothers. We strongly believe that if a causal relationship exists between exclusive breastfeeding duration

and feeding patterns in infants, this relationship does not depend on the mother's age.

In conclusion, this study reinforces the hypothesis that there is an association between a longer duration of exclusive breastfeeding and the intake of a healthy, diverse diet in infants. In a scenario where infant feeding and childhood overweight/obesity are growing concerns, this association reinforces the arguments supporting the WHO recommendation on maintaining exclusive breastfeeding for the first 6 months of life.

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