

Association of Maternal Factors with Twin Births: Evidence from Bangladesh Demographic Health Survey

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Authors' contributions

This work was carried out in collaboration among all authors. Authors MLR and KSI both analyzed the patient data regarding twin births. Authors MLR and TH have written interpreted and revised the manuscript. All authors have read and approved the final manuscript.

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ABSTRACT

Aims: To investigate which maternal factors are associated with the multiple birth status of a child in a developing country like Bangladesh where neonatal mortality, child nutrition and maternal health are matters of concern.

Study Design: This is a cross-sectional study that collects information through several questionnaires including a women's questionnaire that provides demographic and health information on mothers and their children.

Place and Duration of Study: The nationally representative health survey "Bangladesh Demographic and Health Survey (BDHS)" was conducted between November 2010 and April 2011.

Methodology: Information on 45842 live births of which 780 were twins and 45062 were singletons were extracted from the database of the Bangladesh Demographic Health Survey (BDHS). The associations between risk factors and the outcome were assessed using crude and adjusted logistic regression models. Statistically significant associations were identified and the strengths of the associations were measured and compared through odds ratios.

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Results: The rate of twinning was 17 per 1000 live births. The association between a child's birth order and twin birth status appears to be very strong in the data. The crude logistic regression analysis indicates that children from seventh order pregnancies are 7.03 times more likely than first order pregnancies to be twins. Furthermore, adjusted estimates show that an increase of one level of birth order is accompanied by a 1.362 times higher likelihood of being a twin. Although birth interval was significantly associated with the outcome in the bivariate analysis, it was no longer significant after adjusting for other factors in a multivariable model. Moderate to severe maternal anemia and higher maternal education are also found to be associated with increased risk of being a multiple birth.

Conclusion: Birth order is an important correlate of twin birth status in Bangladesh. Higher order pregnancies are more likely to be twin births compared to lower order pregnancies. Among other factors, age of mother, level of maternal anemia and maternal education are associated with the outcome. These factors must therefore be taken into account in any future study aimed at determining the causes of twin births in Bangladesh.

Keywords: Twinning; twin births; birth interval; birth order.

ABBREVIATIONS

ART : Assisted Reproductive Technology
 BDHS : Bangladesh Demographic and Health Survey
 GIFT : Gamete Intrafallopian Transfer
 IVF : In vitro Fertilization
 NIPORT : National Institute of Population Research and Training
 OR : Odds Ratio
 ZIFT : Zygote Intrafallopian Transfer

1,000 live births). In contrast, Asia and Latin America have low rates of twin births (less than 8 per 1,000 live births) [2,10]. In some countries, the rate of twin births has increased over time. In the United States, for example, the rate of twin births rose by 76 percent over the period 1980 to 2009 [4].

The causes of twinning have not been fully explored although the literature hints at potential risk factors. For example, it has been reported that the use of infertility treatment and assisted reproductive technology (ART), such as, in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT) and zygote intrafallopian transfer (ZIFT) may contribute to elevated risk of multiple pregnancy [1,3,5,8,11,12]. Some studies have reported associations between multiple pregnancy and maternal age, race, heredity, number of previous pregnancies, maternal height and weight, and family history of multiple births [1]. Certain studies have indicated that nutrition and diet could be associated with multiple pregnancies. For example, widespread consumption of yam is thought to contribute to an increased multiple birth rate in the African region [13–15].

1. INTRODUCTION

In spite of advances in obstetric care, multiple births are at greater risk of experiencing unfavorable outcomes such as, preterm delivery, perinatal morbidity and mortality compared to singleton births [1–7]. This is perhaps due to the higher rates of obstetric complications observed among women with multiple pregnancies that lead to significant increase in medical risks for both mother and child [1,3,6,8]. The implication is that couples with multiple births may incur greater medical expenses and experience poor quality of life [3]. For developing countries, this is a cause for concern since many couples are unable to bear the economic and social burden of a high risk pregnancy. Hence, there is a general interest in identifying and understanding the factors associated with occurrence of multiple pregnancies.

In developing countries, such as Bangladesh, there appears to be a lack of systematic studies that investigate the link between maternal characteristics and twin births. This study is a pioneer attempt to fill this gap by analyzing information on twin births and maternal characteristics using large scale survey data. In particular, we use the Bangladesh Demographic Health Survey (BDHS) to study the association between maternal characteristics and twin births by performing multiple logistic regression analysis. Such a study may lead to a better

The most common multiple birth, i.e. the twin birth, varies in rate from country to country [2,4,9]. Literature on twinning indicates that the African region has the highest rate of twin births compared to other regions of the world. For example, countries in Central Africa have twin birth rates above 18 per 1,000 live births with Benin having the highest rate in the world (27 per

understanding of factors contributing to increased risk of multiple pregnancies, which in turn may assist couples in making crucial decisions pertaining to family planning.

2. MATERIALS AND METHODS

The data used in this study were obtained from the Bangladesh Demographic and Health Survey (BDHS), which is a nationally representative health survey conducted between November 2010 and April 2011. This is a cross-sectional study that collects information through several questionnaires including a women's questionnaire that provides demographic and health information on mothers and their children. Details on survey methodology and variables recorded are available in BDHS report. The data contained information on 780 twins and 45062 singletons so that there were a total of 45842 live births in the study. The dependent variable 'twin birth status' was coded as 0 for 'singleton' and 1 for 'twin'. The analysis began with 13 independent variables that were chosen based on previous literature and assumptions regarding possible associations with the outcome. However not all were retained in the final analysis. The quantitative maternal risk factors that were investigated include age of mother, length of previous birth interval, birth order, and maternal anemia level. It was also of interest to see how the distribution of twin births varied according to the categories of qualitative socio-economic variables, such as, religion, education level of mother, Division, area of residence and maternal occupation.

Initially, bivariate associations between twin birth status and each of the independent variables were examined by constructing cross-tables and performing chi-square tests of association. This was followed by logistic regression analyses to examine the association between the selected independent variables and twin birth status in a multivariate setting. Stepwise logistic regression was used for variable selection to construct the best regression model. The analysis was performed using statistical software package SPSS version 24.0 (SPSS Inc. Chicago IL).

3. RESULTS

The twin birth rate is estimated as 17 per 1000 live births in Bangladesh. Table 1 shows the percentage distribution of twin births according to the categories of those variables that were found to be significantly associated with the outcome by the chi-square test of association. From this

table it is evident that the dependent variable is significantly associated with important biological variables such as, length of previous birth interval, birth order, maternal age and maternal anemia level (Table 1). The percentage of twin births is observed to be significantly higher among children born to mothers having previous birth interval greater than 3 years. The percentage of twin births increases monotonically with birth order. This trend is evident from the bar chart in Fig. 1, which shows the number of twin births against categories of birth order. The percentage distribution of twin births according to severity of maternal anemia given in Table 1 shows a larger percentage of twin births among children born to mothers with mild anemia. Mother's education is also found to be significantly associated twin birth status. The bar diagram in Fig. 1 indicates that the largest number of twins in the sample were born to mothers in the age group 30-34 years compared to mothers in other age groups. The strengths of the bivariate associations observed between the categorical variables in Table 1 and twin birth status are measured in terms of the odds ratio, which is obtained by fitting simple logistic regression models. It is seen that the odds of being a twin birth is 1.3 times higher for babies born to mothers with length of preceding birth interval greater than 3 years compared to less than 3 years. The odds ratio increases with birth order being largest for birth order 7 and above. The odds of being a twin birth is 1.4 times higher among babies born to mothers with mild anemia compared to mothers with no anemia. Furthermore, the odds ratio for twin birth increases in general with increasing age of the mother. The bivariate associations between twin birth status and other variables such as, gender of child, mother's employment, geographical location, religion and area of residence were also investigated but significant associations were not found and therefore not shown in the table.

Bivariate analysis was also performed via simple logistic regression analysis considering birth order, maternal age, and birth interval as quantitative variables. Similar to the results presented in Table 1, birth interval and birth order are found to be significantly associated with the outcome. In contrast, the association between maternal age and twin birth status is insignificant. Multivariate logistic regression was also performed to examine the association between maternal risk factors and the outcome while adjusting for confounding. The independent variables birth order, birth interval and maternal

Table 1. Percentage distribution of twin births according to maternal characteristics and results of chi-square test of association and simple logistic regression with categorical independent variables

Variable	Category	Total n (%)	Singleton n(%)	Twin n (%)	χ^2 (df)	P-value	OR (Logistic)
Birth interval	Total	45842 (100)	45062(98.3)	780 (1.7)			
	Less than or equal 3 years	15635(100)	15361(98.2)	274 (1.8)	10.709 (1)	.001	1
	Greater than 3 years	14090(100)	13768 (97.7)	322(2.3)			1.311
Birth order	First	16025(100)	15933(99.4)	92(0.6)	280.553(6)	<.001	1
	Second	12335(100)	12142(98.4)	193(1.6)			2.753
	Third	7817(100)	7632(97.6)	185(2.4)			4.198
	Fourth	4483(100)	4350(97.0)	133(3.0)			5.295
	Fifth	2494(100)	2415(96.8)	79(3.2)			5.665
	Sixth	1381(100)	1334(96.6)	47(3.4)			6.102
	Seventh +	1307(100)	1256(96.1)	51(3.9)			7.032
Maternal age	15-19	1187 (100)	1169 (98.5)	18 (1.5)	19.979 (6)	.003	1
	20-24	4836 (100)	4784 (98.9)	52 (1.1)			.706
	25-29	7511 (100)	7375 (98.2)	136 (1.8)			1.198
	30-34	7779 (100)	7621 (98.0)	158 (2.0)			1.346
	35-39	7941 (100)	7797 (98.2)	144 (1.8)			1.199
	40-44	8451 (100)	8301 (98.2)	150 (1.8)			1.740
	45-49	8126 (100)	8004 (98.5)	122 (1.5)			.999
Maternal anemia level	Moderate or severe	1114(100)	1104(99.1)	10(0.9)	10.396(2)	.006	.627
	Mild	5431(100)	5323(98.0)	108(2.0)			1.405
	None	8291(100)	8173(98.6)	118(1.4)			1
Mother's education	No education	16992(100)	16686(98.2)	306(1.8)	9.525(3)	.023	1
	Primary	15101(100)	14859(98.4)	242(1.6)			.888
	Secondary	11674(100)	11492(98.4)	182(1.6)			.864
	Higher	2075(100)	2025(97.6)	50(2.4)			1.346

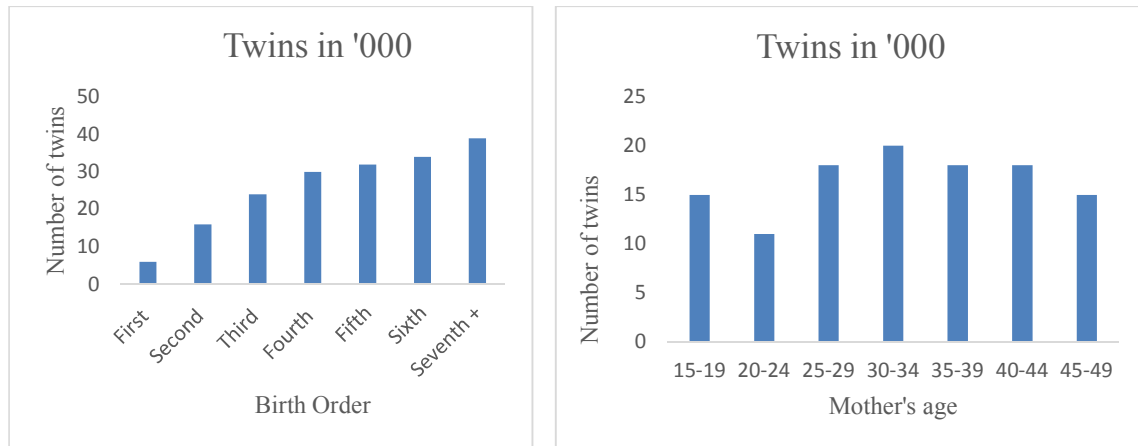


Fig. 1. Number of twins per 1000 live births according to birth order and mother's age

age were considered as quantitative variables while maternal anemia and maternal education were entered as qualitative variables into the model. Interestingly, birth interval is no longer significantly associated with the outcome after adjusting for the effects of the other variables. On the other hand, maternal age emerges as highly significant in the presence of other variables. For every 5-year increase in age of the mother, the odds of being a twin birth decreases by about 16 percent assuming all other variables remain constant. To understand why maternal age has a negative impact on twin birth status, we examine Fig. 1, which shows that the number of twin births follows a non-uniform distribution with respect to age of mothers. The number of twin births is less at the beginning and then slowly increases up to age 34 and then starts to decline reaching a low value for elderly mothers (45+) (also, see Table 1). When maternal age is treated as continuous, this trend is captured in the negative coefficient which reflects the cumulative effect of age over the discrete intervals considered in Fig. 1.

As in bivariate analysis, the association between birth order and twin birth status remains highly significant in the multivariate analysis. When birth order increases by one, the odds of being a twin birth increases by 37%. Level of maternal anemia and maternal education are also significantly associated with the outcome after adjusting for the effects of other maternal variables. The odds of being a twin birth is 1.5 times higher for children born to mothers with severe anemia compared to those born to mothers with no anemia. Furthermore, babies born to women with higher than secondary

education are 2.56 times more likely to be twin births compared to babies of uneducated mothers.

4. DISCUSSION

This study has investigated the association between certain maternal characteristics and twin birth status in Bangladesh using a nationally representative sample from the Bangladesh Demographic and Health Survey (BDHS) conducted in 2011. The study has found that maternal age, birth order, maternal anemia level and maternal education are significantly associated with the occurrence of twin births in Bangladesh. Although birth interval appears to be an important correlate with twin birth status in a bivariate setting, the association is no longer statistically significant in a multivariate setting.

The rate of twinning is 17 per 1000 in the current study. The overall trend in twinning seems upward as the study by Razzaque [16] found the rate being 9 per 1000 in rural Bangladesh. However, recently observed trend in the rate of twin births according to the categories of maternal age was similar to what has been observed in other studies. For example in the study by Gunnar Dahlberg [15], it was reported that the risk of twin pregnancy increased with the mother's age reaching a maximum at about age 37 years and then declined. The observed relationship between maternal age and twin birth rates are also supported by Smits and Monden [2]. Martin et al. [4] in their study reported on the changes in twin birth rates for mothers in different age categories over time. They found that twin birth rates increased for

Table 2. Crude and adjusted estimates from logistic regression analysis of twin birth status with qualitative and quantitative independent variables

Variable	Category	Logistic regression					
		Crude			Adjusted		
		Coeff	P-value	OR	Coeff	P-value	OR
Maternal age		.003	.412	1.003	-.036	.002	.965
Birth interval		.049	.004	1.050	0.054	.098	1.055
Birth order		.299	.000	1.349	.316	<.001	1.371
Maternal anemia level	No anemia			1			1
	Mild	.340	.011	1.405	-.275	.417	.760
	Moderate or Severe	-.466	.159	.627	.406	.009	1.500
Mother's Education	No education			1			1
	Primary	-.119	.171	.888	-.196	.282	.822
	Secondary	-.147	.120	.864	.111	.609	1.117
	Higher	.297	.054	1.346	.940	.008	2.560

women of all ages from 1980 through 2009 with the largest increase being among women aged 30 years and over. In their study, they reported that rates increased by 76 percent for women aged 30-34, nearly 100 percent for women aged 35-39, and by more than 200 percent for women aged 40 and over during the observed time period. Kiely and Kiely [17] and Lazarov [1] also reported that older mothers were more likely to have multiple gestations, mostly twins. Although the studies showed that older age has been associated with multiple births, it is important to point out that the association with age can be confounded by other factors such as consumption of ovulation-inducing drugs and use of ART as older women are more likely to use these methods to conceive.

In the current study, it was found that the frequency of twins increased with number of pregnancies i.e. with increasing birth order. A similar relation was observed by Lazarov [1]. The findings regarding the association between mother's education and multiple births in our sample are quite interesting. Even after controlling for maternal age and other risk factors, mothers with higher than secondary education had greater risk of twin births compared to less educated mothers. Although there does not appear to be a direct explanation for this association, similar findings were reported in a study by Kiely and Kiely [17]. In their study they found that highly educated mothers had given birth to greater number of triplets compared to less educated mothers and the number of triplets increased with maternal age. In Bangladesh where a vast majority of women do not seek secondary education, it is possible that highly educated women are

economically solvent and therefore more likely to seek fertility treatment when they are unable to conceive compared to less educated women. This might in turn increase their risk of having twin births. Again, prospective mothers finish their post-graduation studies generally after the age of 25 years in Bangladesh. Even after graduating, women with higher levels of education often delay their pregnancies as they focus on establishing their careers. The link between increasing age and fertility could have an impact on their ability to conceive, and therefore these women are more likely to seek fertility treatments, which are known to increase the risk of multiple pregnancies. Unfortunately, information on fertility treatment seeking behavior of women was unavailable in the data and therefore it could not be controlled for in the analysis.

5. CONCLUSION

In conclusion, this study which is based on a large scale demographic and health survey data, could be a reference for future studies involving twin births and factors correlating with this outcome. The study identifies birth order as an important factor that is associated with the twin birth status of a child both in a bivariate and multivariate setting. Maternal factors that should also be considered for control in a multivariate analysis involving multiple births include age of the mother, their educational level and whether or not they are anemic.

CONSENT

Consent of participants was not applicable as patients were anonymous.

ETHICAL APPROVAL

We have used secondary data collected by National Institute of Population Research and Training (NIPORT) and Mitra and Associates in Bangladesh. Therefore, it was not essential for us to get an approval of ethics committee and consent of participants.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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