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INFANT MORTALITY RATE IN RURAL ASSAM:
AN EMPIRICAL ANALYSIS

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Abstract:

Reduction of infant mortality rate has been recognised as important goal in the Millennium Development Goals of United Nations Organisation. Assam in north eastern region of India has also experienced high rate of infant mortality in rural areas. Therefore, the paper attempts to highlight the problem of high rate of infant mortality in Assam. The study attempts to examine the trend of infant mortality in rural Assam in comparison with rural India. As adopting policies for reduction of this disparity depends crucially on identification of factors, therefore, the paper also put an endeavour to identify the factors behind the high infant mortality rate in rural Assam. The results show that improvement in health facilities in the state is slow in comparison with the country average. Monthly Per capita Consumer Expenditure, Literacy Rate, and Female Work Participation Rate are the significant factors in influencing infant Mortality Rate in rural Assam.

KEYWORDS:

Infant Mortality Rate, Factors, Rural, Assam.

PROBLEM

Providing quality health facilities to its citizens has remained a big challenge for every country in the world. The problem is more serious for countries in the developing world.

Infant Mortality Rate (IMR) is regarded as an important and sensitive key indicator of health status of a community. Decline in the level of infant mortality is a useful indicator of development in any society. In India, there are considerable rural-urban variations in IMR. In 2010, as against a figure of 31 in urban India, infant mortality rate was much higher at 51 for rural India (Registrar General India, 2012). As these disparities can significantly increase overall infant deaths, the challenge for equal accessibility of health care services in rural and urban areas raises serious questions for the policy-makers.

As adopting policies for reduction of this disparity depends crucially on identification of factors, the identification of the factors behind variations in the infant mortality in rural and urban areas is important. Various studies have discussed the problem of IMR and factors affecting the IMR. The analyses consider background (mother's tribe, religion, and current place of residence), demographic (mother's age, age at marriage, number of children ever born, and duration of breast feeding), and socioeconomic (maternal and paternal education and occupation, and household income) variables (Adlakha and Suchindran, 1985; Bailey, 1988). One study by Poel et al. (2009) examines the determinants of infant and child mortality in six sub-Saharan African countries (Benin, Central African Republic, Chad, Guinea, Mali, and Niger) and the study considers that higher infant mortality rates in rural areas is due to both the community and household characteristics. Rural disadvantage in household characteristics, both observed and unobserved is the main reason behind the high infant mortality rate. Among the observed

characteristics, environmental factors—a safe source of drinking water, electricity, and quality of housing materials—are the most important contributors. According to the study, policy needs to operate at both the community and household levels to correct such deficiencies. In another study by Mustafa and Odimegwu (2008), breastfeeding, ethnicity and fertility variable (birth order and birth interval) are found as the significant determinant in case of rural areas in Kenya.

In India, researchers found that four most significant quantifiable factors that could be changed to reduce IMR are maternal age (IMR increases with maternal age of 30 years and older), parity (IMR increases with parity), literacy (IMR is higher among illiterates than literates), and low socioeconomic status [SES] (IMR increases as SES decreases) (Gupta et al., 1991). Another study empirically tests for factors affecting infant mortality rates in rural Punjab. A major factor is inadequate attention that has been paid to improved health care practices within the home. The study shows that Women's autonomy, social class, and mothers' education significantly influence child survival (Das Gupta, 1990). Based on a cross-sectional model, the results show that fertility rates, female participation in the labour force, per capita GNP, and female literacy rates significantly affect infant mortality rates (Zakir and Wunnava, 1997). According to Sharma (2008), rural infrastructure can have powerful influences on health outcomes of rural India.

Therefore it is important to measure determinants of IMR in different context. Such location-specific like rural-urban analyses are necessary for the state and will serve useful purpose for design of policy (Agnihotri, 2001).

Assam in north eastern region of India has also experienced considerable variations in health care facilities in urban and rural areas. This gets reflected in the variation of IMR in urban and rural Assam which are 36 for urban areas and 60 for rural areas respectively (Registrar General India, 2012). In Assam only a few studies have been found about the IMR in the state and the study related to the high IMR in rural Assam and the factors affecting IMR in rural Assam are scanty. Therefore, the objective of the paper is to examine the trend of infant mortality in rural Assam in comparison with rural India. From the foregoing analysis the factors affecting the IMR in the context of the state can be regarded are demographic changes, and socioeconomic inequality. Thus the study also put an endeavour to identify the factors behind infant mortality in rural Assam.

SIGNIFICANCE OF THE STUDY

In the context of developing countries like India the study assumes significance where providing quality health facilities to its citizens have remained a big challenge for the policy makers. Progress in this regard has remained painfully slow and concerns of the countries in ensuring health facilities are reflected in the reports of different international agencies like United Nations. In particular, reduction of child mortality has been recognised as important goal in the Millennium Development Goals (MDG) of United Nations Organisation. Assam, a comparatively backward state of India, where rural children face higher mortality rates than their urban counterparts, this study is significant as this disparity significantly increases overall infant deaths in the state and the challenge for equal accessibility of health care services in rural and urban areas raises serious questions for the policy-makers. As identification of the factors is important for the policy makers for reduction of the IMR, therefore, determination of the factors behind high infant mortality in rural Assam is very important.

SCOPE AND LIMITATION

The paper examines the factors responsible for the level of IMR in rural areas with the help of regression analysis and therefore the study may be helpful in predicting the factors influencing infant mortality in rural Assam. The present study can be viewed as a research contribution to the effort to address the issue of high infant mortality rate in rural Assam, a backward state of India. The scope of the study lies in identifying the determinants of infant mortality in rural Assam so that the policy makers can make their policies to reduce high infant mortality rate in rural Assam. Although the study is carried out for the state of Assam, the findings of the work may be equally relevant for economies with similar constraints.
The limitation of the study is non-availability of the rural-urban break up data for the state. The present study has taken out with the available break up data only. Field study of cross section data may provide valuable insight in this regard.

DATA SOURCE AND METHODOLOGY

The study is based on the secondary data collected from various sources like Registrar General of

India for various years, National Sample Survey Organisation, Census Reports, 1991, 2001, 2011 etc. A retrospective study design is used to collect yearly data for Assam covering the period from 1991 to 2009.

THE EMPIRICAL MODEL

From the review of literature some factors are found affecting the IMR in rural Assam and following factors can be taken in the context of the state.

1. Total Fertility Rates (TFR): Studies (Measham et al., 1999; Kramer and Greaves, 2007) have shown that fertility rates and infant mortality rates are closely related. Therefore total fertility has been taken as one of the possible important factors influencing IMR in the state. TFR might affect infant mortality rates in a positive way; the relationship is therefore expected to be positive.
2. Literacy Rates (LR): Female literacy rates significantly affect infant mortality rates (Adlakha and Suchindran, 1985; Bailey, 1988; Gupta et al., 1991). The literacy rate has been chosen because educated mothers are more likely to be aware of nutrition and their children's health (Gubhaju, 1986). The data for over all literacy rates are used here due to non-availability of rural-urban break up time series data for female literacy for the state. Here the relationship between IMR and LR is expected to be negative.
3. Female Workforce Participation Rates (FWPR): A study empirically tests for factors affecting infant mortality rates and the results show that female participation in the labour force significantly affects infant mortality rates (Gupta et al., 1991). Another study results indicate that maternal education and occupation affect mortality significantly (Bailey, 1988). Therefore Female Workforce Participation Rate (FWPR) in the labour force has been taken as one of the possible important factors affecting IMR in the state and has a negative relationship with IMR. Initially as female participation in the labour force increases, IMR increases owing to lack of childcare services. After a point, IMR starts to decrease with the concurrent economic development brought about by increased female participation in the economy (Zakir and Wunnava, 1999).
4. Monthly per Capita Consumer Expenditure (MPCE): Bailey (1988) considers household's income as one of the important determinants of IMR. In the context of the state MPCE is taken as the proxy variable of income due to non-availability of rural-urban break up income data. The relationship of MPCE with IMR is hypothesized to be negative implying that an increase in monthly per capita expenditure decreases IMR at a decreasing rate.

To examine the influential factor of IMR in rural Assam a log-linear multiple regression model is constructed in the study. In the model, the IMR is the dependent variable and TFR, LR, FWPR, and MPCE are the main determinants.

The log-linear multiple regression model is constructed as follows:

$$\ln IMR_{ti} = b_0 + b_1 (\ln IMR)_{ti-1} + b_2 (\ln TFR)_{ti} + b_3 (\ln LR)_{ti} + b_4 (\ln FWPR)_{ti} + b_5 (\ln MPCE)_{ti} + u_{ti}$$
where IMR_{ti-1} is the lag variable of IMR_t variable with one year lag.
t = 1991 to 2009 and i = rural and urban areas.

The variable IMR is found non-stationary when the model is tested for stationarity[1]. Taking first difference the variable is made stationary before estimating the parameters. The method of Ordinary Least Squares is applied for estimation of the parameters after making all the variables stationary in the model. Infant Mortality Rate (IMR) is regressed on Total Fertility Rate (TFR), Literacy Rate (LR), Female Workforce Participation Rate (FWPR), and Monthly Per Capita Consumer Expenditure (MPCE).

STATISTICS USED

Log-linear multiple regression model is used to examine the significant determinants affecting the infant mortality rate in rural Assam. Stationarity test is used to test whether the time series is stationary or not. After estimating the parameters, the regression diagnostic test, called the Ljung-Box (LB) or Portmanteau Test is also carried out to test if the residuals of the regression are white noise or that it has some autocorrelation still left[2].

RESULTS AND DISCUSSION

Trend in Infant Mortality Rate in rural Assam in comparison with rural India

The trend in infant mortality rate in rural Assam in comparison with national trend is presented in Table 1. The table presents the fact that rural IMR in the state is more prominent than in the country average. In almost all the study period the rural-urban disparity in Assam is found more than the country average which definitely raises serious concern. The compound annual growth rate (CAGR) from 1991 to 2010 of the IMR shows that IMR in rural Assam falls by 28 per cent where as the IMR in rural India falls by 41 per cent. Therefore it can be easily inferred that improvement in health condition in the state is slow in comparison with the country.

Table1: IMR in rural Assam in comparison with rural India

Year	Assam		India		Rural-Urban Gap		Difference between Rural-Urban disparity for Assam and India
	Rural	Urban	Rural	Urban	Assam	India	
1991	83	42	87	53	41	34	-7
1992	83	50	85	53	33	32	-1
1993	84	60	82	45	24	37	+13
1994	78	76	80	52	2	28	+26
1995	78	50	80	48	19	32	+28
1996	79	37	77	46	42	31	-11
1997	79	37	77	45	42	32	-10
1998	80	36	77	45	44	32	-12
1999	79	36	75	44	43	31	-12
2000	78	35	74	44	43	30	-13
2001	77	34	72	42	43	30	-13
2002	73	38	69	40	35	29	-6
2003	70	35	66	38	35	28	-7
2004	69	38	64	40	31	24	-7
2005	71	39	64	40	32	24	-8
2006	70	42	62	39	28	23	-5
2007	68	41	61	37	27	24	-3
2008	66	39	58	36	27	22	-5
2009	64	37	55	34	27	21	-6
2010	60	36	51	31	24	20	-4
CAGR(%) from 1991 to 2010	-28	-14	-41	-42			

Source: Registrar General of India, Sample Registration System Bulletin for the period from 1991 to 2011.

DETERMINANTS OF INFANT MORTALITY RATE IN RURAL ASSAM

The results of the regression model constructed for rural areas are presented in Table 2. (The raw data for dependent and independent variables are presented in the appendix Table 3.) In Table 2 the R_2 value of the model is found to be 0.5895 indicating good fit to the data. The F-statistic for overall regression is also significant at 0.05 per cent level. Thus on the whole the results obtained from the analysis are credible.

Table 2: Results of the multiple regression analysis for factors affecting IMR in rural Assam

Variables	Estimated Coefficients	t-statistic
Constant	3.5224* (0.9772)	3.60
TFR	- 0.0922 (0.1020)	-0.90
LR	-0.1350** (0.0581)	-2.32
FWPR	-0.0374** (0.0156)	-2.40
MPCE	-0.0838* (0.0248)	-3.38
R^2	0.5895	
$F(n_1=5, n_2=12)$	3.45**	

Note: figures in the parentheses show standard error of the coefficients.
*indicates significant at 0.01 level; ** indicates significant at 0.05 level.

The coefficient of the variables Literacy Rates (LR) has come out to be statistically significant at 0.05 levels and Monthly Per Capita Consumption Expenditure (MPCE) has come out to be statistically significant at 0.01 levels. Moreover, Female Workforce Participation Rates (FWPR) has come out to be statistically significant at 0.05 levels. It indicates that Monthly Per capita Consumer Expenditure i.e income level of the family is the most important determining factor for high IMR in rural Assam. The other two variables, Literacy Rates and mother's participation to work are also important factors affecting the IMR in rural areas. The other variable Total Fertility Rates has come out with a negative sign and has not come out to be statistically significant. Therefore it can be inferred that increase in income level of the people will be more likely to reduce the IMR in rural areas in Assam. Increase in literacy rate of the people, whether the mother is working or not are also the important factors influencing the infant mortality in rural areas in the state. How many children in the family factor is less important in rural areas in the state to reduce the IMR
.

CONCLUSION

From the examination of the trend of IMR in rural Assam in comparison with that of rural India it is clear that IMR in rural Assam is more prominent than in rural India. Rural-urban disparity in Assam is found more than the country average which definitely raises serious concern. The growth rate of IMR compounded annually sows that IMR in rural Assam falls more slowly than in rural India. Therefore it can be easily inferred that improvement in health condition in the state is slow in comparison with the country average. When the factors influencing IMR in rural Assam is examined it is found that the income of the family is the most important factor influencing infant mortality of the rural people in Assam. Literacy Rate, Female Work Participation Rate are also useful in predicting the factors influencing IMR in rural areas in the state.

RECOMMENDATIONS

Government should give importance in improving the economic condition of rural people which will ultimately help to avail better health facilities for mother as well as child in the family. Moreover, government should give importance in spreading education which will make them capable and efficient to be engaged in income generating opportunities especially to the womenfolk in the state to reduce infant mortality in rural areas. In this regard, female participation in workforce is also important factor to be considered for reduction in rural infant mortality in rural Assam. In order to reduce infant mortality rate in the state, it is pertinent to provide better health facilities in the state especially for the rural areas which will bring a positive impact. Recently, the various schemes are initiated by the government for rural health; but those need to be implemented properly. Proper monitoring on the part of the government and awareness about the programmes on the part of the common people is needed in this regard.

NOTES

1.A time series is stationary if the mean, variance and auto covariance (at various lags) remain the same no matter at what point we measure them; i.e they are time invariant (Gujarati and Sangeetha, 2007)
2. The Ljung-Box (LB) or Portmanteau test is better for small samples than Box-Pierce Q test (Gujarati and Sangeetha, 2007).

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Appendix

Table 3: Data for the dependent and independent variables for rural Assam

Year	IMR	TFR	LR	FWPR	MPCE
1991	83	3.6	49.32	17	226.89
1992	83	3.6	45.28	31.3	266.7
1993	84	3.4	69	16.1	154
1994	78	4	67.3	15.9	258
1995	78	3.7	67.3	13.4	305
1996	79	3.4	65	8.5	316
1997	79	3.4	65	9.9	360
1998	80	3.4	65	11.2	338
1999	79	3.3	69	8.7	429
2000	78	3.3	70.8	15.1	426
2001	77	3.2	60.92	12	457
2002	73	3.1	69.6	21.8	537
2003	70	3	69.6	19.7	532
2004	69	3.2	73	16.7	588
2005	71	3.1	73	20.9	543
2006	70	3	73.8	20.7	626
2007	68	2.9	73	15.3	721.37
2008	66	2.80	74.00	15.30	799.00
2009	64	2.80	74.90	25.60	1003.00

NOTES:

1.Data for rural and urban MPCE for 1990-91 are the data of mean consumption per month (in Rs.) data (from 1990-91 to 1993-94) at 1973-74 prices. Due to non-availability of the MPCE data for 1991-92 and 1992-93, MPCE data of 1983 is used for 1991-92 and data of 1987-88 is used for 1992-93.

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