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Association between Maternal Health Status and Birth Weight of Children among Young Mothers of India using Missing Case Analysis

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Abstract

In large-scale sample surveys conducted in developing countries like India, non-response bias is a common problem. The present paper deals with missing cases in the National Family Health Survey, Round III due to non-response in the birth weight data where more than 59 per cent of the cases are missing. The study attempts to impute the missing cases by means of single imputation techniques. Once the dataset is complete by method of imputation, it examines the relationship between the probable birth weight of a child, and the health status and health-seeking behaviour of the mother by means of multinomial logit regression. It also aims to assess the various factors related to birth weight of a child, i.e., maternal lifestyle and health status indicators on one hand, and utilisation of healthcare services and health-seeking behaviour on the other. These are believed to have profound influence on the health of a new-born baby.

Key words: National Family Health Survey, birth weight, missing cases, imputation, maternal health status.

I. Introduction

Most of the data for social science research and national planning comes from large-scale sample surveys in developing countries, either at the household or individual level. These include different domains of the society, economy, demography and politics. Researches in public health are mostly based on large-scale demographic surveys in India. The information in them is collected through survey instruments like questionnaires or interview schedules, mostly by probability sampling techniques. The data collection process is often subject to various forms of error and bias. One such common bias in health data is the problem of non-response. However, this problem is attributed to non-sampling error. The present paper deals with non-response bias in birth weight data in the National Family Health Survey, Round III, 2005-06. The dataset of NFHS-III has around 59.5 per cent of birth weight cases missing due to non-response.

Missing data is a universal problem in public health studies. Dealing with missing cases is a common problem in statistics. Missing data arise in datasets due to several reasons. In socio-economic and demographic sample surveys, people often do not want to disclose their personal information due to fear or prejudice. This is especially true in case of females. Sometimes, collection of data on the part of the surveyor becomes difficult due to cost and time considerations, and the decision might be taken not to collect information for all individuals. In many cases, missing data results from non-responses or intentionally not being reported.

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There are various mechanisms to deal with missing cases in a dataset. Before dealing with such cases, one must know the nature and pattern of missingness in data. Rubin (1976) and colleagues (Little & Rubin, 2002) came up with a classification system that is in use today: missing completely at random (MCAR), missing at random (MAR), and missing not at random (MNAR). These methods describe why the data might be missing and their relationship with measured variables in the dataset. After establishing the assumptions behind the nature of missing data, one can proceed to deal with them with the right technique. The technique of handling missing data depends on these strict assumptions about the pattern of missingness to give unbiased estimators (Baraldi & Enders, 2010). Traditional ways to deal with missing cases include deletion technique, also known as the complete case analysis, which ignores the missing cases and analyses the data based on the available cases. However, this approach is helpful only when the amount of missing data is small and missing completely at random (Peugh & Enders, 2004).

In datasets, specifically in large socio-economic or demographic sample surveys, there are many instances where the amount of missing cases cannot be ignored and they have a distinct socio-economic pattern. They tend to form a pattern, either due to the sensitivity of the questions asked or deliberate attempt by the respondent to avoid answering. For example, in the present case of birth weight data in NFHS-III, the reason for non-response is either mothers do not know the weight of their babies or do not measure at the time of birth. The problem with birth weight data in India is due to the lack of proper measurement facilities in health institutions and lack of awareness of the family members. Not only low birth weight is a problem, but also the timely measurement is not done and knowledge of the health of the new born is often lacking. Public hospitals often do not have proper infrastructure to measure the child at birth or there may be a lack of health personnel who could do it at the time of birth. Family members and mothers are often not aware of the proper health care of the baby. Owing to all these reasons, the birth weight data in large sample surveys like the NFHS often remains incomplete. In such a situation, one cannot get a true picture of the health of the new born or low birth weight problems. Therefore, it can be said that they are missing at random (MAR) and can be efficiently dealt with by another traditional single imputation method known as regression imputation. The advantages of this method will be discussed in the methodology section.

The present study attempts to fill in the incomplete dataset of birth weight in NFHS-III by the single imputation method using regression and then examine the association between maternal health status and health-seeking behaviour and birth weight of children. The analysis is restricted to only young mothers, aged 15-29 years, since birth weight poses to be a problem mostly for them. Also, the study not only focuses on low birth weight problems, but also on high birth weight associating it with maternal health status. Through literature review, it was found that not much work has been done on birth weight in general as well as on low birth weights. It is especially true in the case of India.

Birth weight is not only an important indicator of health status of the new born, but also that of the mother. It is a reflection of many factors. Low birth weight is considered a most hazardous factor for child health, and it not only affects the child health, but also the adult health status in the future. In developed countries, like developing countries, low birth weight is a problem. It often results from pre-term births, that is, births which take place before the full term of pregnancy. But in developing and less developed countries, besides birth being preterm, birth weight is usually small for gestational age (SGA). This is an outcome of a number of related factors which carry a generational effect. It starts from the health status of the mother. An underweight and malnourished mother is likely to give birth to a low birth weight baby, which results from a host of biological factors. This phenomenon is known as Intra-uterine-growth retardation or Intra-uterine malnutrition (IUGR). Therefore, to understand the outcome of birth weight, one needs to have an understanding of the motherôs health status and health seeking behaviour, along with the other socio-economic correlates.

II. Rationale of the study

There are many studies on birth weight using NFHS Data, specifically on high birth weight babies relating to maternal health status and healthcare utilisation. But there have been few attempts to deal with the missing data cases. There are significant numbers of missing cases in birth weight data due to lack of response or no knowledge, or not weighting at birth or errors in data entry. Analyses done by eliminating or ignoring these missing cases make the results of a study biased and lead to erroneous conclusions. To overcome this problem, this paper attempts to bring back the missing cases by regression methods based on the available data and then examines the relationship between maternal health and healthcare utilisation and birth weight of babies. This is hoped to provide better results. The importance of birth weight lies in indicating the maternal health condition. The weight of a child at birth reflects features of a motherôs health such as her nutritional status, anaemia level, internal problems of the reproductive organs and so on. Utilisation of ANC services will work only when a mother has the minimum required physical capacities of carrying a child. This paper aims to assess the various factors related to birth weight of a child, i.e., maternal lifestyle and health status indicators on the one hand and utilisation of healthcare services and health-seeking behaviour on the other. These are believed to have profound influence on the health status of a new-born baby. Hence, the studyôs objectives are: (1) To observe what difference the missing values make on the interpretation of birth weight in relation to various covariates after imputation using the available information; and, (2) To examine the relationship between maternal health status and healthcare utilisation and birth weight of a child.

III. Data Source and Methodology

The present study uses data from the National Family Health Survey-III conducted in 2005-06. This was a national survey with a random sample of 1,24,385 women aged 15-49 years and 74,369 men aged 15-54 years. In addition to information on birth history, survival status of children and age at death, this survey also collected information on parental education, employment status, household characteristics, consumer assets, etc. The unique characteristic of this survey in comparison with its predecessor NFHS-I (1992-93) is its focus on variables measuring womenôs empowerment, particularly womenôs role in household decision- making, their control over resources and experience of domestic violence. The current paper focuses on birth weight of children and their relationship to various socio-economic and demographic indicators as well as motherôs health status and healthcare-seeking behaviour.

Methods

The statistical tools and techniques used in the present study range from simple frequency distributions and crosstabs to regression analysis using multivariate models. For the first objective, i.e. for missing data imputation, simple regression analysis was used. The missing values are replaced by the predicted values of the response variable. For comparing the results before and after imputation procedure, the command for simple linear regression using a set of covariates has been used. The covariates used are place of residence (rural/urban), education level of mothers (not educated, up to primary level and above it), caste (others, Scheduled Castes/Tribes), wealth index (poorest, poor, middle, richer, richest), religion (Hindu/others), region of residence (North, West, Central, East, South and North-east), birth order of new-born (first, second and higher), birth interval (up to two years, more than two years), sex of child (male/female) and Body Mass Index or BMI of mothers (underweight, normal and overweight).

The mathematical expression of the multiple linear regression model used is given below:

Let $z_1, z_2, ..., z_r$ be a set of r predictors believed to be related to a response variable Y.

The linear regression model for the jth sample unit has the form
$Y_j = \beta_0 + \beta_1 z_{j1} + \beta_2 z_{j2} + ... + \beta_r z_{jr} + j$,

where j is a random error and the ϐi, i = 0, 1, ..., r are unknown (and fixed) regression coefficients. ϐ0 is the intercept and sometimes written as ϐ0zj0, where zj0 = 1 for all j.

Regression imputation has the opposite problem of mean imputation. A regression model is estimated to predict observed values of a variable based on other variables, and that model is then used to impute values in cases where that variable is missing. In other words, available information for complete and incomplete cases is used to predict whether a value of a specific variable is missing or not. Fitted values from the regression model are then used to impute the missing values. The problem is that the imputed data do not have an error term included in their estimation, thus the estimates fit perfectly along the regression line without any residual variance. This causes relationships to be over identified and suggest greater precision in the imputed values than is warranted. The regression model predicts the most likely value of missing data but does not supply uncertainty about that value.

For the second objective, that is, analysing the relationship between maternal health status and healthcare-seeking behaviour and birth weight of a child, the data on the most recent births (i.e., births in the last one year preceding the date of survey) have been used. Birth weight data have been categorised into three groups - low, normal and high. The categories are in ordinal scale, therefore, it is desirable to use the ordered logit model for analysis. However, after performing the Brant test to test the validity of the assumption of ordered logit model, it was found that the assumption of parallel regression lines or proportional odds assumption was being violated. Therefore, as an alternative, multinomial logit model has been used which does not hold the property of parallel lines.

Multinomial logit models are used for nominal scale data having three or more categories which are not in any intrinsic order. They estimate a series of binary logit models. One group is chosen as the reference group and other the comparison group. If there are k numbers of categories of the outcome variable, it estimates equations for k-1 number of groups. The following multinomial logistic regression model has been used in this study:

$Z_1 = \text{Log}(P_1/P_3) = a_1 + \times\, _{1j} * X_j$

$Z_2 = \text{Log}(P_2/P_3) = a_2 + \times\, b_{2j} * X_j$

and $P_{1+}\ P_{2+}\ P_3 = 1$

where$a_{i.i\,=}$ 1,2: constants

b_{ij}: i=1,2,é é ..n, j=1,2é é ..n :multinomial regression coefficient.

P1: Estimated probability of low birth weight.

P2: Estimated probability of normal birth weight.

P3: Estimated probability of high birth weight.

Through this model the predicted probabilities can also be derived which are usually easier to understand than the coefficients or the odd ratios. For getting the predicted probabilities, the prvalue command is used in STATA. This can be used with either a categorical variable or a continuous one and shows the predicted probabilities for each of the values of the variable specified. Here, it can be seen how the probabilities of the membership to each category of birth weight change as a particular independent variable is different and the other independent variables are held at their means.

IV. Results

For the first objective, i.e., imputation of missing values for the birth weight variable was done using the simple linear regression method of imputation. The results of the analysis were compared before and after imputing the missing values of the weight of the child at birth. Comparing with the results in Table 1, it was found that the value of the coefficient of determination, R^2 changes from 0.0213 before imputation to 0.0456 after imputation.

Coming to the covariates used for analysis of birth weight as a dependent variable, it was observed that there was a change in the significance level (p value) of several socio-economic and cultural indicators. The variables like wealth quintile, specifically the categories of poorer, middle and richer, education level (primary) and caste (SC/ST), and the northern and eastern region of India became significant determinants after imputation. This implies that any analysis done with the birth weight variable, ignoring the missing values, would yield biased results. It would render more emphasis on the religion, sex of child and BMI of mothers as the significant determinants. However, after imputation, the pattern of significance changes and socio-economic and cultural determinants gain importance.

Table 1: Results of multivariate linear regression before and after imputation of missing cases of birth weight

Independent Variables	Before imputation Coefficient value	After imputation Coefficient value	p value
Place of residence			
Rural®			
Urban	-32.070	-16.882	0.142
Education level			
No education®			
Primary	-23.755	-36.234***	0.000
Above primary	-46.554	-27.123	0.191
Caste type			
Others®			
SC/ST	78.579	44.321***	0.000
Wealth Index			
Poorest®			
Poorer	69.811	30.742*	0.028
Middle	3.378	-29.727*	0.032
Richer	-19.701	-57.178***	0.000
Richest	42.590	-9.951	0.615
Religion			
Hindu®			
Others	77.591***	64.808***	0.000
Region of residence in India			
Central®			
North	-69.475	-109.850***	0.000
West	7.514	-19.863	0.197
East	-8.898	-57.308***	0.000
South	85.502*	69.952***	0.000
North-east	236.50***	217.793***	0.000
Birth order			
One			
Two and above	5.463	4.487	0.645
Birth interval			
Upto 2 years®			
More than 2 years	-3.681	-10.795	0.336
Sex of child			
Male®			
Female	-95.678	-95.705***	0.000
BMI of mother			
Normal®			
Underweight	-80.129	-76.584***	0.000
Overweight	67.108*	62.730**	0.005
Constant	2843.306	2887.089	0.000

Note: * pÒ0.005, ** p Ò0.01, *** p Ò0.001.

Table 2: Percentage distribution of different categories of birth weight across socio-economic, demographic, maternal health status and healthcare indicators

Independent variables	Low	Normal	High
Place of Residence			
Rural	30.4	67.0	2.6
Urban	35.2	60.1	4.6
Religion			
Hindu	32.1	65.0	2.9
Others	29.4	67.0	3.7
Wealth Index			
Poorest	28.8	69.6	1.6
Poorer	30.6	66.6	2.8
Middle	29.9	66.9	3.2
Richer	35.1	61.4	3.5
Richest	35.7	58.6	5.7
Caste type			
Others	31.8	64.9	3.3
SC/ST	30.9	66.6	2.6
Education level			
No education	28.9	69.4	1.7
Primary	33.7	62.3	4.0
Above primary	31.4	63.8	4.9
Sex of Child			
Male	30.2	66.0	3.8
Female	33.0	64.7	2.3
BMI of Mother			
Underweight	32.9	64.9	2.2
Normal	31.1	65.7	3.2
Overweight	29.4	61.8	8.8
Region of residence in India			
North	37.3	60.4	2.3
West	37.4	58.5	4.2
Central	26.9	71.7	1.4
East	34.6	62.5	2.9
South	32.0	62.9	5.1
North-east	21.5	72.1	6.4
Birth order			
One	32.5	64.4	3.1
Two and above	29.7	67.3	3.0
Birth Interval			
Upto 2 years	30.7	66.4	2.9
More than 2 years	27.8	69.5	2.6
Full ANC			
No	30.7	66.4	2.9
Yes	27.8	69.5	2.6
Tobacco consumption in any form			
No	31.6	65.3	3.1
Yes	30.7	66.9	2.3
Presence of any disease			
No	31.5	65.4	3.1
Yes	37.0	60.4	2.6
Guidance on healthcare during pregnancy			
No	31.3	65.9	2.8
Yes	34.1	61.4	4.6
Complications during pregnancy			
No	28.6	68.3	3.1
Yes	33.9	63.1	3.0

For the second objective, i.e. analysing the relationship between birth weight of a child and maternal health status and utilization of healthcare services, the variable of birth weight after imputation has been divided into three categories and multinomial logit model has been used to analyse it.

The multinomial logit model had generated two separate models for the three categories, viz., low, normal and high birth weight of the outcome variable of birth weight of a child. The first one compares the association of low versus normal birth weight with the different socio-economic, cultural, demographic and health status and healthcare indicators, whereas the second model compares that of high birth weight relative to normal one. Thus, the normal birth weight category is the referent group in this case. The two models and their results are discussed separately below.

First Model: Low versus normal birth weight

The probability of incidence of low versus normal birth weight varied across the different covariates and yielded interesting results. The Odds Ratio (OR) gives the value for a one-unit increase in the value of the covariates, or in other words, a switching of the category of each of the covariates, for resulting in low birth weight rather than normal, given that the other variables in the model are held constant. Table 4 shows the variables that significantly affect birth weight outcome of a baby. These are place of residence, sex of the child, BMI of mothers especially underweight mothers, region of residence which acts as a cultural indicator, birth interval and complications during pregnancy.

Socio-economic, cultural and demographic indicators

In the case of place of residence, it was seen that if it changes from rural to urban, the chance of having low birth weight increases compared with normal birth weight by about 22 per cent. Coming to the cultural categories based on the region of residence in India, it is seen that the chance of having a low birth weight baby (LBW) relative to a normal one is highest among the West (55 per cent) and North (35 per cent) Indian mothers compared with the mothers of Central India, followed by South (31per cent), and Eastern region (26per cent) mothers. The chance of having a LBW baby in North-eastern mothers is about 37 per cent less compared with mothers of Central India.

However, there is not much variation seen across the different demographic indicators. In the case of birth order of 2, there is a negligible chance of having a low birth weight baby relative to a normal one compared with the mothers who have only one child. In the case of birth interval, there is a 13 per cent less chance of having a low birth weight baby among mothers who had a birth interval of more than 24 months, compared with those who had it for less than 24 months. Sex of child has an immense impact on the birth weight, with females being more likely to be LBW compared with male babies.

Maternal Health Status Indicators

The health status indicators chosen for the analysis are Body Mass Index of mothers, tobacco consumption in any form (a lifestyle parameter), presence of any disease like diabetes, asthma or goiter/thyroid and complications during pregnancy. However, only BMI and complications during pregnancy were found to be significant. It is seen that there is much difference among underweight and overweight mothers in the probability of having a low birth weight baby compared with a normal one. In underweight mothers, the chance of a LBW baby is more by 22 per cent, whereas in the case of overweight mothers, it is less by about 12 per cent. Among mothers suffering from complications during pregnancy, the chance of having a low birth weight baby was more by about 28 per cent compared with mothers having no pregnancy complications.

Maternal Healthcare Utilisation

Antenatal care utilisation and guidance on healthcare during pregnancy are the only indicators used here as indicators of maternal healthcare utilisation during pregnancy. Mothers fulfilling the basic ANC requirements (at least three ANC check-ups, two TT injections and 90 IFA tablets) and mothers who do not fulfil these basic requirements, do not vary that much in their chance of having a low birth weight baby relative to a normal one. It is less by only 1 per cent in mothers having full ANC utilisation. Similar results are found to be true in the case of guidance on healthcare during pregnancy.

Second Model: High versus normal birth weight

The independent variables playing a significant role in the case of high birth weight outcome versus normal one were education level (primary), sex of child, BMI of mothers (especially underweight mothers), region of residence in India (all regions except East), full ANC utilisation, tobacco consumption in any form, guidance on healthcare and complications during pregnancy.

Socio-economic, cultural and demographic indicators

Table 3 shows that education level (primary), plays a significant role in determining high birth weight of a child. The risk of having a high birth weight baby versus a normal one increases by about 2.21 times odds more compared with mothers with no education. Other variables like place of residence or religion, caste, etc., do not play a significant role. Coming to the cultural categories based on the region of residence, the chance of having a high birth weight baby relative to a normal one is the highest among the North-eastern mothers (about 6 times odds more likely) compared with the mothers of Central India, followed by Southern (4 times odds more likely), and Western (3.1 times odds more likely) and Northern (2.2 times odds more likely) region mothers. For mothers of Eastern India, the chance of having a high birth weight baby is also found to be more likely as compared with normal ones and it is about 80 per cent. However, there is not much variation seen across the different demographic indicators such as birth order or birth interval. However, difference is seen in the case of sex of the child in that female babies had 45 per cent less chance to be overweight as opposed to male babies.

Maternal Health Status Indicators

In case of BMI, it is seen that there is a lot of difference among underweight and overweight mothers in the probability of having a high birth weight baby compared to a normal one. In underweight mothers, the chance is less by 40 per cent, whereas in case of overweight mothers, it is higher by about 50 per cent, although in this case, overweight mothers are not playing any significant role. In case of mothers consuming tobacco in any form (cigarettes, bidis, paan masala, ghutkha, etc), high birth weight babies are more likely to occur relative to normal ones, compared to mothers consuming no tobacco. Even in case of mothers suffering from complications during pregnancy, the chance of having a high birth weight baby is more by about 36 per cent compared to mothers having no pregnancy complications.

Maternal Healthcare Utilisation

Antenatal care utilisation is a significant factor of maternal healthcare utilisation during pregnancy. Mothers fulfilling the basic ANC requirements (at least 3 ANC check-ups, 2 TT injections and 90 IFA tablets) have about 4 per cent less chance of having high birth weight babies versus normal ones compared with mothers who do not fulfil these basic requirements. Among mothers receiving guidance on healthcare during pregnancy, the chance of having a high birth weight baby is found to be 5 per cent less versus normal ones, relative to the mothers who received absolutely no guidance.

Table 3: Results of Multinomial logistic regression showing Odds Ratios (ORs) of low and high versus normal birth weight in relation to different covariates

Independent variables	Model 1	Model 2
Place of Residence		
Rural®		
Urban	1.212**	1.023
Religion		
Hindu®		
Others	0.873	1.329
Wealth Index		
Poorest®		
Poorer	0.976	1.551
Middle	0.961	0.896
Richer	1.088	0.842
Richest	1.217	0.961
Caste type		
Others®		
SC/ST	0.944	1.064
Education level		
No education®		
Primary	1.037	2.213***
Above primary	0.76	1.988
Sex of Child		
Male®		
Female	1.218***	0.546***
BMI of mother		
Normal®		
Underweight	1.216**	0.599***
Overweight	0.878	1.489
Region of residence in India		
Central®		
North	1.354**	2.210*
West	1.547***	3.116***
East	1.264**	1.796
South	1.317**	3.971***
North-east	0.629***	6.923***
Birth order		
One®		
Two and above	1.084	0.88
Birth interval		
Upto 2 years®		
More than 2 years	0.870*	0.935
Full ANC		
No®		
Yes	0.988*	0.960*
Tobacco consumption in any form		
No®		
Yes	1.119	1.396**
Presence of any disease		
No®		
Yes	1.004	0.947
Guidance on healthcare during pregnancy		
No®		
Yes	0.994	0.954*
Complications during pregnancy		
No®		
Yes	1.276***	1.364**
Constant	0.29	0.018

Note: * pÒ0.005, ** p Ò0.01, *** p Ò0.001

V. Discussion

The results obtained by applying multinomial logit model to the data on the most recent births in young mothers show distinct patterns in the case of low versus normal and high versus normal birth weights. Factors affecting low and high birth weight outcomes differ significantly. The common factors affecting both low and high birth weight outcomes are sex of child, BMI of mothers, region of residence in India and complications during pregnancy. In the case of low birth weight babies, socio-cultural and demographic factors play a more important role, whereas in the case of high birth weight babies, apart from socio-cultural factors, lifestyle and healthcare utilisation during pregnancy play important role. Low birth weight is partially a consequence of choices made by the mother before and during pregnancy (Chevalier & OčSullivan, 2007).

Regarding socio-cultural factors, it can be argued that exposure to urban areas does not necessarily mean that it would lead to a healthy pregnancy outcome. But it is associated with a lot of other harmful exposures like tobacco consumption or mental stress or pollution, or even lifestyle changes which are bound to have influence on the pregnancy outcomes. This is evident from the result that is obtained from the analysis that in urban area, low birth weight babies are more likely than in rural areas. Demographic factors like birth interval or sex of child are important because they reflect other social parameters like son preference or status of women in the society. A mother having two consecutive births within a span of less than two years is likely to have a smaller baby since the uterus has not been able to prepare itself properly for sustaining and holding the next child. It requires a minimum of two years and three years are even better. Regarding sex differentials in birth weight, it is obvious that females will have lower birth weights compared with males in a patriarchal society where gender-based discrimination starts from the conception of the baby. The observation that increased birth order is associated with increased birth weight has been made by a number of authors using data from diverse populations (Karn & Penrose, 1951-52; Salber & Bradshaw, 1953; Fraccaro, 1956; Roberts & Tanner, 1963). Few studies have sufficient data available to investigate the separate influences of birth order and maternal age.

Education plays a major role in leading to high birth weight babies as it provides a chance of being aware of nutrition and healthcare during pregnancy (Chevalier & OčSullivan, 2007). Maternal education can potentially affect all these inputs, and a correlation between birth weight and maternal education is a robust finding (Berhman & Wolfe, 1989; World Bank, 1993). Coming to BMI of mothers, it is obvious that underweight mothers are more likely to give birth to smaller babies and overweight mothers giving birth to heavier babies, but not always.

Cultural factors play a significant role in affecting birth weight outcome. In Northern and Western India, there is a higher chance of low birth weights, which is evident from the fact that mothers there are underweight and anaemic. Mothers in North-east as well as South and Western India are likely to have higher birth weight babies which has anthropological factors behind it. Mothers staying in hilly regions are of short stature and as a means of adaptation to the cool climate, intake lots of fat in their diet and thus are prone to have bigger babies. In an earlier study, Mondal (2000) reported from North East India in a Bengali population the mean birth weight of 2677 g and the incidence of low birth weight 32 per cent, whereas the incidence of low birth weight (26 per cent) was comparatively low among tribal population (Khasi) in the same geographical region.

Tobacco consumption is a major factor in giving rise to heavier and big babies. Studies done in developed countries also validate the fact that household type, smoking, gender, maternal health, employment, weight gain during pregnancy, absence of pregnancy complications, etc., have lasting causal effects on birth weight outcomes (McGovern, 2013). There is an increased risk of pre-term birth associated with maternal smoking (Tappin et al., 1996; Lang et al.,1996). There is sufficient medical evidence in support of this statement. Similarly, it is true in the case of complications during pregnancy. A cross-sectional study revealed that maternal anthropometry is more important than metabolic parameters in determining birth weight. It also reaffirmed the fact that glucose-tolerant mothers are not protected from having large gestational age babies (Mitra et al., 2012). These lead to birth defects in babies and may have abnormalities at birth which may make them heavier. Maternal obesity has frequently been identified as a risk factor for high birth weight (Webb, 2014). Research has shown that obesity increases the risk of adverse outcomes such as those listed above for both mother and baby. It may not be an independent covariate affecting birth outcomes but obesity does increase rates of medical complications (such as hypertension and diabetes). However, there is ample evidence regarding maternal smoking causing low birth weight in babies, but the incidence of high birth weight and its associated causes need to be further explored. Proper guidance and utilisation of health services during pregnancy will give rise to a healthy baby within the normal birth weight range. This is evident from our results also.

VI. Conclusion

From the above analysis, it is clear that imputation of missing cases in any dataset makes considerable difference in the results. Studies focussing on birth weight, based on NFHS data should take care of missing cases. Previous studies done on low birth weights relating it to maternal health status or healthcare-seeking behaviour are all based on complete case analysis. The factors affecting birth weight significantly change after imputation, thus leading to more meaningful results.

Looking at the results, one can infer from this study that healthcare utilisation during pregnancy is not the sole determinant of a healthy pregnancy outcome. The health status and lifestyle of mothers in their prime reproductive years are of immense importance in determining the birth weight of a child. Taking care of oneôs health only during the pregnancy period will not give rise to a healthy birth outcome. Here, one can talk about the life-cycle approach to motherôs health in her reproductive span. A healthy reproductive life can only be ensured if the process of healthcare, proper nutrition, guidance and awareness are given to women right from their childhood. This is not only essential for reproductive purpose, but in general for the health of a woman. Another thing to be kept in mind is that a large baby with a high birth weight is also not a desired outcome, since high birth weight babies are at greater risks of several chronic diseases in the latter part of their lives. Also, high birth weight babies are not only due to overweight and obese mothers but also may result from underweight or normal weight mothers.

The most likely known targets for prenatal interventions to prevent low birth weight rates are (1) smoking, (2) nutrition, and (3) medical care. Most medical conditions affect only a small proportion of pregnant women and, therefore, may contribute little to overall low birth weight rates. Continuous access to health care, not only early in pregnancy but also before and after pregnancy, has been advocated as a means to improve health outcomes of pregnancy. A vital area for reducing low birth weight rates may lie with improving socio-economic conditions. There is little done during the standard prenatal care visit that could be expected to reduce low birth weight. Reform of the health care system "offers an opportunity to shape a future that promotes the health of infants and women, facilitates reproductive choice, and assures access and availability of comprehensive health care and ancillary services-all of which are needed to reduce the risks of low birth weight (Alexander & Korenbrot, 1995).

Finally, from a policy perspective, it can be said that policy interventions should be focussed not only on pregnant mothers but to all women in reproductive age group, and even to small girls for making them aware, educating them about proper healthcare and nutrition, safe and healthy practices, and giving access to those who cannot afford the minimum basic needs. Policy interventions should not only focus on mothers in rural areas but also in urban areas because in urban areas also mothers may be anaemic or underweight and the use of tobacco is high. The results of this study suggest that for reducing problems related to birth weight, the strategy needs to focus attention on nutrition education to facilitate better weight gain during pregnancy, encouraging wider birth interval, avoidance of tobacco chewing and exposure to passive smoke and discouraging teenage pregnancy.

Limitations of the study

The present study deals with only the missing cases in the dependent variable. However, it does not address the problem of missing cases in the independent covariates. The missing cases occurring due to not knowing or not weighting at birth are only dealt with. The selection of variables for analysing the relationship of maternal health status, healthcare utilisation and birth weight of a child has been restricted to only a few. Other healthcare utilisation and health status indicators of mother were not considered because of the limitations of data.

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