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# Mother's Education and Mortality under Age Three: An Investigation in Presence of Some Socio-Demographic Correlates

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## ABSTRACT

**Introduction:** Premature death or death during the beginning part of life is the major cause of concern for the research. As far as living and socioeconomic conditions of a country or society are concerned, infant and child mortality is considered a sensitive indicator. Also, child mortality continues to be a major public health issue particularly in developing countries where it is mostly concentrated and keeps occurring in large numbers. In India, the burden of children dying under five years of age is disproportionately carried by socially disadvantaged groups. Mortality under age three has special importance because the child in this developing world is vulnerable to infectious diseases.

**Objective:** The present study is an attempt to examine the factors that affect on mortality of children under age three in the most populous state of India.

**Methods:** In this study, we have utilized the data from the fourth round of the National Family Health Survey (NFHS), conducted in 2015-2016 for Uttar Pradesh. Bivariate analysis of data and unadjusted/adjusted logistic regression has been used in the present study to know the likelihood of the various factors.

**Results:** Logistic regression suggests that, among the socio-demographic variables, women's education emerges as a strong predictor for explaining mortality under age three. As expected, the child of the illiterate mothers has experienced higher mortality as compared with literate mothers. Children of households with poor wealth index and shorter preceding birth interval are more likely to die than their counterparts. Mother's age at childbirth and birth order also plays a significant association in under age three mortality. Male children have almost the same risk of dying as female children.

**Conclusion:** The study indicates mother's age at birth, education, birth order, birth interval and basic immunization emerges as an important factor to influence child mortality under age three, therefore there is an earnest need to intervene in these issues in the society.

**Key Words:** Binary logistic regression, Mortality under age three, Mother's education

## INTRODUCTION

The level of infant and under-five mortality is still not up to the mark in India. The infant mortality rate (IMR) is the probability of dying before one year of age expressed per 1000 live-births and the under-five mortality rate (U5MR) is the probability of dying between birth and age 5 expressed per 1000 live-births have been used as measures of children's well-being for many years. Previous studies in developing countries showed that education played a crucial role in improving the survival status of children.<sup>1,2</sup> There are some pieces of literature are available that documented maternal education as a significant determinant of child health outcome.<sup>3-9</sup> These studies discuss several reasons for the inverse

association between maternal education and infant/child death. It is expected that better maternal education leads to higher use of the modern health care system<sup>10</sup> and highly educated mothers are more likely to take decisions on self illness control<sup>11,12</sup> which helps prevent premature deaths<sup>13-16</sup> and increases empowerment of women about health care and decision making.<sup>10,14,17</sup> Finally, educated mothers have higher levels of physical movements which are associated with their concern for antenatal care<sup>18</sup> and thus treatment-seeking for a sick child.<sup>19</sup> When assessing the health benefits of increased education in less developed countries, many researchers have been concerned about the omission of important determinants of an individual's education from the models. An increase in education would reduce mortality not only be-

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cause more women would enter an educational category associated with lower mortality, but also because everyone, including those who themselves remained uneducated, would benefit from the generally higher level of education in the community. Such a community level contribution was seen in recent analyses of fertility from Africa<sup>20</sup> and India,<sup>21</sup> and a similar effect of literacy was shown for India.<sup>22</sup> These studies have shown that among all socio-economic factors, maternal education has the most influence on the variation of infant and child mortality at the regional level. Some other studies in the domain of education and health have largely focused on examining the role of mother's education in reducing the morbidity and mortality of their children.<sup>23-26</sup>

Mortality under age three has special importance because the child in the developing world is vulnerable to infectious diseases such as diarrhoea, malaria, acute respiratory infections (ARI) and parasites as well as immunizable ones like neonatal tetanus, measles and pertussis.<sup>27</sup> Children have a higher mortality rate (of 30 to 40 %) than any other age group and most of the deaths (70%) occur from infectious diseases such as diarrhoeal diseases, acute respiratory infections (pneumonia), measles and malaria.<sup>28</sup> The above diseases are especially uncommon under six months of age due to presumably protection of breastfeeding. Thereafter, disease prevalence increases with the age of the child. After age five months they may wean from breast milk and supplementary foods may be introduced and at that moment their immune system may be weaker than in older age. Several studies suggest considering special care for children between the age of 7 and 36 months. Poverty usually coexists with illiteracy, unemployment, malnutrition, poor health and low status of women. Child mortality differs remarkably between urban and rural area. Mother's education, mother's age at birth, birth order, basic immunization, household size and sex are the important determinants of infant and child mortality.<sup>29-32</sup> It is noted that preceding short birth intervals adversely affect infant survival and infant and child mortality.<sup>33-35</sup> This study intends to quantify the contribution of education in explaining the gap in mortality under age three with a special focus on the effect of maternal education. The purpose of this paper is to investigate the level of a child under age three mortality in Uttar Pradesh, the most populous state of India, according to some socio-demographic characteristics. Also examines the relative importance of different sets of variables (such as socio-demographic variables) in influencing under-three mortality.<sup>36,37</sup>

## MATERIALS AND METHODS

We have utilized the data from the fourth round of the National Family Health Survey (NFHS)<sup>38</sup>, conducted in 2015-2016. The NFHS is a nationally representative survey firstly conducted by the International Institute for Population Sci-

ence, Mumbai as the Nodal Agency under the patronage of the Ministry of Health and Family Welfare, Government of India during 1992-1993. Consecutively four National Family Health Surveys (NFHS) were completed in India. The NFHS 2015-2016 surveyed 601,509 households, 699,686 women aged 15-49 years with a response rate of 97%, and 112,122 men aged 15-54 years with a response rate of 92%. Besides women and men, this survey also provides relevant information about their children. In this study, we have restricted our sample children born three years before the survey and their mother age is between 16-30 years to reduce recall biases. A detailed description of the sampling design and survey procedure is provided in the national report of NFHS-4, 2015-2016. The births before the three years of the survey in Uttar Pradesh are considered for analysis. For this study, a total of 6482 births which occurred three years before the survey are found and 452 among these is dying before reaching their third birthday. Mortality under age three is (children below 3 years) the outcome of interest in this study. Direct estimates of the probabilities of under age three mortality were calculated for each category of independent variables. Mortality under age three of the child is in dichotomous form (if the child was dead coded as '1' and otherwise '0'). Explanatory variables maternal education is the main predictor variable in this study. Maternal education was categorized into four groups, i.e., no education or illiterate, primary education, secondary education and higher education. Other explanatory variables included in this study are religion, wealth index, residence, maternal age at birth, preceding birth interval, sex of children, birth order, basic immunization, household size, number of eligible women (currently married women aged 15-49 living with her husband) living in the house and media exposure. Descriptive statistics are used to show sample characteristics and bivariate percentage distribution was carried out to assess the differentials in mortality under age three by selected predictor variables. Finally, a binary logistic regression is used to examine the associations between maternal education and child mortality. The regression results were estimated by unadjusted and adjusted odds ratio with a 95% confidence interval.

## A Brief Discussion of the Logistic Regression

Regression analysis is a major subset of multivariate analysis and a very useful tool not only to predict the response variable with the help of one or more predictors but also to understand factors that are responsible to bring out the changes in the response variable. Linear regression is the simplest form of regression. In this form of the regression model, it is assumed that each predictor variable has a direct effect on the study variable. Since many predictor variables affect the response or study variable and these may affect another intervening variable and thus problem of multi-collinearity may come into the picture. In regression analysis, the study variable is generally a quantitative variable measured on the

interval scale.<sup>36,37</sup>

In case the study variable is dichotomous then the linear regression model is not very effective due to the violation of various assumptions, i.e. linearity, homoscedasticity etc. In such a situation if the regression model is used, the fit of the line will be very poor having low  $R^2$  and even testing of the hypothesis is invalid. Under these circumstances (when the study variable is dichotomous and independent variable are of a different type, some are measured on an interval scale and others on the categorical scale) logistic regression model is used. Sometimes it is also known as the logit regression model. The basic form of Logistic function is

$$P = \frac{1}{1 + \exp(-z)} = \frac{\exp(z)}{1 + \exp(z)}$$

Where  $z$  is the predictor variable. Let us suppose that  $z$  instead of being a single predictor variable, is a linear combination of a set of predictor variables i.e.  $z = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n$  and therefore

$$P = \frac{1}{1 + \exp[-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n)]} \text{ and}$$

$$1 - P = \frac{\exp[-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n)]}{1 + \exp[-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n)]}$$

therefore

$$\text{odds} = \frac{P}{1 - P} = \frac{1}{\exp[-(b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n)]}$$

$$= \exp[b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n]$$

$$\text{Ln}(\text{Odds}) = (b_0 + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n),$$

where  $b_0, b_1, b_2, b_3, \dots, b_n$  are predictors.

This function is known as logit of  $P$  or log odds, and this is the familiar form of an ordinary multiple regression equation and therefore the interpretation of logit regression coefficient is the same as regression coefficients but the difference is that the effect is measured not on the study variables but the logit of the study variable.<sup>38,39</sup>

## RESULTS

We have analysed 6482 children's information in this paper and Table 1 shows that more than seventy % (75.6%) of the children are from rural areas and the rest of the children from urban areas. Among the child of the mother, 40.6 % are illiterate and about 11 % of mothers are well educated. About three fourth children belong to the Hindu religion. Half of the children belong to poor households and about 30 % are

from rich households, only 18 % of children having middle wealth index category. The majority of mother's age at birth (77.4%) lies between 20-30 years and very few (5.3%) mother's age at birth below 20 years. One-third of mothers have one child and the majority (79.0%) have up to three births.

More than half of the mothers have their preceding birth interval is more than 24 months and 8.1 %s have a preceding birth interval less than 12 months. As for the sex of the child is concerned, male children are more preferred than females in the sample. Two-third of deliveries of children are observed in hospital (not at home) and the majority of deliveries are normal only 9 %s are by caesarean section. One year immunization coverage (3 dose polio+3 dose DPT and Measles) is considered in this study and found about two-thirds of children are immunized. 37 % of mothers are not exposed to any type of media (newspaper, radio and TV). We observed in the sample about 18 % of children's household size is less than or equal to 4. About 48 % of household size is 7 or more. About 36 % of the children's house, there are 2 or more eligible women are living.

Table 2 shows the under three child mortality rates according to some selected socio-demographic characteristics. The result exhibits that, child mortality under age three is 5 % higher among rural child than their urban counterparts. Education is inversely related to child mortality. Well educated mothers experience lower child mortality. Religion does not pose a difference in mortality under age three. Children of households with poor wealth index category experienced a higher probability of dying. Mothers belong to the age at birth category 20-30 have less probable to have mortality under age three than another comparison group. Higher birth order shows higher under age three mortality (113/1000). When the preceding birth interval is less than 12 months the mortality under age three is about 132 per thousand. Smaller household size shows higher mortality under age three (121 per thousand). Chi-square test and  $p$ -value reveal that all other predictors are significant except the place of residence, sex of the child, type of delivery and eligible women. Overall the estimate of mortality under age three is 75 per thousand for the study sample.

The logistic regression analysis is employed to identify the important contribution of variables that influence mortality under age three. This analysis is also aimed at the relative importance of two sets of socio-demographic characteristics in influencing under age three mortality. In this analysis, the dependent variable is the survival status of the child. A variable is considered significantly associated with under-age three mortality when its  $p$ -value is below 0.1 at least. The results of the analysis are shown in Table 3. In the first model, when all the variables were taken separately, the analysis suggests that, among the socio-demographic variables, mother's education, wealth index, mother's age at birth, birth

order, preceding birth interval, immunization, household size and media exposure are statistically significant concerning the survival status of the mortality under age three.

## DISCUSSION

As expected, the child of illiterate mothers has experienced significantly higher mortality (about 3 times) as compared with the well-educated mothers. Children of households with a poor wealth index are 1.6 times more likely to die than those of households having a better economic standard. The child had born to the mothers at age less than 20 years and 30+ years experienced 1.8 and 1.5 times significantly higher risk of dying respectively, as those born to the mother's age between 20-30 years. Children of birth order 1 is 1.35 times more likely and child with birth order 4+ are 1.98 times more likely than those of 2-3 birth order women. The child with a preceding birth interval less than equal to 12 months and 12-24 months faced significantly higher odds of dying (2.5 and 1.8 times respectively) than those with the birth interval of 24+ months and above. Male child's experienced a 4 % higher risk of dying than female children but it is insignificant. Children who are immunized are 36 % significantly less vulnerable to die before their third birthday. Children from larger household size show a significantly lower chance of dying.<sup>40-42</sup>

In the second model, when all the socioeconomic variables are taken together except the mother's education. This model reveals that the wealth index, mother's education, birth order 4+, preceding birth interval, immunization status and household size are significant predictors for mortality under age three. The third model considered as a full model in this study when all the socio-demographic variables with the mother's education are taken together in the model to examine the net effect of the variables. Though the controls for socio-demographic variables have decreased the effect of mother's education on mortality under age three, yet only mother's education, birth order 4+, preceding birth interval, immunization and household size continue to remain statistically significant for mortality under age three. Some model suitability criterion such as -2Log likelihood, Cox & Snell *R* square and Nagelkerke *R* Square shows that Model 3 is better than Model-2 to explain the under age three mortality.<sup>42,43</sup> It indicates that for explaining under age three mortality mother's education is emerging as an important predictor even in presence of socio-demographic variables.

## CONCLUSION

This study demonstrates that the mother's education emerges as an important factor apart from other socio-demographic variables to influence the child under age three mortality.

Similar findings have been observed. In this study, education of mother, preceding birth interval, immunization, birth order and household size has emerged as a very important factor to influence under age three mortality. It is generally agreed that education acts as independent determinants of under age three mortality and at times it is considered as a proxy variable for other social variables. Education of the mother influence the child survival through various pathways; which are enhanced socio-economic status, greater health choice for children, including interaction with medical personnel, cleanliness, emphasis on child quality in terms of fewer children, and greater food and capital investment<sup>23,41</sup>. Findings of the study show that illiterate mothers experienced higher under age three mortality. Moreover, maternal education seems to have indirect effects through the treatment-seeking behaviours as well as family formation patterns in case of infant mortality. The economic standard of the household, which was taken as the proxy of family income, emerged as one of the most important factors influencing under age three mortality. The better economic standard enables the mother to have greater health choice for children and to have greater food and capital investment. The study reveals that the children of the households with low economic standard experienced more risk of dying than those of the households having a better economic standard. Thus steps should be taken to improve the education and economic standard of the people. In addition to that, free health services could be provided to people in remote rural areas.

A mother's age at childbirth, birth order, and preceding birth interval have a powerful effect on the survival chances of a child. These are also found important variables to influence under age three mortality. Young mothers face more risk of a child dying because they may not be physiologically and emotionally mature enough to adequately manage a pregnancy. Moreover, young mothers also have poor child care skills, which derive partly from inexperience in child-rearing. A preceding birth interval of fewer than one years is significantly associated with higher child mortality risk than those with birth intervals of more than one years. Increasing education and the age at marriage, reproductive span could be cut off to some extent, which in turn will help increase mother's age of childbirth. People should also be encouraged to keep their number of kids small.

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**Ethical Issue:** The data used in this study is taken from NFHS-IV and freely available for research use thus there is no need for ethical clearance.

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**Table 1: Prevalence of child according to some selected socio-demographic variables**

Characteristics	%	N
<b>Residence</b>		
Urban	24.4	1579
Rural	75.6	4903
<b>Mother's education</b>		
No	40.6	2634
Primary	14.9	969
Secondary	33.5	2171
Higher	10.9	708
<b>Religion</b>		
Hindu	76.4	4950
Muslim	23.6	1532
<b>Wealth Index</b>		
Poor	52.3	3387
Middle	18.0	1167
Rich	29.7	1928
<b>Mother's age at birth</b>		
<20 years	5.3	346
20-30 years	77.4	5020
30+ years	17.2	1116
<b>Birth order</b>		
1	33.8	2194
2-3	45.0	2917
4+	21.2	1371
<b>Preceding birth interval</b>		
<12 months	8.1	525
12-24 months	36.5	2369
24+ months	55.4	3588
<b>Sex of child</b>		
Male	52.2	3384
Female	47.8	3098
<b>Place of Delivery</b>		
Home	33.6	2177
Hospital	66.4	4305
<b>Caesarean delivery</b>		
No	91.2	5910
Yes	8.8	572
<b>Basic Immunization</b>		
No	34.7	2249
Yes	65.3	4233
<b>Media Exposure</b>		
No	36.9	2390
Yes	63.1	4092
<b>Household Size</b>		
<=4	17.6	1143
5-6	34.1	2209
7+	48.3	3130

Table 1: (Continued)

Characteristics	%	N
<b>Eligible Women</b>		
1	64.3	4165
2	19.5	1261
3+	16.3	1056
<b>Total</b>	100.0	6482

Table 2: Distribution of live births, deaths and mortality rates under three by some selected socio-demographic variables

Characteristics	Number of Live births	Number of Deaths under age three	Chi-square and p-value	Under three mortality rate (per thousand)
<b>Residence</b>				
Urban	1476	103	0.652 (0.42)	69.8
Rural	4554	349		76.6
<b>Mother's education</b>				
No	2426	208		85.7
Primary	884	85	28.168 (0.00)	96.2
Secondary	2032	139		68.4
Higher	688	20		29.1
<b>Religion</b>				
Hindu	4609	341	0.229 (0.63)	74.0
Muslim	1421	111		78.1
<b>Wealth Index</b>				
Poor	3116	271		87.0
Middle	1083	84	16.818 (0.00)	77.6
Rich	1831	97		53.0
<b>Mother's age at birth</b>				
<20 years	309	37		119.7
20-30 years	4707	313	19.675 (0.00)	66.5
30+ years	1014	102		100.6
<b>Birth order</b>				
1	2038	156		76.5
2-3	2760	157	32.622 (0.00)	56.9
4+	1232	139		112.8
<b>Preceding birth interval</b>				
<12 months	464	61		131.5
12-24 months	2159	210	51.105 (0.00)	97.3
24+ months	3407	181		53.1
<b>Sex of child</b>				
Male	3144	240	0.155 (0.69)	76.3
Female	2886	212		73.5
<b>Place of Delivery</b>				
Home	2011	166	2.148 (0.14)	82.5
Hospital	4019	286		71.2
<b>Caesarean delivery</b>				
No	5497	413	0.023 (0.88)	75.1
Yes	533	39		73.2
<b>Basic Immunization</b>				
No	2046	203	22.378 (0.00)	99.2
Yes	3984	249		62.5

Table 2: (Continued)

Characteristics	Number of Live births	Number of Deaths under age three	Chi-square and p-value	Under three mortality rate (per thousand)
<b>Media Exposure</b>				
No	2196	194	7.638 (0.01)	88.3
Yes	3834	258		67.3
<b>Household Size</b>				
<=4	1020	123	31.634 (0.00)	120.6
5-6	2064	145		70.3
7+	2946	184		62.5
<b>Eligible Women</b>				
1	3868	297	0.749 (0.69)	76.8
2	1180	81		68.6
3+	982	74		75.4
Total	6030	452		75.0

Table 3: Odds of mortality under age three according to some selected socio-economic and demographic variables

Characteristics	Odds of mortality under age three		
	Unadjusted Model	Adjusted Models	
	Model 1	Model 2	Model 3
<b>Mother's education</b>		-	
No	2.949* (1.850-4.703)		2.315* (1.389-3.857)
Primary	3.308* (2.012-5.438)		2.822* (1.673-4.761)
Secondary	2.353* (1.461-3.790)		2.077* (1.272-3.392)
Higher (RC)	1		1
<b>Wealth Index</b>			
Poor	1.642* (1.293-2.086)	1.433* (1.085-1.893)	1.248 (0.940-1.659)
Middle	1.464* (1.083-1.980)	1.435* (1.054-1.956)	1.277 (0.933-1.747)
Rich (RC)	1	1	1
<b>Mother's age at birth</b>			
<20 years	1.801* (1.257-2.580)	1.467 <sup>s</sup> (0.992-2.170)	1.418 <sup>s</sup> (0.958-2.100)
20-30 years (RC)	1	1	1
30+ years	1.513* (1.198-1.911)	1.274 <sup>s</sup> (0.950-1.709)	1.301 <sup>s</sup> (0.967-1.750)
<b>Birth order</b>			
1	1.346* (1.070-1.692)	0.982 (0.757-1.274)	1.039 (0.799-1.351)
2-3 (RC)	1	1	1
4+	1.983* (1.563-2.516)	2.071* (1.553-2.762)	1.990* (1.490-2.659)
<b>Preceding birth interval</b>			
<12 months	2.475* (1.822-3.360)	2.978* (2.135-4.155)	3.010* (2.156-4.202)
12-24 months	1.831* (1.490-2.250)	2.028* (1.637-2.513)	2.025* (1.634-2.509)
24+ months (RC)	1	1	1
<b>Sex of child</b>			
Male	1.039 (0.858-1.259)	1.027 (0.846-1.247)	1.033 (0.850-1.255)
Female (RC)	1	1	1
<b>Place of Delivery</b>			
Home (RC)	1	1	1
Hospital	0.862 (0.707-1.051)	0.949 (0.771-1.168)	0.991 (0.804-1.220)
<b>Basic Immunization</b>			
No (RC)	1	1	1
Yes	0.630* (0.519-0.764)	0.698* (0.586-0.849)	0.732* (0.608-0.901)
<b>Media Exposure</b>			
No (RC)	1	1	1
Yes	0.762* (0.628-0.924)	0.984 (0.784-1.234)	1.017 (0.807-1.281)

Table 3: (Continued)

Characteristics	Odds of mortality under age three		
	Unadjusted Model	Adjusted Models	
	Model 1	Model 2	Model 3
<b>Household Size</b>			
<=4 (RC)	1	1	1
5-6	0.583* (0.453-0.749)	0.504* (0.386-0.658)	0.506* (0.387-0.661)
7+	0.518* (0.408-0.658)	0.413* (0.318-0.535)	0.413* (0.318-0.536)
-2Loglikelihood		3128.097	3110.595
Cox & Snell R Square		0.023	0.026
Nagelkerke R Square		0.058	0.065

RC=reference category, \*= $p < 0.01$ , †= $p < 0.05$ , ‡= $p < 0.1$

95% confidence intervals of odds ratio are given in the parenthesis.