



# An Analytical Framework for the Determinants of Infant Mortality based on 2005 – 06 NFHS Data in India

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## Abstract

Infant mortality is an important indicator of nation's socio-economic welfare. There are many socio-economic, demographic and environmental determinants of infant mortality. As infant has an innate relationship with the mother, therefore the maternal health programmes have also very important repercussion on infant health. The above two dimensions of infant mortality have seldom been examined together in infants-based studies. Thus, the survival analysis for infants regarding its several determinants along with maternal health programmes and their impact is seen in the study. The paper applies Kaplan-Meier and Cox proportional hazard model using National Family Health Survey data 2005-06, in India, to demonstrate the risk of infant death with the above said factors. Poor households are more likely to experience infant deaths than rich and middle households. Maternal health programmes have a significant effect on infant mortality, but the inclusion of breastfeeding, mother education and wealth index make these results insignificant. This study indicates that there is a need to increase birth spacing, improve mother's education level, encourage breastfeeding and discourage teenage pregnancy in order to achieve the desired outcome of reducing infant mortality. Many interesting facets of the successful implementation of government and non-government policies on the improvement of infant survival are also discussed.

**Keywords:** Determinants of Infant Mortality, Infant Mortality, Maternal Health Programmes, National Family Health Survey

## 1. Introduction

Infant mortality rate (IMR) is defined as the deaths of live-born children before completing their first birthday per thousand live births. The first year of life ensures lifelong implications for an individual, therefore infant mortality is a key indicator to demonstrate the socio-economic and health status, and it is unequally distributed across countries in the world. A steady decline in IMR in many countries during the last centuries has come out, but it is still high in Sub-Saharan African and South Asian Countries. Globally, 4.5 million annual deaths occurred within the first year of life, of which 98% occurred in developing countries and majority in Asia and Africa (WHO, 2015). In 2000, world officers concurred on Millennium Development Goals (MDGs) and called for MDGs 4 target to reduce infant and child mortality by two third between 1990 to 2015. In June 2012, world officers reincarnated their commitment during the global launch of Committing to Child Survival: A Promise Renewed, aiming for a continued post-2015 focus to end preventable child deaths. With the ending of MDG era, the international community is in the procedure of concurring on a new structure - the Sustainable Development Goals (SDGs). SDG target for child mortality propose a renewal

commitment to the world's children: By 2030, it is expected to reduce neonatal mortality to at least as low as 12 deaths per 1000 live births and under-five mortality to at least as low as 25 deaths per 1000 live births.

India is the second most populous country in the world and still struggling with high infant mortality rate. Though, India has experienced an impressive decline in infant mortality, yet it has been failed in achieving MDGs 4 target. This article explores the scenario of infant mortality in India which is very helpful to analyze the reason of inadequate progress in the improvement of infant survival, with some suggestions for the future.

Even though death is a biological event, specific disease cause this event, the study of the determinants of infant mortality concentrate on the social, environmental, cultural, and behavioral factors, which may affect the likelihood of ill health, disease and death in infancy period. This study modifies the<sup>15</sup> analytical framework under the consideration of maternal health programmes. Mosley and Chen framework is the most frequently referred in subsequent papers related to infant mortality determinants; this approach tries to integrate two research methodologies employed by medical and social scientists. The core conceptual idea of their framework was

that all backgrounds (cultural and socio-economic) variables have to work through a limited set of proximate variables that directly influence the risk of morbidity and mortality. The framework is closely related to the study, which is based on the education factor and notified that the educated women can consult with doctor easily and take benefits of different policies and treatment for their children because they can handle modern world easily Caldwell (1979)<sup>2</sup> However, in several explanations, it has been shown that the educated women give more value to their own work time, therefore they spendless time with their child which cause poor health of a child<sup>23</sup>.

In developing countries a typical setting and the interaction of socio-economic, demographic and biological variables are treated as the determinants of infant, child and maternal health<sup>6</sup>. A cohort study in Maharashtra (India) showed that birth weight, immunization, nutrition and social as well as medical factors are significantly associated with under-five mortality<sup>7</sup>. Relation of infant and child survival with age of mother at the time of giving birth, birth order, birth interval with and without controlling other explanatory variables was analyzed in Malawi<sup>12</sup>. The impact of household environment, socio-economic and demographic health seeking behavior on the survival of infant and child was studied in Tanzania<sup>22</sup>. A study examined the child survival within three periods (neonatal, infant and under-five) by incorporating the mother's educational attainment, location (rural/urban), religious affiliation, access to basic environmental services and income status in Ethiopia<sup>30</sup>.

Breast milk carries biologically active contents that protect infants in opposition to childhood diseases such as respiratory infection, diarrhea until the abundant growth of immunological system of infants<sup>13,4,11,28,10,14</sup>. Length of unsupplemented and supplemented breastfeeding, toilet sanitation, and presence of piped water are associated with infant mortality and studied through regression analysis. Unsupplemented breastfeeding is highly related to less infant death as compare to supplemented breastfeeding Butz and Habicht (1984)<sup>1</sup>. Breastfeeding and some other socio-economic and demographic factors have significant impact on infant mortality in India<sup>26</sup>. Socio-economic, demographic and environmental determinants have significant impact on infant mortality in Ethiopia<sup>17</sup>. A comparative study found that the proximate determinants highly influence infant mortality as compared to socio-economic determinants in Bangladesh<sup>3</sup>. Above all studies showed the effect of proximate and socio-economic determinants on infant mortality but, missed the impact of the maternal health programmes which may also have a relation to infant health. Few studies examine the link between infant mortality and maternal health programme. This study is based on NFHS-data of India and finds the association of infant mortality with these programmes and examines how it varies with the inclusion and exclusion of proximate and socio-economic determinants of infant mortality.

In recent years, United Nations Secretary Ban Ki-moon launched the global strategy for children's and women's health. Every women and their child is important for the development of a country in term of reducing poverty and increasing health status. In this aspect maternal health programmes are seriously important in infant survival analysis. This study utilizes mainly three programmes: Antenatal Care (ANC), Tetanus Toxoid (TT) and Iron/Folic Acid Tablets/Syrup to see the relationship of these programmes with infant mortality. Antenatal care (ANC) refers to pregnancy related health care, which is usually provided by a doctor or another health professional. ANC is an effective programme to reduced preterm birth and infant mortality in socially disadvantaged women<sup>9</sup>. Ideally, antenatal care should monitor a pregnancy for signs of complications, detect and treat pre-existing and concurrent problems of pregnancy, and provide advice and counseling on preventive care, diet during pregnancy, delivery care, postnatal care, and related issues.

People of all ages can get tetanus, but the disease is particularly common and serious in newborn babies, called neonatal tetanus. Most of the infants who get the disease die. The Tetanus Toxoid vaccine is given during pregnancy to prevent tetanus to mother as well as her baby. Neonatal tetanus is particularly common in rural areas where most of the deliveries occur at home without adequate sterile procedures. Substantial reduction in newborn infant death could be achieved in rural North India by increasing the coverage of TT vaccination<sup>24</sup>. Two doses of tetanus toxoid vaccine provided to the pregnant women. The first vaccination is given in the first trimester soon after pregnancy tests are confirmed and after first antenatal appointment. The second dose of the TT vaccine is given at least four to eight weeks after the first. Pregnant women require additional iron and folic acid to meet their own nutritional needs as well as those of the developing fetus. It is recommended that a pregnant woman take 100 tablets of iron and folic acid during her pregnancy, and health workers are instructed accordingly.

## 2. Data and Methodology

### 2.1. National Family Health Survey

The National Family Health Survey (NFHS) was carried out as the principal activity of a collaborative project to strengthen the research capabilities of the Population Research Centers in India, initiated by the Ministry of Health and Family Welfare, Government of India, and coordinated by the International Institution for Population Sciences, Mumbai. Three round of the survey have been conducted during 1992–93 (NFHS-I), 1998–99 (NFHS-II) and in 2005–06 (NFHS III). NFHS is equivalent to the Demographic Health Survey (DHS) conducted in most of the other countries. The main objective

of the NFHS survey is to provide reliable and up-to-date information on various demographic events and their estimates for comprehensive portrait of population, health, and nutrition in India as well as in each of its states. In this paper we mainly utilized NFHS III data (2005–06) for the analysis purpose. In the third phase of NFHS total 13506 infants are included in the survey. This figure captures all live births during the time five year preceding the survey. Outcome variable in this study is survival time that means the length of time from birth until the date of death measured in one to twelve months.

Proximate variables include five categories: Maternal factor, Environmental contamination, Nutrient deficiency, Injury and Personal illness, whereas socio-economic variables are categorized in three ways: Individual-level, Household-level and Community-level. In this perspective this article includes eleven variables namely, mother's age (categorized in <18, 18–24, 25–29, 30–34 and more than 34 in years), birth interval (<18, 18–29, 30–41 and more than 41 in months), birth order (first, second, third and more than third), place of delivery (home, government hospital and private hospital), sex of child (male and female), breastfeeding (yes and no), mother's education (not educated, primary, secondary and higher education), marital status (not married, early married i.e. 0–4 year, 5–9 and more than 9 years), family size (1–3, 4–6 and more than 6 members in household), wealth index (poor, middle and rich household), place of residence (rural and urban). In addition maternal health programmes are included in the study to see for seeing the effect on infant mortality, categorized as: ANC (no ANC, 1–2 ANC and more than 2 ANC), TT (no TT, 1–2 TT and more than 2 TT) and IFA (received and not received).

Kaplan-Meier estimator and Cox proportional hazard model are used to analyze the data. Kaplan-Meier estimator is a non parametric estimator, uses product-limit methods to estimate the survival function from life time data. Survival function is the probability that a subject survive beyond a point in time. Cox proportional hazard model is a classical semi-parametric method relates the time of an event usually death or failure, to a number of explanatory variables known as covariates. Hazard function is also called the instantaneous failure rate describes the risk of an outcome like death or failure, in an interval after a specified time, conditional on the subject having survived to that specified time. In addition log rank test is used for the comparison of estimated survival curves of the groups of subjects.

### 3. Findings

The sample includes 13506 infants during the five years preceding the date of the survey, out of which 2586 children died before completing their first birthday. In the analysis, there are 10920 censored or survived observations. Table 1 shows

some descriptive statistics. There are about 49% female and 51% male infants in the sample. Out of 13506, only 34% infants belong to urban area which reflects that most of the infants belong to the household in rural area. 15% infants were not breastfeeding and most of them (90%) died before completion of their first year of life, only 7% death occurred when infants were breastfed. Approx 2 in 10 births occurred in private health facilities whereas 54% pregnant women delivered their child at home. Sample considered only the mothers who have delivered birth during last five years preceding the survey date. More than 40% females considered are of age 25 to 29 years. Few of mothers (8%) in the sample are highly educated, whereas 40% mothers are not educated. The study included 61% infants of first and second birth order and 23% of fourth or more birth order of which 24% died in their infancy time period. The birth interval is the interval between reported dates of birth, sample recorded that 17% of birth intervals are shorter (i.e. less than 18 months) and 35% infant death has been occurring in these short birth intervals. About 38% infants in India belong to poor households whereas, 41% belong to rich households and only two out of ten infants belong to middle households. Marital status is considered on the basis of duration after marriage; the majority of birth (40%) is captured in early married couples (i.e. 0–4 years). Here, sample described that most of the families (90%) in India have more than three members in their households. Eight percent death occurred out of 7410 infants when mother had received three and more ANC and 15% when mothers had not received any ANC. The majority of mother (70%) has received three and more TT injection and about one in ten mothers have not received any TT injection. Sixty five percent mothers consumed sufficient IFA tablets (consumed 100 or more IFA tablets) during their pregnancy.

Figure 1-5 shows the Kaplan-Meier product limit estimates of the survival curves a descending step function where each of the descending legs indicates one or more death. As (Figure 1), shows, mothers who have delivered their child at home have poor infant survival than mothers who have delivered their child at government or private hospitals. It can also be seen from the (Figure 1), that the children in birth interval more than 29 months, continue to have better survival curves up to one year of age. As Figure 1 and 3, showed that the infants have better survival curves when their mothers have received any maternal health programmes and poorest survival when infants were not obtain the batter programme support (for e.g. breastfeeding). It is seen from the (Figure 4), that the mothers who are highly educated have better infant survival than non educated mothers and poor households have poor infant survival than rich households. Figure 5, shows that the big families and early married couples have batter survival of infants than small families and late married couples. Results of

**Table 1.** Descriptive Statistics of infants in India (N = 13506)

Covariates	Category	Censored	Dead	Total
Sex	Female	5387	1209 (18.3%)	6596
	Male	5533	1377 (19.9%)	6910
Place of Residence	Rural	6869	1786 (20.6%)	8655
	Urban	4051	800 (16.5%)	4851
Brestfeeding	No	200	1762 (89.8%)	1962
	Yes	10763	781 (6.7%)	11544
Place of Delivery	Home	5679	1638 (22.4%)	7317
	Govt. Hospital	2731	445 (14%)	3176
	Private Hospital	2522	448 (15.1%)	2970
	Other	25	118(42.2%)	43
Mother's Age (Years)	< 18	673	125 (15.7%)	798
	18 – 24	3301	786 (19.2%)	4087
	25 – 29	4899	1006 (17%)	5905
	30 – 34	1390	412 (22.9%)	1802
	35 and more	657	257 (28.1%)	914
Mother's Education	No	4086	1400 (25.5%)	5486
	Primary	1569	425 (21.3%)	1994
	Secondary	4320	691 (13.8%)	5011
	Higher	945	70 (6.9%)	1015
Birth Order	1–2	6832	1464 (17.6%)	8296
	3	1702	366 (17.7%)	2068
	3 and more	2386	756 (24.1%)	3142
Birth Interval (months)	< 18	1530	831 (35.1%)	2361
	18 – 29	3183	887 (21.7%)	4070
	30 – 41	2819	467 (14.2%)	3286
	42 and more	3316	473 (12.4%)	3789
Wealth Index	Poor	3856	1279 (24.9%)	5135
	Middle	2262	550 (19.6%)	2812
	Rich	4802	757 (13.6%)	5559
Marital Status (years)	Never	11	1 (83%)	12
	0 – 4	4762	622 (11.6%)	5384
	5 – 9	3747	1078 (72.3%)	4825
	10 and more	2400	885 (26.9%)	3285
Family Size	1 – 3	890	466 (34.4%)	1356
	4 – 6	4883	1213 (19.9%)	6096
	7 and more	5147	907 (15%)	6054
ANC	No	2382	407 (14.6%)	2789
	1 – 2	2921	386 (11.6%)	3307
	3 and more	6810	600 (8.1%)	7410
TT	No	1979	394 (16.5%)	2373
	1 – 2	1498	149 (9%)	1647
	3 and more	8641	845 (8.9%)	9486
IFA	Yes	4045	616 (13.2%)	4661
	No	8440	735 (8.3%)	8845

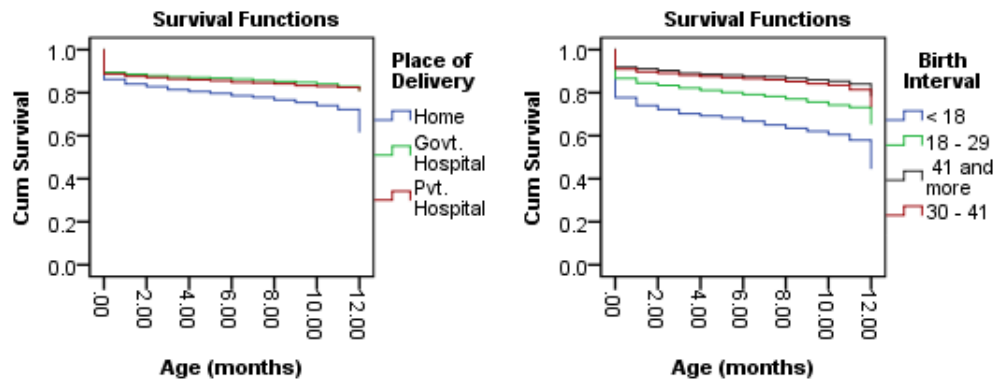


Figure 1. Kaplan-Meier Survival Curves for Place of Delivery and Birth Interval.

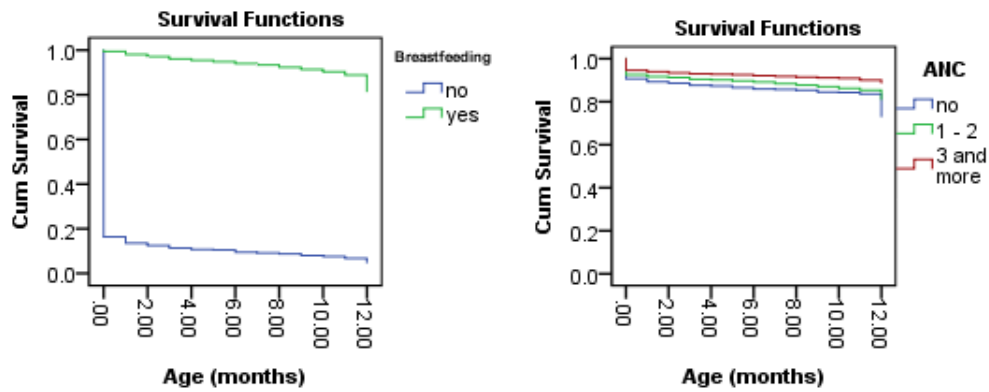


Figure 2. Kaplan-Meier Survival Curves for Breastfeeding and ANC.

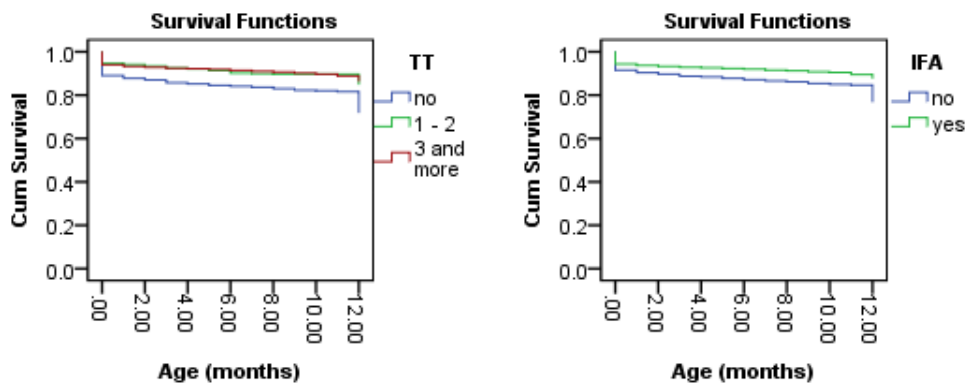


Figure 3. Kaplan-Meier Survival Curves for TT and IFA.

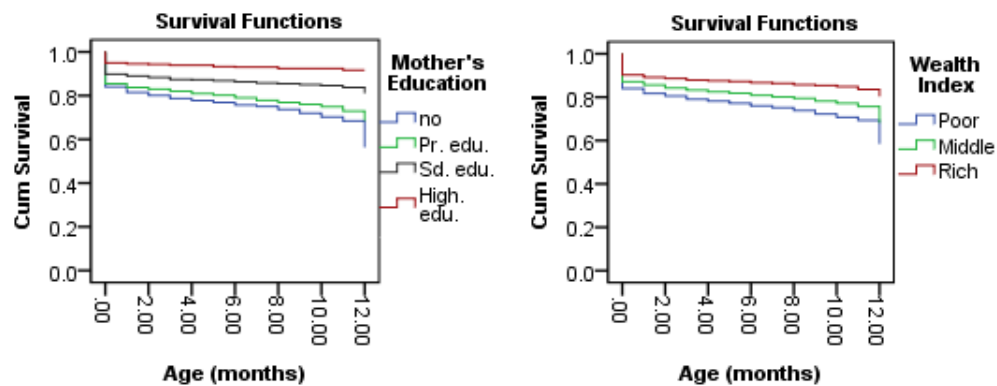


Figure 4. Kaplan-Meier Survival Curves for Mother's Education and Wealth Index.

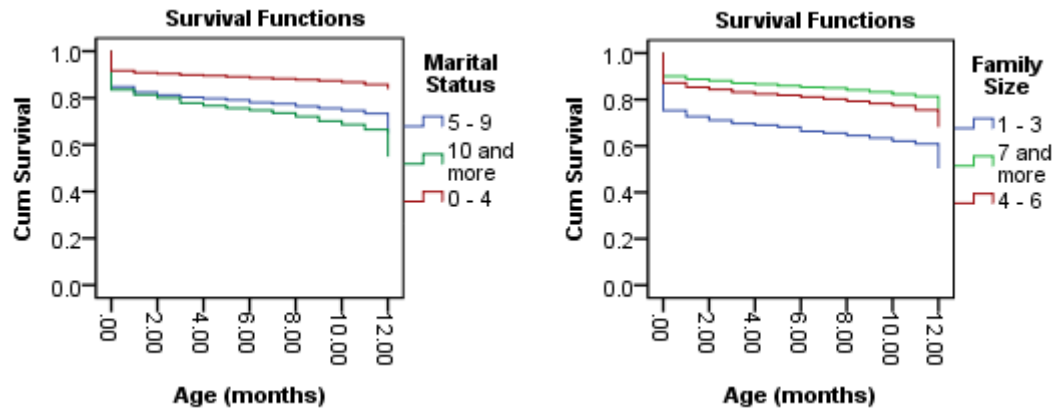


Figure 5. Kaplan-Meier Survival Curves for Marital Status and Family Size.

Table 2. Results of Log Rank Test

Covariates	d.f.	Chi-square	p-value
Sex	1	4.376	0.036
Place of Residence	1	35.946	0.000
Breastfeeding	1	11029.684	0.000
Place of Delivery	3	139.618	0.000
Mother's Age	4	82.301	0.000
Mother's Education	3	338.080	0.000
Birth Order	3	76.040	0.000
Birth Interval	3	316.097	0.000
Wealth Index	2	226.825	0.000
Marital Status	3	354.696	0.000
Family Size	2	274.510	0.000
ANC	2	85.955	0.000
TT	2	95.566	0.000
IFA	1	69.999	0.000

log rank test (Table 2) shows that all the determinants included in the study have significant effect on infant mortality.

The study includes three models, fitted on the basis of Cox proportional hazard regression model. The results are shown in terms of relative risks of other groups in relation to specific baseline/reference groups by the exponent of the regression coefficients. Table 3 (model-I) shows the estimated effect of sex of child, place of residence, breastfeeding, place of delivery, mother's age, mother's education, birth order, birth interval, wealth index, marital status on the risk of infant mortality. The results indicate that infants who were not breastfed have higher risk of death than the infant who were breastfeeding and 95% confidence interval suggest that the risk of death may be 21.4 times as low and 27.4 times as high as compared to breastfed infants. It is observed from the results that, non institutional delivery have a significant impact on the risk of infant mortality and it is noted that, delivery occurs at home have 1.2 times more risk of infant death than delivery occurred

at private hospital. Delivery occurred under government health facilities have 1.1 times more risk of infant death in comparison to the delivery which have taken place in private hospitals, but results are not significant.

It is important to note that, mother's age at birth has significant impact on infant mortality. Mothers giving birth at age < 18 years have 59% more risk of infant death as compared to mothers having age 18 – 24 years at the time of infant birth. Maternal age 30 or more years have a higher risk of infant mortality than mothers of age 18 – 24 years at the time of birth. Mothers having no education and having a primary or secondary level of education showed higher risk of infant death than highly educated mothers. Non educated mothers have 82% more risk of infant mortality than mothers having higher education. Similarly maternal education of primary and secondary level have significantly 68% and 54% more risk of infant death than those mothers, whose education is above secondary level.

First and second born child have 1.4 times higher risk of death than than third born child and results are highly significant. The results clearly suggest that, short birth intervals (less than 18 months) have significantly 74% relatively high chance of child death during infancy than reference category (30–41 months). Long birth intervals (more than 41 months) have less risk of death than the reference group. It is observed that for of dying infants of low and middle households are respectively 25% and 11% more than that for the infant of rich households, but the effect of middle household does not come out to be significant. Marital status emerged as highly

associated variable with infant mortality. It is noted that late married couples (10 and more years) have 2.8 times more risk of infant death than early married couples (0–4 years).

Similarly, the risk of infant death is twice for those couples who have 5–9 years duration after marriage than early married couples. Small family (1–3 members in the household) has 1.2 times higher chance of child death as an infant, whereas for large family (more than 6 members in the household) has 21% lower risk of infant death than the reference group as 4–6 members in the household.

**Table 3.** Summary Statistics of the Cox-proportional Hazard model I

Covariates	Parameter Estimates	s. e.	d.f.	p-value	R.R.	Confidence interval	
						lower	Upper
<b>Sex</b>							
Female	0.031	0.050	1	0.529	1.032	0.936	1.138
Male <sup>a</sup>							
<b>Place of Residence</b>							
Rural	-0.021	0.064	1	0.739	0.979	0.864	1.109
Urban <sup>a</sup>							
<b>Breastfeeding</b>							
No	3.189	0.064	1	0.000	24.257	21.408	27.484
Yes <sup>a</sup>							
<b>Place of Delivery</b>							
Home	0.213	0.080	1	0.007	1.238	1.059	1.447
Govt. Hospital	0.109	0.095	1	0.240	1.115	0.926	1.343
Private Hospital <sup>a</sup>							
Other	0.444	0.344	1	0.196	1.559	0.795	3.056
<b>Mother's Age (Years)</b>							
< 18	0.463	0.210	1	0.027	1.588	1.053	2.395
18 – 24 <sup>a</sup>							
25 – 29	0.067	0.073	1	0.357	1.069	0.927	1.232
30 – 34	0.225	0.093	1	0.015	1.252	1.044	1.501
35 and more	0.239	0.105	1	0.024	1.270	1.033	1.561
<b>Mother's Education</b>							
No	0.600	0.216	1	0.006	1.822	1.192	2.785
Primary	0.519	0.220	1	0.018	1.681	1.091	2.589
Secondary	0.433	0.213	1	0.041	1.542	1.017	2.339
Higher <sup>a</sup>							
<b>Birth Order</b>							
1–2	0.342	0.083	1	0.000	1.408	1.197	1.657
3	0.140	0.078	1	0.071	1.150	0.988	1.339
4 and more <sup>a</sup>							
<b>Birth Interval (months)</b>							
< 18	0.554	0.080	1	0.000	1.740	1.488	2.034
18 – 29	0.317	0.072	1	0.000	1.373	1.192	1.583

Covariates	Parameter Estimates	s. e.	d.f.	p-value	R.R.	Confidence interval	
						lower	Upper
30 – 41 <sup>a</sup>							
42 and more	-0.242	0.084	1	0.004	0.785	0.665	0.926
<b>Wealth Index</b>							
Poor	0.224	0.078	1	0.004	1.251	1.074	1.457
Middle	0.106	0.080	1	0.185	1.112	0.951	1.301
Rich <sup>a</sup>							
<b>Marital Status (years)</b>							
Never	1.001	1.017	1	0.325	2.720	0.370	19.973
0 – 4 <sup>a</sup>							
5 - 9	0.696	0.108	1	0.000	2.005	1.621	2.480
10 and more	1.049	0.134	1	0.000	2.855	2.196	3.713
<b>Family Size</b>							
1 – 3	0.248	0.083	1	0.003	1.281	1.088	1.509
4 – 6 <sup>a</sup>							
7 and more	-0.236	0.056	1	0.000	0.789	0.708	0.881

Note: <sup>a</sup>ReferenceCategory

**Table 4.** Summary Statistics of the Cox-proportional Hazard model II

Covariates	Parameter Estimates	s. e.	d.f.	p-value	R.R.	Confidence interval	
						lower	Upper
<b>ANC</b>							
No	0.256	0.102	1	0.012	1.293	1.057	1.578
1 – 2	0.341	0.075	1	0.000	1.415	1.222	1.638
3 and more <sup>a</sup>							
<b>TT</b>							
No	0.389	0.097	1	0.000	1.475	1.219	1.785
1 – 2	-0.860	0.112	1	0.442	0.918	0.737	1.142
3 and more <sup>a</sup>							
<b>IFA</b>							
Yes <sup>a</sup>							
No	0.202	0.076	1	0.007	1.224	1.056	1.419

Note: <sup>a</sup>Reference Category

**Table 5.** Summary Statistics of the Cox-proportional Hazard model III

Covariates	Parameter Estimates	s. e.	d.f.	p-value	R.R.	Confidence interval	
						lower	Upper
<b>ANC</b>							
No	-0.070	0.140	1	0.499	0.932	0.761	1.143
1 – 2	0.158	0.078	1	0.042	1.171	1.005	1.363
3 and more <sup>a</sup>							
<b>TT</b>							
No	0.159	0.097	1	0.102	1.172	0.969	1.418
1 – 2	-0.110	0		0.326	0.896	0.719	1.116



Covariates	Parameter Estimates	s. e.	d.f.	p-value	R.R.	Confidence interval	
						lower	Upper
3 and more <sup>a</sup>							
<b>IFA</b>							
Yes <sup>a</sup>							
No	0.116	0.075	1	0.122	1.123	0.969	1.300
<b>Breastfeeding</b>							
No	3.870	0.071	1	0.000	47.933	41.743	55.041
Yes <sup>a</sup>							
<b>Mother's Education</b>							
No	0.714	0.200	1	0.000	2.042	1.379	3.024
Primary	0.618	0.205	1	0.003	1.855	1.242	2.770
Secondary	0.487	0.194	1	0.012	1.627	1.113	2.377
Higher <sup>a</sup>							
<b>Wealth Index</b>							
Poor	0.426	0.084	1	0.000	1.532	1.299	1.806
Middle	0.324	0.089	1	0.000	1.382	1.161	1.645
Rich <sup>a</sup>							

Note: <sup>a</sup>Reference Category

Table 4 (model II) presents the effect of maternal health programmes on infant mortality. It is observed that the risk of infant death decreases with the increase of number of ANC. Mothers who have not received ANC are 29% more, and mothers who have received one or two ANC are 42% more likely to experience an infant death than the mothers having three or more ANC during their pregnancy. As expected, pregnant mothers who did not receive TT injection are significantly more likely to experience infant mortality than reference category (mother who have received more than two TT dose during their pregnancy). The consumption of IFA tablets during pregnancy have a positive impact on decreasing infant mortality. Females who have not consumed IFA tablets are 1.2 times more likely to experience child death as an infant than the mothers consumed IFA during their pregnancy.

Table 5 (model III) shows some variation in the maternal health programmes with the inclusion of some proximate and socio-economic factors in model II. Inclusion of these covariates reduce the effect of ANC on infant mortality and it is found that the mothers receiving one or two ANC have significantly 17% higher chance of infant death in comparison to mothers having more than two ANC during pregnancy. From this (Table 5), it can be seen that the consumption of IFA tablets and TT are not highly associated with infant mortality and results are not significant with the inclusion of the above said factors. The effect of breastfeeding, mother education and wealth index (model III) is significantly increased (model III)

and it is noted that the mothers with no education have a two times higher risk of infant death than highly educated mothers.

## 4. Discussion

This paper investigate the effect of proximate, socio-economic determinants and maternal health programmes on infant mortality using Cox-proportional hazard model and data from 2005–06, National Family Health Survey. Breastfeeding practices are related to child rearing in traditional societies in which breastfeeding is identified not only a way to increase birth spacing, but also as a basic source of nutrition for the survival of the child<sup>19,20</sup>. Findings suggest that there is direct evidence of breastfeeding on infant death: it consistently reduces the risk of infant mortality, even in the presence of other proximate, socio-economic and maternal health programmes and finding is consistent with the finding of the authors<sup>10,12</sup>. It has been established that higher level of maternal education contributed to the survival of the child by making females more likely to marry, enter motherhood later, have less children, utilize health care facilities and immunize their children<sup>8</sup>. Whereas other studies explore that the educated mothers spend much time on their own works than child rearing, caused poor child health<sup>23</sup>, and in Tanzania, it is observed that education have no impact on infant death<sup>16</sup>. The current study shows that maternal education has significantly positive impact on infant mortality and as the level of education increases risk of infant death decreases. Household income has no effect on

child survival in infancy, but the effect is pronounced during early childhood<sup>3</sup>. In contrast, our finding shows that richer households have significantly better infant survival than poor households. Higher income households (or, to be more precise, rich household, as employed in the analysis) are associated with better rearing of children in terms of healthcare, nutrition etc.

One of the major focus of this study was to identify the effect of programmatic factors (ANC, TT and IFA tablets) during pregnancy on the survival of the infant. It is found that maternal programmes have a significant effect on infant mortality as these programmes theoretically save the life of a child by promoting the better health before childbirth and the early postnatal period which is a time period of highest risk of dying of infant. Effect of ANC on infant death may be driven due to the fact that the use of ANC services is correlated to the socio-economic characteristics<sup>21</sup>. ANC always has a significant impact on infant death, even after controlling demographic and socioeconomic variables<sup>26</sup>. It is observed that maternal health programmes do not have a strong effect on child survival in infancy after controlling breastfeeding, maternal education and wealth index. While the effect of these variables on infant death is significantly increased with the inclusion of maternal health programmes.

The risk of infant death is high for the mothers less than 18 years compared to 18 – 24 years, may be due to the complications of pregnancy, delivery, premature birth and other related issues in teenage. It may also be noted that the risk of infant death increases with mother's age after 30 years. It may be due to the physical depletion in mothers at the time of conception caused poor fetal growth and low birth weight of child. Infant mortality is very high for short birth intervals and these findings reminiscent the study that the effect of maternal age and birth intervals are largely limited to the infancy period of mortality<sup>12</sup>. More than half of births occurred at home, whereas these births are more likely to experience infant deaths than births occurred in private hospitals and results are consistent with the work<sup>26</sup> Singh et al., 2007.

Families of large size have less risk of infant death. More members in households have more care of infants and provide better health care facilities. It is also very important question to deal with that how marital status affects infant death. There are few studies governed in the literature of infant mortality to consider such issues. Time duration after marriage is strongly associated with infant mortality: early married couples (0 – 4 years, after marriage) are less likely to experience infant death, may be due to the change in fecundity.

We recommend that it is need to strengthen maternal health programmes within country. Also, a lot of efforts are required to promote family planning programs to achieve:

increase in birth spacing intervals, improve the level of education of mothers, encourage breastfeeding and discourage teenage pregnancy. The results supported and promote a joint family system in India, which is in alarming situation now days. Towards achieving these objectives there is strong recommendation to improve the existing health policies or new ones need to be formulated to reduce infant mortality in India further.

## 5. References

1. Butz WP, Habicht JP and Davanzo J. Environmental factors in the relationship between breastfeeding and infant mortality: The role of sanitation and water in Malaysia. *American Journal of Epidemiology*. 1984; 119(4):516-25. <https://doi.org/10.1093/oxfordjournals.aje.a113769>.
2. Caldwell JC. Education as a factor in mortality decline: An examination of Nigerian data. *Population Studies*. 1979; 33(3):395-413. <https://doi.org/10.2307/2173888>.
3. Casterline JB, Cooksey EC and Ismail AF. Household income and child survival in Egypt. *Demography*. 1989; 26:15-35. <https://doi.org/10.2307/2061491> PMID:2737355.
4. Chandra RK. Immunological aspects of human milk. *Nutrition Reviews*. 1978; 36(9):265-72. <https://doi.org/10.1111/j.1753-4887.1978.tb07393.x> PMID:362248.
5. Chowdhury AH. Determinants of under five mortality in Bangladesh. *Open Journal of Statistics*. 2013; 3:213-9. <https://doi.org/10.4236/ojs.2013.33024>.
6. Govindasamy P, Stewart MK, Rutstein SO, Boerma JT and Sommerfelt AE. High risk births and maternal care. *Demographic and Health Surveys Comparative Studies*, No. 8, Macro International Inc. Columbia, Maryland, USA. 1993.
7. Hirve S and Ganatra B. A prospective cohort study on the survival experience of under five children in rural western India. *Indian Pediatrics*. 1997; 34:995-1001. PMID:9567529.
8. Hobcraft J. Womens education, child welfare and child survival: A review of the evidence. *Health Transition Review*. 1993; 3(2):159-73. PMID:10146571.
9. Hollowell J, Oakley L, Kurinczuk J, Brocklehurst P and Gray R. The effectiveness of antenatal care programmes to reduce infant mortality and preterm birth in socially disadvantaged and vulnerable women in high-income countries: a systematic review. *BMC Pregnancy and Childbirth*. 2011. <https://doi.org/10.1186/1471-2393-11-13> PMID:21314944 PMID:PMC3050773.
10. Janowitz B, Lewis JH, Parnell A, Hefnawi F, Younis MN and Serour GA. Breastfeeding and child survival in Egypt. *Journal of Biosocial Science*. 1981; 13(3):287-98. <https://doi.org/10.1017/S0021932000013493> PMID:7276033.
11. Jelliffe DB and Jelliffe EFP. *Human Milk in the Modern World*. Oxford University Press, Oxford. 1978; p. 84-96. <https://doi.org/10.1136/bmj.2.6151.1573>.
12. Manda S. Birth intervals, breastfeeding and determinants of childhood mortality in Malawi. *Social Science and Medicine*. 1999; 48(3):301-12. [https://doi.org/10.1016/S0277-9536\(98\)00359-1](https://doi.org/10.1016/S0277-9536(98)00359-1).

13. Mata LJ and Wyatt RG. Host resistance to infection. *American Journal of Clinical Nutrition*. 1971; 24(8):976-86. <https://doi.org/10.1093/ajcn/24.8.976> PMID:4327608.
14. McCann MF, Liskin LS, Piotrow PT, Rinehart W and Fox G. Breastfeeding, fertility and family planning. *Population Reports*. 1981; 24(Series-J):526-75.
15. Mosley W and Chen L. An analytical framework for the study of child survival in developing countries. *Population & Development Review*. 1984; 10:25-45. <https://doi.org/10.2307/2807954>.
16. Mturi AJ and Curtis SL. The determinants of infant and child mortality in Tanzania. *Health Policy Plan*. 1995; 10:384-94. <https://doi.org/10.1093/heapol/10.4.384> PMID:10154361.
17. Muluye S and Wencheke E. Determinants of infant mortality in Ethiopia: A study based on the 2005 EDHS data. *Ethiopian Journal of Health Devision*. 2012; 26(2):72-7.
18. National Family Health Survey: (NFHS) Reports for India and states (2005-06).
19. Palloni A and Millman S. Effects of Inter Birth Intervals and Breastfeeding on infant and early Childhood Mortality. *Population Studies*. 1986; 40:215-36. <https://doi.org/10.1080/0032472031000142036>.
20. Palloni A and Tienda M. The effects of breastfeeding and pace of childbearing on mortality at early ages. *Demography*. 1986; 23:31-52. <https://doi.org/10.2307/2061406> PMID:3956805.
21. Pandey A, Bhattacharya BN, Sahu D and Sultana R. Are too Early, Too Quickly and Too many Births the High Risk? An analysis of Infant mortality in India using National Family Health Survey. *Demography India*. 2004; 33(2):127-57.
22. Schellenberg JA, Nethan R, Abdulla S, Mukasa O, Marchant TJ, Tanner M and Langelier C. Risk factors for child mortality in rural Tanzania. *Tropical Medicine and International Health*. 2002; 7(6):506-11. <https://doi.org/10.1046/j.1365-3156.2002.00888.x>.
23. Schultz T. Studying the impact of household economic & community variables on child mortality. *Population & Development Review*. 1984; 10:215-35. <https://doi.org/10.2307/2807962>.
24. Singh A, Pallikadavath S, Ogollah R and Stones W. Maternal Tetanus Toxoid Vaccination and Neonatal Mortality in Rural North India. *Plos One*. 2012; 7(11):1-7. <https://doi.org/10.1371/journal.pone.0048891>.
25. Singh A, Pallikadavath S, Ram F and Alagarajan M. Do antenatal care interventions improve neonatal survival in India? *Health Policy Plan*. 2013; 29(7):842-8. <https://doi.org/10.1093/heapol/czt066> PMID:24038077 PMCid:PMC4471439.
26. Singh KK, Pandey N and Gautam A. Effect of Breastfeeding and Maternal Health Care programme on infant mortality. *Demography India*. 2007; 36(2):253-66.
27. Stoorbant MG. The Determinants of infant mortality: How far are conceptual frameworks really modeled? *Institute Demographic Universities Catholique de Louvain*. 2001.
28. UNICEF and WHO. Background paper for the Meeting on Infant and Young Child Feeding. Geneva, 9-12 October. 1979.
29. UNICEF. State of world's children, 2007. New York: UNICEF; 2006.
30. Wang L. Environmental determinants of child mortality: Empirical results from the 2000 EDHS. *The World Bank, Washington D. C.* 2003.