

Do breastfeeding practices correlate with childhood diarrhoea? Multiple data analyses using national surveys in Ghana

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Research

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Abstract

Background: Breastfeeding is a natural intervention that tends to have a protective effect on the occurrence of diarrhoea in children. In environments where breastfeeding is suboptimal coupled with the early introduction of complementary foods, children are at a higher risk of experiencing diarrhoea. This study examined whether breastfeeding practices are associated with childhood diarrhoea in Ghana using multiple secondary datasets.

Methods: The study used Ghana Demographic and Health Survey (GDHS) 2003, 2008 and 2014 datasets. These datasets contain data on women and issues related to children who were two years of age (0-23 months). An appended weighted sample of 4,675 mother-child pairs was used for the analyses. Logistic regression analyses were performed to assess the association between breastfeeding practices (including other explanatory variables) and childhood diarrhoea.

Results: Children who were not exclusively breastfed had higher odds of experiencing diarrhoea. These categories of children most likely to be exposed to diarrhoea included those who were not breastfeeding (OR = 3.382, 95% CI = 2.019, 4.820), predominantly breastfeeding (OR = 1.824, 95% CI = 1.198, 2.777), and partially breastfeeding (OR = 2.795, 95% CI = 1.931, 4.047).

Conclusions: Findings for this study further affirms to the protective effect breastfeeding has against childhood diarrhoea. Exclusive breastfeeding and at times predominant breastfeeding could prevent or minimize diarrhoea compare to non-practice of breastfeeding or partial breastfeeding.

Introduction

Infectious diseases among children are accorded much public health attention due to their adverse impact on their growth and development. And diarrhoea is one of the leading causes of morbidity and mortality among children worldwide with much of its burden being accounted for by less developed and resource-poor countries [1]. Projections show that diarrhoea contributed to about nine percent of all deaths among children under age five thus being the second-highest cause of childhood mortality [2]. However, appropriate feeding practices have proven to be effective at reducing these mortalities. In a cohort study consisting of 18,819 infants, optimal breastfeeding was associated with a 53 percent decrease in hospital admissions for diarrhoea [3].

Global projections show that diarrhoea contributed to about 63 percent of morbidities among children under age five and it is the second highest cause of childhood morbidity [4,5] (Zhang et al., 2017; Kotloff, 2017). Also, an estimated 1.3 million diarrhoeal morbidities annually occur in developing countries where living conditions are mostly unfavourable for the nurturing of children [6,7] (Global Burden of Diarrhoeal Diseases Collaborators [GBDDC], 2017; Charyeva et al., 2017).

In Ghana, national surveys suggest that a decline, although still high, in the prevalence of diarrhoea from 19.8 percent in 2008 to 12 percent in 2014 [8-10]. However, the same surveys have documented decrease in the rates of exclusive breastfeeding (63% in 2008 to 54% in 2014) and an increase in the introduction of complementary foods (68% in 2008 to 88% in 2014) to children. This certainly means that more infants and young children are being introduced to complementary foods early that has reduced exclusive breastfeeding rates therefore contributing to steady incremental occurrence of diarrhoea among the children. The slight decline in diarrhoea and the downward and upward rates of exclusive and complementary feeding respectively suggests the interplay of some confounding factors. And in situations where complementary foods are contaminated or are not nutritionally balanced, infants and young children are most likely to be exposed to morbidities such as diarrhoea.

Notwithstanding the contributions made by studies [11, 12] to child health and nutrition literature, less attention has been paid to breastfeeding practices (of mothers with children less than two years) which is a key variable in early childhood

infections pathways. At best, where breastfeeding is considered, it is presented as a confounding variable including others. Yet, breastfeeding practices of children are pre-requisite to their positive growth and development, health and survival [13]. In this study was intended to respond to the question of whether breastfeeding practices correlate with diarrhoea among infants and young children.

The study sought to assess breastfeeding practices and risks of childhood diarrhoea in Ghana using separate datasets from the Ghana Demographic and Health Surveys (GDHS) conducted in years of 2003, 2008 and 2014. It considered potential factors at the individual-level, community-level, health-level and environmental-level to accomplish its purpose. Findings of the study would add new insights to the interactions between breastfeeding practices and diarrhoea by holding constant some pertinent factors in the areas of child health and nutrition.

Methods

Data source and sample group

The study used data from GDHS. More information about the surveys can be found at <http://dhsprogram.com/data/dataset/Ghana>. The specific data used in this study were from the GDHS 2003, 2008 and 2014 datasets. These datasets contain details on, but not limited to, mothers characteristics, breastfeeding practices and childhood morbidity (diarrhoea). Mothers (15-49 years) who had a child less than two years of age (0-23 months) and that child was living with the mother at the time of the survey were selected. An appended weighted sample of 4,675 mother-child pairs was used for the analyses (Table 1). Also, more about the sample procedures used in the GDHS are available at <http://www.dhsprogram.com/publications/publication-FR307-DHS-Final-Reports.cfm>.

Table 1: Sample group

Age	Survey year		
	2003	2008	2014
0-5	307 (26.15)	307 (26.14)	561 (47.71)
6-11	370 (29.68)	297 (23.81)	579 (46.51)
12-23	662 (29.38)	530 (23.50)	1062 (47.12)
Total	1339 (28.64)	1134 (24.25)	2202 (47.11)

N = 4675

Exposure variable

The exposure variable, breastfeeding practice(s), which is hierarchically and mutually exclusive, was coded as *no breastfeeding* = 0; *exclusive breastfeeding* = 1; *predominant breastfeeding* = 2; and *partial breastfeeding* = 3. These categories are defined as follows, within 24 hours preceding each survey: (i) no breastfeeding – children were not breastfeeding; (ii) exclusive breastfeeding – children were only fed with breast milk; (iii) predominant breastfeeding – children were breastfed with breast milk including plain water, non-milk liquids and other milk; and (iv) partial breastfeeding – children were fed with breast milk plus complementary foods.

Outcome variables

The outcome variable was diarrhoea. Data on 'all diarrhoea' and 'diarrhoea with blood' were collected. Mothers were asked, "whether any of their children under five years of age had diarrhoea during the two weeks preceding the survey". The responses to this question were: *No*=0; *Yes, last two weeks*=1; *Don't know*=8. All the "Don't Know" responses on the dependent variables were excluded from the analysis since the study was only interested in responses that were captured on either a child had diarrhoea or no diarrhoea. The outcome variable was dichotomized a format of *No* = 0 and *Yes* = 1.

Explanatory variables

The review of related literature and extensive data mining informed the choice of afore-mentioned explanatory variables. These variables included: maternal education, working status, place of residence, preceding birth interval, source of drinking water, type of toilet facility, and type of floor material. The explanatory variables were arbitrarily assigned numeric codes starting with either '0' or '1'.

Maternal education was categorized into no education, primary, and secondary or higher. For preceding birth interval, births of mothers were recoded into those who had less than 24 months and those of 24 months or more. Environmental variables that may help explain diarrhoea episodes in children include a source of drinking water, type of toilet facility, and type of floor material. The various responses given by mothers, in the aforementioned variables, were recoded as either 'improved' or 'unimproved'. Responses for source of drinking water were categorized as follows: improved sources (piped into dwelling, piped to yard/plot, public tap or standpipe, tube-well or borehole, protected well, protected spring, rainwater) and unimproved sources (unprotected spring, unprotected well, river/dam/lake/ponds/stream/canal/irrigation, tanker-truck, cart with small tank, bottled water sachet).

For type of toilet facility, improved facilities included flush to piped sewer system, flush to septic tank, flush to pit latrine, flush to somewhere else, ventilated improved pit latrine (VIP), pit latrine with slab, composting toilet, and a special case (i.e., flush/pour flush of excreta to a place unknown to the respondent); and unimproved facilities consisted of flush/pour flush to elsewhere (such as street, yard/plot, open sewer or a ditch), pit latrine without slab, bucket, hanging toilet or hanging latrine, shared sanitation, no facilities, bush or field). The above categorizations are in accordance to World Health Organisation (WHO) and United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) for Water and Sanitation [14].

Furthermore, type of floor material was grouped as improved (tablets/wood/planks, palm/bamboo, mat, adobe, parquet/polished wood, vinyl/asphalt strips/ floor mat, linoleum, ceramic tiles/mosaic, cement, carpet, stone, bricks); and unimproved (earth, sand, clay, mud, dung). These categorizations conform with the Demographic and Health Surveys (DHS) programme [15].

Data analysis

Prevalence rates of diarrhoea were initially examined among the explanatory variables and the chi-square test of independence was used to identify significant associations. Only independent variables that had a p -value less than 0.25 at the chi-square test were considered for the logistic regression. Applying hierarchical logistic regression modelling procedures, categories of significant factors associated with diarrhoea were ascertained. To finally examine the interactive nature of the outcome, exposure and explanatory variables, a single multilevel logistic modelling approach was applied. Thus, logistic regression analyses were performed to assess the effect of explanatory variables that were considered as potential confounders on the association between breastfeeding practices and childhood diarrhoea. Essentially, the various explanatory variables were nested in the exposure variable to estimate their effect on the outcome variable (diarrhoea). Probability values (p -values) of 0.01, 0.05 and 0.001 were used to establish significant associations. Results were presented in odds ratio and 95% Confidence Interval (CI). STATA (version 12.0) was used to process the data.

Results

Prevalence of breastfeeding practices among children aged 0-23 months

Fig. 1 shows the prevalence of breastfeeding practices among children aged 0-23 months. A gradual increase in numbers from the middle ages towards the last ages were not breastfeeding. An opposite pattern was observed with those who were exclusively breastfeeding. Thus, exclusive breastfeeding rates from birth starts to decrease steadily as children grew older. Predominant breastfeeding was common among children aged 0-6 months and then starts to decrease steadily as they aged. The occurrence of partial breastfeeding was normally distributed among the children and much of the partial breastfeeding practices were heaped in the middle ages.

Prevalence of diarrhoea among children (0-23 months)

From preliminary analysis, the prevalence of diarrhoea was 13 percent among the children. The results further indicate that maternal education, working status, place of residence, source of drinking water, and type of toilet facility were statistically associated with diarrhoea.

Slightly more than two-fifth of children whose mothers had no education (20%) and 15 percent of those with secondary or higher levels of education reported childhood diarrhoea episodes (Table 2). A higher prevalence of diarrhoea cases was observed among children whose mothers were working. Also, the proportion of diarrhoea among children in rural areas was 20 percent compared with 15 percent in urban areas. Prevalence of diarrhoea was higher among children with mothers who had access to an improved source of drinking water (19%) compared with those who had access to an unimproved source of drinking water (15%). A higher proportion of diarrhoea was linked with children whose mothers had access to unimproved toilet facilities (21%) than those who had access to improved toilet facilities (16%) (Table 2).

Table 2: Prevalence of diarrhoea among mother-child pairs (0-23 months) for all years

Variable	p-value	Reported cases of diarrhoea	
		n	%
Maternal education	0.0016***		
No education		304	20.41
Primary		195	19.74
Secondary/Higher		337	15.37
Working status	0.4539*		
Not working		156	16.91
Working		679	18.16
Place of residence	0.0121***		
Urban		288	15.47
Rural		548	19.52
Preceding birth interval	0.2128		
Less than 24 months		68	15.83
24 months or more		592	18.44
Source of drinking water	0.0014*		
Improved		542	19.13
unimproved		204	14.54
Type of toilet facility	0.0002***		
Improved		468	15.87
Unimproved		368	21.42
Type of floor material	0.1463		
Improved		631	17.41
Unimproved		206	19.63

*. $p < 0.01$; **. $p < 0.05$; ***. $p < 0.001$

Breastfeeding practices and risks of diarrhoea among children (0-23 months)

The multilevel logistic analysis of breastfeeding practices and risks of diarrhoea among children revealed significant associations (Table 3). In the models for each survey year, even upon controlling for potential explanatory variables,

breastfeeding practices were significantly linked to diarrhoea cases among children. The results presented hereafter are based on the models generated from pooled data from various survey years (2003,2008 and 2014). Univariate analysis revealed that children who were not exclusively breastfeeding had higher odds of experiencing diarrhoea. These categories of children most likely exposed to diarrhoea included those who were not breastfeeding (OR = 3.120, 95% CI = 2.019, 4.820), predominantly breastfeeding (OR = 1.824, 95% CI = 1.198, 2.777), and partially breastfeeding (OR = 2.795, 95% CI = 1.931, 4.047). This pattern of results was reflective in the final model when other variables were held constant. Aside children who were exclusively breastfeeding (as a reference group), those not breastfeeding (OR = 3.382, 95% CI = 2.084, 5.490) had the highest odds ratio of reported cases of diarrhoea followed by those partially breastfeeding (OR = 2.899, 95% CI = 1.965, 4.278) and the least group were those predominantly breastfeeding (OR = 1.684, 95% CI = 1.059, 2.676).

For place of residence, rural mothers (OR = 1.310, 95% CI = 1.045, 1.643) had higher odds of reported cases of diarrhoea among their children compared to their urban counterparts (Table 3). Children whose mothers had preceding birth interval of 24 months or more (OR = 1.384, 95% CI = 0.987, 1.939) had slightly higher likelihood of having diarrhoea compared to mothers with preceding birth intervals less than 24 months. Likewise, concerning mothers who had access to improved sources of water, children whose mothers used unimproved sources of drinking water had lower odds of having diarrhoea (OR = 0.726, 95% CI = 0.580, 0.910). The likelihood for the occurrence of childhood diarrhoea was higher among mother-child pairs who used unimproved toilet facilities (OR = 1.442, 95% CI = 1.156, 1.799).

Table 3: Multilevel logistic regression modelling for breastfeeding practices and the risk of diarrhoea

	Diarrhoea cases							
	2003		2008		2014		All survey years	
	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
Feeding practices								
Exclusive BF	1 9.722*** (4.382, 21.57)	1 6.290*** (2.182, 18.131)	1 3.562*** (1.917,6.618)	1 3.656*** (1.755,7.617)	1 2.800** [1.370,5.723]	1 3.495* [1.541,7.924]	1 3.120*** [2.019,4.820]	1 3.382*** [2.084,5.490]
Partial BF	6.139*** (2.948, 12.785)	3.893* (1.380, 10.983)	2.353* (1.189,4.654)	2.149* (1.075,4.297)	2.839** [1.348,5.976]	2.345** [1.013,5.426]	1.824** [1.198,2.777]	1.684** [1.059,2.676]
No BF	7.590*** (3.940, 14.622)	5.677*** (2.378, 13.549)	2.832*** (1.694,4.734)	2.877*** (1.675,4.944)	2.914*** [1.577,5.383]	3.236*** [1.617,6.474]	2.795*** [1.931,4.047]	2.899*** [1.965,4.278]
Maternal education								
Maternal education level	n.a. n.a.	1 1.862** (1.066, 3.254)	n.a. n.a.	1 0.829 (0.559,1.272)	n.a. n.a.	1 0.692 [0.425,1.126]	n.a. n.a.	1 0.924 [0.709,1.204]
Maternal education level	n.a.	1.310 (0.757, 2.268)	n.a.	0.820 (0.521,1.310)	n.a.	0.711 [0.485,1.042]	n.a.	0.785 [0.608,1.015]
Marital status								
Married	n.a. n.a.	1 0.928 (0.454, 1.897)	n.a. n.a.	1 0.603 (0.347,1.048)	n.a. n.a.	1 0.683 [0.451,1.035]	n.a. n.a.	1 0.816 [0.610,1.093]
Marital status								
Married	n.a. n.a.	1 0.970 (0.566, 1.662)	n.a. n.a.	1 1.345 (0.816,2.215)	n.a. n.a.	1 1.305 [0.918,1.856]	n.a. n.a.	1 1.310* [1.045,1.643]
Age at birth								
Age at birth	n.a. n.a.	1 1.294 (0.649, 2.579)	n.a. n.a.	1 0.939 (0.573,1.537)	n.a. n.a.	1 2.065** [1.082,3.942]	n.a. n.a.	1 1.384** [0.987,1.939]
Access to drinking water								
Improved	n.a. n.a.	1 1.065 (0.640, 1.772)	n.a. n.a.	1 0.985 (0.645,1.504)	n.a. n.a.	1 0.605* [0.423,0.867]	n.a. n.a.	1 0.726* [0.580,0.910]
Access to toilet								
Improved	n.a. n.a.	1 1.370 (1.873, 2.148)	n.a. n.a.	1 1.357 (0.940,1.973)	n.a. n.a.	1 1.609** [1.114,2.324]	n.a. n.a.	1 1.442** [1.156,1.799]
Access to floor latrine								
Improved	n.a. n.a.	1 1.820** (1.082, 3.062)	n.a. n.a.	1 1.234 (0.831,1.831)	n.a. n.a.	1 0.879 [0.581,1.328]	n.a. n.a.	1 1.222 [0.968,1.543]

*: $p < 0.01$; **: $p < 0.05$; ***: $p < 0.001$; BF: breastfeeding

Discussion

There is available evidence to show that breastfeeding minimizes the risk of diarrhoea among children [16,17,18]. The practice of optimum breastfeeding lessens exposure of infants from consuming other fluids and foods that may be unwholesome and hence their immune systems are fortified adequately to counteract any infections that may lead to diarrhoea [19]. This assertion was confirmed in the present study and some statistically significant covariates were found to be influencing the links between breastfeeding and the occurrence of diarrhoea.

Studies in sub-Saharan Africa have documented the protective effect breastfeeding has on the occurrence of diarrhoea among children [20,21]. Findings from this study indicated that exclusive breastfeeding had a protective effect on the occurrence of childhood diarrhoea. Thus, children who were not breastfeeding, predominant breastfeeding, and partial breastfeeding were at a much higher risk of contracting diarrhoea than those who were exclusively breastfed. The protective effect of breastfeeding was still evident after controlling for other potential factors. This suggests that breastfeeding could minimize episodes of childhood diarrhoea even at instances where conditions are not favourable. Human milk glycans contain oligosaccharides in their natural and conjugated forms constitute a natural immunological mechanism that accounts for the manner in which human milk offers a protective effect for breastfed infants against diarrhoea [22]. These glycans found in human milk function as soluble receptors against pathogens from adhering to their target receptors on the mucosal surface of the children's gastrointestinal tracts [23]. Also, optimum breastfeeding tends to prevent infants from consuming other fluids and foods that may be unwholesome. By so doing, infants' immune systems are fortified adequately to counteract any infections that may lead to diarrhoea [24].

Moreover, the environment in which exclusively breastfed children live could predispose them to some morbidity either in an urban area or in a rural setting. Place of residence, as an indirect factor, was found to be significantly associated with diarrhoea in this study. Children in rural areas were much burdened with the occurrence of diarrhoea. For instance, the consumption of contaminated foods, drinking of unimproved water, poor handling of water, poor socioeconomic status, lack of proper sanitation and poor hygiene are some factors deemed to individually or collectively overshadow the protective effect of exclusive breastfeeding, therefore, contributing to higher prevalence of diarrhoea in rural environments [25]. Although diarrhoea cases are also common in urban areas especially in urban slums, however, children in rural areas are more disadvantaged [26]. Most rural areas in Ghana are noted for unfavourable health and environmental conditions and are also associated with some cultural beliefs that may act as agents for the frequent occurrence of childhood diarrhoea [27, 28].

Furthermore, birth interval of a mother is critical to determining the health outcomes of her children. A showed that the preceding birth interval of a mother was significantly associated with reported episodes of diarrhoea among children. As documented by Fotso, Cleland, Mberu, Mutua and Elungata [29] in Kenya, shorter preceding birth interval tends to lessen the time required for a mother to adequately feed younger children and that could lead to diarrhoeal morbidity and mortality. In this study, children whose mothers had a preceding birth interval of 24 months or more were more likely to have episodes of diarrhoea. This is intriguing since such breastfeeding mothers are deemed to have ample time to cater to their children. On the contrary, another study established that children with a previous birth interval of less than 18 months had a higher risk of dying from certain causes of death such as diarrhoea than children with a previous birth interval of 24-35 months [30]. For this reason, education programmes on birth spacing tailored into activities of nurses at the various community-based planning and services compounds could be beneficial to the health of mother and their children at prevent or minimizing diarrhoea cases.

It has been asserted that infants who are partially breastfed have higher odds of experiencing diarrhoea compared to those exclusively breastfed [31]. Even at instances where children are optimally breastfed and given unwholesome water,

they would be at risk of diarrhoeal infections. It was found that the source of drinking water used by breastfeeding mothers contributed to childhood diarrhoea. Unimproved sources of water that are mostly contaminated account for a high proclivity of exposing children to diarrhoeal diseases. Elsewhere, studies have found that the use of an unimproved source of drinking water is associated with diarrhoea among infants and young children [32, 33]. Continuously educating mothers on the fact that breastmilk contains 80 percent of water and exclusively breastfed children do not need to drink water would be imperative to curtailing diarrhoea cases. It would also be necessary for household visitations to be made by community nurses to educate mothers to use improved sources of water or carefully treat unimproved water sources before using them to prepare complementary foods for their children.

Children whose mothers used unimproved toilet facilities had higher odds of experiencing diarrhoea. This implies that during optimal breastfeeding, children would still have higher chances of experiencing diarrhoea if their households use unimproved toilet facilities. The usage of unimproved toilet facilities could expose mothers to getting in contact with diarrhoeal pathogens. At instances where mothers do not practice adequate personal hygiene, they can transmit these pathogens to their children in the process of breastfeeding, handling or preparing complementary foods. Even the manner in which stools of children are disposed of in unimproved toilets equally is a pathway to childhood diarrhoeal episodes.

The main strength of this study is that it used a large nationally representative data set to analyze breastfeeding practices and childhood diarrhoea in the country. This was done using various variables at the individual, community, health, and environmental levels. Notwithstanding these strengths, limitations embedded in this study include the inability of it to assign any causality to its findings. Also, there is likely to be a recall bias since mothers reported diarrhoea cases within the last two weeks preceding the surveys. Besides, the prevalence of diarrhoea may vary seasonally and data for this study were collected between September and December, hence, interpretation of results should be linked to this period. To prevent or minimize the limitations outlined, it would be prudent, in future, to conduct longitudinal cohort studies on breastfeeding practices and childhood diarrhoea among children less than two years.

Conclusions

Conclusively, the findings of this study further reveal that breastfeeding especially exclusive breastfeeding has a protective effect on childhood diarrhoea. Potentially, place of residence, preceding birth interval, source of drinking water, and type of toilet facility of breastfeeding children can interfere with the protective effect of breast milk on the occurrence of diarrhoea in children. It would be prudent for local health authorities to reinforce measures or implement situational-based interventions to curtail the negative effects of factors that can predispose children to diarrhoea episodes. Educational programmes such as peer-supports could potentially encourage mothers to appropriately practice optimal breastfeeding to ensure the occurrence of childhood diarrhoea would be minimized or prevented.

Abbreviations

CI – Confidence Interval

DHS – Demographic and Health Survey

ICF – Inner City Fund

JMP – Joint Monitoring Program

UNICEF – United Nations Children’s Fund

WHO – World Health Organisation

Declarations

Ethical approval and consent to participate

Ethics review committees of Ghana Statistical, Ghana Health Service in Ghana including ICF International's institutional review board gave ethical approval for the Demographic and Health Surveys (DHS) to be conducted in Ghana. Informed consent was sought from each respondent during the survey. Permission to use the data set was gotten from MEASURE DHS.

Consent for publication

Not applicable

Availability of data and material

The datasets analysed during the current study are available in the MEASURE DHS repository, <https://dhsprogram.com/data/available-datasets.cfm>

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Author's contribution: The corresponding author conceived the study, obtained needed data, conducted analysis and wrote the paper.

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Figures

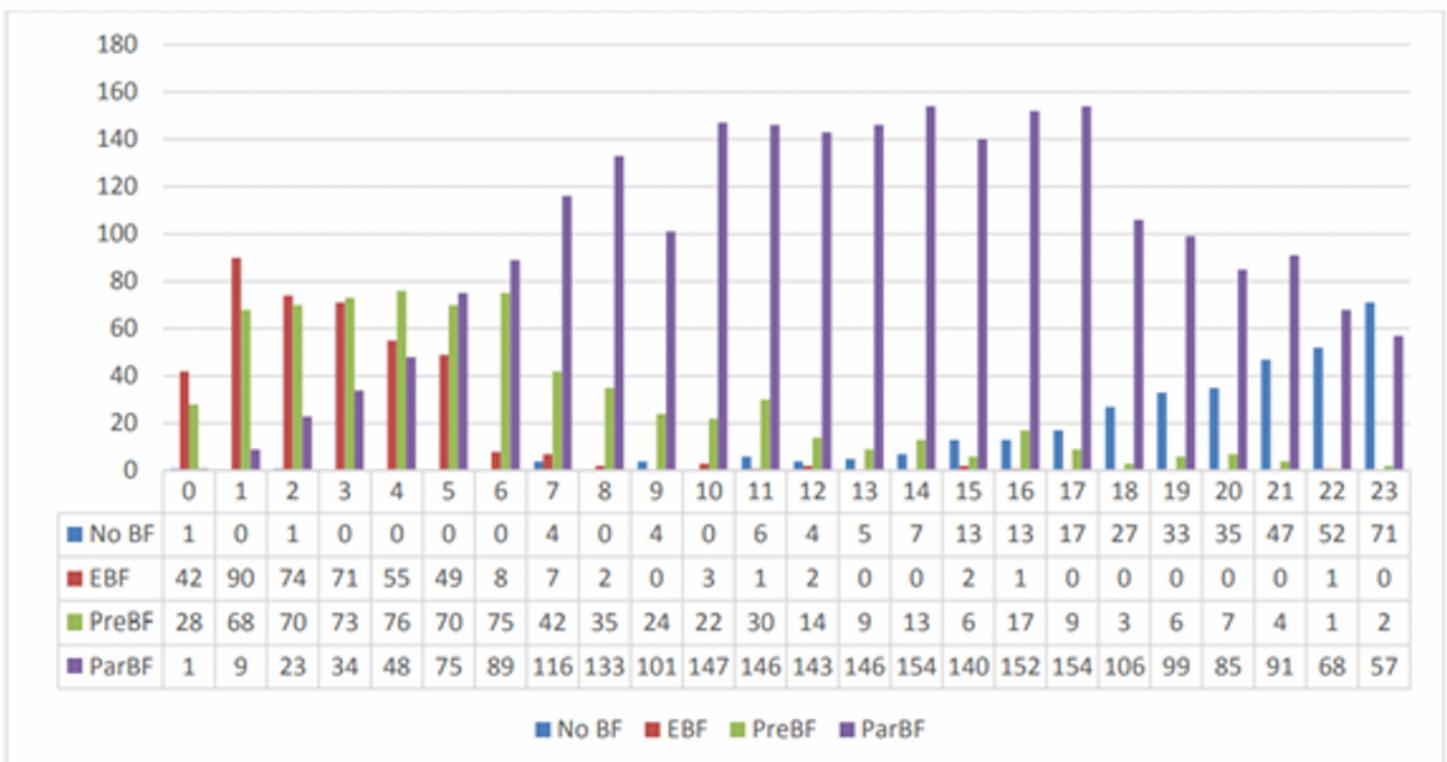


Figure 1

Age of child (0-23 months) and breastfeeding practices. No BF – No Breastfeeding; EBF – Exclusive Breastfeeding; PreBF – Predominant Breastfeeding; ParBF-Partial Breastfeeding