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Trends and predictors of early initiation, exclusive and continued breast-feeding in Bangladesh (2004–2018): a multilevel analysis of demographic and health survey data

Md. Sabbir Ahmed[1], Kyly C. Whitfield[2] and Fakir Md Yunus[3]*

[1]*Department of Community Health and Hygiene, Faculty of Nutrition and Food Science, Patuakhali Science and Technology University, Patuakhali 8602, Bangladesh*
[2]*Department of Applied Human Nutrition, Mount Saint Vincent University, Halifax, NS B3M 2J6, Canada*
[3]*Department of Psychology and Neuroscience, Dalhousie University, Halifax, NS B3H 4R2, Canada*

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Abstract

The early initiation of breast-feeding (EIBF) within 1 h of birth, exclusive breast-feeding (EBF) to 6 months and continued breast-feeding (CBF) to 2 years are key infant and young child feeding guidelines promoted globally for optimal child health and development. Using publicly available national survey data from the five most recent, consecutive Bangladesh Demographic and Health Surveys (2004, 2007, 2011, 2014 and 2017–2018), we assessed the trends in these key breast-feeding indicators. Multiple multilevel logistic regression models were built to assess socio-demographic predictors of breast-feeding using the latest 2017–2018 data set. Both EIBF and EBF have increased significantly between 2004 and 2017–2018, from 26 % to 60 % and 36 % to 68 %, respectively, and CBF decreased from 94 % to 85 %. Caesarean section delivery conferred lower EIBF practice (OR = 0·34, 95 % CI 0·27, 0·42) compared with vaginal delivery. Women who were currently working had 32 % lower odds of EBF (OR = 0·68, 95 % CI 0·48, 0·95). Compared with delivery at home, women who delivered in a health facility had 81 % higher odds of EBF (OR = 1·81, 95 % CI 1·25, 2·34). Larger family size (≥5) also predicted EBF (OR = 1·70, 95 % CI 1·21, 2·40). Rural residency was associated with 2·39 (95 % CI 1·32, 4·31) times of higher odds of CBF. Regional variation was also predictive of the various breast-feeding indicators. Although Bangladesh currently exceeds the 2019 global prevalence rates for these three breast-feeding indicators, efforts should be made to continue improving EIBF and EBF and to prevent future decreases in CBF.

Key words: **Breast-feeding: Infant and young child feeding indicators: Demographic and health survey: Bangladesh**

Optimal infant and young child feeding is an essential component in supporting the growth and development of children and is also a critical element in the global development initiative for a healthy, productive and sustainable world[1–3]. A major facet of global infant and young child feeding recommendations is optimal breast-feeding, which is recognised as one of the most cost-effective interventions for reducing child mortality[4]. To promote optimal breast-feeding, the WHO and UNICEF jointly recommend: (i) early initiation of breast-feeding (EIBF) within one hour of birth; (ii) exclusive breast-feeding (EBF) for the first 6 months and (iii) continued breast-feeding (CBF) for 2 years and beyond[5–7]. Despite these clear recommendations, in 2019, the WHO and UNICEF reported that only 43 % of children were breastfed within the first hour of birth, 41 % exclusively breastfed to 6 months and 45 % continued breast-feeding to 2 years[8].

Investment in breast-feeding is promoted as one of the greatest investments not only for the health and well-being of citizens but also for the economic development of a country[9]. The 2016 Lancet Breast-feeding Series indicates that increased breast-feeding could contribute USA$302 billion additional income per year, which is about 0·5 % of global gross national income[10]. In addition, breast-feeding provides invaluable protection against childhood morbidity and mortality caused by infection, as well as probable reductions in non-communicable diseases including overweight and diabetes[4]. As a pragmatic action for protecting maternal and child health, breast-feeding has become a crucial element in addressing the 2030 Agenda for Sustainable Development[3]. The major targets of achieving: (1) sustainable development goals; (2) zero hunger and (3) good health and well-being are to scale-up proven nutrition actions, including

Abbreviations: BDHS, Bangladesh Demographic and Health Surveys; CBF, continued breast-feeding; EBF, exclusive breast-feeding; EIBF, early initiation of breast-feeding.

* **Corresponding author:** Dr F. M. Yunus, email fakir.yunus@dal.ca

breast-feeding, as a means of reducing the burden of malnutrition, stunting and infectious disease among children[11]. These efforts were underscored when the UN recently revised its commitment to improve child nutrition, including a strong focus on increasing breast-feeding outcomes globally, through the United Nations Decade of Action on Nutrition[12].

Collectively, the 'calls to action' noted above, insight provided by the Lancet Breast-feeding Series, and movements such as The First 1000 d and Scaling Up Nutrition (SUN) have provided momentum to promote breast-feeding[3,4,11–14]. The Government of Bangladesh endorsed several initiatives to promote breast-feeding, including adopting the Baby Friendly Hospital Initiative, mother support groups and breast-feeding counselling among mothers[15,16]. In Bangladesh, breast-feeding practices improved between 2000 and 2014, with the prevalence of EIBF and EBF increasing by 36 % and 13 %, respectively[17–20]. Although previous studies have reported several predictors of EIBF and EBF in Bangladesh, including maternal BMI, education, location and mode of delivery[21–24], little is known about CBF. In addition, a comprehensive trend analysis of these three breast-feeding indicators in Bangladesh is lacking. As such, the objective of this study was to investigate the trends and predictors of EIBF, EBF and CBF in Bangladesh between 2004 and 2018. This timeframe was selected to capture potential changes over both the United Nations Millennium Development Goals era (2000–2015) and the beginning of the United Nations sustainable development goals (2015–2030), in hopes of identifying future modifiable areas for action.

Methods

Our present study is based on the secondary analysis of publicly available data from five consecutive Bangladesh Demographic and Health Surveys (BDHS) of 2004, 2007, 2011, 2014 and 2017–2018. These nationally representative surveys were conducted by the National Institute of Population Research and Training in collaboration with ICF International and Mitra and Associates[17–20,25]. Data were collected from households following a two-stage stratified cluster sampling method (enumeration areas, then household samples). Detailed protocols for the sampling process, data collection procedures and questionnaires are available in the final reports of each BDHS[17–20,25]. Considering the outcome variables for our present analysis, we used completed data of 14 603 (weighted) women who were currently living with their youngest child aged 0–23 months.

Outcome measures

The outcome variables for our study were EIBF, EBF and CBF, which were defined according to WHO/UNICEF infant and young child feeding guidelines[26,27]. The method of collecting data and calculating breast-feeding indicators were same for all survey years[17–20,25].

Early initiation of breast-feeding was defined as the proportion of children aged 0–23 months who were put to the breast within the first hour after birth, which was assessed from maternal recall. Mothers were asked *'How long after birth did you first put (name of child) to the breast?'*.

Exclusive breast-feeding was defined as the proportion of infants aged 0–5 months who were fed only human milk, which was captured by maternal recall of infant intakes in the 24 h preceding the survey. Per the UNICEF/WHO definition, infants were not considered exclusively breastfed if they consumed other food or drink (even plain water), but were considered EBF if oral rehydration salts, micronutrient drops or syrups or medicines were provided. Mothers were asked *'Now I would like to ask you about liquids or foods that (name of child) had yesterday during the day or at night. I am interested in whether your child had the item I mentioned even if it was combined with other foods'* (responses were categorised as- Plain water? Juice or juice drinks? Yoghurt? Bread, rice, noodles, porridge or other foods made from grains? etc.).

Continued breast-feeding at 2 years was defined as the proportion of children aged 20–23 months who are fed breastmilk. Mothers were asked *'Are you still breast-feeding (Name)?'*.

Study variables

A two-level multilevel analysis was performed by grouping study variables into individual- and community-level variables.

Individual-level variables included child sex (male or female), birth order (1, 2, or 3+), mother's age (15–24 years, 25–34 years or 35–49 years), mother's education (no education, primary (5 years), secondary (10 years), or higher (≥ 11 years)), mother's current working status (yes or no), number of antenatal care visits (no visits, 1–3 or 4+), place of delivery (home or health facility), mode of delivery (caesarean or vaginal), wealth index (poor (poorest + poorer), middle, or rich (richer + richest)), family size (≤ 4 or 5+) and sex of the head of household (male or female).

Community-level variables included place of residence (rural or urban) and geographical administrative divisions (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, Sylhet or Mymensingh).

Data analysis

Data sets were cleaned before formal data analysis. Descriptive statistics including frequency and percent distribution and prevalence of EIBF, EBF and CBF for each data set (i.e., 2004, 2007, 2011, 2014 and 2017–2018) were computed according to DHS guidelines[28]. Pearson's χ^2 test statistics were performed to assess associations between the prevalence of outcome variables (i.e. EIBF, EBF and CBF) and other study variables. The sampling weight provided by BDHS was applied in these analyses to ensure the acceptability of our results at the national level. The average annual average rate of change in the prevalence of outcome variables was calculated between two consecutive BDHS surveys and between 2004 and 2017–2018 via the equation $Y_{t+n} = Y_t * (1 \pm b\,\%)^{n}$[29], where Y_t = prevalence of EIBF/EBF/CBF of any given year $(_t)$, b = annual rate of change, $_n$ = number of years between two surveys and Y_{t+n} = prevalence of EIBF/EBF/CBF of the $(_{t+n})^{th}$ year. These are presented as an annual average rate of increase or annual average rate of reduction (AARR). A similar method was also used in earlier studies[30,31].

To identify the factors associated with EIBF, EBF and CBF, we used the most recent data set (i.e. BDHS 2017–2018). Since

BDHS data are hierarchical in nature (i.e. individuals (children) are nested within households, and households are nested within a higher level (clusters, termed enumeration areas in the BDHS)), the use of traditional logistic regression models could underestimate the standard errors of the effect sizes. With such data, it is assumed that children's socio-economic characteristics are more likely to be similar within a cluster as compared with children from other clusters. This violates the assumption of standard model, independence of observation and equal variance across the clusters, which implies a need to consider cluster variability. With this, mixed effect multilevel modeling was employed to compute both fixed (both individual and community factors) and random (cluster variation) effects simultaneously. For our multilevel multivariable regression analyses, we fitted four models for each of the outcome variables (EIBF, EBF and CBF): Model I (null model) was fit without explanatory variables to assess the variance in the outcome of interest between clusters; Model II was fit for individual-level variables; Model III was fit for community-level variables and Model IV was fit for both individual- and community-level variables. The measure of community variations (random effect) was estimated as the intraclass correlation coefficient (ICC), and an ICC value of greater than zero was considered adequate to conduct multilevel modeling[32]. For measures of variations we also calculated median odds ratio and proportional change in variance[33]. Variables with $P < 0{\cdot}25$ in the bivariate analysis were selected for multivariable analysis[34]. The effect of predictive variables (fixed effect) was measured using OR with 95 % CI. Akaike's information criterion (AIC) was used to assess goodness of fit of each model. Multicollinearity between independent variables was checked using variance inflation factor (VIF); none of the variables showed multicollinearity problems (VIF < 10).

All statistical tests were two-sided and considered significant at $P < 0{\cdot}05$ level. Data were analysed by using Stata v14.2 (StataCorp.).

Ethics

Since the present study was based on secondary data analyses of data obtained from the 2004, 2007, 2011, 2014 and 2017–2018 BDHS, ethical approval was not required. The data files are publicly available at (https://www.dhsprogram.com/). Formal ethical approval for all BDHS was obtained by ICF international, and participants provided free, informed consent.

Results

Background characteristics

A total of 14 603 mother–child paired data were extracted from five consecutive, publicly available BDHS data sets collected between 2004 and 2018. Demographic and socio-economic characteristics of study population are presented in Table 1. Pooled data indicate that 49 % of children were female, 59 % were delivered at home, 59 % of mothers were aged between 15 and 24 years, 29 % of mothers completed their primary education and 24 % lived in urban areas (pooled data not shown in the table).

Trend in early initiation of breast-feeding, exclusive breast-feeding and continued breast-feeding during 2004–2018

The prevalence of EIBF, by study year, is presented in Fig. 1. The overall prevalence of EIBF increased more than twofold during this time, from 25·9 % (95 % CI 23·8, 28·1) in 2004 to 60·4 % (95 % CI 58·3, 62·6) in 2017–2018. Figure 2 illustrates that the prevalence of EBF also increased during this time, from 35·9 % (95 % CI 32·2, 39·8) in 2004 to 67·5 % (95 % CI 64·1, 70·7) in 2017–2018. As shown in Fig. 3, continued breast-feeding up to 2 years decreased from 93·9 % (95 % CI 92·1, 95·3) in 2004 to 85·4 % (95 % CI 81·8, 88·4) in 2017–2018.

Table 2 shows average annual rate of change in breast-feeding indicators during 2004 to 2017–2018. EIBF and EBF showed an increasing trend; however, CBF showed a negative trend. Annual average rate of increase was highest for EIBF and EBF during 2004 to 2007 and 2007 to 2011, respectively. During our study period, an average annual rate of CBF decreased by 0·67 % (AARR = −0·67). Year wise prevalence of EIBF, EBF and CBF by individual- and community-level factors are presented in Supplemental Tables 1, 2, and 3, respectively.

Predictors of early initiation of breast-feeding

As shown in Table 3, the null model (Model I) reveals that clustering exists in determining EIBF status. ICC value of null model indicates that 9 % of the variance in EIBF is a result of cluster variability. The final model (Model IV) showed the effect of community heterogeneity, suggesting that if a mother–child pair moved to a community with a higher probability of EIBF, the median increase in the odds of having EIBF would be 1·55-fold (median odds ratio = 1·55). Additionally, 36 % of the variance is the odds of EIBF across communities was explained by both individual- and community-level factors, as indicated by the proportional change in variance.

The mode of delivery and geographic region (division) were significant predictors of EIBF. Infants born via Caesarean section were 66 % less likely to EIBF (OR = 0·34, 95 % CI 0·27, 0·42). Infants from Chittagong division were 29 % less likely to EIBF compared with Barisal division (OR = 0·71, 95 % CI 0·51, 0·98).

Predictors of exclusive breast-feeding

The predictors of EBF are presented in Table 4. The null model (Model I) indicates the existence of significant clustering (ICC = 14·54 %) which justifies multilevel analyses. The final model (Model IV) revealed that if a mother–child pair moved to a community with a higher probability of EBF, the median increase in the odds of having EBF would be 1·66-fold (median odds ratio = 1·66). Additionally, nearly half of the variance in the odds of EIBF across communities was explained by both individual- and community-level factors (proportional change in variance = 48·21 %).

Maternal working status was predictive of EBF, with mothers who were currently working being 32 % less likely to exclusively breastfeed their baby (OR = 0·68, 95 % CI 0·48, 0·95). Mothers who delivered at health facility and belong to larger household had a 1·81- and 1·70-times higher odds of exclusively breast-feeding, respectively. Geographic region (division) was also predictive of EBF.

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Table 1. Background characteristics of the children aged 0–23 months and their families surveyed for Bangladesh demographic and health surveys* (Number and percentages)

	2004		2007		2011		2014		2017–2018	
Characteristics	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Individual level characteristics										
Child sex										
Male	1238	49·2	1123	50·1	1633	51·0	1629	53·4	1861	51·9
Female	1280	50·8	1118	49·9	1568	49·0	1423	46·6	1728	48·1
Child birth order										
1	761	30·2	814	36·3	1163	36·3	1252	41·0	1332	37·1
2	654	26·0	617	27·5	937	29·3	934	30·6	1193	33·2
3+	1103	43·8	810	36·2	1101	34·4	866	28·4	1064	29·7
Mother's age (years)										
15–24	1522	60·5	1349	60·2	1934	60·4	1778	58·3	1974	55·0
25–34	844	33·5	772	34·5	1124	35·1	1141	37·4	1418	39·5
35–49	152	6·0	120	5·3	143	4·5	133	4·3	197	5·5
Mother's education										
No education	832	33·0	496	22·1	538	16·8	409	13·4	231	6·4
Primary	792	31·4	684	30·5	951	29·7	859	28·2	983	27·4
Secondary	745	29·6	896	40·0	1486	46·4	1466	48·0	1747	48·7
Higher	149	6·0	165	7·4	226	7·1	318	10·4	628	17·5
Mother currently working										
No	2150	85·4	1787	79·8	3008	93·9	2399	78·6	2364	65·9
Yes	368	14·6	454	20·2	193	6·1	653	21·4	1225	34·1
No. of antenatal care visits										
No visit	1010	40·9	801	36·4	338	19·5	613	20·1	285	8·2
1–3	1034	41·9	894	40·6	842	48·7	1484	48·6	1611	46·1
4+	423	17·2	508	23·0	551	31·8	955	31·3	1601	45·8
Place of delivery										
Home	1616	64·2	1243	55·5	2221	69·4	1839	60·3	1748	48·7
Health facility	902	35·8	998	44·5	980	30·6	1213	39·7	1841	51·3
Mode of delivery										
Vaginal	2393	95·0	2017	90·0	2623	82·0	2312	75·7	2367	66·0
Caesarean section	125	5·0	224	10·0	578	18·0	740	24·3	1218	34·0
Wealth index										
Poor	1106	44·0	949	42·3	1341	41·9	1248	40·9	1489	41·5
Middle	545	21·6	438	19·6	633	19·8	621	20·3	691	19·3
Rich	867	34·4	854	38·1	1227	38·3	1183	38·8	1409	39·3
Family size										
≤ 4	643	25·5	601	26·8	842	26·3	912	29·9	1033	28·8
5+	1875	74·5	1640	73·2	2359	73·7	2140	70·1	2556	71·2
Sex of the household head										
Male	2362	93·8	2024	90·3	2964	92·6	2785	91·2	3115	86·8
Female	156	6·2	217	9·7	237	7·4	267	8·8	474	13·2
Community-level characteristics										
Type of place of residence										
Urban	482	19·2	491	22·0	722	22·5	789	25·8	955	26·6
Rural	2036	80·8	1750	78·0	2479	77·5	2263	74·2	2634	73·4
Division										
Barisal	154	6·0	133	5·9	169	5·3	180	5·9	213	6·0
Chittagong	565	22·5	514	22·9	787	24·5	660	21·6	753	21·0
Dhaka	751	29·8	714	31·8	962	30·2	1124	36·8	912	25·4
Khulna	272	10·8	186	8·3	301	9·4	236	7·8	329	9·2
Rajshahi	564	22·5	506	22·6	430	13·4	303	9·9	404	11·3
Rangpur	–		–		325	10·1	282	9·3	384	10·7
Sylhet	212	8·4	188	8·5	227	7·1	267	8·7	288	8·1
Mymensingh	–		–		–		–		302	8·4
Total, *n*	2518		2241		3201		3052		3589	

Weighted frequencies and percentages are reported after rounding.
* Wealth index was computed by principal component analysis based on household assets and materials used to build houses, using the national wealth index quintile provided in each data set.

Predictors of continued breast-feeding

In Table 5, the null model indicates the appropriate use of multilevel analysis (ICC = 26·47 %), suggesting that variation in CBF status may be attributed by cluster variation. The median odds ratio of 1·36 of the final model (Model IV) revealed the effect of community heterogenicity; however, the variance was not significant.

Urban *v.* rural residence was the only significant predictor of CBF in our analysis. Children residing in rural Bangladesh had 2·39-fold higher odds (95 % CI 1·32, 4·31) of continued breast-feeding to 2 years compared with their urban counterparts.

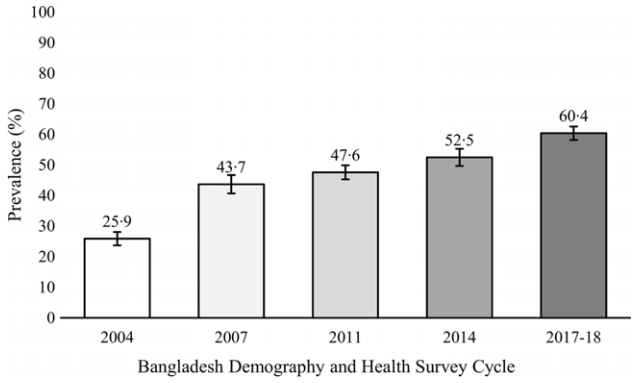

Fig. 1. Trends in early initiation of breast-feeding, within one hour of birth, in Bangladesh, 2004–2018 (error bars indicate 95 % CI).

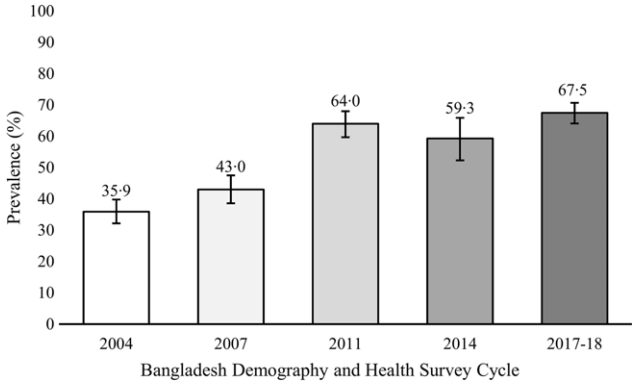

Fig. 2. Trends in exclusive breast-feeding to 6 months in Bangladesh, 2004–2018 (error bars indicate 95 % CI).

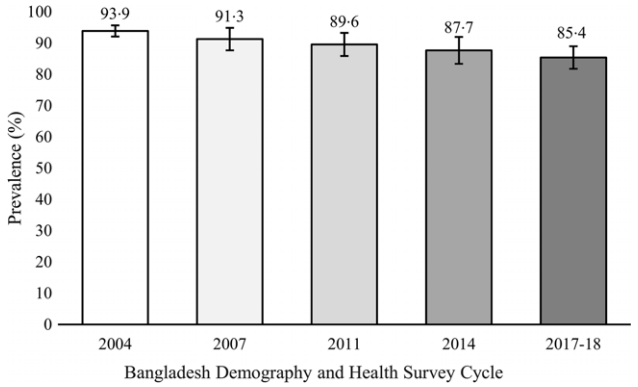

Fig. 3. Trends in continued breast-feeding to 2 years in Bangladesh, 2004–2018 (error bars indicate 95 % CI).

Discussion

This study investigated the trends and predictors of EIBF, EBF and CBF in Bangladesh by analyzing five consecutive, publicly available, nationally representative BDHS data sets from 2004 through 2017–2018. We presented the results in individual (child, maternal and household) and community-level factors as a means of identifying potential modifiable factors to improve EIBF, EBF and CBF in Bangladesh.

Table 2. Average annual rate of change in the breast-feeding practices in Bangladesh 2004–2017/18

	Average annual rate of change (%) in breast-feeding indicators				
	2004–2007	2007–2011	2011–2014	2014–2017/18	2004–2017/18
EIBF	19·04	2·16	3·31	3·56	6·23
EBF	6·20	10·45	-2·51	3·29	4·61
CBF	-0·93	-0·46	-0·71	-0·66	-0·67

Positive values indicate an average annual rate of increase (AARI), while negative value indicates an average annual rate of reduction (AARR).

There have been several calls to action to increase breast-feeding rates globally. For instance, UNICEF stated that breast-feeding could play a key role in achieving many of the SDG focused not only on hunger and health but also those goals to address poverty, economic growth, inequalities, education and sustainability[3]. Beyond meeting these global goals, breast-feeding has the potential to address child mortality: as part of the 2016 Lancet Breast-feeding Series, an estimated 823 000 under five deaths could be averted annually by near-universal scaling up of breast-feeding[4]. We found that Bangladesh has made remarkable progress in increasing the rates of early initiation (25·9 % to 60·4 %) and exclusive (35·9 % to 67·5 %) breast-feeding between 2004 and 2018. According to the most recent data (i.e. BDHS 2017–2018), the prevalence of EIBF and EBF of 60·4 % and 67·5 % in Bangladesh was higher than neighbouring India (2015–2016 DHS: EIBF – 42 % and EBF – 55 %)[35] and Nepal (2016 DHS: EIBF – 55 % and EBF – 65 %)[36]. CBF rates were already impressive during the period between 2004 and 2018, but did experience a slight decrease (93·9 % to 85·4 %). Prevalence of CBF is high in the South Asia region: 85 %, 90 % and 74 % in Bangladesh (2017–2018), Nepal (2016) and India (2015–2016), respectively[25,35,36]. Although not the focus of this analysis, improvements in these key breast-feeding indicators can likely be linked to recent efforts to scale-up interventions like breast-feeding counselling, mass media campaigns and other education programmes throughout South Asia[37].

Several modifiable demographic factors were significant predictors of the breast-feeding indicators of interest in the 2017–2018 data set. The greatest increase in EIBF was seen between the period of 2004 and 2007, with an increase of 19 %, with only modest gains in the subsequent years assessed. Mode of delivery is an acknowledged predictor for EIBF; a systematic review and meta-analysis reported that the rates of EIBF were 43 % lower after the Caesarean delivery as compared with vaginal delivery[38]. Failure to initiate breast-feeding within the recommended hour after birth has been attributed to time required for recovery from anaesthesia and other surgical procedures[39]. Caesarean delivery could be a key factor halting the breast-feeding initiation in Bangladesh, as we found that Caseation section delivery reduced the likelihood by of EIBF by 66 % as compared with the vaginal delivery. The 2014 BDHS reported that 24·3 % of infants were born via Caesarean delivery[20], with another report suggesting an alarming number of unnecessary Caesarean deliveries, which increased by 51 % between 2016 and 2018[40]. Non-medically indicated Caesarean delivery should be avoided both to support breast-feeding initiation, but also safeguard both

Table 3. Factors associated with early initiation of breast-feeding in Bangladesh, BDHS 2017–2018 (Odd ratio and 95 % confidence intervals)

	Model I†		Model II‡		Model III§		Model IV‖	
Characteristics	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Individual-level characteristics								
Child birth order								
1			Ref.				Ref.	
2			1·00	0·82, 1·21			1·01	0·83, 1·23
3+			1·22	0·94, 1·58			1·24	0·96, 1·60
Mother's age (years)								
15–24			Ref.				Ref.	
25–34			1·11	0·91, 1·34			1·11	0·91, 1·35
35–49			1·11	0·76, 1·62			1·11	0·76, 1·62
Mother's education								
No education			Ref.				Ref.	
Primary			1·29	0·91, 1·81			1·31	0·93, 1·84
Secondary			1·24	0·88, 1·74			1·31	0·93, 1·85
Higher			1·29	0·88, 1·90			1·36	0·92, 2·01
Mother currently working								
No			Ref.				Ref.	
Yes			0·92	0·78, 1·09			0·93	0·78, 1·10
No. of antenatal care visits								
No visit			Ref.				Ref.	
1–3			1·06	0·79, 1·43			1·07	0·80, 1·45
4+			1·17	0·85, 1·61			1·16	0·85, 1·60
Place of delivery								
Home			Ref.				Ref.	
Health facility			0·79	0·63, 1·00*			0·81	0·64, 1·01
Mode of delivery								
Vaginal			Ref.				Ref.	
Caesarean section			0·34	0·27, 0·43***			0·34	0·27, 0·42***
Wealth index								
Poor			Ref.				Ref.	
Middle			0·79	0·64, 0·98*			0·82	0·66, 1·02
Rich			0·85	0·70, 1·04			0·86	0·69, 1·06
Sex of the household head								
Male			Ref.				Ref.	
Female			0·80	0·64, 1·01			0·81	0·64, 1·02
Community-level characteristics								
Type of place of residence								
Urban					Ref.		Ref.	
Rural					1·17	0·98, 1·39	0·99	0·81, 1·20
Division								
Barisal					Ref.		Ref.	
Chittagong					0·75	0·54, 1·03	0·71	0·51, 0·98*
Dhaka					1·13	0·81, 1·57	1·29	0·92, 1·81
Khulna					0·65	0·46, 0·92*	0·77	0·54, 1·10
Rajshahi					0·85	0·60, 1·21	0·92	0·64, 1·32
Rangpur					1·17	0·82, 1·65	1·20	0·84, 1·71
Sylhet					1·34	0·95, 1·87	1·30	0·92, 1·84
Mymensingh					1·19	0·84, 1·68	1·12	0·79, 1·59
Measure of variation								
Variance	0·332		0·266		0·269		0·213	
SE	0·074		0·073		0·068		0·068	
ICC								
%	9·17		7·49		7·57		6·09	
PCV								
%	Ref.		19·87		18·97		35·84	
MOR	1·72		1·63		1·64		1·55	
Model fit statistics								
AIC	4709·05		4359·50		4690·83		4347·92	

Ref., reference category; SE, standard error; ICC, intraclass correlation; PCV, proportional change in variance; MOR, median odd ratio; AIC, Akaike's information criterion. Early initiation of breast-feeding was defined as the proportion of children aged 0–23 months who were put to the breast within the first hour after birth.

* $P < 0·05$, *** $P < 0·001$.

† Model I (Null model) was fitted without determinant variables.

‡ Model II is adjusted for individual-level variables only.

§ Model III is adjusted for community-level variables only.

‖ Model IV is the final model adjusted for both individual- and community-level variables.

Table 4. Factors associated with exclusive breast-feeding in Bangladesh, BDHS 2017–2018 (Odd ratio and 95 % confidence intervals)

	Model I†		Model II‡		Model III§		Model IV‖	
Characteristics	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Individual-level characteristics								
Mother's age (years)								
15–24			Ref.				Ref.	
25–34			1·01	0·74, 1·38			1·05	0·77, 1·43
35–49			0·65	0·32, 1·31			0·70	0·35, 1·40
Mother currently working								
No			Ref.				Ref.	
Yes			0·71	0·51, 0·99			0·68	0·48, 0·95*
Place of delivery								
Home			Ref.				Ref.	
Health facility			1·95	1·33, 2·34**			1·81	1·25, 2·34**
Family size								
≤ 4			Ref.				Ref.	
5+			1·80	1·28, 2·55**			1·70	1·21, 2·40**
Community-level characteristics								
Type of place of residence								
Urban					Ref.		Ref.	
Rural					1·16	0·84, 1·59	1·13	0·82, 1·56
Division								
Barisal					Ref.		Ref.	
Chittagong					1·96	1·10, 3·50*	1·98	1·11, 3·55*
Dhaka					0·76	0·42, 1·35	0·79	0·44, 1·42
Khulna					0·83	0·45, 1·51	0·88	0·48, 1·61
Rajshahi					1·57	0·81, 3·05	1·62	0·83, 3·14
Rangpur					1·97	1·02, 3·81*	2·27	1·16, 4·41*
Sylhet					1·42	0·78, 2·56	1·35	0·74, 2·45
Mymensingh					0·65	0·36, 1·18	0·70	0·39, 1·27
Measure of variation								
Variance	0·560		0·522		0·313		0·290	
SE	0·265		0·262		0·229		0·230	
ICC								
%	14·54		13·70		8·69		8·10	
PCV								
%	Ref.		6·78		44·10		48·21	
MOR	2·03		1·98		1·70		1·66	
Model fit statistics								
AIC	1266·23		1255·75		1252·21		1242·76	

Ref., reference category; SE, standard error; ICC, intraclass correlation; PCV, proportional change in variance; MOR, median odd ratio; AIC, Akaike's information criterion. Exclusive breast-feeding was defined as the proportion of infants aged 0–5 months who were fed only human milk, excluding other food or drink (even plain water), but allowing for consumption of oral rehydration salts (ORS), micronutrient drops or syrups or medicines.

* $P < 0·05$, ** $P < 0·01$.

† Model I (Null model) was fitted without determinant variables.

‡ Model II is adjusted for individual-level variables only.

§ Model III is adjusted for community-level variables only.

‖ Model IV is the final model adjusted for both individual- and community-level variables.

mother and infant health. However, promotion of early skin-to-skin contact (Kangaroo care), both among vaginal and Cesarean section deliveries, could increase EIBF[41]. Similar to other research[38], Caesarean delivery was not a significant predictor of EBF in Bangladesh.

It is important to note that socio-economic characteristics changed over the 14-year period (2004–2018) of this study. For instance, the prevalence of maternal employment increased by ~20 percentage points between 2004 and 2018, which could have affected breast-feeding practices among working mothers. We found that, overall, working mothers were 32 % less likely to EBF (0·68 (95 % CI 0·48, 0·95)). Our findings are consistent with a study in Ghana that identified two key factors for exclusive breast-feeding – breast-feeding knowledge and maternal workplace factors such as office hours, company policy on maternal leave, unfavourable institutional policies and work-life balance[42]. A qualitative study in urban Bangladesh reported that increased workload, lack of day-care facilities within workplaces and a lack of caregivers at home were all major barriers to breast-feeding exclusivity among working mothers[43]. Similar barriers have also been identified in China, where mothers who experienced either inadequate employment benefits, longer commute times to work, unfavourable workplace environments and increased labour intensity work would reduce the breast-feeding frequency or cease breast-feeding altogether[44]. This inverse relationship between maternal employment status and breast-feeding is a global phenomenon[45], so efforts towards

Table 5. Factors associated with continued breast-feeding in Bangladesh, BDHS 2017–2018 (Odd ratio and 95 % confidence intervals)

	Model I†		Model II‡		Model III§		Model IV‖	
Characteristics	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Individual-level characteristics								
Child birth order								
1			Ref.				Ref.	
2			1·13	0·61, 2·08			1·18	0·65, 2·15
3+			1·29	0·66, 2·51			1·40	0·72, 2·71
Mother currently working								
No			Ref.				Ref.	
Yes			1·38	0·79, 2·42			1·24	0·71, 2·16
No. of antenatal care visits								
No visit			Ref.				Ref.	
1–3			1·21	0·43, 3·42			1·22	0·44, 3·38
4+			0·91	0·31, 2·61			0·83	0·29, 2·41
Mode of delivery								
Vaginal			Ref.				Ref.	
Caesarean section			1·09	0·59, 2·01			1·17	0·63, 2·16
Wealth index								
Poor			Ref.				Ref.	
Middle			0·75	0·35, 1·60			0·84	0·39, 1·78
Rich			0·63	0·32, 1·22			1·00	0·50, 1·99
Sex of the household head								
Male			Ref.				Ref.	
Female			0·69	0·34, 1·41			0·69	0·34, 1·40
Community-level characteristics								
Type of place of residence								
Urban					Ref.		Ref.	
Rural					2·97	1·66, 5·30***	2·39	1·32, 4·31**
Division								
Barisal					Ref.		Ref.	
Chittagong					0·35	0·12, 1·02	0·36	0·13, 1·03
Dhaka					0·43	0·14, 1·31	0·46	0·16, 1·33
Khulna					1·00	0·28, 3·56	1·09	0·31, 3·84
Rajshahi					0·68	0·19, 2·43	0·78	0·22, 2·73
Rangpur					1·77	0·43, 7·20	1·90	0·48, 7·50
Sylhet					0·67	0·21, 2·13	0·62	0·20, 1·86
Mymensingh					0·52	0·16, 1·71	0·53	0·17, 1·65
Measure of variation								
Variance	1·184		0·471		0·512		0·109	
SE	0·833		0·677		0·613		0·566	
ICC								
%	26·47		12·53		13·47		3·21	
PCV								
%	Ref.		60·21		55·99		90·79	
MOR	2·81		1·91		1·97		1·36	
Model fit statistics								
AIC	469·65		462·02		456·44		455·21	

Ref, reference category; SE, standard error; ICC, intraclass correlation; PCV, proportional change in variance; MOR, median odd ratio; AIC, Akaike's information criterion. Continued breast-feeding to 2 years was defined as the proportion of children aged 20–23 months who were fed breastmilk. Continued breast-feeding to 2 years was defined as the proportion of children aged 20–23 months who were fed breastmilk.

† Model I (Null model) was fitted without determinant variables.

‡ Model II is adjusted for individual-level variables only.

§ Model III is adjusted for community-level variables only.

‖ Model IV is the final model adjusted for both individual- and community-level variables.

** $P < 0·01$.

*** $P < 0·001$.

workplace lactation support programmes are warranted. These programmes not only improve breast-feeding outcomes but also lower absenteeism and increase job satisfaction[46]. In the present study, mothers who delivered in a healthcare facility were 1·81 times more likely to EBF compared with the home delivery. Delivery at a healthcare facility is a well-established predictor of EBF, as trained healthcare professionals can provide education and support to mothers to assist with establishing breast-feeding soon after birth[47]. Furthermore, we found that larger family size (5+ members) predicted a 1·7 times higher odds for EBF, which is consistent with previous research[48].

With regard to CBF to 2 years, we found that rural residents had a 2·39 times higher likelihood of continued breast-feeding than urban residents. Although previous studies have explained such differences by higher maternal employment in the cities

and more widespread availability and financial access to human milk substitutes in urban centres[49,50], maternal employment was not a significant predictor in our models. Of note, only modest changes in CBF were found across the survey period (<1 %, see Table 2).

The trends for a number of socio-economic characteristics factors changed over the 14 years encompassing these five national data sets; however, these changes did not always impact breast-feeding outcomes as anticipated. For example, maternal education is a well-established predictor of breast-feeding[51]. In this analysis, the proportion of women with no education decreased from 33 % to 6 % between the 2004 and 2017–2018 surveys; however, maternal education was not a significant predictor of any of the breast-feeding outcomes. Similarly, although the prevalence of the number of antenatal care visits increased over time, we could hypothesise that interaction with healthcare providers could improve breast-feeding outcomes. However, we did not find the number of Antenatal Care (ANC) visits is a significant breast-feeding predictor. These null results underscore the importance of country-specific analyses to understand the drivers of breast-feeding in specific contexts. Future research should explore why such predictors in other settings do not translate to this Bangladeshi context.

A major strength of this study is the analysis of five consecutive, nationally representative data sets over 14 years. This allowed us to track the progress and identify factors that influence EIBF, EBF and CBF, as well as to identify the gaps for future consideration. Another strength is the consistent data collection methods and terminology/definitions of EIBF, EBF and CBF used in all our analysed data sets. This study has a number of limitations. A major limitation of this study is the data; with consecutive, cross-sectional data collection, no causal relationships can be established, and it is possible that reverse temporal relationships or bidirectional relations could emerge. We thus advise caution in interpretation. Our analyses are also subject to residual confounding bias because these publicly available, secondary data from five consecutive demographic and health surveys may not have collected all potential factors that could have influenced breast-feeding practices in Bangladesh. Another challenge of the study was to generate generalised results (pooled analysis) from five cumulative time points (2004–2017/20) as socio-economic characteristics have changed considerably over this 14-year period. We therefore used the latest 2017–2018 data set to establish association across variables.

Conclusion

Rates of EIBF and EBF have been increasing since 2004, and Bangladesh has already achieved the World Health Assembly Resolution 65·6 to increase the rate of EBF to 50 % by the year 2025[52]. While CBF rates have decreased slightly since 2004, 85 % of Bangladeshi children still meet the WHO recommendation of continued breast-feeding to 2 years. The major significant predictors of optimal breast-feeding outcomes include vaginal delivery, mother not working, delivery at healthcare facility, larger family size and rural residency. There is also indication of geographic differences across Bangladesh, which warrants further investigation.

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There are no conflicts of interest.

Supplementary material

For supplementary material/s referred to in this article, please visit https://doi.org/10.1017/S0007114521004761

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