



Nutrición Hospitalaria



Trabajo Original

Pediatría

Poor breastfeeding, complementary feeding and dietary diversity in children and their relationship with stunting in rural communities

Pobre lactancia materna, alimentación complementaria y diversidad de la dieta, y su relación con la baja talla en comunidades rurales

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Abstract

Introduction: stunted growth is the most common manifestation of malnutrition in México. Breastfeeding, adequate introduction of complementary feeding and dietary diversity can avoid this.

Objective: to characterize the feeding practices in children 1-24 months of age in rural communities of Hidalgo and define their relationship with stunting.

Methods: a 24-hour recall was used to obtain information. Z-scores for length-for-age (ZLA), complementary feeding (CF) and minimal dietary diversity (MDD) were determined. The sample was divided into breastfed and not breastfed children

Results: one hundred eighty nine mother-child dyads were evaluated; 59.3% were breastfed and 40.7% were not. Stunting was found in 10.1% and was identified starting at the fourth month of life. This was accompanied by early CF close to the third month (57.0%) and by a reduction in exclusive breastfeeding during the second month of life to only 30%. The proportion of not breastfed children with stunting (27.5%) was almost twice that of breastfed children (12.0%) ($p < 0.03$). By age, mean ZLA was different with a trend towards stunting increasing with age ($p < 0.05$): 1-6 months -0.463 ± 1.445 ; 7-12 months -0.669 ± 1.225 ; and 13-24 months -0.985 ± 0.917 . MDD was greater in not breastfed children (69.7%) ($p < 0.04$) and by age greater in children 13-24 months (69.7%) ($p < 0.02$).

Conclusions: the feeding practices of most mothers did not meet WHO recommendations. It is necessary to carry out nutrition education interventions aimed at mothers in rural population.

Key words:

Feeding practices.
Breastfeeding.
Complementary feeding.

Resumen

Introducción: el retraso en el crecimiento es la forma más común de desnutrición en México. La lactancia materna, la introducción adecuada de alimentos complementarios y la diversidad en la dieta pueden evitarla.

Objetivo: caracterizar las prácticas de alimentación de niños de 1-24 meses de comunidades rurales de Hidalgo y determinar su relación con baja talla.

Métodos: se aplicó un recordatorio de 24 horas para obtener la información. Se determinó la puntuación Z longitud para la edad (ZLE), alimentación complementaria (AC) y diversidad alimentaria mínima (DAM). La muestra fue dividida en niños amamantados y no amantados.

Resultados: se evaluaron 189 diadas madre-hijo, 59.3% fueron amamantados y 40.7% no lo fueron. La baja talla fue del 10,1%, identificada a partir del cuarto mes, acompañada de AC precoz cerca del tercer mes (57,0%) y la disminución de la lactancia materna exclusiva durante el segundo mes de edad a solo 30%. La proporción de niños no amamantados con baja talla (27,5%) fue más del doble que los niños amamantados (12,0%) ($p < 0,03$). Por edad, las medias de ZLE fueron diferentes con tendencia hacia la baja talla, aumentando con la edad ($p < 0,05$): 1-6 meses, $-0,463 \pm 1,445$; 7-12 meses, $-0,669 \pm 1,225$; y 13-24 meses, $-0,985 \pm 0,917$. La DAM fue mayor en los niños no amamantados (67,1%) ($p < 0,04$) y, por edad, mayor en niños de 13-24 meses (69,7%) ($p < 0,02$).

Conclusión: las prácticas de alimentación en la mayoría de las madres evaluadas no cumplen con las recomendaciones de la WHO. Se recomienda realizar intervenciones educativas nutricionales dirigidas a las madres.

Palabras clave:

Prácticas de alimentación.
Lactancia materna.
Alimentación complementaria.

Received: 13/06/2017 • Accepted: 01/10/2017

Financial statement: This project was entirely funded by the Servicios de Salud Hidalgo with the 2016 budget.

Zaragoza-Cortes J, Trejo-Osti LE, Ocampo-Torres M, Maldonado-Vargas L, Ortiz-Gress AA. Poor breastfeeding, complementary feeding and dietary diversity in children and their relationship with stunting in rural communities. *Nutr Hosp* 2018;35:271-278

DOI: <http://dx.doi.org/10.20960/nh.1352>

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INTRODUCTION

Childhood food practices directly impact a child's nutritional status and health. If they are adequate, the child's growth will be healthy; if they are not, it will hinder growth and the consequences will extend into adult life (1). The multiple benefits that breastfeeding (BF) provides to the mother and child affect the immune nutritional, body, and psychological status of the child, and has economic advantages also (2).

The World Health Organization (WHO) recommends exclusive breastfeeding (EBF) up to six months of age followed by the introduction of safe and appropriate foods for this age, maintaining BF for two years or beyond (3). In Mexico, according to the National Survey of Health and Nutrition 2012 (ENSANUT 2012), the percentage of EBF in children less than six months of age has declined to 14.4% in comparison to 22.3% reported in 2006 (4). As has been reported, the lack of EBF in the first months of life increases the probability of introducing foods prematurely, increasing the risk of allergies and infectious diseases (5). It has also been associated with chronic diseases such as diabetes, cardiovascular disease, and obesity in childhood (1). Furthermore, the absence of EBF, especially in low-income families, impacts the family's economy due to the need to buy maternal milk substitutes (6).

The age when complementary feeding (CF) is introduced is a particularly important moment in the child's development (7). The way the mother starts CF will determine the contribution of energy and nutrients to the child's growth and development without weaning, a situation that can prevent or favor iron and zinc deficiency, foment or not the inherent ability of the child to control food intake as well as determine the pleasure or displeasure for different food flavors, smells, and textures (8). Likewise, the introduction of foods will influence the acquisition of abilities that facilitate a smooth transition from total dependence on the parents to self-feeding, such as chewing, using a spoon and cup, etc. As shown, this period represents a key moment in the establishment of eating patterns. These are crucial moments in which there could be a stunting because of an inadequate nutritional intake or the development of overweight due to an excessive or hypercaloric intake (9). Mexico ranks first in childhood obesity (10), a situation that occurs at a young age and is associated with short stature, a hypothesis that has been tested in several studies (11).

Introducing children to the family diet is recommended at 12 months of age when the development of the nervous, digestive and renal system is similar to that of the adult (12); in other words, when the child is capable of consuming something from most food groups. Ideally, the child should have access to a diverse diet. According to the Food and Agriculture Organization (FAO) of the United Nations and the WHO, dietary diversity is a qualitative measure of food consumption that reflects household access to food and is a key factor for ensuring adequate consumption of nutrients and health promotion (13). Scientific evidence considers it a factor that protects against growth failure, a frequent nutritional problem in the country. It has been associated with nutritional adaptation, availability of foods in the home, and better food habits in adults (14).

In Mexico, less than 60% of children between six and eight months of age in rural communities consume a diet that meets nutritional recommendations (15). In Hidalgo, 78.3% of children under five years of age receive only the minimum recommended food diversity (16). The promotion of EBF and adequate CF as well as the maintenance of a diversified diet are fundamental for reducing child mortality and the burden of disease associated with nutrition in Mexico. The aim of this study is to characterize feeding practices in children under two years of age in rural communities of Hidalgo and determine their relationship with stunting. The findings can be used to identify and show the problems of nutrition and dietary patterns in infancy, and provide opportunities for designing and implementing programs for improving the diets and health of infants, in order to avoid the consequences in growth and short and long-term health.

MATERIAL AND METHODS

STUDY POPULATION

This was a descriptive cross-sectional study of a convenience sample of 189 mother-child dyads in children 1-24 months of age. The rural communities selected and evaluated during the national vaccination campaign were: Yolotepec, Patria Nueva, Ojo de Agua, San José Tepenené, La Estancia, and Dextho de Victoria, all within the Health Jurisdiction of Actopan, in the state of Hidalgo. Exclusion criteria were diseases requiring a special diet, not being a resident of the aforementioned communities, and not being the child's caretaker. Mothers and tutors provided written informed consent. The study was previously approved by the Ethics and Research Committees of the Health Services of Hidalgo.

CHILD NUTRITION

A 24-hour recall was applied to determine CF and minimum dietary diversity (MDD) in children six to 24 months of age. The latter was defined as the diet that includes at least four of the following seven food groups: a) cereals/tubers; b) legumes/oleaginous foods; c) milk derivatives (cheese, yogurt or milk substitutes); d) animal products (red meats, fish, chicken, viscera); e) eggs; f) fruits/vegetables rich in vitamin A; and g) other fruits and vegetables (17). The total group of children was divided into: a) breastfed children; and b) not breastfed children the day before, day or night. In breastfed children less than six months of age, maternal milk is exclusive when no other food or drink (including water) is offered. It is predominant (PBF) when infant formulas are used, and complimentary (CF), when foods other than maternal milk are offered (18). Women who did not breastfeed their child or combined it with formula were asked why. A questionnaire to obtain the mother's (age, education, occupation) and the child's (sex, birth date, and if they were born by cesarean section) socio-demographic data was applied.

ANTHROPOMETRIC MEASURES

Children were weighed and measured using standardized methods by trained personnel. A SECA® model 874 scale (Seca GmbH & Co. KG, Hamburg, Germany) with a mother-baby function was used, together with a SECA® 217 stadiometer. Length-for-age was determined with WHO Anthro version 3.2.2.

DATA ANALYSIS

Collected data were captured and analyzed with IBM SPSS for Windows version 23.0. Student's t-test and one-way ANOVA were applied with 95% confidence intervals. For qualitative variables, the Chi-squared test was used ($p < 0.05$).

RESULTS

A total of 189 mother-child dyads were evaluated. Mean age in months was 10.5 ± 0.46 ; 59% were girls and 40% were boys. Classified by age groups, 33.3% were between 1-6 months, 31.7% between 7-12 months, and 34.9% between 13-24 months. Mean age of the mothers was 25.5 ± 5.6 years. Regarding occupation, 82.5% were housewives, 13.2% worked, and 4.2% were students. Mean years of education was calculated as 10.3 ± 2.6 years. In relation to births, 44.1% were primiparous, and according to type of delivery, 48.1% were vaginal and 51.9% were by cesarean section. Additionally, 92.6% of children were breastfed during the first two weeks after birth; 14.6% said they did not know the advantages to breastfeeding. In relation to advice about breastfeeding, 26.8% said they received no advice, 68.7% were counseled by healthcare personnel, and 4.5% received advice from their mother or mother-in-law.

An overview of feeding practices by age groups is shown in figure 1. As shown in this figure, 37% of children 1-6 months old were EBF, and the mean number of times children were breastfed per day was 6.4 ± 3.9 , 95% CI: 0.5-7.3; 16.0% were PBF, 6.0% were fed with infant formula, and 33.0% had begun CF and were breastfed. Eight percent were not being breastfed but were consuming other foods. All of the children in the 7-12 month age group had started CF; however, 63% were still breastfed and 37% were not; the mean number of times children were breastfed per day was 2.6 ± 2.4 times (95% CI: 1.9-3.2). In the 13-24 months group, 29% were breastfed and the mean number of times children were breastfed per day was 0.98 ± 1.6 times (95% CI: 0.57-1.4), while 71.0% were not consuming maternal milk anymore.

The trend followed by food practices is shown in figure 2. Regarding EBF, 73% of the children one month of age had received it. Nevertheless, when EBF in children two months of age was analyzed, there was a drastic decline, since only 30% were receiving it. Children three and four months of age had a similar percentage (43% and 40%, respectively) and those five months of age, 29%. Nine percent of children six months of age were EBF. Continuous breastfeeding counted from the sixth month was

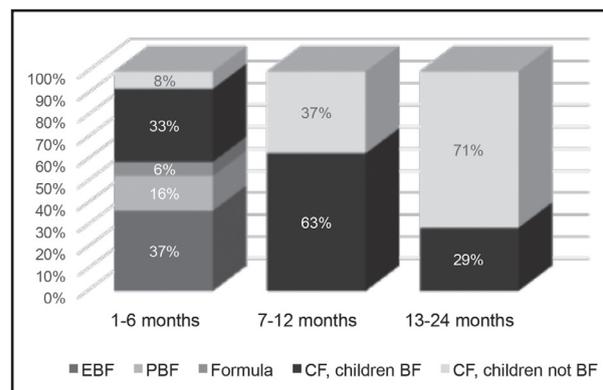


Figure 1.

Characteristics of food practices in the study population by age groups (%). CF: complimentary foods; BF: breastfed; PBF: predominantly breastfed; EBF: exclusively breastfed.

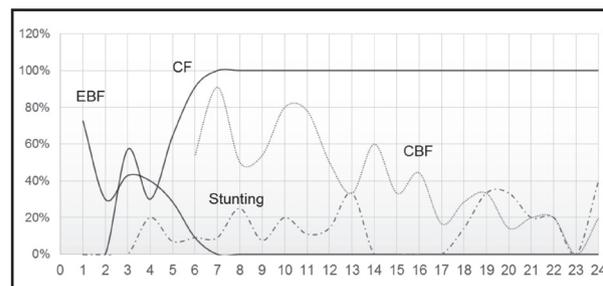


Figure 2.

Percentage of exclusively breastfed (EBF), continuously breastfed (CBF), complimentary foods (CF) and short stature in children 1-24 months of age.

54.0% for children six months of age and 91.0% for those seven months of age. In the eighth and ninth months, a decline of 50.0% and 54%, respectively, was seen. However, the trend increased again in children ten and eleven months of age (80% and 78%, respectively). After 12 months of age, continuous breastfeeding declined considerably.

CF were present starting at the third month of age in 57% of children, in 33% at four months, in 63% at five months, and in 90% at six months. Regarding stunting included in this figure, our study reported 10.1% in the total sample, excluding the risk of short stature classification (31.9%).

Mean ZLA were different by age group. Younger children (1-6 months) showed a score of -0.463 ± 1.445 , and the values closest to low height were in the 7-12 month group (-0.669 ± 1.225). This was even greater in those 13-24 months of age (-0.985 ± 0.917 ; $p < 0.05$) (Table I). This trend is better seen in figure 3, where, notwithstanding, the three means are negative values; in other words, they tend towards low height.

The study population according to type of breastfeeding is described in table II. Of the total sample, 40.7% were not breastfed the day before and 59.3% were.

Table I. Z-score means of the growth indicators length for age and weight for age in children aged 1-24 months by age and by type of lactation

Age group	n	Length for age Z-score	
		Mean	95% CI
1-6 months	63	-0.4632 ± 1.445	-0.820, -0.106
7-12 months	60	-0.6692 ± 1.225	-0.989, -0.359
13-24 months	66	-0.9857 ± 0.917	-1.208, -0.762
*p-value		< 0.05	
Not breastfed	76	-0.992 ± 1.11	-0.0513, 0.375
Breastfed	111	-0.5179 ± 1.26	-0.190, 0.251
†p-value		< 0.009	

*ANOVA; †Student's *t*-test.

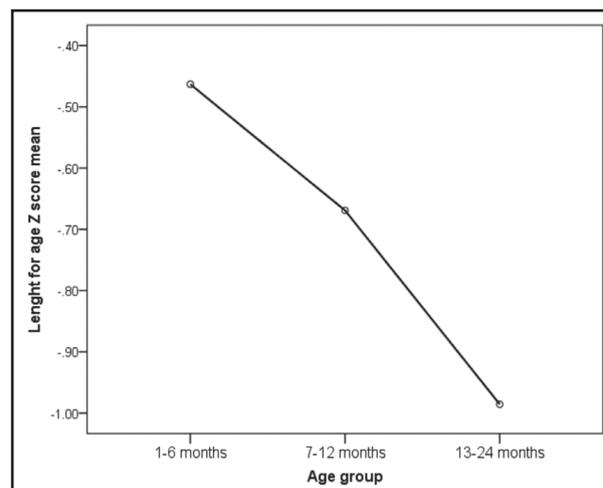


Figure 3.

Length for age Z-score mean of the study population by age group.

Table II. Study population according to type of breastfeeding

Variable	Total %	Breast-fed yesterday		p value
		No % n = 77	Yes % n = 122	
<i>Sex (n = 189)</i>				
Women	59.3	62.3	57.1	0.28
Men	40.7	37.7	42.9	
<i>*Age of child (n = 189)</i>				
1-6 months	33.3	11.7	48.2	0.00
7-12 months	31.7	27.3	34.8	
13-24 months	34.9	61.0	17.0	
<i>Age of the mother</i>				
≤ 20 years	23.9	24.7	23.4	0.48
> 20 years	76.1	75.3	76.6	
<i>Mother's occupation</i>				
Home	82.5	77.9	85.7	0.12
Works or studies	17.5	22.1	14.3	
<i>Mother's education</i>				
≤ 9 years	61.1	64.0	59.1	0.30
> 9 years	38.9	36.0	40.9	
<i>Primiparous women (n = 189)</i>				
Yes	44.1	48.7	40.9	0.18
No	55.9	51.3	59.1	
<i>*Type of birth (n = 189)</i>				
Vaginal	48.1	55.8	42.9	0.05
Cesarean section	51.9	44.2	57.1	
<i>*Breast-fed first 2 weeks after birth</i>				
Yes	92.6	84.2	98.2	0.00
No	7.4	15.8	1.8	

(Continue in the next page)

Table II (Cont.). Study population according to type of breastfeeding

Variable	Total %	Breast-fed yesterday		p value
		No % n = 77	Yes % n = 122	
<i>Received counselling about breast-feeding (n = 189)</i>				
No	26.8	23.6	29	0.30
Healthcare provider	68.7	70.8	67.3	
Mother/mother-in-law	4.5	5.6	29	
<i>Knew about advantages of breast-feeding (n = 189)</i>				
Yes	85.2	88.3	83.0	0.22
No	14.8	11.7	17.0	
<i>Reasons for not breast-feeding† (n = 57)</i>				
Disease	14.0	22.9	0.0	0.04
Child did not want it	8.8	14.3	0.0	
Did not have milk	22.8	22.9	22.7	
Child was not satisfied	12.3	5.7	22.7	
Studied	8.8	8.6	9.1	
Worked	12.2	11.4	13.6	
Other	21.1	14.3	31.8	
<i>Dietary diversity in children 6-24 months (n = 136)</i>				
Not diversified	44.1	32.9	57.1	0.04
Diversified	55.9	67.1	42.9	
<i>*Length for age (n = 126)</i>				
Short stature + severe short stature	18.3	27.5	12.0	0.03
Adequate length	81.7	72.5	88.0	

*Differences between breast-fed and not breast-fed children $p < 0.05$. †Exclusive breast-feeding.

In those 1-6 months, the proportion of children who were not breastfed (11.7%) was lower than that of those who were (48.2%), while in the 7-12 month group the proportions were similar (27.3% and 34.8%, respectively). In those older than 12 months, the number of children who were not breastfed was greater (61.0%; $p < 0.000$).

With regard to the type of birth, the high number of cesarean sections is notable (51.9%). Of those born by cesarean section, 44% were not breastfed and 57.1% were. Of the children born by vaginal delivery, a greater number were not breastfed (55.8%), against 42.9% who were ($p < 0.05$). On the other hand, the mothers of 1.8% of the group of children who were not breastfed the day before the survey indicated that they did not do it in the first two weeks, which means that they resumed the practice later. In the group of children who were not breastfed, there was a large percentage that was breastfed in the first days of life (84.2%). The rest (15.8%) were not breastfed at any time regardless of their age ($p < 0.000$).

When the mothers were asked why they fed their children formula or alternated breast milk and formula during the first six months of life, 38.6% of those who breastfed the previous

day stated that they did not have enough milk (22.7%); they had a feeling that the child was not satiated (22.7%); they studied (9.1%) or worked (13.6%); and others (31.8%) complained of weakness, a cesarean birth, pregnancy, lactose intolerance, and advice of a healthcare provider or use of contraceptives. Of the women who did not breastfeed, 22.9% answered that they were sick, 14.3% that the child did not want it, 22.8% that did not have milk, 5.7% said that their child was not satiated, 8.6% argued that they studied and 11.4%, that they worked ($p < 0.04$).

Stunting was also related to the absence or presence of BF. Regarding this relationship, it is notable that children who were not breastfed had a greater proportion of short stature (27.5%) than those who were breastfed (12.0%).

Finally, and according to the results of MDD in children six to 24 months, 55.9% received a diverse diet that included at least four of the seven food groups described in the methodology. In relation to not breastfed (67.1%) and breastfed (42.9%) children, it was found that the former had a higher proportion of MDD ($p < 0.04$). On the other hand, when this variable was compared, it was found that less than half of the children six to 12 months of age did not reach DMM (42.9%) and that those 13 to 24 months

Table III. Relationship of dietary diversity in the study population by age groups

Dietary diversity	Age in months*		
	(n = 136) %	6-12 months (n = 70) %	13-24 months (n = 66) %
Not diversified	44.1	57.1	30.3
Diversified	55.9	42.9	69.7
Odds ratio	1.6 (1.2-2.3), $p < 0.02$		

Values are percentages. *Differences by age group, $p < 0.05$.

represented a greater proportion (69.7%) ($p < 0.02$) (Table III). It is important to point out that this difference could be influenced by inadequate introduction of CF in the first group.

DISCUSSION

The percentage of EBF found in our study was 22.3%, in contrast with the results of the last state report in rural population, which was 18.5% (18). A good precedent is that more than 90% of the mothers exclusively breastfed their baby at least during the first two weeks after birth. At one month of age, the percentage was still high (73.0%); however, after this month the decline is drastic, since only 30% provided EBF. A study carried out in a low-income population in South America found a similar trend: 95.4% of children began with EBF, followed by a gradual decline (19). Another study carried out in the rural area of Gambia, where children have a high risk of malnutrition, reported that the mean interruption of EBF was 5.2 months and that the decline in growth began at 3.5 months of age (20). This study was able to identify that stunting becomes evident in the fourth month of age, a problem that in our study corresponded graphically to the month of decline of EBF and the early introduction of CF in the third month of age. It is important to point out that the problem with introducing foods at an early age (under four months) is that it favors a reduction in maternal milk consumption. With food, a child becomes satiated more quickly, which impedes reaching nutritional goals. In addition, there is a tendency to offer watery porridges, and a low energy density food, such as fruits and vegetables, which favors the risk of undernourishment (21); or overfeeding, which leads to overweightness (22).

The ENSANUT 2012 reported that 75% of children consumed fruits and vegetables before six months of age (4). Nevertheless, the recommendation is to begin CF at six months (23), considering that the signs that indicate that the infant is capable of receiving solid foods, such as axial tone and head control, motor coordination between the eyes, hands and mouth as well as the disappearance of the extrusion reflex, are present. It is also known that taste buds reach their maximum development at six months (24).

Stunting in this study population was determined as 10.1%; however, the high percentage of children classified at risk of short stature (31.9%) is noteworthy. Likewise, children who were not breastfed had a higher proportion of stunting than children who were breastfed, a finding that confirms the nutritional relevance of maternal milk during this stage.

Chronic malnutrition occurs because of a constant and inefficient consumption of energy and nutrients in the first years of life; this is the most common nutritional deficit in Mexico. Chronic malnutrition first affects weight and later, lineal growth. In Hidalgo, stunting was estimated in 2012 as 12.9% in children under five years of age, a figure similar to the estimated prevalence in Latin America in 2015 (11.6%, 5.9 million children) (25). Nevertheless, when the urban setting (9.6%) is separated from the rural setting in Hidalgo, it is seen that the latter is more affected (16%) (16). The delay in growth increases the risk of mortality from infectious diseases during infancy and deteriorates cognitive development. It is also associated with low financial resources and a low education in adolescents and adults (26). There is evidence that children who do not reach their development in height or muscle mass require less energy to gain weight in comparison with those who did because of changes in hormone response due to abnormal deceleration of lineal growth, an event that increases the risk of obesity (11).

In addition to EBF in the first six months of life, the WHO recommends that maternal milk be continued until two years of age or more if the child and the mother are willing (3). In our work, the decline in breastfeeding occurred starting at the 13th month (with 30% of children being breastfed, and the mean number of times children were breastfed being 2.6 times per day, 95% CI: 1.9-3.2); this was not greater after this age. Several studies have reported that long-lasting breastfeeding has a protective effect against obesity in childhood; however, this practice is rapidly disappearing (1,27).

In the past several years, a decline in the provision of maternal milk has been reported in groups with greater social vulnerability, such as those who live in rural communities, those with a low income, those who do not have health services and mothers who do not have a paying job (28). It is important to mention that maternal milk has also been related to economical convenience related to family savings associated with the purchase of formula and accessories as well as a smaller number of medical consultations and drug purchases (29); however, the abandonment of maternal milk is still notable. Scientific evidence suggests that the incorporation of women in the workplace could also be a factor for premature abandonment (30); however, most women in the evaluated study population were housewives (82.5%).

Although there were no significant differences with regard to knowledge and lack of knowledge of mothers regarding the advantages of breastfeeding and the fact that they did or did not receive counseling, the proportion of women who said that

they did not receive counseling (26%) or who did not know the advantages of breastfeeding (15%) was noteworthy. Some advantages for infants are protection from diarrhea and other infections, protection against obesity and chronic diseases in adulthood, and healthy growth; in women, breastfeeding delays fertility, helps them lose the weight gained during pregnancy, decreases the risk of cancer (breast and ovarian) and improves the relationship between the mother and baby (1). On the other hand, 35% of women who did not breastfeed said that "the child was not satisfied" or that "she had no milk." Scientific evidence suggests that regardless of maternal body mass index, lactating women are able to produce sufficient volume and macronutrient concentrations to support the child's needs, but tests are limited regarding micronutrient concentrations over a long period of time in those who experience nutritional vulnerability (31). This is why we believe that the nutritional status of the mother should be assessed in later studies with the aim of identifying if it is a mother's perception or a physiological cause (32). Nevertheless, the decision to breastfeed is strongly influenced by the information that mothers receive through physical, psychological, and social support provided during pregnancy, birth, and puerperium, and family, medical, and cultural attitudes, which can favor or hinder breastfeeding (33). A lack of counseling and a fear of breastfeeding can also possibly influence the decision to carry it out. A study performed in low-income African-Americans identified that the difference between women who breastfed for long periods and those who did it for a short period of time or did not do it at all was related to a clear intention of breastfeeding with positive experiences in hospital nutrition programs and with feeling more comfortable breastfeeding in public (34).

Also, the industry has been responsible for low breastfeeding rates and its consequences, with aggressive practices of commercialization of food for infants, such as the distribution of misleading information on food for infants with maternal milk substitutes, the distribution of free samples to mothers, and the direct and indirect publicity about the feeding of infants with maternal milk substitutes (35).

Regarding the quality of CF, Mexico has registered positive changes in recent years (16). In this study, the significant difference observed between the 6 to 12-month age group and the 12 to 24-month age group suggests a low level of knowledge about when, how, and what foods to introduce correctly. According to current recommendations, the group of meats, cereals, vegetables and fruits should be introduced starting at the sixth month of life, beginning each separately, observing their tolerance, and with an appropriate consistency; legumes should be started at seven to eight months of age; and milk derivatives, egg and fish, at eight to 12 months of age. The recommendation of meat at six months of age has to do, first, with avoiding iron deficiency since body iron reserves are depleted at that age, and second, with the high biological value proteins that meat provides (23). It is important to mention that the mother's fear regarding the ability of the child to eat these foods reduces the opportunity to offer them; (36) this should also be considered, together with the low availability and accessibility characteristic of this food group in rural communities.

In Mexico, a nationally-representative sample of infants showed that the alarming dietary problems arise before 12 months of age. They develop quickly during the second year of life and persist during the first few years of life, emphasizing the low prevalence of the consumption of meats and iron-fortified cereals for infants, in the second half of their infancy, especially children from 6-8,9 months of age (37). On the other hand, MDD in children 6-24 months was 55.9% (a diverse diet includes at least four of the seven food groups). In Hidalgo, this percentage was 78.3% of children under five years. Nevertheless, it calls our attention that children that were breastfed the day before (42.9%) had lower proportions of MDD than those who had not been breastfed (67.1%) ($p < 0.04$). It is important to remember that, in this period, a high or low consumption of calories and nutrients from foods rapidly affects the increase or loss of weight in children (38). In this work, the difference in the means of the ZLA indicator evidenced the progression of the risk of short stature in relation to age.

Maternal education on breastfeeding and CF as well as improvements in childhood dietary diversity have been found to be a major factor in reducing stunting, according to a study carried out in children at risk of malnutrition, which reported a total indicator change of up to 20 percent (39). Accordingly, the evident decline of breastfeeding makes it necessary to propose and perfect strategies that aim at increasing its prevalence among women, both in rural and urban environments (40). Likewise, the inappropriate promotion of formulas must be eliminated, and support during pregnancy and planned breastfeeding should be promoted. Finally, the introduction of complementary foods represents a critical period in which basic questions regarding when, what, and how they should be started and established with the correct feeding pattern should be answered. The evidence that this project presents suggests that there is a low level of knowledge about this topic, which is why we propose approaching this with nutritional counseling.

ACKNOWLEDGEMENTS

We thank Rosa Gilda Becerra-Díaz, deputy director of the Health Jurisdiction 7 in Actopan, Hidalgo, for her support and help; the nursing staff of the health centers of the evaluated communities, because without their valuable support this project would not have been possible; and Sergio Lozano-Rodríguez for his help in translating the manuscript. We would like to thank also Alejandro Bellazetin-Sánchez, editor of the Coordinación de Investigación en Salud.

REFERENCES

1. Horta BL, Victora CG. Long-term effects of breastfeeding. A systematic review. Geneva: World Health Organization; 2013. Accessed on October 20, 2016. Available from: http://www.who.int/maternal_child_adolescent/documents/breastfeeding_long_term_effects/en/
2. Gale C, Logan KM, Santhakumaran S, Parkinson JR, Hyde MJ, Modi N. Effect of breastfeeding compared with formula feeding on body composition: a

- systematic review and meta-analysis. *Am J Clin Nutr* 2012; 95(3):656-69. DOI: 10.3945/ajcn.111.027284
3. World Health Organization. Health topics. Breastfeeding. Geneva: World Health Organization; 2016. Accessed on October 10, 2016. Available from: <http://www.who.int/topics/breastfeeding/en/>
 4. Gutiérrez JP, Rivera-Dommarco J, Shamah-Levy T, Villalpando-Hernández S, Franco A, Cuevas-Nasu L, et al. Encuesta Nacional Salud y Nutrición 2012. Resultados Nacionales. Cuernavaca, México: Instituto Nacional de Salud Pública; 2012.
 5. Ortiz-Prado E, Stewart-Ibarra AM, Ramirez D, Espín E, Morrison A. Artificial infant formula consumption and breastfeeding trends in Ecuador. A population-based analysis from 2007 to 2014. *Glob J Health Sci* 2016;8(11):184-93. DOI: 10.5539/gjhs.v8n11p184
 6. Cuevas LL. Impacto en la economía familiar por uso de sucedáneos de leche materna en bebés sanos y uso de fórmulas especiales. *Pediatría Méx* 2010;12(1):23-8.
 7. Pardo-López J. Alimentación complementaria del niño de seis a 12 meses de edad. *Acta Pediatr Mex* 2012;33(2):80-8. Available from: <http://www.redalyc.org/pdf/4236/423640333007.pdf>
 8. Mennella JA, Trabulsi JC. Alimentos complementarios y experiencias de sabor: estableciendo las bases. *Ann Nutr Metab* 2012;60(Suppl 2):40-50.
 9. Young BE, Krebs NF. Complementary feeding: critical considerations to optimize growth, nutrition, and feeding behavior. *Pediatr Rep* 2013;1(4):247-56. DOI: 10.1007/s40124-013-0030-8
 10. Organisation for Economic Cooperation and Development (OCDE). Obesity Update 2017. Accessed on June 6, 2017. Available from: <http://www.oecd.org/health/obesity-update.htm>
 11. Herrera CM. The double burden of malnutrition: the obesity/under nutrition paradox, non-communicable diseases and the challenge of early prevention public policies. *J Diabetes Metab Disord Control* 2014;1(1):00002. DOI: 10.15406/jdmcd.2014.01.00002
 12. Noguera BD, Márquez JC, Campos CI, Santiago R. Alimentación complementaria en niños sanos de 6 a 24 meses. *Arch Venez Puer Ped* 2013;76(3):128-35.
 13. Kennedy G, Ballard T, Dop MC. Guidelines for measuring household and individual dietary diversity. Rome: Food and Agriculture Organization of the United Nations; 2013.
 14. Rah JH, Akhter N, Semba RD, De Pee S, Bloem MW, Campbell AA, et al. Low dietary diversity is a predictor of child stunting in rural Bangladesh. *Eur J Clin Nutr* 2010;64(12):1393-8. DOI: 10.1038/ejcn.2010.171
 15. Mundo-Rosas V, Cruz-Góngora V, Jiménez-Aguilar A, Shamah Levy T. Diversidad de la dieta y consumo de nutrimentos en niños de 24 a 59 meses de edad y su asociación con inseguridad alimentaria. *Salud Pub Mex* 2014;56(Suppl 1):539-46.
 16. Instituto Nacional de Salud Pública. Encuesta Nacional de Salud y Nutrición 2012. Resultados por entidad federativa, Hidalgo. Cuernavaca, México: Instituto Nacional de Salud Pública; 2013.
 17. Organización Mundial de la Salud (OMS). Indicadores para evaluar las prácticas de alimentación del lactante y del niño pequeño: conclusiones de la reunión de consenso llevada a cabo del 6 al 8 de noviembre de 2007 en Washington, DC, EE.UU. Accessed on October 10, 2016. Available from: http://apps.who.int/iris/bitstream/10665/44156/1/9789243596662_spa.pdf
 18. World Health Organization (WHO). Infant and young child feeding. Model Chapter for textbooks for medical students and allied health professionals. Geneva: World Health Organization; 2009.
 19. Macias SM, Rodríguez S, Ronayne PAF. Patrón de alimentación e incorporación de alimentos complementarios en lactantes de una población de bajos recursos. *Rev Chil Nutr* 2013;40(3):234-42. DOI: 10.4067/S0717-75182013000300004
 20. Eriksen KG, Johnson W, Sonko B, Prentice AM, Darboe MK, Moore SE. Following the World Health Organization's recommendation of exclusive breastfeeding to 6 months of age does not impact the growth of rural Gambian infants. *J Nutr* 2017;147(2):248-55. DOI: 10.3945/jn.116.241737
 21. Przyrembel H. Timing of introduction of complementary food: short- and long-term health consequences. *Ann Nutr Metab* 2012;60(Suppl 2):8-20. DOI: 10.1159/000336287
 22. Wang J, Wu Y, Xiong G, Chao T, Jin Q, Liu R, et al. Introduction of complementary feeding before 4 months of age increases the risk of childhood overweight or obesity: a meta-analysis of prospective cohort studies. *Nutr Res* 2016;36(8):759-70. DOI: 10.3945/ajcn.111.027284
 23. Diario Oficial de la Federación. Norma Oficial Mexicana, NOM-043-SSA2-2012. Servicios básicos de salud. Promoción y educación para la salud en materia alimentaria. Criterios para brindar orientación. January 22, 2013. Accessed on December 5, 2016. Available at: http://dof.gob.mx/nota_detalle.php?codigo=5285372&fecha=22/01/2013
 24. Romero-Velarde E, Villalpando-Carrión S, Pérez-Lizaur AB, Iracheta-Gerez MDLL, Alonso-Rivera CG, López-Navarrete GE, et al. Consenso para las prácticas de alimentación complementaria en lactantes sanos. *Bol Med Hosp Infant Mex* 2016;73(5):338-56. DOI: 10.1016/j.bmhmx.2016.06.007
 25. Andersen CT, Stein AD, Reynolds SA, Behrman JR, Crookston BT, Dearden KA, et al. Stunting in infancy is associated with decreased risk of high body mass index for age at 8 and 12 years of age. *J Nutr* 2016;146(11):2296-303. DOI: 10.3945/jn.116.234633
 26. Aguilar CMJ, Baena GL, Sánchez LAM, Guisado BR, Hermoso RE, Mur VN. Beneficios inmunológicos de la leche humana para la madre y el niño. Revisión sistemática. *Nutr Hosp* 2016; 33(2):482-93. DOI: 10.20960/nh.526
 27. Yan J, Liu L, Zhu Y, Huang G, Wang PP. The association between breastfeeding and childhood obesity: a meta-analysis. *BMC Public Health* 2014;14(1267):1-11. DOI: 10.1186/1471-2458-14-1267
 28. González de Cosío MT, Hernández-Cordero S, Rivera-Dommarco JA, Hernández-Ávila M, en representación del Comité de Expertos. Recomendaciones para una política nacional de promoción de la lactancia materna en México: postura de la Academia Nacional de Medicina. *Salud Pub Mex* 2017;59(1):106-13. DOI: 10.21149/8102
 29. Eidelman AI, Schanler RJ, Johnston M, Landers S, Noble L, Szucs K, et al. Breastfeeding and the use of human milk. *Pediatrics* 2012;129(3):e827-e41. DOI: 10.1154/peds.2011-3552
 30. Rivera-Pasquel M, Escobar-Zaragoza L, González de Cosío T. Breastfeeding and maternal employment: results from three national nutritional surveys in Mexico. *Matern Child Health J* 2015;19(5):1162-72. DOI: 10.1007/s10995-014-1622-9
 31. Winkvist A, Brantsaeter AL, Brandhagen M, Haugen M, Meltzer HM, Lissner L. Maternal prepregnant body mass index and gestational weight gain are associated with initiation and duration of breastfeeding among Norwegian mothers. *J Nutr* 2015;145(6):1263-70. DOI: 10.3945/jn.114.202507
 32. Flores-Peña Y, Aguado-Barrera ME, Cerda-Flores RM, Cortes-Gutiérrez EI, Dávila-Rodríguez MI. Maternal perception of her child's weight and unrelated children less than 1 year old. *Aten Primaria* 2016;48(9):579-85. DOI: 10.1016/j.aprim.2015.10.003
 33. Haider R, Saha KK. Breastfeeding and infant growth outcomes in the context of intensive peer counselling support in two communities in Bangladesh. *Int Breastfeed J* 2016;11(18):1-10. DOI: 10.1186/s13006-016-0077-6
 34. Barbosa CE, Masho SW, Carlyle KE, Mosavel M. Factors distinguishing positive deviance among low-income African American women: a qualitative study on infant feeding. *J Hum Lact* 2017;33(2):368-78. DOI: 10.1177/0890334416673048
 35. Cobo-Armijo F, Charvel S, Hernández-Ávila M. La regulación basada en desempeño: estrategia para incrementar las tasas de lactancia materna. *Salud Públ Méx* 2017;59(3):314-20. DOI: 10.21149/8122
 36. Arsenault JE, Brown KH. Dietary protein intake in young children in selected low-income countries is generally adequate in relation to estimated requirements for healthy children, except when complementary food intake is low. *J Nutr* 2017;147(5):932-9. DOI: 10.3945/jn.116.239657
 37. Deming DM, Afeiche MC, Reidy KC, Eldridge AL, Villalpando-Carrión S. Early feeding patterns among Mexican babies: findings from the 2012 National Health and Nutrition Survey and implications for health and obesity prevention. *BMC Nutrition* 2015;1(40):1-14. DOI: 10.1186/s40795-015-0035-5
 38. Ramírez-Luzuriaga MJ, Unar-Munguía M, Rodríguez-Ramírez S, Rivera JA, González de Cosío. A food transfer program without a formal education component modifies complementary feeding practices in poor rural Mexican communities. *J Nutr* 2016;146(1):107-13. DOI: 10.3945/jn.115.215962
 39. Nguyen PH, Headey D, Frongillo EA, Tran LM, Rawat R, Ruel MT, et al. Changes in underlying determinants explain rapid increases in child linear growth in alive & thrive study areas between 2010 and 2014 in Bangladesh and Vietnam. *J Nutr* 2017;147(3):462-9. DOI: 10.3945/jn.116.243949
 40. 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):1-14. DOI: 10.1186/1471-2458-11-S3-S25