Original Article

INTER-STATE VARIATION IN NEONATAL MORTALITY RATE AMONG INDIAN STATES

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ABSTRACT

Background: Infant Mortality Rate has been accepted as an important indicator of overall health status of community and has also been included in millennium development goal indicators. The study was conducted to find the: Association of neonatal mortality rate with different risk factors

and association of neonatal mortality rate with various interventional variables

Methods: This study uses data from Indian National Family Health Survey -3 (NFHS-3). Sample for analysis includes all 29 states of India in which third round of National Family Health Survey were conducted and reports for the same were available. Data was obtained from state reports of National Family Health Survey -3.Neonatal mortality rates of different states were taken as dependent variable.

Results: Bi-variate regression showing influence of percentage of women age 15-19 years who have begun childbearing and percentage of women with BMI < 17 on neonatal mortality was confounding effect of socio-economic status. Bi-variate regression showing influence of ante-natal check up, iron-folic acid supplementation and post natal check up on neonatal mortality was confounding effect of socio-economic status.

Conclusions and Recommendations: The only variable other than socio-economic condition which was having association with neonatal mortality rate was percentage of hospital delivery. Government of India should take all possible measures to make health care services particularly facility based services available, accessible and affordable.

Keywords-Neonatal mortality rate, Risk factors, NFHS-3, Regression analysis, interventional variables

INTRODUCTION

Infant Mortality Rate has been accepted as an important indicator of overall health status of community and has also been included in millennium development goal indicators. According to MDG4 Infant mortality rate should decline by two-thirds between 1990(84/1000 live births) and 2015(28/1000 live births).[1] However from 2000 to 2010 IMR in India has declined from 68/1000 live births to 47/1000 live births with average annual decline of only 2.1/1000 live births.[2] IMR has departed from the longer term trend since 1994. In 1997 IMR was 71/1000 live births against predicted value of 63.5/1000 live births based on longer term trend. Recent data is clearly indicating that rate of decline in IMR is

slowing down and at the current rate of decline it will be difficult for India to achieve millennium development goal.[3, 4]

Two-thirds of infant deaths occur during first month of life. Out of all neonatal deaths three quarter happens within first week of life.[5] Home delivery contributes to half of neonatal deaths.[6]

Most important determinant of neonatal mortality and morbidity is Low birth weight. Low birth weight contributes to three-fourth of neonatal deaths and half of infant deaths. Principal risk factors for low birth weight are poor maternal nutrition and too early, too frequent and too many pregnancies.[7]

Out of all neonatal deaths one third are due to infections. Pre-term birth complications are second major cause of death among neonates which is followed by Birth asphyxia.[8] Neonatal sepsis is primary cause of death in 20% of neonatal deaths.[9] A study in Uganda on three delay model to understand neonatal deaths has identified that among 50% cases delay was due to failure in problem recognition or in deciding to seek care. 30% cases received delayed care at health facility.[10]

To accelerate the pace of decline of IMR it is essential that important risk factors for infant death among several are identified and also more effective interventions among all are selected.

METHODS

Data sources: This study uses data from Indian National Family Health Survey -3 (NFHS-3).[11] The International Institute for Population Sciences coordinated the survey with support from several international organizations. The large-scale cross-sectional survey was conducted in a representative sample of households throughout India during 2005-06. A summary of the coverage and target population is presented in Table 1. The sampling, questionnaire structure, and content of the NFHS surveys follow what has been adopted by the Demographic Health Surveys (DHS) in other developing countries. The NFHS uses nationally representative area-based sampling frames in each survey. During Nov. 2005 to Aug. 2006 1,24,385 women age 15-49 and 74,369 women age 15-54 were interviewed by eighteen research organizations. Sample size was calculated in terms of ever-married women in the reproductive age group. Initial target was set to interview 1,500 ever married women in states with less than 5 million population, 3,000 women in states with a population between 5 and 30 million, and 4000 women in states with more than 30 million populations according to 2001 census. In each state urban and rural samples were drawn separately. Within each state, villages were selected with probability proportional to population size followed by random selection of households within each village. In urban areas, wards were selected with PPs sampling. Within wards census enumeration block (CEB) were randomly selected. Selection of households within CEB was done by random method. Interviewer team was trained with eight different manuals to maintain standardized survey procedures across states and to minimize non-sampling errors. Manuals described procedures for drawing location and layout maps of sample areas, listing households and selecting household for surveys as well as standard interviewing techniques and procedures, field procedures to be followed in the process of measurement of bio-markers. Height and weight of women was measured by two health investigators on each survey team. Health investigators took blood samples of women and measured hemoglobin level in the field using portable HemoCue instruments. The NFHS produced high response rates in all states ranging from 90% in Maharashtra and Meghalaya to 99% in Madhya Pradesh and Chhattisgarh. Details of the survey methodology and response rates have been published.[11]

Our sample for analysis includes all 29 states of India in which third round of National Family Health Survey were conducted and reports for the same were available. Data was obtained from state reports of National Family Health Survey - 3.

Indicators and measures: Neonatal mortality rates of different states were taken as dependent variable. Independent variables were following percentages/proportions of different states: proportion of the population in lowest quintile of wealth index, percentage of women in age 15-49 having BMI < 17, percentage of women age 15-19 years who have begun childbearing, percentage of pregnant women with moderate(7.0-9.9g/dl) anaemia, percentage of live births delivered at home, Percentage of live births delivered with assistance from non-health professionals (other than doctor, ANM, Nurse, Mid-wife, LHV), Percentage of higher birth order (4th or above)

among total births during last three years, percentage of births having interval < 2 years since the preceding birth.

Data analysis: The analyses in this paper are primarily descriptive and present regression of neonatal mortality rate by proportion of various risk factors. In first step bi-variate linear regression was done followed by multiple linear regression was done with three variables. As numbers of states were only twenty nine, regression analysis with more than three variables was not done. Regression of neonatal mortality rate by selected interventional variables was done in similar manner. Data were managed and analyzed using SPSS (version) software which usually reveals F statistic (ANOVA) for relationship between two variables, un-standardized regression co-efficient and t statistics for comparing un-standardized coefficients.

RESULTS

Table -1 shows the bi-variate linear regression of neonatal mortality rate by prevalence of different risk factors. Relationship of Neonatal mortality rate with percentage of births having interval less than two years since preceding birth was not significant (F-0.26, p-0.61). There was no strong linear relationship between two variables with coefficient of determination only 0.01. On comparing the t value with one another it is clearly evident that percentage of the population in lowest quintile of wealth index has highest influence on neonatal mortality rate (t-7.48, p-0.00). Other risk factors showing major influence on neonatal mortality rate were percentage of women age 15-19 who have begun childbearing (t-4.60,p-0.000), percentage of live births delivered at home (t-4.40,p-0.00) and percentage of women in age 15-49 with BMI < 17 (t-4.36,p-0.00).

Table-1 Univariate Regression analysis of Neonatal mortality rate with different risk factors

Variables	R square	F	P value	B	SE	t	P value
Lowest	0.68	55.97	0.00	0.65	0.09	7.48	0.00
BMI	0.41	19.03	0.00	1.34	0.31	4.36	0.00
Anaemia	0.21	6.88	0.01	0.61	0.23	2.62	0.01
Teenage pregnancy	0.44	21.20	0.00	1.17	0.25	4.60	0.00
Home delivery	0.42	19.43	0.00	0.32	0.08	4.41	0.00
Assistance by non-professional	0.35	14.19	0.00	0.33	0.09	3.77	0.00
Percentage of birth before two years	0.01	0.27	0.61	0.26	0.50	0.51	0.61
Higher birth order	0.21	6.95	0.01	0.49	0.18	2.63	0.01

Table-2 Mutivariate Regression analysis of Neonatal mortality rate with selected risk factors

Variables	R square	F	P value	B	SE	t	P value
BMI	0.68	30.87	0.00	0.45	0.28	1.60	0.12
Anaemia	0.65	26.06	0.00	0.07	0.18	0.40	0.69
Teenage preg	0.66	28.71	0.00	0.29	0.27	1.07	0.29
Home delivery	0.70	33.69	0.00	0.13	0.06	2.09	0.05
Assistance by non-professional	0.70	33.71	0.00	0.14	0.06	2.10	0.05
Higher birth order	0.65	27.00	0.00	0.04	0.14	0.25	0.80

Table-2 shows the multiple linear regressions of neonatal mortality rate by percentage of population in lowest quintile of wealth index and other risk factors. Suggested by F test all six variables were having significant relationship with neonatal mortality rate. Controlling for the percentage of population in lowest quintile of wealth index, only two variables were reliably predicting neonatal mortality rate – percentage of deliveries assisted by non-health professional (t-2.09, p-0.046) and percentage of births delivered at home (t-2.09, p-0.046). Bi-variate regression showing influence of percentage of women age 15-19 years who have begun childbearing and percentage of women with BMI < 17 was confounding effect of socio-economic status.

Table -3 shows the bi-variate linear regression of neonatal mortality rate by prevalence of different interventional variables. Relationship of Neonatal mortality rate with percentage of mothers who received supplementary food during pregnancy was not significant (F-0.0, p-0.98).

Table-3 Univariate Regression analysis of Neonatal mortality rate with possible interventional variables

Variables	R square	F	P value	B	SE	t	P value
Supplementary food taken	0.00	0.00	0.98	0.00	0.13	0.02	0.98
Antenatal care by health professional	0.15	4.71	0.03	-0.29	0.13	-2.17	0.04
IFA for 90 days	0.28	10.69	0.00	-0.37	0.11	-3.27	0.00
> 3 ANC taken	0.32	13.28	0.00	-0.32	0.08	-3.64	0.00
Post natal check up within 2 days	0.37	15.99	0.00	-0.32	0.08	-3.99	0.00

There was no strong linear relationship between two variables with coefficient of determination only 0.0. On comparing the t value with one another it was clearly evident that risk factors showing major influence on neonatal mortality rate were percentage of pregnant women who took Iron Folic Acid for more than 90 days (t-3.27, p-0.000), percentage of pregnant women who had at least three antenatal check up (t-3.64, p-0.00) and percentage of women who had post natal check up within two days of delivery (t-3.99, p-0.00).

Table-4 Multivariate Regression analysis of Neonatal mortality rate with selected interventional variables

Variable	R square	F	P value	B	SE	t	P value
Antenatal care by health professional	0.68	27.21	0.00	-0.04	0.09	-0.41	0.68
IFA for 90 days	0.71	31.67	0.00	-0.15	0.08	-1.75	0.09
> 3 ANC taken	0.70	29.65	0.00	-0.10	0.07	-1.32	0.20
Post natal check up within 2 days	0.71	31.35	0.00	-0.12	0.07	-1.69	0.10
Supplementary food taken	0.74	36.45	0.00	-0.18	0.07	-2.49	0.02

Table -4 shows the multiple linear regressions of neonatal mortality rate by percentage of population in lowest quintile of wealth index and other interventional variables. Suggested by F test all four variables were having significant relationship with neonatal mortality rate. Controlling for the percentage of population in lowest quintile of wealth index, not a single variable was reliably predicting neonatal mortality rate – percentage of pregnant women who took Iron Folic Acid for more than 90 days (t-1.75, p-0.09), percentage of pregnant women who had at least three antenatal check up (t-1.32, p-0.19) and percentage of women who had post natal check up within two days of delivery (t-1.69, p-0.10). Bi-variate regression showing influence of ante-natal check up, iron-folic acid supplementation and post natal check up was confounding effect of socio-economic status.

DISCUSSION

Our study shows that bi-variate regression showing influence of percentage of women age 15-19 years who have begun childbearing and percentage of women with BMI < 17 on neonatal mortality rate was confounding effect of socio-economic status. Influence of ante-natal check up, iron folic acid supplementation and post natal check on neonatal mortality rate was also confounded by socio-economic status. The only variable other than socio-economic condition which was having association with neonatal mortality rate was percentage of hospital delivery. Thus variation in neonatal mortality rate among Indian states can be attributed to percentage of population in lowest quartile of wealth index and percentage of hospital delivery.

Infant Mortality rate is not only used for measurement of health status but also as a part of standard of living evaluations in economics.[12] The infant mortality rate correlates very strongly with, and is among the best predictors of state failure.[13]

Rationale for selecting the infant mortality rate as an health indicator was not only to measure health status of children but was to measure health status of total population. It also reflects the socio-economic condition in which children live and also availability, accessibility and affordability of health care services particularly peri-natal and neonatal care.[14,15]

For more than 20 years India emphasized on "Dai" training (TBA) to reduce maternal mortality rate. Ultimately some reduction in maternal mortality rate was achieved in recent years by promoting hospital delivery and providing transport facility.

A review of potential interventions to reduce neonatal mortality rate has suggested that at 90% coverage family-community based interventions along with outreach services can reduce neonatal deaths by 18-37%. Settings with very high neonatal mortality rate will show greater effect. For more than 50% reduction in neonatal mortality rate simultaneous expansion of facility based clinical services which make up 62% of total programme cost is needed.[16]

Facility based neonatal care might be available up to district level in India but availability at sub-district level is questionable. Even if neonatal care is available at district and higher level, its affordability is also questionable. Government of India has regulated the petrol price since several years but cost of medical services is not under any regulation and escalating day by day.

If we will reduce neonatal mortality rate without reducing economic disparity and making healthcare (neonatal care) services available, accessible and affordable, question will still remain whether we have treated an indicator or underlying cause for which an indicator was selected. In the race of reducing infant mortality rate, have we forgotten the purposes for which an indicator has been selected?

The main limitations of this study are those associated with all ecologic studies. Data were collected at the community level; therefore, it is not possible to infer individual-level risk from the results. However, Indian institute of population science can conduct further analysis with individual data. As number of states were limited it was not possible to conduct multiple regressions with more variables.

Another limitation of our study is that we have tested only limited number of variables and not all. It does not include variables like availability, accessibility and affordability of neonatal care services, three delays, etc. as data for same was not available. District level health surveys have included certain variables pertaining to health services but they have surveyed only government facilities and not private. DLHS can expand their survey to private sector for the measurement of availability, accessibility and affordability.

Government of India should take all possible measures to make health care services particularly facility based services available, accessible and affordable. As well as it should adopt economic policies that can reduce economic disparity rather than wasting scarce resources on other interventions to reduce infant and neonatal mortality rate.

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