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Gender differentials in infant and under-five mortality in India

Jyotishman Mukhopadhyay [1]*

[1] *Dept. of Community Medicine, Jagannath Gupta Institute of Medical Sciences and Hospital, Kolkata, West Bengal, India*

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ABSTRACT

Background: Perspective vista of child-health in India reclaim within the framework of Sustainable Development Goals to ensure healthy living and well-being for all at all ages. With significant young populace in India, health status of children becomes paramount undoubtedly.
Aim: Study precisely traces gender differential in child mortality, highlighting role of pointers like IMR and U_5MR in the context of parental, socio-economic, and environmental settings.
Materials and Methods: Commissioning a comprehensive approach, study evaluates data from National Family Health Survey (NFHS-4) alongside Demographic Health Survey (DHS), USAID spanning over 2015-2016.
Results: Risk of mortality was higher among male infants and under-five children compared to female. Birth order, birth spacing, mother's age at birth, maternal and parental education were observed valuable for child survival. Birth order higher than four with birth-spacing less than two years for mothers bearing child at 35 years of age and above were deleterious for child survival. Certain socioeconomic and environmental factors appeared significantly contributory in gender differences in child mortality. High-risk zone of Central India need critical and incisive surveillance to control child mortality due to preventable causes. Planning and implementation of health programs need to consider gender gap in child mortality for maternal and child health related policies and interventions.
Conclusion: Study emphasizes attention of policymakers and public health entrepreneurs to foresee rewarding interventions targeting the cohort of children at risk.

1. Introduction

The prime determinant of the health and well-being of a community is resonated by two most important indicators related to child health i.e. Infant mortality rate (IMR) and Under-five mortality rate (U_5MR). Sustainable Development Goals (SDGs) promulgated them as indicators of proposed development for all the member nations. Overall, IMR and U_5MR mirror the socioeconomic progression of a country including utilization of maternal and child health care (MCH) services. As a part of accomplishing the Millennium Development Goals (MDGs) with implementation of various family welfare measures, India was able to reduce the IMR and U_5MR to 32 and 37 per 1000 live births in 2018.[1] During 1990 to 2015, female IMR declined from 81 to 39, while male IMR dropped from 78 to 35 in India; and that furthered to 32 and 33 for male and female IMR correspondingly in 2018 reported by Sample Registration System (SRS), India.[1] However, the gender gap in IMR lingers to persist thereafter although in shrinking mode; still making the presence relevant.

Males are often considered at higher risk of mortality and morbidity against their female complements during the complete span of human life.[2,3] Bigoted treatment of

* *Corresponding author*.
E-mail address: jmukho@yahoo.co.in (J. Mukhopadhyay).

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girls in some of the Asian countries reportedly reflected lower rates of IMR in male than the female infants.[4] Newborn girls have advantageous biological survival than boys because they are less vulnerable to birth complications, infections, and congenital abnormalities.[5] This advantage, however, is annulled by the discriminatory care of the girls in some communities. As the child grows, the influence of socioeconomic and demographic variables on the child survival increases exposing the primal association between bio-demographics and child mortality.[6]

All countries of the South East Asia region, except India, have lower girl infant mortality compared to the boys.[7] Studies reported that parent's education, occupation, family income, types of wash-ups, and access to electricity had significant effects on child mortality.[8] WHO reiterated that the chance of survival of a child is strongly determined by the living conditions into which a child is born, brought up, nurtured, and nursed during illness.[9] Odds of compromised child-health is strongly related to remoteness of residences, rural dwellings, low educational status of parents, and marginalized subsistence due to poor socioeconomic position of the family.[10] Infant sex ratio in India has been favorable for males since 1980s. According to the Census 2011, infant sex ratio dropped by 8 counts, – from 927 in 2001 to 919 in 2011. The foremost reason of the descent in female births in India has been assumed to be the strong preference for male child in mediocre Indian families backed by technological advances in prenatal tests preventing birth of a girl child.[11]

1.1. Novelty and justification

Besides the estimates of child mortality trends, information about sex-specific child mortality is desirable to monitor progress of SDGs, though the elucidation of pattern in the gender relative mortality is not simple. Newborn girls survive better than boys because they are less exposed to birth complications, infections, and congenital anomalies. Therefore, in early infancy, ratio of IMR among boys and girls is greater than one, provided both sexes have equal access to food, nutrition, general care, medical attention and treatment. During late infancy, boys and girls are equally susceptible to infections and communicable diseases, so the gender ratio of IMR during 3 months of age to 1 year is nearer to 1. Post-infancy in toddlerhood, although boys and girls are similarly prone to infections and accidents under the well-developed canopy of protective immunity and adaptability, yet the sex ratio of mortality in the 1–4-year age group is actually more than 1. Notably, with the improvement in living conditions in developing countries and advent of antibiotics, frequency of infectious diseases has declined; and therefore, the same no more bear high relevance as cause of mortality during childhood. Thus, in the absence of sex-specific differences in the health seeking behaviour, medical attention and treatment of children, the sex ratio of infant mortality (M:F) is expected to be greater than one considering biological superiority of girl children; and also, to increase further although overall under-five mortality rate in developing countries is likely to decrease.

This study is unique in its outline to check and compare sex specific IMR and U_5MR during 2010 to 2016 in the background of demographic and socioeconomic stand of the communities and thereby monitor the progress in accomplishment of SDGs as recommended.

2. Aim

Striding through the trend, this endeavor aims to assess the gender disparities in infant and under-five mortality in India in the backdrop of certain socioeconomic and demographic factors.

3. Materials and Methods

Data from the fourth round of the National Family Health Survey (2015–16), and the Indian chapter of the Demographic and Health Survey (DHS), USAID was used as the base-line information in this study.[12,13] NFHS-4 is a nationally representative household survey conducted across the 29 states and 6 union territories of India. The key objectives of NFHS-4 are to provide state and district level estimates of fertility, mortality, family planning, maternal and child health indicators, and related factors. The household and individual response rates in NFHS-4 were 98 percent and 97 percent, respectively. The NFHS-4 is a cross-sectional study and was executed through a stratified multi-stage random sampling design. The rural sample was picked up through a two stage sampling with villages as the Primary Sampling Units (PSUs) at the first stage, followed by a random selection of 22 households in each PSU at the second stage. Two stage sample design was also applied in urban areas with Census Enumeration Blocks (CEBs) selected at the first stage and a random selection of 22 households in each CEB at the second stage.

In both the urban and rural areas during the second stage, households were selected after carrying out a comprehensive mapping, recording, and household listing with available residential address with prominent landmark in the selected first-stage units for easy recognition purpose later. PSUs having less than 40 households were combined and pulled together in the closest PSU for sampling convenience.

In each stratum, six approximately equal substrata were created on the basis of the estimated number of households in each village – each having two sub-substrata on the basis of the percentage of the population belonging to scheduled castes and scheduled tribes (SCs/STs) for equal

representation of the member families of the community in the study sample. The women gave information on all the children they had within last five years preceding the survey including their survival status or otherwise. Socioeconomic, environmental, and demographic data was suitably collected either from the mother or from other family members as per convenience.

The outcome measures were IMR and U_5MR during the study tenure. Infant mortality has been defined as the no. of death of infant per 1000 live birth in a defined geographical area in a particular year. Under five mortality is the death of a child aged between one to five year per 1000 live births in a defined geographical area in a specific year.

The NFHS-4 data rendered the socioeconomic and environment factors related to child health and survival. The present study considered factors such as current age of mother, mother's age at the time of child birth, education of parents, occupation of parents, religion, social group, mass media exposure, birth order and interval, sex of the child, sanitation facility, safe toilet facility, safe drinking water facility, place of residence, and region of residence to ascertain their effect on child health. Studies recorded in the recent past that the data collected in NFHS-4 are of reasonably good quality; even very close to SRS and Health Management Information System (HMIS) estimates.[14,15]

The work is based on a secondary data from the NFHS-4 report with no identifiable information on the study subjects. NFHS-4 team obtained the consent before and during the survey. This dataset is available in the public domain for research use and, hence, no ethical approval was contemplated specifically for the present study.

4. Results

Estimated Male and female IMR & U_5MR were noted according to various socio-demographic factors (Table 1), and it reflects that the male rate of mortality in infancy as well as under-five group has been significantly higher as compared to the female. Among all the factors, higher birth order, illiteracy, unemployed parents, and media exposure were found highly contributory.

Table 2 shows higher male IMR and U_5MR in the different facets and facades of social, religious, and economic front as compared to female; and the difference seen among the various socio-economic groups has been significant.

All environmental parameters show significant association with higher male IMR and U_5MR except the quality of drinking water (Table 3). Central Indian region reported highest IMR and U_5MR among the male and female respectively.

5. Discussion

Elements and determinants of gender gaps in infant and under-five mortality in India have been studied and reflected in this work. As a whole IMR and U_5MR reduced throughout the research period (2015-2016) compared to the past. While the difference between male and female IMR was 11.8 in 1992, the same was 10.8 per 1000 live births for U_5MR. Currently, the difference between male and female IMR is 5.4 against 3.6 per 1000 live births for U_5MR.[16] The rates have fallen considerably over the last decade.[13]The risk of mortality was revealed to be higher among male children; suggesting in support of the biological theory that portrays the disadvantages of male children clobbered with excess mortality culminating in the gender gap in child mortality in India.[17,18] The trend of gender gap in infant mortality appears to be the same across all over India; however, it has reflected some differences for under-five children.

Infant mortality among male children was higher than that of females in the context of maternal education, exposure to mass media, religion, caste status, cooking fuel, and residential origin. Studies in sub-Saharan countries documented insignificant differences in IMR due to gender differences; however, that indicated a higher risk of male under-five mortality perhaps due to genetic reasons.[19]It has been reported in the past that genetic reasons often predispose a higher risk of mortality among male children as compared to females.[20,21]

Certain socioeconomic traits appeared to have significant contribution to gender differences in infant and under-five mortality in India. Although variations exist between the survival chances of children of women with different socioeconomic characteristics, the same may not be the most conceivable deciding factor to cause the death of children of two sexes differentially. Differential treatment of children regarding food, nutrition, care, and medical attention within the family is unlikely even in the face of limited resources. Therefore, the gender gap in mortality can be explained based on genetic and biological reasons that place a girl child in an advantageous position compared to the boys.[22]

From 1992 (NFHS-1) to 2018 (NFHS-4) IMR and U_5MR have reduced considerably with U_5MR declining more than the IMR. Certain Indian states even attained SDG targets of child mortality beforehand; others are likely to follow shortly.[13] Male child attrition was higher than that of females in the early '90s, but somehow got changed the reverse way later (NFHS-2 &3). The male child mortality reported to have upsurged comparatively in recent times (2018-19) because of the GOI campaign titled 'Beti Bachao – Beti Padao' and compulsive prohibition of pre-natal sex determination followed by sex-selective abortion.[13]

IMR decreased identically for both sexes during 1992 to 2018 but the decline in male mortality was more than

Table 1: Estimated IMR and U_5MR across parental demographic characteristics

Background Demographic Characteristics	Estimated IMR per 1000 live births		Estimated U_5MR per 1000 live birth		Sample Size		Significance	
	Male	Female	Male	Female	Male	Female	IMR	U_5MR
Current Mother's age								
15–24	49.5	40.4	57.3	49.8	43,738	40,712		
25–34	38.7	33.7	49.1	44.5	77,951	70,764	p ≠0.05	p ≠0.05
35–49	52.6	51.3	68.1	68.6	13,844	12,619		
Mother's age at the time of childbirth								
15–24	46.1	37.2	55.2	45.6	69,235	64,113		
25–34	38.0	35.5	49.8	49.0	58,879	53,022	p <0.05	p <0.05
35–49	65.2	61.3	78.9	85.0	7418	6958		
Birth order and interval								
Birth order 1	46.6	35.7	55.1	42.6	50,438	46,563		
Birth order-2/3 and interval ≤24	49.8	43.8	58.3	57.5	19,335	17,424	p <0.05	p <0.05
Birth order-2/3 and interval ≥24	29.2	25.4	40.1	34.9	43,911	39,842		
Birth order-4+ and interval ≤24	82.5	96.5	105.7	126.6	6076	5835		
Birth order-4+ and interval ≥24	47.5	44.8	60.8	64.9	15,392	14,051		
Mother's education								
Illiterate	58.7	48.5	72.8	68.3	41,075	38,891	p <0.05	p <0.05
Literate	37.2	32.8	45.9	48.6	94,457	85,204		
Father's education								
Illiterate	66.7	51.2	83.9	74.4	4211	4028	p <0.05	p <0.05
Literate	40.4	30.3	49.9	37.7	19,320	17,635		
Mother's occupation								
Not working	43.8	32.3	54.9	42.4	18,345	16,837		
Agricultural work	57.1	43.7	71.3	58.5	2908	2675	p <0.05	p ≠0.05
Professional work	34.6	30.5	38.9	41.9	1233	1165		
Father's occupation								
Not working	42.9	45.1	59.4	68.9	1322	1226		
Agricultural work	51.2	38.2	71.7	49.8	7075	6589	p ≠0.05	p <0.05
Skilled/Unskilled	47.9	37.3	52.4	50.1	7858	7259		
Professional work	36.7	24.7	44.5	29.5	7277	6590		
Mass media exposure								
No exposure	58.6	49.8	71.8	69.2	36,909	34,939	p <0.05	p <0.05
Any exposure	38.2	33.0	47.5	41.0	98,624	89,156		

the female as regards U_5MR.[5] Extraneous factors like exclusive breastfeeding, improved maternal nutrition, better child rearing, upgraded housing and sanitation, enhanced awareness of childhood immunization could have resulted in a favorable situation for the male children. The child caring for a son is all the more likely to be better than the girl child in patriarchal Indian communities – could be perhaps supportive of the survival trend.[23] Belonging to lower social strata, scheduled class, and tribes resulted in higher mortality because of ignorance, poor awareness, and even aversion to access the health care provisions at the time of need. Although a high index of domestic hygiene, hygienic and sanitary wash-ups, clean cooking fuel, and safe water for drinking often stood pertinent for infant and child health;[23] but not always showcased proportional and comparable decline of child mortality as such.

The peninsular India reflected lower rates of IMR and U_5MR as compared to Central India, perhaps because the latter harbored the largest conglomeration of tribal and Indian aborigines – that could have been contributory.[24,25] Present work revealed that maternal attributes like education contributed considerably to child survival depicting lower IMR and U_5MR among children belonging to mothers with baseline education; and the finding corroborates with the noting of the studies of recent past.[26,27] Childbirth in higher maternal age (35-49 years) with shortened birth interval had heightened risk of child mortality with increased IMR and U_5MR in the present work; being supported by the

Table 2: Estimated IMR and U_5MR across parental social and economic characteristics

Social & Economic Characteristics	Estimated IMR per 1000 live births		Estimated U_5 MR per 1000 live birth		Sample Size		Significance	
	Male	Female	Male	Female	Male	Female	IMR	U_5 MR
Religion								
Hindu	44.7	38.1	55.3	49.5	99,138	90,023	p ≠0.05	p ≠0.05
Non-Hindu	39.3	35.7	49.1	46.2	36,394	34,072		
Caste								
Scheduled castes (SCs)	50.1	40.0	62.4	53.3	25,965	24,130	p ≠0.05	p ≠0.05
Scheduled tribes (STs)	51.9	36.1	66.5	50.6	23,727	22,885		
Other back- ward classes (OBCs)	43.1	40.9	53.7	52.1	54,708	49,139		
Socio-economic status								
Lower	61.6	51.1	75.5	70.1	34,712	32,987		
Upper lower	51.9	42.2	62	58.3	30,595	28,816		
Lower middle	40.7	37.9	52.3	44.4	26,838	23,903	p <0.05	p <0.05
Upper middle	30.0	28.2	41.0	32.6	23,037	21,120		
Upper	22.0	17.4	24.9	20.8	20,349	17,268		

Table 3: Estimated IMR and U_5MR across environmental characteristics

Environmental Characteristics	Est, IMR per 1000 live birth		Est. U_5 MR per 1000 live birth		Sample Size		Significance	
	Male	Female	Male	Female	Male	Female	IMR	U_5MR
Cooking fuel								
Unsafe unhygienic	51.4	26.3	63.2	33.1	75,321	70,304	p <0.05	p <0.05
Safe hygienic	28.6	43.8	37.5	57.4	40,235	35,512		
Drinking water								
Unsafe	45.1	40.5	56.3	56.7	12,855	12,062	p ≠0.05	p ≠0.05
Safe	43.1	37.5	53.8	48.5	112,122	1,02,227		
Housing								
Urban	29.5	27.1	38.3	36.3	35,562	31,635	p <0.05	p <0.05
Rural	49.2	41.6	60.2	53.6	99,970	92,459		
Region								
North	36.1	36.5	45.1	45.8	25,908	22,807		
Central	61.7	57.3	73.7	74.5	39,607	36,314		
East	45.9	36.6	54.8	45.9	28,350	26,280	p <0.05	p <0.05
Northeast	45.7	37.4	54.1	47.3	18,832	17,733		
West	31.1	22.4	37.9	30.1	9,445	8,585		
South	26.9	21.0	41.4	29.9	13,389	12,377		
India	43.3	37.9	51.4	47.8	135,532	124,094		

observation of study from the past.[28] A baby girl of a poor uneducated mother stood a higher mortality risk during infancy. Similarly, maternal age, birth order & interval, and parental education were seen as significantly contributing to U_5MR. The higher score in parental education was observed associated with lower mortality in children of both genders.

6. Strength and Limitations

The study used NFHS 4 data portraying the countrywide representation of both rural and urban populations from a variety of socio-economic strata. The observations perhaps appear appropriate for generalization to a certain extent, being population-based and applicable to the Indian context as such, thereby likely to throw light on the mortality differential of infants and children if further explored in depth. There is a general tendency in under-reporting of child death in South-East Asian countries which could alter the result and may not be a welcome notion.[29] Factors like pre-conceptional maternal health, nutrition, well-being, and morbidity state were neither counted nor considered for determining the cause of infant and child mortality, therefore factual indeterminacy continues to exist. Immunization, duration of exclusive breastfeeding, child feeding, and rearing practices were not taken into account nullifying their relatively high impact on child health and survival. The work only used secondary data on certain social, demographic, and economic factors to

find their association with gender differential in IMR and U_5MR which probably stand offering restricted universality of the findings in totality. An all-inclusive, comprehensive, and holistic approach to child survival may be resonating a better option for future intents.

7. Conclusion

Birth order, birth spacing, mother's age at birth, maternal and parental education were found as valuable indicators of child survival in the family sphere. Birth order higher than 4 with birth-spacing less than 24 months for the mothers bearing children at 35 years of age and above could have a deleterious effect on child survival. Tracking expectant women with such a combination of attributes appears desirable for pursuing better child survival in the Indian community. High-risk zones of Central India need critical and decisive surveillance to control and prevent child mortality due to common avertible causes. Planning and implementation of health programs need to consider the gender gap in child mortality for maternal and child health-related policies and interventions.

8. Source of Funding

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9. Conflict of Interest

None.

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Author's biography

Jyotishman Mukhopadhyay, Professor https://orcid.org/0000-0002-9470-9453