

# Poor Birth Size a Badge of Low Birth Weight Accompanying Less Antenatal Care in Bangladesh with Substantial Divisional Variation: Evidence from BDHS - 2011

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**Abstract** In spite of having a pretty good progress in maternal and child health, low birth weight is still a serious public health issue for Bangladesh. The prime concern of this study was to crosscheck the eventual influence of antenatal care on poor birth size, a substitution of low birth weight and to explore the divisional variation along with its individual role on poor birth size. A nationally representative data, Bangladesh Demographic and Health Survey (BDHS) 2011 was used for this purpose. Sample size for this study was 7324 children from the different parts of the country born within last five years preceding the survey and all of them were the last child. Logistic regression analysis was applied to examine the influence of ANC on poor birth size as well as other relevant variables such as mother's level of education, house hold income, division, age of mother at birth, birth order, sex of child, place of residence, media exposure etc. A total of 17.5% children had poor birth size (reported as "very small" or "smaller than average" by mothers) at the time of birth. The result of the analysis shows that ANC is negatively and significantly associated with poor birth size after controlling for all other potential factors. Four or more times ANC visited mothers, compared to no ANC visited mothers, have 26% lower risks of having poor birth size babies ( $p=0.002$ ). Highest frequency (23%) of poor birth size was found at South-eastern part of Bangladesh which is Chittagong division and lowest frequency (10.1%) was observed in both Barisal and Khulna division. In comparison to Dhaka division, mothers living at Sylhet or Chittagong division have 42% or 35% higher risk of having poor birth size babies respectively ( $p=0.003$  or  $p=0.001$ ). As per current study it is well documented that provision of adequate antenatal care and proper utilization of it can effectively reduce poor birth size, eventually low birth weight in Bangladesh and divisional variation is also prominent in Bangladesh.

**Keywords** Antenatal care, Poor birth size, Low birth weight, BDHS, Bangladesh

## 1. Introduction

Within limited time and capacity, Bangladesh has achieved a considerable progress in maternal and child health [1]. We need a long term sustainable approach, as infant mortality rate is still 38 per 1,000 live births [2]. Poor birth size which is a suitable proxy for low birth weight is a vital risk factor for neonatal mortality, eventually infant mortality. Current research evidence shows that low birth weight increases the odds of neonatal deaths by 20-30 times and infant death by 3 times [3, 4]. In case of very low birth weight, mortality rate is significantly high. Regardless of the gestational age if the birth weight is less than 2500 gram it is usually treated as low birth weight [5, 6] and in majority

cases poor birth size coincide with low birth weight. In this particular study we have used this poor birth size as a symbol of low birth weight. Poor birth size is used for those babies whose mother reported their birth size as "very small" or "smaller than average". At present around the globe about 20 million babies born with low birth weight and the vast majority, 95.6% are from developing countries [7]. The Prevalence of low birth weight is around 15% in developing countries [5]. According to "National low birth weight Survey of Bangladesh-(2003-2004)" over one-third of infants (36%) of Bangladesh born with low birth weight [8] which is more than twice of that 15% threshold which clearly indicates its public health significance. Recent evidence shows unexpected high prevalence of low birth weight in Bangladesh. Selina Khatun has reported 23.2% of low birth weight out of 465 samples at a maternal and child health training institute in Dhaka in 2008 [9]. Bishal Dhar has reported 15.18% low birth weight out of 316 samples in a government maternity hospital in Dhaka in 2002 [10].

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Another community-based longitudinal study shows that infants who died before 12 months, 73% among them were low birth weight babies [11].

**Table 1.** Frequency distribution of selected independent and dependent variables

Variable	Frequency	Percentage (%)
<b>Poor birth size (n=7324)</b>		
Yes	1282	17.5
No	6042	82.5
<b>No of antenatal care visits (n=7319)</b>		
0	2445	33.4
1-3	2940	40.2
4 or more	1934	26.4
<b>Age of mother at birth (n=7126)</b>		
<20	1838	25.8
20-29	4107	57.6
30 or more	1181	16.6
<b>Birth order (n=7324)</b>		
1 <sup>st</sup>	2476	33.8
2 <sup>nd</sup> -3 <sup>rd</sup>	3472	47.4
4 <sup>th</sup> or more	1376	18.8
<b>Sex of child (n=7324)</b>		
Male	3790	51.7
Female	3534	48.3
<b>BMI of mother (n=7167)</b>		
<18.5	1898	26.5
18.5 or more	5269	73.5
<b>Place of residence (n=7324)</b>		
Urban	2327	31.8
Rural	4997	68.2
<b>Exposure to media (n=7313)</b>		
No	2517	34.4
Yes	4796	65.6
<b>Belong to NGO (n=7322)</b>		
No	5439	74.3
Yes	1883	25.7
<b>Wealth index (n=7324)</b>		
Poor	2925	39.9
Middle	1408	19.2
Rich	2991	40.8
<b>Mother's level of education (n=7324)</b>		
No education	1332	18.2
Primary	2193	29.9
Secondary	3173	43.3
Higher	626	8.5
<b>Region (n=7324)</b>		
Barisal	856	11.7
Chittagong	1393	19.0
Dhaka	1229	16.8
Khulna	876	12.0
Rajshahi	949	13.0
Rangpur	962	13.1
Sylhet	1059	14.5

Poor birth size a substitute of low birth weight is not only a vital risk factor for infant mortality it also causes severe physical and mental impairment to the survivors for the rest of their lives. A series of physical illness like malnutrition, cerebral palsy, breathlessness, higher incidence of diseases and growth retardation is very common [6, 12, 13, 14]. When low birth weight infants are grown up they usually face plenty of mental health issues like cognitive immaturity, poor social adaptation in school and other locations [12, 15]. low birth weight is also linked with a tendency to higher rates of coronary heart diseases, hypertension, diabetes and other future chronic diseases [16, 17]. Eventually low birth weight increases the overall burden of diseases.

Risk factors and the causes of Poor birth size a substitute of LBW are multifactorial, complicated and are different among countries or regions. In the developed countries, preterm delivery and intrauterine growth retardation is the main common cause of low birth weight [18], however, in the developing countries biological and socioeconomic causes are more common. According to literature review we can consider the following factors for low birth weight in Bangladesh such as maternal age (lower than 20 or higher than 30), maternal under nutrition, birth order, maternal health conditions like diabetes, hypertension & anemia, obstetric factors, socio-economic factors like house hold income, maternal education, household leadership, service related factors like antenatal care (Care for the expected mothers up to child birth) [7, 8, 9, 19, 20, 21, 22]. Upon considering all the factors of low birth weight we may say maternal health condition especially during pregnancy period is the key determinant and it is also related with biological, social and service related factors. Antenatal care is an effective and feasible way by which we can monitor the health condition of both mother and the baby. It can efficiently reduce the low birth weight or poor birth size prevalence [22, 23, 24, 25].

So ANC with a link to low birth weight is not a new area to be discovered as WHO recommended 4 antenatal visits for a woman with normal pregnancy for a better pregnancy outcome [26]. In our country like the different parts of the globe, many studies have also been conducted so far targeting the same issue but majority of them was not representative for the entire country as some of them was done in urban areas, sample size was relatively small, lack of socio-demographic factors or based on clinical practice [7, 9, 10, 11]. An exploration on the current version of main national databases that can represent the whole country have not yet been done to oversee the linkage between ANC and low birth weight in Bangladesh. One of the major causes could be absence of the direct birth weight data in national representative health survey like BDHS (Bangladesh Demographic and Health Surveys), conducted every five years. In BDHS, direct measurement of birth weight is not available, because birth weight was not likely to be known for many babies, particularly for those born at home and in Bangladesh the majority of births occur at home. Data on

birth size is available and even though subjective, this birth size is highly related with birth weight [27], so poor birth size could be a useful proxy for LBW. Another interesting finding regarding poor birth size in Bangladesh is regional or divisional variation. According to BDHS-2011, among the divisions (Bangladesh is divided into seven major administrative regions called division-2011), the highest percentage of very small children is seen in Chittagong and Sylhet (7%) though these two divisions are economically much more stable than others and the lowest (3%) is in Rangpur division [28]. So it is clear that region plays a vital role either independently or via other potential determinants. So, the aim of this study is to identify the independent effect of each of the factors of LBW with an eye to our key independent variable ANC and also to explore the divisional differences with a view to decrease poor birth size, eventually LBW prevalence in Bangladesh.

## 2. Research Hypothesis

The hypothesis considered in this study is stated as “Less antenatal care (ANC) can increase poor birth size prevalence in Bangladesh eventually low birth weight prevalence”. It is not a new one but the interesting thing is here we are using birth size as a proxy for birth weight in a nationally representative dataset and want to observe whether it supports the mentioned hypothesis or not.

## 3. Data and Method

The present study uses the data from Bangladesh Demographic and Health Survey (BDHS) 2011, conducted under the authority of the National Institute of Population Research and Training (NIPORT) of the Ministry of Health and Family Welfare and implemented by Mitra and Associates of Dhaka. ICF International provided financial and technical assistance for the survey through USAID/Bangladesh. The BDHS is part of the worldwide Demographic and Health Surveys program, which is designed to collect data on fertility, family planning, and maternal and child health. BDHS-2011 covered a nationally representative sample of 18,222 ever married women of age 12–49 years and their children born 0–59 months prior to the survey date. It is the sixth national demographic and health survey. As a sampling frame BDHS used the list of enumeration areas (EAs) prepared for the 2011 Population and Housing Census, provided by the Bangladesh Bureau of Statistics (BBS). So the primary sampling unit (PSU) for the survey is an EA. The survey is based on a two-stage stratified sample of households. In the first stage, 600 EAs were selected with probability proportional to the EA size, with 207 clusters in urban areas and 393 in rural areas. In the second stage of sampling, a systematic sample of 30 households on average were selected per EA. Using this design; the survey selected 17,964 residential households of seven divisions of Bangladesh and 17,511 were found to be

occupied. Within those households out of 18222 ever-married women 17842 were interviewed, yielding a response rate of 98 percent. In order to reduce the recall bias in the BDHS survey, information regarding Antenatal care (ANC), Post natal care (PNC), immunization, diseases etc. were asked only for the children of age less than 60 months. Therefore, a file was created for the sample of children of age 0–59 months including all variables of household and mother. In order to make it more precise and further reduce the recall bias, the data of last child (last life birth) were taken and the number was 7324 out of total 16025 births.

Here we have considered twelve variables out of which one is dependent variable and other eleven are independent variables. Poor birth size is our dependent variable, outcome either poor birth size or not. In BDHS, direct measurement of birth weight is mostly not available, because birth weight was not likely to be known for many babies, particularly for those born at home. Therefore instead of direct measurement of birth weight, we have adopted the mother's estimate of the baby's size from the BDHS 2011. A mother's report of a child being “very small”, “smaller than average”, “average or larger” in size, even though subjective, is highly related with birth weight and considered a useful proxy for low birth weight. So, here we have considered “very small” and “smaller than average” as poor birth size and “average or larger” as normal birth size. The key independent variable is the number of ANC (antenatal care) visit. Here we have categorized ANC visits into 3 groups: Never ANC visit group, 1 to 3 ANC visit group and 4 or more ANC visit group. Other independent variables are Age of mother at birth: three age groups are less than 20 years, 20 – 29 years and 30 years or above; Birth order: the categories of birth orders are first birth, 2<sup>nd</sup> to 3<sup>rd</sup> birth group and 4<sup>th</sup> or more birth group; Sex of the child: male or female; Mother's body mass index (BMI): categories of BMI are less than 18.5 and 18.5 or more [29] and in BDHS BMI of mother was measured at survey time; Place of residence: as urban or rural; Exposure to media: as exposed or non-exposed; Belong to NGO as an proxy for sort of empowerment and also financial involvement; Region or Division: 7 divisions- Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur and Sylhet; Maternal education: four levels of education, no education, primary education, secondary education and higher education group; Economic status: here we have used 3 categories for household economic status; poor, middle income group and rich.

The analysis was done into multiple steps. Firstly, a univariate analysis was done for both dependent and independent variables. Then, bivariate analysis was done by the Chi-square test to examine the association between the dependent variable and all other independent variables separately. Finally, multivariate analysis was done by fitting the logistic regression model for LBW to examine the impact of ANC visit after controlling the other potential factors. This was done by following a step-by-step procedure and we have included the factors in the logistic regression model those are found to be statistically significant in the bivariate analysis ( $p < 0.05$ ). In first step, we have considered ANC as

1-3 visits and 4 or more visit in reference with no ANC visit and division as Barisal, Chittagong, Khulna, Rajshahi, Rangpur and Sylhet in reference with Dhaka for poor birth size. In second step along with ANC visit and division, we have also considered birth order as 1<sup>st</sup> birth and 4th or more birth in reference to 2<sup>nd</sup> - 3<sup>rd</sup> birth, sex of the child, mother's level of education as primary, secondary and higher with the reference of no education, house hold income as poor and rich in reference with middle income and BMI of mothers.

**Table 2.** Examining the association between poor birth size and selected independent variable: A bivariate analysis

Variable	Poor birth size (%)		p-value
	No	Yes	
<b>No of antenatal care visits</b>			
0	9.5	20.5	.000
1-3	82.3	17.7	
4 +	86.5	13.5	
<b>Age of mother at birth</b>			
<20	81.7	18.3	.172
20-29	83.4	16.6	
30 or more	81.7	18.3	
<b>Birth order</b>			
1 <sup>st</sup>	82.1	17.9	.003
2 <sup>nd</sup> -3 <sup>rd</sup>	83.8	16.2	
4 <sup>th</sup> or more	79.8	20.2	
<b>Sex of child</b>			
Male	84.5	15.5	.000
Female	80.3	19.7	
<b>BMI of mother</b>			
<18.5	80.0	20.0	.001
18.5 or more	83.4	16.6	
<b>Place of residence</b>			
Urban	83.2	16.8	.253
Rural	82.1	17.9	
<b>Exposure to media</b>			
No	82.4	17.6	.823
Yes	82.6	17.4	
<b>Belong to NGO</b>			
No	82.5	17.5	.983
Yes	82.5	17.5	
<b>Wealth index</b>			
Poor	80.6	19.4	.002
Middle	82.9	17.1	
Rich	84.1	15.9	
<b>Mother's level of education</b>			
No education	79.5	20.5	.000
Primary	81.3	18.7	
Secondary	83.4	16.6	
Higher	88.5	11.5	
<b>Region</b>			
Barisal	84.9	15.1	.000
Chittagong	78.8	21.2	
Dhaka	83.8	16.2	
Khulna	85.2	14.8	
Rajshahi	84.0	16.0	
Rangpur	86.0	14.0	
Sylhet	77.1	22.9	

## 4. Results

Table 1 describes the profile of both dependent and independent variables. In case of dependent variable poor birth size out of 7324 cases 17.5% was poor birth size while 82.5% were not. Among the independent variables, our main point of interest is number of ANC visits. Within ANC visits 33.4% of mothers haven't reported ever ANC visits while 40.2% of mothers have received from one to three ANC visits and the rest 26.4% of mothers have received 4 or more ANC visits. Regarding age of mother at birth, 57.6% of mothers were in-between 20 to 29 years and 25.8% were below 20 years while 16.6% were 30 years or above. Within Birth order, the 1st birth group consists of 33.8%, the 2nd to 3rd birth group consists of 47.4% while 18.8% are in the 4<sup>th</sup> and more birth groups. Male sex ratio which is 51.7% is slightly higher than the female sex ratio that is 48.3%. Body mass index (BMI) of mother has categorized into the two groups; one, BMI <18.5, and the other, BMI ≥18.5. BMI <18.5 represents lower BMI group which is 26.5%, on the other hand normal or higher BMI group consists of 73.5% mother. Among the respondents, 68.2% people reside in rural area while 31.8% reside in urban area. Respondents in exposure with media are 65.6% while 34.4% are not in exposure with media. In case of involvement with NGOs, only 25.7% mothers belong to NGO while 74.3% don't. In case of wealth index, 40.8% are rich, 39.9% are poor and 19.2% are in middle class group. Within Mother's level of education, 18.2% are in no education group, 29.9% are in primary education group, 43.3% are in secondary education group, while higher education group consists of 8.5%. Here we have considered 7 divisions named Barisal (11.7%), Chittagong (19.0%), Dhaka (16.8%), Khulna (12.0%), Rajshahi (13.0%), Rangpur (13.1%) and Sylhet (14.5%) which contain certain amount of our study population mentioned along with their names.

Table 2 represents the results of the bivariate analysis for poor birth size with all independent variables. Out of all independent variables four appears insignificant as p-value is greater than 0.05. These four variables are age of mother at birth, place of residence, exposure to media and belong to NGO. Note the p-values for these four variables are 0.172, 0.253, 0.823 and 0.983 respectively. Out of remaining seven significant variables, under the number of ANC visits, 4 or more ANC visits group have lowest poor birth size that is 13.5% and zero or no ANC visits group have the highest poor birth size which is 20.5% while one to three ANC visits group have 17.7% poor birth size. Considering the birth order poor birth size is highest in 4th and more birth group which is 20.2% and lowest among the 2nd to 3rd birth group which is 16.2% while 1st birth group contain 17.9% of poor birth size. Poor birth size is prominent in female child that is 19.7%, on the other hand 15.5% LBW found in male child. More poor birth size is also found in greater number (20%) among mothers whose BMI is <18.5. Within wealth index, poor birth size is lowest among rich peoples, which is 15.9% and highest among poor people, which is 19.4%. poor birth

size among middle class group is 17.1%. Under the mother's level of education, higher education group has lowest frequency of poor birth size that is 11.1% and the secondary and primary groups have 16.6% and 18.7% of poor birth size respectively. No education group has highest poor birth size which is 20.5%.

**Table 3.** Divisions of Bangladesh and the distribution of Poor birth size

			Division							
			Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Rangpur	Sylhet	
Poor Birth Size	YES	Number	129	295	199	130	152	135	242	1282
		% with Division	15.1	21.2	16.2	14.8	16.0	14.0	22.9	17.5%
		% within Poor birth size	10.1	23.0	15.5	10.1	11.9	10.5	18.9	100%
	NO	Number	727	1098	1030	746	796	827	817	6042
		% with Division	84.9	78.8	83.8	85.2	84.0	86.0	77.1	82.5%
		% within poor birth size	12.0	18.2	17.0	12.3	13.2	13.7	13.5	100%
		856	1393	1229	876	949	962	1059	7324	

**Table 4.** Logistic regression models for poor birth size after controlling all other factors - A multiple regression analysis

Variable	Model I		Model II	
	Odds ratio	p-value	Odds ratio	p-value
<b>No of ANC visit</b> (ref. no visit)				
1-3	(-)0.868	0.045	(-)0.924	0.298
4 or more	(-)0.651	0.000	(-)0.740	0.002
<b>Region</b> (ref. Dhaka)				
Barisal	(-)0.923	0.515	(-)0.873	0.286
Chittagong	1.364	0.002	1.356	0.003
Khulna	(-)0.930	0.558	(-)0.933	0.577
Rajshahi	(-)0.993	0.951	(-)0.970	0.802
Rangpur	(-)0.876	0.278	(-)0.839	0.157
Sylhet	1.481	0.000	1.419	0.001
<b>Birth order</b> (ref. 2 <sup>nd</sup> -3 <sup>rd</sup> birth)				
1 <sup>st</sup>			(-)0.822	0.007
4 <sup>th</sup> or more			(-)0.892	0.242
<b>Sex of child</b> (ref. Female )				
Male			(-)0.746	0.000
<b>BMI of mother</b> (ref. <18.5)				
18.5 or more			(-)0.889	0.099
<b>Wealth Index</b> (ref. Middle)				
Poor			1.096	0.309
Rich			(-)0.998	0.981
<b>Mother's level of education</b> (ref. No education )				
Primary			0.958	0.645
Secondary			0.883	0.215
Higher			(-)0.678	0.019
<b>Constant</b>	(-)0.227	0.000	(-)0.326	0.000

Table 3 shows the percentage of both poor birth size and normal birth size within the respective divisions in aspect of study population and also demonstrate the percentage of poor birth size in each division in aspect of total poor birth size. In Barisal there were 15.1% poor birth size and 84.9% normal birth size. Within Chittagong 21.2% were poor birth size and 78.8% were normal birth size. In case of Dhaka 16.2% were poor birth sizes while 83.8% were normal birth size. Khulna, Rajshahi, and Rangpur have 14.8, 16.0% and 14.0% of poor birth size respectively while normal birth size were 85.2%, 84.0% and 86% respectively. In Sylhet 22.9% were poor birth size and 77.1% were normal birth size. Among the total LBW Chittagong division has the highest poor birth size which is 23% and both Barisal and Khulna has lowest LBW which is 10.1%. Sylhet, Dhaka, Rajshahi, and Rangpur has the following frequency of poor birth size that is 18.9%, 15.5%, 11.9% and 10.5% respectively.

Table: 4, Model I presents the first logistic model for poor birth size with ANC visit as 1-3 visits and 4 or more visit and division represented by Barisal, Chittagong, Khulna, Rajshahi, Rangpur and Sylhet. It is found that both the ANC visited groups have a significant negative impact on poor birth size. With the reference of no ANC visited mothers, 4 or more times ANC visited mothers have 35% lower risk of having poor birth size babies, keeping other independent variable division at a constant level and it is statistically significant as  $p\text{-value}=0.000$ . On the other hand 1-3 ANC visited mothers compared to no ANC visited mothers, have 14% lower risk of having poor birth size babies and it is also significant as  $p\text{-value}=0.045$ . Mothers living at Chittagong or Sylhet, compared to mothers living at Dhaka, have 36% and 48% higher risk of having poor birth size babies respectively ( $p=0.002$  and  $0.000$  respectively).

Table: 4, Model II presents the second as well as final logistic model for poor birth size. In this model in addition to number ANC visit and division, we have also considered birth order, sex of child, BMI, wealth index, Mother's level of education as independent variable. Here we observed, 4 or more times ANC visited mothers, compared to no ANC visited mothers, have 26% lower risk of having poor birth size babies, keeping all other independent variables at a constant level and it is statistically significant as  $p\text{-value}=0.002$ . Here we did not find any significant effect for 1-3 ANC visited mothers compared to no ANC visited mothers on poor birth size which was found significant in Model-I. Mothers living at Chittagong or Sylhet, compared to mothers living at Dhaka, have 35% and 42% higher risk of having poor birth size babies respectively ( $p=0.003$  and  $0.001$  respectively). After controlling with all other variables, the risk of having poor birth size babies is slightly reduced for both Chittagong and Sylhet. The 1st birth group, compared to the 2nd - 3rd birth group, have 18% lower risk of having poor birth size and it is also found significant, ( $p=0.007$ ). Male children compared to female children, have 26% lower risk of having poor birth size ( $p=0.000$ ). Higher educated mothers, compared to no educated mothers, have 32% lower risk of having poor birth size ( $p=0.019$ ). In this

model we did not find any significant effect of BMI of mother and wealth index on LBW.

## 5. Discussion

It is very difficult to concentrate on a single factor and focus that as a predictor for poor birth size eventually low birth weight, especially in a developing country like Bangladesh, but definitely ANC is such a factor that can explain poor birth size from different perspectives. This is an attempt, which reports the factors linked with poor birth size based on the national level data which represent the whole country. One of the interesting as well as significant finding of this particular study is, 4 or more times ANC visited mothers have 26% lower risk of having poor birth size babies in comparison to no ANC visited mothers but we didn't find any significant finding regarding poor birth size in case of one to three ANC visited mothers compared to no ANC visited mothers. One of our recommendation is at least 4 ANC is needed to get a desired outcome regarding poor birth size. One fourth of the poor birth size can easily be prevented by ensuring 4 or more ANC visit. Other modifiable risk factors that predict poor birth size could also be facilitated by ANC, focusing the general health condition of the mothers including nutritional support, weight gain during pregnancy, anemia control and further follow-up checkups. This study shows 4 or more times ANC visit is negatively associated with LBW which is also supported by other studies [7, 31] except one [18], although in that particular study they consider  $<6$  ANC visit and  $\geq 6$  ANC visit and pointing towards the quality of ANC. So in policy level implication in Bangladesh, our focus should be at least 4 or more ANC provision during pregnancy period. In our study we have found that the prevalence of poor birth size eventually low birth weight is 17.5% which differs from other studies in Bangladesh as they have found 23.2% [30] or 24% [18] or even more, important reasons could be less sample size (350 and 583 respectively), place of the study (Central part of Dhaka and different villages of Nabinagar under Savar Upazila respectively) or time period of the study (2003 to 2005 and 2000 to 2001 respectively).

Another interesting finding of this study is the divisional variation regarding poor birth size in Bangladesh. Northeastern (Sylhet) and south-eastern (Chittagong) part of Bangladesh is denoted as a higher risk zone for poor birth size. The highest prevalence of poor birth size was found in the port city Chittagong which is 23% and second to it was Sylhet (18.9%). The lowest prevalence of poor birth size was observed in both Barisal and Khulna division which is 10.1%. Overall scenario in aspect of provision and access to health care system, human resources and development of Dhaka division, the capital of Bangladesh is far better than Barisal and Khulna division. Despite of this, frequency of poor birth size is higher in Dhaka (15.5%) than Barisal or Khulna division. Division plays a vital role in determining poor birth size even after controlling all other potential factors. Mothers living in the Sylhet division have 42% higher risk of having

poor birth size babies compared to mothers living at Dhaka division. Similar finding is also observed for mothers living at Chittagong division, they have 35% higher risk of having poor birth size babies compared to mothers living at Dhaka. This divisional inconsistency direct towards a strange scenario. Both Chittagong and Sylhet are economically stable divisions of Bangladesh but we did not find any significant effect of house hold income on poor birth size in this particular study after controlling with other factors. Most likely explanation could be both of these Chittagong and Sylhet have difficult topography with hilly areas and population distributions versus basic facilities are not uniform throughout the division. Poor transportations system, distance between the community and health care provider, social norms and culture, poor status of women empowerment and less employment opportunity; all of these could collectively affect maternal health during pregnancy and one of the outcome would be poor birth size. Quality of health care system including ANC could be a vital cause for this divisional variation but we didn't consider the quality due to lack of information. Without any doubt these findings leads us to further research pointing divisional difference on poor birth size in Bangladesh.

Another modifiable key factor to reduce poor birth size in this study is mother's education. Mother's level of education has a significant influence on the poor birth size of child. The finding of present study also comply with previous studies that incidence of poor birth size decreases as mother's education level increases [9, 32]. This study also shows that there is a gradual decrease of the frequency of poor birth size as education level increases from no education to higher education. So with a view to decrease poor birth size the education level of this country should be raised with a special attention to create opportunities for mother's education. Community and religious leaders should be encouraged to advocate in favor of maternal education and the awareness. In this particular study no statistical significance was observed between maternal age at birth and poor birth size which is also supported by few studies in terms of low birth weight [33, 34, 35] and also disagreed by other studies [7, 31, 32]. In case of place of residence, we did not find any significant association with poor birth size. One possible explanation could be, health care facilities are much more available in rural areas in comparison to previous years and there is no such big difference in urban and rural areas in aspect of facility provision. Another interesting finding is we did not observe any significant effect of house hold income on poor birth size. In line of this finding we can say, due to both governmental and non-governmental efforts money is not the prime factor to have health facilities as it was in previous ages. We also did not find any statistically significant effect of mother's BMI on poor birth size. An acceptable explanation could be, this BMI of mother was measured at survey time. We found a significant effect of birth order and sex of the child on poor birth size as less poor birth size is seen in first birth group compared to 2nd -3rd birth group and in male child compared to female child.

The focal limitation of this study is to use baby's birth size as a substitute of direct measurement of birth weight as birth weight data is not available in BDHS 2011 and this birth size is also taken from the mothers assumption on the other hand however we can say that the baby's birth size is a suitable proxy for birth weight as other findings of this study match with several finding of other studies in Bangladesh that used birth weight. Furthermore, because of lack of data, we could not evaluate quality of antenatal care visits, but only the number of ANC visits. As the data is not longitudinal in nature, we could not draw a causal implication and also due to recall bias, there is a possibility of under estimation of poor birth size eventually low birth weight.

## 6. Conclusions

Using a nationally representative data set, it is verified that antenatal care can significantly reduce the poor birth size eventually LBW prevalence in a developing country like Bangladesh. Ensured provision of 4 or more ANC visit would be an effective public health measure to combat poor birth size in our country. There must be other hidden factors regarding poor birth size that led the substantial divisional difference which need to be evaluated by further mixed method research (both qualitative & quantitative) as we haven't found much evidence.

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## REFERENCES

- [1] <http://www.thefinancialexpress-bd.com/2015/08/11/103469> accessed on 5th November, 2015.
- [2] Bangladesh Demographic and Health Surveys (BDHS)-2014, page-34.
- [3] Romero C, Duke J, Dabelea D, Romero T and Ogden L, "Does the epidemiologic paradox hold in the presence of risk factors for poor birth size infants among Mexican-born women in Colorado?" *J Health Care Poor Underserved*, 2012, 23:604-614.
- [4] Meharban Singh, "Care of the newborn" 1993, 4th edition, Sagar Publications, New Delhi.
- [5] Vishnu Khanal, Yun Zhao and Kay Sauer, "Role of antenatal care and iron supplementation during pregnancy in preventing poor birth size in Nepal: comparison of national surveys 2006 and 2011" *Archives of Public Health*, 2014, 72:4, 2-10.

- [6] Kramer MS, "Determinants of low birth weight: methodological assessment and meta-analysis" *Bull World Health Organ*, 1987, 65:663-737.
- [7] Selina Khatun, and Mahmudur Rahman "Socio-economic determinants of poor birth size in Bangladesh: A multivariate approach" *Bangladesh Med Res Counc Bull* 2008, 34: 81-86.
- [8] National Poor birth size Survey of Bangladesh, 2003-2004, page: 24.
- [9] Khatun S and Rahman M., "Quality of antenatal care and its dose-response relationship with birth weight in a maternal and child health training institute in Bangladesh" *Journal of Biological Science*, 2008, 40(3):321-337.
- [10] Dhar B, Mowla G, Nahar S and Islam N., "Birth weight status of newborns and its relationship with other anthropometric parameters in a public maternity hospital in Dhaka, Bangladesh" *Journal of Health Population and Nutrition*, 2002, 20(1):36-41.
- [11] Gazi R, Karim F, Ali A., "Poor birth size was the major predictor of infant deaths: Evidence from a prospective study in rural Bangladesh" *Brac Research Annual report*, 2001.
- [12] United Nations Children's Fund, World Health Organization: Low birthweight: country, regional and global estimates. Geneva, 2004.
- [13] Berkowitz GS, Papiemik E., "Epidemiology of preterm birth" *Epidemiol Rev*, 1993; 15: 414-43.
- [14] Dunin-Wasowicz D, Rowecka-Trzebicka K, Milewska-Bobula B, Kassur-Siemenska B, Bauer A, Idzik M, Lipka B and Marcinski P., "Risk factors for cerebral palsy in very poor birth size infants in the 1980s and 1990s" *J Child Neurol*, 2000; 15: 414-20.
- [15] Pei L, Chen G, Mi J, Zhang T, Song X, Chen J, Ji Y, Li C and Zheng X., "Poor birth size and lung function in adulthood: retrospective cohort study in China, 1948-1996" *Pediatrics*, 2010, 125:899-905.
- [16] Barker DJP, Forsen T, Uutela A, Osmond C and Eriksson JG., "Size at birth and resilience to effects of poor living conditions in adult life: Longitudinal study" *Br Med J*, 2001; 323: 1273-76.
- [17] Eriksson JG, Forsen T, Tuomilehto J, Winter PD, Osmond C and Barker DJP., "Catch up growth in childhood and death from coronary heart disease: Longitudinal study" *Br Med J*, 1999, 318: 427-431.
- [18] Hosain M, Chatterjee N, Begum A and Saha S C., "Factors Associated with Low Birthweight in Rural Bangladesh" *J of Tropical Pediatrics*, 2005, 52 (2):87-91.
- [19] Kennedy BP, Kawachi I, Glass R and Prothrow-Stith D., "Income distribution, socio-economic status and self rated health in the united states: Multilevel analysis" *Br Med J*, 1998; 317: 917-21.
- [20] Ecob R and Smith GD., "Income and health: What is the nature of the relationship?" *Soc Sci Med*, 1999, 48: 693-705.
- [21] Sreeramareddy C, Shidhaye R and Sathiakumar N, "Association between biomass fuel use and maternal report of child size at birth—an analysis of 2005-06 India demographic health survey data" *Bmc Public Health*, 2011, 11: 403.
- [22] Sebayang SK, Dibley MJ, Kelly PJ, Shankar AV and Shankar AH., "Determinants of low birthweight, small-for-gestational-age and preterm birth in Lombok, Indonesia: analyses of the birth weight cohort of the SUMMIT trial" *Trop Med Int Health*, 2012, 17:938-950.
- [23] Hueston WJ, Gilbert GE, Davis L and Sturgill V., "Delayed prenatal care and the risk of poor birth sizedelivery, *J Community Health*, 2003, 28:199-208.
- [24] Coria-Soto I, Bobadilla J and Notzon F "The effectiveness of antenatal care in preventing intrauterine growth retardation and poor birth sizedue to preterm delivery" *Int J Qual Health Care*, 1996; 8: 13-20.
- [25] Munjanja SP, Lindmark G and Nystrom L., "Randomized controlled trial of a reduced-visits program of antenatal care in Harare, Zimbabwe" *Lancet* 1996; 348:364-69.
- [26] WHO publications available at [http://www.who.int/reproductivehealth/publications/RHR\\_01\\_30/](http://www.who.int/reproductivehealth/publications/RHR_01_30/) accessed on 9th November 2015.
- [27] Anderson GD, Blinder IN, McClement S and Sinclair JC., "Determinants of size at birth in a Canadian population" *American Journal of Obstetrics and Gynecology*, 1984, 150:236-144.
- [28] Bangladesh Demographic and Health Surveys(BDHS)-2011, page-145.
- [29] World Health Organization (WHO): Physical Status-The Use and Interpretation of Anthropometry, 1995, Technical Report Series. 854: 9.
- [30] Matin A, Azimul Sk, Matiur Akm, Shamianaz S, Shabnam Jh and Islam, "Maternal Socioeconomic And Nutritional Determinants Of Poor birth size In Urban Area Of Bangladesh" *J Dhaka Med Coll*, 2008, 17(2) : 83-87.
- [31] Naher N, Afroza S, and Hossain M., "Incidence of LBW in three selected communities of Bangladesh. Bangladesh" *Med Res Counc Bull*, 1998, 24: 49-54.
- [32] Karim E and Mascie-Tayler CGN, "The association between birth weight, socio-demographic variables and maternal anthropometry in an urban sample from Dhaka, Bangladesh" *Annals of Human Biology*, 1997, 24(5):387-401.
- [33] Mukesh Dhankar, Rawat A.K, and Varun, "Etiological Factors Associated With Poor birth size Newborns" *International Journal of Basic and Applied Medical Sciences*, 2013, Vol. 3 (3), p.44-48.
- [34] Radhakrishnan T, Thankkappan KR, R S Vasan and Sharma PS., "Socioeconomic and demographic factors associated with birth weight: a community based study in Kerala Indian" *Pediatrics*, 2000, 37 872-6.
- [35] Mondal B., "Poor birth size in relation to sex of baby, maternal age and parity: a hospital based study on Tangsa tribe from Arunachal Pradesh" *Indian Medical Association*, 1998, 96:362-4.