Association between type of delivery and childhood disease: evidence from multiple indicator cluster survey,Bangladesh

1Jenifar Jahan, 1Mohammad Nayeem Hasan, 1Sumyea jahan, 2Muhammad Abdul Baker Chowdhury and 1,3\* MD Jamal Uddin

*1 Department of Statistics, Shahjalal University of Science & Technology, Sylhet-3114, Bangladesh*

*2 Department of Emergency Medicine, University of Florida College of Medicine, Gainesville, FL, USA, Phone: +1 352-265-5911, Fax: +1 352-265-5606*

*3 Section of Biostatistics, Department of Public Health, University of Copenhagen, Denmark*

\*E-mail: [jamal-sta@sust.edu](mailto:jamal-sta@sust.edu)

**Abstract**

The rate of caesarean delivery (C-section) has increased worldwide including Bangladesh over the past decades. As the C-section is a major surgery, it has a negative impact on mother and child health. However, research on this area in Bangladesh is sparse.

Our objective was to inspect the association between C-section delivery and infantile disease (e.g. cough, diarrhoea, difficulty in breathing).

We used multiple indicator cluster survey (MICS) data (2012-13). There were 7921 children under 2 years, of which the information of the mode of delivery (C-section vs. normal) was available for 2138 children. Important factors were considered as age of child, child ever been breastfed, child had diarrhoea, child ill with cough, child's weight, child's length or height, division, sex(child), mother's education, religion of household head, wealth index quintile, age of woman, weight at birth. Models were fitted using logistic regression and Poisson regression.

We found 38% children were born in normally and 62% children were born in C-section. Moreover, we observed 16.90% of caesarean section babies are in risk of having more diseases whereas normally delivered babies have 6.89% risk. The Poisson regression analysis showed that the expected log count for the C-section is 0.04 times higher than the expected log count for normal delivery.

Our analysis shows that caesarean delivery is associated with increased rate of

disease among children less than 2 years of age. We recommend increasing public

awareness for the negative impact of the caesarean delivery in Bangladesh.

Keywords: Caesarean section; delivery type; disease; public awareness; cough; diarrhoea

**Introduction:**

A caesarean section(CS) is a surgical procedure which is often performed when a vaginal delivery would put the baby or mother at risk(1). It has been reported in recent years as a major surgery related to immediate risk of maternal and childbirth and may be important for pregnancy and long term effects on child (2). CS is rapidly increasing in many developed and developing countries(3,4). A Trend analysis based on data from 121 countries reported that, from 1990 to 2014, the average CS rates increased by 12.4% and the average annual rate increased by 4.4%(2).A 2004-2008 World Health Organization (WHO) survey recorded an average rate of 25.7% for caesarean section, with 27.3% for Asia, 19.0% for Europe and 29.2% for Latin America(5,6).According to this research, China had a global rate of CS (46.2%), India (17.8%), Japan (19.8%), Sri Lanka (30.6%), Nepal (20.3 %), Thailand(34.1%), Vietnam(35.6%) (5).Worldwide the rates of caesarean section have risen consequentially in recent years including Brazil(30%)(7), Chile(40%)(8),USA((26.1%)(9),Malaysia(15.7%)(10)& England (26.2%)(11). As stated by WHO, there is no justification for any region to have a caesarean rate higher than 10 -15%, which weighs a serious reason for worry in most of the countries worldwide (12).In Bangladesh, CS rate is 3.5% in 2004 and is increased to 23% in 2014(13).CS are more common in the first birth (12.7%), urban birth (15.9%)and especially in private sector (67.3%) are born, whereas the public sector was (34.6%)(12). Women experiencing the CS delivery without a clear intimationfor the process have a risk of major morbidity including cardiac arrest, hysterectomy, puerperal infection, thromboembolism, wound hematoma,anaesthetic complications than those undergoing planned vaginal delivery(14,15). But reports showed that postpartum blood transfusion haemorrhage appears most frequently in vaginal delivery(14,16). In addition, babies born by caesarean sections are at risk of developing asthma(17–19) and type 1 diabetes (17,18) Crohn's disease(15), allergic diseases (18,19),immune deficiencies and leukemia(19). As Caesarean section born individuals do not make contact at birth with maternal, vaginal and intestinal bacteria, this can lead to long-term changes in the gut microbiota that can contribute to obesity (20). A US study found that Individuals born by Caesarean delivery were15% more likely to become obese during follow up than those born by normal delivery(11,15). Caesarean section in the northern part of Bangladesh and its relation has been studied(12). Also studies about  socioeconomic correlates of preference for institutional delivery and caesarean sections has been performed(16).As the CS delivery is going upward and a vital public health issue in Bangladesh, it is important to study the consequence on the child health and to raise public awareness upon caesarean delivery. As far we know, there is no research has been conducted to determine the association between type of delivery and child disease in Bangladesh. So our aim

was to find if there was any relationship between the CS delivery and childhood diseases. As there is lack of studies on this area, we hope that our findings may be potentially suggestive.

**Methodology**

**Study design**

We used multiple indicator cluster survey (MICS) data (2012-13).

It is based on a sample of 51,895 households (43474 rural, 8421 urban) interviewed with response rate 98.5% and provides a comprehensive picture of children and women in the seven divisions (Dhaka, Chittagong, Sylhet, Rajshahi, Rangpur, Barisal, Khulna) of the country. Districts were identified as the main sampling strata for the sample selection in 2 stages. A systematic sample of 20 households was drawn in each sample. From the interviewed households, 59599 women (age 15-49 years) were identified and 51791 were successfully interviewed with response rate 89.3%. Overall 19.1% women had delivery by C section. There were 7921 children under 2 years, of which the information of the mode of delivery (C-section vs. normal) was available for 2138 children. The following flow chart shows the above information clearly.

|  |
| --- |
| Total population of Bangladesh with the sample frame of the list of enumeration areas (EA) made for the population and housing census ,2011 |

|  |
| --- |
| Districts were identified as the main sampling strata for the sample selection in 2 stages |

|  |
| --- |
| A systematic sample of 20 households was drawn in each sample (EA) |

|  |
| --- |
| Selection of 55120 households (46040 rural , 9080 urban) from the sampled EAs |

|  |
| --- |
| 51895 households (43474 rural , 8421 urban) were successfully interviewed household yielding response rate 98.5% |

|  |
| --- |
| From the interviewed households,59599 women(age 15-49 years) were identified and 51791 were successfully interviewed with response rate 89.3% |

|  |
| --- |
| Overall 19.1% women(age 15-49 years) had Caesarean delivery |

**Statistical analysis**

We have considered two outcome variables of interest, using Poisson regression analysis & Logistic regression analysis.Using this two analysis, we have reviewed the variability of the two results. First of all, we count all disease for Poisson regression analysis and then we count higher disease and lower disease by their median point for Logistic regression analysis. The dependent variables considered as (i) disease (count) for Poisson regression and (ii) disease (outcome binary, where 0 means lower disease [<3] and 1 means higher disease [ ≥3 ] ) for logistic regression. In the Poisson’s crude model the independent variable is C-section And for adjusted model the independent variables are C-section, religion, breastfed, sex (child), education (mothers), child Age (in months) , BMI (mothers), wealth

Index. In crude model for logistic regression the independent variable is C-section and for adjusted model the independent variables are C-section , religion, breastfed, sex (child), education (mothers), child Age (in months), BMI (mothers), wealth Index.

**Result: table1**

**Fig1**

Table1 represents mother’s characteristics.

Women who had undergone a caesarean delivery had mean age 25.37 years and women with normal delivery had mean age 25.10 years. From the religious point of view, of all women with caesarean delivery 1182 were Muslim,140 were Hindu ,7 were Buddhist,15 were Christian. Besides, of all women with vaginal delivery 734 were Muslim, 85 were Hindu,12 were Buddhist,5 were Christian and 1 women had other religion. According to their residence area women who had undergone a caesarean delivery 79 were from Barisal, 179 were from Chittagong, 428 were from Dhaka, 310 were from Khulna, 155 were from Rajshahi, were from Rangpur and 79 were from Sylhet. On the other hand women undergone a vaginal delivery 42 were from Barisal, 156 were from Chittagong, 173 were from Dhaka, 167 were from Khulna, 112 were from Rajshahi,116 were from Rangpur and 71were from Sylhet. Beyond all women give birth children via caesarean section 81 were illiterate, 71 were primary incomplete, 135 were primary completed, 614 were secondary incomplete, 443 were secondary completed or higher. Of all women give birth children normally 105 were illiterate, 98 were primary incomplete, 97 were primary completed, 373 were secondary incomplete, 164 were secondary completed or higher. Among women with caesarean delivery 121 had poorest wealth index which is comparable to the 154 women with vaginal delivery had poorest wealth index. Beyond all women undergone a vaginal delivery 144 had second wealth index, 158 had middle wealth index, 179 had fourth wealth index, 201 had richest wealth index which is compared to the women undergone a caesarean delivery with 144 had second wealth index, 158 had middle wealth index, 179 had fourth wealth index, 201 had richest wealth index. Women gave birth via caesarean delivery 47 were underweight, 929 were normal or healthy weight, 315 were overweight, 53 were obese and women gave birth via caesarean delivery, 34 were underweight, 646 were normal or healthy weight, 137 were overweight, 20 were obese.

**Table2**

Table 2 shows child’s characteristics.

Of the 2181 children 1153(51.36%) were male and 1028(48.64%) were female. Of the male child 423(19.01%) child were born by vaginal delivery whereas 730(32.35%) were born by C-section. On the other hand 414(18.90%) female child were born by vaginal delivery while 614(29.94%) were born in C-section. 1096(36.12%) children were between 0 and 12 months of age, out of whom 410(27.60%) were vaginal births and 686(33.05%) were born in C-section.

1079 (35.75%) children were aged between 13 and 24 months of which 426 (26.86%) were born by vaginal delivery and 653 (32.58%) were born in the C section. The child born from the C-section had an average (SD) birth weight of 2,731 kg while the child born by vaginal delivery had 2.62 kg. 526(24.86%) children had average size at birth born from vaginal delivery while 794(37.4%) children had average size at birth born from C-section. 24(1.21%) children had very small size at birth born by vaginal delivery while 41(1.74%) children for C-section babies. 382(17.20%) children who had born by vaginal delivery had less than three diseases while 559(25.61%) children who had born by C-section had less than three diseases. 435(20.23%) children who had born by vaginal delivery had less than three diseases while 746(36.50%) children who had born by C-section had less than three disease. 422(20.97%) children, who were born in C-Section, had three diseases and 285(13.82%) children, who were born from normal delivery, had three diseases. Disease (by count) variable from table 2 shows that more diseases occur in C-section babies than infants born by vaginal delivery.

**Fig2**

**Fig3**

Fig 2 displays the frequency of disease against number of babies. Bars represent the incidence of the disease. 2129 babies have three types of disease while only 12 babies have all the diseases. Children with two illnesses are 1884 and children with one illness are 488. So there are 2372 children with less than three diseases and 3274 children with three or more disease. These things are also shown in fig3.

Fig2 represents the frequency of disease (disease binary, where 0 means lower disease [<3] and 1 means higher disease [ ≥3 ] ) against number of babies.

**Table3**

A crude model (only C-section variable in the model) and adjusted model(C-section & other covariates in the model) for Poisson regression analysis is shown in table 3. The analysis showed that the relative risk for the C-section was 1.06 (Crude) & 1.03 (Adjusted), indicates that children were born in C-section compare to the normal delivery are at increased risk for developing childhood disease. However, the association was not significant in the adjusted model according to p value (0.14). The p value (0.03) for crude model shows significance. Additionally, the adjusted Poisson model shows the chi square value with P value, which is greater, and it means variable C-section, religion, breastfed, sex, maternal education, child age, BMI category (mother) is not significant.

**Table4**

From the crude and adjusted logistic model (table4) we may say that, the crude and adjusted logistic regression analyses showed that the odds ratios for the C-section were 1.18 and 1.10 times higher than the odds ratio for the normal delivery, respectively, though the association was not statistically significant at 5% level of significance. For the crude model as the confidence interval 1.00-1.11 crosses 1 at 95% CI, this implies there is lack of statistical significance .Also for the adjusted model the confidence interval 0.93-1.50 crosses 1 at 95% CI which implies there is no statistical significance. From the table of adjusted logistic model we see that, for C-Section, Breastfed, Mother’s Education, Wealth index corresponding p-values are 0.44, 0.29, 0.36, 0.01 which are less than .05 at 5% level of significance. So we may reject the null hypothesis for those variables at 5% level of significance based the data .We may conclude that, Disease-recode has dependence on C-Section, Breastfed, Mother’s Education, Wealth index.

**Discussion:**

**Conclusion:**

**Acknowledgements:**

**References:**

1. Caesarean section - Wikipedia.

2. Betrán AP, Ye J, Moller A-B, Zhang J, Gülmezoglu AM, Torloni MR. The Increasing Trend in Caesarean Section Rates: Global, Regional and National Estimates: 1990-2014. Zeeb H, editor. PLoS One [Internet]. World Health Organization; 2016 Feb 5 [cited 2017 Aug 28];11(2):e0148343. Available from: http://dx.plos.org/10.1371/journal.pone.0148343

3. Gomes UA, Silva AA, Bettiol H, Barbieri MA. Risk factors for the increasing caesarean section rate in Southeast Brazil: a comparison of two birth cohorts, 1978-1979 and 1994. Int J Epidemiol [Internet]. 1999 Aug [cited 2017 Aug 28];28(4):687–94. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10480697

4. Leung GM, Lam TH, Thach TQ, Wan S, Ho LM. Rates of cesarean births in Hong Kong: 1987-1999. Birth [Internet]. 2001 Sep [cited 2017 Aug 28];28(3):166–72. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11552964

5. Lumbiganon P, Laopaiboon M, Gülmezoglu AM, Souza JP, Taneepanichskul S, Ruyan P, et al. Method of delivery and pregnancy outcomes in Asia: the WHO global survey on maternal and perinatal health 2007-08. Lancet. 2010;375(9713):490–9.

6. Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, et al. Caesarean delivery rates and pregnancy outcomes: the 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet. 2006;367(9525):1819–29.

7. Belizán JM, Althabe F, Barros FC, Alexander S. Rates and implications of caesarean sections in Latin America: ecological study. BMJ [Internet]. BMJ Publishing Group; 1999 Nov 27 [cited 2017 Aug 28];319(7222):1397–400. Available from: http://www.ncbi.nlm.nih.gov/pubmed/10574855

8. Murray SF. Relation between private health insurance and high rates of caesarean section in Chile: qualitative and quantitative study. BMJ [Internet]. 2000 [cited 2017 Aug 28];321(7275). Available from: http://www.bmj.com/content/321/7275/1501

9. Hamilton BE, Martin JA, Sutton PD. Births: Preliminary Data for 2002. 2003 [cited 2017 Aug 28];51(11). Available from: https://www.cdc.gov/nchs/data/nvsr/nvsr51/nvsr51\_11.pdf

10. Ravindran J. Rising caesarean section rates in public hospitals in Malaysia 2006. Med J Malaysia [Internet]. 2008 Dec [cited 2017 Aug 28];63(5):434–5. Available from: http://www.ncbi.nlm.nih.gov/pubmed/19803313

11. Babies born by caesarean more likely to be obese as adults, study suggests | Society | The Guardian [Internet]. [cited 2017 Aug 28]. Available from: https://www.theguardian.com/society/2016/sep/06/babies-born-by-caesarean-more-likely-to-be-obese-as-adults-study-suggests

12. Rahman M, Shariff AA, Shafie A, Saaid R, Tahir RM. Caesarean delivery and its correlates in Northern Region of Bangladesh: Application of logistic regression and cox proportional hazard model. Vol. 33, Journal of Health, Population and Nutrition. 2015.

13. DHS points to abnormal rise of C-section in Bangladesh - bdnews24.com [Internet]. [cited 2017 Aug 28]. Available from: http://bdnews24.com/health/2015/04/26/dhs-points-to-abnormal-rise-of-c-section-in-bangladesh

14. Liu S, Liston RM, Joseph KS, Heaman M, Sauve R, Kramer MS. Maternal mortality and severe morbidity associated with low-risk planned cesarean delivery versus planned vaginal delivery at term. [cited 2017 Aug 28]; Available from: https://s3.amazonaws.com/academia.edu.documents/45171188/Maternal\_mortality\_and\_severe\_morbidity\_20160428-4972-13p6oz4.pdf?AWSAccessKeyId=AKIAIWOWYYGZ2Y53UL3A&Expires=1503932766&Signature=CjYYaSydqaQX9JRsGJbURdFb%2FkU%3D&response-content-disposition=inline%3B filename%3DMaternal\_mortality\_and\_severe\_morbidity.pdf

15. Yuan C, Gaskins AJ, Blaine AI, Zhang C, Gillman MW, Missmer SA, et al. Association Between Cesarean Birth and Risk of Obesity in Offspring in Childhood, Adolescence, and Early Adulthood. JAMA Pediatr [Internet]. 2016 Nov 7 [cited 2017 Aug 28];170(11):e162385. Available from: http://www.ncbi.nlm.nih.gov/pubmed/27599167

16. Kamal SMM. Preference for institutional delivery and caesarean sections in Bangladesh. J Health Popul Nutr [Internet]. 2013 Mar [cited 2017 Aug 28];31(1):96–109. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23617210

17. Darmasseelane K, Hyde MJ, Santhakumaran S, Gale C, Modi N. Mode of Delivery and Offspring Body Mass Index, Overweight and Obesity in Adult Life: A Systematic Review and Meta-Analysis. Dewan A, editor. PLoS One [Internet]. 2014 Feb 26 [cited 2017 Aug 28];9(2):e87896. Available from: http://dx.plos.org/10.1371/journal.pone.0087896

18. Ajslev TA, Andersen CS, Gamborg M, Sørensen TIA, Jess T. Childhood overweight after establishment of the gut microbiota: the role of delivery mode, pre-pregnancy weight and early administration of antibiotics. Int J Obes [Internet]. 2011 Apr 8 [cited 2017 Aug 28];35(4):522–9. Available from: http://www.ncbi.nlm.nih.gov/pubmed/21386800

19. Cesarean Section and Chronic Immune Disorders \_ Articles \_ Pediatrics.

20. Flemming K, Woolcott CG, Allen AC, Veugelers PJ, Kuhle S. The association between caesarean section and childhood obesity revisited: a cohort study. Arch Dis Child [Internet]. 2013 Jul 1 [cited 2017 Aug 29];98(7):526–32. Available from: http://www.ncbi.nlm.nih.gov/pubmed/23680850

**Appendix**