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Key correlates of exclusive breastfeeding at three timepoints: Evidence from Ethiopia

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Abstract

Aim: To compare factors associated with exclusive breastfeeding (EBF) within 1 h of birth, within 3 days, and within the first 6 months post-birth.

Methods: We used multivariate logistic regression models and data from "The Alive and Thrive Phase 2 Amhara Baseline Survey 2015" from Ethiopia ($N = 3113$).

Results: Giving colostrum was strongly associated with EBF at all three time points, controlling for multiple confounders. Putting the baby to the breast before cleaning the baby and before cleaning the mother was significantly associated with EBF within 1 h and for the first 3 days. EBF within an hour of birth was more likely for girl babies than boy babies. Having a healthcare professional check whether the baby was sucking well was significantly associated with EBF 3 days post-birth.

Conclusions: The World Health Organization recommends breastfeeding within 1 h of birth and exclusively thereafter for 6 months, which can improve health outcomes for infants and children. In Ethiopia, many factors influence breastfeeding practices, but little is known about how these factors differ at various key timepoints in the 6 months after birth. Our study provides important information on correlates of EBF at three timepoints and shows that factors that are significantly correlated with EBF vary over time. Future research should assess the potential causal links among statistically significant associations between EBF and risk factors at various times between birth and 6 months of age. Ultimately, these findings have the potential to inform areas of intervention related to promoting EBF.

KEYWORDS

breastfeeding, colostrum, Ethiopia, infant, logistic models, mothers, surveys and questionnaires

INTRODUCTION

Exclusive breastfeeding (EBF) is the single most effective intervention for reducing the global burden of disease for children under 6 months, while suboptimal breastfeeding plays a major part in the poor health and livelihood of young children globally.[1] The current World Health Organization (WHO) breastfeeding recommendations were introduced in 1990 and state that every child be breastfed within 1 h of birth and breastfed exclusively for 6 months before complementary feeding begins.[2] The WHO considers breastmilk integral for all babies' growth and development.[2]

Abbreviations: CI, confidence Interval; DAG, directed acyclic graph; DALYs, disability-adjusted life years; DHS, Demographic and Health Survey; EBF, exclusive breastfeeding; HAD, Health Development Army; IYCF, infant and young child feeding; LMICs, low- and middle-income countries; OR, odds ratio; WDA, Women's Development Army; WHO, World Health Organization.

The WHO defines the following breastfeeding terms: early initiation of breastfeeding, exclusive breastfeeding, complementary breastfeeding, optimal breastfeeding, and suboptimal breastfeeding. Early initiation of breastfeeding is breastfeeding that occurs within the first hour after birth.[2] Exclusive breastfeeding is defined as giving only breastmilk to an infant for their first 6 months of life without any additional food or liquids, even water.[2] Complementary breastfeeding is the coupling of breastfeeding with other age-appropriate foods from 6 months until 2 years old.[2] Optimal breastfeeding refers to breastfeeding practices that meet the WHO global guidelines for EBF for 6 months after birth, while suboptimal breastfeeding practices do not meet the WHO guidelines of EBF for 6 months after birth.[2] In 2019, the Global Burden of Disease Study showed that suboptimal breastfeeding contributed to 2.4% of the disability-adjusted life years (DALYs) for children 0–9 years old.[3] According to the current WHO standards, if optimal breastfeeding were universal in 75 low- and middle-income countries (LMICs), this could prevent an estimated 823 000 deaths per year.[4] Victora et al.[4] also estimated that over 22 000 lives per year would be saved if complementary breastfeeding was continued up to 2 years after birth in LMICs.

The Federal Ministry of Health in Ethiopia recommends breastfeeding in line with the current recommendations from the WHO.[4,5] A study in the predominantly rural regions of Northwest Ethiopia followed 1752 live births for 12 months and showed that EBF was the strongest predictor of infant mortality.[6] Infants who experienced suboptimal breastfeeding in their first 6 months were eight times more likely to die than infants who were exclusively breastfed.[6] Exclusive breastfeeding has the potential to reduce infant mortality in rural Ethiopia. Ethiopia has substantially reduced the national infant mortality rate from 97/1000 to 48/1000 live births between 2000 and 2016.[7] However, there is still considerable progress to be made in rural regions, specifically the Amhara region, where the infant mortality rate was 67/1000 live births as of 2016, among the higher rates in the country.[7] Making progress towards promoting EBF requires an understanding of the maternal factors (e.g., maternal education and demographic characteristics), familial/community factors (e.g., intergenerational differences in beliefs related to EBF), and institutional factors that serve as barriers to EBF.[8]

Maternal factors associated with EBF have been considered in multiple recent studies.[8] A study conducted in Debre Markos, Ethiopia showed that mothers' breastfeeding knowledge and education during their antenatal/postnatal care visits and mothers' unemployment status were significantly and positively associated with EBF.[1] A study using 2016 Ethiopian Demographic and Health Survey (DHS) data showed that less than 20% of women in Ethiopia practiced EBF in Afar, Gambella, Somali, and Beninshangul, the "Emerging regions" of the country, which are characterised as having relatively low socioeconomic status, among other factors.[9] Maternal-level factors, such as the desire for more children and lower household socioeconomic status, were associated with a decreased likelihood of practicing EBF.[9] In another study that also relied on Ethiopian DHS data, maternal demographic variables such as education level, maternal age, region, religion, and socioeconomic status were associated with breastfeeding status.[10] While both studies used DHS data, many of their analyses were conducted using different variables.[9,10] However, for the variables that were aligned, they had similar findings with respect to factors significantly associated with shorter duration of breastfeeding status: employment of mothers and lower socioeconomic statuses of households.[9,10] Azeze et al.[11] showed that EBF was more likely when mothers reported no problems or pain associated with their breast in the first 6 months.[11] Maternal barriers to optimal breastfeeding may include maternal perceptions of inadequate milk supply, limited maternal knowledge of breastfeeding,[12] and some medical conditions that make it difficult or impossible to breastfeed.[13]

Familial/community factors can also act as barriers to breastfeeding; mothers may experience negative reactions when breastfeeding in public, experience lack of support for breastfeeding in places of employment, and generally lack of support from their families.[8] In a recent study that focused on mothers in northern Ethiopia, the authors showed that intergenerational differences in perspectives related to breastfeeding influenced the mothers' decisions to breastfeed their children.[12] In this study, some older generations of family members had views that conflicted with mothers'

Practitioner Points

- Our models show that colostrum given at birth is strongly associated with whether mothers continue to exclusively breastfeed for 6 months, as recommended by the World Health Organization (WHO).
- We found that early breastfeeding supports are associated with exclusive breastfeeding for 3 days post-birth. Supports such as having a healthcare provider check whether the baby was sucking well after birth and having assistance putting the baby to the breast before cleaning had positive effects on exclusive breastfeeding for the 3 days following birth.
- Given our own findings and the earlier work of others, breastfeeding support given at birth can be instrumental in improving the prevalence of exclusive breastfeeding. Interventions given at birth should be prioritised as the Ministry of Health in Ethiopia continues to develop and deliver comprehensive interventions to promote exclusive breastfeeding in rural regions of Ethiopia.

views on breastfeeding when the mothers' views were consistent with current scientific guidelines. Some older community members had other markers for determining when an infant was ready for complementary breastfeeding, such as when the infant was able to smell foods.[12] Mothers noted that while the grandparents had influence, mothers were often guided by their own their personal beliefs on breastfeeding.[12] In a study by Feenstra et al., lower maternal self-efficacy related to breastfeeding was strongly associated with early breastfeeding issues among mothers in Southern Denmark.[14] While this study did not directly explore familial or community level factors, the level of support that mothers receive from family members and health professionals in their communities can influence their level of self-efficacy related to breastfeeding.[15] A study from Ethiopia found a correlation between family size and early initiation of breastfeeding, with children born into families larger than seven people being less likely to experience early initiation of breastfeeding.[10] Similarly, participants in a qualitative study from Nigeria reported that insufficient family support was a barrier to exclusive breastfeeding.[16]

Finally, institutional factors are associated with EBF. Rollins et al.[8] conducted a systematic review and meta-analysis and found that insufficient support from healthcare providers is negatively associated with breastfeeding, and the authors described multiple effective interventions that can be employed by health systems to improve breastfeeding rates. In Ethiopia, a study conducted at University of Gondar Hospital showed that offering postnatal care services was positively associated with EBF.[17] In this study, mothers who did not receive postnatal care were more than twice as likely to report having stopped EBF early, compared with mothers who received postnatal care, with the mean time of EBF cessation at 2.49 ± 1.73 months.[17] The location of the baby's delivery was not significantly associated with EBF in this study.[17] Tsegaw et al.[18] showed that institutional variables such as delivery at a healthcare facility, delivery assistance personnel present at the birth, and consistent antenatal/postnatal care, were significantly associated with an increased likelihood of EBF in Ethiopia.[18] While these maternal health services are greatly underutilized in Ethiopia and need further strengthening, they are still significantly associated with improving EBF practices,[19] but these types of interventions generally require specific timing.

Significance

A meta-analysis published in 2018 reviewed 83 full-text studies on breast and complementary feeding practices and predictors in Ethiopia; the authors concluded that while there is substantial literature on EBF, there are still significant gaps, specifically centred on maternal behaviours related to breastfeeding.[20] Our goal was to compare the relationships among an array of factors (maternal behaviours, familial/community factors, and institutional factors) and EBF at three timepoints: (1) within 1 h of birth, (2) within 3 days of birth, and (3) within the first 6 months. We used multivariate logistic regression models and data that was previously collected from women residing in the Amhara Region of Northwest Ethiopia. Following our review of the literature, we assessed all variables in the data set that were temporally plausible, aligned with our original hypotheses, and appropriate for logistic regression models. We compared the findings of our models to better understand whether factors associated with EBF at three different timepoints remained consistent or varied over time; our comparison of associations at different timepoints contributes to methods that can be used to understand breastfeeding practices more thoroughly at an increasingly granular level.

MATERIALS AND METHODS

Study design

All data were from "The Alive and Thrive Phase 2 Amhara Baseline Survey 2015," a cross-sectional survey that was originally conducted in 2015 by the Addis Continental Institute of Public Health and in collaboration with the International Food Policy Research Institute and Save the Children. All data were from the pretrial (baseline) information collected during The Alive and Thrive Phase 2 Survey. The Amhara region is divided into 11 zones, including 167 woredas (districts). In the Western Amhara region, which is the focus of our study, there are three zones that contain 41 woredas. Of these 41 woredas, 20 were chosen by Save the Children for an intervention trial to address complementary feeding practices of infants and young children. In these 20 woredas, mothers in households with children under 2 years old were interviewed at baseline before any intervention taking place. Additional details on The Alive and Thrive Phase 2 Survey and methodology as it relates to children 6–23.9 months of age were published by Kim et al.[21]; for our study, we used data from the baseline survey that related to when children were between 0 and 6 months of age.

Face-to-face semi-structured interviews were conducted by trained data collectors as part of a baseline data collection exercise. For the purposes of our study, we used no data collected beyond baseline and the data we analysed are cross-sectional in nature. We requested only the following subsets of data from the survey: all household identification questions, Module 1 (Household Roster/Composition), Module 2 (Work Condition and Child Care Arrangements), and Module 4 (Infant and Young Child Feeding (IYCF) Practices for Children 0–23.9 months). The data were originally collected by interviewers who spoke with mothers in three zones (Awi, North Gondar, and West Gojam) in the Amhara Region of Ethiopia who had children younger than 24 months old. Interviewers asked an array of questions, including about a mother's demographic and

household information, employment, and questions focused on one specific child under 24 months, referred to as the "index child". A total of 59 variables were provided for 3113 mothers and their children.

Outcome variables

We defined the three key outcome variables as follows: (1) EBF within 1 h of birth (vs. giving anything other than breastmilk to the baby within 1 h after birth or not initiating breastfeeding within 1 h of birth); (2) EBF within the first 3 days after birth (vs. giving anything other than breastmilk to the baby within the first 3 days after birth); and (3) EBF for 6 months (vs. giving any complementary food to the baby within 6 months of birth). The outcome variable of EBF for the first 6 months is characterised by mothers who did not give any complementary foods or drinks when the baby was 1, 2, 3, 4, or 5 months old. However, if a baby had received traditional substances or milk other than breastmilk (e.g., raw butter, honey, etc.) within the first hour or first 3 days, but no complementary foods or drinks before six months of age, we characterised the baby as experiencing EBF for the first 6 months. Our goal was to separate the behaviours and the intentions associated with early complementary feeding from the behaviours and intentions associated with giving a newborn a traditional substance that was not intended as complementary feeding. For outcome three, we excluded from the model any data associated with index children under 6 months of age.

Covariates of interest

We included covariates of interest from three domains in our analysis: maternal, familial/community, and institutional. We considered one binary maternal behavioural variable in the regression models: whether the baby was given colostrum. We considered five additional maternal variables: maternal educational status, marital status, language spoken, literacy status, and the assigned sex of the index child; we assumed that these variables would not have changed between the time that the baby was born and the interview. Based on the distribution of marital status, we grouped the responses into two categories: (a) married living with spouse or (b) "single", which refers to single/living separately, widowed, divorced, never married, and so forth. We grouped mother's language into two categories: "Amharic" versus "other." We grouped literacy into two categories based on the overall distribution of answers: (a) can both read and write versus (b) "can read but cannot write" and also "can neither read nor write."

We controlled for one familial/community variable, the mother's geographic zone, in all models to account for differences in accessibility and use of health services, as well as cultural differences that may be present in different locations. Victora et al.[22] recently reviewed evidence on maternal and child undernutrition and emphasised that many variables, including those related to breastfeeding, demonstrate substantial heterogeneity, even within countries.

Finally, two institutional variables were available and appropriate to consider: whether the baby was put to the breast before or after the mother was cleaned, and whether the baby was put to the breast before or after the baby was cleaned. Given strong collinearity between these variables (Spearman's Rank Correlation Coefficient, results not shown), we collapsed these two variables into a single variable with the following categories: baby put to the breast before both baby *and* mother were cleaned; baby put to the breast after both baby *and* mother were cleaned, and baby put to the breast after *either* mother *or* baby were cleaned. We also assessed the variable that captures whether someone checked to see if the baby was sucking well; this variable could be considered either "institutional" or "maternal," depending on where the mother gave birth (data were not available) and who checked, which in some cases was the mother herself. We constructed this variable as categorical; we compared whether nobody checked versus a healthcare worker (i.e., doctor, nurse, midwife, physician assistant, traditional birth attendant, health extension worker, or volunteer HDA/WDA [Health Development Army/Women's Development Army]), only the mother, or family/friends checked.

Data cleaning

Each variable was checked for blank values and outliers. One mother was recorded as breastfeeding >40 times per day; we excluded that value from the analysis due to low biological plausibility but retained the rest of the data for that participant. No other data was discarded.

Approach to model building

We developed three directed acyclic graphs (DAGs) to describe the hypothesised relationships among covariates of interest and potential confounders (Figures S1a, S1b, and S1c). Based on the hypothesised causal relationships shown in the three DAGs, we used multivariate logistic regression models to assess associations between each covariate of interest (maternal, familial/community, and institutional factors) and the three outcome variables, controlling for possible confounders.

The three outcomes, described above, captured EBF at three timepoints: within 1 h of birth, within 3 days of birth, and within 6 months of birth (optimal breastfeeding). Additional variables were selected based on a background literature review, temporal plausibility, our original hypotheses, the availability of data, and the appropriateness of the data for logistic regression models. We only used data in the logistic regression models if doing so did not violate

temporal plausibility. For example, data collected about a mother's employment referred to her employment *at the time of the interview*, while data about how an infant was fed within the first hour, within the first 3 days, and within the first 6 months may have happened months before the interview date and possibly before she had undertaken her present employment. We also received a substantial amount of data on complementary feeding practices,[21] which is not the focus of the present study. Variables related to complementary feeding were used only to determine whether EBF had occurred for 6 months. We had data about the mother's religion at the time of the interview, but nearly all respondents reported the same religion, so we excluded this variable from our statistical models out of concern for unstable estimates.

Observations with missing data were excluded from analyses. We calculated frequencies and percentages for demographic and breastfeeding variables, including our three outcomes of interest. Mother's age, education level, marital status, and primary language were not associated with any of the three outcomes of interest in a set of exploratory analyses (not shown), so we did not use them as control variables. We cleaned and verified the data using SPSS (Version 28.0.0) and all other statistical analyses were performed using SAS version 9.4 (SAS Institute).

Protection of human subjects

The initial study was reviewed and approved by the Addis Continental Institute of Public Health Review Board. The Tufts University Institutional Review Board deemed this study exempt from review. The data set contained no identifying information, and the data analysis was secondary and did not involve manipulation of any personal information from human participants.

RESULTS

Descriptive statistics

Demographic variables

A total of 3113 women participated in this study from three zones in Northwest Ethiopia (Table 1). At the time of the interview, most had never attended school or did not finish first grade (67.6%) and were married and living with their spouse (90.3%). About a quarter of participants were able to read and write (24.5%). The average age of the mothers was 28 ± 6.1 years old and the average age of infants was 12.5 ± 6.2 months. Infants were 49.6% female. Mothers mainly reported that they were not heads of households (93.4%) and almost all mothers (96.0%) reported they were Orthodox Christian. Most (85.0%) reported Amharic as their primary language and most mothers performed unpaid household work, as of the time of their interview

TABLE 1 Distribution of demographic variables ($N = 3113$)

Variable	*N*	%
Mother's education level		
Never attended school or did not finish 1st grade	2103	67.6
Completed Grade 1, 2, or 3	320	10.3
Completed Grade 4, 5, or 6	241	7.7
Completed Grade 7, 8, 9, 10, or 11	289	9.3
Completed high school or beyond	83	2.7
Missing	77	2.5
Mother's marital status		
Married living with spouse	2811	90.3
Divorced/separated	154	4.9
Single/never married	64	2.1
Married living separately	64	2.1
Widowed	20	0.6
Mother's literacy status		
No, cannot read or write	2281	73.3
Yes, read and write	764	24.5
Yes, read but cannot write	63	2.0
Missing	4	0.1
Mother is head of household		
No	2908	93.4
Yes	196	6.3
Missing	9	0.3
Religion of mother		
Orthodox Christian	2990	96.0
Muslim	111	3.6
Other	6	0.2
Missing	6	0.2
Language of mother		
Amharic	2677	86.0
Other	398	12.8
Missing	38	1.2
Interviewer used translator		
No	2580	82.9
Yes	417	13.4
Missing	116	3.7
Mother's age		
15–20 years	401	12.9
21–25 years	793	25.5

(Continues)

TABLE 1 (Continued)

Variable	N	%
26–30 years	1007	32.3
31–35 years	520	16.7
36–40 years	328	10.5
41+ years	61	2.0
Missing	3	0.1
Child's assigned sex		
Male	1569	50.4
Female	1544	49.6
Child's age		
0–1 months	90	2.9
2–3 months	127	4.1
4–5 months	153	4.9
6–7 months	358	11.5
8–9 months	363	11.7
10–11 months	340	10.9
12+ months	1634	52.5
Missing	48	1.5
Mother works outside of household		
No	2698	86.7
Yes	373	12.0
Missing	42	1.3
Mother's profession		
Household work	2634	84.6
Business/trader	168	5.4
Farmer	117	3.8
Other/self-employment	56	1.8
Salary/wage worker permanent	51	1.6
Handicraft	30	1.0
Daily labourer	27	0.9
Other	26	0.8
Missing	4	0.1
Method of payment for main occupation		
Missing	2641	84.8
Money	297	9.5
Nothing	137	4.4
In kind	21	0.7
Money and in kind	17	0.5

(84.6%) (Table 1). Finally, 13.4% of mothers requested a translator for the interview.

Breastfeeding overview

Most babies (89.9%) received strictly breastmilk within 1 h after birth, within the first 3 days (84.2%), and within the first 6 months (77.7% of babies 6 months and older, $n = 2712$) (Table 2). Most mothers (73.8%) reported giving colostrum. When colostrum was not given, the most common reason reported for this was the perception that it was "not good for the baby" (12.3%). About half (52.7%) of babies were put to the mother's breast before someone cleaned the baby. Similarly, about half (54.4%) of babies were put to the mother's breast before someone cleaned the mother, and in most cases (72.3%), participants reported that they or someone else checked to see if the baby was sucking well during the first time they breastfed. Midwife/nurse/physician assistants (27.1%) or mothers (27.8%) were most commonly the persons who checked to see if the baby was sucking well.

Multivariate logistic regression models

Three covariates of interest were significantly associated with the first outcome, EBF within 1 h of birth: the baby's assigned sex being male (OR 0.75, 95% CI 0.59–0.97), colostrum being given (OR 2.13, 95% CI 1.64–2.77), and the baby being put to the breast before cleaning the baby *and* before cleaning the mother (OR 2.28, 95% CI 1.65–3.15) (Table 3). Three covariates were significantly and positively associated with EBF for the first 3 days: colostrum being given (OR 1.87, 95% CI 1.50–2.33), at least one health professional having checked to see if the baby was sucking well (OR 1.80, 95% CI 1.34–2.41), and the baby being put to the breast before cleaning the baby *and* before cleaning the mother (OR 2.28, 95% CI 1.75–2.97). For the final outcome of interest, EBF for 6 months, a single covariate of interest was significantly and positively correlated: colostrum being given (OR 1.85, 95% CI 1.41–2.43).

DISCUSSION

Breastfeeding is a learned health behaviour that requires a supportive environment.[2] It is also a health behaviour that tends to be practiced more frequently in households with lower SES than in households with higher SES, when considering the case of LMICs.[22] Women in the three zones of our study had high rates of breastfeeding overall and strong early initiation of breastfeeding, in line with WHO recommendations. While these findings are undoubtedly

TABLE 2 Distribution of breastfeeding variables ($N = 3113$)

Variable	N	%
Given to the baby within 1 h after birth		
Only breastmilk	2799	89.9
Something other than breastmilk or breastmilk not given within 1 h	300	9.6
Don't know/remember	14	0.4
Given to the baby during the first 3 days after birth		
Breastmilk	2635	84.6
Anything besides strictly breastmilk/don't know	475	15.3
Missing	3	0.1
Given to the baby during the first 6 months after birth		
Only breastmilk*	2420	77.7
Complementary foods/drinks, water, formula, rice gruel, etc. in addition to or as a replacement for breastmilk	288	9.3
Missing	4	0.1
Not applicable - child <6 months old	401	12.9
Baby was put to the breast before/after someone cleaned the baby		
Before cleaning baby	1639	52.7
After cleaning baby	1446	46.5
Don't know/remember	25	0.8
Missing	3	0.1
Baby was put to the breast before/after someone cleaned mother		
Before cleaning mother	1695	54.4
After cleaning mother	1399	44.9
Don't know/remember	8	0.3
Missing	11	0.4
Someone checked to see if the baby was sucking well		
Yes	2250	72.3
No	846	27.2
Don't know/remember	14	0.4
Missing	3	0.1
Person who checked to see if the baby was sucking well (multiple responses possible)		
Mother (self)	913	29.3
No one checked	846	27.2
Midwife/nurse/physician assistant	844	27.1
Volunteer (WDA/HDA)	491	15.8
Maternal or paternal grandmother of baby	491	15.8
Neighbour/friend of mother	396	12.7
Other family member	224	7.2
Health extension worker (HEW)	177	5.7
Traditional birth attendant (TBA)	96	3.1
Doctor	60	1.9
Other	11	0.4
Baby given colostrum		
Yes	2296	73.8
No	805	25.9
Missing	12	0.4
Reason for not giving colostrum		
Not good for the baby	382	12.3
It was yellow/dirty	222	7.1
Traditionally not given	183	5.9
Told to not give it	92	3.0
Other	89	2.9
Baby was thirsty	16	0.5

*If a substance was giving immediately after birth, but not intended as a complementary food/beverage source, we did not exclude those mother/child pairs from being characterised as performing EBF for 6 months.

positive, other studies have found varying prevalences of EBF, emphasising the need to better understand factors related to EBF.[23] For example, a systematic review and meta-analysis of breastfeeding across Ethiopia showed heterogenous prevalence; the pooled prevalence for Ethiopia was 59%, but prevalence by region ranged from 29% to 86% across multiple studies.[24] In our models, mother's zone of residence likely captures many potential factors that could impact EBF at different times, including factors as varied as social norms and local culture and the typical distance to primary and secondary healthcare facilities.

Our study showed that EBF prevalence at 6 months was 77.7%. This is relatively high, compared with studies focused on other areas. In one study from a semi-urban Nigerian community, 53% of women reported EBF at 6 months.[25] Similarly, a systematic review that assessed 18 studies across East Africa (Ethiopia, Kenya, Rwanda, Uganda, and Tanzania) found that 55.9% of mothers practiced EBF for a minimum of 6 months.[26] While we do not have causal evidence to demonstrate this, higher rates of EBF in our data set may result, in part, from progressive initiatives implemented by the Ministry of Health of Ethiopia focused on infant and young child feeding that may increase engagement in EBF. Implementation guides, as well as concrete interventions and goals, have continuously been championed by Ethiopian national agencies, which have contributed to increased rates of EBF

TABLE 3 Logistic regression models showing each of three outcomes

Model #	Potential risk factors	OR	95% CI	Outcome
1	Baby's assigned sex male (ref. = female)	**0.75**	**(0.59–0.97)**	EBF within 1 h of birth ($n = 3099$)
2	Mother able to read and write (ref. = cannot read and write/cannot write)	1.26	(0.92–1.72)	EBF within 1 h of birth ($n = 3099$)
3	Colostrum given (ref. = not given)	**2.13**	**(1.64–2.77)**	EBF within 1 h of birth ($n = 3099$)
4	Person who checked to see if baby was sucking well (ref. = nobody)			EBF within 1 h of birth ($n = 3099$)
	At least one health professional	1.28	(0.90–1.83)	
	Only mother	1.12	(0.75–1.68)	
	Other family/friends	0.94	(0.69–1.30)	
5	Baby fed before/after cleaning mother and baby (ref. = baby fed after cleaning both)			EBF within 1 h of Birth ($n = 3099$)
	Baby fed before cleaning mother and before cleaning baby	**2.28**	**(1.65–3.15)**	
	Baby fed after cleaning either mother or baby	1.14	(0.83–1.58)	
6	Baby's assigned sex male (ref. = female)	0.83	(0.67–1.02)	EBF for 3 days ($n = 3113$)
7	Mother able to read and write (ref. = cannot read and write/cannot write)	1.02	(0.79–1.32)	EBF for 3 days ($n = 3113$)
8	Colostrum given (ref. = not given)	**1.87**	**(1.50–2.33)**	EBF for 3 days ($n = 3113$)
9	Person who checked to see if baby was sucking well (ref. = nobody)			EBF for 3 days ($n = 3113$)
	At least one health professional	**1.80**	**(1.34–2.41)**	
	Only mother	1.08	(0.79–1.49)	
	Other family/friends	1.18	(0.90–1.54)	
10	Baby fed before/after cleaning mother and baby (ref. = baby fed after cleaning both)			EBF for 3 days ($n = 3113$)
	Baby fed before cleaning mother and before cleaning baby	**2.28**	**(1.75–2.97)**	
	Baby fed after cleaning either mother or baby	1.06	(0.81–1.39)	
11	Baby's assigned sex male (ref. = female)	1.20	(0.93–1.54)	EBF for 6 months ($n = 2712$)
12	Mother able to read and write (ref. = cannot read and write/cannot write)	1.03	(0.77–1.39)	EBF for 6 months ($n = 2712$)
13	Colostrum given (ref. = not given)	**1.85**	**(1.41–2.43)**	EBF for 6 months ($n = 2712$)
14	Person who checked to see if baby was sucking well (ref. = Nobody)			EBF for 6 months ($n = 2,712$)
	At least one health professional	0.99	(0.71–1.38)	
	Only mother	1.09	(0.72–1.65)	
	Other family/friends	1.07	(0.76–1.50)	

Abbreviations: CI, confidence interval; OR, odds ratio.

Model 1 adjusted for zone, mother's literacy, whether colostrum was given, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 2 adjusted for zone, baby's sex, whether colostrum was given, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 3 adjusted for zone, baby's sex, mother's literacy, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 4 adjusted for zone, baby's sex, mother's literacy, whether colostrum was given, and whether the baby/mother were cleaned before the baby was fed.

Model 5 adjusted for zone, baby's sex, mother's literacy, whether colostrum was given, and who checked to see if baby was sucking well.

Model 6 adjusted for zone, mother's literacy, whether colostrum was given, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 7 adjusted for zone, baby's sex, whether colostrum was given, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 8 adjusted for zone, baby's sex, mother's literacy, who checked to see if baby was sucking well, and whether the baby/mother were cleaned before the baby was fed.

Model 9 adjusted for zone, baby's sex, mother's literacy, whether colostrum was given, and whether the baby/mother were cleaned before the baby was fed.

Model 10 adjusted for zone, baby's sex, mother's literacy, whether colostrum was given, and who checked to see if baby was sucking well.

Model 11 adjusted for zone, mother's literacy, whether colostrum was given, who checked to see if baby was sucking well.

Model 12 adjusted for zone, baby's sex, whether colostrum was given, who checked to see if baby was sucking well.

Model 13 adjusted for zone, baby's sex, mother's literacy, who checked to see if baby was sucking well.

Model 14 adjusted for zone, baby's sex, mother's literacy, whether colostrum was given.

across the country, particularly in the rural regions.[27] We also found statistically significant associations between EBF at three timepoints and maternal behaviours, familial/community factors, and institutional factors, which we discuss here in greater detail.

Practice of giving colostrum

Giving colostrum immediately after birth was the factor most strongly associated with EBF at all three timepoints. Nearly three quarters of women in our study gave their babies colostrum. In the literature, there have been mixed findings related to this. A study in Northwest Ethiopia showed that colostrum avoidance was 22%; the authors concluded that there was a significant association between delayed breastfeeding initiation and colostrum avoidance.[28] G/slassie et al.[28] also found that mothers who gave birth in healthcare institutions were 94% less likely to avoid colostrum, adjusting for place of delivery and counselling on timely breastfeeding initiation; this suggests a key area for an experimental study to determine whether promoting colostrum feeding results in improved EBF at multiple times. In contrast, a study from Northeast Ethiopia showed that most women (>75%) discarded their colostrum[29] and Rollins et al.[8] reviewed work that described colostrum avoidance in India. In general, while there is ample evidence showing the importance of colostrum for newborns, linking various health and developmental indicators to colostrum feeding for newborns within the first 3 days of birth,[30,31] it remains unclear whether a causal relationship exists between giving colostrum and longer-term EBF. This is an important area for future study.

There is also a need for additional research on strategies to strengthen colostrum feeding knowledge and behaviours among mothers and community members. Some authors recommend strengthening colostrum feeding knowledge among mothers and developing trust between mothers and healthcare providers to encourage early initiation of breastfeeding and colostrum feeding in Ethiopia.[29] Not only is encouragement important, the type of support provided may also help ensure an understanding of the cultural and traditional beliefs and attitudes surrounding colostrum-feeding.[32] The development of breastfeeding promotion programmes, especially those that specifically support colostrum feeding, should account for social beliefs based on the setting.[32] We recommend additional research that builds upon our findings and specifically considers whether the strong relationship we see between giving colostrum and EBF is causal, or if there is simply an association.

Early breastfeeding support

Our second key finding was that putting the baby to the breast before cleaning the baby and before cleaning the mother was positively associated with EBF within the first hour and the first 3 days of life. We hypothesise that immediate prioritisation of putting the baby to the breast following birth is associated with breastfeeding support that aligns with current scientific guidelines. Those attending the birth where breastfeeding support occurs may be well equipped to ensure that a mother receives current guidance about the importance of feeding colostrum and continuing exclusive breastfeeding for 6 months. The birth attendants may also be more likely to discourage the mother, other family, or friends from giving the baby anything other than breastmilk. Finally, cleaning the baby and cleaning the mother takes time, and spending time on those actions detracts from the time available to put the baby to the breast within 1 h of birth. If further research can show a causal relationship between encouraging birth attendants to feed the baby *before* cleaning the baby or the mother and EBF, this could be an opportunity to improve early initiation of EBF.

A third key finding, which is also related to early breastfeeding support, is that having at least one healthcare provider check to see if the baby was sucking well was significantly associated with EBF for the first 3 days. While our study is not designed to explore *why* this action is associated with EBF, we speculate there may be a positive impact of receiving or perceiving the receipt of support, especially from a trained health professional. In Ethiopia, at the time that the data for our study were collected, most women gave birth at home (90% of women in 2011 and 73% of women in 2016) and only 11% of births were attended by a skilled provider in 2011, compared with 28% in 2016.[33] These numbers have since improved with the Ethiopian government's focus on institutional deliveries, but still only about half of births take place in healthcare facilities and about half are attended by skilled providers,[33] suggesting a continuing strong role for community-based support of early and exclusive breastfeeding. Given that many births continue to occur outside of healthcare settings, it would be useful to study whether having a healthcare professional check to see if the baby is sucking well has a causal relationship with EBF; if so, it would be extremely helpful to conduct qualitative research and understand the underlying mechanism.

Early breastfeeding support in the form of education may be welcomed in rural parts of Ethiopia. A study conducted in Northeastern Ethiopia pointed to the need for education about the early initiation of breastfeeding, especially for girls and young women who lack formal education.[34] Socio-cultural influences, such as during home births, can have more influence on mothers' decision-making than professional breastfeeding counselling.[35] In a study in Uganda, women received an intervention focused on breastfeeding education and support from peer counsellors rather than professional healthcare workers; of those who received the peer counselling, approximately 95% reported satisfaction with their counsellors, especially with respect to their friendliness, suggesting that these types of

positive interactions can serve as an avenue to receive proper breastfeeding instruction in a relaxed and familiar format.[36] Support systems, such as educational programmes to effectively promote EBF, should be culturally sensitive and adapt to varying settings, and should be rigorously assessed to see if they would be effective in different zones of Ethiopia.

Other studies have shown that extra support, by either breastfeeding professionals or lay people, can improve the duration of EBF.[37] Abdulahi et al.[38] conducted a study in rural Ethiopia focused on peer support to improve early initiation of breastfeeding and found that community-led education where trained peers provided support to mothers improved breastfeeding attitudes and breastfeeding practices. There was a 25.9% increase in early breastfeeding initiation and 14.6% increase in EBF among the women in the programme compared to those in the control group.[38] Maternal concerns about insufficient milk supply and worries about a baby's fussiness were also reviewed by Rollins et al.[8]

Rollins et al.[8] showed a significant and positive impact on breastfeeding with home- and family based interventions that provided mothers with support, especially if they focused on *both* antenatal *and* postnatal counselling. Similarly, positive and significant findings were associated with community-based interventions such as group counselling or group education,[8] both of which can be perceived by mothers as supporting EBF.

Finally, we hypothesise that the practice of immediately putting baby to the breast and the intentional focus on checking the baby's breastfeeding could minimise early distractions that, under different circumstances, might delay breastfeeding initiation. Additional research is needed to understand whether putting the baby to the breast before cleaning the baby or mother and having someone check to see if the baby is sucking well might both be associated with a mother's strong overall support system and recognition of the importance of early and exclusive breastfeeding. Qualitative work in this area is also merited, specifically to understand the ways that these institutional factors might promote EBF.

Timebound breastfeeding challenges

In our study, we have highlighted the need to consider factors associated with breastfeeding at multiple timepoints. Interventions to improve breastfeeding frequently have timebound impacts.[8] Rollins et al.[8] performed a systematic review and meta-analysis and presented the effectiveness of interventions at various timepoints: within 1 h of birth, EBF for 0–5 months of age, continued breastfeeding from 12 to 23 months, and "any" breastfeeding for the first 6 months. This study discussed a suite of statistically significant interventions that have positively impacted breastfeeding outcomes in health systems/facilities; among family and in the community; in the work environment; and in a combination of settings.[8]

Early in the postnatal period, factors such as the lack of breastfeeding support at hospitals and insufficient lactation education can prove to be challenges.[8] These challenges can present differently at varying time periods post-partum. Later in the postnatal period, for example, in many countries in Africa and Asia, informal workplaces with few or no maternity leave policies can significantly challenge EBF,[8] but the impact would depend on the percentage of women returning to the paid workforce after giving birth and the specifics of their circumstances when they do return. Breastfeeding cessation due to women returning to or remaining in the paid workforce outside the home would likely be at least partially addressed by implementing paid maternity leave, affordable childcare options, and explicit support for breastfeeding and breastmilk expression in workplaces.[8] The impact of these types of changes remains to be well-studied in LMICs.[8]

Limitations

Our study has several limitations. First, our study was limited to quantitative data; thus, we were unable to understand in greater depth why certain factors are associated with EBF. Second, we lacked data on whether the index child was the first child a mother had tried to breastfeed, which may influence a mother's breastfeeding experiences. Third, participants in this study may not have recalled all information related to their breastfeeding practices or behaviours or they may have exhibited social desirability bias. Mothers were sometimes interviewed months after the birth of the index child, and they may not accurately remember details from immediately after childbirth. Some studies show an overestimation of breastfeeding practices when retrospective data collection, such as interviews with mothers, takes place.[39] Finally, in future studies, there are additional variables that would be ideal to consider at multiple timepoints during the first 6 months of a child's life, such as whether or not they were born in a healthcare facility, whether their mothers were employed before giving birth, whether their mothers returned to work or planned to return work within the first 6 months, whether mothers perceived that employment impacted their decision to breastfeed and to offer complementary foods, and the family's socioeconomic status, among others.

CONCLUSIONS

In this study, we illuminated two key findings by looking at outcomes that differed temporally. First, giving babies colostrum was significantly associated with exclusive breastfeeding at every time point, controlling for multiple confounders. Second, giving colostrum, putting the baby to the breast before cleaning, and healthcare professionals checking whether the baby was sucking well were all

significantly associated with EBF for 3 days post-birth. These results align with evidence in the literature that colostrum feeding is a positive factor in EBF prevalence in northern Ethiopia. Our study further showed that 6 months of exclusive breastfeeding was strongly associated with giving colostrum. These results suggest a connection between social and institutional supports and exclusive breastfeeding, and demonstrate the consistency of some relationships among variables, even over time. Given that the Ministry of Health in Ethiopia seeks to improve EBF prevalence,[5] our findings could aid in developing strategies and interventions to promote EBF. It is important that factors such as colostrum feeding, timing of cleaning the baby and mother after birth, and support systems for mothers who are breastfeeding are thoroughly considered while developing facility-based interventions that aim to increase EBF prevalence in the Northern, rural regions of Ethiopia. Additionally, community-based interventions can also incorporate an understanding of cultural norms that impact EBF. Our research can inform strategies to promote sustained breastfeeding among women and suggest future directions for research that could establish causal relationships.

AUTHOR CONTRIBUTIONS

Seblewongel Yigletu and Karen C. Kosinski conceptualised the study. Seblewongel Yigletu, Shalini A. Tendulkar, Ashley C. Holmes, and Karen C. Kosinski drafted the manuscript, and all co-authors edited the manuscript. Semira Abdelmenan, Amare W. Tadesse, and Hanna Y. Berhane provided access to and support with data and data analysis. Ashley C. Holmes performed statistical analyses. All co-authors contributed to the literature review for this study. The manuscript was approved by all authors.

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We received no funding for this study, and we have no conflicts of interest to declare. SY, SA, AT, HYB, and KCK contributed to the study conceptualisation and study design. SY conducted a review of the literature. SY, ST, ACH, and KCK analysed the data and wrote the results. All authors discussed the findings, contributed to manuscript preparation, reviewed the manuscript, and approved the final manuscript. The authors received no funding to conduct this study.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data analysed in this study were secondary data and as such, we do not have permission to share the data set. Access can be requested from the data-holding entity. Data used in our study can be obtained by contacting the Addis Continental Institute of Public Health in Ethiopia and making a request for data access.

ETHICS STATEMENT

The initial study was reviewed and approved by the Institutional Review Board of Addis Continental Institute of Public Health. The Tufts University Institutional Review Board deemed this study exempt from review. The data set contained no identifying information, and the data analysis was secondary and did not involve manipulation of any personal information from human participants.

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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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