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Original Research Article

Influence of socio-demographic and environmental factors on child mortality in India

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ABSTRACT

Background: According to National Family Health Survey (NFHS) report (round 5), under five child mortality rate is 42 per 1000 live births which is far behind the sustainable development goal and National Health Policy, 2017. This research work aims to investigate the socio-demographic and environmental risk factors associated with child mortality between age 0-59 months in India.
Methods: To analyse the objective of this study secondary data of NFHS round 5 are used. NFHS is a large scale, multi-rounds survey conducted by ministry of Health and Family Welfare (MoHFW) with the collaboration of International Institute for Population Sciences (IIPS), Mumbai. Cox regression model is used for the statistical analysis and the data analysis work is carried out using R software.
Results: The research found that mortality rate is higher among mother's age less than 20 years and mother's having no education. In rural areas mortality rate is high compared to urban residence. Birth order of child more than 6 has 2.0966 times higher risk to die and the male child is more likely die than the female. Children born to family having richest wealth index (HR=0.6550, CI: 0.5856-0.7327) has the least mortality rate. Use of polluting cooking fuel and unimproved sanitation facility increase death risk on under-five mortality 1.1334 times and 1.0905 times respectively.
Conclusions: The study found a strong influence of socio-demographic and environmental factors on child mortality under the age of five.

Keywords: Socio-demographic factors, Environmental factors, Under-five mortality, Cox regression

INTRODUCTION

In southern Asia 36 children died per 1000 live births before reaching their fifth birthday in the year 2021.[1] National family health survey round-5 (NFHS-5) report indicates that 42 children in 1000 live birth in India die before their fifth birth day while the rate was 50 five years before in 2015-16.[2,3] Under-five mortality rate in India is declining over the decades but still it is far from the goal set by National health policy 2017, where the goal was set to reduce mortality rate to 23 by 2025.[4] Socio-demographic and environmental factors play a pivotal role in under five survival rate.[5]

Mother's education is the important determinant of child mortality. An educated mother can understand healthcare facility and their benefits and is more likely to access medical facility.[6,7] A study in Sub-Saharan Africa found that child morbidity is higher among children to mothers whose age at birth is less than 20 years.[8] Recent report of NFHS-5 indicates that some bio-demographic risk factors, mother's age, sex of the child and birth order are responsible for death in the first five years of life. Children born to women in the age group <20 years and 40-49 years have higher risk to death compared to women in the age group 20-40 years of age. Male children are more likely to die before reaching their fifth birthday and birth order of one or more than 6 are more likely to die during the first

five years of life.[2] Another research work published by Lancet revealed that in low-income and medium-income countries there is a huge disparity in mortality rate of under-5 children among the poor and rich people.[9]

Previous studies based on household air pollution (HAP) suggest that polluting cooking fuels create higher mortality risk for under five children.[10] Indoor air pollution due to cooking fuel increases premature mortality of children in India.[11] Unimproved sanitation facility is the cause of malnourishment or in the worst situation, death among under five children in India.[12]

The objective of this study is to identify the influence of socio-demographic and environmental factors on under-five mortality in India.

METHODS

Data source and study period

This research paper is based on cross-sectional study design. This study is an analytical study on child mortality in India uses secondary data of National Family Health Survey (NFHS) round 5 which was conducted in the year 2019-2020 in two phases- phase I from 17 June 2019 to 30 January 2020 and phase II from 2 January 2020 to 30 April 2021 by ministry of health and family welfare (MoHW) with the collaboration of International Institute of population studies (IIPS), Mumbai and is available in DHS website.

Sample selection criteria

NFHS-5 data provide estimates of all key indicators at the national and state levels for all 707 districts of India. The sample was selected through a two-stage sampling design, where the first stage unit was selected with probability proportional to size followed by a random selection of units in the second stage. The data of children aged 0-59 months are included in the study. The required data is extracted from nationally representative data set NFHS-5.

Statistical analysis

In this study cox regression model of survival analysis is used. It is very useful to find socio-demographic and environmental risk factors of child mortality related studies. The general form of cox regression model based on hazard function is given as follows

$$\lambda_x(t) = \lambda_0(t)e^{\sum_{i=1}^{k} b_i x_i}$$

Where $\lambda_0(t)$ is the baseline hazard at time t, x_i ($i=1,2,3,\ldots,k$) denotes a set of independent variables and $e^{\sum_{i=1}^{k} b_i x_i}$ is a multiplier specific to persons with the set of x_i and regression coefficient b_i.

Assumption of cox regression is related to proportional hazard. The assumption states that the multiplier $e^{\sum_{i=1}^{k} b_i x_i}$ is constant over time, then the model is proportional hazard model with $\lambda_x(t)$ proportional to $\lambda_0(t)$ and $e^{\sum_{i=1}^{k} b_i x_i}$ the constant of proportionality. The model can be given as follows.

$$\frac{\lambda_x(t)}{\lambda_0(t)} = e^{\sum_{i=1}^{k} b_i x_i}$$

In this analysis live births during the time preceding the survey, i.e., length of time from birth until the death in the survey period is taken as survival time.

Mother's age at birth, mother's education, place of residence, birth order, sex of the child and wealth index of family are taken as independent factors for under five child mortality. Mother's age is divided into class intervals <20 years, 20-29 years, 30-39 years, and 40-49 years. Mother's education is categorised as not educated, completed primary education, completed secondary education, and completed higher education. Place of residence as urban, rural and sex of the child as male, female. Birth order of a child is categorized as 1, 2-3, 4-5, 6+ and wealth index as poorest, poorer, middle, rich and richest.

Parents smoking status (smoking, not smoking), cooking fuel (Green fuel, polluting fuel and others), source of drinking water (improved, unimproved and others) and type of toilet use (improved, unimproved and others) are taken as predictor variables of environmental risk factors for the statistical analysis of child mortality in India.

RESULTS

Table 1 shows that mother's age >20 years have significantly lower risk of child mortality compared to mothers below 20 years of age. Mortality rate of under 5 children decreases as mothers' education increases. Mothers whose educational status are primary (HR=0.9168, CI: 0.8579-0.9798), secondary (HR=0.8299, CI: 0.7853-0.8771) or higher (HR=0.7453, CI: 0.6761-0.8215) have lower risk of child death than the reference category, not educated.

Risk of death is 1.033 times more among children residing in rural areas (HR=1.03316, CI: 0.9669-1.1040) as compared to the urban area. Female children have a significantly lower risk of dying (HR=0.8563, CI: 0.8208-0.8933) compared to their male counter parts. The result also revealed that birth order categories, 4-5 (HR=1.4414, CI: 1.3337-1.5579) and 6+ (HR=2.0996, CI: 1.8621-2.3673) have significantly higher risk of under 5 child mortality 1.44 times and 2.099 times respectively compared to first birth order. Also, wealth index decreases mortality rate significantly compared to the reference category (poorest).

Type of toilet facility and cooking fuel use in household play a significant role in child mortality. Death risk is 1.0905 times more among those peoples who uses unimproved (HR=1.0905, CI: 1.0376-1.1462) toilet facility than those who use improved facility. Polluting fuel (HR=1.1334, CI: 1.0709-1.1996) has 1.1334 times higher risk of child mortality (Table 1). Figure 1 represents survival probability of children aged 0-59 months under different risk factors. Figure 1a represents the demise of a child before his fifth birthday and the red line indicates mothers having no education. In Figure 1b there is a huge gap between the curves. It shows how the mother's age <20 years is responsible for under-five child death compared to other age groups. Similar results are also found in the graph for birth order and wealth index (Figure 1c and d). The purple line representing birth order 6+ is going downwards faster than others but in the case of wealth index the purple line represents the richest group which is falling slower than the other lines. Figure 1e indicates that households using green fuel has less chance to child mortality and the Figure 1f shows households using improved toilet facility having a negative effect on mortality rate (Figure 1).

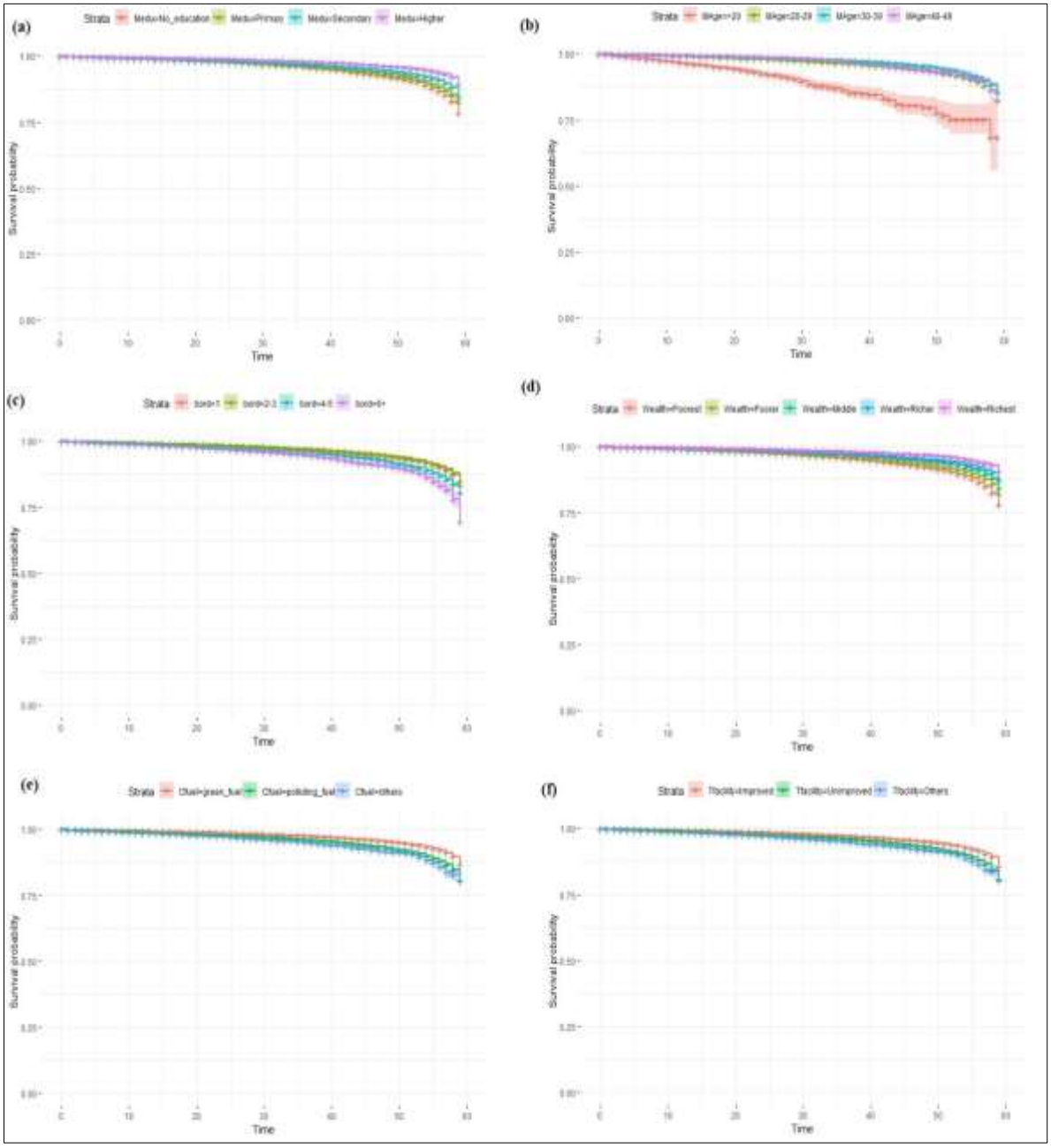

Figure 1: (a-f) Represent survival probability of under-five children for mother's education, mother's age, birth order, wealth index, cooking fuel and toilet facility.

Table 1: Hazard ratio and confidence interval of cox regression analysis of socio-demographic and environmental factors of under-five child mortality.

Independent variables	HR	CI
Mother's age		
<20	Reference	
20-29	0.2786	(0.2450-0.3168)***
30-39	0.1801	(0.1568-0.2069)***
40-49	0.1509	(0.1252-0.1820)***
Mother's education		
No education	Reference	
Primary	0.9168	(0.8579-0.9798)*
Secondary	0.8299	(0.7853-0.8771)***
Higher	0.7453	(0.6761-0.8215)***
Place of residence		
Urban	Reference	
Rural	1.03316	(0.9669-1.1040)
Sex of child		
Male	Reference	
Female	0.8563	(0.8208-0.8933)***
Birth order		
1	Reference	
2-3	0.9681	(0.9216-1.0170)
4-5	1.4414	(1.3337-1.5579)***
6+	2.0996	(1.8621-2.3673)***
Wealth index		
Poorest	Reference	
Poorer	0.9351	(0.8833-0.9899)*
Middle	0.8341	(0.7763-0.8963)***
Richer	0.8153	(0.7478-0.8889)***
Richest	0.6550	(0.5856-0.7327)***
Source of drinking water		
Improved	Reference	
Unimproved	0.90325	(0.8428-0.9681)**
Others	0.7945	(0.5716-1.1044)
Type of toilet facility		
Improved	Reference	
Unimproved	1.0905	(1.0376-1.1462)***
Others	1.2545	(0.9362-1.6810)
Type of cooking fuel		
Green fuel	Reference	
Polluting fuel	1.1334	(1.0709-1.1996)***
Others	1.6312	(1.1377-2.3388)**
Parent's smoking		
No	Reference	
Yes	0.7371	(0.4080-1.3317)

***p<0.01, **p<0.05, *p<0.1

DISCUSSION

In this research work, socio-demographic and environmental risk factors affecting child mortality are examined. The statistical analysis revealed that mother's age and mother's education have a significant effect on child mortality. Mortality rate of a child is highest among the younger mothers whose age is less than 20 years while rate of risk decreases as the age of mother increases, excluding the age group 40-49 years. A study in India among EAG states showed the similar result that child loss to young mothers is more than the elder mothers.[13] A similar pattern is also found in mother's education, i.e., risk of child loss decreases with increase in educational status. A mother with no education has a higher under five mortalities than those highly educated because an educated mother better understands the importance of periodical health check-ups and vaccination.[14] Birth order is a significant indicator of child mortality. Higher birth order 4-5 or 6+ increase more risk on child survival compared to birth orders 2, 3 or 4. Thus mother's age at birth, her educational status and birth order have significant effect on child mortality.[15]

Death risk of a female child of 0-59 months is comparatively lower than a male child of the same age. Findings from the study also indicates that there is a huge disparity in mortality between rural and urban area. This result is in concordance with research of Ethiopia which reveals that hazard of death of under-five child is higher in rural areas compared to urban area.[16]

The present study revealed that hazard rate is much higher among children who are born in the poorest family while it is very low among children born in the richest family. As the wealth index increases the risk of death decreases because affordability for better health facility. This result is similar with a study done in Ghana. Child mortality is highest among the poor.[17] Socio-economic factors such as mother's education, age, sex of child, birth order, wealth index and place of residence are important factors in under – five mortality disparities.[18]

The study examined that some of the environmental factors (type of toilet and cooking fuel) has substantial influence on child mortality. The children using unimproved toilet facilities are more likely to die compared to those using improved toilet facility. A study on impact of water and sanitation on child mortality in Nigeria observed that the improved facility of water and sanitization facility can help to reduce mortality rate.[19] Cooking fuel plays an important role in lowering under five mortalities. Households where green fuels are used the risk of death is less than the households using any other fuel. Air pollution due to polluting cooking fuel is associated with modest child mortality rate.[20] Also mortality rate is lower in the households who have access to improved sanitation facility.[21] Environmental factors such as poor sanitation and cooking fuel are still responsible for childhood mortality in Nigeria.[22]

Limitations

There are some limitations in selection of independent variables. Examination of influence of some variables like outdoor air pollution, place of residence near industrial

area, and consuming unhygienic food items on child mortality is restricted due to use of secondary data analysis.

CONCLUSION

Under-five child mortality rate is still high in India for some socio-demographic and environmental factors. Younger mothers of age less than 20 years and having no education face child loss more than the mothers of elder age group and higher education. The reason may be younger mothers are physically and mentally not matured enough to maintain a balance between household activities and childcare and an uneducated mother unable to understand the routine health care measures that should be taken. In the rural areas death rate of children are higher than urban areas. This study found that the chance of dying a child is more for birth orders of 4+. Wealthier people can provide good health care facility and nutrition food to their child, thus lowering child mortality. Under five mortalities is the lowest in richest households compared to the poorest one. Environmental factors have significant impact on mortality. Use of polluting fuel and unimproved sanitation facility leads to increase in mortality rate.

Government has made a lot of policies to overcome the situation of high mortality rate among children below five years, but it is not reached to each household at the time of need. A proper monitoring is required to check why after a lot of schemes under five mortalities is still high in India. Mother's education must be given utmost priority as it will increase mother's age at birth and can counter other socio-demographic and environmental factors responsible for higher child mortality. Government should provide health care facility to the poorest and in the rural areas and ensure to provide nutritional food to the poorest child. There should be awareness camps to educate women about the environmental risk factors such as cooking fuels and use of improved toilet facilities to lower child mortality.

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