

RESEARCH ARTICLE

Do maternal grandmothers influence breastfeeding duration and infant nutrition? Evidence from Merida, Mexico

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Abstract

Objectives: Breast-feeding is sensitive to somatic, hormonal, behavioral and psychological components of maternal capital. However, through grandmothers, older women may also influence breast-feeding by transferring informational resources to their daughters. We hypothesized that mothers with prolonged instrumental support from their own mother are more likely to have received advice and to have favorable attitudes/practices regarding breastfeeding, compared to those lacking such support, with implications for the grandchild's somatic capital.

Methods: We recruited 90 mother-infant dyads (52 with grandmaternal support, 38 without) in Merida, Yucatan, Mexico. All children were first-borns, aged ~2 years. Anthropometry and body composition were assessed. Data on grandmother's breast-feeding advice and maternal breastfeeding duration were obtained by questionnaire. Maternal attitudes to breast-feeding were assessed using the Iowa Infant Feeding Attitude Scale.

Results: Women with instrumental support were more likely to have received grandmaternal advice during pregnancy/infancy on exclusive breast-feeding duration (60% vs. 37%, $p = 0.033$) and the type of first complementary food (81% vs. 47%, $p = 0.001$). However, women with support had a less favorable attitude to breast-feeding than those without and breastfed their children for less time (median 5 vs. 10.5 months, $p = 0.01$). No group differences were found in children's length, weight, skinfolds or lean mass z-score.

Discussion: Although grandmothers providing instrumental support provided advice regarding breastfeeding, their attitudes may reflect issues beyond nutritional health. Advice of maternal grandmothers did not promote extended breastfeeding, however the differences in breastfeeding attitudes were not associated with the children's

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nutritional status. Grandmothers should be included in public health interventions promoting breastfeeding.

KEYWORDS

breastfeeding, maternal grandmothers, Mexico, mother-infant health, social support

1 | INTRODUCTION

Numerous studies have shown that breastfeeding is beneficial for both mother and child in a dose-dependent manner (Azad et al., 2017; Binns et al., 2016; Pandolfi et al., 2019), so it is concerning that in many population, rates of breastfeeding remain low (Rollins et al., 2016; Victora et al., 2016). Addressing this issue requires that we gain an improved understanding of the factors that interfere with breastfeeding duration. Of particular relevance, breast-feeding is a complex physiological and behavioral process, characterized by dynamic interactions between mother and infant (Fewtrell et al., 2020; Wells, 2003). Understanding these dynamics may offer new avenues for interventions that improve breast-feeding outcomes.

A large volume of research has demonstrated that breast-feeding is sensitive to diverse components of maternal capital, a concept that builds on the evolutionary economics framework of embodied capital (Kaplan et al., 2003). The maternal capital approach treats maternal phenotype as a composite of many forms of capital, all of which may favor investment in infants and children. Components of maternal capital include physical traits such as height, micronutrient and energy stores, but also social traits (support networks and kin assistance) and educational components (Kaplan et al., 2003; Wells, 2010a, 2016; Wells & Marphatia, 2018). For instance, traits such as maternal body composition and BMI affect milk volume/composition, suggesting that maternal physical conditions may determine energy and macronutrient content (Bzikowska-Jura et al., 2020; van Marken Lichtenbelt et al., 2005). Moreover, the energy available via lactation for infant growth can also be influenced by the mother's psychosocial state. Activating the stress response is metabolically costly (Rabasa & Dickson, 2016), hence reducing maternal stress levels is predicted to increase the energy demands of lactation, as recently demonstrated experimentally (Mohd Shukri et al., 2019). In addition, milk composition and microbiota may differ according to maternal health status. For example, it has been reported that the milk of mothers with celiac disease is characterized by a reduced abundance of immunoprotective compounds (TGF- β 1 and sIgA) and bifidobacteria (Olivares et al., 2015). This could potentially diminish the protective effects of breastfeeding on the child's risk of developing celiac disease (Olivares et al., 2015). Likewise, certain diseases, such as malaria, can lead to unfavorable impacts on the mother such as anemia and malnutrition (Ekvall, 2003; Gao et al., 2014; Rogerson et al., 2000). Maternal anemia can induce changes in nutritional (higher fat in the colostrum and lower calorie content in mature milk) and immunological (lower IgA and IgG levels in colostrum) components of milk at different

maturation stages, affecting the characteristics of the milk provided to their babies (França et al., 2013).

To date, most research on breast-feeding has focused on direct measurements of maternal and infant phenotype. However, it is also well-established that human reproduction has a significant social component (Hrdy, 2009), suggesting that the role of other individuals should also be considered. According to the principles of kin selection and parental investment theory, individuals can increase their inclusive fitness by investing time, knowledge and material resources in their kin (Hamilton, 1964). Consistent with these principles, evidence from studies of primates suggests that females gain fitness advantages by remaining in their area of birth and associating with their relatives (Hrdy, 2009). This may be because they gain confidence and support from relatives, as well as being able to share the care of their infants, thus gaining "alloparental" support.

In humans, such alloparents often include grandmothers. There is good evidence that grandmothers often provide a wide range of resources to their grandchildren, and have a beneficial impact on their survival (Hawkes et al., 1998; Hrdy, 2009; Kaplan et al., 2000; Sear et al., 2000) and nutritional status (Mace & Sear, 2005; Sear et al., 2000). However, maternal and paternal grandmothers may not increase grandchildren's health conditions equally. In a comprehensive review, Sear and Mace (2008) reported that most cross-sectional studies found that the presence of the maternal grandmother is associated with higher child survival rates, whereas associations for paternal grandmother's presence showed greater variation. Overall, maternal grandmothers appear to be more reliable helpers and have stronger, more frequent and more positive effects on child outcomes compared to paternal grandmothers (Gibson & Mace, 2005; Jamison et al., 2002; Sear et al., 2002; Sear & Mace, 2008). A key question is therefore whether maternal grandmothers may impact the breast-feeding behavior of their daughters, for example by transferring information resources in ways that alter the nutritional transfer of maternal capital to the grandchild via breast-feeding.

To date, the presence of maternal grandmothers has been widely associated with both improved survival and better nutritional status of grandchildren (Dong et al., 2017; Gibson & Mace, 2005; Moschonis et al., 2010; Ragsdale, 2004; Schrijner & Smits, 2018; Sear et al., 2000, 2002; Sheppard & Sear, 2016), as well as with feeding practices (Dashti et al., 2014; Eli et al., 2017; Farrow, 2014; Johnson et al., 2010; Karmacharya et al., 2017; Mahoney & James, 2000; Mukuria et al., 2016; Nunes et al., 2011). However, it should be noted that there have also been some reports where maternal grandmothers' presence was associated with less favorable

outcomes in the grandchild (Modin & Fritzell, 2009; Sheppard & Sear, 2016; Tanskanen, 2013).

As part of the mother's immediate social network, grandmothers could be particularly important as a source of emotional and practical support and knowledge during critical stages of their grandchildren's life; especially after birth, their influence on breastfeeding practices might thereby benefit infant nutritional status. Previous research has shown that the presence, preferences, attitudes and practices of the maternal grandmother may be associated (either positively or negatively) with maternal breastfeeding patterns and duration (Bernie, 2014; Cisco, 2017; Dashti et al., 2014; Emmott & Mace, 2015; Liu et al., 2013; Negin et al., 2016; Odom et al., 2014; Susiloretni et al., 2015; Wasser et al., 2013) and could influence the mother's acquisition of knowledge about breastfeeding, potentially benefitting children's long-term health. Breastfeeding practices are permeated by beliefs, traditional knowledge and previous experience that can be transmitted across generations (Muse et al., 2021). For instance, some women in Mexico believe that negative maternal emotions (anger or fright) can be transferred through maternal milk and negatively affect infant health by causing diarrhea (Guerrero et al., 1999; Pak-Gorstein et al., 2009). Relevant to this, social relationships are especially important for breastfeeding, as it is learned and practised within the mother's social milieu (Mangrio et al., 2018; Zhang et al., 2018).

In Mexico, where our research was conducted, successive studies have shown that the prevalence of exclusive breastfeeding up to 6 months was 22.3% in 2006, 14.4% in 2012 and 28.6% in 2018 (INEGI, INSP, & SS, n.d.; González de Cosío et al., 2013). The trend between 2006 and 2012 was associated with increased consumption of formula-milks, other milks, and water. The median duration of breastfeeding among Mexican women was 10.2 months (González de Cosío et al., 2013) and according to the 2012 National Health and Nutrition Survey (ENSANUT 2012) (Gutiérrez et al., 2012), the main reasons why mothers of children under 24 months of age never breastfed their babies were the "feeling of not having milk," maternal illness or that the baby did not want to breastfeed. However, this and other studies carried out in Mexico (Bueno-Gutierrez & Chantry, 2015; Guerrero et al., 1999; Perez-Escamilla et al., 1993) did not explore the family network of the nursing mother, limiting our understanding of how grandmothers might influence breastfeeding practices.

Our study aimed to compare breastfeeding advice and duration and infant growth between mothers with, versus without, prolonged instrumental support of the maternal grandmother in Merida, Yucatan, Mexico. Due to time constraints, we did not include any observations of alloparental care outside of grandmothers. We assessed two types of supporting behaviors from the grandmother, instrumental and information support (Heaney & Israel, 2008). We hypothesized that women receiving prolonged grandmothers' instrumental support were more likely to have received advice about breastfeeding and would therefore have more favorable attitudes and practices regarding breastfeeding that, in turn, would be associated with more favorable body composition in their children (greater length and lean mass, lower body fatness). While body fat promotes short-term survival in

early life (Kuzawa, 1998; Wells, 2010b), in adulthood a greater proportion of lean mass is associated with reproductive fitness in both sexes (Lassek & Gaulin, 2009; Wells, 2018). Therefore, the mother can maximize her own reproductive success by investing in offspring lean mass (Wells, 2018). Through longer breastfeeding, women may be potentially investing in their reproductive success by increasing infant's lean mass. Our hypothesis is therefore that the provision of informational capital from the grandmother might potentially impact somatic capital of the grandchild, mediated by breast-feeding behavior of the mother (Figure 1).

2 | MATERIALS AND METHODS

Ethical clearance was obtained from University College London Graduate School Ethics Committee and the Bioethics Committee for the Study of Human Beings in Mexico. All participants provided written informed consent.

The study was conducted in Merida, the capital city (~895,000 inhabitants) of Yucatan. Merida is a regional hub and a major tourist destination, with good quality services and infrastructure relative to the broader region. Approximately 48% of the population are indigenous, mostly of Mayan ethnicity, however, none of the participant women in our study had characteristics that could identify them as a contemporary Maya group (e.g., presence of Mayan surnames). Nationally, Yucatan has low unemployment, and it is typical for women to work. The average daily income is Mex\$141.7 (6.8 USD). According to the last census (2010), 80% reported being Catholic, the remaining 20% following other Christian religions. Regarding the broader context, in Merida, families have been characterized by a great sense of familiarity and high levels of cohesion (Galaz et al., 2013), with 29% of households comprising extended families that include grandparents (maternal and/or paternal) (Instituto Nacional de Estadística y Geografía, 2016). The contribution to childcare by different members of the family, particularly grandmothers, has been reported in various studies in Yucatan (Estrella-Tzuc & Esquivel-Alcocer, 2005; Hernández-Escalante et al., 2015; Pool & Balam-Gómez, 2014). This childcare contribution can include the provision of information and advice on various topics, such as breastfeeding (Briceño Medina, 2017; Reyes-Gutierrez & Cervera-Montejano, 2013). For example, grandmothers recommend a range of maternal care practices, such as bathing the breasts with hot water, not consuming "cold" food, showering with orange leaves, consuming plenty of fluid (water and a traditional hot drink, *atole*) and consuming a healthy diet, to ensure the production of breastmilk in the new mother (Briceño Medina, 2017; Reyes-Gutierrez & Cervera-Montejano, 2013). Some of these practices are traditional and reflect the Mesoamerican "hot-cold" classification of food that is typical of the Yucatecan culture and could promote breastfeeding. However, there is also evidence that women in Yucatan share practices that do not promote extended breastfeeding. For instance, mothers and grandmothers agree that breastfeeding should be stopped if they are sick (have a fever or the flu) because they might

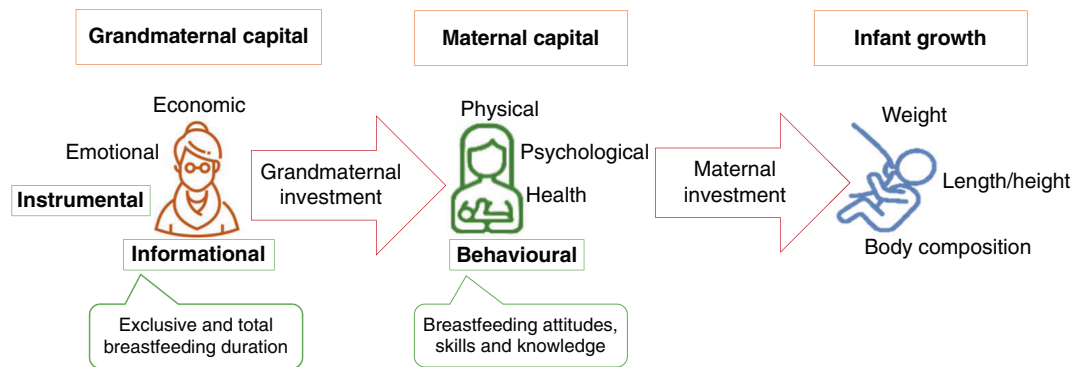


FIGURE 1 Grandmaternal influence on breastfeeding. We included two types of supporting behaviors from the grandmother, instrumental and informational support. Through “grandmothering” and providing instrumental support in terms of spending time with the mother-infant dyad, older women may also influence breastfeeding by transferring informational resources to their daughters. We hypothesized that women with grandmothers’ instrumental support are more likely to receive advice compared to mothers lacking grandmaternal support and then, would have more favorable attitudes and practices regarding breastfeeding that, in turn, would be associated with the grandchild’s somatic capital

transmit the disease through their milk (Reyes-Gutierrez & Cervera-Montejano, 2013).

Data were collected from June 2017 to July 2018. The cross-sectional sample consisted of 90 mother-infant dyads from urban Merida. Participants were recruited from childcare centers and other networks, such as local universities, health centers and social media. Children were first-borns and aged 1.7–2.3 years. All women were the biological mothers of the children, were married to or living with the biological father of the child, were not pregnant at the time of the study and were without a diagnosis of diabetes or high blood pressure during pregnancy/delivery, and depression and/or anxiety. All maternal grandmothers were the biological mother of the mother.

We assessed two types of supporting behaviors from the grandmother, instrumental and information support. “Instrumental support” includes providing direct tangible services that may assist an individual, such as childcare support, whereas “information support” refers to the provision of knowledge and advice that could help a person (Heaney & Israel, 2008). In our study, we use time-based measures of childcare support provided by the grandmother as markers of instrumental support and we asked about the kinds of advice and knowledge provided toward breastfeeding as markers of information support. By providing instrumental support, in terms of spending time with the mother-infant dyad, older women may also influence breastfeeding by transferring informational resources to their daughters.

Pilot work was conducted to assess the frequency of contact and support given by grandmothers (instrumental support), to establish how to allocate participants to the appropriate group. We categorized these pilot data into (a) *women without support*, where the grandmother had either passed away ($n = 4$) or was living in another city ($n = 12$), or (b) *women with support* among whom the grandmother was either co-resident ($n = 6$) or not ($n = 28$). The 34 women receiving support had a median of 2 days per week of grandmaternal support. Among those receiving above this median (≥ 2 days of support), the median daily duration was 3.1 h. Based on these pilot data, for the main study, in which 90 new mothers were recruited, we defined

mothers as GM+ if they received childcare support and had physical contact with their mothers at least twice weekly for ≥ 3 h per day, and the remaining mothers as GM-. Unexpectedly, in our study sample ($n = 90$), GM- women scored 0 for days per week and hours per day of support and physical contact with the grandmother. Thus, the two groups showed markedly different levels of GM support, either known or above a threshold as defined above.

Despite not having physical contact and direct support from the grandmothers, GM- women could communicate with them remotely (except where the grandmother was deceased, $n = 5$) to ask for advice. Therefore, we collected information from all mothers on whether the grandmother had provided advice about the duration of exclusive and total breastfeeding. In addition, an interview was carried out with the grandmothers from the GM+ group and we were able to obtain some information about the advice provided to their daughters about breastfeeding practices. Finally, semi-structured interviews were conducted with a subset of the participating mothers ($n = 21$) to explore how they acquired and used their knowledge on various aspects of childcare, including breastfeeding. These interviews took the form of recorded conversations where the interviewer asked questions and the mothers responded freely in their own words. In Mexico, pregnant women are supposed to receive at least five prenatal consultations by specialized medical staff (NOM-007-SSA2-2016, 2016), up to a maximum of eight consultations. The first consultation is scheduled between 6–8 weeks of pregnancy; the second between 10–13 weeks; the third between 16–18 weeks; the fourth at 22 weeks; the fifth at 28 weeks; the sixth at 32 weeks; the seventh at 36 weeks and the eighth between 38 and 41 weeks of gestation. Throughout this care, valuable information related to healthy lifestyles, nutritional aspects that reduce risks, and exclusive breastfeeding is provided (NOM-007-SSA2-2016, 2016).

Home visits were undertaken with the mother and child to obtain the data. Anthropometric measurements were taken on the left side of the body, following published guidelines (Lohman et al., 1988). Participants were measured while wearing light clothing. Infant’s weight

was measured with 0.05 kg precision (Seca® scale) and recumbent length using a Rollameter100.

Stunting and overweight in infants were categorized using WHO Growth Standards (WHO, 2006). Stunting was categorized as length-for-age z-score < -2, while at risk of overweight was calculated as weight-for-length z-score >1 and overweight as z-score >2. A proxy for child lean mass was calculated by regressing body mass index (BMI) on the subscapular skinfolds (subscapular skinfold), the regression residuals were divided by the standard error of the estimate of the regression, to obtain z-scores. A high z-score of BMI holding constant for subscapular skinfold was considered to indicate a high lean mass. This method has been used previously and calibrated in adults (Wells, 2012; Wells et al., 2007; Wells et al., 2012).

Using customized questionnaires, we obtained information on antenatal care and perinatal outcomes and the family's current socioeconomic condition. As socioeconomic indicators, we used housing quality (if the house was constructed with durable or perishable materials), sanitation and access to basic services (potable water, gas, electricity, and toilet), parental education (years of education) and maternal employment status (employee, employed or self-employed), considering their widely reported influence on health outcomes and their potential use as control variables.

Women were asked to complete the Iowa Infant Feeding Attitude Scale to assess maternal attitudes toward infant feeding (breastfeeding, formula feeding) (Mora et al., 1999). The scale was designed to cover various dimensions of infant feeding such as costs, nutrition and infant bonding. Moreover, has been widely used to know infant feeding attitudes of expectant women and postpartum women with small children. However, this instrument has been also used to assess infant feeding intentions and attitudes of adolescents and to compare the attitudes and perceptions of women from different cultural backgrounds. These studies included women without children or with older children (Foulkes et al., 2008; Jefferson, 2014, 2015; Simmie, 2005, 2006). The questionnaire has been translated and validated for the Mexican population (Aguilar-Navarro et al., 2016). In our study, we use this scale to assess attitudes between women with and without support from the grandmother. We do not use this scale to predict breastfeeding attitudes, but instead to know if the attitudes were different between our groups considering the differences in social support and to know if the results were related with the breastfeeding duration acknowledge by the participants. Participants were asked to indicate the extent to which they agreed with each statement on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Summing the individual responses, a high score reflected a preference for breastfeeding.

All statistical analyses were performed with Stata/IC 15.1 statistics package (StataCorp LP, 2017). Significance level was set at $\alpha = 0.05$. Descriptive statistics were reported by grandmaternal group (GM+ and GM-) for the variables used. Most analyses focused on identifying differences between the groups. Independent-sample T-test was used to test differences between the groups in the variables that were normally distributed and Mann-Whitney test was used in variables that were non-normally distributed. In the Results section, we reported the differences and the confidence interval

(CI 95%) for these tests. Chi-square test was used in categorical data and Fisher's exact was reported in those cases in that chi-square assumptions were not fulfilled. Spearman rank correlation was used to measure the degree of association between variables that were non-normally distributed.

Finally, we performed a multivariable linear regression analysis of breastfeeding attitude scores, including as predictors the following variables: grandmaternal support status (yes/no), grandmaternal advice (yes/no), maternal education (years) and type of delivery (vaginal/caesarean). This model did not include any of the other socioeconomic indicators due to the lack of variability between the two groups in the sample. Non-collinearity between explicative variables was corroborated by calculating variance inflation factors.

3 | RESULTS

3.1 | Characteristics of the sample

The final groups comprised 52 women with grandmothers' instrumental support at 2 years (GM+) and 38 mothers without (GM-). Among GM- mothers, 14% reported that the grandmother passed away before the child was born, 22% of the grandmothers were living in another city, and 63% reported that their mothers were not one of the main caregivers and did not provide adequate help to mothers as defined in this study. Overall, the mean age of mothers was 30.2 ± 5.3 years, while the median age of grandmothers was 58 years, IQR = 52.2–62.6 years. None of the women of our sample were beneficiaries of social programs such as *Becas para el Bienestar* and *Liconsa*.

Most of the families (72%) were nuclear (mother, partner and child), and 28% were extended families in which at least one other paternal and/or maternal family member shared the home. In 14 of these 25 extended families, the maternal grandmother was one of the members.

The two groups did not differ in total years of maternal or paternal education, or women's employment status (Table 1). Regarding household sanitation (access to potable water and toilet) and access to basic services (electricity, gas), all families had access. In terms of household construction quality (building materials), overall, houses were constructed of durable materials (blocks, bricks, concrete, cement) resistant to water and humidity.

3.2 | Antenatal care and perinatal data

All the mothers had access to antenatal care services during pregnancy and took prenatal micronutrient supplements such as iron, folic acid, and multivitamins provided by the health system. Concerning tobacco exposure, 13.3% of the mothers mentioned that they cohabited with smokers during pregnancy, but none of the women reported having smoked during pregnancy.

On average, the mothers became pregnant at $27.4 (\pm 5.4)$ years of age. According to recalled data, median weight before pregnancy was

TABLE 1 Characteristics of the sample and descriptive statistics of infants' anthropometric variables stratified by grandmaternal groups [mean (SD) or median (IQR)]

	With GM (n = 52)	Without GM (n = 38)	Differences
<i>Age</i>			
Women (years)	29.4 (4.6)	30.2 (6.1)	-0.83 (-3.07; 1.40) ^b
Infants (years)	1.9 (0.3)	1.8 (0.2)	-0.10 (-0.35; 0.14) ^a
<i>Education</i>			
Women (years)	16.0 (1.0)	16.7 (3.0)	-0.03 (-0.28; 0.23) ^a
Partner (years)	16.0 (5.0)	16.0 (5.0)	-0.10 (-0.35; 0.14) ^a
<i>Antenatal care and perinatal data</i>			
Age at pregnancy (years)	27.0 (4.8)	27.9 (6.2)	0.89 (-1.41; 3.19) ^b
Weight before pregnancy (kg) ^c	57.5 (10.0)	56.0 (12.0)	0.06 (-0.18; 0.31) ^a
Weight gain during pregnancy (kg) ^d	11.0 (5.0)	10.0 (6.6)	0.10 (-0.16; 0.36) ^a
Gestations weeks ^e	39.0 (1.0)	39.0 (1.1)	-0.07 (-0.32; 0.17) ^a
Infant's birth weight (kg) ^e	3.0 (0.4)	3.2 (0.5)	-0.12 (-0.31; 0.07) ^b
<i>Infants anthropometry^f</i>			
Length-for-age (z-score)	-0.2 (0.9)	-0.3 (1.2)	-0.07 (-0.39; 0.53) ^b
Weight-for-length (z-score)	0.6 (0.9)	0.3 (0.9)	0.31 (-0.10; 0.73) ^b
BMI	16.2 (1.2)	16.2 (1.3)	0.28 (-0.26; 0.84) ^b
<i>Type of delivery (%)^c</i>			
Vaginal	55.6	44.4	$\chi^2_{(1)} = 0.08, p = 0.78$
Caesarean	58.7	41.3	
<i>Women employment status</i>			
Employee	82.7	68.4	Fisher's exact: $p = 0.20$
Employed/Self-employed	13.5	18.4	
Other (student or housewife)	3.8	13.2	

Abbreviations: BMI, body mass index; GM, grandmother; IQR, interquartile range; SD, standard deviation.

^aMann-Whitney: Difference (CI 95%).

^bT-test: Difference (CI 95%).

^cThis data was recalled by the mother.

^dSix cases were excluded due to women lost weight during pregnancy (between 4 kg and 20 kg) by medical recommendation. This data was recalled by the mother.

^eThis data was obtained from the birth certificates.

^fOne missing infant data from the "Without GM" group. The mother withdrew from the study before obtaining the child's measurements.

56.5 kg (IQR = 52–63 kg) and median weight gain during pregnancy was 10 kg (IQR = 9–14 kg). All children were born in hospital, with 70% born by caesarean and 30% vaginally. No statistical difference was found between the groups in type of delivery (Table 1). The median duration of gestation was 39 weeks (IQR = 38–39), with 14% of infants being born preterm. On average, the birth weight of children was 3.1 (± 0.5) kg, with only 8% of the infants having a birth weight <2.5 kg. Infants of GM– mothers showed a higher birth weight (approx. 200 g). However, there were no significant differences between the groups in these variables (Table 1).

3.3 | Anthropometry and body composition

Not all participants provided full data for each measurement, hence the sample size varies per outcome variable. Only 9% of the children

met the criteria for stunting, while 22.5% were classified as at risk of overweight, and 4.5% with overweight. No differences were found between the groups in these outcomes (Table S1). Moreover, the groups did not differ in length-for-age, weight-for-length, or BMI (Table 1).

No statistical differences were found between the groups in z-scores for subscapular skinfold (Differences = 0.09, CI95% = -0.15; 0.35) and z-scores for lean mass (Difference = -0.28, CI95% = -0.60; 0.04) (Figure 2c,d). However, infants whose mothers receive grandmaternal support showed a higher lean mass z-score.

3.4 | Attitudes toward breastfeeding

Significant differences were found among the groups, with women that received instrumental support showing a less favorable attitude

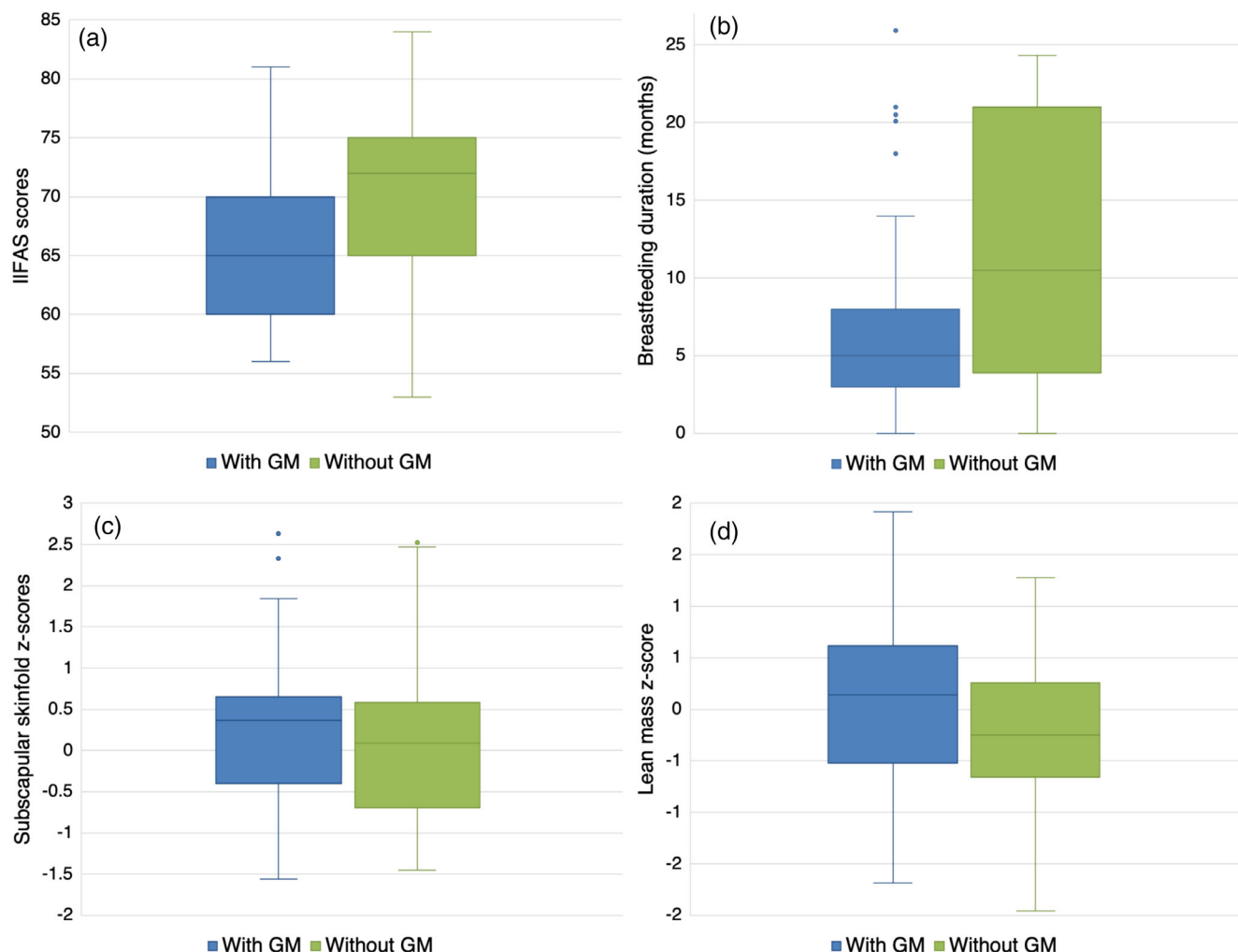


FIGURE 2 Maternal IIFAS' scores and infant's body composition stratified by grandmaternal groups. (a) IIFAS scores[†], (b) total duration of breastfeeding[§], (c) infants z-scores for subscapular skinfold[‡], (d) infants z-scores for lean mass^{††}. [†]Only 80 mothers completed the Iowa Infant Feeding Attitude Scale (IIF-AS) (GM+ $n = 45$ and GM- $n = 35$). Statistical differences were found in the IIFAS scores by grandmaternal groups (T-test: differences = 4.22; CI95% = 0.94; 7.50) with women that received practical support showing a less favorable attitude toward breastfeeding. [§]Statistical differences were found in the total duration of breastfeeding among the groups. GM+ women breastfed their children for less time than GM- mothers (GM+ median = 5 months vs. GM- median = 10.5 months; Mann-Whitney: differences = -0.31, CI95% = -0.55; -0.06). [‡]Outliers were identified in the subscapular z-scores data and two analysis were performed (with and without the outliers). In both analyses, no differences were found between the groups. Subscapular skinfolds z-scores (including outliers): GM+ median = 0.36 versus GM- median = 0.1; Mann-Whitney: differences = 0.09, CI95% = -0.15; 0.35. ^{††}No statistical differences were found between the groups in lean mass z-scores (T-tests: difference = -0.28, CI95% = -0.60; 0.04).

TABLE 2 Multiple regression model for breastfeeding attitudes^a

Variable	Coefficient	CI 95%	t	p	
Maternal years of education	0.73	0.14	1.32	2.45	0.02
Grandmaternal instrumental support (GM+)	-4.66	-7.99	-1.34	-2.79	<0.01
Advice on exclusive BF duration (yes)	0.86	-2.65	4.38	0.49	0.63
Advice on total BF duration (yes)	0.74	-2.65	4.14	0.48	0.66
Type of delivery (Caesarean)	0.25	-3.23	3.72	0.14	0.88
Constant	57.12	46.97	67.27	11.21	<0.00

^aBreastfeeding attitude scores were normally distributed: Shapiro-Wilk: $w = 0.98$, $p = 0.33$. BF: Breastfeeding. $n = 80$ (GM+ = 45; GM- = 35), $F(5,74) = 2.64$, $p = 0.03$, adjusted $R^2 = 0.09$, root mean square error = 7.20; Testing residual normality: Kolmogorov-Smirnov: $k-s = 0.07$, $p = 0.82$; Breusch Pagan/Cook-Weisberg homoscedasticity test: $X^2_{(1)} = 0.56$, $p = 0.45$; There was no collinearity of the variables of the model according to the Inflation Factor Variance (IFV).

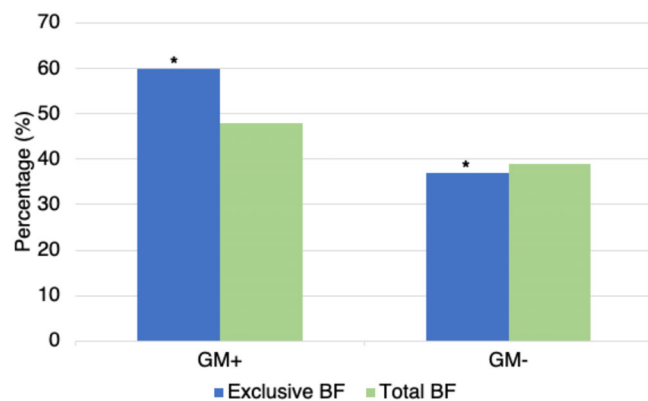


FIGURE 3 Women that received grandmaternal advice about total and exclusive breastfeeding duration stratified by grandmaternal support groups. GM+: With grandmaternal support ($n = 52$); GM-: Without grandmaternal support ($n = 33$). Five cases were excluded from “GM- group” due to the grandmother passed away before the child was born and according to the mothers, they were not able to have the opportunity to talk to their mothers about breastfeeding practices. *Differences were found, GM+ women received more frequently advice from their mothers about exclusive breastfeeding duration ($X^2_{(1)} = 4.6, p = 0.03$)

toward breastfeeding (Differences = -0.31 , CI95% = $-0.55; -0.06$; Figure 2a).

A multivariable linear regression analysis was performed on breastfeeding attitude data, including grandmaternal support (instrumental and informational), maternal education and type of delivery as predictors. The results show that in combination, these variables explain 9% of the variance in the outcome (Table 2). Having grandmaternal instrumental support had a significant negative association with breastfeeding attitudes, whereas maternal education showed a positive and significant association. Grandmaternal informational support and type of delivery showed non-significant associations.

3.5 | Grandmaternal advice toward breastfeeding

Sixty per cent of GM+ women ($n = 31$) and 37% of GM- women ($n = 12$) received advice from the grandmother about exclusive breastfeeding ($X^2_{(1)} = 4.6, p = 0.03$) (Figure 3). Forty-two-per cent of the grandmothers who provided instrumental support and 36% that did not provide support recommended that their daughters breastfeed exclusively during the first 6 months ($p = 0.54$), while 48% of GM+ women and 64% of GM- women reported that the grandmother emphasized the importance of exclusive breastfeeding, but without specifying any particular optimal duration ($p = 0.54$) (Table 3). Although a higher percentage of GM+ women received advice about breastfeeding duration, or information about the importance of exclusive breastfeeding, this group had a high percentage of children who were not exclusively breastfed (55% vs. 41%, $X^2_{(2)} = 1.8, p = 0.41$) (Table 4).

TABLE 3 Grandmaternal advice about exclusive and total breastfeeding duration

Variable	GM+ ($n = 31$)	GM- ($n = 12$)
<i>Exclusive breastfeeding duration</i>		
6 months	13	4
12 months	3	0
Not specified	15	8
	GM+ ($n = 25$)	GM- ($n = 13$)
<i>Total breastfeeding duration</i>		
4 months	0	1
6 months	7	3
12 months	7	4
>12 months	4	2
Not specified	7	3

Note: Data were obtained from the women who received advice about the amount of time (in months) that the grandmother advised that breastfeeding practices should last. Regarding the total duration of breastfeeding, the range was between 4 to >12 months and some participants reported that they received advice without specifying any particular duration. In those cases, women reported that their mothers told them that breastfeeding should last until “they stopped producing milk.”

Regarding the total duration of breastfeeding, 48% and 39% of GM+ ($n = 25$) and GM- ($n = 13$) women, respectively, received advice from their mothers ($X^2_{(1)} = 0.65, p = 0.42$) (Figure 3). The range was between 4 to >12 months and some participants reported that they received advice, without specifying any particular duration (Table 3). In those cases, women reported that their mothers told them that breastfeeding should last until “they stopped producing milk.” Due to the lack of specificity of this advice, we asked the grandmothers of GM+ mothers how they explained to their daughters how they could know that they were not producing milk. They considered the quality of the infant's crying and the color of the milk as indicators of milk production. For example, if after breastfeeding, the baby continued crying, that meant that the child was still hungry, and the mother did not have enough milk. If the milk had a “pale color” (interpreted as dilute or thin milk), that meant that the mother was not producing good “quality” milk.

Statistical differences between the groups were found in the total duration of breastfeeding; GM+ women breastfed their children for less time than GM- mothers (Median = 5 months, IQR = 3–8 months vs. Median = 10.5 months, IQR = 4–21 months; Difference = -0.31 , CI95% = $-0.55; -0.06$, Figure 2b and Table 4). The timing of introducing formula milk did not differ among the groups, although a higher percentage of GM+ women fed their babies with formula from the day of birth (57% vs. 46%, $X^2_{(2)} = 1.1, p = 0.58$).

Moreover, the timing of introducing solid food was similar between the groups, with most of the mothers initiating complementary feeding at 6 months after birth (Table 4). Although the total duration of breastfeeding differed between the groups, no overall association was found between total duration of breastfeeding and

TABLE 4 Maternal infant feeding practices

Variable	GM+ (n = 52)	GM- (n = 38)	
<i>Breastfeeding</i>			
Any breastfeeding	50	38	Fisher's exact: $p = 0.51$
Never breastfeed	2	0	
<i>Exclusive breastfeeding duration</i>			
<6 months	13	13	
6 months	10	9	$\chi^2_{(2)} = 1.8, p = 0.41$
No exclusively breastfed	29	16	
<i>Total breastfeeding duration</i>			
1–3 months	23	10	
4–6 months	18	6	$\chi^2_{(2)} = 11.7, p = 0.003^a$
>6 months	11	22	
<i>Introduction of formula milk</i>			
First day of birth	30	17	
1–5 months	11	11	$\chi^2_{(2)} = 1.1, p = 0.58$
≥ 6 months	11	10	
<i>Complementary feeding initiation</i>			
<6 months	16	9	
6 months	31	25	Fisher's exact: $p = 0.81$
>6 months	5	4	

Note: Duration of exclusive breastfeeding and the total duration of breastfeeding reported by the mothers. Mothers provided information about the ages at which feeding with formula milk and complementary feeding were initiated. p -values refer to differences between groups, analyzed using Chi-square and Fisher's exact test.

^aDifferences were found in the total duration of breastfeeding between the groups, GM+ women breastfed their children for less time.

subscapular skinfold ($S_r = -0.18, p = 0.08$) or lean mass z-score ($S_r = -0.19, p = 0.07$).

4 | DISCUSSION

Considering that females make key contributions to a range of strategies that enable the rearing of offspring (Hrdy, 2009), the effective use of a social group is an important evolutionary strategy. As in non-human animals, human mothers are able to use their social capital to protect their children and provide them with resources. Due to shared genetic interests, relationships with family members could be reliable sources of support, and women could feel more confident around relatives and therefore, be more likely to accept contributions to the care of their infants, thus gaining “alloparental” support (Hrdy, 2009; Robison et al., 2002). Our study stems from the theoretical expectation that family members can effectively subsidize maternal care and contribute a wide range of resources that could enhance healthy development of the children. Within this social group, maternal grandmothers appear to be more reliable helpers and mothers may gain from them through the sharing of experiences, provision of knowledge/information and emotional support.

From an evolutionary perspective, being genetically related to both mother and grandchild, maternal grandmothers have a vested

interest in the wellbeing of both parties, while also gaining fitness benefits (Hamilton, 1964). Therefore, knowing if the grandmother supports breastfeeding is important in light of its many health benefits, both short and long term, for the mother and baby (Chung et al., 2007; Eidelman et al., 2012; Emmott & Mace, 2015; Grassley & Eschiti, 2008). In our study, differences by grandmaternal groups were found in attitudes to breastfeeding, and its actual duration. Women with grandmaternal support showed less favorable attitudes toward breastfeeding and breastfed their children for less time.

Our results contribute to the growing volume of research that reports mixed findings regarding the association of grandmaternal presence and/or support with breastfeeding practices. While some studies report a positive influence of grandmothers toward breastfeeding (Arora et al., 2000; Winterburn et al., 2003), others have found negative influences (Pilkauskas, 2014; Susin et al., 2005). For instance, a study in Brazil reported that grandmothers may have a negative influence on breastfeeding, both on its duration and its exclusivity. Abandonment of exclusive breastfeeding within the first month and breastfeeding within the first 6 months was associated with maternal and paternal grandmothers who advised that water or tea and other kinds of milk should be given (Susin et al., 2005). In our study, one participant that co-habited with the maternal grandmother reported in the interview:

... There was a time when I simply could not (provide breast milk) because I was at school... (but) they told me (maternal grandmother and mother) that when I was with him, I should give him breast milk, and when he was not with me, that he should be given formula milk... (GM+ Women, 20 years old).

Moreover, grandmothers may perceive breastfeeding as an obstacle to their daughters obtaining adequate rest, and as a barrier to their own bonding with their grandchildren (Grassley & Eschiti, 2008). Helping their daughters to rest and releasing them from the demands of infant feeding is relevant in the Mexican context, considering that mothers still commonly practice “*la cuarentena*” (40 days rest after giving birth). The maternal grandmother traditionally assists the mother during this time and provides support with household chores and childcare activities, such as infant feeding, while the mother rests (Hockenberry & Wilson, 2018). In our sample, all the GM+ women reported receiving support from their mothers during “*la cuarentena*.” Grandmothers helped them in diverse activities such as bathing, cleaning, and feeding the child as well as cooking. Hence, is also relevant to consider the independent role of practical support in breastfeeding outcomes. Grandmothers may want to have more opportunities to assist their daughters, and formula feeding could be seen as an activity that promotes that, while also allowing them greater direct participation in childcare support (Emmott & Mace, 2015). For instance, one participant mother reported in the interview:

... my mother moved with me (during the first month) to help me with the baby... the advice of my mother was (how to take) care of me, you know?, ‘Don’t bend over, don’t move, rest’, things like that, or (how to) take care of the baby, (how to) hold the baby, (how to) hold her head, for example, you know?, how to burp (the baby after feeding)... mostly my mom advised and helped on everything, about the milk, how to feed her (with the bottle), how to wrap her with the blanket, cuddle her... (GM+ Women, 30 years old).

Another factor to be considered is whether grandmaternal knowledge of breast-feeding is adequate and well-informed. In our sample, 28% of GM+ women reported that their mothers advised that breastfeeding should last until “they stop producing milk” and used the frequency of the infant’s crying and the color of human milk as indicators of the adequacy of milk production. These indicators are important to take into account, considering that in the ENSANUT 2012 carried in Mexico (Gutiérrez et al., 2012), the main reason given by mothers of children under 24 months of age for never having breastfed their babies was the “feeling of not having milk” (37.4%, $n = 269$ women aged 12 to 49 years). In this category, women reported insufficient production of milk as “not having enough milk,” “the baby was not satisfied,” “the milk was thin” and “the milk is not good.” Other studies carried out in Mexico, including Merida, have reported similar

findings, resulting in concern that the baby will not satisfy its hunger if only breastfed (Bonvecchio et al., 2016; Moguel Canul et al., 2011; Perez-Escamilla et al., 1993; Sacco et al., 2006; Swigart et al., 2017). Two of these studies (Bonvecchio et al., 2016; Swigart et al., 2017) reported that women from the mother’s family (particularly maternal and paternal grandmothers) were influential in breastfeeding practices, and although the ENSANUT 2012 survey did not obtain data specifically about maternal family networks, the advice provided by grandmothers could be a related factor. For example, one participant reported in the interview:

She (the maternal grandmother) said that obviously, I had to give him breast milk but also combine it (with formula milk), because there is the belief that, because he is a boy, he eats more... they don’t feel full (not satisfied), no? Then you must feed him with the formula... (GM+ Women, 33 years old).

Grandmaternal influence on breastfeeding practices may have long-term health consequences, as several studies have shown an association of shorter duration of breastfeeding with obesity, body fatness and the metabolic syndrome in childhood and adolescence (Ejlerskov et al., 2015; Grummer-Strawn & Mei, 2004; Horta et al., 2013; Martorell et al., 2001; Nascimento et al., 2016; Wisniewski et al., 2018), though other studies find no such associations (Harder et al., 2005; Kramer et al., 2007; Sanchez-Escobedo et al., 2020; Schwartz et al., 2015). Moreover, there is evidence that infant feeding mode may shape children’s subsequent eating behaviors (Li et al., 2014; Mariscal Rizo et al., 2017). For instance, it has been reported that bottle-fed infants show a low satiety response at 6 years of age, and that bottle-feeding practices may have long terms effects on maternal feeding styles (Li et al., 2014). Frequent bottle emptying encouraged by mothers during infancy was associated with an increased likelihood of mothers pressuring their children to consume all food on the plate at later ages (Li et al., 2014).

In our study, although the advice of maternal grandmothers was associated with shorter breastfeeding duration, no differences between the GM groups were found in children’s weight, BMI, skinfolds or body composition, and no overall association was found between the duration of breastfeeding and body composition variables. Previous research on the association of maternal grandmothers’ support with grandchildren’s nutritional status has shown inconsistent results (Chambers et al., 2017; Negin et al., 2016; Pulgaron et al., 2016; Sadruddin et al., 2019; Young et al., 2018). These inconsistent findings could be due to the diverse ways in which grandmothers are involved in the lives of their grandchildren. In our study, we included children whose grandmothers provided direct childcare support and had physical contact with them at least two times per week for ≥ 3 h per day. However, many other factors such as traditions, maternal knowledge about diet, maternal feeding styles, food availability, sedentary behaviors and complementary feeding practices may also be associated with nutritional conditions (Campbell et al., 2013; Sothorn, 2004; Udoh & Amodu, 2016).

Regarding the GM– group, it is possible that these women could have a higher disposition to breastfeed their babies for the recommended time. There is evidence that women who are highly motivated and confident to exclusively breastfeed score highly on the IIFAS scale (Ishak et al., 2014). In addition, it is possible that these women benefited from accurate information about breastfeeding practices provided by other female relatives and other sources, such as medical staff. We were unable to obtain information about the specific advice on breastfeeding provided by other relatives or friends, however, women that were not supported by the grandmother reported that when they needed tips and advice on a range of child-care and parenting topics, they went to other female relatives, such as aunts, cousins, sisters, stepmothers, mothers-in-law, and sisters-in-law (Vázquez-Vázquez et al., 2021). For instance, one participant without support from her mother reported receiving advice from her own grandmother:

...My grandmother's first advice was to take baths with orange leaves... I remember that they boiled orange and lemon leaves and they gave me baths with them (the cooked leaves), and I don't know if it is the orange leaves or the heat of the water, but when my grandmother finished with my bath, my milk started to flow... (GM– Women, 27 years old).

Moreover, all women from our sample had access to antenatal care. Independent of that, women without GM support appear to have benefited from not having the influence of grandmothers on breastfeeding decisions. Studies have reported that according to medical staff, such as midwives, cultural and traditional practices by women and their families are an important barrier to the promotion of exclusively breastfeeding (Pemo et al., 2020). For example, regarding the efforts of clinicians to promote breastfeeding, one participant mother of a baby girl reported in the interview:

...he is a doctor, her paediatrician, he is really pro-breast milk and he even gave (me) advice on how to increase my breast milk, that you give yourself massages and things like that, and the first thing he said is (only human) milk... (GM– Women, 27 years old).

In future studies in Mexico and Yucatan, it will be important to investigate women attitudes to breastfeeding in more detail, such as their motivation and confidence in achieving extended breastfeeding duration, and about the cultural beliefs and practices typical of the region that are shared across generations and practised by women to improve breastfeeding.

In addition, it would be interesting to know if the effect of the maternal grandmother depends on whether she herself breastfed her children, that is, if she had the appropriate experience and knowledge. Knowing the experiences of successive generations can help us understand current breastfeeding patterns. For instance, it has been

reported that during the late 1970s, changes in infant feeding practices in some rural areas of Yucatan presented a challenge. In a study carried out between 1978 and 1979, it was found that perceptions of bottle-feeding were different between older and younger women, with older women resorting to it only on an emergency basis while younger women used it as a supplement to, and eventual replacement for breastfeeding. Older participants (all grandmothers) strongly believed that human milk was more nutritious than formula milk. However, among younger women, breastfeeding was seen as “old-fashioned,” whereas powdered formula was modern, used by better-off families, and recommended by some health care professionals (Howrigan, 1988).

Furthermore, it is relevant to consider grandmaternal exposure to infant formula advertising. Although bottle-feeding has been practiced in the area since at least the late 1930s (Howrigan, 1988), it was only recently that an analysis of formula marketing was conducted in Mexico (Chessa, 2016). The results showed that the decrease in exclusive breastfeeding duration coincided with an increase in the sale of infant formulas. A key contributing factor is poor legislation around the commercialization of milk substitutes. In comparison to other Latin American countries, such as Brazil, Mexico does not accurately follow the International Code of Marketing of Breast-milk Substitutes proposed by the WHO in 1981. Moreover, the Code is highly monitored by the food industry and not by the Mexican authorities, which may help explain the increased sales of formula milks (Chessa, 2016).

Unfortunately, according to our review, studies in Mexico do not show in detail the patterns of social support associated with changing breastfeeding patterns. From the studies presented above, it is possible that grandmothers in our study could have been exposed to changes in breastfeeding practices experienced years ago, which could be related to the inaccuracy of the information and knowledge provided to their daughters.

Our cross-sectional study had several limitations. Generalization is not appropriate because our sample is not statistically representative of the studied population. Moreover, although retrospective recall allowed us to explore the support of the grandmother after their daughter's first birth and the information/knowledge during the period of breastfeeding, it could also potentially introduce bias in the recollection process. Furthermore, due to time constraints, we were unable to obtain detailed information about the specific advice or information provided by other female relatives regarding breastfeeding, which could have helped us demonstrate their beneficial role among women without grandmaternal support and advice. Finally, we are aware that in developing countries, such as Mexico, the partner plays an important role in the initiation and maintenance of breastfeeding (González de Cosío & Hernández-Cordero, 2016; Hernández-Cordero et al., 2020). Due to cultural constraints, and hence to prevent women from dropping out from the study, we did not include in our questionnaire specific questions about their partners' role in breastfeeding practices. However, our data also show that women did not mention their partners as sources of knowledge/information toward this activity.

5 | CONCLUSION

Counter-intuitively, women who did not have instrumental support from their own mother showed a more favorable attitude toward breastfeeding and breastfed their children for longer. Overall, grandmothers' advice may reflect cultural beliefs and practices that do not protect breastfeeding, as reported in other populations. Although we need more detail data about grandmother's beliefs and attitudes about breastfeeding, as well as information about their own breastfeeding experiences, to improve interpretation of our findings, the lack of adequate knowledge and misinformation from the grandmother could be considered potential factors influencing the breastfeeding patterns of their daughter. Grandmothers may therefore represent a key group for potential interventions. Supporting that, previous studies have found that counseling sessions with the grandmother positively influences breastfeeding practices (Ingram et al., 2003; Mahoney & James, 2000; Nunes et al., 2011).

AUTHOR CONTRIBUTIONS

Adriana del Pilar Vázquez-Vázquez: Conceptualization (lead); data curation (lead); formal analysis (lead); methodology (lead); project administration (lead); writing – original draft (lead). **Mary S. Fewtrell:** Conceptualization (equal); methodology (equal); supervision (equal); writing – review and editing (equal). **Hidekel Chan-García:** Data curation (equal); methodology (equal); project administration (equal); writing – review and editing (equal). **Carolina Batún-Marrufo:** Data curation (equal); methodology (equal); project administration (equal); writing – review and editing (equal). **Federico Dickinson:** Conceptualization (equal); funding acquisition (lead); methodology (equal); project administration (equal); resources (lead); supervision (equal); writing – review and editing (equal). **Jonathan C. K. Wells:** Conceptualization (lead); formal analysis (supporting); funding acquisition (lead); methodology (lead); resources (lead); supervision (lead); writing – review and editing (equal).

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available upon reasonable request from the corresponding author (AVV). The data are not publicly available due to privacy and ethical concerns.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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