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Comparison of factor associated infant mortality between NFHS 4 and NFHS 5 data, India- Spatial Analysis

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I. Introduction:

WHO defines Infant mortality rate as the probability of a child born in a specific year or period dying before reaching the age of one, if subject to age-specific mortality rates of that period. The infant mortality rate is the number of infant deaths for every 1,000 live births. It is often used to identify vulnerable populations. Increasing IMR can be attributed to dissatisfied hygienic requirements, undesirable environmental factors, economic conditions, environmental health, and health care. The risk of child dying before completing the first year of age was highest in the African Region, 52 per 1000 live birth and 7 per 1000 live births in European region in 2018. Globally, in 1990 the infant mortality rate was 65 deaths per 1000 live births have been decreased to 29 deaths per 1000 live births in 2018. In total, more than 5 million children under age 5, 2.3 million new born's along with 2.1 million children died in 2021[1]. The infant mortality is mostly associated with socio-economic status and mother's health. The Sustainable Development Goals (SDGs) proposed to target for child mortality aims to end by 2030, preventable deaths of new born and children under 5 years of age. In India, according to National Family Health Survey 3(2005- 2006) and 4 (2015-2016) (India fact sheet) the infant mortality rate was reduced from 57% to 41% respectively[2]. The aim of the study is to compare two rounds of NFHS (4 and 5) of infant mortality and identify the factors associated with them across the states of India.

II. Methods:

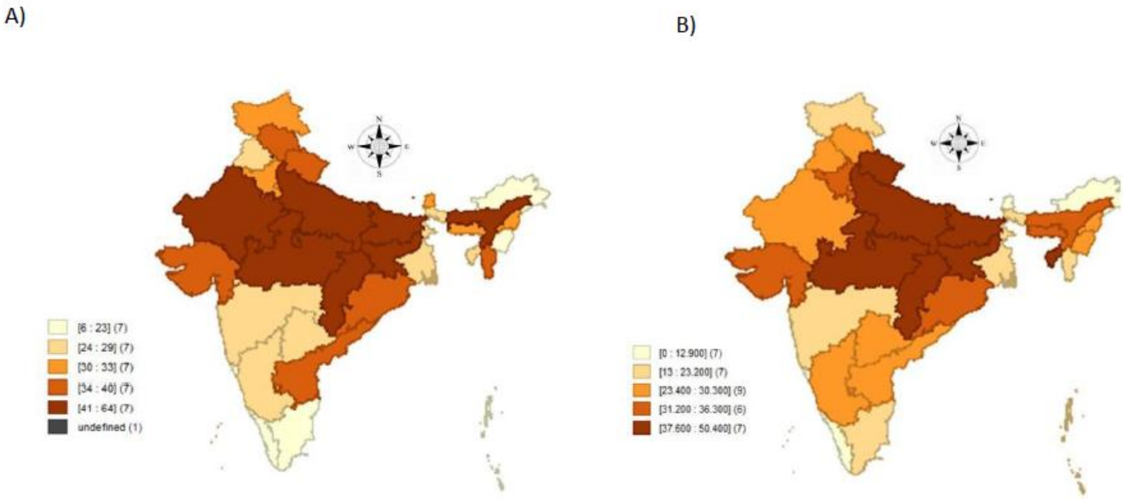
National Family Health Survey round four (2015-16) and round 5(2019-2021) data is used for analyses. NFHS-4 and NFHS-5 provides information on population, health and nutrition comprehensive information on fertility, mortality, maternal and child health care including children nutritional status for each States and Union Territory of India. A state level data was prepared on the basis of socio-demographic, mother's education, body mass index and infant mortality rate. The state level estimate was compiled from the state fact sheet of NFHS-4 and NFHS-5[2 3].

Descriptive Statistics, Spatial autocorrelation helps to understand the degree to which one object is similar to other nearby objects. Spatial autocorrelation can be positive and negative. Positive spatial autocorrelation occurs when similar values occur near one another. Negative autocorrelation occurs when dissimilar values near one another. Spatial relationship is defined formally through values called spatial weight structure as a spatial weight matrix. Contiguity means that two spatial units share a common border of non-zero length. In this study, the first order queen's contiguity weight is used to measure the spatial relationship which encompass and defines neighbors as spatial units sharing common edges. Global Moran's I is one of the measures of spatial autocorrelation. Global spatial autocorrelation Moran's I is used to measure the overall clustering of the data and to project the strength and pattern of spatial autocorrelation.

To explore the relationship between the dependent and independent variables set of regression models is used in the analyses. Taking spatial dependence into an account spatial regression technique is used to predict the values of an outcome variables based on values of set of explanatory variables. On the assumption of random error terms Ordinary least square estimation is built. Other assumptions of OLS are independent variables are uncorrelated and follows normal distribution. If the OLS is confirmed spatial autocorrelation in its error term for the outcome variables then the further estimate are spatial lag model (SLM) and spatial error model (SEM). Assumption of a spatial lag model is that the observations of the dependent variable are affected in the neighborhood areas whereas the spatial error model is used to consider the effect of those variables which are not present in the regression model but have an effect on the outcome variables. The value of Lagrange multiplier, Log likelihood, Akaike information criterion (AIC), R-squared and Schwarz criterion are the diagnostic test for spatial dependence. Software used for identifying spatial clustering GeoDa V.1.20.0.22, for descriptive statistics STATA V.17.

III. Results:

Figure 1: Quantile Map showing the spread of Infant Mortality Rate A) NFHS-4B)NFHS-5



The spatial clustering of prevalence of Infant mortality rate have categorized the states of India into five. According to the NFHS-4 and NFHS-5 prevalence of IMR is high in 7 states, but the IMR have been reduced from 64% to 50% in India, respectively.

Table 1 and Table 2 represent the mean, standard deviation, minimum, maximum value of the independent and dependent variables of the study of NFHS-4 and NFHS-5 respectively. The mean value of Infant mortality rate is 32.2 and 26.1 of NFHS-4 and NFHS-5 respectively. The average value of mother's whose Body Mass Index is less than 18.5 kg/m2 are 17.4 and
14.7 of NFHS-4 and NFHS-5 respectively.

Table 1: Descriptive statistics of NFHS 4

Variables	Mean	StandardDeviation	Minimum	Maximum
Infant Mortality Rate	32.2	12.3	6	64
BMI less than 18.5kg/m2 ofMother	17.4	7.6	2.5	31.5
Women's married under 18years	20.6	10.4	1.9	42.5
Birth through Caesarean method	20.4	11.6	5.8	57.7
Women's illiterate	24.1	11.7	2.1	50.4
Mother's consumer iron folicacid for more than 100 days	61.0	19.3	18.3	95.6
Children getting adequate diet	88.2	7.9	69.2	100
Unimproved Drinking water	12.1	10.9	0.5	58.4
Unimproved Sanitation	39.9	19.7	0.8	75.6
Poor electricity facilities	6.5	9.1	0	41.4
less usage of cooking fuel	50.2	22.4	2.1	82.2

Table 2: Descriptive statistics of NFHS 5

Variables	Mean	StandardDeviation	Minimum	Maximum
Infant Mortality Rate	26.1	12.0	2.9	50.4
BMI below 18.5 kg/h^2 of mothers	14.7	6.5	4	26.2
Women's married under 18years	17.5	10.9	1.3	41.6
Birth through Caesarean method	27.4	17.0	5.2	93.4

Women's illiterate	22.0	10.3	2.6	45
Mother's consumer iron folicacid for more than 100 days	66.3	19.6	30.9	95.9
Children getting adequate diet	85.9	6.5	70.2	100
Unimproved Drinking water	5.8	5.4	0.1	22.9
Unimproved Sanitation	25.1	17.2	0.2	100
Poor electricity facilities	1.9	2.3	0	9
less usage of cooking fuel	36.2	21.3	1.1	68.1
less Use of iodized salt	25.1	17.2	0.2	100

Spatial regression model:

Ordinary least square is the model to check the association between the infant mortality rate state level correlates (independent variables). The Jarque-Bera test score (1.45; *P*=0.485) indicated normality of the error term and the low probability of the Breusch-Pagan test (13.01; *P*=0.111).Based on the Moran's I value of OLS model, the further spatial effect models are performed. Comparing NFHS-5 data, the OLS model with Moran's I value of infant mortality rate is I^2 = 2.5665 p-value= 0.0102 is positively spatially autocorrelated and NFHS-4 data the OLS model with Moran's I value of IMR is I^2 = -0.0544, p-value= 0.498 is spatially negatively auto correlated. Since the Moran's I is not significant, there is no spatial cluster finding by NFHS-4 state aggregated data. Since, Ordinary least square model indicates the positive spatial autocorrelation in the prevalence of Infant mortality rate and we further estimate using NFHS-5 data.

Table 3: The ordinary least square and spatial lag model of Infant mortality rate

	Ordinary least square model		**Spatial Lag model**	
Variables	**Standard error**	**P- Value**	**Standarderror**	**P- Value**
Women's illiterate	0.2	0.02	0.2	0.00198
Women's marriedbelow 18 years	0.2	0.342	0.1	0.21263
Mother's consumed	0.09	0.109	0.1	0.17568
Iron Folic acid				
Unimprovedsanitation	0.09	0.452	0.06	0.08943
BMI below 18.5 kg/$h^2$of mothers	0.3	0.016	0.1	0.00087
Birth under caesareansection	0.08	0.892	0.07	0.83162
Consuming oftobacco	0.1	0.079	0.09	0.00371
Consuming of alcohol	0.3	0.024	0.2	0.00394
R^2	0.77		0.82	

The spatial regression OLS model says that Women's illiterate, BMI below 18.5 kg/h2 of mother's, consumption of alcohol is associated with infant mortality rate.

The LM test for Spatial lag model was statistically significant (6.9814; 0.008) and LM test for LM Spatial error model was statistically insignificant (2.4531; 0.117). The Robust LM of spatial lag model (4.6; *P*=0.03) was significant, whereas the Robust LM error model (0.02; *P*=0.09) was insignificant, which meant that in the presence of error-dependent variable, the spatial lag dependency disappeared. As a result, comparing to OLS model the general model fit improved for Robust LM spatial lag model, as indicated with the higher values of R^2 (0.82), significant P=0.03, higher Log likelihood value of -111.704 and lower AIC value of 243.408. Hence, the spatial lag model was considered to be the best model fit rather than OLS.[4]

Discussion:

Social inequalities in infant mortality have persisted and remained marked, with the disadvantaged ethnic and socioeconomic groups and geographic areas experiencing substantially increased risks of mortality despite the declining trend in mortality over time. Widening social inequalities in infant mortality are a major factor contributing to the worsening international standing of the United States[5].

The communication studied the impacts of fertility rates, female participation in the labour force, per capita GNP, female literacy rates, and government expenditure on health as a percentage of GNP on infant mortality rates. Results, based on 117 countries for the year 1993, and after adjusting for heteroscedasticity, indicate that with the exception of expenditure on health programmes, all other factors significantly affect infant mortality rates. However, our findings contradict Chowdhury's (1988) theory that there is a dual causality between infant mortality rates and fertility rates, but demonstrate that fertility rates do have an effect on infant mortality rates[6].

The suggests that its needs to build on past achievements by stepping up efforts to further reduce infant and under-five mortality, in order to achieve MDG 4. The most efficient policy interventions are likely to be public awareness campaigns to target behavioural variables. One central behavioural component in this context is the promotion of gender equality, both in terms of improved health care for young girls and in terms of access to education. If in addition the percentage of smoking mothers can be effectively reduced, birth intervals increased and the average duration of breastfeeding expanded, Jordan may yet achieve the goal of reducing under-five mortality by two thirds on time by 2015. Increased public spending in these areas could thus be a more efficient tool for achieving the desired development outcomes.[6]

Identifying the factors that affect the infant mortality rates would help in better targeting of the programs leading to enhanced efficiency of such programs. Earlier studies have shown the influence of socio-economic factors on infant mortality rates at a global level and found that variables like fertility rate, national income, women in labour force, expenditure on health care and female literacy rates influence the infant mortality rates. Using a regression analysis method, we not only identify the influence of the variables on infant mortality, we went a step further in identifying the performance of states and union territories in reducing IMR. The performance was measured using 'technical efficiency' analysis. We then compared the performance and growth rate of IMR to classify the states as good performers and laggards. Our results suggest that most of the major states are on track on their performance on IMR. However, a few small states and union territories like Andaman and Nicobar Island, Mizoram, Arunachal Pradesh as well as Jammu & Kashmir need special attention and targeting to reduce IMR[7].

Conclusion:

The aim of the study is to compare two rounds of NFHS (4 and 5) of infant mortality and identify the factors associated with them across the states of India. Moran's I were used to identify the spatial autocorrelation among the states of India for Infant mortality rate. Spatial regression model was used to understand the relationship between dependent and independent indicators. The study indicated that the infant mortality rate is more spatially cluster by using NFHS-5. Consuming of tobacco, alcohol, women's literature and Mother's BMI below 18.5 kg/h^2 are associated with infant mortality rate.

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