Determinants of incomplete measles vaccination of children in Bangladesh

By

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Declaration

It is hereby declared that

1. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through complete and accurate referencing.

2. The thesis does not contain material that is submitted for any other degree or diploma at a university or other institution.

3. I have acknowledged all primary sources of help.

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Approval

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Abstract

Background: Measles, a highly infectious, acute respiratory illness causes pneumonia, diarrhoea and malnutrition; caused by the genus Morbillivirus. Immunization of children against communicable diseases (including measles) has become a globally public health contribution to reducing child mortality & morbidity. The government of Bangladesh initiated the EPI program against six preventable diseases in 1979; among them, the measles and rubella vaccines were introduced in 2012. The 1st measles-containing vaccine (measles & rubella) is given at or soon after the age of 9 months & the 2nd vaccine is given at 15th months of age. In Bangladesh, measles vaccination coverage was 88% among less than 12 months aged children. The 4th HPNSP sets a target of coverage by 2022. The objective of this study is to identify the determinants of incomplete measles vaccination of children which may improve measles vaccination status in Bangladesh.

Methods: Determinants influencing incomplete measles vaccination were analysed from the secondary data analysis of dataset 2017-18 from the nationally representative Bangladesh Demographic & Health Survey that followed a stratified, multi-stage cluster sampling design; conducted in urban and rural contexts. A cross-sectional study was conducted among 2651 children aged 15-59 months. Frequency, Pearson Chi-square test and regression analysis were done by IBM SPSS Statistics 22 software to understand the appropriate method for the dataset.

Results: 2651 children aged 15-59 months old were surveyed, of whom 531 children (20%) were reported non-compliance with the measles vaccine. Among fifteen factors, mother's and father's education, place of residence, mother's access to electronic exposure, wealth index, place of delivery, age of mother at 1st birth, birth

order of index child, mother's empowerment, division, religion, ANC visit during pregnancy played a significant role in incomplete measles vaccination. The dependent variable was the number of children who did not take two doses of the measles vaccine, or either missed 1st dose or 2nd dose. After simultaneous adjusting for covariates in multivariate logistic regression, children who had a secondary or higher educated mother, who lived in the urban area, who had employed mothers, and which mothers took ANC visits during pregnancy were observed to be significantly associated with incomplete measles vaccination.

Conclusion: By identifying determinants we can take steps to improve measles vaccination rate. This will help to achieve EPI targets, establish to herd immunity and reduction in disease transmission. However, these findings will support policymakers in formulating strategies for improving measles vaccination coverage as well as to achieve further reduction in disease burden & mortality in Bangladesh.

Keywords: Measles, Vaccination, Bangladesh.

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Contents

List of Tables

List of Figures

List of Acronyms:

EPI- Expanded Programme on Immunization

WHO-World Health Organization

MCV1-First dose of measles-containing vaccine

MCV2- Second dose of measles-containing vaccine

SIA- Supplementary Immunization Activities

UNICEF- United Nations International Children's Emergency Fund

MOHFW- Ministry of Health and Family Welfare

MR- Measles Rubella

SIAs- Supplementary Immunization Activities

HNPSP- Health, Nutrition and Population Sector Programme

CAN-BD- Carbon dioxide Assisted Nebulization with a Bubble Dryer

BD-MAX- Becton Dickinson

SDG- Sustainable Development Goals

ANC- Antenatal Care

PNC- Post Natal Care

GAVI- Global Alliance for Vaccines and Immunization

UN- United Nations

BDHS- Bangladesh Demographic and Health Survey

NIPORT- National Institute for Population on Research and Training

DHS- Demographic and Health Survey

EA- Educational Assistant

SPSS- Statistical Package for the Social Sciences

IBM- International Business Machines

Chapter1

Introduction

Measles, a highly infectious disease, is caused by Genus *Morbillivirus.* Human is the only host for Measles disease. It causes acute respiratory illness (pneumonia), diarrhoea and malnutrition to the people (1). Measles vaccine is highly efficacious, whereas active and passive immunity is very durable (2).

According to WHO (2005), the 5th most common cause of child mortality in Bangladesh is measles (3). Each year approximately 1.5 million children die due to vaccine-preventable diseases (3). In the other way, in 2019, globally measles cases have been almost tripled; in south-East Asia and in the Western Pacific region increases about 40% (3).

In the 21st century with the tremendous support of the World Health Organization (WHO), the American Red Cross, the Centres for Disease Control and Prevention, United Nations Foundation ,United Nations Children's Fund (UNICEF) the 'Measles Initiative' (Launched in 2001) committed to reduce measles related mortality worldwide.

EPI program, one of the most cost-effective globally programs, provides immunization to children to communicable diseases (measles included) which reduces infant and child mortality and morbidity (4). The Bangladesh Government initiated the EPI program in 1979 (against six preventable diseases); among them measles and rubella vaccines were introduced in 2012(4).

In Bangladesh, First dose of measles-containing vaccine (MCV1), administered at 9 months aged which was introduced nationwide in 1989 and Second dose of measles-containing vaccine (MCV2), administered at 15 months aged, in 2012(5).

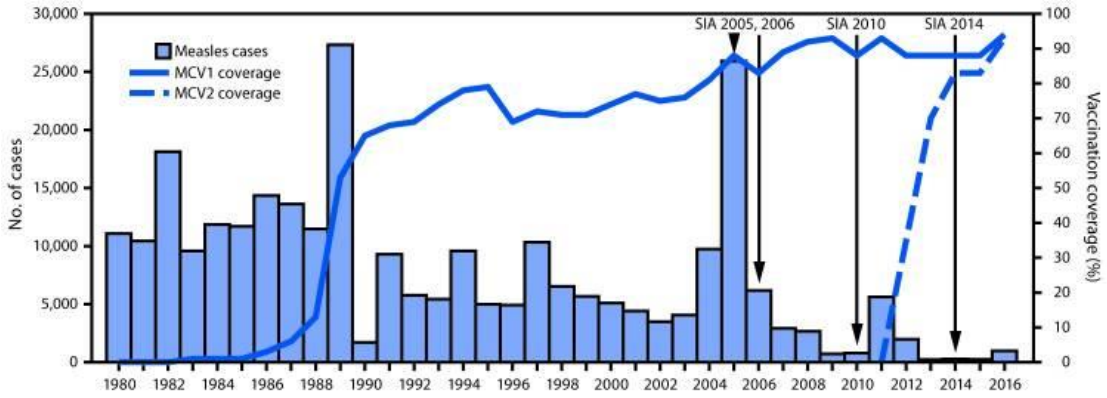


Figure 1: Estimated measles coverage with 1st and 2nd dose of measles containing vaccines (MCV1 and MCV2); supplementary immunization activities (SIAs), Vaccine Preventable Disease Surveillance Report, Bangladesh, 1980-2016 (5).

The national measles coverage in 1994 and 2002 were 59% and 67% accordingly (6, 7). Measles deaths were only constituted 12.4% of the non-accidental death in 2002 (8) in Bangladesh. Valid vaccination coverage was 90.6% and 87.3% among tribal & non-tribal population (cohort study, Tangail district, 2012) (9).

The proportion of early & timely measles vaccination in 2014 was 12 % & 53% accordingly (10). Despite overall high levels of immunization, the EPI program on measles immunization has not reached the coverage level targeted by the Bangladesh Government (11).

In 2014, Bangladesh, one of the 11 countries in South-East Asian Region, adopted a national goal for measles elimination by 2018 (5). Vaccine coverage and adherence of EPI schedule in 8 resource poor settings in the Malnutrition & enteric disease cohort study shows that measles vaccine coverage was highest in Nepal & Bangladesh. But <40% were administered measles vaccine on schedule (12).

The Ministry of Health and Family Welfare (MOHFW) of the Government of Bangladesh implemented an Measles-Rubella(MR) campaign in January-February 2014 to the children aged 9 months to <15 years to increase MR vaccination coverage (13). In 2018 the worldwide vaccination coverage was 86% and 69% for the first and second doses of measles containing vaccine (14). Among children, measles vaccination coverage of less than 12 months aged was 88% (according to BDHS data 2017-18). The 4th Health Nutrition & Population Sector Program (HNPSP) sets a target of 90% coverage by 2022(1).

The cost-effectiveness of various measles mortality reduction and eradication was evaluated in six countries in four regions: Bangladesh, Brazil, Colombia, Ethiopia, Tajikistan, and Uganda. The number of measles cases and deaths were projected from 2010 to 2050 by using a dynamic, age-structured compartmental model (2).

Table 1: Estimated Cost per Dose of Measles Immunization by Country

Cost of Measles Immunization	**Bangladesh**
Current routine measles coverage	85%
Average cost per dose of routine immunization	$1.46
Cost per dose of SIA	$0.52
Added cost per additional percent immunization	0.07 until 90%; 0.15 for 90%+
Household cost of obtaining measles immunization	$0.50
Cost of treating a case of measles	**$12.40**

This table presents the cost estimates for measles vaccination for Bangladesh. The cost of a dose of measles vaccine is shown for routine vaccination and for supplementary immunization activities (SIAs) for the period 2010-2050(2).

A safe and effective vaccine can easily prevent the diseases. To address the high childhood disease complication through immunization services in 1999, Global Alliance for Vaccines and Immunization (GAVI) and United Nation (UN) agencies prioritized the poorest and low-income countries of the world(4). Moreover, they paid more concern to expanding coverage to prevent morbidity, disability and mortality from vaccine-preventable diseases (4).

Early measles vaccination with an additional dose from 15 days to 9 months of age might have beneficial effects such as it reduces maternally reported diarrhea, vomiting and fever (16). When vitamin A treatment is given additionally with two doses of measles vaccination, as a result, measles mortality is reduced by 62% (17).

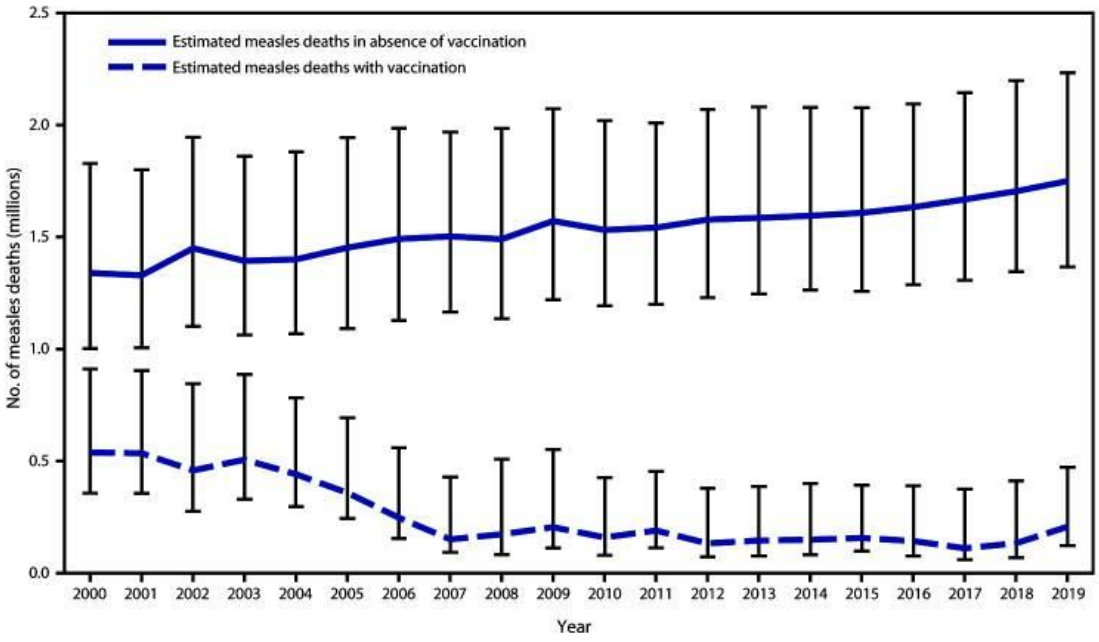


Figure 2: Estimated number of annual measles deaths with vaccination and in the absence of vaccination- worldwide, 2000-2019.

In this figure 2, the line graph represents the estimated number of annual measles deaths worldwide (during 2000-2019) with and without vaccination. Deaths prevented by vaccination are calculated by the area between estimated deaths with vaccination and those without vaccination (cumulative total of 25.5 million deaths prevented during 2000-2019). Vertical bars represent upper and lower 95% confidence intervals around the point estimate (5).

Children who had measles antibody detected, when they received their 1st dose of measles vaccine at 4-6 months of age had lower mortality than children having no maternal antibody (12). Paternal education status influences measles immunization uptake which is satisfactory in six nations (14). An inhalable needle-free live attenuated measles vaccine has developed in developing countries where powders were processed by carbon dioxide Assisted Nebulization with a Bubble Dryer (R) (CAN-BD)(15). Australia developed a TaqMan-based multiplex reverse-transcription-PCR assay using the BD MAX platform (Becton Dickinson) that detects measles virus (18).

A study conducted by Yasmin Jahan and her team (2019) has illustrated the changing trends in Measles vaccination status between 2004 and 2014 among 12-23 months children of Bangladesh. This study shows that maternal education determines the possibility to receiving a child's measles immunization along with increasing maternal years of schooling (3). In another study directed by Md Jasim Uddin and his team (2016) has encapsulated the evaluation of impact of measles rubella campaign in Bangladesh on vaccination coverage and routine immunization services. Their findings were children of caregiver having primary or secondary or higher education had higher vaccination coverage compared to no formal educated caregiver of children (13).

In 2021, a country representative survey was conducted by Md. Moazzem Hossain and his team about trends and determinants of vaccination among 06-59 months aged children in Bangladesh. In their analysis, mother's working status was found insignificant but, amazingly children of unemployed mothers failed to receive timely vaccinations for BCG/measles (19). Nurnabi and his team (2018) oversaw coverage, timeline and determinants of incomplete immunization in Bangladesh. And according to their study, children of unemployed mothers were significantly at high risk to fail receiving the BCG and Measles vaccines respectively (10).

Although Bangladesh has achieved a high immunization status against other vaccine-preventable diseases, coverage for measles vaccine is still low than desired target level of <90 % (3).The objective of this study was to investigate the determinants of incomplete measles immunization among children in Bangladesh and to find out the aim for improving measles vaccination coverage and eradicating measles from Bangladesh.

Barriers can be resolved for targeting attainment and reassessment of measles immunization and reducing measles related mortality. Here, mortality reduction means the incidence may be low in most of the countries, but unbroken chains of transmission remain (2).

We should determine contexts that may improve measles vaccination coverage and take steps to improve measles vaccination rates and reduce delayed vaccination to achieve EPI targets related to the establishment of herd immunity and reduction in disease transmission. These findings will be helpful for accelerating the achievement target of 3rd Sustainable Development Goal (SDG) and act as a key driver towards Children's health in Bangladesh (19).

Research question(s)

Do maternal education and maternal empowerment play any significant role in incomplete Measles Vaccination in Bangladesh?

Research Hypothesis:

Maternal education and employed mothers have significant role in increasing measles vaccination in Bangladesh.

Study Objectives:

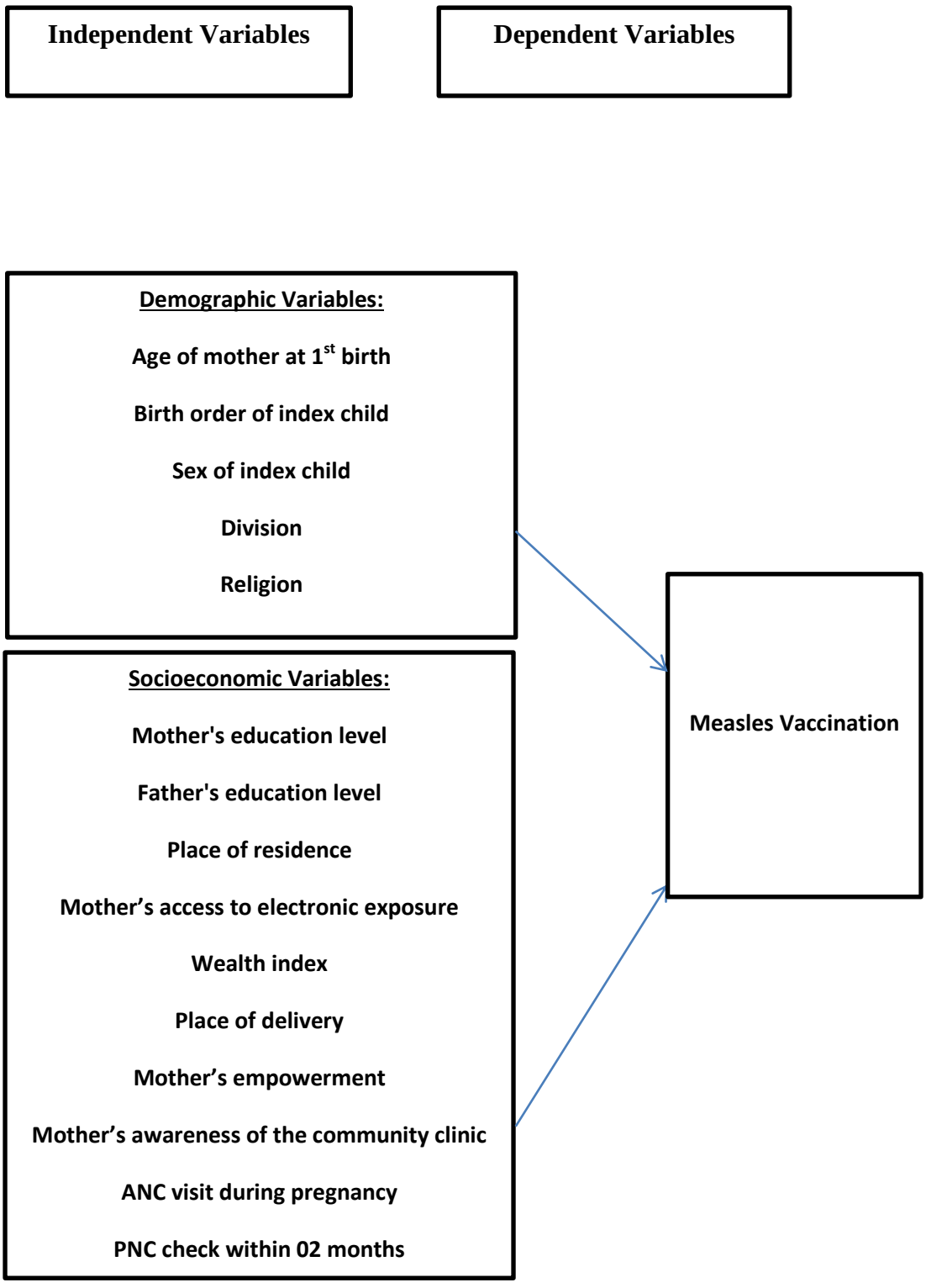
General Objective:

The objective of this study is to identify the determinants of incomplete measles vaccination of children in Bangladesh.

Specific objective:

- To assess the current measles vaccination status in Bangladesh.
- To determine the demographic, socio-economic and other factors that may improve measles vaccination status in Bangladesh.
- To find out the factors associated with measles-related mortality.

Conceptual Framework:



Chapter 2

Methodology and Research Plan

Study Design:

It is a cross-sectional study.

Sample & Sampling:

This study uses data from the Bangladesh Demographic and Health Survey (BDHS) 2017-18. The BDHS 2017-18 survey was performed under the authority of the National Institute of population Research and Training (NIPORT), Medical Education and Family Welfare Division, Ministry of Health and Family Welfare. DHS-Bangladesh-2017-18 covered a nationally representative sample of 20,100 ever-married women aged 15-49 years and their children born 0-59 months prior to the survey date.

Sample Size:

The sample size used in the analysis is 2651 children. Note that all the children are of age between 15 and 59 months and they are the last child of respective respondents prior the survey.

Inclusion Criteria

In this particular study we included the data of children of Bangladesh aged 15 months to 59 months who have taken either one or two doses or no dose of measles vaccination.

Study Variable:

In this study sixteen variables are considered, out of which one is dependent variable and fifteen are independent variables.

Dependent variable:

- **Measles vaccination :**

  Measles vaccination is the dependent variable of this study. This variable is considered whether the respondent's children have received two doses of Measles vaccination or not. The measles vaccination has been categorized into two groups and they are vaccinated and not vaccinated.

Independent variables:

- **Mother's education level:**

  Mother is the first teacher from the moment a child is born and as they mature into adults. Mother's education may have a positive relation with full coverage of measles vaccination in Bangladesh. This variable has been divided into four levels of education and they are- 0= "No education", 1= "Primary", 2= "Secondary" and 3= "Higher" education group;

- **Father's education level:**

  There may be association between father's education level and measles vaccination. This variable has been divided into four levels of education and the levels are- 0= "No education", 1= "Primary", 2= "Secondary" and 3= "Higher" education group;

- **Place of residence:** The place of residence refers to the civil subdivision of a country in which the individual resides. Place of residence may influences measles vaccination status. The place of residence has been divided in two groups which are 0= "Rural" and 1= "Urban".

- **Mother's access to electronic exposure:**

  Media is important part of giving a message to mass people. This variable includes watching TV, listening radio, reading newspaper. This dichotomous variable has been divided into two groups reported 0= "No" and 1= "Yes"; that are exposed and non-exposed group;

- **Wealth index:**

  Wealth index is a composite measure of a household's cumulative living standard. This variable may influence the measles vaccination. Within the wealth index it has been considered three groups, 0= "Poor", 1= "Middle", 2= "Rich".

- **Place of delivery :**

  An important aspect of reproductive health care is place of delivery. It often determines the quality of care received by mothers and infants. It is considered measles vaccination may be influenced by place of delivery. This variable has been labeled into 0= "Non-institutional" and 1= "Institutional" groups;

- **Age of mother at 1st birth:** Age of mother at 1st birth may influences measles vaccination. This variable has been labeled in two age groups like as 0= "18 and above" and 1= "Below 18 years";
- **Birth order of index child:** There may be association between birth order of index child and measles vaccination. This variable has been categorized into three groups and they are 0= "1", 1= "2-4", 2= "5 and above" as 1st birth, 2nd-4th birth and 5th or more;
- **Sex of index child:** Sex of index child may have significant role in measles vaccination. This variable has been grouped into two groups which are 0= "Female" and 1= "Male";
- **Mother's empowerment:**

  Empowerment of mother enables them and their family members to live to their fullest potential and to particular their own work. For measles vaccination coverage mother's empowerment may play a significant role. This dichotomous covariate has been divided into two groups; 0= "Not employed" and 1= "Employed";
- **Mother's awareness of the community clinic:**

  Child care is mostly the responsibility of mothers. By gathering information about community clinic mothers can improve maternal and child health issues. There may be association between mother's awareness of the community clinic and Measles Vaccination. This variable has been grouped into two and they are 0= "No" and 1= "Yes";

- **Division:** There may be regional variation in receiving Measles vaccination. This variable has been categorized into eight groups, 0= “Dhaka”, 1= Barisal”, 2= “Chittagong”, 3= “Khulna”, 4= “Mymensing”, 5= “Rajshahi”, 6= “Rangpur” and 7= “Sylhet”;
- **Religion:** As majority of the respondents are Muslim and other religions are small in number so this variable has been categorized into 0= “Muslim” and 1= “Other” groups;
- **ANC visit during pregnancy:**

  Antenatal care (ANC) is widely recognized as an accessible and cost-effective method to improve maternal and perinatal health outcomes. For measles vaccination coverage ANC visit during pregnancy may play a significant role. This variable has been divided into two groups reported as 0= “No” and 1= “Yes”;
- **PNC check within 02 months:**

  Post natal period (including post-partum period) is one of the most crucial period for health and survival of both the mother and her newborn. PNC check within 02 months may influences measles Vaccination. This dichotomous variable has been divided into two groups; reported as 0= “No” and 1= “Yes”.

Data Analysis Plan

The analysis was done into three steps. Firstly, univariate analysis was done for both dependent and independent variables. Then, bivariate analysis was done to examine the association between the dependent variable and all other independent variable separately. Finally, multivariate analysis was done by fitting the logistic regression model for measles vaccination to examine the impact of independent variables to the incomplete measles vaccination. Statistical Package for Social Sciences (SPSS) windows (version 22, IBM) was used for data analysis.

Operational Definitions

Vaccination:

Vaccination is the administration of a vaccine to help the immune system for developing immunity for a disease. Vaccines contain a microorganism or virus in a weakened, live or killed state, or proteins or toxins from the organism.

Complete Measles Vaccination:

Complete Measles Vaccination refers to the children who have received both dose of measles vaccination (at 9 and 15 months of age).

Incomplete Measles vaccination:

Incomplete Measles vaccination refers to the children who have taken either one or two doses or no dose of measles vaccination (at 9 or 15 months of age).

EPI:

The Expanded Program on Immunization (EPI) is a World Health Organization (WHO) program whose goal is to make vaccines available to the children.

Community Clinic:

Community Clinic means a clinic operated by a tax-exempt nonprofit corporation that is supported in whole or in part by donations, bequests, gifts, grants, government funds, or contributions.

Age of mother at 1st birth:

The age of mother at first birth refers to the age when a woman conceives and gives birth to a child for the first time.

ANC Visit:

Antenatal care (ANC) coverage is an indicator of access and use of health care during pregnancy.

PNC Visit:

Postnatal care (PNC) is defined as the care given to the newborn baby immediately after birth (within 24 hours) and for the first 6 weeks (42 days) of life, with the aim of ensuring optimum health for the newborn.

CHAPTER 3

RESULT

This study is a cross-sectional study whose sample size is 2651 children aged 15-59 months. Table 3 describes the frequency distribution of selected both dependent and independent variables of 2651 children.

In case of dependent variable 'measles vaccination', out of 2651 cases two thousand one hundred and twenty (80%) were vaccinated while five hundred thirty one (20%) of the respondents were not vaccinated. Among the independent variables, within level of mother's education one hundred and sixty four (6.2%) mothers are in no education group, seven hundred and thirty (27.5 %) mothers are in primary education group, one thousand two hundred and eighty five (48.5%) mothers are in secondary education group, while higher education group consists of four hundred seventy two (17.8%) mothers. Within level of father's education four hundred fourteen (15.6%) fathers were in no education group, eight hundred sixty three (32.6%) fathers were in primary education group, eight thousand fifty eight (32.3%) fathers were in secondary education group, while higher education group consists of five hundred and sixteen (19.5%) fathers. Among the respondents, one thousand seven hundred and thirty seven (65.5%) people reside in rural area while nine hundred fourteen (34.5%) people reside in urban area. Respondents' access to electronic exposure is one thousand two hundred sixty one (47.6%) while around one thousand three hundred ninety (52.4%) respondents didn't have access to electronic exposure.

Table 3: Frequencies distribution of selected independent & dependent variables

Variables	Category	Frequency	Percentage (%)
Measles Vaccination (Dependent Variable)	**Not vaccinated (ref)**	531	20
	Vaccinated	2120	80
Mother's education level	No education(ref)	164	6.2
	Primary	730	27.5
	Secondary	1285	48.5
	Higher	472	17.8
Father's education level	No education(ref)	414	15.6
	Primary	863	32.6
	Secondary	858	32.3
	Higher	516	19.5
Place of residence	Rural(ref)	1737	65.5
	Urban	914	34.5
Mother's access to electronic exposure	No(ref)	1390	52.4
	Yes	1261	47.6
Wealth index	Poor(ref)	1093	41.2
	Middle	462	17.4
	Rich	1096	41.3
Place of delivery	Non institutional(ref)	1327	50.1
	Institutional	1324	49.9
Age of mother at 1st birth	18 and above 18 years(ref)	1567	59.1

	Below 18 years	1084	40.9
Birth order of index child	1(ref)	1033	39.0
	2-4	1477	55.7
	≥5	141	5.3
Sex of index child	Female(ref)	1260	47.5
	Male	1391	52.5
Mother's empowerment	Not employed(ref)	1550	58.5
	Employed	1101	41.5
Mother's awareness of the community clinic	No(ref)	1143	43.1
	Yes	1508	56.9
Division	Dhaka(ref)	395	14.9
	Barisal	259	9.8
	Chittagong	453	17.1
	Khulna	265	10.0
	Mymensing	320	12.1
	Rajshahi	295	11.1
	Rangpur	296	11.2
	Sylhet	368	13.9
Religion	Muslim(ref)	2410	90.9
	Non-muslim	241	9.1
ANC visit during pregnancy	No(ref)	196	7.4
	Yes	2455	92.6
PNC check within 02 months	No(ref)	907	34.2
	Yes	1744	65.8

In case of wealth index, one thousand ninety six (41.3%) respondents were rich, one thousand ninety three (41.2%) are poor and four hundred sixty two (17.4%) are in middle class group. Institutional delivery is done among one thousand three hundred twenty four (49.9%) mothers and non-institutional delivery is done among one thousand three hundred twenty seven (50.1%) mothers. Out of 2651 mothers, one thousand eighty four (40.9%) were experienced their first child within 18 years of age and one thousand five hundred sixty seven (59.1%) were experienced their first child at 18 years and above 18 years of age. In the birth order of index child, 1^{st} order children were one thousand thirty three (39.0%), 2^{nd} to 4^{th} order children were one thousand four hundred seventy seven (55.7%) and 5^{th} and above order children were one hundred forty one (5.3%) in number. In case of sex of index child, one thousand three hundred ninety one (52.5%) were male and one thousand two hundred sixty (47.5%) were female. Majority that were one thousand five hundred fifty (58.5%) mothers were not employed while one thousand one hundred one mothers (41.5%) were employed. One thousand five hundred eight (56.9%) mothers had awareness of the community clinic while one thousand one hundred forty three (43.1%) mothers didn't have awareness. Among division, more people, around four hundred fifty three people (17.1%) lived in Chittagong and less people; around two hundred fifty nine (9.8%) people lived in Barisal. In other division named Dhaka, Khulna, Mymensing, Rajshahi, Rangpur and Sylhet number of living people were three hundred ninety five, two hundred sixty five, three hundred twenty, two hundred ninety five, two hundred ninety six and three hundred sixty eight respectively. In case of religion, majorities (90.9%) were Muslims and they were two thousand four hundred and ten people. Around two hundred forty one (9.1%) people were non-muslim. Among 2651 mothers, two thousand four hundred fifty five mothers (92.6%) had ANC visit during

pregnancy and one hundred ninety six mothers (7.4%) did not take ANC visit during pregnancy. One thousand seven hundred forty four mothers (65.8%) had done PNC check within 02 months and nine hundred seven mothers did not take PNC check within 02 months (34.2%). (Table 3)

Table 4: Examining the association between measles vaccination and selected independent variables: A bivariate analysis

Variables	Measles Vaccination		P-value
	Not vaccinated (%)	Vaccinated (%)	
Mother's education level			<0.001
No education	36.59	63.41	
Primary	28.22	71.78	
Secondary	16.03	83.97	
Higher	12.5	87.5	
Father's education level			<0.001
No education	26.81	73.19	
Primary	25.49	74.51	
Secondary	15.62	84.38	
Higher	12.79	87.21	
Place of residence			0.187
Rural	19.29	80.71	
Urban	21.44	78.56	
Mother's access to electronic exposure			<0.001
No	23.74	76.26	

Yes	15.94	84.06	
Wealth index			<0.001
Poor	24.34	75.66	
Middle	17.97	82.03	
Rich	16.61	83.39	
Place of delivery			<0.001
Non institutional	24.19	75.81	
Institutional	15.86	84.14	
Age of mother at 1st birth			<0.001
18 and above 18 years	17.42	82.58	
Below 18 years	23.8	76.2	
Birth order of index child			<0.001
1	16.26	83.74	
2-4	21.73	78.27	
≥5	29.79	70.21	
Sex of index child			0.725
Female	20.32	79.68	
Male	19.77	80.23	
Mother's empowerment			0.256
Not employed	20.77	79.23	
Employed	18.98	81.02	
Mother's awareness of the community clinic			0.237
No	21.08	78.92	
Yes	19.23	78.92	

Division			0.030
Dhaka	20.25	79.75	
Barisal	22.78	77.22	
Chittagong	19.87	80.13	
Khulna	14.72	85.28	
Mymensing	20.94	79.06	
Rajshahi	20.34	79.66	
Rangpur	15.20	84.80	
Sylhet	24.73	75.27	
Religion			0.025
Muslim	20.58	79.42	
Non-muslim	14.52	85.48	
ANC visit during pregnancy			<0.001
No	36.74	63.26	
Yes	18.70	81.30	
PNC check within 02 months			0.580
No	19.45	80.55	
Yes	20.36	79.64	

Table 4 represents the results obtained from the bivariate analysis for measles vaccination with all independent variables.

Out of all independent variables five appears insignificant as p-value is greater than 0.05. These five variables are place of residence, sex of index child, mother's empowerment, mother's awareness of the community clinic and PNC check within 02

months. Note the p-values for five variables are 0.187, 0.725, 0.256, 0.237 and 0.580, respectively.

Out of remaining ten significant variables, under the level of mother's education, no education group has highest not vaccination coverage of Measles that is 36.59% and the primary ,secondary and higher groups have 28.22% ,16.03% and 12.5% respectively. Under the level of father's education, no education group has highest not vaccination coverage of Measles that is 26.81% and the primary, secondary and higher groups have 25.49%,15.62% and 12.79% respectively. Mother's access to electronic exposure is 15.94% not vaccination coverage of measles and not exposure is 23.74% respectively. In case of wealth index, poor people (24.34%) are not giving vaccination to children compared to middle and rich people (17.97% and 16.61%). Mother who has non-institutional delivery has comparatively more tendency to not giving vaccination to children (24.19%) than who have institutional delivery (15.86%). Among mother below 18 years (23.8%) more child are not vaccinated than mothers aged 18 and above 18 years (17.42%). Considering the birth order, not vaccination coverage of Measles is highest among the 5^{th} and more birth group which is 29.79% and lowest among first birth group which is 16.26%. Among 2^{nd} to 4^{th} birth group it is 21.73%. Among division, not vaccination coverage of Measles is highest in Sylhet (24.73%) and lowest in Khulna (14.72%). In other divisions Dhaka, Barisal, Chittagong, Mymensing, Rajshahi and Rangpur not vaccination coverage of Measles are 20.25%, 22.78%,19.87%,20.94%, 20.34% and 15.20% accordingly. In case of religion Muslim are less vaccinated (79.42%) than non-Muslims (85.48%). Those who don't take ANC visit during pregnancy have more tendency not giving Measles vaccination to children (36.74%) than who take ANC visit (18.70%) during pregnancy. (Table 4)

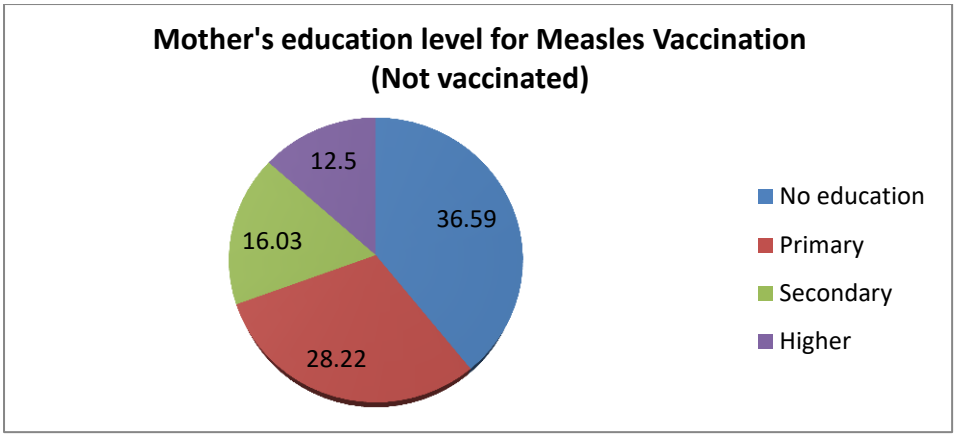


Figure 3: Proportion of mother's education level for Measles Vaccination (Not vaccinated)

This pie chart shows the proportion of mother's education level for Measles Vaccination (Not vaccinated). The children who did not get two doses of measles vaccination, among their mothers the majority are not educated (36.59%), primary and secondary educated mother are 28.22% and 16.03% respectively. And few in numbers are higher educated (12.5%).

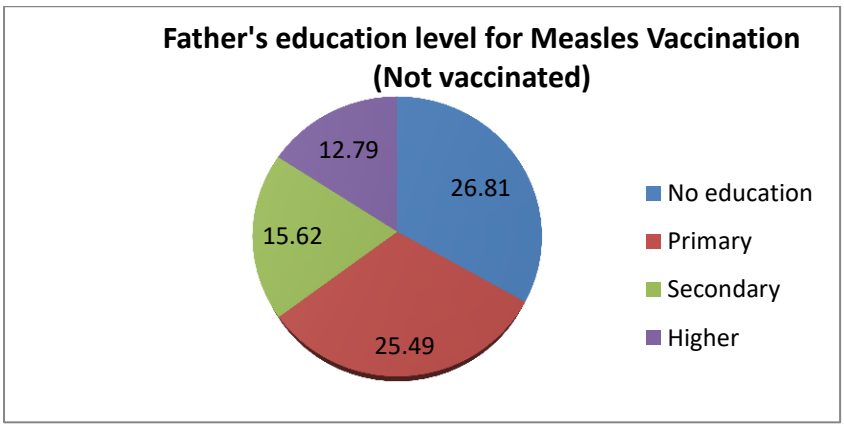


Figure 4: Proportion of father's education level for Measles Vaccination (Not vaccinated)

The proportion of father's education level for Measles Vaccination (Not vaccinated) is represented by this pie chart. The children who did not get two doses of measles vaccination, among their fathers the majority are not educated (26.81%) or had primary educated (25.49%). Secondary educated father are 15.62% and the lowest number of fathers were higher educated (12.79%).

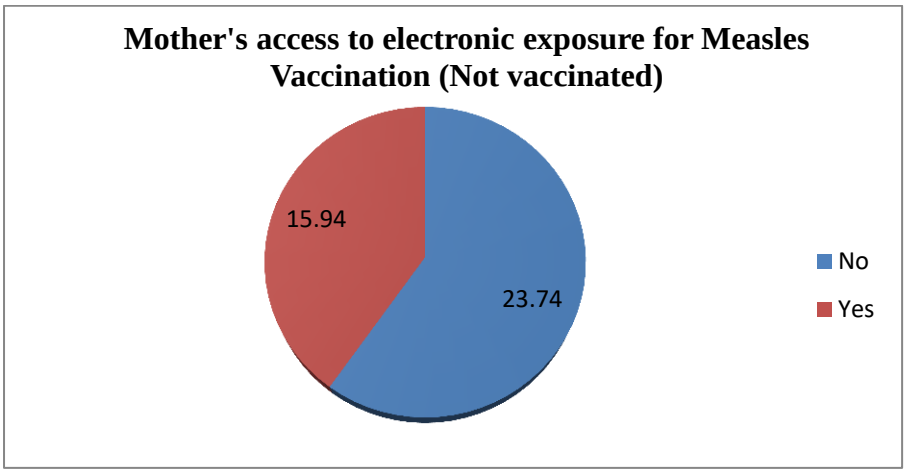


Figure 5: Proportion of mother's access to electronic exposure for Measles Vaccination (Not vaccinated)

In figure 5 , this pie chart shows that avoidable tendency for both doses of measles vaccination were more in mothers who did not have access to electronic exposure (radio, television, newspaper)(23.74%) than the mothers who had access to electronic exposure (15.94%).

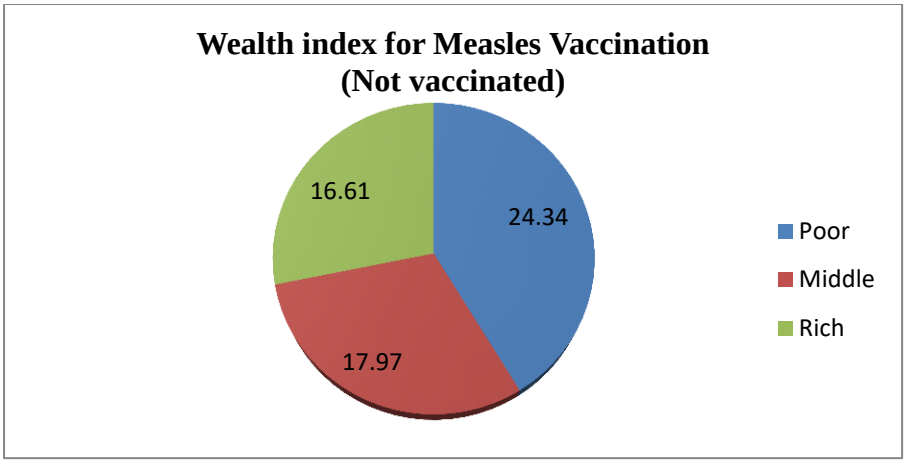


Figure 6: Proportion of wealth index for Measles Vaccination (Not vaccinated)

This pie chart shows the proportion of wealth index for Measles Vaccination (Not vaccinated). The children who did not get two doses of measles vaccination, among them majority are in poor condition according to wealth index (24.34%). Middle and rich families are comparatively low in number (17.97 % and 16.61% respectively).

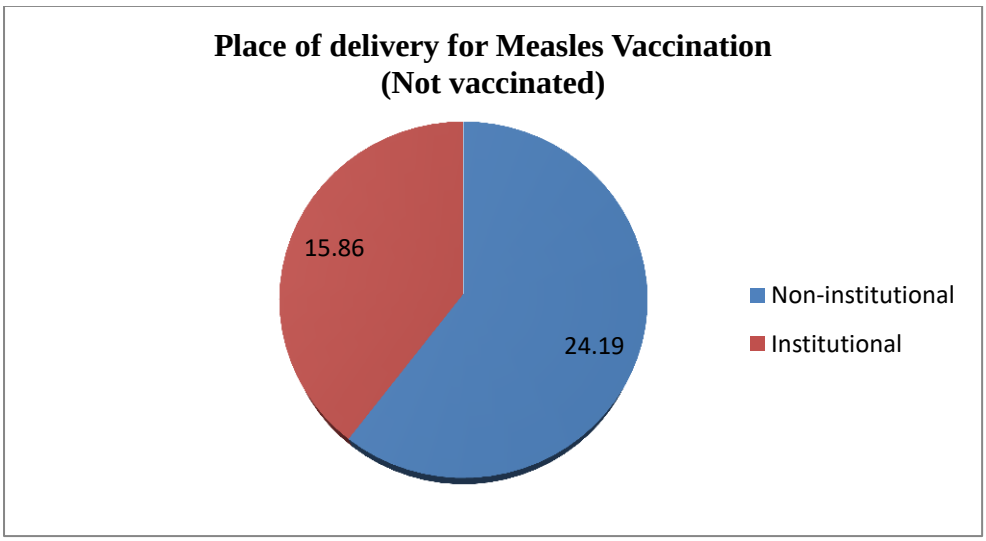


Figure 7: Proportion of place of delivery for Measles Vaccination (Not vaccinated)

The proportion of place of delivery for Measles Vaccination (Not vaccinated) is represented by this pie chart. The children who did not get two doses of measles vaccination, among their mother's history of place of delivery non- institutional delivery (24.19%) are more than institutional delivery (15.86%).

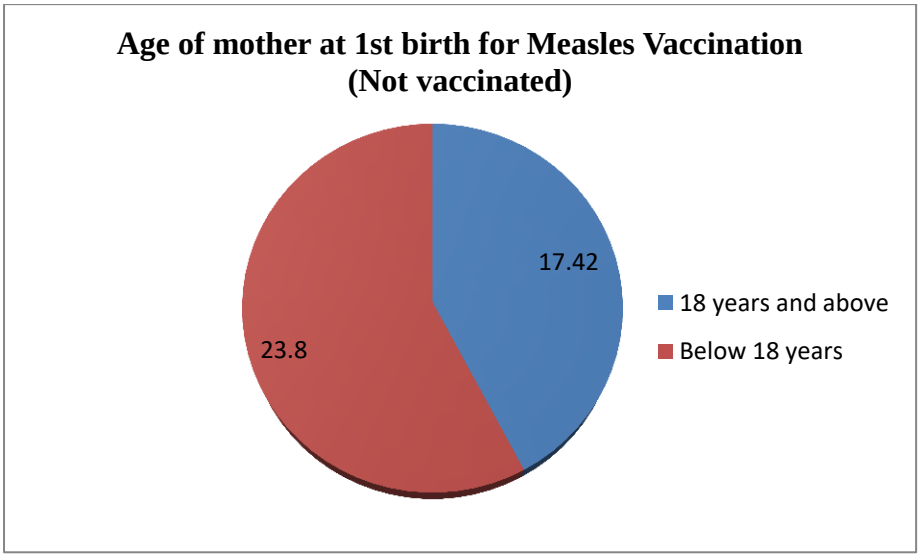


Figure 8: Proportion of age of mother at 1st birth for Measles Vaccination (Not vaccinated)

In figure 8 , this pie chart shows that avoidable tendency of mother for giving both doses of measles vaccination to their child were more in mothers whose age were below 18 years (23.8%) than the mothers having age 18 years and above (17.42%).

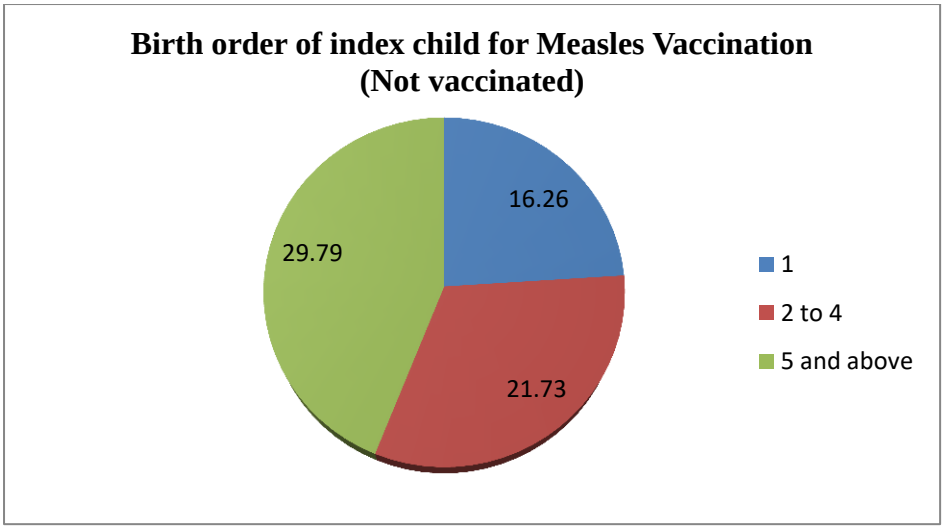


Figure 9: Proportion of birth order of index child for Measles Vaccination (Not vaccinated)

This pie chart shows the birth order of index child for Measles Vaccination (Not vaccinated). The children who did not get two doses of measles vaccination, among them those who were 5th or more in number of child of their parents are more in quantity (29.79 %). Children being 2nd to 4th order of their parents are about 21.73 %. And the children who were 1st issue of their parents are the lowest in number (16.26%) who did not complete their Measles vaccinations.

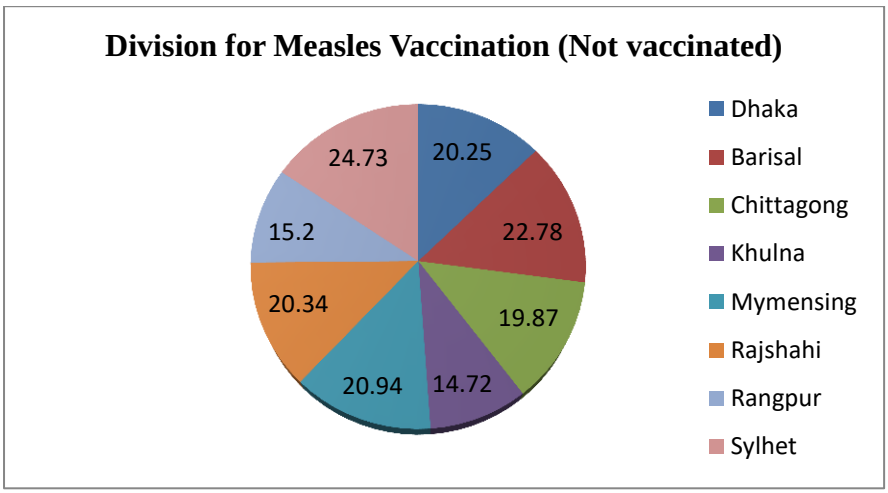


Figure 10: Proportion of division for Measles Vaccination (Not vaccinated)

The proportion of division for Measles Vaccination (Not vaccinated) is represented by this pie chart. The children who did not get two doses of measles vaccination, among their living area Khulna Division had the lowest proportion (14.72%) and Sylhet Division had the highest proportion (24.73%) for not completing two doses of measles vaccination. Not vaccinated status of Measles Vaccination among the other divisions are 20.25% in Dhaka, 22.78% in Barisal, 19.87% in Chittagong, 20.94% in Mymensing, 20.34% in Rajshahi and 15.20% in Rangpur.

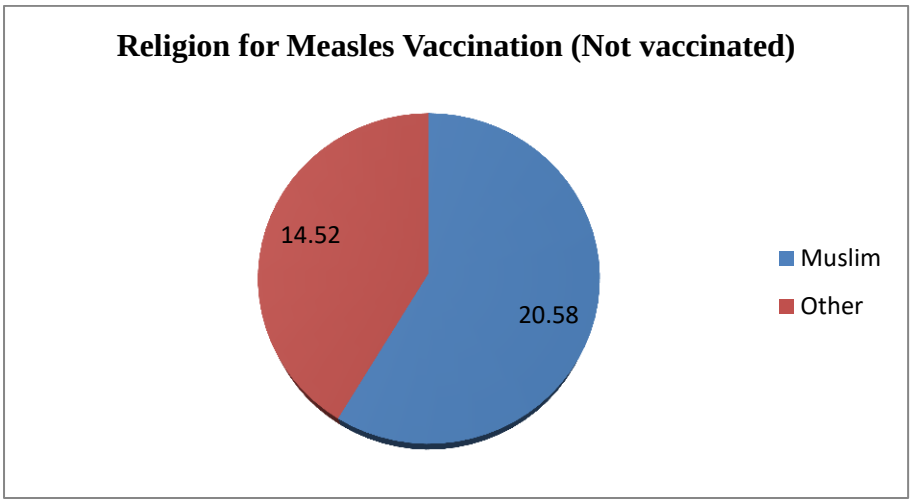


Figure 11: Proportion of religion for Measles Vaccination (Not vaccinated)

In figure 11, this pie chart shows that avoidable tendency for both doses of measles vaccination were more in Muslims (20.58%) than the others (14.52%).

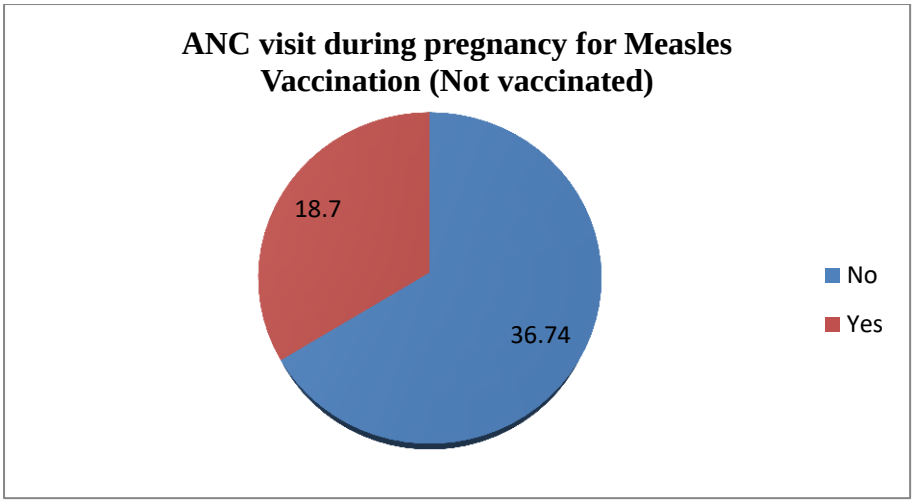


Figure 12: Proportion of ANC visit during pregnancy for Measles Vaccination (Not vaccinated)

This pie chart shows the proportion of ANC visit during pregnancy for Measles Vaccination (Not vaccinated). The children who did not get two doses of measles vaccination, among their mothers the most were not taking ANC visit during pregnancy (36.74%) than those were taking ANC visit during pregnancy (18.7%).

Table 5: Logistic Regression models for measles vaccination: A multiple regression analysis

Variables	Category	OR	p-value
Mother's education level	No education(ref)		
	Primary	1.331	0.153
	Secondary	2.120	<0.001

	Higher	2.021	0.012
Father's education level	No education(ref)		
	Primary	0.873	0.369
	Secondary	1.239	0.218
	Higher	1.303	0.255
Place of residence	Rural(ref)		
	Urban	0.718	0.008
Mother's access to electronic exposure	No(ref)		
	Yes	1.270	0.061
Wealth index	Poor(ref)		
	Middle	1.107	0.517
	Rich	1.055	0.744
Place of delivery	Non institutional(ref)		
	Institutional	1.257	0.085
Age of mother at 1st birth	Above 18 years(ref)		
	Below 18 years	0.825	0.075
Birth order of index child	1(ref)		
	2-4	0.849	0.150
	≥5	0.870	0.543
Sex of index child	Female(ref)		
	Male	1.018	0.862
Mother's empowerment	Not employed(ref)		
	Employed	1.247	0.048
Mother's awareness	No(ref)		

of the community clinic	Yes	0.998	0.989
Division	Dhaka(ref)		
	Barisal	0.929	0.728
	Chittagong	0.965	0.846
	Khulna	1.147	0.546
	Mymensing	0.924	0.693
	Rajshahi	0.899	0.606
	Rangpur	1.279	0.270
	Sylhet	0.849	0.382
Religion	Muslim(ref)		
	Non-muslim	1.318	0.172
ANC visit during pregnancy	No(ref)		
	Yes	1.620	0.005
PNC check within 02 months	No(ref)		
	Yes	1.253	0.073
Constant		1.175	0.611

Table 5 represents the logistic regression model for measles vaccination along with independent variables. In our logistic regression model, all the independent variables were added. The variables may not be statistically significant but they had socio-cultural significance. In this model we considered mother's education level, father's education level, place of residence, mother's access to electronic exposure, wealth index, place of delivery, age of mother at 1st birth, birth order of index child, sex of index child, mother's empowerment, mother's awareness of the community clinic,

division, religion, ANC visit during pregnancy and PNC check within 02 months (Table 5).

According to this model, with the reference of no education; secondary and higher educated mother vaccinated their children (Measles Vaccination) two times higher than non-educated mother. Significant effect of mother's education level on Measles Vaccination was found as p-value were 0.000 and 0.012 respectively for secondary and higher educated mother.

We didn't find any significant effect of father's education level on Measles Vaccination with the reference of no education (p-value were 0.369, 0.218 and 0.255 respectively for primary, secondary and higher educated father). In case of place of residency, rural people vaccinated their children significantly 1.4 times higher than urban people. The p-value for urban people was 0.008 which was significant. Mother's access to electronic exposure did not have any significant effect on Measles Vaccination (p-value= 0.061). We also didn't find any significant effect of wealth index on Measles Vaccination (p-value were 0.517 and 0.744 respectively for middle and rich people). Place of delivery and age of mother at 1st birth didn't have any significant effect on Measles Vaccination (p-value= 0.085 and 0.075 respectively).

We didn't find any significant effect of birth order of index child and sex of child on Measles Vaccination (p-value were 0.150, 0.543 and 0.862 accordingly). Mother's empowerment had a significant role on Measles Vaccination (p-value=0.048). Employed mother vaccinated their children Measles Vaccination more than not employed mother (p-value is 0.048), which is significant. In case of mother's awareness of the community clinic we didn't find any significant effect (p-value=0.989) on Measles Vaccination. There were also no significant effect found in

case of division which are Barisal, Chittagong, Khulna, Mymensing, Rajshahi, Rangpur and Sylhet (p-value= 0.728, 0.846, 0.546, 0.693, 0.606, 0.270 and 0.382 respectively and religion (p-value is 0.172).

Mothers who took ANC visit during pregnancy had 62% higher chance of giving Measles vaccination to their children than who did not take ANC visit. It was significant as p-value was 0.005. Any significant effect was not found of PNC check within 02 months on Measles Vaccination (p-value was 0.073).

CHAPTER 4

DISCUSSION

Measles is a communicable disease, caused by genus *Morbillivirus*, can be prevented by vaccination. To decrease measles related mortality and morbidity; EPI provides immunization since 2001. In Bangladesh EPI immunization was since 2012. Among less than 12 months aged children measles vaccination coverage was 88 % (according to BDHS data 2017-18) (1). To accelerate the achievement target of 3rd Sustainable Development Goal (SDG) we need identify the factors to overcome the obstacles (19). In this study, the objective is to identify the determinants of incomplete measles vaccination of children in Bangladesh. We can assess the current measles vaccination status, determine the demographic, socio-economic and other factors that may improve measles vaccination status and find out the factors associated with measles-related mortality in Bangladesh.

In this study the determinants of incomplete measles vaccination of children in Bangladesh were explored where it is found that maternal education and mother empowerment have possibility to increase measles vaccination in Bangladesh. There is also possibility that people living in rural area and regular taking antenatal care can have a positive role of increasing measles vaccination in Bangladesh.

It is found that around 20% children are not measles vaccinated. According to this study, secondary educated mother's children and primary educated father's children are more in number who are vaccinated. Those who live in rural area are more vaccinated than urban region. Mothers having exposure to electronic access is low in number in this study. Age of mother at 1st birth is 18 years and above in most family,

number of index child is two to four is average. Most of the people are rich in wealth index, male, Muslims. Among division, more people live in Chittagong and less people live in Barisal. On the other hand, less people prefer institutional delivery and less aware of the community clinic, mothers are not empowered in most of the families. But, ANC and PNC visits taking mothers are comparatively more in number. In bivariate analysis, among the fifteen significant variables, mother's education, father's education, mother's access to electronic exposure, wealth index, place of delivery, age of mother at 1st birth, birth order of index child, division, religion, ANC visit during pregnancy have association with measles vaccination.

By logistic regression model, it is found that secondary and higher educated mother vaccinated their children (Measles Vaccination) two times higher than non educated mother. In case of place of residency, rural people vaccinated their children significantly 1.4 times higher than urban people. However, employed mother vaccinated their children around 24% more than not employed mother. Mothers who took ANC visit during pregnancy had 62% higher chance of giving Measles vaccination to their children than who did not take ANC visit during pregnancy.

It is found that mother who had secondary and higher education had a significant role on Measles Vaccination. In a study among 5468 children aged 12-23 months were surveyed, who had mothers with no formal schooling were observed to be significantly associated with lack of measles vaccination (3). In another study, in a campaign survey 1735 households were sampled. Children of caregivers with primary or secondary or higher education had higher coverage of Measles-Rubella vaccine compared to children of caregivers with no formal education (13).

Urban people had significantly lower coverage than rural people of Measles vaccination in this study. In another study where secondary data analysis was done from BDHS 1992 to 93 to 2014, urban people had significantly higher coverage than rural people for measles vaccination (19). In a study among 5468 children aged 12-23 months were surveyed, rural people were observed to be significantly associated with lack of measles vaccination(3).

Employed mother provided significant role on measles vaccination coverage. On the other hand, in another study secondary data analysis was done from BDHS 1992 to 93 to 2014, not employed mother had significantly higher measles vaccination coverage than employed mother (19). Significant influencing factor 'not employed mother' had contribution to untimely and incomplete childhood vaccination in the context of Bangladesh (10).

ANC visit during pregnancy had significantly influenced this study for measles vaccination. A case control study was held in Dhaka, Bangladesh to evaluate vaccine effectiveness and to assess risk factors for Measles. In that study, health care visit had significant role on measles vaccination (20).

During the analysis and interpretations of the study we felt the need of some qualitative and quantitative data which were missing in the survey data. If we collected data primarily we could add some qualitative components for analysis.

More data need to analyze to find out the objective of the study. Limited appropriate reference studies were done on this current topic. Hence the explanation outcome has to justify with a few studies.

Mother is the first teacher of her child after its birth. So, it is very important to bring up young girls as educated women in our country. When they start a family they recognize the importance of education and ensure education for their children as well. One of the key reasons that influenced mothers' choice to postpone, or avoid children's vaccination, is knowledge which will be corrected by education. Education availed by women will not only lead to increased household incomes and contribute to building a more skilled labor force, but it will also make these individuals more socially mobile. Child marriage, household responsibilities, high levels of pregnancies, lack of access to appropriate information about sexual and reproductive health, mental health issues, school-based violence and poverty are some of the main factors for female dropout rates to lost years in schooling. Bangladesh Government has already provided stipends for females up to secondary education level. Facilities provided by the government, increase teaching institutes, providing incentive, awareness of the guardian and utilize the importance of education may improve female education.

Place of residence influences Measles vaccination coverage. Measles vaccination rate in urban children is significantly lower than in rural children. In Bangladesh, immunization services are delivered through satellite clinics or static health facilities. Staff members of health systems are mostly involved in updating and motivating mothers on vaccination by community visits (3).

EPI program mainly depends on the grassroots' disease prevention and control units and even vaccination stations. In rural area, primary health providers usually have close connection with residents. So that, the primary caregivers of rural children are better encouraged to vaccinate, with the efforts of rural health providers. In the rural area perceived social norms were positively correlated with willingness to pay. One

important factor in the decision making of child's vaccination is social impact of the group effect which is more obvious in rural areas and population is closely linked. In rural areas, where the influence of mass media is limited, negative effect will be relatively low about vaccination insecurity or fear of adverse reactions. The government should strengthen financial support and regulation for the vaccination services. And awareness may be improved by the key persons (Chairman, Imam Etc.) by providing their valuable opinion which will be granted seriously by people and try to be followed their words.

Good ANC visit during pregnancy is essential for the health of both the mother and the developing unborn baby. By this visit mothers are provided health education, newborn care, breast feeding. Analysis by the WHO shows that the first 28 days of life for a baby is called neonatal period .In this period child's survival is most threatened. Based on 2018 estimation, around 2.5 million neonates die in their first month of life, annually around the world. So, to prevent neonatal death EPI vaccines should be given timely. And by increasing ANC visit this awareness should be increased among mothers and their family for their upcoming children.

Measles and Rubella are public health problems in poor countries in Africa and Asia, including Bangladesh. National level MR campaign covering children aged 9 months to <15 years may substantially eliminate measles and rubella (13).

In this thesis, the determinants of incomplete measles vaccination of children in Bangladesh were traced. By identifying determinants we can take steps to improve measles vaccination rates. We can also reduce incomplete vaccination to achieve EPI targets which is related to the establishment of herd immunity and reduction in disease transmission. These findings will support policy makers in formulating strategies for improving measles vaccination coverage in order to achieve further

reduction in mortality and disease burden in Bangladesh. And we should consider immunization as a fundamental element of the human right to health and must be realized by individual, community and the government.

CHAPTER 5

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