Birth Interval and its Association With Adverse Childhood Nutritional Outcomes Among Under-Five Children in Bangladesh: A Longitudinal Study

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ABSTRACT

Introduction: Short birth spacing is reported to have health consequences for both mother and child. This study aims to examine the effect of short birth interval on nutritional outcomes of under-five children in Bangladesh.

Methods: We used data from the latest five rounds of successive Bangladesh Demographic and Health Surveys conducted during 2004 to 2017-18. Short birth interval is defined as birth spacing of < 24 months between two subsequent live births. The outcomes of interest are stunting and underweight. Both bivariate and multivariate statistical analyses were employed. Results of the multivariate analysis are shown by odds ratios (ORs) with 95% confidence intervals (CIs). Data were analyzed by Stata 15/IC.

Results: A total of 16,100 under-five children of second and higher - order births were included for analysis. Of the children, 12% were born at a space of < 24 months, and 19% were born with a space of 24 - 35 months. The proportion of children with short birth interval was found decreasing over successive surveys. Results of the logistic regression analysis show that compared to the birth interval of 24 - 35 and 36 - 59 months, children born to women with birth interval < 24 months were significantly ($P < 0.001$) at higher risk of being stunted and underweight.

Conclusions: Short birth interval has significant impact on childhood stunting and underweight. It remains a major factor resulting in childhood malnutrition in Bangladesh. Research to explore causal pathways and programs to lengthen space between inter-pregnancy should be intensified.

Keywords: Birth interval; childhood nutrition; logistic regression; stunting; underweight

INTRODUCTION

The birth interval is referred to the intermission between two subsequent births of siblings. In recent decades birth interval between two pregnancies has gained significant research interest not only for fertility reduction but also for the implications of both maternal and child health outcomes in the low and middle-income countries (LMICs). Both short and very long interval between two successive live births can place both mother and child at adverse health outcomes for various reasons.[1] Despite this, short birth interval has attracted much attention among researchers and policy makers as it is associated with horrible health and pregnancy outcomes,[2] particularly for the mother and child.

Short birth interval is associated with a variety of adverse health and pregnancy outcomes such as increased risk of preterm birth, low birth weight, small for gestational age births, and neonatal, perinatal and infant mortality,[3,4] autism[5], and congenital anomalies.[6] Short birth interval also increases high blood pressure of mother and contributes to morbidities like preeclampsia.[7] Similarly, very long birth interval (A birth interval of greater than five years) also increases pregnancy complications like preeclampsia.[7] Understanding the increased adverse situation, the technical consultants of the World Health Organisation (WHO) recommended waiting at least 24 months for conceiving again after a live birth, and a birth interval of around 33 months.[8] Thus, following the literature and WHO observations, spacing of < 24 months between two successive live births has been defined as short birth interval.

The practice of birth interval differs between and within countries. In countries where fertility is high, generally the birth interval is short. In general, women with low or no utilization of contraceptive methods are at higher risk of short birth interval. The traditional belief, cultural norms and usage of traditional family planning methods may shorten the duration between two subsequent pregnancies. A more recent review study on 2,802 documents reported that maternal age and education, sex of the preceding child, breastfeeding, socioeconomic status and parity are important determinants of short and long birth interval.[9] An estimated one-fifth of the under-five mortality in the LMICs can be averted by increasing birth interval to more than two years.[10]

A study from the USA has shown that a short birth interval compared to longer birth interval significantly increases the risk of perinatal mortality and low birth weight.[11] Using 17th Demographic and Health Survey data from LMICs, a study demonstrated moderate influence on the children's nutritional status and weak association with lower attendance at prenatal care.[12] Very short birth intervals of less than 21 months were found to be significantly associated with increased stillbirth rate and neonatal mortality in Bangladesh.[13] Besides, short interval was found to be associated with higher fertility in Brazil.[14] In India, child's under-nutrition and adverse birth outcome (Low birth weight) was found higher among those children whose birth interval was less than two years.[15]

The study of childhood nutritional status is of great importance since undernourished children lose their productive capability in their adulthood, which in turn hampers the development of a country. A landmark review of pieces of the literature suggests that a short duration between inter-pregnancy is positively associated with childhood nutritional status, particularly with stunting and underweight.[10-12,15,16] However, little is known regarding the present status of the issue in Bangladesh. Thus, this study aims to examine the effect of birth interval on childhood nutritional status, particularly stunting and underweight using nationally representative data sets. Hopefully, the findings will enrich the existing literature and help the policy makers to adopt suitable strategies.

METHODS

In this study, we used data extracting from the latest five rounds of Bangladesh Demographic and Health Surveys (BDHSs) conducted during the period 2004 to 2017-2018. The survey followed a two-stage sampling procedure to gather information from 78,175 married women aged 15 to 49 years covering urban-rural areas and all administrative regions. The survey gathered various socio-demographic information including current age,

age at marriage, history of births, survival status of children, fertility, maternal and child health care status, nutritional status of mother and child etc. The surveys recorded a total of 38,456 births born to mothers in the last five years preceding the survey. We excluded first order children from our analysis. Moreover, twin births children and those with missing information on anthropometric measurements were also excluded.[17] Besides, the latest two surveys 2014 BDHS and 2017-18 BDHS collected information of receiving maternal and child health care only from those who were born in the last three years preceding the surveys. Children with missing information on maternal health care services utilization, particularly antenatal care (ANC) were also excluded from the analysis. Thus, the final sample size of this study stood at 16,100 children aged 0 to 59 months.

The outcomes of interest are (i) stunting; and (ii) underweight. Stunting and underweight of the under-five children were measured from height-for-age and weight-for-age z-scores. A child whose height-for-age was greater than two standard deviations (SDs) below the median of the WHO reference population was classified as short or stunted, and a child whose weight-for-age was below two SDs from the median of the reference population was considered as underweight. The main explanatory variable in this study is the birth interval between two successive births; and particularly, the interval of the most recent two live births. The birth interval was categorized as < 24 months, 24 - 35 months and ≥ 36 months. The other covariates included for analysis are survey years (2004, 2007, 2011, 2014 and 2017-18), wealth index (poorest, poorer, middle, richer and richest), place of residence (urban and rural), region (Barisal, Chittagong, Dhaka, Khulna and Rajshahi), women's level of education (no education, primary, secondary and higher), the current age of the child (0 - 11, 12 - 23, 24 - 35, 36 - 48 and 49 - 59 months), birth order (second, third and fourth or higher), wantedness of last pregnancy (wanted and unintended), and receiving ANC at least once (no and yes). The variable 'wealth index' was measured from household amenities. The construction procedure of the wealth index has been given elsewhere.[17] At present Bangladesh is divided into eight administrative regions. Rajshahi division was

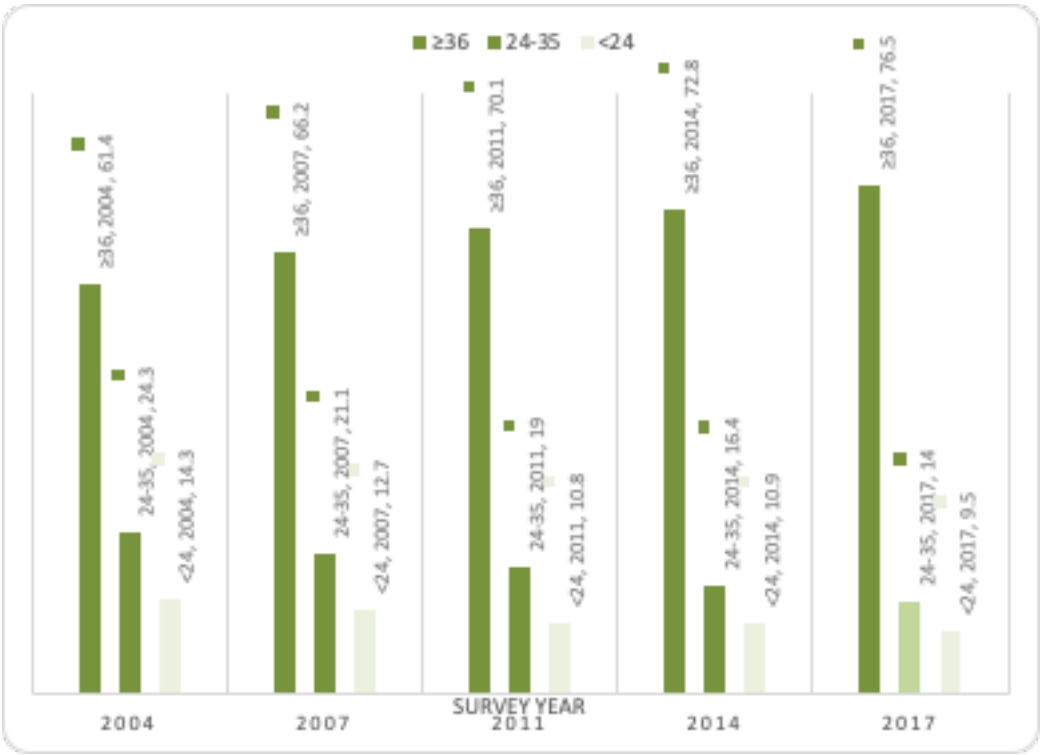

Figure 1. Trends of birth interval of women in Bangladesh

Table 1. Percentage distribution of under-five children by their background characteristics and birth interval, BDHS 2004-2018

Background characteristics	Distribution of women		Birth interval (in month)			Chi-square P-value
	N	%	<24	24-35	36-59	
Birth interval						
<24	1879	11.7	---	---	---	
24-35	3101	19.3	---	---	---	
36	11120	69.1	---	---	---	
Survey year						P<0.001
2004	3438	21.4	14.3	24.3	61.4	
2007	2990	18.6	12.7	21.1	66.2	
2011	4330	26.9	10.8	19.0	70.1	
2014	2511	15.6	10.9	16.4	72.8	
2017	2831	17.6	9.5	14.0	76.5	
Wealth index						P<0.001
Poorest	4117	25.6	12.7	23.0	64.3	
Poorer	3418	21.2	11.8	20.9	67.3	
Middle	3067	19.0	11.5	19.0	69.4	
Richer	2911	18.1	11.8	16.3	71.9	
Richest	2587	16.1	9.8	14.8	75.3	
Residence						P<0.001
Urban	3482	21.6	10.8	16.1	73.1	
Rural	12618	78.4	11.9	20.1	68.0	
Region						P<0.001
Barisal	962	6.0	10.9	15.0	74.1	
Chittagong	3553	22.1	12.3	23.4	64.3	
Dhaka	5186	32.2	11.2	19.5	69.3	
Khulna	1475	9.2	9.6	11.4	79.0	
Rajshahi	3593	22.3	9.9	15.7	74.4	
Sylhet	1331	8.3	19.4	28.7	51.9	
Women's education						P<0.001
No education	4334	26.9	12.1	22.2	65.7	
Primary	5248	32.6	11.4	19.8	68.8	
Secondary	5608	34.8	11.5	17.1	71.4	
Higher	911	5.7	12.2	15.6	72.2	
Birth order						P<0.001
2nd	7152	44.4	11.8	18.2	69.9	
3rd	4269	26.5	9.8	17.1	73.1	
4th+	4679	29.1	13.1	22.8	64.1	
Child age (in month)						P<0.01
0-11	4232	26.3	10.8	19.4	69.8	
12-23	4245	26.4	12.8	18.8	68.4	
24-35	3761	23.4	11.7	18.3	69.9	
36-47	2090	13.0	11.1	19.5	69.4	
48-59	1772	11.0	11.6	21.7	66.7	
Wantedness of last child						P<0.001
Wanted	10422	64.7	8.3	16.6	75.1	
Unintended	5678	35.3	17.9	24.1	58.0	
Received ANC						P<0.001
No	7577	47.1	12.6	23.6	63.7	
Yes	8523	52.9	10.8	15.4	73.8	
Total	16,100	100.0	11.7	19.3	69.1	

divided into Rajshahi and Rangpur divisions and Dhaka division was divided into Dhaka and Mymensingh divisions in 2010 and 2015 respectively. We merged these and kept the divisions as those were in 2004. The responses for the wantedness of the last child were categorized as by wanted then, wanted later and not wanted at all. The latter two responses were merged and labeled as 'unintended'.

Simple cross-tabulation, bivariate and multivariate statistical analyses were employed. Bivariate analysis namely, chi-square tests, was applied to examine the association between the outcomes of

Table 2. Percentage distribution of stunted and underweight children by their background characteristics, BDHS 2004 - 2018

Background characteristics		Stunted			Total	Underweight			Total
		<24	24-35	≥36		<24	24-35	≥36	
Survey year		P < 0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	2004	45.6	46.9	36.1	40.1	53.4	50.8	42.1	45.8
	2007	49.2	49.7	40.2	43.4	47.0	46.0	39.6	41.9
	2011	49.4	47.7	38.2	41.2	43.9	39.7	34.7	36.6
	2014	39.3	36.7	32.0	33.6	40.2	36.9	29.4	31.8
	2017	37.3	35.0	28.7	30.4	23.5	23.3	17.4	18.8
Wealth index		P < 0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	Poorest	53.2	52.2	44.6	47.5	53.1	50.6	43.3	46.2
	Poorer	45.5	47.8	40.0	42.3	46.9	43.0	37.8	39.9
	Middle	48.3	44.1	33.8	37.4	43.0	39.6	31.4	34.3
	Richer	40.4	38.5	32.4	34.3	37.2	36.4	27.7	30.3
	Richest	30.1	29.7	21.9	23.8	28.3	25.6	19.1	21.0
Residence		ns	ns	P < 0.001		ns	P < 0.001	P < 0.001	
	Urban	41.9	42.7	29.7	33.1	40.1	35.2	26.0	29.0
	Rural	46.0	45.3	37.0	39.7	44.4	42.9	34.7	37.5
Region		P < 0.05	P < 0.05	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	Barisal	44.8	54.1	40.5	43.0	35.1	45.8	37.9	38.8
	Chittagong	46.5	44.3	35.5	38.9	44.5	40.5	33.7	36.6
	Dhaka	46.8	45.4	35.8	38.9	47.3	43.1	30.6	34.9
	Khulna	36.4	35.3	30.0	31.2	35.7	36.0	28.8	30.3
	Rajshahi	40.6	44.0	34.1	36.3	40.2	40.2	33.7	35.4
	Sylhet	50.2	46.3	40.3	43.9	46.0	42.2	38.2	40.8
Women's education		P < 0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	No education	52.9	54.1	43.4	46.9	54.3	54.3	45.4	48.5
	Primary	45.9	49.9	38.6	41.6	46.5	42.8	34.7	37.6
	Secondary	41.7	33.3	29.7	31.7	36.6	30.8	24.7	27.1
	Higher	24.6	22.8	16.3	18.3	18.2	17.9	15.2	16.0
Birth order		P < 0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	2nd	38.3	41.5	31.9	34.4	37.7	37.7	28.9	31.5
	3rd	48.6	38.8	34.2	36.4	48.1	37.2	31.5	34.1
	4th+	52.3	53.0	42.1	45.9	48.6	49.2	40.3	43.4
Child age (in month)		P < 0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	0-11	22.3	22.5	16.6	18.4	25.7	23.1	17.8	19.7
	12-23	54.0	50.3	40.3	43.9	45.9	45.6	34.5	38.0
	24-35	51.9	53.6	43.7	46.5	50.9	47.3	37.5	40.9
	36-47	51.2	59.1	45.0	48.4	48.7	54.1	43.8	46.4
	48-59	51.1	50.2	39.1	42.9	55.8	48.5	41.3	44.5
Wantedness of last child		P<0.01	ns	P < 0.01		ns	ns	P < 0.001	
	Wanted	48.2	44.8	34.5	37.4	44.7	42.1	31.5	34.3
	Unintended	42.6	44.9	37.2	40.0	42.6	40.7	35.7	38.1
Received ANC		P<0.001	P < 0.001	P < 0.001		P < 0.001	P < 0.001	P < 0.001	
	No	51.3	50.9	42.4	45.5	51.6	48.1	41.5	44.4
	Yes	38.7	36.5	29.9	31.8	35.3	32.5	25.9	28.0
Total	45.1	44.8	35.3	38.3	43.6	41.5	32.7	35.7	

interest and multivariable logistic regression (MLR) was applied to examine the effects of the explanatory variables on stunting and underweight. Before execution of the multivariate analysis, multicollinearity was checked and found its non-existence. Results of the MLR analyses are presented by odds ratios (ORs) with 95% confidence intervals (CIs). We set the level of significance at $\alpha = 0.05$. The statistical analyses were executed by Stata 15/IC. In the study, we used secondary data. The data sets were obtained from MEASURE DHS upon request. Prior to the survey, both oral and written consent was taken from the respondents. The ethical approval was taken from the Ethics Review Board of ICF International, USA and the Ministry of Health and Family Welfare, Bangladesh. Thus, it was not necessary to take further approval from any other ethical approval committee.

Table 3. Logistic regressions estimates of stunting and underweight among under-five children in Bangladesh, BDHS 2004 - 2018

Background characteristics		Stunting			Underweight		
		OR	95% CI		OR	95% CI	
			Lower	Upper		Lower	Upper
Birth interval							
	<24	1.44***	1.27	1.57	1.42	1.27	1.58
	24-35	1.35***	1.24	1.41	1.22***	1.12	1.33
	36	Ref.	---	--	Ref.	---	---
Survey year							
	2004	Ref.	---	--	Ref.	---	---
	2007	1.20***	1.08	1.34	0.88**	0.80	0.98
	2011	1.15**	1.04	1.27	0.72***	0.65	0.80
	2014	0.91	0.81	1.03	0.67***	0.60	0.76
	2017	0.93	0.82	1.04	0.38***	0.33	0.43
Wealth index							
	Poorest	Ref.	---	--	Ref.	---	---
	Poorer	0.88**	0.80	0.97	0.84***	0.77	0.93
	Middle	0.74***	0.67	0.82	0.69***	0.62	0.77
	Richer	0.66***	0.59	0.74	0.60***	0.53	0.67
	Richest	0.44***	0.38	0.51	0.42***	0.36	0.48
Residence							
	Urban	Ref.	---	--	Ref.	---	---
	Rural	0.91*	0.82	1.00	0.96	0.87	1.06
Region							
	Barisal	Ref.	---	--	Ref.	---	---
	Chittagong	0.96	0.82	1.12	1.07	0.91	1.25
	Dhaka	0.92	0.79	1.07	0.92	0.79	1.08
	Khulna	0.70***	0.59	0.84	0.80**	0.67	0.96
	Rajshahi	0.77***	0.66	0.90	0.88*	0.75	1.02
	Sylhet	1.05	0.88	1.26	1.12	0.93	1.34
Women's education							
	No education	Ref.	---	--	Ref.	---	---
	Primary	0.96	0.88	1.05	0.84***	0.76	0.91
	Secondary	0.82***	0.73	0.90	0.71***	0.64	0.79
	Higher	0.49***	0.40	0.60	0.47***	0.38	0.58
Birth order							
	2nd	Ref.	---	--	Ref.	---	---
	3rd	0.96	0.88	1.04	0.94	0.86	1.03
	4th+	1.15***	1.05	1.26	1.02	0.93	1.12
Child age (in month)							
	0-11	Ref.	---	--	Ref.	---	---
	12-23	3.65***	3.30	4.04	2.64***	2.39	2.93
	24-35	4.01***	3.62	4.45	2.92***	2.63	3.24
	36-47	3.87***	3.42	4.38	2.93***	2.59	3.31
	48-59	2.99***	2.63	3.40	2.68***	2.36	3.05
Wantedness of last child							
	Wanted	Ref.	---	--	Ref.	---	---
	Unintended	0.97	0.90	1.04	1.02	0.94	1.10
Received ANC							
	No	Ref.	---	--	Ref.	---	---
	Yes	0.83***	0.77	0.89	0.81***	0.75	0.87

*Note: Level of significance *** P<0.001; *** P<0.01; and *** P<0.05.*

RESULTS

Table 1 represents the background characteristics of under-five children. Of the children, slightly over one in ten fell in the birth interval of less than 24 months and one fifth had a birth interval between 24 to 35 months. More children were from 2011 BDHS, one-fourth of the children were from poorest households, slightly over one-fifth was

urban residents, and more children were from Dhaka division. Almost three-fifths of the mothers of the children had some primary or no education. Over 44% of the children were second-order births, more than one-third were unintended and more than half of the mothers received ANC services at least for once.

Trends of birth interval of married women are pictured in Figure I. As shown in the figure, short birth interval of less than 24 months has declined from 14% in 2004 to 10% in 2017-18. Besides, the birth interval of 24-35 months has declined more sharply from 24% in 2004 to 14% in 2017-18. Altogether, birth interval of less than 36 months has declined from 38% in 2004 to 24% in 2017-18.

Table 2 shows the differentials of stunting and underweight by background characteristics of the children in Bangladesh. Overall, the prevalence of stunted and underweight children was 45% and 44% who were born with a birth interval of less than 24 months. The corresponding figures for those born with a birth interval of 24 to 35 months were 45% and 42% respectively. The rate of stunting and underweight was significantly higher in the children with a short birth interval of < 24 months and 24 to 35 months compared to an interval of ≥ 36 months. The other covariates found statistically associated with stunting and underweight were survey year, wealth index, region, maternal education, birth order of the child, child age and mothers' receiving of ANC services at least once.

Results of the MLR analysis for stunting and underweight are presented in Table 3. The results suggest that both stunting and underweight are inversely associated with birth interval. For instance, compared to a birth interval of 36 to 59 months, children born to mothers with birth interval 24 to 36 months (OR = 1.35, 95%CI: 1.24, 1.41) and < 24 months (OR = 1.44, 95% CI: 1.27, 1.57) were significantly at higher risk of being stunted. On the other side, the likelihood of being underweight was significantly higher in the children born to mothers with birth interval 24 to 36 months (OR = 1.22, 95% CI: 1.12, 1.33) and < 24 months (OR = 1.42, 95% CI: 1.27, 1.58) compared to those born at an interval of 36 to 59 months of the previous birth. Risk of underweight status decreases consistently across survey years; although the risk of being stunted increased in 2007 and 2011 significantly and then decreased in 2014 and 2017-18, the decrease was not found to be statistically significant.

Household wealth index and women's level of education were statistically inversely associated with stunting and underweight. Children from Khulna and Rajshahi divisions compared to those of Barisal division were more likely to be stunted and underweight. Child age was found to have a significant effect of being stunted and underweight; however, it did not show any apparent pattern of risk of increasing of stunting and underweight status of the children. Fourth-order birth was more likely to be stunted than second-order birth, but birth order was not a significant predictor of being underweight. The children whose mothers received ANC services at least once were less likely to be stunted (OR = 0.83, 95% CI: 0.77, 0.89) and underweight (OR = 0.81, 95% CI: 0.75, 0.87) compared to those whose mothers did not receive any ANC services.

DISCUSSION

There is a general consensus that in most developing countries, stunting and underweight children are at higher risk of childhood mortality and morbidity. The duration between inter-pregnancy is identified as a vital cause of stunting and underweight. In this study, we examined the association of birth interval and childhood stunting and underweight using nationally representative longitudinal data sets extracting from the last five BDHSs conducted during the period 2004 to 2017-18.

Our findings show that, on average, 10% of the births had a birth interval of less than 24 months and 14% had a birth interval of 24 to 35 months. The corresponding figures in India were reported to be 27% and 32% respectively.[18,19] In Nepal, 23% of the births were delivered within a short birth interval of < 24 months.[20] A study from Sub-Saharan Africa reported that the proportion of women having short birth intervals between two subsequent births in Chad and the Democratic

Republic of Congo was 30% and 27% respectively.[21] Moreover, this study shows that the proportion of short birth spacing is being decreased over time though the result was not found to be statistically significant in the multivariate analysis.

Consistent with previous studies, our findings show that short birth intervals are statistically associated with a higher likelihood of childhood stunting and underweight.[2,17-22] A plausible reason may be that a mother cannot recover biological maturity within a concise period of her delivery, which in turn affects the next pregnancy and resulting in low birth weight of the child. In addition, food sharing and rearing of two infants at same time and place would pose the children at greater risk of being stunted and underweight.

Our results that showed that children from poor households and having no or low educated mothers are more likely to be stunted and underweight. This finding of ours is also in good agreement of earlier studies conducted elsewhere.[2,17-21] It is likely that poor families cannot provide enough and nutritious food to their children which results in an increased risk of stunting and underweight. Besides, low educated mother have no sufficient knowledge regarding nutritious food which also place their children at risk to be undernourished.

The other factors identified to have a significant effect on stunting and underweight are region, birth order, child's age and mothers' ANC seeking. The children whose mothers received ANC services than those whose mothers did not receive this service were less likely to be stunted and underweight. This finding is also concurrent to those of earlier studies conducted elsewhere.[14-17] ANC seeking is a vital factor for both mothers and child health. It helps pregnant mothers in detecting any complications earlier which can be solved by the counselling and advice provided by the medical personnel.

This study has some limitations and strengths that urge to be discussed. This study is based on retrospective information which is not free of recall biases. We could not show causality due to the cross-sectional nature of the data sets, urges the need for prospective research. An important limitation of the study is that the inclusion of various survey data may have influenced to be changed other variables over years. The main strength of the study is the usage of nationally representative data which are reliable and publicly used around the globe. Moreover, the sophisticated statistical analysis yielded quantitatively important and reliable estimates.

CONCLUSIONS

Findings reveal that short birth interval adversely affects the nutritional status of under-five children in Bangladesh. Women should be informed about the adverse health outcomes for both mother and child that occur due to short birth interval. Women should be motivated to use a family planning method to lengthen the space between subsequent pregnancies or to limit childbearing who do not desire for more children. Use of suitable family planning methods may be the viable means of longer spacing or limiting childbearing which in turn may lessen undernourishment of under-five children.

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