A Study on Determinants of Fertility and its Association with Child Mortality in India

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ABSTRACT---- ***The present study is based on Johan Bongarts famous framework for determinants of fertilityto the best of our knowledge the present study is 1st of its kind in Indiaexploring the variation on fertility determinants in light of mortality globally also we find limited work in this area according to the framework four proximate variables are capable of explaining 96 per cent of all fertility variations in any population however the rest four per cent variation in fertility levels are left to uncertainty and the present study also do not cover them.***

1. INTRODUCTION

In the developing world as a whole, a woman has a 1 in 76 life-time risk of maternal death, compared with a probability of just 1 in 8,000 for women in industrialized countries(1).Each year, about 7.5 million babies born in Sub-Saharan Africa, Asia, Latin America, and the Middle East and North Africa die before their first birthday(2). In most Sub-Saharan African countries, infant death is so common that more than half of women aged 30-49 have experienced such a loss.(3).Understanding the relationship between fertility rates and child mortality risks has been a longstanding interest of demographers and biologists. Standard demographic transition theory is one classic approach (Coale1973; Coale and Watkins1987; Davis1945; Davis1963). This theory posits that mortality rates for infants and children drive fertility rates, mediated through cultural, social and psychological processes the above theory is supported by numerous other studies(4)(5)(6).The association between child mortality and fertility continues to occupy a central place in population research. Fertility is the driving force of demographic growth globally. Low-birth weight, which is related to maternal malnutrition, is a causal factor in 60-80 per cent cases of neonatal deaths(7)Mortality rates are relatively low around the world by historical standards, though exceptions exist. It is widely believed that for most of human history fertility and mortality were both quite high and kept human populations from growing except very slowly over very long time scales. Population growth "took off" on its dramatic rise when death rates started to fall with the advent of industrialization and, even more importantly, the development of the germ theory of disease, healthy sanitation practices, and antibiotics and other medicines. But high levels of fertility raises the child mortality risks, because family resources are stretched, and the biological capacity of a woman to bear healthy children gets compromised due to short birth-intervals.Bongaarts found that family planning programs can reduce the child mortality rate by delaying the age at first birth, preventing high parity births and improving birth spacing(8).

Unobserved features of the woman, her household and her community may contribute to both high child mortality and high fertility. Failure to take into account the influence of these unobserved factors affecting both the variables can result in observation of a spurious relationship between fertility and child mortality. To further complicate the matter, fertility and mortality are known to be affected by common factors which are normal unmeasured but leave indelible imprints on both processes(4). Infant (and child) mortality is connected with fertility in two ways. Reductions in child mortality is regarded as a key trigger for the fertility transition (it reduces the 'demand' for children by improving the chances of survival to adulthood), and although this is no longer seen as a hard and fast causal link, there are analyses which strongly suggest that continuing high rates of infant and child mortality act as significant barriers to fertility decline. Indeed, a number of strategies can be employed to attempt replacement, all of which leave an imprint in the length of the birth interval. Among them, earlier resumption of sexual intercourse and cessation of contraception use are worth a mention. In societies practicing contraception, for example, evidence for replacement strategy is reflected as discontinuation or delayed adoption of contraception. Finally, a third mechanism may be implicated. This is the so-called 'insurance (hoarding) effect' and refers to the practice of bearing more children than the desired family size even if none

of the children ever died. This protects the size of a couple's sibship against any future child death and, therefore, insures that the couple would attain the desired family size at the end of their reproductive period. This form of anticipatory behaviour can result in raised fertility when an uncertainty in the prevailing mortality environment rises or when mortality increases with certainty. In some countries, fertility trends have followed the decline in mortality rates, thus equiblirizing the births and deaths producing zero or minimal growth over long period of time. Elsewhere, of course, fertility has not fallen to match the plummeted mortality rates. Indeed, the essence of rapid world population growth today is this incongruence between fertility and mortality rates. Where growth rates are nearly zero, the transition to a low-fertility regime isnearly complete.The causal relation also goes in the opposite direction since infant and early childhood mortality could affect fertility levels and patterns. The centrality of this particular relation in demographic research can hardly be exaggerated since it plays a pivotal role in the theories of fertility decline, particularly those associated with the demographic transition framework(10).In contrast to the remarkably unambiguous empirical evidence supporting the existence of an impact of fertility on infant and child mortality, evidence of an effect of infant and child mortality on fertility has been stubbornly elusive, with different data and models yielding very different results. This occurs in spite of the fact that the potential mechanisms producing the relation are relatively clear, at least in theory. This arouses the need for the present study which is aimed to examine variation in fertility levels in light of child mortality in India.

2. METHODOLOGY

The present study is a cross sectional study representing a national samplefor the present study NFHS-3 data was considered. National Family Health Survey-3collectedinformationfromanationallyrepresentative sampleof109,041 households,124,385womenage15-49,and74,369menage15-54.TheNFHS-3samplecovers 99percentofIndia'spopulationlivinginall the 29states. NFHS-3provides information on fertility, mortality, familyplanning, HIV-related knowledge, and important aspectsofnutrition,health,andhealthcare however for the present study fertility, mortality and vital variables related to family planning aspects were studied. The present study is based on famous Bongaarts framework(8) on fertility determinants with few modifications in light of child mortality. Bongaarts has refined the list of intermediate variables suggested by Davis and Blake. He proposed a list of eight intermediate variables and termed them as the proximate determinants of fertility. However using the data of 41 historical, developing and developed countries, it was concluded that 96 per cent of the variation in the total fertility rate of the population could be explained by the four principle proximate determinants, namely, marriage, contraception, induced abortion and lactationalinfecundability. The fertility inhibiting effects of the four principal variables are measured by four indices, which are defined as follows.

Index of Non-Contraception (C_c): The index of contraception varies inversely with the prevalence and use effectiveness of contraception practices by couples thus, if contraceptive practice is absent, C_c =1.00 and it declines below 1 with increasing prevalence and effectiveness. TheindexC_c *can*beestimated as

$$c_c = 1 - 1.18ue$$

Where

u=Proportion ofmarried women usingcontraception; and

e=Average use-effectiveness of contraception.

Index of Abortion (Ca): It is defined as the ratio of the observed total fertility rate (TFR) to the estimated TFR without induced abortion.TFR is a synthetic rate, not based on the fertility of any real group of women since this would involve waiting until they had completed childbearing. Nor is it based on counting up the total number of children actually born over their lifetime. Instead, the TFR is based on the age-specific fertility rates of women in their "child-bearing years", which in conventional international statistical usage is ages 15–44 or 15–49.The TFR is, therefore, a measure of the fertility of an imaginary woman who passes through her reproductive life subject to all the age-specific fertility rates for ages 15–49 that were recorded for a given population in a given year. The TFR represents the average number of children a woman would have were she to fast-forward through all her childbearing years in a single year, under all the age-specific fertility rates for that year. In other words, this rate is the number of children a woman would have if she was subject to prevailing fertility rates at all ages from a single given year, and survives throughout all her childbearing years(11).However reliable measurementsofprevalence ofinducedabortionarelacking hence an approximate measurement suggested by J. Bongaarts was used

$$c_a = \frac{TFR}{TFR + 0.4(1+u)TA}$$

Where

u=Proportionprotected bycontraceptionamong womenwhohave hadaninducedabortion. Since this information was unavailable thus zero value was assigned to it.

TA= Total abortion rate

Induced abortion incidence is extremely difficult to measure in most countries and India is no exception no single reliable data is available for much record however numerous of studies conducted by Indian council of medical research (ICMR) and other population and public health organizations have reported certain range values so based on through review of literature for the entire country the number of abortions a woman will have on an average throughout her reproductive

years is estimated to be between approximately 1.0 and 2.6(12). Thus an average figure of 1.8 is used for the present study.

Index of Infecundability (C_i): The index C_i equals to the ratio of total natural marital fertility in the presence and absence of postpartum infecundability caused by breastfeeding. It is estimated as

$$C_i \frac{20}{18.5 + i}$$

Where, i= Average duration of postpartum infecundability caused by breastfeeding and is calculated using the following equation

$$i = 1.7532e^{0.1396B - 0.001872B^2}$$

Where, B=median duration of breast-feeding, in months.

Index of Marriage (C_m) = For the present study child mortality experience is studied among married females of reproductive age group thus index of marriage is not considered for the present study.

Logistic regression and Poisson regression modelling is used to analyse birth histories in a flexible way were births are the dependent variable, and independent variables include age groups and other types of covariates such as child mortality in our case.AccordingtothePoissonmodel,theprobabilitythattherandomvariableY_i is equaltotheobservednumberofbirths(y_i)isassumedtofollow aPoissondistribution, with mean$\mu_i P(Y_i = y_i | \mu_i) = \frac{exp(\mu i)\mu i^{y_i}}{yi!}$.

The mean $\mu_i$can be broken down into the product of fertility rate (λ_i) and exposure (t_i). The regression model consists of modeling the logarithm of rates (λ_i) as a linear combination of age and additional covariate as child mortality. Thus the fertility rates can be computed directly as the product of the exponentials of the functions of age and child mortality as explanatory variables $\lambda i = exp[f(age)] * exp[g(child\ mortality)]$

3. RESULTS & DISCUSSION

In most of the developing world marriage signals the beginning of reproductive life, hence early marriage is associated with early child bearing and higher fertility, both of which are detrimental of child survival. From Table 1 one can observe the following findings among all the women reporting neonatal or post neonatal mortality, three-fifths were married before attaining 18 years of age. 37.5% of those who suffered loss of a child in the early neonatal period were married in the age of 18- 25 years whereas only 2.7% of those reporting early neonatal mortality had married at age 25 years or later. The effect of the age of the mother at first birth on child health outcomes has been explored in several studies in low- to middle-income countries and similar pattern had been widely reported by various different studies(13)(14)(15).Most women throughout the world understand that it is healthier to have children at widely spaced intervals. In all regions, most women who say they want another child want to delay their next pregnancy for 3-5 years. Women who practice family planning can avoid high-risk births and therefore reduce their chances of having a baby who will die in infancy. Few studies have indicated towards a strong negative correlation between levels of contraceptive use and levels of infant mortality(16).The present study also reveals that seventy per cent early, late and post neo natal mortality was observed among females who were presently not using any contraceptive methods and who doesn't intend to use it in future also, were as less than one third child mortality during neonatal and post neonatal period was contributed by women's who were using either modern or any traditional family planning methods. However few studies do suggest that the correlation between the two is not linear(17) and in few situations it's quite unpredictable too for example a study by Alberto Palloni(18) suggest that breastfeeding practises can act as confounding factor while dealing with such a relationship. While a fourth of those reporting early neonatal mortality desired childbirth within 2 years (of the loss), a fifth of the respondents who had lost their child in late or post neonatal periods, expressed a similar desire. A similar proportion desired subsequent child after 2 years of birth interval. While more than a third of those who lost a child in early neonatal period, want no more children; almost two- fifth of those who lost a child in late or post neonatal periods expressed their desire for no more childbirth the findings are in concordance with that of similar other studies(19)(20) cited. A whopping 96% and 93% of those who lost their child in early or late neonatal periods respectively stated that they had never breast-fed the child. In contrast, 87% of those who lost their child in post neonatal period had breast fed either for less than six months (47.5%) or for more (39.5%) similar findings from various other studies suggest that Infants aged 0–5 months who are not breastfed have seven-fold and fivefold increased risks of death, compared with infants who are exclusively breastfed(21). At the same age, non-exclusive rather than exclusive breastfeeding results in more than two-fold increased risks of dying (22),6–11-month-old infants who are not breastfed also have an increased risk of such deaths(23).Table 2 reflects that as compared to the women married before the legal age, those married later are at protection against child mortality. While those married in the age of 18- 25 years are at a reduced risk of 0.67 times, the risk of child mortality further dips to 0.31 times for maternal age at marriage more than 30 years. The risk of child mortality among contraceptive non- users is 1.35 times (95% CI= 1.13 to 1.62 times) as compared to that among the users of modern methods. Breast feeding is a statistically significant determinant, protecting against child mortality. As compared to non-breast feeders, those who breast fed their children for less than six months were at lower risk (0.07 times) of child mortality. The protection against child mortality is further evident among those who fed their children for six months or more (OR= 0.01 to 0.02 times as compared to non-feeders.) Those who desired

more children or who were undecided for future child births seemed to be at a higher risk of suffering a child loss, as compared to those who want no more children. This, however, may not be a causal association for child mortality but should rather be looked as an associated factor which may instead be influenced by the death of the child. From table 3 it's evident that early mortality in neonatal period has a greater impact in accelerating fertility levels which is in line with findings of similar studies in past.Johan Bongarts in his famous framework for determinants of fertility had defined four proximate variables that are capable of explaining 96 per cent of all fertility variations in any population he termed them as Index of contraception C_c, Index of abortion (C_a), Index of lactationalinfecundability (C_i) and Index of marriage. Index of contraception C_c=1.00 if contraceptive practices are absent and declines below 1 with Increasing prevalence of contraception the presence the present study reveals(Table 4) a 20 per cent growth in the index in presence of under-five mortality so one can conclude that non-contraceptive practices increases given the history of child mortality. A similar pattern was observed for Index of abortion (C_a) also where a hike of 11% was observed. However in light of breastfeeding duration it was accounted from previous studies(17) that the relationship between fertility and child mortality is non-linear and the same was observed in present study also were the Index of lactationalinfecundability (C_i) decreases by forty five per cent in couples who experienced child loss compared to couples who don't have such experience. Figure 1 reflects that there was a percentage change of eighty per cent (2.63 to 4.75) in total fertility rate in presence of child mortality as compared to that in the absence, Kaplan et al (24) compared TFR in two regions having different pattern of child mortality and had observed similar findings to that of our study
. While age specific fertility rate tends to rise in the presence of child mortality till 39 years of maternal age, thereafter it witnessed almost an equilibrium position. Poisson regression results are presented in Table 5, coefficients have to be interpreted as Incidence rate ratios (IRR) Total fertility rate (T.F.R) is observed highest in early (5.32) and late (5.64) neonatal period and a sharp decline (0.63) is observed after the post neonatal period moreover the model reports a positive impact of child mortality on total fertility which is in line with other empirical studies. More precisely we find out that women who have experienced child mortality during neonatal period (early/late) have almost twice (1.85 and 1.98) TFR than women's who don't have such experiences. However such an increase is proved to be larger than the one needed to replace the lost live, Bousmah et al(25) have reported similar findings were they observed a hike of 1.47 in presence of child mortality.

4. CONCLUSION

Age at marriage, contraceptive use, desire for male child and breastfeeding duration are proximate variables determining the fertility level nationally. Moreover it is observed that fertility and child mortality is tightly linked high fertility levels are observed in population exposed to child death especially in neonatal phase however the relationship is not purely linear in nature.

5. LIMITATIONS OF THE STUDY

The present study is based on Johan Bongarts famous framework for determinants of fertility according to the framework four proximate variables are capable of explaining 96 per cent of all fertility variations in any population however the rest four per cent variation in fertility levels are left to uncertainty and the present study also do not cover them.

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Table1. Percentage distribution of early, late and post neonatal mortality with respect to prominent fertility variables

Prominent Fertility variables	Early Neo-natal Mortality (N=1378)	Late Neo-natal Mortality (N=337)	Post Neo-natal Mortality (N=983)
Age at Marriage (Years)			
Less than 18	824(59.8)	208 (61.7)	630 (64.1)
18 – 25	516 (37.5)	120 (35.6)	337 (34.3)
25 – 30	32(2.3)	7 (2.1)	15 (1.5)
> 30 years	5 (0.4)	2 (0.6)	1 (0.1)
Contraceptive Use			
Non user (Intends to use latter)	728(52.8)	155(46.0)	488 (49.6)
Does not intend to use	270 (19.6)	70 (20.8)	198 (20.2)
Modern Method	278 (20.2)	86 (25.5)	233 (23.7)
Traditional Method	102 (7.4)	26 (7.7)	64 (6.5)
Desire for more Child			
Wants within 2 years	338 (24.5)	73 (21.7)	195 (19.8)
Wants after 2+ years	326 (23.7)	62 (18.4)	215 (21.9)
Wants (unsure about timing)	25 (1.8)	10 (3.0)	24 (2.4)
Undecided	42 (3.1)	11 (3.2)	30 (3.1)
Wants no more	492 (35.7)	131 (38.9)	380 (38.7)
Sterilized & Others	155 (11.2)	50 (14.8)	139 (14.1)
Duration of Breast feeding			
Never	1325 (96.2)	314 (93.2)	128 (13.0)
Less than 6 months	-	-	467 (47.5)
6 months & Above	53 (3.8)	23 (6.8)	388 (39.5)

Table 2: Logistic regression analysis with dependent variable as child mortality and prominent fertility variables as independent variables.

	Odds ratio (95% CI)	Standard Error	P -Value
Age at Marriage			
Less than 18 years	1	-	-
18 – 25 years	0.67 (0.61, 0.74)*	0.03	0.000
25 – 30 years	0.54 (0.39, 0.74)*	0.08	0.000
Above 30 years	0.31 (0.13, 0.70)*	0.13	0.005
Contraceptive Use & Intension			
Modern Method	1	-	-
Traditional Method	1.10 (0.88, 1.37)	0.12	0.371
Intends to use latter	1.11 (0.95, 1.30)	0.08	0.162
Non User	1.35 (1.13, 1.62)*	0.12	0.001
Breast feeding Duration			
Never	1	-	-
Less than 6 months	0.07 (0.06, 0.08)*	0.00	0.000
≥ 6 months	0.01 (0.01, 0.02)*	0.00	0.000
Desire for more child			
No	1	-	-
Wants within 2 years	3.24 (2.83, 3.70)*	0.22	0.000
Wants after 2+ years	1.38 (1.22, 1.56)*	0.08	0.006
Wants (timing unsure)	1.57 (1.13, 2.18)*	0.26	0.000
Undecided	1.68 (1.28, 2.21)*	0.23	0.000

Table 3:Linear regression analysis for predicting the association of fertility with explanatory variables as mortality

	β Coefficients (95% CI)	Standard Error	P- Value
Neonatal Mortality	0.26 (0.01, 0.50)*	0.12	0.036
Infant Mortality	0.07 (0.04, 0.09)*	0.01	0.000
Under five Mortality	0.03 (0.02, 0.04)*	0.005	0.000

Table 4: Per cent change in the values of fertility Indices in the relation with mortality

Fertility Index	Absence of Under-five mortality	Presence of Under-five mortality	Ratio (Presence/Absence)	Per cent Change* (Ratio-1)100
Index of Non-Contraception (C_c)	0.418	0.502	1.199	19.9
Index of Infecundability (C_i)	0.882	0.480	0.544	-45.5
Index of Abortion (Ca)	0.785	0.868	1.105	10.6

*Positive sign indicate increase in the fertility levels whereas negative sign indicates decline in the index.

Table5. Poisson regression analysis for Total fertility rate (TFR) by levels of child mortality as covariates.

Levels of Child Mortality	TFR (95% CI)	Incidence Rate Ratio (IRR)
No mortality (reference)	2.63 (2.60, 2.66)	-
Early Neo-natal Mortality	5.32 (4.89, 5.76)	1.85*
Late Neo-natal Mortality	5.64 (4.76, 6.52)	1.98*
Post Neo-natal Mortality	4.73 (4.23, 5.23)	1.55*
Under 5 Mortality after Infancy	0.63 (0.07, 1.19)	0.20*

* P-value< .01