Original Article

Block-wise Comprehensive Health Index in Gadchiroli: A Tribal District in Maharashtra

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Abstract

Background: The National Health Mission expects bottom-up approach for preparing Project Implementation Plan and also expects special attention toward tribal areas. Some district-level health information is available from national health surveys, but subdistrict-level information is mostly not available. Gadchiroli is the farthest district from the state capital. There are 12 blocks in the district. It is a notified tribal district having 8.61%–81.50% tribal population in different blocks and block-wise urbanization varies from 0.00% to 37.10%. **Objectives:** The objective was to assess community health status at block level in Gadchiroli district and then develop comprehensive health index for ranking the blocks. **Methods:** The author has used available secondary data sources including Census, Survey of Cause of Death scheme, health management information system, Directorate of Economics and Statistics, and Maharashtra Medical Council. Ten indicators were selected after discussion with public health specialists to evolve comprehensive health index. Blocks having best statistic in each indicator were given 100 marks and other blocks were given proportionate marks. Thus, the highest possible score for any block was 1000. **Results:** The range of block-wise score was from 424 to 781. The highest scoring block was Gadchiroli and was an outlier. The comprehensive score was having correlation with urbanization, $r = 0.63$ (95% confidence limits, 0.09–0.88). After principal component analysis, the extracted three components were responsible for most of the variations. **Conclusions:** Reasonably reliable and valid block-wise data are available to carry out community health assessment and develop comprehensive health index. The index is useful for comparison among blocks.

Key words: Block level, Gadchiroli, health index, health indicators, Maharashtra

Introduction

The National Health Mission expects bottom-up approach for planning and implementation to improve community health status. Accordingly, guidelines are regularly disseminated for preparation of district implementation plans. A robust systematic plan and its implementation require at least two resources: adequately trained team and valid data. Community health assessment data would be ideal for the purpose of planning. Some district-level data are available from District-Level Household Surveys, National Family Health Surveys, and Annual Health Surveys in nine states. However, data below district level are scarcely available. Only health management information system (HMIS) provides information about some health outcome indicators up to block level.[1] HMIS includes several indicators of varied validity and may not give comprehensive information. The community health status can be described by the number of indicators. There is a plethora of indicators but their importance is not uniformly agreed. These indicators may be classified on several axes. The health status is a product of health determinants and existing interventions. Conventionally, almost all health outcome indicators are classified under two major groups; morbidity related and mortality related. Disability-adjusted life years (DALY) is an excellent concept combining both aspects. Unfortunately, the prerequisite information for calculation of DALY is not available even at state level. Comprehensive health index will be useful for comparison, financial allocation, focused attention, etc., Usually, community health assessment is accomplished by obtaining information on several aspects of health including opinion about one's own health and about

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health-care services through surveys covering a large number of areas and population.[2] The national surveys mentioned above are typical examples of health assessment surveys. The need to have comprehensive indicator is universally felt.[3-6] It is generally observed that health indicators of tribal areas are poorer than nontribal areas[7] and there are difficulties in obtaining precise information; hence, Gadchiroli district was chosen. An attempt is made here to assess community health status at block level in Gadchiroli district, Maharashtra, using secondary data and then develop comprehensive health index using that data for ranking the blocks.

Material and Methods

This study was carried out in 2015. It is an analysis of secondary data pertaining to Gadchiroli district.

Study location and population

The population of Gadchiroli district is 10,72,942 and area is 10.72 km^2, implying population density of 74/km^2. There are 12 blocks having population ranging from 36,325 to 1,45,963. It is a notified tribal district having 38.7% (block-wise range: 8.61% to 81.50%) of tribal population. Gond, Bada Madia, and Rajgond are main scheduled tribes in the district. The urban population is 11% (block-wise range: 0%–37.10%). The map of district is depicted in Figure 1. Per capita net district domestic product (2013–2014) is Rs. 58,603. Literacy rate is 74.4%. Population sex ratio is 982 and child sex ratio is 961. There are 376 subcenters, 45 primary health centers, and 11 community health centers.

Selection of indicators for comprehensive health index and ranking

A speculative list of all important health indicators was prepared and block-wise data collection was attempted from different sources. The number of indicators was substantially reduced due to unavailability of block-wise data. The available information of the indicators was compiled block wise. It was decided to develop a comprehensive health index using the following steps; selection of health indicators having reasonably reliable information, block-wise assigning appropriate score to the value of each indicator, and block-wise summation of scores of indicators. Specialists from public health were consulted for designing such index. After thorough discussion, it was unanimously agreed to develop a scoring system having 1000 marks like some accreditation processes adopt and limiting the number of indicators to ten for easy calculation. Considering the reliability of the available data, the following ten indicators from four categories with equal weightage of 100 marks to each were also finalized after discussion. For calculation of score, block was considered as a unit. A maximum of 100 marks were allotted for each indicator. The block having the best value of the indicator was given 100 marks and rest of the blocks were given marks proportionately. The procedure was repeated for all the ten indicators. Thus, the maximum possible mark was 1000. When information about indicator was available from >1 source, mean of those values was calculated. Block-wise variation was analyzed by checking any outliers as in box plot concept.

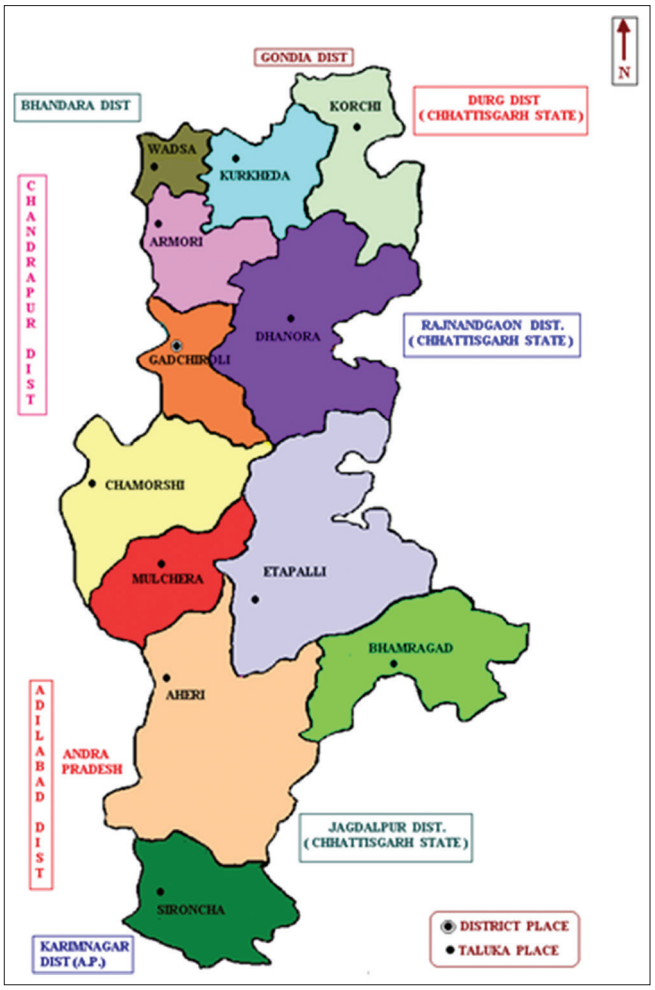

Figure 1: Gadchiroli District.

Statistical analysis

Principal component analysis was carried out using SPSS 17th version. The author assumed and checked that whether multiple variables were measured at the continuous level. There is a linear relationship between all the variables. Most of the coefficients were >0.3. Hence, data are suitable for reduction. There are no significant outliers. In these data, Kaiser Meyer Olkin (KMO) test value is 0.42 which indicates that the sample is inadequate. However, Bartlett's test of sphericity is calculated and is significant. Bartlett's test of sphericity, $P < 0.05$, taking a 95% level of significance, $\alpha = 0.05$, indicates that the factor analysis is valid. The extraction criterion for deciding the number of factors was Eigenvalues >1 by principal component analysis method. Cutoff of 0.5 on the rotated factor loadings was considered. Rotation method by Varimax with Kaiser normalization was used.

Selected indicators

- Health outcome
  1. Infant mortality rate

2. Birth rate
3. Sickle cell carrier rate
4. Annual parasite incidence of malaria.

- Health System:
  1. Doctor population ratio
  2. Nurse population ratio
  3. Bed population ratio.
- Other health determinants
  1. Use of latrine (by subtracting the proportion of open air defecation)
  2. Use of nonfire wood fuel for cooking.
- Health-care utilization
  1. Institutional deliveries.

Data sources (specific indicators)

1. Census 2011 (use of latrine and fuel for cooking)[8]
2. Survey of Causes of Death Scheme (rural) (average of three calendar years 2012–2014 for infant mortality and birth rate)[9]
3. HMIS, 2013–2014 (infant mortality rate, birth rate, annual parasite incidence, proportion of sickle cell anemia carriers, and proportion of institutional deliveries)[10]
4. Annual District Socio Economic Survey Report of Directorate of Economics and Statistics, Government of Maharashtra, for 2013–2014 (doctor population ratio, nurse population ratio, and bed population ratio)[11]
5. Maharashtra Medical Council (list of MBBS doctors for calculation of doctor population ratio)[12]
6. Management Information System of Women and Child Development Department (malnutrition in children)
7. Interactions with key informants (morbidity and mortality experiences, functioning of public and private health sectors, and traditions and cultural factors in seeking health care)
8. Special survey conducted (preferred health-care provider, drug addiction).

The author has dichotomized the fuel used for cooking into firewood and nonfirewood categories because the third category of other biomass was contributing only 1.5% and has been included in nonfirewood category. Nonfirewood fuel is considered as clean fuel. Information obtained from the last three sources is not used here for further analysis.

Results

Block-wise information of 52 important indicators was obtained from different sources. The values of some indicators were unbelievably low. The block-wise status of selected ten health indicators is summarized in Table 1. The outlier values in the blocks in each indicator are underlined in the table. The score obtained by each block in each of the ten indicators and total of the ten indicators is summarized in Table 2. The index may be calculated by dividing the score by 1000 without change in ranking. There is a wide block-wise variation in the following seven indicators. Etapalli and Gadchiroli blocks have high birth rate and are outliers. Bhamragad block has high Annual Parasite Incidence (API) and was an outlier. Doctor population ratio, nurse population ratio, and bed population ratio are best in Gadchiroli block and were outliers. There were 222 doctors in public sector and 42 in private sector. Out of the total doctors, 99 were MBBS. The total beds in the district were 961 and 95.32% were in public sector. The total number of hospitals was 27 and out of these, 14 hospitals were private but none of them employed qualified/registered nurse. The total number of nurses was 570. Nurse population ratio was poor and there was an outlier i.e. Desaiganj block. Use of clean fuel was maximum (includes 1% households using other biomass) in Gadchiroli block and is outlying. Etapalli block is having minimum institutional deliveries and is an outlier. The box plot with whiskers for total marks of ten indicators is shown in Figure 2. Gadchiroli block has the highest total marks and is an outlier. The Etapalli block scored least and the score was about 50% score of the best block. The comprehensive

Table 1: Selected health indicators of Gadchiroli, Maharashtra

Block	Mean IMR*	Mean BR*	API	Sickle cell anemia carrier (%)	Doctor/10,000	Nurse/10,000	Bed/10,000	Latrine use (%)	Clean fuel use (%)	Institutional deliveries (%)
Aheri	43	15	8	2.22	1.79	4.53	6.84	22	17	75
Armori	27	14	13	1.71	1.85	4.84	7.62	37	17	89
Bhamragad	42	13	44	0.63	3.85	7.43	13.21	15	7	65
Chamorshi	27	19	6	2.17	1.23	4.02	5.36	22	14	83
Desaigunj	15	14	5	2.73	3.35	2.63	7.54	47	23	92
Dhanora	34	16	23	1.16	2.30	6.05	7.26	19	7	74
Etapalli	21	26	16	1.28	2.08	5.38	5.87	16	8	43
Gadchiroli	68	26	2	2.85	4.86	7.81	18.77	42	35	96
Korchi	27	17	3	1.25	2.80	6.31	9.81	18	6	73
Kurkheda	21	15	16	1.45	2.09	5.46	7.90	38	11	92
Mulchera	22	16	20	0.55	1.97	4.80	10.48	24	7	75
Sironcha	25	14	14	1.53	2.68	6.02	8.03	13	10	81
District	36	16	17	1.70	2.51	5.31	8.96	28	16	83

Underlined figures are outliers. IMR: Infant mortality rate, BR: Birth rate, API: Annual parasite incidence

Table 2: Block-wise marks for selected indicators of Gadchiroli District

Block	Mean IMR	Mean BR	API	Sickle cell anemia carrier (%)	Doctor/10,000	Nurse/10,000	Bed/10,000	Latrine use (%)	Clean fuel use (%)	Institutional deliveries (%)	Total score
Aheri	35	92	25	25	37	58	36	46	48	78	479
Armori	55	93	16	32	38	62	41	79	47	92	555
Bhamragad	36	100	5	87	79	95	70	33	21	68	594
Chamorshi	55	68	33	25	25	51	29	47	41	86	460
Desaiganj	100	94	42	20	69	34	40	100	67	96	662
Dhanora	44	86	9	47	47	77	39	40	21	76	488
Etapalli	71	52	13	43	43	69	31	34	24	44	424
Gadchiroli	22	52	100	19	100	100	100	88	100	100	781
Korchi	55	78	70	44	58	81	52	38	17	75	568
Kurkheda	71	89	13	38	43	70	42	81	30	95	572
Mulchera	69	81	10	100	41	61	56	50	20	77	566
Sironcha	59	97	15	36	55	77	43	27	27	84	521

IMR: Infant mortality rate, BR: Birth rate, API: Annual parasite incidence

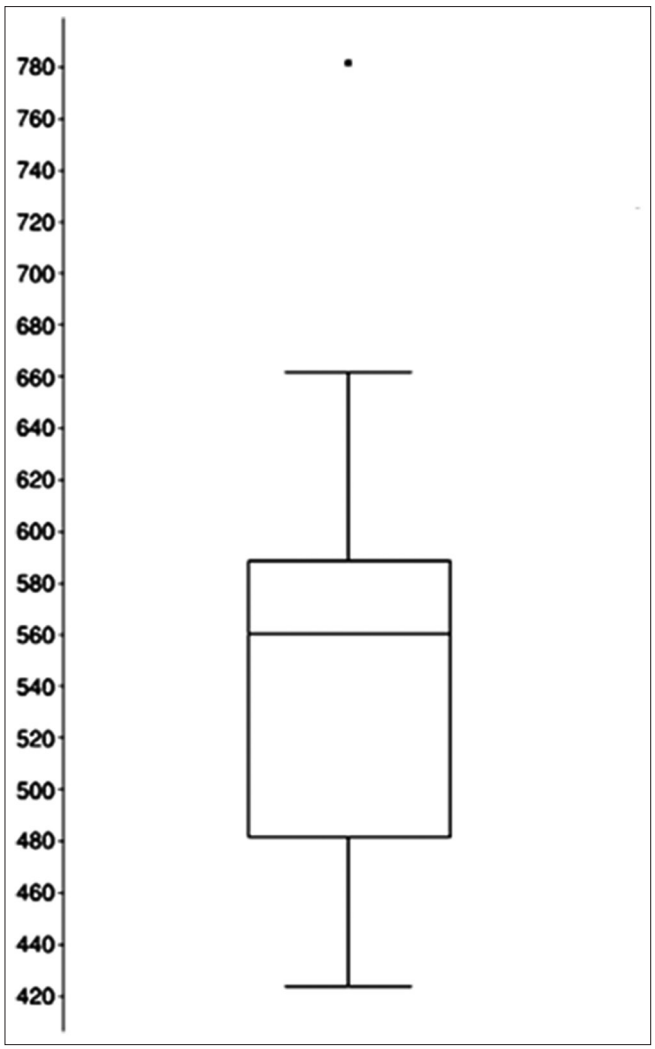

Figure 2: Block wise comprehensive score.

score was having correlation with urbanization, $r = 0.63$ (95% confidence limits, 0.09–0.88). There was weak negative correlation between comprehensive score and proportion of tribal population. The coefficient of correlation was −0.30. The correlation was not significant. The correlation matrix among all the ten indicators is summarized in Table 3. The best positive correlation (0.879; 95% confidence interval [CI]: 0.616–0.965) was observed between sickle cell anemia carrier rate and use of clean fuel. The strongest negative correlation (−0.743; 95% CI: −0.295 to −0.923) was observed between sickle cell anemia carrier rate and annual parasite incidence. Using principal component analysis, three components were extracted. Rotation of sum of squared loadings indicated that 36.72%, 33.675%, and 15.67% of variance was attributable to the extracted three components, respectively. The first factor included API, sickle cell anemia carrier rate, latrine use, clean fuel use, and institutional deliveries. The second factor included infant mortality rate (IMR), doctor population ratio, nurse population ratio, and bed population ratio. The third factor included birth rate. The rotated component matrix is given in Table 4. The initial Eigenvalues for the three components ranged from 1.350 to 4.265 and after rotation ranged from 1.567 to 3.672.

Discussion

Various national and international organizations such as CDC and WHO have differently enlisted and categorized health indicators.[13-16] Multiplicity of groups and indicators clearly indicates lack of uniformity. Realistic health assessment may be carried out through large-scale surveys covering diverse geographical areas and using tools containing questions about health and health system. It seems to be the best method. It demands multidisciplinary teams, extensive resources, and is a mammoth task. The term comprehensive health index is used to differentiate it from the community health index. In Scotland, the National Health Services community health index term is used for population register. From the register, a unique personal identity number is generated which gives all details pertaining to health of an individual. For community health assessment, the author has considered four categories almost similar to WHO, excepting exclusion of category of risk factors because block-wise risk factor data are not

Table 3: Correlation matrix

	IMR	CBR	API	Sickle cell anemia carrier (%)	Doctor/10,000	Nurse/10,000	Bed/10,000	Latrine use (%)	Clean fuel (%)	Institutional deliveries (%)
IMR	1.000	0.385	−0.016	0.315	0.610	0.676	0.768	0.079	0.567	0.186
CBR	0.385	1.000	−0.358	0.286	0.226	0.289	0.294	0.045	0.365	−0.267
API	−0.016	−0.358	1.000	−0.743	0.074	0.362	0.087	−0.437	−0.548	−0.436
Sickle cell anemia carrier (%)	0.315	0.286	−0.743	1.000	0.249	−0.301	0.101	0.642	0.879	0.579
Doctor/10,000	0.610	0.226	0.074	0.249	1.000	0.582	0.861	0.294	0.519	0.220
Nurse/10,000	0.676	0.289	0.362	−0.301	0.582	1.000	0.713	−0.309	−0.020	−0.150
Bed/10,000	0.768	0.294	0.087	0.101	0.861	0.713	1.000	0.252	0.494	0.274
Latrine use (%)	0.079	0.045	−0.437	0.642	0.294	−0.309	0.252	1.000	0.750	0.745
Clean fuel (%)	0.567	0.365	−0.548	0.879	0.519	−0.020	0.494	0.750	1.000	0.631
Institutional deliveries (%)	0.186	−0.267	−0.436	0.579	0.220	−0.150	0.274	0.745	0.631	1.000

IMR: Infant mortality rate, API: Crude birth rate, CBR: Crude birth rate

Table 4: Pattern of coefficients

	Component		
	1	2	3
IMR	0.156	0.833	0.276
CBR	−0.012	0.271	0.905
API	−0.662	0.264	−0.545
Sickle cell	0.857	0.014	0.400
doctor/10,000	0.241	0.859	−0.007
Nurse/10,000	−0.383	0.854	0.068
Bed/10,000	0.176	0.947	0.009
Latrine use (%)	0.889	0.073	−0.088
Clean fuel (%)	0.842	0.381	0.308
Institutional deliveries (%)	0.861	0.129	−0.327

IMR: Infant mortality rate, API: Crude birth rate, CBR: Crude birth rate

available. The health outcome indicators are broadly divided into morbidity and mortality groups. Life expectancy is the overall best indicator which is used in the calculation of Human Development Index (HDI). Unfortunately, subdistrict or even district data about life expectancy are not available. While conceptualizing global burden of disease, Murray and Lopez developed DALY indicator taking into consideration both morbidity and mortality. Again, unfortunately, district-level or subdistrict-level prerequisite information for calculation of DALY is not available.

In the present article, indicators from health outcome category are further subdivided into the following four groups: (1) mortality, (2) fertility, (3) morbidity due to communicable diseases, and (4) morbidity due to noncommunicable diseases. Then, one indicator from each subgroup is included in the final list. Sickle cell anemia is a district-specific noncommunicable disease and hence is included.[17,18] The present health management system gives information about many health outcome indicators but does not provide adequate information about health determinants. Among sociodemographic determinants, education and income are the most influencing determinants of health. However, they are not directly under health domain. Their inclusion will lead to a statistic similar to HDI. Although studied, sociodemographic determinants are not analyzed here. In this article, only community health status assessment is deliberated. Apart from education and income, health status is a product of interaction of many sociodemographical factors. One strongly influencing determinant is presence and functioning of health system. Availability of physical infrastructure and workforce is expected to be directly proportional to the health status. Therefore, many times, government first creates infrastructure and then health workforce is deployed. In Maharashtra, private sector is well developed and competes public sector in grabbing patients. In Gadchiroli district, this observation is not pertinent, as private sector is meagerly developed. Information about hospitals and beds is available with Directorate of Health Services and Maharashtra Pollution Control Board because hospital registration is mandatory under Bombay Nursing Home Act and Bio-Waste Management Rules. These two data sources are not open source. Register of nurses and non-MBBS doctors is not available through respective councils' websites. Information about water contamination was also considered for inclusion. In a small exercise, it was revealed that out of per capita income, female literacy rate, age at marriage, availability of tap water supply, and open air defecation, the last indicator had better correlation with infant mortality rate. Hence, use of latrine was preferred over water contamination for inclusion as other determinant. The number and selection of indicator from each group may be debated. The entire purpose of community health assessment is taking actions so that the disparity is minimized.[19] Therefore, the author has given differential weightage to various groups. The highest weightage of 50% is given to health determinants, 40% to health outcomes, and 10% to health-care utilization. In the category of health determinants, 60% weightage is given to health system. The author after thorough discussion with experts has included one presumably best indicator each from mortality, fertility, communicable diseases, and noncommunicable diseases to represent health outcome. The choice of indicators may be argued, but the limitation was availability of reliable data of subdistrict level. IMR itself is a comprehensive indicator and

can be used as a proxy of life expectancy.[20,21] The precise information about IMR is also not readily available. One source of IMR estimate used here reflects exclusively rural area, but fortunately urbanization in Gadchiroli is only 11% and hence the district figure may not be very different than quoted here. Similarly, birth data are available from rural area only and may be applicable to the whole district. Reliable recent data about latrine use, use of clean fuel, and institutional deliveries from sources other than used here are available.[22,23] As validity check, district information from the source (census) used in the calculation of comprehensive index is compared with the DLHS and NFHS recent data. Use of latrine is slightly lower in census findings compared to the national-level surveys (24.95%–27.9%); findings about clean fuel are similar to census figures (13.3%–14.5%). Proportion of institutional deliveries from HMIS matches with the findings of DLHS and NFHS fourth rounds (77.1%–86.2%). While calculating Urban Health Index,[24,25] the well-acknowledged procedure of calculating HDI is used, but author in this article has used a very simple method of calculation.

The tribes are usually slow to accept any changes in their traditional lifestyle. These factors lead to communication difficulties resulting into vulnerability of the population to some health problems. Some correlation between total score and proportion of tribal population was expected, but was not found. The confounding variables may be block-wise differential extent of forest and hills. As expected, there was correlation between urbanization and total score. Gadchiroli is the best block and reasons are obvious, being a district place, there is district general hospital with 200 operational beds. Therefore, there are more doctors and nurses compared to other blocks. The principal component analysis has indicated the inter-relationship between API, sickle cell anemia carrier rate, latrine use, clean fuel use, and institutional deliveries. Some protection against *Plasmodium falciparum* malaria among sickle cell carriers is well known.[26,27] The commonalties may be social factors such as urbanization, higher income, better education, and availing services.

Some efforts of developing district-wise comprehensive health index and ranking the districts using the calculated index are documented.[3,5] Subdistrict comprehensive health assessment is scarce. HMIS also assigns scores and generates district composite index using data pertaining to 16 indicators from four stages of life cycle under "Reproductive, Maternal, Newborn, Child Plus Adolescent Health domain." However, the method uses procedure similar to calculation of HDI.[6] Star rating facility of community health centers using indicators from six domains is provided in HMIS.[28] The present comprehensive health index encompasses the whole gamut of health at community level. Focused attention is a well-acknowledged concept. The classification of Empowered Action Group (EAG) and non-EAG states is the best example. An attempt was already made in this regard in Maharashtra in 2006 by establishing a special commission, for improving block-wise HDI. The criteria for selection of blocks were female literacy rate and proportion of families below poverty line. Health component was not included due to lack of data. Construction of subcenters and incentives to pregnant women were arbitrarily included interventions under Government Public Health Department Apart from additional financial resources, workforce deployment and other management tools such as close monitoring and supervision can be utilized for improvement of lagging blocks. This is surely in the preview of district society. Even the people's representatives from the blocks may be interested knowing the health status in a comprehensive manner and actions taken for the improvement.

Limitations

Although every attempt is made to obtain reasonably valid data, the validity of available sources may be debatable. Among the available indicators, the author has chosen ten indicators after discussion with specialists. Due to accepted limit of ten indicators for simplicity in calculation, some other good indicators such as water contamination, fully immunized children, and malnutrition in children were not included in spite of availability of information. The comprehensive health index is useful only for comparison between blocks. Sample size was small for principal component analysis.

Conclusions

Reasonably valid comprehensive health index can be calculated from available data sources. The calculation process is very simple. The block-wise variation is related to urbanization. For various reasons, Gadchiroli block scored the highest. The process adopted here provides comparative information of the blocks in specific indicators as well as overall view of the blocks to the administrators for focusing attention.

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Conflicts of interest

There are no conflicts of interest.

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