

ORIGINAL ARTICLE

Inter-State Disparities and Correlation of Health Indicators of Major States in India

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ABSTRACT

Background: While the nation is striving for the novel goal of “Health for All,” it is meaningful to assess the disparities in state level indicators related to demography, nutrition, immunization, and family planning along with related socio-economic indicators. This study aims to assess the disparities of health-related indicators across major states, to classify major states based on composite indices, and to assess magnitude and direction of correlation of health-related indicators in relation to health-related indicators across states in India using published data by government sources. **Methodology:** The quantitative techniques included estimation of interstate coefficient of variation (CV) of indicators, calculation of state wise composite indices, and estimation of correlation coefficients between socio-economic and health-related indicators. The indicators with low and high inter-state CV values identified and the states classified according to composite indices. **Results:** Kerala was the best performing state and Madhya Pradesh the least performing state based on 33 health-related indicators. The negative association of crude birth rate, infant mortality rate, crude death rate, and total fertility rate with female literacy reveals the importance of female literacy to combat death rates and birth rates in India. Share of below poverty line (BPL) population has also crucial role in deciding the direction and magnitude of health indicators. **Conclusion:** It is revealed that the health development is closely associated with demographic pattern and socio-economic development. Improvement in female literacy and reduction in BPL population together would push up most of it health indicators of different states.

Key words: Disparities, correlation, composite indices, Indian states

INTRODUCTION

The WHO launched the global immunization program in 1974 as “expanded program of immunization” for prevention and control of six major fatal diseases causing morbidity and mortality of children.^[1] Government of India also launched the same program in 1978 and is in operation in all the states of the country. The Millennium Development Goals (MDGs) adopted at the Millennium Summit of the United Nations in September 2000, call for a dramatic reduction in poverty and marked improvements in the health of the poor.^[2] The subsequent Sustainable Development Goals (SDGs) were aimed to push up the MDGs. The agenda of SDGs included 17 goals and 169 targets to be achieved by 2030.

The National Health Mission of India having two broad sub-missions of rural health and urban health was aimed to strengthen the health system for achieving universal access to equitable, affordable, and quality health-care services as per the needs of the people.^[3] Planning, implementation, evaluation, correction, and continuation of programs are the necessary requirements for success of any developmental interventions. Health sector is no exception to this fact. A large number of central and state sponsored health programs focusing on different segments of population were launched in different states of India. As a result, remarkable achievements have been made by various states over the period in health and social development sectors. However, the rate of progress

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made over the years by different states has not been uniform in the process of health development. The inter-temporal and inter spatial variation in health-related indicators continued to be a matter of great concern.

The Ministry of Health and Family Welfare (MoHFW) has been bringing out periodical statistical publications entitled “Family Welfare Statistics in India.” The publication has been recently renamed as “Health and Family Welfare Statistics in India.” The National Family Health Survey 2015–2016 (NFHS-4)^[4] provides information on population, health and nutrition for India and each State/Union territory. The main objective of each successive round of the NFHS has been to provide essential data on health and family welfare, which will be useful in setting benchmarks and examining the progress in health sector, the country has made over time. Data on health-related indicators are available in publications based on Census of India (2011),^[5] Sample Registration System (SRS) (2013)^[6] and District Level Household Survey 3 (DLHS 3)^[7] and many others. Mostly such data is used for administrative purposes and is seldom used by researchers, while a number of indicators are available for major states some of these are not available for smaller states of India. Hence, present study is confined to major states only.

While the nation is striving for the novel goal of “Health For All,” it is meaningful to assess the state level indicators related to demography, nutrition, immunization, and family planning along with related socio-economic indicators. Grading of states according to individual indicators can easily be done. However, if someone has to grade the states on the basis of combined effect of a set of indicators, appropriate statistical technique is required to be used as these indicators are in different units and not additive as such to get the overall impact of many of such indicators. The technique of composite indices developed by statisticians to classify states according to overall development of different sectors like economic, social, demographic, environmental, and others can be used for health-related indicators also. Some efforts in this direction was made earlier by Indian Institute of Management (IIM) Ahmadabad and others.

The large inter-state variation of factors representing demography, family planning, maternal care, immunization, health infrastructure, and other associated factors prompts to assess the extent of disparity in health-related indicators across states and also classification of states based on composite indices of states as combined effect of all these indicators. The magnitude and direction of correlation between these interstate indicators also assume great significance. The specific objectives of the study are: To assess the range of variation of health-related indicators across major states of India, to classify major states according to values of composite indices based on health related indicators and to assess magnitude and direction of correlation of demographic and socio-economic indicators with other health related indicators.

METHODOLOGY

The study is based on latest state level secondary data related to health and health indicators published by MoHFW, Government of India, and other official sources. The statistical procedure for estimation of composite index is similar to that developed by Prem Narain and others to classify districts based on social development indicator.^[8] Assuming that there are “*n*” states and “*k*” health related indicators the methodology adopted for the study is explained as under:

States Covered

The health-related statistical data at state level are generally available under three broad heads as (i) major states which include 17 states which existed since long back, (ii) 12 smaller states which include new states formed in the north east and those states formed either through upgradation of union territories or through bifurcation of big states, and (iii) six union territories. For the present study, the 17 major states mentioned above have been included as wide range of health indicators is available for this category of states. These states with abbreviation used in forthcoming sections are as under:

Andhra Pradesh (AP), Jammu and Kashmir, Punjab (Puj), Assam (Ass), Karnataka (Kar), Rajasthan (Raj), Bihar (Bih), Kerala (Ker), Tamil Nadu (TN), Gujarat, Madhya Pradesh (MP), Uttar Pradesh (UP), Haryana (Har), Maharashtra (Mah), West Bengal (WB), Himachal Pradesh (HP), and Odisha.

Indicators

The list of health-related indicators included in the present study along with its codes, data sources, and time reference and codes are given as under:

Demographic and vital health indicators

- I₁ - Population density; I₂ - Decadal growth rate; I₃ - Sex ratio, Census 2011.
- I₄ - Crude birth rate (CBR); I₅ - Crude death rate (CDR); I₆ - Neonatal mortality rate; I₇ - Infant mortality rate (IMR), SRS 2013.
- I₈ - Under five mortality rate; I₉ - Total fertility rate (TFR), NFHS 4.
- I₁₀ - Life expectancy at birth, SRS based life table 2010–2014.

Socio-economic indicators

- I₁₁ - Total literacy rate; I₁₂ - Female literacy rate, Census 2011.
- I₁₃ - Percentage of population below poverty line (BPL), National Health profile 2015, Central Bureau of Health Intelligence (CBHI).^[9]
- I₁₄ - Mean age at effective marriage of female, SRS 2013.
- I₁₅ - Percentage of total slum population to urban population, Census 2011.

- I₁₆ - Percentage of households with drinking facility, NFHS 4.
- I₁₇ - Health expenditure as a percentage of Gross State Domestic Products, National Health Profile 2015, CBHI.
- I₁₈ - Percentage of households with sanitation, NFHS 4.

Reproductive and child health indicators

- I₁₉ - Percentage of women who had antenatal check up in the first trimester, DLHS 3.
- I₂₀ - Percentage of women who received at least 4 ANC visit, NFHS 4.
- I₂₁ - Percentage of women who had at least one TT injection; I₂₂ - Percentage of women who consume 100 or more IFA tablets, DLHS 3.
- I₂₃ - Percentage of Institutional delivery; I₂₄ - Percentage of delivery at home conducted by skilled health worker out of total delivery; I₂₅ - Contraceptive prevalence rate, DLHS 3.
- I₂₆ - Unmet need of family planning, NFHS 4.
- I₂₇ - Percentage of Sterilization-Male and Female; I₂₈ - Percentage of children received full immunization, DLHS 3.

Nutritional indicators

- I₂₉ - Prevalence of LBW, Rapid Survey on Children (RSOC) 2013–2014 by MOHFW and UNICEF.^[10]
- I₃₀ - Percentage of child (0–6 month) exclusively breast feed; I₃₁ - Prevalence of malnutrition under 5 children; I₃₂ - Prevalence of anemia among children; I₃₃ - Prevalence of anemia among reproductive women, NFHS 4

As values of all these indicators are not available in single source, latest estimates of indicators available in different sources have been used.

Inter-State Disparity of Health Indicators

For each of the 33 health indicators, the Coefficient of Variation (CV) across states was calculated as under:

$$\text{Coefficient of Variation (CV)} = \frac{\text{Standard deviation}}{\text{Arithmetic mean}} \times 100$$

Computation of Composite Indices

The steps involved in the computation of composite indices are briefly explained below:

Let [X_{ij}] denotes the data matrix representing the ith states and jth health indicator

$$i = 1, 2, \dots, n \text{ states and } j = 1, 2, \dots, k \text{ indicators}$$

As [X_{ij}] denotes different indicators in different units of measurement these are not additive as such to get the required composite index. Hence, the [X_{ij}] are transformed to standardized indicators [Z_{ij}] as under:

$$[Z_{ij}] = (X_{ij} - \bar{X}_j) / S_j$$

Where,

- \bar{X}_j = Mean of jth indicator
- S_j = Standard deviation of jth indicator
- [Z_{ij}] = The matrix of standardized indicators

The arithmetic mean of the indicators was used to standardize the values needed for the calculation of composite indices.

From [Z_{ij}], the best value of each indicator is identified. In the case of positive indicators, the best value can be the maximum and in the case of negative indicators it can be the minimum value of the indicators, depending on the direction of the impact of indicator on overall health development. If the indicator is health pushing, maximum state value is considered as the best value and if it is health pulling, the minimum state value is considered as the best value. Let Z_{0j} denote the best value of jth indicator, achieved by anyone state.

To get the pattern of development, first deviation matrix P_{ij} is calculated

Where,

$$P_{ij} = (Z_{ij} - Z_{0j})^2$$

The pattern of development C_i is given as under

$$C_i = \sqrt{\sum_{j=1}^k P_{ij} / (C.V.)_j}$$

Where (C.V.)_j is the CV of jth indicator in matrix X_{ij}.

Composite index Di is given by

$$D_i = C_i / C \text{ where } C = + 3S_{D_i}$$

\bar{C} = Mean of C_i and S_{D_i} = standard deviation of C_i

Smaller value of Di will indicate high level of health development and higher value of Di will indicate low level of health development.

Correlation of Socioeconomic and Health Indicators

The correlation of indicators has been worked out to assess the direction and magnitude of association between the indicators selected for the study.

The correlation coefficient between health-related indices Xi and Xj is calculated as

$$r_{XiXj} = \frac{\text{Cov.XiXj}}{\text{SdXi} \times \text{SdXj}}$$

Where,

Cov.XiXj = Covariance between Xi and Xj Indicators

SdXi=Standard deviation of Xi (ith Indicator)
SdXj = Standard deviation of Xj (jth Indicator)

The test of significance of correlation coefficient is done using "t" statistic as

$$t(n-2) = \frac{r \times \sqrt{n-2}}{\sqrt{1-r^2}}$$

Where,

r = Correlation coefficient between indicators

n= No. of pairs of indicators.

RESULTS

The CV and the ideal or best value for each of the indicators and top performing and bottom performing state as applicable

Table 1: Range of variation in health-related indicators across major states in India

No.	Indicator	Ideal value	C.V	Top performer		Bottom performer	
				Value	State	Value	State
1	I ₁	Min.	64.25	123	Himachal Pradesh	1106	Tamil Nadu
2	I ₂	Min.	29.82	4.9	Kerala	25.4	Haryana
3	I ₃	Max.	5.29	1084	Kerala	879	Gujarat
4	I ₄	Min.	22.28	14.7	Kerala	27.6	Haryana
5	I ₅	Mini.	11.07	5.3	Jammu and Kashmir	8.4	Tamil Nadu
6	I ₆	Min.	32.95	6	Kerala	37	Bihar
7	I ₇	Min.	32.55	12	Kerala	54	Bihar
8	I ₈	Min.	39.00	7	Kerala	78	Oddisa
9	I ₉	Min.	25.40	1.6	West Bengal	3.4	Gujarat
10	I ₁₀	Max.	4.56	74.9	Kerala	63.7	Bihar
11	I ₁₁	Max.	10.54	94	Kerala	61.8	Madhya Pradesh
12	I ₁₂	Max.	15.36	92.1	Kerala	51.5	Madhya Pradesh
13	I ₁₃	Min.	52.89	7.1	Kerala	33.7	Kerala
14	I ₁₄	Max.	4.76	24.4	Jammu and Kashmir	20.6	Maharashtra
15	I ₁₅	Min.	55.17	1.3	Kerala	28.3	Jammu and Kashmir
16	I ₁₆	Max.	7.04	99.1	Punjab	72.7	Jammu and Kashmir
17	I ₁₇	Max.	14.63	5.9	Andhra Pradesh	3.88	Madhya Pradesh
18	I ₁₈	Max.	35.67	98.1	Kerala	25.2	Assam
19	I ₁₉	Max.	17.32	82.2	Kerala	49.4	Assam
20	I ₂₀	Max.	31.86	90.2	Kerala	26.4	Assam
21	I ₂₁	Max.	10.38	97.6	Odisha	66.2	Utter Pradesh
22	I ₂₂	Max.	51.17	75.6	Kerala	9.7	Assam
23	I ₂₃	Max.	18.74	99.6	Kerala	54.9	West Bengal
24	I ₂₄	Max.	95.87	42.6	Punjab	0.1	Maharashtra
25	I ₂₅	Max.	19.05	65.7	Andhra Pradesh	36.5	Haryana
26	I ₂₆	Min.	33.00	4.7	Andhra Pradesh	18.1	Jammu and Kashmir
27	I ₂₇	Max.	35.10	58.2	Andhra Pradesh	13.7	Punjab
28	I ₂₈	Max.	13.82	82.4	Kerala	52.1	Jammu and Kashmir
29	I ₂₉	Min.	16.86	13.0	Kerala	23.2	Maharashtra
30	I ₃₀	Max.	13.17	67.2	Andhra Pradesh	41.6	Kerala
31	I ₃₁	Min.	27.84	16.1	Kerala	43.9	Maharashtra
32	I ₃₂	Min.	19.03	35.6	Kerala	71.7	Kerala
33	I ₃₃	Min.	14.29	34.2	Kerala	62.5	Gujarat

to the present study are shown in Table 1. The health-related indicators such as sex ratio, life expectancy at birth, and effective average marriage age were found with relatively low CV implying that the inter-state variation in these indicators have not been very high. However, indicators such as density of population, neonatal mortality rate, IMR, under five mortality rate, share of population BPL, share of households with sanitation facilities, share of pregnant women with at least four ANC visits, share of pregnant women consuming at least 100 IFA tablets, share of women having at home delivery with the help of skilled health workers, and share of sterilization by eligible couple showed high inter-state variation as evidenced from high CV for these indicators. The name of the states having the highest and the lowest values of the indicators is shown in Table 1. While Ker topped in 19 out of 33 indicators; AP topped in 5; Puj, Kar and Jammu and Kashmir topped in two each; HP, WB; and Odisha topped in one each of the indicators. The states remained at bottom for any of the health indicators included Bih, Har, Odisha, MP, UP, AP, Ass, Raj, and WB.

The state wise composite indices based on the 33 indicators under study revealed that Ker, HP, TN, Puj, Mah, and Jammu and Kashmir are the top-ranking states. The composite indices of these states ranged from 0.2357 in Ker to 0.5049 in Jammu and Kashmir. The six states remained at bottom are Odisha, Bih, Har, Raj, UP, and MP. The composite indices of these states ranged from 0.6607 in Odisha to 0.8075 in MP [Table 2].

The strength of association between relevant socioeconomic indicators with health-related indicators is evident from correlation value given in Table 3. The adoption of

health-related practices may have a strong bearing on socio-economic conditions of the people. An effort was

Table 3: Socioeconomic indicators having significant correlation with health-related Indicators

No	Socio-economic indicator	Associated health-related indicators	Correlation coefficient	P value		
1	Female Literacy (I12)	Crude Birth Rate (I4)	-0.74	0.0006		
		Infant mortality rate (I7)	-0.76	0.0004		
		Total fertility rate (I9)	-0.67	0.0032		
		Life expectancy at birth (I10)	0.61	0.0093		
		Percentage of women who received at least 4 ANC visit (I20)	0.67	0.0032		
		Percentage of women who consume 100 or more IFA tablets (I22)	0.76	0.0003		
		Percentage of Institutional delivery (I23)	0.56	0.0193		
		Prevalence of malnutrition under 5 children (I31)	-0.56	0.0193		
		2	Percentage of population below poverty line (I13)	Crude birth rate (I4)	0.70	0.0017
				Crude death rate (I5)	0.58	0.0146
Infant mortality rate (I7)	0.69			0.0021		
Total fertility rate (I9)	0.67			0.0032		
Life expectancy at birth (I10)	-0.80			0.0001		
Percentage of women who received at least 4 ANC visit (I20)	-0.68			0.0026		
3	Mean age at effective marriage of female (I14)	Percentage of women who consume 100 or more IFA tablets (I22)	-0.60	0.0108		
		Prevalence of malnutrition under 5 children (I31)	0.72	0.0011		
4	Percentage of households with sanitation (I18)	Prevalence of malnutrition under 5 children (I31)	-0.81	0.0001		
		Infant mortality rate (I7)	-0.68	0.0026		
		Prevalence of malnutrition under 5 children (I31)	-0.70	0.0017		

Table 2: Estimated values of composite indices for major states and their ranks

S. No	State	Composite index value	Rank
1	Kerala	0.2357	1
2	Himachal Pradesh	0.4108	2
3	Tamil Nadu	0.4648	3
4.	Punjab	0.4777	4
5.	Maharashtra	0.4835	5
6	Jammu and Kashmir	0.5049	6
7	West Bengal	0.5152	7
8	Gujarat	0.5982	8
9.	Andhra Pradesh	0.6224	9
10	Assam	0.6225	10
11.	Karnataka	0.6575	11
12	Odisha	0.6607	12
13	Bihar	0.665	13
14	Haryana	0.6966	14
15	Rajasthan	0.7039	15
16	Uttar Pradesh	0.7208	16
17	Madhya Pradesh	0.8075	17

made to assess the magnitude and direction of association of health-related indicators with socio-economic indicators of various states by calculating the coefficient of correlation between these two. The female literacy was found negatively associated with CBR, IMR, TFR, and prevalence of malnutrition of under five children. It was also seen that female literacy is positively associated with health-related indicators such as life expectancy at birth, regular ANC visits by pregnant women, consumption of required number of IFA tablets, and institutional delivery. Similarly, the share of BPL population in states was found to have significant and positive correlation with CBR, CDR, IMR, TFR, and prevalence of malnutrition among children. The share of BPL population was found to have negative association with indicators such as life expectancy at birth, ANC visits of pregnant women, and consumption of IFA tablets. The average age of marriage of women was found to have negative association with malnutrition of under five children. The negative association of indicator on households with access to sanitation with infant mortality and prevalence to malnutrition of children also throws light on the importance of sanitation for better health. The female literacy and share of BPL population are the socio-economic indicators having strong association with other health-related indicators.

DISCUSSION

The inter-state consistency at moderate level as evidenced by low CV values for indicators such as sex ratio, CDR, life expectancy at birth, literacy rate, mean age at effective marriage of women, and share of health expenditure to state GDP is indicative of uniform impact of public health and family welfare programs across states in the country. At the same time, large interstate variations in health related indicators as evidenced by large CV values for health related indicators such as density of population, neonatal mortality rates, infant mortality, under five mortality rate, share of BPL population, share of slum population to urban population, share of household with sanitation, share of women consuming IFA tablets, share of home delivery by skilled health workers, unmet needs of family planning measures, and share of terminal methods of family planning measures are indicative of the need to take urgent steps by those states which stand at the bottom performing states with respect to these indicators. These results are in confirmatory with the findings by National Institute of Public Cooperation and Child Development.^[11]

The states such as Bih, Odisha, UP, MP, and Har appearing at the bottom for individual health-related indicators must make concerted efforts to push up the states with respect to these indicators. Unless the position of these states with respect to those indicators is improved, this state will continue as weak states with respect to health development. Being the states responsibilities, the healthcare has traditionally been influenced by state's budgetary allocation and it has

implications for achievement of health for all at national level.^[12]

The states such as Odisha, Bih, Har, Raj, UP, and MP are found to remaining at bottom with respect to composite indices. The study by Kumar SP *et al.* also categorized these states among the struggler states.^[13] The study by Singh *et al.* also categorized MP, Odisha, and Bih as poor performing states with respect to health development.^[14] These states are required to identify the individual indicators for which these states are poor performers so as to take corrective steps to improve its position.

The negative and significant correlation of female literacy with CBR, IMR, TFR, and prevalence of malnutrition is indicative of the scope to bring down the current rates of these indicators through promotion of female literacy. The study by Mondal *et al.* also mentioned that several socioeconomic, demographic, and health related variables effect on infant and child mortality.^[15] Study done by Salam and Siddiqui also revealed that those women who are better educated have maximally availed delivery care services when compared to less educated and illiterate women.^[16] Similar observations were given by Ghorbani and Kumar in their study.^[17,18] By enhancing female literacy, it is possible to push up the indicator values of life expectancy at birth, regular ANC visits of pregnant women, consumption of IFA tablets, and institutional delivery. It is revealed that the reproductive and child health indicators can also be improved through higher literacy level of women. The economic empowerment leading to reduction in the share of BPL population can help to reduce infant mortality, CBR and CDR, rate of malnutrition as well as TFRs in Indian states. The reduction in share of BPL population will help to enhance life expectancy at birth, ANC visits of pregnant women, and consumption of IFA tablets. The study by Mukhopadhyay stated the coefficient involving female literacy rate is negative implying higher is the female literacy rate, lower is the IMR and higher state level per capita income leads to decline in infant mortality level in the state.^[19] The negative association of infant mortality and prevalence of malnutrition with sanitation implied that the promotion of sanitation could result in reduced infant mortality and malnutrition in children. The World Health Organization estimates that 50% of malnutrition is associated with repeated diarrhea or intestinal worm infections from unsafe water or poor sanitation or hygiene.^[20] Rah *et al.* also showed inverse association between reported personal hygiene practices and stunting was stronger among households with access to toilet facility or piped water (all interaction terms, $P < 0.05$).^[21,22] The pushing up of marriage of women could help to reduce the total fertility level and thereby better nutritional level of children.

CONCLUSION/RECOMMENDATION

The inter-state consistency at moderate level as evidenced by low CV values in indicators such as sex ratio, CDR,

life expectancy at birth, literacy rate, mean age at effective marriage of women, and share of health expenditure to state GDP is indicative of positive impact of public health and family welfare programs across states in the country. The states such as Odisha, Bih, Har, Raj, UP, and MP remaining at bottom with respect to combined effect of the 33 health indicators required to identify the individual indicators for which these states are poorly performing so as to take corrective steps to improve its position. The negative association of CBR, IMR, CDR, and TFR with female literacy reveals the importance of female literacy to combat death rates and birth rates in the country. Share of BPL population of states was found to have positive and strong association with CBR, CDR, IMR, TFR, and negative association with Life Expectancy at Birth. Improvement in female literacy and reduction in BPL population together would push up health indicators of different states. Health indicators are associated with demographic and socioeconomic indicators which reveal that the health development is closely associated with demographic pattern and socio-economic development.

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REFERENCES

1. Park K. Park's Textbook of Preventive and Social Medicine. Jabalpur: M/S Banarsidas Bhanot; 2015.
2. Sachs JD. Macroeconomics and Health: Investing in Health for Economic Development. Geneva: World Health Organization; 2001.
3. Suryakantha AH. Community Medicine with Recent Advances. 3rd ed. New Delhi: Jaypee Brother; 2014.
4. International Institute for Population Sciences and ICF. National Family Health Survey (NFHS-4), 2015-16. Mumbai, India: International Institute for Population Sciences; 2017.
5. Available from: <http://www.censusindia.gov.in/2011-common>. [Last accessed on 15 Jun 2017].
6. Sample Registration System, Registrar General, India; 2013. Available from: https://www.censusindia.gov.in/vital_statistics/SRS_bulletins/SRS_bulletin-September_2013.pdf. [Last accessed on 21 Jun 2017].
7. International Institute for Population Sciences. District Level Household and Facility Survey 2007-2008. India, Mumbai: International Institute for Population Sciences; 2007-2008.
8. Prem N, Sharma SD, Rai SC, Bhatia VK. Statistical evaluation of social development at district level. *J Indian Soc Agric Stat* 2007;61:216-26.
9. Central Bureau of Health Intelligence. National Health Profile 2015. New Delhi: Ministry of Health and Family Welfare, Government of India; 2015.
10. Ministry of Women and Child Development, Government of India. Rapid Survey on Children (RSOC) 2013-14, National Report. New Delhi: Ministry of Women and Child Development, Government of India; 2013-2014.
11. National Institute of Public Cooperation and Child Development. An Analysis of Levels and Trends in Maternal Health and Maternal Mortality Ratio in India. Bengaluru: National Institute of Public Cooperation and Child Development; 2015. p. 72.
12. National Institute of Public Cooperation and Child Development. An Analysis of Levels and Trends in Maternal Health and Maternal Mortality Ratio in India. Bengaluru: National Institute of Public Cooperation and Child Development; 2015. p. 72.
13. Purohit BC. Inter-state disparities in health care and financial burden on the poor in India. *J Health Soc Policy* 2004;18:37-60.
14. Kumar SP, Sahay A, Koul S. Development of a Health Index of Indian States. Indian Institute of Management Ahmedabad (IIMA); 2017. Available from: <https://www.indiaoppi.com/sites/default/files/PDF%20files/Development%20of%20a%20Health%20Index%20of%20Indian%20States.pdf>. [Last accessed on 11 Jan 2018].
15. Singh S, Sheera VP. Health and education development level disparities in Indian states. *Int J Hum Soc Sci Invent* 2016;5:20-3.
16. Mondal NI, Hossain K, Ali K. Factors influencing infant and child mortality: A case study of Rajshahi district, Bangladesh. *J Hum Ecol* 2017;26:31-9.
17. Salam A, Siddiqui SA. Socioeconomic inequalities in use of delivery care services in India. *Obstet Gynecol India* 2006;56:123-7.
18. Sikder UK. Interstate Disparity in infant mortality rates and its important determinants in North East India. *Am Int J Res Hum Arts Soc Sci* 2015;11:21-8.
19. Ghorbani ZA. An association between health and economic growth in India. *International J Innov Res Dev* 2016;5:1.
20. Mukhopadhyay D. Regional Disparities in Health Outcome Indicators: A Study Across Indian States. MPRA Paper No. 66239. Germany: University Library of Munich; 2015.
21. World Health Organization. Safer Water, Better Health: Costs, Benefits, and Sustainability of Interventions to Protect and Promote Health. Geneva: World Health Organization; 2008.
22. Rah JH, Cronin AA, Badgaiyan B, Aguayo VM, Coates S, Ahmed S. Household sanitation and personal hygiene practices are associated with child stunting in rural India: A cross-sectional analysis of surveys. *BMJ Open* 2015;5:e005180.