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Maternal Years of Schooling but Not Academic Skills Is Independently Associated With Infant-Feeding Practices in a Cohort of Rural Guatemalan Women

Aimee L. Webb, PhD,

Canadian Institutes of Health Research, Initiatives in Global Health research fellow in the Department of Anthropology at the University of Toronto, Ontario, Canada

Daniel W. Sellen, PhD [Associate Professor],

Department of Anthropology, University of Toronto, Ontario, Canada, and holds a Canada Research Chair in Human Ecology and Public Health Nutrition

Usha Ramakrishnan, PhD [associate professor], and

Hubert Department of Global Health, Rollins School of Public Health, and a contributing faculty member in the Program for Nutrition and Health Sciences at Emory University, Atlanta, Georgia

Reynaldo Martorell, PhD

The Robert W. Woodruff professor of international nutrition and the chair of the Hubert Department of Global Health at the Rollins School of Public Health, Emory University, Atlanta, Georgia

Abstract

The effects of maternal academic skills on infant-feeding practices are not clear. From 1996 to 1999, the authors collected information on infant-feeding practices from birth on infants born to 279 mothers from 4 rural villages in Guatemala. They examined associations between maternal academic skills and indicators for the initiation of exclusive breastfeeding (EBF) and timely introduction of complementary foods (CF). Mothers in the highest category of academic skills had greater odds of initiating EBF, but this association failed to remain significant after adjusting for schooling. Compared with mothers with < 1 year of school, mothers with > 3 to 6 years had greater odds of initiating EBF; mothers with > 6 years of school had greater odds of introducing CF early, while mothers with 1 to 3 years had greater odds of introducing CF late. Unmeasured schooling-related factors influenced infant-feeding practices to a greater extent than academic skills.

Keywords

exclusive breastfeeding; full breastfeeding; complementary foods; maternal schooling; academic skills; Guatemala

In resource-poor settings, optimal infant feeding is critical to infant and young child survival and well-being.¹⁻³ Maternal factors influencing the initiation of exclusive breastfeeding (EBF), the timely introduction of complementary foods (CF), and their subsequent effects on maternal, neonatal, and child health are thus a focus of research and programming.

Among these, the effects of maternal exposure to formal schooling are not well understood. In more affluent settings, greater maternal education correlates with greater initiation and duration of breastfeeding and increased exclusivity of breastfeeding to age 6 months.⁴⁻⁹ However, in developing countries where primary school for women may not be universal, the effects of schooling on the optimal initiation and duration of breastfeeding are equivocal.¹⁰⁻¹⁶

Multiple pathways have been hypothesized to explain the effects of maternal schooling on child health.¹⁷⁻²¹ In Figure 1, we extend these hypotheses to appropriate infant-feeding practices. It has been hypothesized that the acquisition of academic skills through formal schooling (ie, literacy, problem solving) is one route by which schooling may influence mothers' child care and, by extension, infant-feeding practices. For example, literacy and basic knowledge of disease processes may enhance women's ability to understand and assimilate breastfeeding promotion campaigns. Enhanced problem-solving skills could enable mothers to overcome barriers to optimal infant feeding. Specific health curricula may arm women with the knowledge necessary to implement appropriate practices. Conversely, other schooling-acquired traits may adversely influence infant-feeding patterns. Joshi hypothesized that schooling increases maternal identification with the modern sector.¹⁷ While this may benefit mothers and their children with respect to health seeking and illness management, modernizing influences may also incline women to be more accepting of nontraditional practices such as bottle-feeding and/or the use of breast milk substitutes.

In many societies, both women's involvement in work outside the home and greater household wealth can negatively affect infant-feeding practices by reducing mothers' availability for breastfeeding or increasing income available for purchasing breast milk substitutes and/or bottles.^{16,22-25} Schooling and academic skills may each increase women's access to these by increasing capacity and acceptability for employment outside of the home and enhancing social networks.

In theory, studies to examine the direction of associations between infant feeding and indicators of maternal exposure to schooling (ie, academic skills, identification with the modern sector) and various potential confounders and effect modifiers should allow testing of these alternative hypotheses. To date, studies examining the influence of schooling on infant feeding practices have used an educational attainment variable such as years of formal schooling, highest grade achieved, or level of education (ie, primary school, secondary school, college). However, educational standards and school resources to deliver quality education differ widely across settings. Thus, the use of variables that predominantly measure years or categories of schooling completed may not capture the transfer of knowledge and skills. Standardized academic tests that assess skills acquisition and knowledge may prove a useful tool to understand how skills and knowledge obtained via schooling may enhance or undermine infant-feeding practices.

To date, research to isolate the influence of academic skills, independent of other schooling-related exposures and outcomes, such as modernity, income, or employment, on adherence to optimal infant-feeding practices is scant. We therefore examined whether academic skills were independently associated with the initiation of EBF and the timely introduction of CF in a cohort of rural Guatemalan mothers.

Methods

Study Population and Design

From March 1996 to September 1999, investigators from Emory University and the Institute of Nutrition of Central America and Panama (INCAP) conducted a longitudinal follow-up

study in 4 villages of mixed Spanish-Mayan descent, located 40 to 110 km east of Guatemala City, Guatemala. The objective of the study was to assess the consequences of early childhood malnutrition in females on pregnancy outcomes and the birth weight and postnatal growth and development of their children. Pregnant women and women with children younger than 36 months were eligible to participate. Children participated in the longitudinal study of growth and development until they reached 36 months of age or end of study, whichever occurred earlier. Institutional review boards at INCAP and Emory University approved the study protocols; all participants provided informed consent. Detailed descriptions of the villages and their selection are published elsewhere.²⁶

Infant-Feeding Practices

Breastfeeding data were recorded longitudinally for 501 infants born during the 1996 to 1999 longitudinal study (84.2% of births). Detailed data on feeding in the first week were collected by maternal recall at 8 days postpartum for a random subsample of infants ($n = 338$). Mothers were asked to recall the day and time at which the newborn was first put to the breast (Spanish: *¿Que día/A que hora le empezó a dar el pecho a su niño?*). They were also asked the frequency, quantities, and times of feeding of breast milk and all other substances on each of the first 7 days of infant life, beginning with the day of birth. Retrospective infant feeding and morbidity questionnaires were administered every 2 weeks to mothers in the home by trained interviewers. For each of the previous 14 days, feeding status was categorized as the following: exclusive breastfeeding, breastfeeding with liquids, breastfeeding with formula, breastfeeding or formula-feeding with solids, or no breast milk-feeding (ie, exclusive formula, animal milk, or other non-breast milk food).

An indicator of initiation of EBF was constructed as a dichotomous variable, which took a value for 1 (yes) if infants received only breast milk for the first 24 hours following delivery.²⁷ The timely introduction of CF was based on World Health Organization (WHO) guidelines at the time of the study, which recommended mothers introduce CF between 4 and 6 months.²⁸ Because continued EBF was rare in this population²⁹ (only 24 mothers [9%] initiated and maintained EBF to 3.5-6.5 months), we examined the timely introduction of CF among mothers who initiated with full breastfeeding (FBF). Infants were categorized as initiating FBF if, within the first 24 hours following delivery, they received breast milk as their sole source of nutrition or were supplemented with limited quantities of water-based liquids, for example, sugar waters, ritual teas, rehydration salts, and diluted fruit waters.²⁷ Thus, we defined the timely introduction of CF as the time from initiation of FBF to the time, in days, from birth to the day on which formula, solids, or a cereal-based fluid was first introduced and then fed for at least 3 consecutive days. Thus, our category of FBF included the category of EBF but excluded those infants who received nutritive substances such as non-human milk, formula, cereal-based fluids, semisolids, and solids. Women who initiated FBF and continued this pattern to 3.5 to 6.5 months were categorized as timely. Mothers who initiated FBF and either introduced CF earlier than 3.5 months or introduced the first CF after 6.5 months were categorized as untimely.

Maternal Academic Skills

We measured maternal academic skills in 1996 to 1999 using a series of academic achievement tests. We assessed general knowledge, numeracy (numbers and simple calculations), preliteracy (ability to sound letters, words, phrases), literacy (ability to read and interpret a local newspaper headline), and reading comprehension (scores on 2 modules from the InterAmerican Reading Series related to comprehension and vocabulary). All tests were administered in quiet environments. We calculated a summary measure of academic skills from the knowledge, numeracy, literacy, and reading comprehension components. The individual tests exhibited high test-retest reliability ($r = 0.85-0.95$), and the summary

measure proved to be a reliable and robust estimate of global educational achievement. A detailed description of the validity and reliability of the summary measure and the individual tests can be found in Li et al.³⁰ For analyses, we categorized maternal scores on academic achievement tests according to population-based tertiles.

Additional Covariates

Data on household socioeconomic status (SES), household size, maternal age, years of formal schooling, and marital and work status were collected as part of a study-related household census in 1996. Socioeconomic status was expressed as the score derived from principal components analysis from data on household characteristics and possessions, with lower scores representing lower SES.³¹ Information on infant sex, birth weight, place of birth, and details on the mode, duration, and complications of delivery were collected within 24 to 72 hours of delivery by trained field nurses. Parity was verified from census records and medical history.

Maternal age and household SES were defined categorically according to approximate population-based tertiles. In Guatemala, although primary school is 6 years, the median years of schooling in this population was 3; < 10% of mothers completed 6 or more years of schooling. We therefore classified years of schooling according to the following categories: < 1 year, 1 year to 3 years, < 3 years to 6 years, and > 6 years. Community of residence (A, B, C, or D) was defined categorically, and community D was arbitrarily selected as the reference community. Maternal work and marital status were categorized dichotomously as employed outside of the home versus not and single versus not single (married and/or cohabiting), respectively. Place of birth was coded dichotomously as having taken place in a home or at a health facility. Birth weight was dichotomized as < 2500 g versus ≥ 2500 g.

Statistical Analyses

SAS version 9.1 statistical software (Cary, NC, 2007) was used for all statistical analyses. To minimize potential bias due to systematic missing data and to include as many cases as possible in the analysis, a category of “missing” was created for mothers missing scores on the academic skills test. If, as assumed, data on academic skills are missing at random with respect to the outcome variable, we would expect the effect size for the missing category to fall within the range of those in the nonmissing categories.

Our first objective was to examine the independent influence of maternal academic skills on the initiation of EBF, where initiation of EBF was specified as dichotomous variable (yes/no) and examined using logistic regression.³² We first estimated the odds for initiating EBF according to tertiles of maternal academic skills scores adjusted for maternal and infant factors that were determined a priori including maternal age, community of residence, parity, place of delivery, infant sex, and infant low birth weight (model 1A). The categorical variables for maternal employment outside of the home (model 1B), household SES (model 1C), and maternal years of schooling (model 1D) were then added in a stepwise-additive fashion.

We used logistic regression to examine the associations between scores on the maternal academic skills scores and the odds of timely introduction of CF following the strategy outlined for initiation of EBF (models 2a-d). We further tested whether academic skills were independently associated with early versus timely and late versus timely introduction of CF using multinomial logistic regression following the previously outlined strategy (models 3a-d; PROC CATMOD, SAS version 9.1).

Potential interactions between academic skills and schooling, and sociodemographic and infant characteristics were assessed for individual multiplicative interaction terms by comparing the log-likelihood statistics of models with and without the interaction terms. Main effects and interactions were considered significant at $P < .05$.

Results

The current analyses were conducted with 279 mother-infant dyads with complete first-week infant feeding recall and complete sociodemographic data. Mothers excluded from the current analyses due to incomplete data were of higher median parity (3 children vs 2 children; $P = .02$) but were similar with respect to other maternal and infant characteristics and infant-feeding practices. Approximately 11% of mothers were missing scores on the academic achievement tests. Mothers missing scores did not differ significantly from mothers with this information with respect to infant-feeding practices or other infant, maternal, or sociodemographic factors ($P > .05$). Assessment of the missing indicator method against listwise deletion indicated that no substantial bias was introduced.

Although initiation of breastfeeding was universal (all but 1 woman initiated some form of breastfeeding) and initiation of EBF and FBF was high, 86% and 93%, respectively, the median duration of EBF and FBF in this sample of women was 8 and 141 days, respectively. Among mothers initiating with FBF ($n = 259$), 46% practiced timely introduction of CF, 33% introduced CF prior to 3.5 months (early), and 21% introduced CF after 6.5 months (late; Table 1). At 1 year postpartum, 87% of women reported they were still breastfeeding their infants.

Mothers scoring in the highest tertile for academic skills had 3-times greater odds of initiating EBF compared with mothers scoring in the lowest tertile independent of maternal and infant characteristics, maternal work status, and household SES (Table 2, model 1C). However, addition of maternal schooling to the model attenuated the effect of the association and rendered it not significant ($P = .48$, Table 2, model 1D). In adjusted models, multiparous mothers and mothers between 23 and 27 years of age each had significantly higher odds of initiating EBF compared with their reference categories (Table 2; model 1D). Mothers with > 3 to 6 years of schooling had almost 4 times the odds of initiating with EBF compared with mothers with < 1 year of schooling, independent of maternal and infant characteristics, maternal work status, academic skills, and household SES (Table 2; model 1D).

Maternal scores on academic skills tests was not associated with timely introduction of CF in any of the logistic models tested (Table 3; models 2a-2d). Maternal academic skills were not associated with early versus timely or late versus timely introduction of CF in multinomial analyses (models 3a-d; data available on request). Mothers in communities B and C and mothers who did not work outside of the home each had significantly greater odds of timely introduction of CF compared with their reference categories in all models (Table 3; models 2a-2d). In multinomial analyses, mothers in community C had significantly lower odds of introducing complementary foods early versus timely (model 3d: 0.35 [0.17, 0.71]) when compared with mothers in the reference community. Although not significantly associated with timely introduction of CF in binomial analyses, mothers in community A had greater odds of introducing CF late versus timely (model 3d: 1.79 [1.08, 2.98]) when compared with mothers in the reference community. Mothers who did not work outside of the home had significantly lower odds of both early and late versus timely introduction of CF when compared with mothers who were employed outside of the home (model 3d: 0.62 [0.42, 0.90] and 0.58 [0.37, 0.90], respectively).

Mothers who completed > 6 years of schooling had a borderline significant ($P = .048$), 80% reduction in the odds of timely introduction of CF compared with mothers with < 1 year of schooling, independent of maternal and infant characteristics, maternal work status, academic skills, and household SES (Table 3; model 2D). Multinomial analyses revealed that, compared with mothers with < 1 year of schooling, mothers with > 6 years of schooling had significantly greater odds of early versus timely introduction of CF (model 3d: 4.74 [1.59, 14.15]), while mothers with 1 to 3 years of schooling had significantly greater odds of late versus timely introduction of CF (model 3d: 2.18 [1.01, 4.70]).

No additional covariates were associated with early versus timely or late versus timely introduction of CF in multinomial analyses. No significant interactions were observed at $P < .05$.

Discussion

We used longitudinally collected, detailed descriptive data to examine the influence of acquired maternal academic skills on initiation of EBF and the timely introduction of CF while accounting for relevant sociodemographic, maternal, and infant characteristics. Using a series of validated and reliable academic achievement tests to quantify academic skills, we observed that higher scores on these tests were not associated with increased initiation of EBF or the timely introduction of CF after accounting for maternal schooling, work, and household SES status. Although a limited number of studies have reported a beneficial effect of maternal academic skills, namely, literacy, on maternal uptake of child health practices such as vaccinations, preparation of oral rehydration solutions, and hygiene,³³⁻³⁵ to our knowledge, this is the first study to explore the effects of such skills on infant-feeding practices. Our finding of a lack of an independent association between infant-feeding practices and academic skills may indicate that a threshold level of skills, which may be higher than what was achieved in this population, is required to enable mothers to overcome barriers to optimal infant feeding. It is also plausible that skills are less important in determining infant-feeding outcomes than other schooling-acquired exposures. Assessment of infant-feeding practices across a wider distribution of academic skills and/or among mothers who obtained academic skills outside the traditional schooling venue (ie, from siblings, parents, adult literacy programs) could facilitate greater understanding of the independent role of this factor.

A second key finding was that maternal schooling was associated with infant-feeding practices in differing ways. Mothers with an intermediate level of schooling (> 3 to 6 years) had greater odds of initiating exclusive breastfeeding compared with mothers with no schooling (< 1 year). Mothers with the highest level of schooling (> 6 years) had increased odds of early introduction of CF, while limited schooling (1 to 3 years) was associated with late introduction of CF. Similarly, in a Pakistani study, mothers with some schooling introduced CF early or on time at a greater frequency than mothers without schooling, whereas mothers without schooling reported a greater frequency of late or very late introduction of CF.³⁶ However, this study did not account for potential sociodemographic confounders. Our finding that the associations between years of schooling, initiation of EBF, and timely introduction of CF remained strong and significant in adjusted models indicates that additional, unmeasured schooling-related exposures are associated with infant-feeding practices in this population independent of schooling's ability to enhance maternal skill sets, employment opportunities, and household SES.

Schooling-related exposures with the potential to influence infant feeding include maternal identification with the modern sector and exposure to specific health-related curricula.^{17, 18} To our knowledge, specific health education curricula related to infant feeding were not

offered in these schools when these mothers were in attendance. Identification with the modern sector was not assessed as part of this study, and so we cannot identify to what extent modernization influenced mothers' choices. Qualitative work to understand how mothers' attitudes, knowledge, and perceived barriers toward breastfeeding differ across levels of schooling could help in clarifying some of these less well-defined aspects of schooling, including modernization, and their influence on the uptake of infant-feeding practices.

A third finding of our study is that additional maternal and community-level factors not necessarily related to schooling or academic skills, including parity, age, community, and work status, significantly influenced infant-feeding practices in rural Guatemala, where low levels of schooling are the norm. Specifically, we observed that multiparous mothers and mothers between 23 and 27 years of age were more likely to initiate EBF. Greater exposure to prenatal care and its health care messages, previous breastfeeding experiences, and enhanced mother-support networks may be more common among multiparas and young adult women compared with primiparas, teens, or older adult women. Thus, these women may be less inclined to give traditional prelacteal feedings, which interfere with initiation of EBF. These hypotheses require further exploration. Although community of residence was not associated with initiation of EBF, 2 communities exhibited greater odds of timely introduction of CF. Although there were differences in the 4 communities with respect to population size, proximity to Guatemala city, household SES, work opportunities for both men and women, and the practice of home births,³⁷ no significant pattern was evident that could explain why these 2 communities had significantly higher odds of timely introduction of CF. Furthermore, we are unaware of the presence of infant-feeding education and promotion campaigns that may have differentially affected these communities. Additional research to clarify community factors that potentially support or undermine infant-feeding recommendations is needed. Our finding that maternal work outside of the home reduced the odds of timely introduction of CF is not novel. Maternal employment, specifically return to work outside of the home, has been observed to decrease both the initiation^{4,38-41} and duration^{4,38-40,42} of exclusive and any breastfeeding. This effect has been consistently reported in developed and developing countries.

Strengths and Limitations of the Study

The frequency and duration of data collection on breastfeeding was a strength of the current analyses. Breastfeeding information was gathered over an extended period of time (up to 36 months) using a recall survey method that was administered with high frequency (every 2 weeks). This recall method allowed for highly accurate collection of day-to-day variation in breastfeeding practices as well as an accurate determination of the timing of introduction of CF. In addition, we used a series of validated and culturally relevant academic achievement tests to create a summary measure of maternal academic skill sets. The achievement tests quantified academic skill sets that could be acquired via formal schooling, for example, literacy, vocabulary, numeracy, general knowledge, and reading comprehension. Given that educational curricula and quality differ widely depending on the setting, use of standardized tests to quantify skills and knowledge acquisition may reduce interpopulation variability potentially inherent in variables used to capture schooling (ie, those with the same years of schooling from different localities may possess very different skill and knowledge sets). Thus, standardized measures may reduce bias and allow for comparisons across settings and communities.

We acknowledge that we were limited in our ability to examine the impact of other potential schooling-related exposures, specifically identification with the modern sector, and so are unable to delineate all of the pathways by which schooling may influence infant feeding. However, the original study did not aim to examine the varying pathways by which

schooling affects infant-feeding practices, and thus, such an assessment was not included in the original protocols.

We did not collect information on quantities or proportions of supplemental nutritive and nonnutritive liquids and foods. The WHO definition for FBF requires that breast milk be the predominant source of nutrition for the infant, although the volume of breast milk definition of full is not clear.⁴³ Our definition for FBF required that the consumption of nonnutritive liquids, in the absence of consumption of cereal or non-human milk-based foods and drinks, was limited and did not constitute a major source of nutrition for the infant. In addition, because we examined infant-feeding practices per the recommendations available at the time of the study, it may be argued that our findings lack relevance to the present-day situation as mothers are currently recommended to EBF to 6 months.⁴⁴ However, only 7 and 39 women practiced timely cessation of EBF and FBF, respectively, when defined as cessation at 5.5 to 6.5 months. To avoid such limitations of small sample size, future studies may consider oversampling of women who will likely practice optimal infant feeding. Small sample size may also have limited our ability to detect a statistically significant association between academic skills and infant-feeding practices. With the current sample of 279 women, we had approximately 60% power to detect 10% differences in initiation of EBF and timely introduction of CF between women in the highest versus the lower quantiles. However, given that the effect of academic skills was substantially attenuated and not significant after the introduction of years of schooling to the model, in this population, academic skills appeared to serve more as a proxy for schooling rather than an independently associated effect.

Lastly, we cannot rule out that preceding biological factors may have influenced breastfeeding behavior. We have previously shown in this population a relationship between delayed onset of lactation and risk of ending EBF¹¹ and a positive association between maternal obesity and delayed onset of lactation.²⁹ Other factors not measured in the current study, such as perceived insufficient milk and social/family support, have been identified as key determinants of breastfeeding exclusivity and duration. Additional work to tease apart these complex physiological, behavioral, cultural, and cognitive factors and how different levels of schooling influences or modifies these factors is needed.

In conclusion, in this population of rural Guatemalan women with low levels of formal schooling, the acquisition of academic skills was not associated with infant-feeding practices independent of other, unmeasured schooling-related factors. Clarification of these additional schooling-related factors and understanding of how they contribute to differences in women's attitudes toward infant feeding, responses to breastfeeding education and promotion campaigns, and abilities to overcome problems with and barriers to optimal infant feeding are areas in need of greater investigation.

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Figure 1.

Conceptual framework of the direct and indirect pathways by which specific aspects of maternal schooling may influence infant-feeding practices. This framework was informed by and adapted from the works of Cleland et al,¹⁹ Joshi,¹⁷ Caldwell,²⁰ Engle et al,¹⁸ and Boyle et al.²¹ Dashed arrows represent potential direct pathways; dotted arrows represent potential indirect pathways.

Table 1
Descriptive Characteristics of the 279 Guatemalan Mother-Infant Dyads Overall and by Infant-Feeding Pattern

Effect	Study Population, % (n =279)	Proportion Initiating With EBF (n =239)	Proportion Introducing CF at <3.5 Mo (n =86) ^{a,b}	Proportion Introducing CF at 3.5-6.5 Mo (n =119) ^{a,b}	Proportion Introducing CF at >6.5 Mo (n =54) ^{a,b}
Maternal academic skills score ^c					
Missing	11.5	81.3	42.9	42.9	14.3
< 37.0	29.0	82.7	22.7	48.0	29.3
37.0-75.2	29.0	84.0	34.7	52.0	13.3
> 75.2	30.5	91.8	38.3	39.5	22.2
Mother is single					
No	95.7	85.4	23.9	46.2	21.5
Yes	4.3	91.7	50.0	41.7	8.3
Community of residence					
A	30.8	89.5	42.7	40.2	17.1
B	29.8	86.8	31.2	53.3	15.6
C	17.9	80.0	17.0	59.6	23.4
D	21.5	83.3	35.9	32.1	32.1
Mother is primiparous					
No	81.0	88.5	31.5	46.0	22.5
Yes	19.0	73.6	41.3	45.7	13.0
Infant sex					
Female	51.3	83.8	33.1	49.6	17.3
Male	48.8	87.4	33.3	42.4	24.2
Infant delivered at home					
No	58.4	85.9	34.4	46.4	19.2
Yes	41.6	85.3	31.5	45.4	23.2
Infant born < 2500 g					
No	88.5	84.6	32.5	47.4	20.2
Yes	11.5	93.8	38.7	35.5	25.8
Mother's age at enrollment, y					
< 23	29.0	82.7	38.7	41.3	20.0
23 years < 28	36.6	92.2	29.9	48.5	21.7

Effect	Study Population, % (n = 279)	Proportion Initiating With EBF (n = 239)	Proportion Introducing CF at <3.5 Mo (n = 86) ^{a,b}	Proportion Introducing CF at 3.5-6.5 Mo (n = 119) ^{a,b}	Proportion Introducing CF at >6.5 Mo (n = 54) ^{a,b}
28	34.4	81.3	32.2	47.1	20.7
Mother works outside of the home					
No	68.5	81.9	29.4	50.6	20.0
Yes	31.5	87.1	41.8	35.4	22.8
Household socioeconomic status ^d					
Lower	25.8	81.9	38.5	43.1	18.5
Middle	36.2	87.1	34.8	42.4	22.8
Upper	38.0	86.8	28.4	51.0	20.6
Mother's years of schooling					
<1	17.6	81.6	27.3	52.3	20.5
1 to 3	22.6	79.4	29.8	36.8	33.3
> 3 to 6	51.6	90.3	30.7	52.6	16.8
>6	8.2	82.6	71.4	14.3	14.3

Abbreviations: CF, complementary foods; EBF, exclusive breastfeeding.

^aMothers were categorized as initiating exclusive breastfeeding if infants received only breast milk for the first 24 hours following delivery.²⁷

^bIntroduction of complementary foods was defined as the time from initiation of full breastfeeding (FBF) to the time, in days, from birth to the day on which formula, solids, or a cereal-based fluid was first introduced and then fed for at least 3 consecutive days.

^cMaternal academic skills tests assessed general knowledge, numeracy (numbers and simple calculations), preliteracy (ability to sound letters, words, phrases), literacy (ability to read and interpret a local newspaper headline), and reading comprehension (scores on 2 modules from the InterAmerican Reading Series related to comprehension and vocabulary) and were categorized according to population-based tertiles with a category for missing data.³⁰

^dSocioeconomic status was expressed as the score derived from principal components analysis from data on household characteristics and possessions with lower scores representing lower socioeconomic status.³¹

Table 2
Odds Ratios and 95% Confidence Intervals for Factors Associated With Initiation of Exclusive Breastfeeding in 279 Rural Guatemalan Women

Effect	Model 1a ^a	Model 1b	Model 1c	Model 1d
Maternal academic skills score ^b				
Missing	0.95 (0.30, 3.07)	1.03 (0.32, 3.34)	1.18 (0.35, 3.98)	1.07 (0.29, 3.87)
<37.0	1.00	1.00	1.00	1.00
37.0-75.2	1.08 (0.45, 2.57)	1.01 (0.42, 2.43)	1.05 (0.43, 2.54)	0.57 (0.19, 1.67)
>75.2	2.36 (0.84, 6.61)	2.43 (0.86, 6.90)	2.99 (1.01, 8.86)	1.80 (0.45, 7.16)
Mother is primiparous				
No	3.64 (1.49, 8.88)	2.68 (1.02, 7.02)	2.62 (0.99, 6.96)	2.88 (1.06, 7.80)
Yes	1.00	1.00	1.00	1.00
Mother's age at enrollment, y				
<23	1.58 (0.63, 4.01)	1.51 (0.59, 3.86)	1.46 (0.56, 3.80)	1.38 (0.52, 3.62)
23 years < 28	3.22 (1.25, 8.30)	3.17 (1.22, 8.22)	3.02 (1.15, 7.91)	2.77 (1.03, 7.47)
28	1.00	1.00	1.00	1.00
Mother works outside of the home				
No		2.01 (0.89, 4.51)	2.03 (0.90, 4.60)	2.44 (1.04, 5.75)
Yes		1.00	1.00	1.00
Household socioeconomic status ^c				
Low			1.38 (0.54, 3.54)	2.73 (0.97, 7.73)
Medium			0.65 (0.26, 1.66)	2.46 (0.90, 6.73)
High			1.00	1.00
Mother's years of schooling				
<1				1.00
1 to 3				1.20 (0.21, 7.01)
> 3 to 6				3.86 (1.05, 14.16)
>6				0.96 (0.32, 2.89)

^aMothers were categorized as initiating exclusive breastfeeding if infants received only breast milk for the first 24 hours following delivery.²⁷

^bLogistic regression models examining associations between maternal academic skills and initiation of exclusive breastfeeding were built using a progressively inclusive modeling strategy such that model 1a was adjusted for marital status (single vs not), community of residence, parity (primiparous vs not), infant sex, place of birth (home vs not), infant birth weight (< 2500 g vs not), and maternal age at enrollment. Model 1b included all variables in model 1a + maternal work status (works outside of the home vs not), model 1c included all variables in model 1b + household socioeconomic status, and model 1d included all variables in model 1c + maternal years of schooling. For brevity, only those variables significant in multivariate analyses are presented here.

^cMaternal academic skills tests assessed general knowledge, numeracy (numbers and simple calculations), preliteracy (ability to sound letters, words, phrases), literacy (ability to read and interpret a local newspaper headline), and reading comprehension (scores on 2 modules from the InterAmerican Reading Series related to comprehension and vocabulary) and were categorized according to population-based tertiles with a category for missing data.³⁰

^dSocioeconomic status was expressed as the score derived from principal components analysis from data on household characteristics and possessions with lower scores representing lower SES.³¹

Table 3
Odds Ratios and 95% Confidence Intervals for Factors Associated With the Timely
Introduction of Complementary Foods^a in 279 Rural Guatemalan Women

	Model 2a ^b	Model 2b	Model 2c	Model 2d
Maternal academic skills score ^c				
Missing	0.88 (0.36, 2.14)	1.01 (0.41, 2.52)	1.04 (0.41, 2.61)	1.10 (0.41, 3.00)
<37.0	1.00	1.00	1.00	1.00
37.0-75.2	1.23 (0.65, 2.32)	1.14 (0.59, 2.18)	1.16 (0.60, 2.22)	0.82 (0.37, 1.83)
>75.2	0.84 (0.44, 1.61)	0.83 (0.43, 1.60)	0.87 (0.44, 1.71)	0.68 (0.28, 1.64)
Community of residence				
A	1.54 (0.73, 3.25)	1.56 (0.73, 3.33)	1.60 (0.75, 3.43)	1.78 (0.81, 3.91)
B	2.50 (1.20, 5.22)	2.60 (1.23, 5.47)	2.57 (1.22, 5.43)	3.73 (1.67, 8.33)
C	3.30 (1.45, 7.50)	3.75 (1.61, 8.71)	3.47 (1.45, 8.34)	3.24 (1.32, 7.94)
D	1.00	1.00	1.00	1.00
Mother works outside of the home				
No		2.48 (1.32, 4.67)	2.48 (1.32, 4.67)	2.73 (1.38, 5.38)
Yes		1.00	1.00	1.00
Household socioeconomic status ^d				
Low			1.21 (0.64, 2.30)	1.36 (0.70, 2.67)
Medium			1.01 (0.52, 1.98)	0.94 (0.46, 1.90)
High			1.00	1.00
Mother's years of schooling				
<1				1.00
1 to 3				0.61 (0.26, 1.44)
>3 to 6				1.91 (0.76, 4.77)
>6				0.21 (0.05, 1.00)

^a Introduction of complementary foods was defined as the time from initiation of full breastfeeding (FBF) to the time, in days, from birth to the day on which formula, solids, or a cereal-based fluid was first introduced and then fed for at least 3 consecutive days. Mothers who introduced complementary foods between 3.5 and 6 months were classified as timely according to World Health Organization recommendations at the time of the study.²⁸

^b Logistic regression models examining associations between maternal academic skills and initiation of exclusive breastfeeding were built using a progressively inclusive modeling strategy such that model 2a was adjusted for marital status (single vs not), community of residence, parity (primiparous vs not), infant sex, place of birth (home vs not), infant birth weight (< 2500 g vs not), and maternal age at enrollment. Model 2b included all variables in model 2a + maternal work status (works outside of the home vs not), model 2c included all variables in model 2b + household socioeconomic status, and model 2d included all variables in model 2c + maternal years of schooling. For brevity, only those variables significant in multivariate analyses are presented here.

^c Maternal academic skills tests assessed general knowledge, numeracy (numbers and simple calculations), preliterate (ability to sound letters, words, phrases), literacy (ability to read and interpret a local newspaper headline), and reading comprehension (scores on 2 modules from the InterAmerican Reading Series related to comprehension and vocabulary) and were categorized according to population-based tertiles with a category for missing data.³⁰

^d Socioeconomic status was expressed as the score derived from principal components analysis from data on household characteristics and possessions with lower scores representing lower SES.³¹