On Correlates of Taking Complementary Foods among Children of Age 6-23 Months in Bangladesh

B.S. 4th Year Project

A Project Submitted to the Department of Statistics, University of Dhaka, as a Partial Fulfillment of the Requirements for the Degree of Bachelor of Science

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Contents

List of Tables

List of Figures

Abstract

It is well documented in literature that child survival, growth and development depend on Infant and Young Child Feeding (IYCF) practices to a great extent. Therefore, it is essential to identify the potential demographic and socio-economic factors associated with IYCF practices in Bangladesh. In this study, we considered three indicators related to IYCF practices, namely minimum dietary diversity (MDD), minimum meal frequency (MMF), minimum acceptable diet (MAD). For the purpose of analysis, data were extracted from national representative Bangladesh Demographic and Health Survey (BDHS) 2017-18. Univariate, bivariate, logistic regression analysis have been conducted. On the basis of results some recommendations have suggested to increase the IYCF practices among the children of age 6-23 months in Bangladesh.

Chapter 1
Introduction

1.1. Motivation

In low-income and middle-income nations, child undernutrition is a major problem that has a significant impact on death rates and overall burden of disease [1]. Economic and environmental factors have a significant impact on children's nutritional health [2,3,4], but direct reasons like feeding habits are also linked to nutritional outcomes, particularly stunting, regardless of socioeconomic determinants [5,6]. If supplementary food is not provided in sufficient amounts and of sufficient quality, children, even those who were breastfed exclusively, are still at risk of being stunted [7]. The gradual introduction of soft food, semisolid food, and solid food, starting around the period of 6 months of age and continuing until 24 months, is known as complementary feeding practice [2,3]. It has a significant impact on the well-nourishment of children [8]. There is an estimate that 6% of all deaths in children under the age of 5 years in developing countries can be prevented if appropriate complementary feeding practices are followed [9]. Therefore, timely introducing complementary feeding and giving nutritionally adequate and safe Health Organization (WHO) [10].

In Bangladesh, the persistence of malnutrition and nutrition-related health issues are major worries, one third of young children under the age of five have stunted growth [11,12]. Despite significant gains over the past three decades, Bangladesh still has a high rate of undernutrition among children under the age of five [13]. Inadequate complementary feeding practices and late introduction are two of the main causes of child malnutrition in Bangladesh [14]. Various socio-economic and individual factors influence complementary feeding practices among young children, according to prior studies [12,14,15]. Geography, household food insecurity, income, women's empowerment, exposure to mass media, antenatal care practices, factors of these kind are associated with young children's dietary diversity [13,16].

For proper growth and development, infants and young children should be provided a minimum acceptable diet (MAD). Combining minimum dietary diversity (MDD) and minimum meal frequency (MMF), the WHO recommends a minimum

acceptable diet [11]. The definition of these indicators according to WHO is given below:

- MDD: A child satisfies the criteria of MDD, if the child takes at least five of the eight selected food groups (1. Breast milk, 2. Grain, roots, and tubers, 3. Legumes and nuts, 4. Dairy products, 5. Flesh, 6. Eggs, 7. Vitamin-A rich fruits and vegetables, 8. Other fruits and vegetables).
- MMF: A child satisfies the criteria of MMF, if the minimum number of solid or semi-solid food given to the child maintains a standard number, which is 2 meals per day for children between 6-8 months, 3 or more meals per day for breastfed children between 9-23 months and 4 or more times for non-breastfed children between 9-23 months.
- MAD: A child who satisfies both MDD and MMF is said to follow MAD.

1.2. Literature Review

Worldwide, there are more than 10 million deaths of under five children each year, with 98% of those deaths occurring in developing nations [17]. Malnutrition has been recognized as the underlying cause of around 50% of under-five deaths in developing countries and is currently the leading factor contributing to the worldwide burden of illness [18]. Less than one-fourth of infants aged between 6 and 23 months in many countries achieve the standards for dietary diversity and feeding frequency that are age-appropriate. Few children receive complementary foods that are safe and nutritionally enough [19]. The WHO advises complementary feeding because it enables infants and young children to satisfy changing nutritional requirements essential for their best growth, development, and health [20]. Infants and young children that receive better nutrition have better cognitive abilities, which translates to higher adult productivity [21].

Inappropriate complementary feeding techniques have been linked to under-5 mortality, wasting, stunting, and nutritional outcomes worldwide [9,22]. Based on this, the World Health Organization (WHO) has created a set of key indicators to evaluate infant and young child feeding (IYCF) practices, and these indicators cover both complementary feeding practice and breastfeeding [22]. Previous research has demonstrated that introducing complementary foods to newborns and young children at the right time can lower their risk of malnutrition, infectious diseases in infancy and

mortality [23]. Interventions aimed at these groups should be made due to the significant current and future illness burden caused by malnutrition in children under the age of two [24].

1.3. Objective of the Project

The main objectives of this study are given below

- To study the Infant and Young Child Feeding (IYCF) practices in Bangladesh.
- To obtain the prevalence of IYCF indicators such as MDD, MMF and MAD by selected demographic and socio-economic variables.
- To determine the potential factors associated with IYCF indicators by using logistic regression models.
- To provide some suggestions, based on the results of this study, to the policy makers to improve the IYCF practices among the children of age 6-23 months.

1.4. Organization of the Project

This project is organized into six chapters. In chapter 1, motivation of the study, literature review, objective of the study are given. Data and variables are discussed in chapter 2. Chapter 3 contains a brief description of the inference procedure of univariate, bivariate, and logistic regression. Univariate and bivariate tables, bivariate figures including p-value, and interpretations based on the results are given in chapter 4. A table containing estimated regression coefficients, standard error, p-value, and odds ratios obtained from logistic regression is provided in chapter 5 along with the interpretations of the odds ratio. In Chapter 6, brief discussion on the whole study has been done and on the basis of the results some recommendations have suggested to the policymakers.

Chapter 2

Data, Variables and Materials

2.1. Data and Variables

For this study, we used secondary data extracted from nationally representative Bangladesh Demographic Health Survey 2017-18 (BDHS) data downloaded from the DHS website (www.dhsprogram.com) after taking permission from DHS authority. This is a cross-sectional survey followed by two-stage stratified sampling and covered all eight divisions [25].

A subset of the data was taken by only considering the children whose age is between 6-23 months and who live with its mother. Under this condition, 2425 children were eligible for our study.

Table 2.1: List of dependent variables with their categories

Dependent variables	Categories
MDD	Yes
	No
MMF	Yes
	No
MAD	Yes
	No

The computation of these indicators is based on the data collected from the last 24 hours.

For independent variables, we considered socio-demographic data like mother's age, where she lives, economic status, etc. All the covariates used here is a factor with two or more categories. For this study, we recoded some variables and some variables were created by combining information from other variables. The table below shows all the covariates with category and label.

Table 2.2: List of independent variables with their categories

Factors	Categories	Labels
Maternal Age	<20	Mother's age is less than 20 years
	20-30	Mother's age is between 20 to 30 years
	>30	Mother's age is more than 30 years

Division	Dhaka	Respondent lives in Dhaka
	Barishal	Respondent lives in Barishal
	Chittagong	Respondent lives in Chittagong
	Sylhet	Respondent lives in Sylhet
	Khulna	Respondent lives in Khulna
	Mymensingh	Respondent lives in Mymensingh
	Rajshahi	Respondent lives in Rajshahi
	Rangpur	Respondent lives in Rangpur
Residence	Rural	Respondent lives in Rural area
	Urban	Respondent lives in Urban area
Wealth Index	Poor	Respondent is from poor family
	Middle	Respondent is from middle class family
	Rich	Respondent is from rich family
Maternal Education	No Education	Mother has no education
	Primary	Mother completed primary education
	Secondary	Mother completed secondary education
	Higher	Mother completed higher education
Exposed to media	Not Exposed	Mother is not exposed to media
	Exposed	Mother is exposed to media
Maternal Working Status	Not Working	Mother does not work
	Working	Mother is a working person
Birth Order	1st	1st child of mother
	2nd	2nd child of mother
	>=3rd	3rd or next child's of mother
ANC Visit	<4	Antenatal care visit less than 4 times
	>=4	Antenatal care visit more or equal than 4 times
Place of Delivery	Home	Delivery conducted at home
	Institute	Delivery conducted at any institute
Gender	Female	Child is a female
	Male	Child is a male

2.2. Software and Technical Support:

Different softwares were used to complete this study. We used IBM SPSS Statistics (version 26), RStudio (R version 4.2.0) and MS Word 2016 in different aspects.

2017-18 BDHS were extracted in SPSS format. Data reading, cleaning and analysis (univariate, bivariate and logistic) were done using SPSS. For visualization of our data, we used RStudio. To write the report we used MS Word.

Chapter 3

Statistical Methods

3.1. Univariate Analysis:

Since all variables considered in this study are categorical variables, we calculated the percentage distribution for each category of each variable.

3.2. Bivariate Analysis:

To examine how the prevalence of MAD, MDD and MMF changes with the change of category of each covariate we considered, we used the Pearson Chi-square test [26].

The Chi-square test statistic can be defined as-

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij} - E_{ij})^2}{E_{ij}},$$

where

$O_{ij} =$ the number of observations in the cell (i, j) ; $i = 1,2,\dots,r \quad and \quad j = 1,2,\dots,c$

$E_{ij} = Np_i =$ Expected cell value. Note that the test statistic follows a Chi-squared distribution with (r-1)*(c-1) degrees of freedom. P-value collected from this test is used to make the decision. The hypothesis in bivariate analysis can be formulated as-

$\boldsymbol{H_0}$: *There is no association between selected covariate and the outcome variable.*

$\boldsymbol{H_a}$: *There is association between selected covariate and the outcome variable.*

3.3. Logistic Regression Analysis:

3.3.1. Logistic Regression as Generalized Linear Model

Under a binary logistic regression model, the response variable Y has a Bernoulli distribution. Suppose there are n independent response variables Y_i, $i = 1,2,\dots,n$ with mean μ_i.Let $X_i = (x_{i0}, x_{i1}, x_{i2}, \dots, x_{ij}, \dots, x_{ip})'$ be set of covariates associated with Y_i where $x_{i0} = 1$ and $\beta = (\beta_0, \dots, \beta_j, \dots, \beta_p)'$ be the regression

coefficients that are to be estimated. Under this model, mean and variance of binary response Y_i is given by

$$E(Y_i) = P(Y_i = 1) = \pi_i$$

$$Var(Y_i) = \pi_i(1 - \pi_i).$$

Binary logistic regression model is a member of generalized linear model (GLM) because of the following reasons: [27]

a. The probability distribution function of Y_i , $f(y_i)$ is a member of the exponential family with canonical form, i.e.,

$$f(y_i) = \pi_i^{y_i}(1 - \pi_i)^{1-y_i}$$

$$= \exp\left[y_i \log\left(\frac{\pi_i}{1-\pi_i}\right) + \log(1 - \pi_i)\right].$$

Therefore, Bernoulli distribution belongs to exponential family of distribution with $a(y_i) = y_i$; $b(\pi_i) = \log\left(\frac{\pi_i}{1-\pi_i}\right)$; $c(\pi_i) = \log(1 - \pi_i)$; $d(y_i) = 0$. Since, $a(y_i) = y_i$, Bernoulli distribution has a canonical form with natural parameter, $b(\pi_i) = \log\left(\frac{\pi_i}{1-\pi_i}\right)$. One can use this natural parameter, $b(\pi_i)$ as a link function.

From the properties of exponential family of distribution, one may write,

$$E(Y_i) = \mu_i = \frac{\pi_i(1-\pi_i)}{(1-\pi_i)} = \pi_i \quad \text{and} \quad Var(Y_i) = \pi_i(1 - \pi_i).$$

b. The GLM for binary response can be written as

$$\log\left(\frac{\mu_i}{1-\mu_i}\right) = x_i'\beta.$$

which is called as a logit model.

The link function permits the mean of response to be related non-linearly with the covariates, i.e.

$$\mu_i = [1 + \exp(-x_i'\beta)]^{-1}$$

This model is known as binary logistic regression model.

3.3.2. Inferential Procedure: Estimation

Under GLM set-up, the estimation procedure of Binary Logistic Regression model is described below:

Likelihood Function

Let $Y = (Y_1, \cdots, Y_i, \cdots, Y_n)'$ be a random sample of size n from Bernoulli distribution function. Then likelihood function can be defined as,

$L(\beta; Y) = \prod_{i=1}^{n} f(y_i) \quad \Rightarrow \prod_{i=1}^{n} {\pi_i}^{y_i} (1-\pi_i)^{1-y_i}$.

The log-likelihood function can be expressed as

$$l(\beta; Y) = logL(\beta; Y)$$

$$= \sum_{i=1}^{n} [y_i log\, \pi_i + (1-y_i) log(1-\pi_i)].$$

Score Function

The score function, denoted by $U(\beta)$, can be obtained as

$$U(\beta) = \frac{\partial}{\partial \beta} l(\beta; Y)$$

The j[th] element of score function for our model is

$U_j(\beta) = \frac{\partial}{\partial \beta_j} l(\beta; Y), \quad j = 0,1,2, \cdots p$

Here, the j[th] element of score function is (Dobson A.; 2008),

$$U_j(\beta) = \frac{\partial}{\partial \beta_j} l(\beta; Y)$$

$$= \sum_{i=1}^{n} x_{ij}\, Var(Y_i)\, [Var(Y_i)]^{-1} (y_i - \pi_i)$$

$$= \sum_{i=1}^{n} x_{ij}\, (y_i - \pi_i)$$

In matrix notation, the score function can be expressed as

$$U(\beta) = X'(Y - \pi).$$

where, $X = ({x_1}', \cdots, {x_i}', \cdots, {x_n}')'$, $Y = (y_1, \cdots, y_i, \cdots, y_n)'$, $\pi_i = (\pi_1, \cdots, \pi_i, \cdots, \pi_n)'$.

Information Matrix

The information matrix, denoted by $I(\beta)$, is the variance covariance matrix of the score function $U(\beta)$.

$$I(\beta) = Var\, [U(\beta)] = \left[-E \left[\frac{\partial}{\partial \beta_k} U_j(\beta) \right] \right] = [I_{jk}(\beta)]; \quad \text{j,k=0,1,2,}\cdots\text{,p.}$$

The (j,k)[th] element of information matrix is given by [27]

$$I_{jk}(\beta) = \sum_{i=1}^{n} x_{ij} x_{ik}\, \pi_i (1-\pi_i).$$

In matrix notation,

$$I(\beta) = X' Var(Y) X = X' W X$$

where

$$W = Var(Y) = diag[Var(Y_1), \cdots, Var(Y_i), \cdots, Var(Y_n)]$$
$$= diag[\, \pi_1(1-\pi_1), \cdots, \, \pi_i(1-\pi_i), \cdots, \, \pi_n(1-\pi_n).$$

Maximum Likelihood Estimating Equation

The maximum likelihood estimating equation for regression parameter β is given by

$$U(\beta) = 0$$

This equation can easily be solved for β by Newton Raphson iterative procedure. The estimate obtained at the mth $(m = 1,2, \cdots)$ iteration is given by

$$\hat{\beta}^{(m)} = \hat{\beta}^{(m-1)} + [I(\beta)]^{-1}_{\beta=\hat{\beta}^{(m-1)}} U(\beta)_{\beta=\hat{\beta}^{(m-1)}}$$
$$= \hat{\beta}^{(m-1)} + \left[X' \hat{W}^{(m-1)} X\right]^{-1} X' \left[Y - \hat{\pi}_i^{(m-1)}\right]$$

It is well known that the asymptotic distribution of the estimator, $\hat{\beta}$ for the regression parameter is normal with mean β and variance-covariance matrix $[X'WX]^{-1}$, i.e.

$$\hat{\beta}_{(p+1)\times 1} \sim N_{p+1}[\beta, [X'WX]^{-1}] \quad \text{as } n \to \infty$$

Chapter 4

Exploratory Data Analysis

We have conducted univariate and bivariate analysis in this chapter.

4.1. Result: Univariate

We consider percentage frequency for each category of the selected covariates and results are reported in table 4.1.

Table 4.1: Descriptive statistics of the selected variables

Variable	Frequency	Percentage (%)
Minimum Dietary Diversity		
No	1484	61.2
Yes	941	38.8
Minimum Meal Frequency		
No	409	16.9
Yes	2016	83.1
Minimum Acceptable Diet		
No	1532	63.2
Yes	893	36.8
Residence		
Urban	806	33.2
Rural	1619	66.8
Division		
Barishal	262	10.8
Chittagong	395	16.3
Dhaka	352	14.5
Khulna	240	9.9
Mymensingh	293	12.1
Rajshahi	255	10.5
Rangpur	284	11.7
Sylhet	344	14.2
Maternal Age (Years)		
<20	449	18.5
20-30	1570	64.7
>30	406	16.7
Wealth Index		
Poor	1031	42.5
Middle	425	17.5
Rich	969	40.0

Maternal Education Level		
No Education	145	6.0
Primary	662	27.3
Secondary	1169	48.2
Higher	449	18.5
Exposed to Media		
No	861	35.5
Yes	1564	64.5
Maternal Working status		
Not working	1529	63.1
Working	896	36.9
Birth order		
first child	908	37.4
second child	814	33.6
3rd or next childs	703	29.0
Antenatal Care Visit		
<4	1274	52.5
>=4	1151	47.5
Place of Delivery		
Institute	1234	50.9
Home	1191	49.1
Sex of Child		
Male	1254	51.7
Female	1171	48.3

Total 2425 observations are distributed throughout each category of various factors in our data.

Of the total respondents, 33.2% came from urban areas, while 66.8% do so from rural ones. Chittagong, one of Bangladesh's eight divisions, had the largest percentage of respondents (16.3%), followed by Dhaka (14.5%), Sylhet (14.2%), Mymensingh (12.1%), Rangpur (11.7%), Barishal (10.8%), Rajshahi (10.5%), and Khulna (9.9%), which had the lowest percentage of respondents overall. Of the respondents 18.5% were under 20 years old, 64.7% were between 20 and 30, and 16.7% were over 30.

According to the data, 40.5% of respondents are wealthy, 17.5% were from middle-class households, and 42.5% were poor. A little less than 6% of women were uneducated, while 27.3% read through elementary, 48.2% read through secondary, and 18.5% read through higher education. It is found that 64.5% of our respondents were

exposed to media, whereas the remaining 35.5% were not. Working mothers made up 36.9% of the population, while non-working mothers made up 63.1%.

Of all children, 39.6% were firstborns, 33.6% were second born, and 29% were thirdborns or afterwards. From all respondents, 47.5% had received antenatal care more than four times, while 52.5% had had it no more than four times. Of the total deliveries, 50.9% took place in institutions, while 49.1% took place at homes. In the data, the distribution of male and female children was 51.7% and 48.3%, respectively.

4.2. Result: Bivariate

In bivariate analysis, we examined the association between selected covariates and three outcome variables MDD, MMF and MAD. The results obtained from this analysis are given in Figure 4.1-4.11 and in Table 4.2.

Association between the MDD and Covariates

MDD vs Residence:

From figure 4.1, it is clear that the prevalence of MDD in urban was 45.5% whereas MDD prevalence in rural was 35.5%. Since the p-value is <0.001, one may conclude that there exists a significant association between MDD and residence. So, residence plays an important role to fill the MDD criterion.

MDD vs Division:

From figure 4.2, it is seen from figure 1.2 that the highest prevalence of MDD among 8 districts was 48% which belongs to Rangpur district followed by Dhaka district which was 40.6%. On the contrary, the lowest prevalence of MDD was Sylhet district which was 34.0%. As the p-value is 0.011, one may conclude that there is a significant association between MDD and Division. That is division plays a significant role to fill up the MDD criterion.

MDD vs Maternal Age:

From figure 4.3, it is seen that the prevalence of MDD in maternal age less than 20 was 37.6% and age 20-30 was 39.3% followed by age greater than 30 was 38.3. As the p-value is .784 the null hypothesis should not be rejected. That is there is no significant relationship between MDD and maternal age.

Figure 4.1 : Percentage distribution of MAD,MDD & MMF by residence

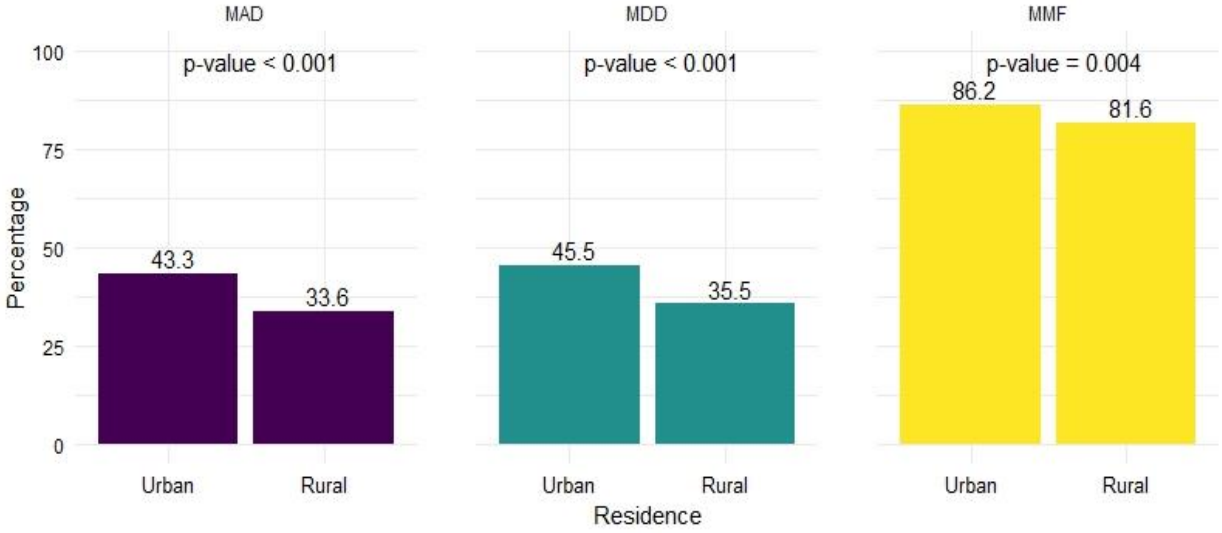

Figure 4.2 : Percentage distribution of MAD,MDD & MMF by division

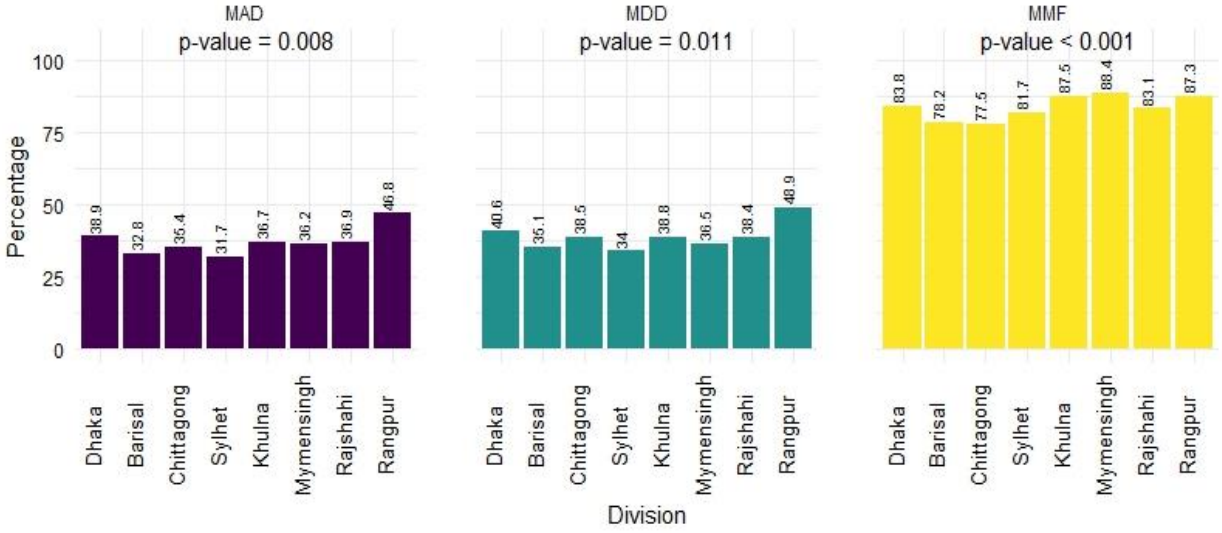

Figure 4.3 : Percentage distribution of MAD,MDD & MMF by mother's current age

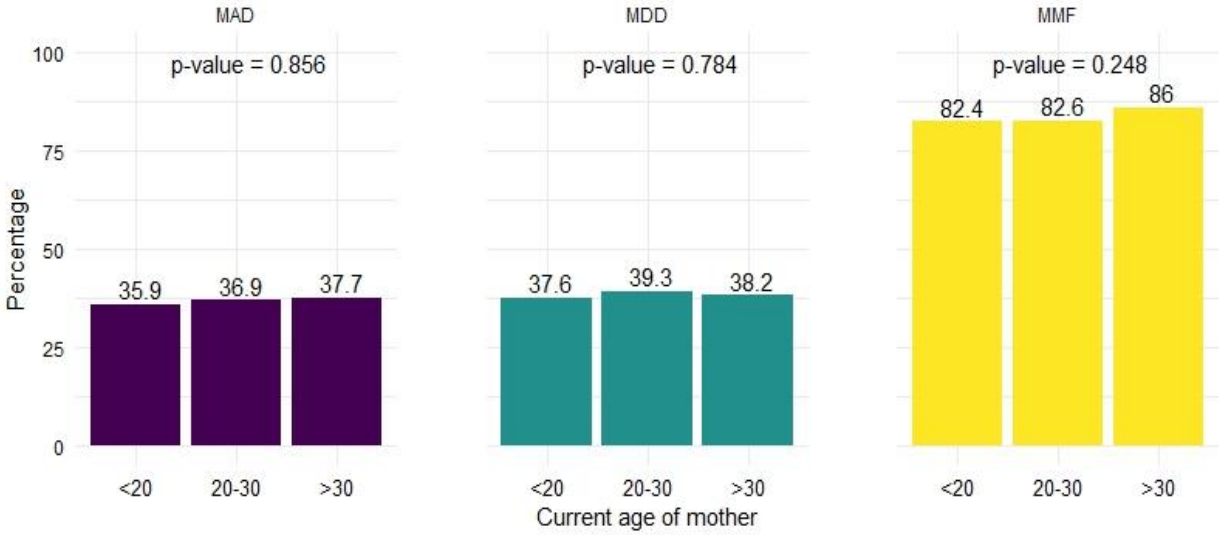

Figure 4.4 : Percentage distribution of MAD,MDD & MMF by wealth index

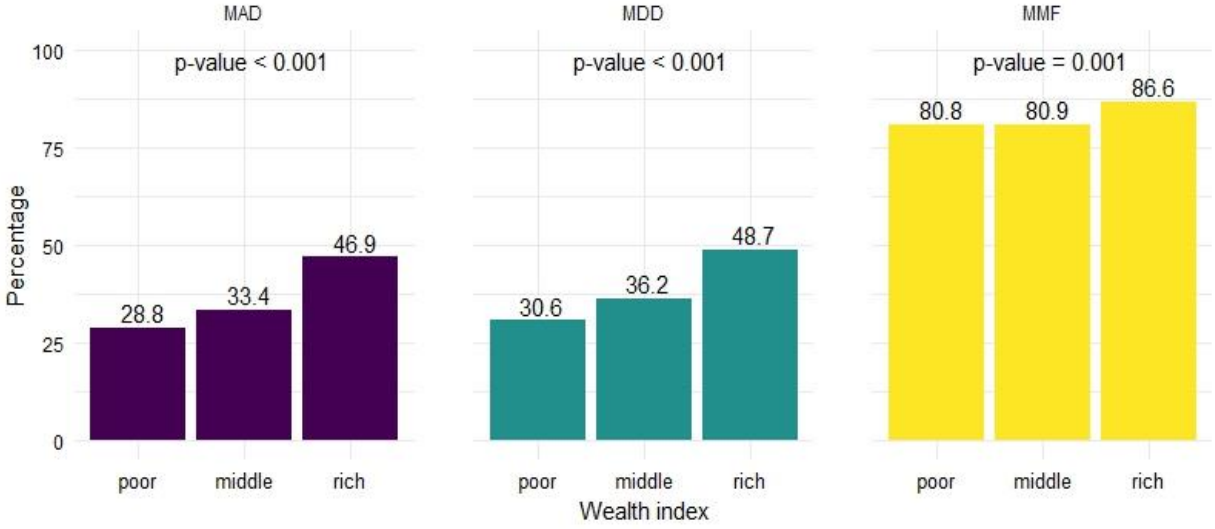

Figure 4.5 : Percentage distribution of MAD,MDD & MMF by education level

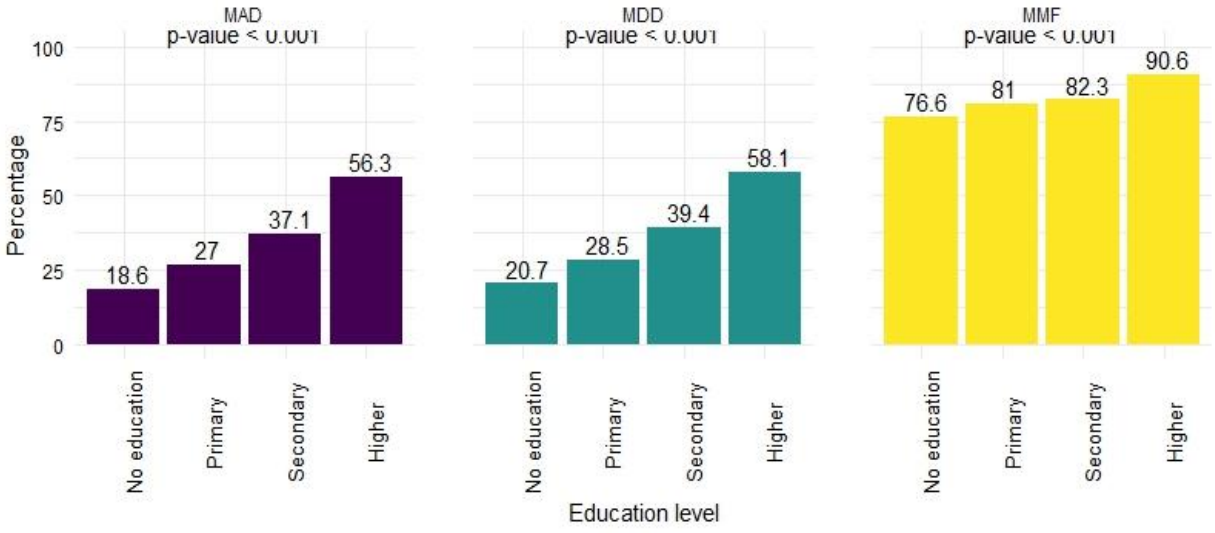

Figure 4.6 : Percentage distribution of MAD,MDD & MMF by media

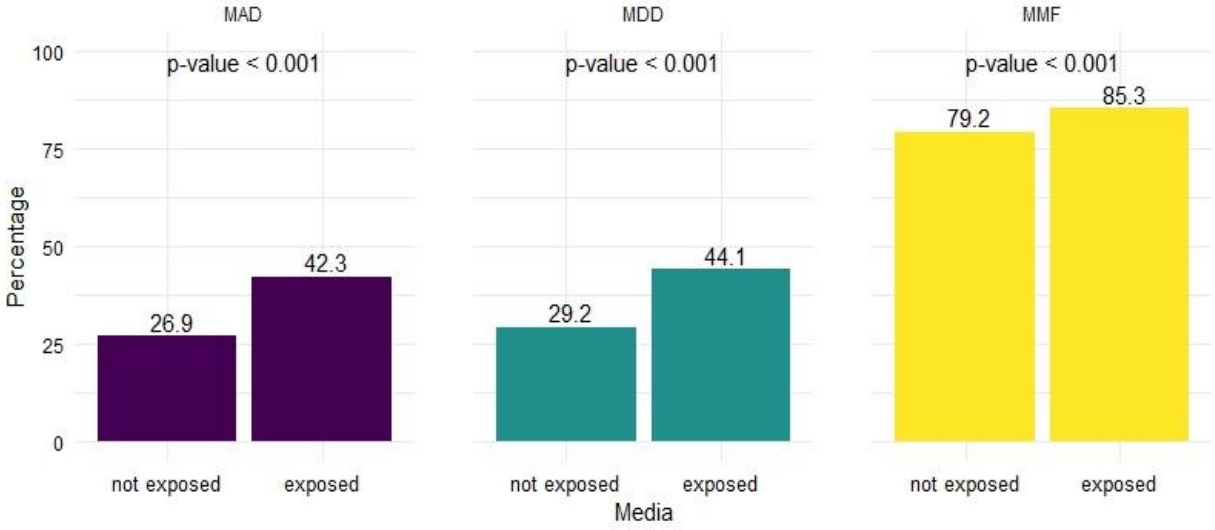

Figure 4.7 : Percentage distribution of MAD,MDD & MMF by working status

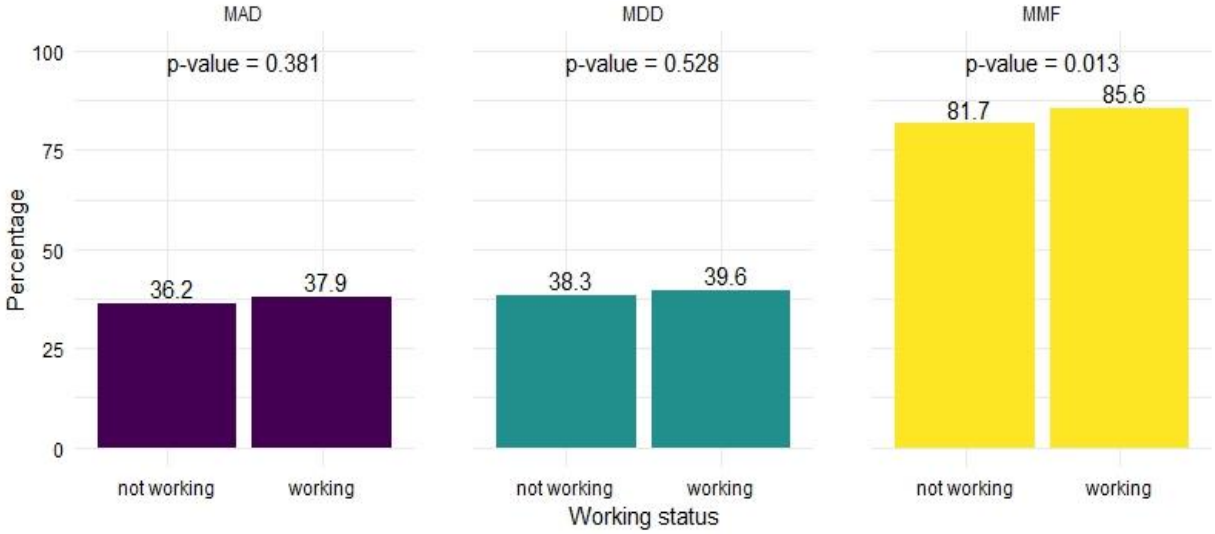

Figure 4.8 : Percentage distribution of MAD,MDD & MMF by birth order

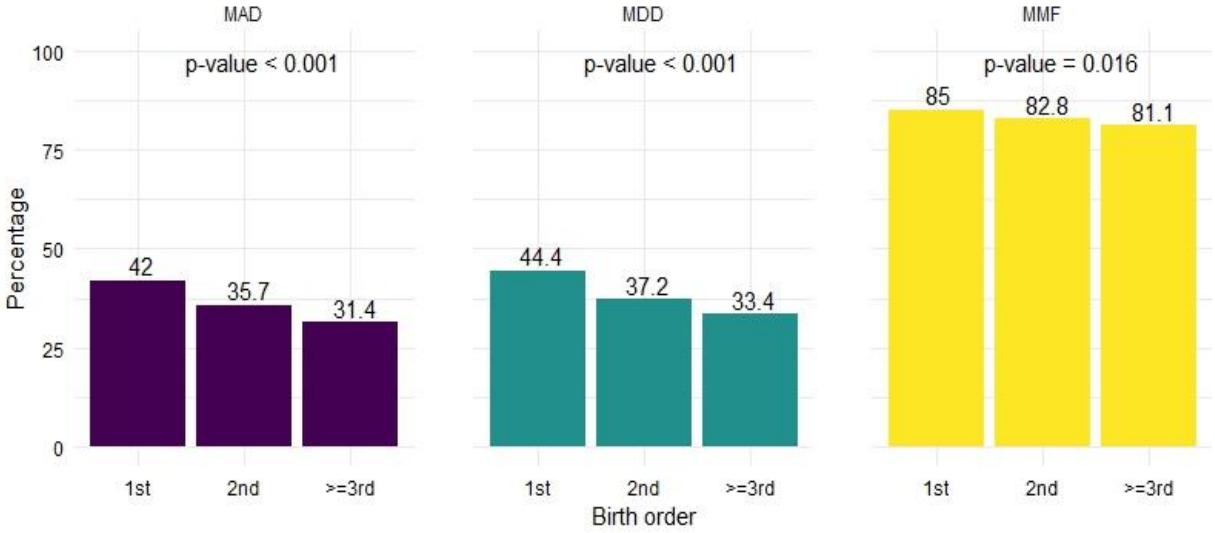

Figure 4.9 : Percentage distribution of MAD,MDD & MMF by antenatal care

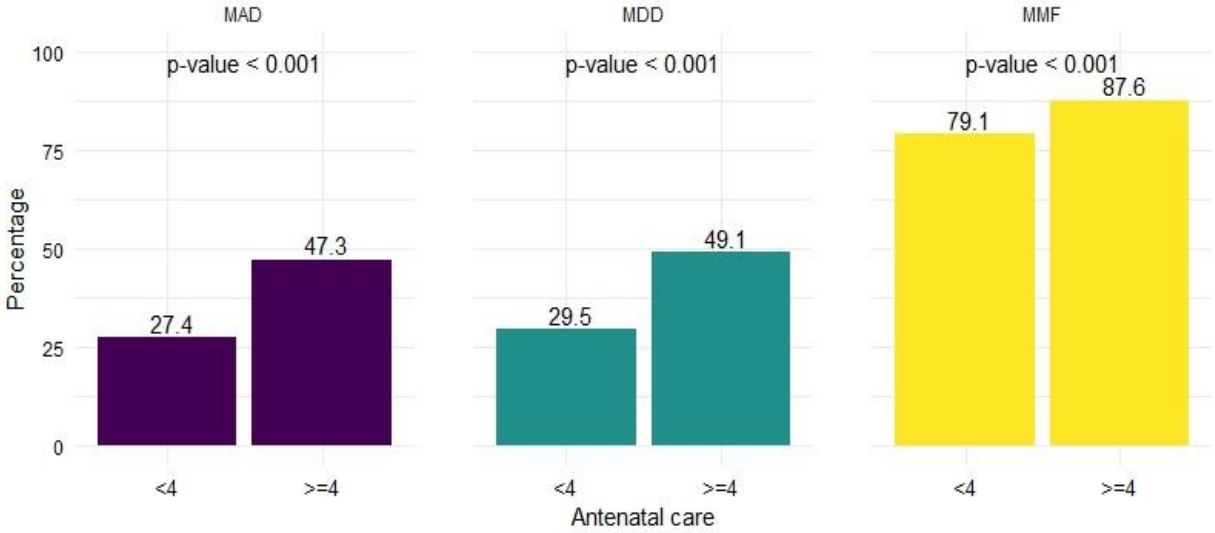

Figure 4.10 : Percentage distribution of MAD,MDD & MMF by place of delivery

Figure 4.11 : Percentage distribution of MAD,MDD & MMF by gender

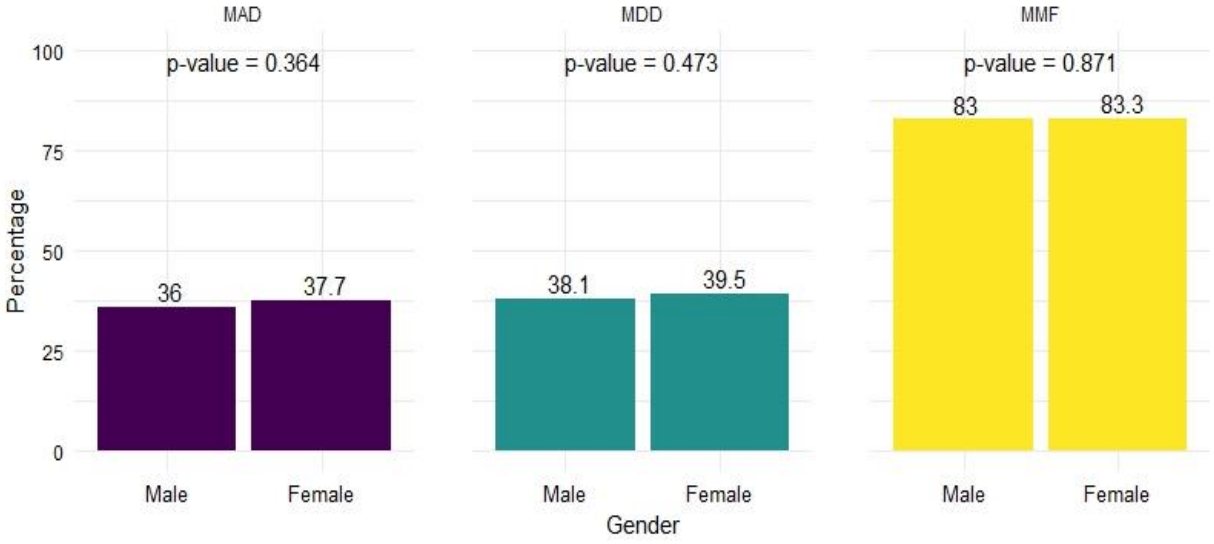

Table 4.2: Percentage distribution of MDD, MMF & MAD among the different categories of selected covariates along with p-value

Variable	MDD			MMF			MAD		
	Yes	**No**	**p-value**	**Yes**	**No**	**p-value**	**Yes**	**No**	**p-value**
Residence			<0.001			0.004			<0.001
Urban	45.5	54.5		86.2	13.8		43.3	56.7	
Rural	35.5	64.5		81.6	18.4		33.6	66.4	
Division			0.011			<0.001			0.008
Barishal	35.1	64.9		78.2	21.8		32.8	67.2	
Chittagong	38.5	61.5		77.5	22.5		35.4	64.6	
Dhaka	40.6	59.4		83.8	16.2		38.9	61.1	
Khulna	38.8	61.3		87.5	12.5		36.7	63.3	
Mymensingh	36.5	63.5		88.4	11.6		36.2	63.8	
Rajshahi	38.4	61.6		83.1	16.9		36.9	63.1	
Rangpur	48.9	51.1		87.3	12.7		46.8	53.2	
Sylhet	34.0	66.0		81.7	18.3		31.7	68.3	
Maternal Age (Years)			0.784			0.248			0.856
<20	37.6	62.4		82.4	17.6		35.9	64.1	
20-30	39.3	60.7		82.6	17.4		36.9	63.1	
>30	38.2	61.8		86.0	57.0		37.7	62.3	
Wealth Index			<0.001			0.001			<0.001
Poor	30.6	69.4		80.8	19.2		28.8	71.2	

Middle	36.2	63.8		80.9	19.1		33.4	66.6	
Rich	48.7	51.3		86.6	13.4		46.9	53.1	
Maternal Education Level			<0.001			<0.001			<0.001
No Education	20.7	79.3		76.6	23.4		18.6	81.4	
Primary	28.5	71.5		81.0	19.0		27.0	73.0	
Secondary	39.4	60.6		82.3	17.7		37.1	62.9	
Higher	58.1	41.9		90.6	9.4		56.3	43.7	
Exposed to Media			<0.001			<0.001			<0.001
No	29.2	70.8		79.2	20.8		26.9	73.1	
Yes	44.1	55.9		85.3	14.7		42.3	57.7	
Maternal Working status			0.528			0.013			0.381
Not working	38.3	61.7		81.7	18.3		36.2	63.8	
working	39.6	60.4		85.6	14.4		37.9	62.1	
Birth order			<0.001			0.016			<0.001
first child	44.4	55.6		85.0	15.0		42.0	58.0	
second child	37.2	62.8		82.8	17.2		35.7	64.3	
3rd or next childs	33.4	66.6		81.1	18.9		31.4	68.6	
Antenatal Care Visit			<0.001			<0.001			<0.001
<4	29.5	70.5		79.1	20.9		27.4	72.6	
>=4	49.1	50.9		87.6	12.4		47.3	52.7	
Place of Delivery			<0.001			0.001			<0.001
Institute	44.7	55.3		85.6	14.4		42.9	57.1	
Home	32.7	67.3		80.6	19.4		30.5	69.5	
Sex of Child			0.473			0.871			0.364
Male	38.1	61.9		83.0	17.0		36.0	64.0	
Female	39.5	60.5		83.3	16.7		37.7	62.3	

MDD vs Wealth Index:

It is clear from figure 4.4 that the prevalence of MDD within rich families is the highest which was 48.7% and within poor, the prevalence of MDD was the lowest was 30.6%. Since the p-value is <0.001, one may reject the null hypothesis. There is a significant association between MDD and wealth index

MDD vs Maternal Education level:

It is obvious from figure 4.5 that the highest prevalence of MDD belonging to the Higher education level was 58.1% and followed by secondary education was 39.4%. This prevalence sequentially decreased in primary and no education. As the p-value is <0.001, the null hypothesis should be rejected. So, maternal education level is an important factor to satisfy the MDD criterion.

MDD vs Exposed to Media:

From figure 4.6 we see that the prevalence of MDD among respondents who are not exposed to media was 29.2%, compared to 44.1% among those who are exposed to media. The null hypothesis should be rejected because the p-value is < 0.001. So to meet MDD requirements whether to be exposed to media has a significant effect.

MDD vs Maternal Working Status:

From figure 4.7 it is seen that with regard to the not working and working status of the mother, the prevalence of MDD was 38.3% and 39.6%, respectively. The p-value is .528, so the null hypothesis may not be rejected. Maternal working status has no significant effect on MDD.

MDD vs Birth order:

From figure 4.8, it is clearly seen that the prevalence of MDD among first children is the highest, 44.4%, and the lowest among 3rd or next children 33.4%. Since the p-value is <0.001 one may conclude that birth order has a significant association with MDD.

MDD vs Antenatal Care Visits:

From figure 4.9, it is seen that if the number of antenatal care visits is less than 4 times the prevalence of MDD was 29.4% and the prevalence was 49.1 when antenatal care visits occurred equal to or greater than 4 times during the pregnancy. As the p-value is

less than 0.001 one may reject the null hypothesis. There is a strong association between antenatal care visits and MDD.

MDD vs Place of Delivery:

From figure 4.10, it is found that the prevalence of MDD was 44.7% if the delivery occurred under any institute. in the case of home delivery, it was 32.7%. As the p-value is <0.001., so the place of delivery is highly associated to meet the MDD criterion.

MDD vs Sex of child:

From figure 4.11, it is clearly seen that the prevalence of MDD in males and females was 38.1% and 39.5% respectively. The p-value of the chi-square test is .473 which is less than 0.05. So one may not reject the null hypothesis. So the Sex of children has no significant effect on MDD.

Association between the MMF and Covariates

MMF vs Residence:

From figure 4.1, it is clear that the prevalence of MMF in urban was 86.2% whereas MMF prevalence in rural was 81.2. Since the p-value is 0.004, one may conclude that there exists a significant association between MMF and residence. So, residence plays an important role to fill the MMF criterion.

MMF vs Division:

From figure 4.2, it is seen that the highest prevalence of MMF among 8 districts was 88.4% which belongs to the Mymensingh district followed by Khulna l district which was 87.5%. On the contrary, the lowest prevalence of MDD was Chittagong district which was 77.5%. As the p-value is <0.001, one may conclude that there is a significant association between MMF and Division. That is division plays a significant role to fill up the MMF criterion.

MMF vs Maternal Age:

From figure 4.3, it is seen that the prevalence of MMF in maternal age less than 20 is 82.4 and age 20-30 is 82.6 followed by age greater than 30 is 86. As the p-value is .248 the null hypothesis should not be rejected. That is there is no significant relationship between MMF and maternal age.

MMF vs Wealth Index:

It is clear from figure 4.4 that the prevalence of MMF within rich families is the highest which was 86.6 and within poor, the prevalence of MDD is the lowest which was 80.8. Since the p-value is <0.001, one may reject the null hypothesis. There is a significant association between MMF and wealth index

MMF vs Maternal Education level:

From figure 4.5, it is obvious that the highest prevalence of MMF belonging to the Higher education level was 90.6% and followed by secondary education was 82.3%. This prevalence sequentially decreased in primary and no education. As the p-value is <0.001, the null hypothesis should be rejected. So, maternal education level is an important factor to satisfy the MMF criterion.

MMF vs Exposed to Media:

From figure 4.6, it is obvious that the prevalence of MDD among respondents who are not exposed to media was 79.2%, compared to 85.3% among those who are. The null hypothesis should be rejected because the p-value is < 0.001. So, to meet MMF requirements whether to be exposed to media has a significant effect.

MMF vs Maternal Working Status:

From figure 4.7, With regard to the not working and working status of the mother, the prevalence of MMF was 81.7% and 85.6%, respectively. The p-value is 0.013, so the null hypothesis may be rejected. Maternal working status has a significant effect on MMF.

MMF vs Birth order:

From figure 4.8, it is clearly seen that the prevalence of MMF among the first child is the highest,85.0%, and the lowest among 3rd or next children 81.1%. Since the p-value is 0.016 one may conclude that birth order has a significant association with MMF.

MMF vs Antenatal Care Visits:

Figure 4.9 shows that the prevalence of MMF was 79.1% when there are less than 4 antenatal care visits, and 87.6% when there are at least 4 antenatal care visits during the pregnancy. As the p-value is less than 0.001, the null hypothesis may be rejected. Visits to antenatal care facilities are significantly associated with MMF.

MMF vs Place of Delivery:

From figure 4.10. the prevalence of MMF was 85.6% if the delivery occurred under any institute. In the case of home delivery, it was 80.6%. As the p-value is <0.001., so the place of delivery is highly associated to meet the MMF criterion.

MMF vs Sex of child:

From figure 4.11. it is clearly seen that the prevalence of MMF in males and females is 83.0% and 83.3% respectively. The p-value of the chi-square test is 0.871 which was less than 0.05. So, one may not reject the null hypothesis. So, the Sex of children has no significant effect on MMF.

Association between the MAD and Covariates

MAD vs Residence:

From figure 4.1, it is evident that the prevalence of MDD was 43.3% in urban areas compared to 33.6% in rural areas. Given that the p-value is <0.001, so the null hypothesis should be rejected. Hence there is a significant association between residence and MAD. Therefore, the residence is significant to meeting the MDD requirement.

MAD vs Division:

From figure 4.2, it is seen that the highest prevalence of MAD among 8 districts was 46.8% which belongs to Rangpur district followed by Dhaka district which was 38.9%. On the contrary, the lowest prevalence of MAD was Sylhet district which was 31.7%. As the p-value is 0.008, one may conclude that there is a significant association between MAD and Division. That is division plays a significant role to fill up the MAD criterion.

MAD vs Maternal Age:

From figure 4.3, it is seen that the prevalence of MAD in maternal age less than 20 was 35.9% and age 20-30 was 36.9% followed by age greater than 30 was 37.7. As the p-value is 0.856 the null hypothesis should not be rejected. That is there is no significant relationship between MAD and maternal age.

MAD vs Wealth Index:

From figure 4.4, it is clear that the prevalence of MAD within rich families is the highest which was 46.9% and within poor, the prevalence of MAD was the lowest was 28.8%. Since the p-value is <0.001, one may reject the null hypothesis. There is a significant association between MAD and wealth index

MAD vs Maternal Education level:

From figure 4.5, it is obvious that the highest prevalence of MAD belonging to the Higher education level was 56.3% and followed by secondary education was 37.1%. This prevalence sequentially decreased in primary and no education. As the p-value is <0.001, the null hypothesis should be rejected. So, maternal education level is considered an important factor in satisfying the MAD criterion.

MAD vs Exposed to Media:

From figure 4.6, it was found that the prevalence of MAD among respondents who are not exposed to media is 26.9%, compared to 42.3% among those who are. The null hypothesis should be rejected because the p-value is < 0.001. So to meet MAD requirements whether to be exposed to media has a significant effect.

MAD vs Maternal Working Status:

From figure 4.7, with regard to the not working and working status of the mother, the prevalence of MAD was 36.2% and 37.9%, respectively. The p-value is .381, so the null hypothesis may not be rejected. Maternal working status has no significant effect on MAD.

MAD vs Birth order:

From figure 4.8, it is clearly seen that the prevalence of MAD among first children was the highest,42.0%, and the lowest among 3rd or next children 31.4%. Since the p-value is <0.001 one may conclude that birth order has a significant association with MAD.

MAD vs Antenatal Care Visits:

It can be observed from figure 4.9 that the prevalence of MAD was 27.4% if antenatal care visits occurred less than four times throughout the pregnancy and was 47.3 if visits occurred four times or more. As the p-value is less than 0.001, the null hypothesis may be rejected. Antenatal care appointments and MAD are strongly correlated.

MAD vs Place of Delivery:

From figure 4.10, the prevalence of MAD was 42.9% if the delivery occurred under any institute. In the case of home delivery, it was 30.5%. As the p-value is <0.001., so the place of delivery is highly associated to meet the MAD criterion.

MAD vs Sex of child:

From figure 4.11, it is clearly seen that the prevalence of MAD in males and females was 36.0% and 37.7% respectively. The p-value of the chi-square test is .473 which is less than 0.05. So, one may not reject the null hypothesis. So the Sex of children has no significant effect on MAD.

Chapter 5

Regression Analysis

In chapter 4, we found the unadjusted association between outcome variables and covariates. To find the adjusted association, we conducted logistic regression analysis as the response variables are binary. The results obtained from regression analysis for MDD, MMF and MAD are given in table 5.1, table 5.2 and table 5.3, respectively.

5.1. Logistic Regression Result: MDD

Table 5.1: Estimated regression co-efficient ($\widehat{\boldsymbol{\beta}}$), standard error (SE), p-value, odds ratio (OR) and 95% confidence interval (CI) of OR, obtained from logistic regression model for MDD.

Variable	$\widehat{\boldsymbol{\beta}}$	SE	p-value	OR	95% CI
Intercept	-1.925	0.286	<0.001	0.146	
Maternal Age (Years)					
<20	-0.128	0.133	0.337	0.880	(0.677,1.143)
20-30 (Ref)					
>30	0.057	0.138	0.679	1.059	(0.808,1.387)
Division					
Dhaka (Ref)					
Barishal	0.014	0.182	0.937	1.014	(0.710,1.449)
Chittagong	0.114	0.160	0.476	1.121	(0.819,1.533)
Khulna	-0.098	0.182	0.591	0.907	(0.634,1.296)
Mymensingh	0.115	0.176	0.512	1.122	(0.795,1.584)
Rajshahi	0.011	0.180	0.952	1.011	(0.710,1.439)
Rangpur	0.425	0.177	0.017	1.529	(1.080,2.164)
Sylhet	0.055	0.169	0.745	1.057	(0.758,1.473)
Residence					
Rural (Ref)					
Urban	0.155	0.102	0.128	1.168	(0.957,1.425)
Wealth Index					
Poor	0.004	0.132	0.974	1.004	(0.775,1.302)
Middle(Ref)					
Rich	0.252	0.133	0.058	1.287	(0.992.1.670)
Maternal Education Level					
No Education (Ref)					
Primary	0.354	0.228	0.121	1.425	(0.911,2.229)
Secondary	0.673	0.226	0.003	1.961	(1.259,3.054)
Higher	1.134	0.250	0.000	3.108	(1.903,5.077)
Exposed to Media					
Not exposed (Ref)					
Exposed	0.267	0.107	0.013	1.306	(1.059,1.611)
Maternal Working status					

Not working (Ref)					
working	0.235	0.097	0.015	1.264	(1.046,1.529)
Birth order					
First child	0.250	0.117	0.033	1.284	(1.020,1.616)
Second child (Ref)					
3rd or more childs	0.063	0.126	0.618	1.065	(0.832,1.363)
Antenatal Care Visit					
<4 (Ref)					
>=4	0.521	0.096	0.000	1.684	(1.395,2.032)
Place of Delivery					
Home (Ref)					
Institute	-0.009	0.100	0.928	0.991	(0.814,1.206)
Sex of Child					
Female (Ref)					
Male	-0.072	0.088	0.410	0.930	(0.783,1.105)

Maternal Age

We consider "20-30" as reference category. It has found that the odds ratio (OR) of satisfying MDD for mothers of age less than 20 against the reference category was 0.880, which means that mothers who aged less than 20 have (1-$\widehat{OR}$)*100%= 12% lower odds of having child being in MDD compared to the mothers aged between 20 and 30. Since p-value is 0.337, this association is not statistically significant at 5% level of significance.

The OR of satisfying MDD for mothers of age greater than 30 against the reference category was found 1.059, which means that mothers who aged greater than 30 have 5.9% higher odds of having child being in MDD compared to the mothers aged between 20 and 30.Since p-value is 0.679, this association is not statistically significant at 5% level of significance.

Division

We consider "Dhaka" as reference category. Children who live in Khulna had 9.3% lower odds of being in MDD compared to the children who live in Dhaka. Children who come from Barishal had 1.4%, children who are form Chittagong had 12.1%, children who live in Mymensingh had 12.2%, children who come from Rajshahi had 1.1%, children who live in Rangpur had 52.9% higher and children who come from Sylhet had 5.7% higher odds of being in MDD compared to the children who live in Dhaka. Barishal, Chittagong, Khulna, Mymensingh, Rajshahi, Sylhet is not significant at 5% level of significance. Rangpur is significant at 5% level of significance.

Residence

It has found that the odds ratio (OR) of satisfying MDD for children live in urban areas against the reference category was 1.168, which means that the odds of being in MDD for the urban resident children were 16.8% higher compared to the rural resident children. Keeping all other factors at a fixed level. We consider "Rural" as reference category. Since p-value is 0.128, this association is not statistically significant at 5% level of significance.

Wealth Index

We consider "Middle" as reference category. The odds ratio (OR) of satisfying MDD for children with low wealth index against the reference category was found 1.004, which means that the odds of being in MDD for the children belong to a family with wealth index poor was 0.4% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a fixed level. Since p-value is 0.974, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MDD for children with high wealth index against the reference category was found 1.287, which means that the odds of being in MDD for the children belong to a family with wealth index rich was 28.7% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a fixed level. Since p-value is 0.058, this association is not statistically significant at 5% level of significance.

Maternal Education Level

We consider "No Education" as reference category. It has found that the odds ratio (OR) of satisfying MDD for mothers having primary level education against the reference category was 1.425, which means that mothers who have primary level education were 42.5% higher odds of having child being in MDD compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is 0.121, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MDD for mothers having secondary level education against the reference category was found 1.961, which means that mothers who have secondary level education were 96.1% higher odds of having child being in MDD compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is 0.003, this association is statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MDD for mothers having higher level education against the reference category was found 3.108, which means that mothers who have higher level education were 210.8% higher odds of having child being in MDD compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is <0.001, this association is statistically significant at 5% level of significance.

Media Exposure

We consider "Not exposed" as reference category. The odds ratio (OR) of satisfying MDD for mothers having media exposure against the reference category was found 1.306, which means that mothers who have media exposure were about 30.6% higher odds of having child being in MDD compared to mothers who have no media exposure Keeping all other factors at a fixed level. Since p-value is 0.013, this association is statistically significant at 5% level of significance.

Maternal Working Status

We consider "Not working" as reference category. The odds ratio (OR) of satisfying MDD working mothers against the reference category was found 1.264, which means that working mothers had 26.4% higher odds of having child being in MDD compared to mothers who does not work . Keeping all other factors at a fixed level. Since p-value is 0.015, this association is statistically significant at 5% level of significance.

Birth order

For first born child, the odds ratio (OR) of satisfying MDD against the reference category was found 1.284, which means that the odds of being in MDD for first born child was 28.4% higher compared to the second born child. Keeping all other factors at a fixed level. We consider "second child" as reference category. Since p-value is 0.033, this association is statistically significant at 5% level of significance.

For third or more child, the odds ratio (OR) of satisfying MDD against the reference category was found 1.065, which means that the odds of being in MDD for third or more child was 6.5% higher compared to the second born child. Keeping all other factors at a fixed level. Since p-value is 0.618, this association is not statistically significant at 5% level of significance.

Antenatal Care Visit

We consider "<4" as reference category. The odds ratio (OR) of satisfying MDD for mothers who have number of ANC visits during pregnancy more than 4 or equal 4 times

against the reference category was found 1.684, number of ANC visits of mothers during pregnancy more than 4 visits or equal 4 visits were 68.4% higher odds of having child being in MDD compared to number of ANC visits of mothers during pregnancy less than 4 visits. Since p-value is <0.001, this association is statistically significant at 5% level of significance.

Place of Delivery

It has found that the odds ratio (OR) of satisfying MDD for mothers who give birth at institute against the reference category was 0.991, which means that mothers who give birth at institute had 0.9% lower odds of having child being in MDD compared to mothers who give birth at home. Keeping all other factors at a fixed level. We consider "Home" as reference category. Since p-value is 0.928, this association is not statistically significant at 5% level of significance.

Sex of Child

We consider "Female" as reference category. The odds ratio (OR) of satisfying MDD for male child against the reference category was found 0.930, which means that the odds of being in MDD for male child is 7% lower compared to the female child. Keeping all other factors at a fixed level. Since p-value is 0.410, this association is not statistically significant at 5% level of significance.

5.2 Logistic Regression Result: MMF

Table 5.2: Estimated Regression co-efficient ($\widehat{\beta}$), standard error (SE), p-value, odds ratio (OR) and 95% confidence interval (CI) of OR, obtained from logistic regression model for MMF.

Variable	$\widehat{\beta}$	SE	P-value	OR	95% CI
Intercept	0.497	0.313	0.113	1.643	
Maternal Age (Years)					
<20	-0.074	0.172	0.669	0.929	(0.663,1.302)
20-30 (Ref)					
>30	0.409	0.182	0.025	1.505	(1.054,2.149)
Division					
Dhaka (Ref)					
Barishal	-0.200	0.220	0.362	0.819	(0.532,1.259)
Chittagong	-0.250	0.196	0.202	0.779	(0.531,1.143)
Khulna	0.290	0.251	0.247	1.337	(0.818,2.186)
Mymensingh	0.558	0.243	0.022	1.747	(1.086,2.812)
Rajshahi	-0.003	0.230	0.989	0.997	(0.635,1.566)
Rangpur	0.274	0.244	0.261	1.315	(0.816,2.121)
Sylhet	0.122	0.211	0.564	1.129	(0.747,1.708)
Residence					

Rural (Ref)					
Urban	0.208	0.135	0.123	1.231	(0.945,1.603)
Wealth Index					
Poor	0.151	0.159	0.344	1.163	(0.851,1.590)
Middle (Ref)					
Rich	0.238	0.169	0.159	1.269	(0.911,1.768)
Maternal Education Level					
No Education (Ref)					
Primary	0.265	0.228	0.244	1.303	(0.834,2.036)
Secondary	0.286	0.229	0.212	1.331	(0.849,2.084)
Higher	0.805	0.289	0.005	2.236	(1.268,3.942)
Exposed to Media					
Not exposed (Ref)					
Exposed	0.181	0.129	0.162	1.198	(0.930,1.544)
Maternal Working status					
Not working (Ref)					
working	0.360	0.126	0.004	1.433	(1.121,1.833)
Birth order					
First child	0.170	0.156	0.274	1.186	(0.874,1.609)
Second child (Ref)					
3rd or next childs	-0.102	0.154	0.506	0.903	(0.668,1.220)
Antenatal Care Visit					
<4 (Ref)					
>=4	0.376	0.126	0.003	1.457	(1.138,1.865)
Place of Delivery					
Home (Ref)					
Institute	0.032	0.125	0.799	1.032	(0.808,1.320)
Sex of Child					
Female (Ref)					
Male	-0.012	0.111	0.913	0.988	(0.794,1.229)

Maternal Age

We consider "20-30" as reference category. It has found that the odds ratio (OR) of satisfying MMF for mothers of age less than 20 against the reference category was 0.929, which means that mothers who aged less than 20 have 7.1% lower odds of having child being in MMF compared to the mothers aged between 20 and 30. Since p-value is 0.669, this association is not statistically significant at 5% level of significance.

The OR of satisfying MMF for mothers of age greater than 30 against the reference category was found 1.505, which means that mothers who aged greater than 30 have 50.5% higher odds of having child being in MMF compared to the mothers aged between 20 and 30. Since p-value is 0.025, this association is statistically significant at 5% level of significance.

Division

We consider “Dhaka” as reference category. Children who live in Barishal had 18.1%, children who are form Chittagong had 22.1% and children who live in Rajshahi had 0.3% lower odds of being in MMF compared to the children who live in Dhaka. Children who are form khulna had 33.7%, children who live in Mymensingh had 74.7%, children who come from Rangpur had 31.5% and children who come from Sylhet had 12.9% higher odds of being in MMF compared to the children who live in Dhaka. Barishal, Chittagong, Khulna, Rangpur, Rajshahi, Sylhet is not significant at 5% level of significance. Mymensingh is significant at 5% level of significance.

Residence

It has found that the odds ratio (OR) of satisfying MMF for children live in urban areas against the reference category was 1.231, which means that the odds of being in MMF for the urban resident children were 23.1% higher compared to the rural resident children. Keeping all other factors at a fixed level. We consider “Rural” as reference category. Since p-value is 0.123, this association is not statistically significant at 5% level of significance.

Wealth Index

We consider “Middle” as reference category. The odds ratio (OR) of satisfying MMF for children with low wealth index against the reference category was found 1.163, which means that the odds of being in MMF for the children belong to a family with wealth index poor was 16.3% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a fixed level. Since p-value is 0.344, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MMF for children with high wealth index against the reference category was found 1.269, which means that the odds of being in MMF for the children belong to a family with wealth index rich was 26.9% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a fixed level. Since p-value is 0.159, this association is not statistically significant at 5% level of significance.

Maternal Education Level

It has found that the odds ratio (OR) of satisfying MMF for mothers having primary level education against the reference category was 1.303, which means that mothers who have primary level education were 30.3% higher odds of having child being in MMF compared to mothers who have no education. Keeping all other factors at a fixed

level. We consider “No Education” as reference category. Since p-value is 0.244, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MMF for mothers having secondary level education against the reference category was found 1.331, which means that mothers who have secondary level education were 33.1% higher odds of having child being in MMF compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is 0.212, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MMF for mothers having higher level education against the reference category was found 2.236, which means that mothers who have higher level education were 123.6% higher odds of having child being in MMF compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is 0.005, this association is statistically significant at 5% level of significance.

Media Exposure

We consider “Not exposed” as reference category. The odds ratio (OR) of satisfying MMF for mothers having media exposure against the reference category was found 1.198, which means that mothers who have media exposure were about 19.8% higher odds of having child being in MMF compared to mothers who have no media exposure keeping all other factors at a fixed level. Since p-value is 0.162, this association is not statistically significant at 5% level of significance.

Maternal Working Status

We consider “Not working” as reference category. The odds ratio (OR) of satisfying MMF working mothers against the reference category was found 1.433, which means that working mothers had 43.3% higher odds of having child being in MMF compared to mothers who does not work. Keeping all other factors at a fixed level. Since p-value is 0.004, this association is statistically significant at 5% level of significance.

Birth order

For first born child, the odds ratio (OR) of satisfying MMF against the reference category was found 1.186, which means that the odds of being in MMF for first born child was 18.6% higher compared to the second born child. Keeping all other factors at a fixed level. Here we consider “second child” as reference category. Since p-value is 0.274, this association is not statistically significant at 5% level of significance.

For third or more child, the odds ratio (OR) of satisfying MMF against the reference category was found 0.903, which means that the odds of being in MMF for third or more child was 9.7% lower compared to the second born child. Keeping all other factors at a fixed level. Since p-value is 0.506, this association is not statistically significant at 5% level of significance.

Antenatal Care Visit

We consider "<4" as reference category. The odds ratio (OR) of satisfying MMF for mothers who have number of ANC visits during pregnancy more than 4 or equal 4 times against the reference category was found 1.457, number of ANC visits of mothers during pregnancy more than 4 visits or equal 4 visits were 45.7% higher odds of having child being in MMF compared to number of ANC visits of mothers during pregnancy less than 4 visits. Since p-value is 0.003, this association is statistically significant at 5% level of significance.

Place of Delivery

It has found that the odds ratio (OR) of satisfying MMF for mothers who give birth at institute against the reference category was 1.032, which means that mothers who give birth at institute had 13.2% higher odds of having child being in MMF compared to mothers who give birth at home. Keeping all other factors at a fixed level. We consider "Home" as reference category. Since p-value is 0.799, this association is not statistically significant at 5% level of significance.

Sex of Child

We consider "Female" as reference category. The odds ratio (OR) of satisfying MAD for male child against the reference category was found 0.988, which means that the odds of being in MMF for male child was 1.2% lower compared to the female child. Keeping all other factors at a fixed level. Since p-value is 0.913, this association is not statistically significant at 5% level of significance.

5.3 Logistic Regression Result: MAD

Table 5.3: Estimated Regression co-efficient ($\widehat{\boldsymbol{\beta}}$), standard error (SE), p-value, odds ratio (OR) and 95% confidence interval (CI) of OR, obtained from logistic regression model for MAD

Variable	$\widehat{\boldsymbol{\beta}}$	SE	P-value	OR	95% CI
Intercept	-2.115	0.294	<0.001	0.121	
Maternal Age (Years)					
<20	-0.080	0.135	0.552	0.923	(0.709,1.202)
20-30 (Ref)					

>30	0.162	0.139	0.246	1.175	(0.895,10545)
Division					
Dhaka (Ref)					
Barishal	-0.004	0.185	0.983	0.996	(0.694,1.430)
Chittagong	0.060	0.162	0.709	1.062	(0.773,1.459)
Khulna	-0.121	0.184	0.510	0.886	(0.617,1.271)
Mymensingh	0.185	0.177	0.296	1.203	(0.850,1.703)
Rajshahi	0.011	0.182	0.952	1.011	(0.708.1.444)
Rangpur	0.409	0.179	0.022	1.505	(1.060,2.135)
Sylhet	0.028	0.172	0.869	1.029	(0.735,1.440)
Residence					
Rural (Ref)					
Urban	0.126	0.103	0.221	1.134	(0.927,1.387)
Wealth Index					
Poor	0.055	0.135	0.686	1.056	(0.811,1.376)
Middle (Ref)					
Rich	0.308	0.135	0.023	1.360	(1.044,1.772)
Maternal Education Level					
No Education (Ref)					
Primary	0.411	0.237	0.082	1.509	(0.949,2.399)
Secondary	0.707	0.235	0.003	2.028	(1.281,3.211)
Higher	1.182	0.258	<0.001	3.262	(1.968,5.407)
Exposed to Media					
Not exposed (Ref)					
Exposed	0.296	0.109	0.007	1.345	(1.086,1.665)
Maternal Working status					
Not working (Ref)					
working	0.253	0.098	0.010	1.288	(1.063,1.562)
Birth order					
first child	0.203	0.119	0.087	1.225	(0.971,1.545)
second child (Ref)					
3rd or more childs	0.009	0.128	0.941	1.010	(0.786,1.297)
Antenatal Care Visit					
<4 (Ref)					
>=4	0.540	0.097	<0.001	1.717	(1.419,2.077)
Place of Delivery					
Home (Ref)					
Institute	0.015	0.101	0.880	1.015	(0.832,1.239)
Sex of Child					
Female (Ref)					
Male	-0.092	0.089	0.301	0.912	(0.767,1.086)

Maternal Age

We consider "20-30" as reference category. It has found that the odds ratio (OR) of satisfying MAD for mothers of age less than 20 against the reference category was 0.923 which implies that mothers who aged less than 20 had 7.7% lower odds of having child being in MAD compared to the mothers aged between 20 and 30. Since p-value is 0.552, this association is not statistically significant at 5% level of significance.

The OR of satisfying MAD for mothers of age greater than 30 against the reference category was found 1.175, which means that mothers who aged greater than 30 had 17.5% higher odds of having child being in MAD compared to the mothers aged between 20 and 30. Since p-value is 0.246, this association is not statistically significant at 5% level of significance.

Division

We consider "Dhaka" as reference category. Children who live in Barishal had 4% and children who live in Khulna had 11.4% lower odds of being in MAD compared to the children who live in Dhaka. Children who are form Chittagong had 6.2%, children who live in Mymensingh had 20.3%, children who come from Rajshahi had 1.1%, children who live in Rangpur had 50.6% higher and children who come from Sylhet had 2.9% higher odds of being in MAD compared to the children who live in Dhaka. Barishal, Chittagong, Khulna, Mymensingh, Rajshahi, Sylhet is not significant at 5% level of significance. Rangpur is significant at 5% level of significance.

Residence

It has found that the odds ratio (OR) of satisfying MAD for children live in urban areas against the reference category was 1.134, which means that the odds of being in MAD for the urban resident children were 13.4% higher compared to the rural resident children. Keeping all other factors at a fixed level. Here we consider "Rural" as reference category. Since p-value is 0.221, this association is not statistically significant at 5% level of significance.

Wealth Index

We consider "Middle" as reference category. The odds ratio (OR) of satisfying MAD for children with low wealth index against the reference category was found 1.056, which implies that the odds of being in MAD for the children belong to a family with wealth index poor was 5.6% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a fixed level. Since p-value is 0.686, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MAD for children with high wealth index against the reference category was found 1.360, which means that the odds of being in MAD for the children belong to a family with wealth index rich was 36% higher compared to the children belong to a family with wealth index middle. Keeping all other factors at a

fixed level. Since p-value is 0.023, this association is statistically significant at 5% level of significance.

Maternal Education Level

It has found that the odds ratio (OR) of satisfying MAD for mothers having primary level education against the reference category was 1.509, which means that mothers who have primary level education were 50.9% higher odds of having child being in MAD compared to mothers who have no education. Keeping all other factors at a fixed level. We consider "No Education" as reference category. Since p-value is 0.082, this association is not statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MAD for mothers having secondary level education against the reference category was found 2.028, which means that mothers who have secondary level education were 102.8% higher odds of having child being in MAD compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is 0.003, this association is statistically significant at 5% level of significance.

The odds ratio (OR) of satisfying MAD for mothers having higher level education against the reference category was 3.262, which means that mothers who have higher level education were 226.2% higher odds of having child being in MAD compared to mothers who have no education. Keeping all other factors at a fixed level. Since p-value is <0.001, this association is statistically significant at 5% level of significance.

Media Exposure

We consider "Not exposed" as reference category. The odds ratio (OR) of satisfying MAD for mothers having media exposure against the reference category was found 1.345, which means that mothers who have media exposure were about 34.5% higher odds of having child being in MAD compared to mothers who have no media exposure keeping all other factors at a fixed level. Since p-value is 0.007, this association is statistically significant at 5% level of significance.

Maternal Working Status

We consider "Not working" as reference category. The odds ratio (OR) of satisfying MAD working mothers against the reference category was found 1.288, which means that working mothers had 28.8% higher odds of having child being in MAD compared to mothers who does not work. Keeping all other factors at a fixed level. Since p-value is 0.010, this association is statistically significant at 5% level of significance.

Birth order

For first born child, the odds ratio (OR) of satisfying MAD against the reference category was found 1.225, which means that the odds of being in MAD for first born child was 22.5% higher compared to the second born child. Keeping all other factors at a fixed level. Here we consider "second child" as reference category. Since p-value is 0.087, this association is not statistically significant at 5% level of significance.

For third or more child, the odds ratio (OR) of satisfying MAD against the reference category was found 1.010, which means that the odds of being in MAD for third or more child was 1% higher compared to the second born child. Keeping all other factors at a fixed level. Since p-value is 0.941, this association is not statistically significant at 5% level of significance.

Antenatal Care Visit

We consider "<4" as reference category. The odds ratio (OR) of satisfying MAD for mothers who have number of ANC visits during pregnancy more than 4 or equal 4 times against the reference category was found 1.717, which implies that number of ANC visits of mothers during pregnancy more than 4 visits or equal 4 visits were 71.7% higher odds of having child being in MAD compared to number of ANC visits of mothers during pregnancy less than 4 visits. Since p-value is <0.001, this association is statistically significant at 5% level of significance.

Place of Delivery

It has found that the odds ratio (OR) of satisfying MAD for mothers who give birth at institute against the reference category was found 1.015, which means that mothers who give birth at institute had 1.5% higher odds of having child being in MAD compared to mothers who give birth at home. Keeping all other factors at a fixed level. We consider "Home" as reference category. Since p-value is 0.880, this association is not statistically significant at 5% level of significance.

Sex of Child

We consider "Female" as reference category. The odds ratio (OR) of satisfying MAD for male child against the reference category was found 0.912, which means that the odds of being in MAD for male child was 8.8% lower compared to the female child. Keeping all other factors at a fixed level. Since p-value is 0.301, this association is not statistically significant at 5% level of significance.

Chapter 6

Conclusion

In this project, an attempt has been made to find out socio-economic and demographic factors associated with taking complementary foods among children of age 6-23 months in Bangladesh. This phenomena was explained with three well known indicators Minimum Dietary Diversity (MDD) and Minimum Meal Frequency (MMF) and Minimum Acceptable Diet (MAD). For the purpose of analysis, data were extracted from the nationally representative Bangladesh Demographic and Health Survey (BDHS, 2017-18). In this project univariate, bivariate and regression analysis were conducted.

It is observed from the bivariate analysis that nine covariates other than Maternal Age and Sex of child have significant impact on MDD, MMF and MAD. It can be concluded that maternal working status has significant association with MMF but it has insignificant impact on MDD and MAD.

As adjusted association cannot be determined from bivariate analysis, regression analysis is necessary to find out the significant factors associated with the complementary feeding practice.

According to the findings of the study, mothers of age greater than 30 are more likely to have child being in MMF. Divisionally available data provide a notable result. Children who are form Rangpur are more likely being in MDD and MAD compared to the Dhaka resident children. And those who are from Mymensingh are more likely to satisfy MMF compared to the children from Dhaka. Children from the rich wealth quintiles are more likely to being in MDD and MAD compared to the children belong to a family with wealth index middle. Maternal education has been identified as a crucial factor that may affect the complementary feeding practice. Mothers having higher level education are 2.236 times as likely as to have child satisfying MMF and having secondary and higher level education are about 2 times and 3 times as likely as to have child satisfying MDD, mothers with primary, secondary and higher level education are 1.509, 2.028 and 3.262 times as likely as to have child being in MAD compared to the mothers with no education. Mothers who are exposed to media and currently working are more likely having child satisfying MDD and MAD. Working

mothers are more likely to have child being in MMF compared to the mothers who are not working. It has been found that first born child are more likely to satisfy MDD and MAD compared to the 2nd born child. Mothers having four or more than four times antenatal care visits are more likely to have child being in MDD and MAD. No obvious gender differences were found while examining complementary feeding practices across child characteristics.

Recommendations

On the basis of the findings of this project, some recommendations are suggested to the policymakers to increase IYCF practices among the children of age 6-23 months in Bangladesh. These specific recommendations are given below:

- Necessary steps should be taken so that women get easily access to different sources of media. Since mothers who follow media are more conscious of their child's feeding practice, a strong media campaign is required to increase complementary feeding practice.
- Maternal education plays a vital role in increasing IYCF practice. The required actions must be undertaken to promote female education in Bangladesh.
- Maternal employment status has a positive impact on child's feeding practice. Also, children from rich family are more likely to follow MDD, MMF and MAD since they have more purchasing power than poor or middle-class family. Working mothers can support the family financially, with the increase in income, children's diets become more diversified. Additional attention must be ensured to promote women empowerment.
- Necessary efforts must be taken to encourage women to receive four or more antenatal care visits during their pregnancy. Maternal health intervention should be promoted to improve maternal health since mothers having four or more antenatal care visits during their pregnancy have a greater chance of having child being in MDD, MMF, MAD.
- Children of younger mothers (aged <20 years) have reported lower achievement in MMF. As younger mothers may need additional support in achieving optimal feeding practices, they need to be given priority by policymakers to ensure appropriate complementary feeding practice.

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