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Spatial Analysis of Healthcare Facility: A Block Level Study in Purulia District, West Bengal

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Abstract:
The study basically deals with five basic indicators namely: Healthcare Institution Population Ratio (HCIPR), Doctor Bed Ratio (DBR), Bed Population Ratio (BPR), Doctor Healthcare Institution Ratio (DHCIR) and Bed Healthcare Institution Ratio (BHCIR) to explore the status of healthcare facility (HCF) of the Purulia district. We have collected secondary database from District Statistical Handbook, Purulia, 2012.The Healthcare Facility Index (HCFI) has been computed to understand the status of HCF of the district. The study reveals that Purulia-I block enjoys the best HCF among the all blocks. The majority of the blocks have lagged behind from the Purulia-I on the basis of HCF.

Keywords: *HCIPR, DPR, BPR, DHCIR and BHCIR*

1. Introduction

Health is a fundamental aspect of human being to build a nation. Development of community has a direct link with the health of people and to make the society strong and to enjoy a good quality of life, healthcare facility plays an important role and it should be available to everyone instead of a particular section of people (Mandal, 2012, p.299). Health of people must be given priority after food, shelter and education. Health does not refer to mere absence of disease. Good health gives freedom to people from illness and the ability to realize his/her potentiality. Health therefore, is the one's sense of well-being. There is an important linkage between health and healthcare. Healthcare should not be considered only as medical care. It also provides pro-preventive care (Planning Commission). Health has been defined in wider sense by the World Health Organization (W.H.O.) in its 1948 constitution as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' (W.H.O., Geneva, 1964).

A person having ill-health in a society becomes liability to the community where he/she lives in and with that burden the society cannot prosper as the ill-health and poverty are the two sides of a coin (Mandal, 2010, p.503). Thus health related services and facilities become more vital to everyone. Health facility, in common is regarded as a source point where small clinics, doctor's offices to urgent care centres and large hospitals with several facilities are available. The prosperity of a region also depends on number and quality of health facilities (Wikipedia.org). The most effective path to promote healthcare for a vast majority of people is to develop effective primary healthcare delivery system. The Government of India has implemented several programmes regarding healthcare such as medical care, maternal and child healthcare, immunization, family planning and millions of people are being benefitted of it. In this present study we try to investigate the status of healthcare facility available in the Purulia district.

2. Literature Review

In a study done to review the healthcare delivery system provided by Punjab Health Systems Corporation (PHSC), Punjab, 2008 revealed that health facilities are in good condition under PHSC and other infrastructure and buildings are also good. But more attention must be paid to the cleanliness of facility, surroundings and landscape. It was also found that some facilities had sufficient equipment. If these equipment were found in some places, was either not being used or non-functional (NIHFW, 2008, p.9). The general health of people is affected by the primary healthcare services though there are ample factors which determine the quality and efficiency of primary healthcare services in developing countries. Some studies were done on status of healthcare facility in different districts of West Bengal and found very poor condition of health related facilities. In one study done in Bankura district of West

Bengal, it was found that majority of blocks having the facility of beds not more than one to four and almost all the blocks did not have any doctor for per ten thousand people which is really shocking and alarming. In case of availability of primary health centre (PHC), in an average more than forty thousand people were being served by per PHC. The overall condition of the district is not satisfying (Mandal, 2010, pp. 503-510). In another study carried out in Hooghly district of West Bengal, it was observed that on an average more than fifty thousand people were being served by per PHC. The highest number of beds was observed in Tarakeswar block for per ten thousand people. All most not a single doctor was available for per ten thousand people. In brief, health is in neglected condition in Government sector (Mandal, 2012, pp. 299-309).

In our study we try to identify firstly, to investigate the spatial distribution of Healthcare Facility (HCF) across the blocks. Secondly, from the distribution of individual facility of HCF across the blocks, it is difficult to identify the relative position of the blocks in terms of HCF status. Keeping in mind, we try to develop a composite index of HCF status of each block. Thirdly, the study assesses the nature of similarity of blocks in terms of the HCF facility.

3. Materials and Methods

The present study is carried out based on secondary data of 2012 which have been collected from District Statistical Handbook Purulia, 2012. The district map of Purulia has been collected from 18th All India Livestock Census, Agriculture Implements & Machinery, Fishery Statistics, West Bengal, 2007. The work is done considering all Hospitals, Rural Hospitals, Block Primary Health Centres, Primary Health Centres, other Departments of Government of West Bengal including State Government undertaking, Government of India including central Government undertaking & N.G.O./Private Bodies and all of these are together termed as Healthcare Institution (HCI)**.**Moreover, all the urban population has been added to their respective administrative block's population.

We have analyzed the secondary database to explore the healthcare delivery system of Purulia district. Firstly, Healthcare Institution Population Ratio (HCIPR), Bed Population Ratio (BPR), Doctor Population Ratio (DPR), Doctor Healthcare Institution Ratio (DHCIR)and Bed Healthcare Institution Ratio (BHCIR) indicators have been calculated by using following formulae.

$$HCIPR = \frac{HCI \times 1,00,000}{Population} \quad (1)$$

$$DPR = \frac{Doctor \times 1,00,000}{Population} \quad (2)$$

$$BPR = \frac{Bed \times 10,000}{Population} \quad (3)$$

$$DHCIR = \frac{Doctor}{HCI} \quad (4)$$

$$BHCIR = \frac{Bed}{HCI} \quad (5)$$

In the next step,the indicator indexfor each block of the Purulia district is constructed from HCIPR, DPR, BPR, DHCIR and BHCIR to compute the Healthcare Facility Index (HCFI). The calculated indicators are mentioned in the table-1.

Indicators	Goalposts of the indicators	
	Maximum value	Minimum value
Healthcare Institution/'00000 Population (HCIPR)	5.510 (Purulia-I)	1.759 (Barabazar)
Doctor/'00000 Population (DPR)	30.486 (Purulia-I)	2.360 (Purulia-II)
Bed/'0000 Population (BPR)	37.700 (Santuria)	2.360 (Purulia-II)
Doctor/Healthcare Institution (DHCIR)	5.533 (Purulia-I)	1.000 (Purulia-II)
Bed/ Healthcare Institution (BHCIR)	74.000 (Santuria)	10.000 (Purulia-II & Manbazar-II)

Table 1: Indicators of Healthcare Facility and their goalposts
Source: Authors' computation

Following is the formula used to calculate the indicator index of each parameter.

$$I_i = \frac{A_i - m_i}{M_i - m_i} \quad (6)$$

Where; I_i= Indicator index of i^{th} indicator, A_i = Actual value of i^{th} indicator, M_i = Maximum value of i^{th} indicator and m_i = Minimum value of i^{th} indicator.

On the basis of the indices of indicators, the actual position of the j_{th}block in the five dimensional Cartesian spaces may be plotted by the vector $(I_{1j}, I_{2j}, I_{3j}, I_{4j}, I_{5j})$. The best situation, which is perfect healthcare facility, can be found in Cartesian space vector in terms of (1, 1, 1, 1, 1). The worst healthcare facility is denoted by the vector (0, 0, 0, 0, 0). At the end the Healthcare Facility Index has been

computed measuring the normalized inverse Euclidian distance of the vector $(I_{1j}, I_{2j}, I_{3j}, I_{4j}, I_{5j})$ from the worst condition (0, 0, 0, 0, 0). Therefore, the following formula can be put here as the each indicator/parameter has been given same weight age.

$$HCFI = 1 - \sqrt{\frac{\sum_{i=1}^{5}(1-I_i)^2}{5}} \quad (7)$$

The normalization of Euclidian distance is done in order to ensure the range of HCFI from '0' to '1'. As the inverse distance has been taken, higher value of HCFI represents higher HCF. Thus the value '0' indicates no HCF and '1' indicates highest HCF. This distance-based approach has an advantage over the UNDP methodology of measuring achievement or deprivation Index. In UNDP methodology, the index presents the arithmetic or geometric average of the standardised indicators. It assumes perfect substitutability across the dimensions or indicators. Under this assumption a decrease in value of one indicator can be compensated by an increase of equal magnitude in another indicator.

Thus, if all dimensions or indicators are equally important for the all over index value the perfect substitutability among the indicators is an unrealistic assumption. In the distance based approach we do not need this unrealistic assumption. Our HCFI formula satisfies the properties of normalisation, symmetry, monotonicity, proximity, uniformity and signalling. But methodology of HDI follows only the properties viz. normalisation, symmetry, monotonicity. Thus, our distance based measure of HCF is superior to the measures based on UNDP methodology. This methodology is also applied in a study by Bagli and Adhikary, 2015.The HCFI varies from '0' to '1' where; the value '0' and '1' refers to perfect healthcare facility and worst healthcare facility respectively. To have the better understanding of HCFI of each block, the value of HCFI has been divided into five sub-ranges. The very good condition of HCFI is represented by $0.8< HCFI \leq 1.0$ and good condition of healthcare facility is indicated by $0.6< HCFI \leq 0.8$. The range $0.4<HCFI\leq 0.6$ refers the moderate condition of HCF and the poor condition is experienced by those blocks having the HCFI range of $0.2< HCFI \leq 0.4$. The very poor condition is represented by the range of $0\leq HCFI \leq 0.2$.

Ranking of the HCFI has been done (after Kendall's method) to identify the position of each block in the district. In order to investigate which blocks are close to each other based on HCIPR, DPR, BPR, DHCIR and BHCIRindicators, we have used the tool of cluster analysis (SPSS Software-20) following squared Euclidian distance method. Finally, to show the possible clusters of the blocks we have drawn the Dendrogram adopting average linkage method.

4. Study Area at a Glance

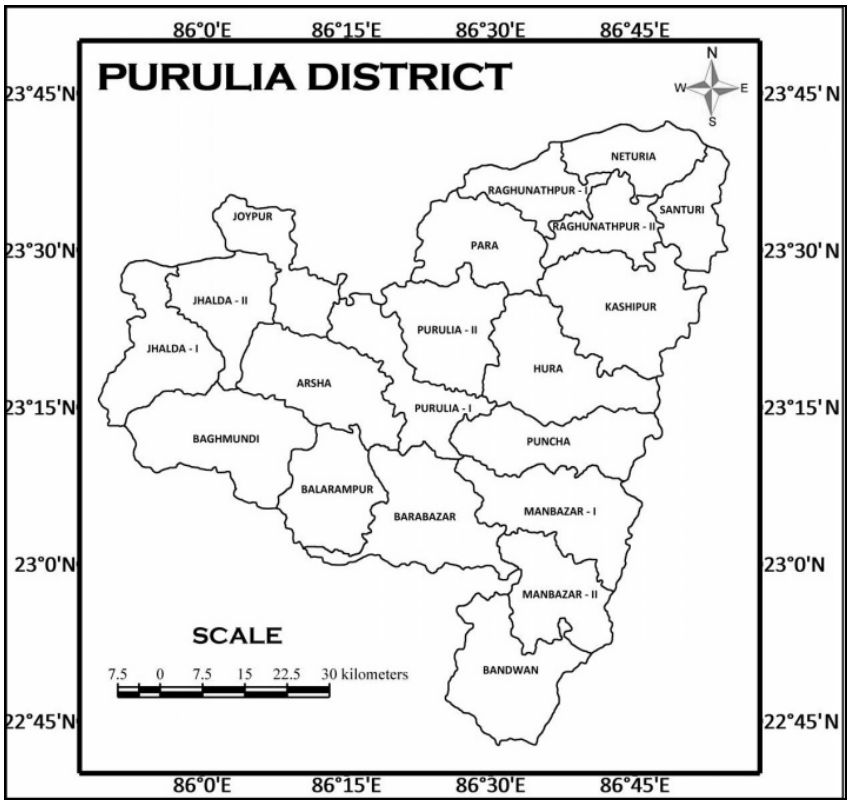

Figure 1

In the year 1956 Manbhum district was partitioned between Bihar and West Bengal under the States Reorganization Act (Transfer of Territories) Act 1956 and the present Purulia district was born on 1st November, 1956 (Wikipedia.org). The geographical coordinates(District Statistical Handbook, Purulia, 2008, p.1) of the district are23°42′N86°54′E to 22°43′ N 85°49′E (Fig:1).It has an

area of 6,259 km^2. The population size and density of the district are 29,27,965 (Male-51.09% & Female- 48.91%) and 468/km^2 respectively (Census of India, 2011). Total rural and urban population are 87.26% & 12.74% respectively. The literacy rate of the district is 64.48% in which male is 77.86% and female is 50.52%. Total number of blocks, police stations, municipalities and sub-divisions are 20, 21, 3 &3 respectively (District Statistical Handbook, Purulia, 2012).

5. Results and Discussion

5.1. Population Served by Healthcare Institution (HCIPR)

The parameter Healthcare Institution Population Ratio (HCIPR) refers tonumber of persons served by a medical/health institution. The study reveals that Purulia-I block enjoys the first position where per lakh population is served by 5 HCIs followed by Manbazar-II and Santuria. The poor condition is experienced by Barabazarblock where per lakh population is served by only 1 HCI followed by Arsha and Manbazar-I. The moderate condition is experienced by the remaining blocks where 2-4 PHCs serve per lakh people.

5.2. Doctor Population Ratio (DPR)

The indicator Doctor Population Ratio (DPR) is used to refer number of doctors available per lakh persons and is a good reflector of healthcare facility. Purulia -I block again possesses the first position having 30 doctors per lakh persons followed by Raghunathpur-I (16) &Kashipur (12). The block Purulia-II ranks last having 2 doctors per lakh persons followed by Barabazar. Remaining blocks enjoy moderate condition facility and the range of doctors available per lakh persons is 3-9.

5.3. Bed Population Ratio (BPR)

Bed Population Ratio (BPR) indicates number of beds available per ten thousand persons. It is another important indicator to comprehend the status of healthcare facility. On the basis of this parameter, Santuria stands first having 37 beds available per ten thousand persons followed by Purulia-I (36). In contrast, worst condition is observed in Purulia-II block where only 2 beds are available per ten thousand persons followed by Para, Arsha, Barabazar, Jhalda-I and Jhalda-II blocks. The moderate condition is experienced by rest of the blocks and their BPR values range from 3-12.

5.4. Doctor Healthcare Institution Ratio (DHCIR)

The term Doctor Healthcare Institution Ratio (DHCIR) expresses number of doctors available per healthcare institution (HCI). The availability of doctor is found to be highest in Purulia-I i.e. 5. The moderate condition is experienced by Raghunathpur-I, Kashipur, Para, Jhalda-II, Manbazar-I, Neturia, Arsha and Baghmundi having the range of values4-2. The poor condition of this parameter is observed in rest of the blocks having the value 1.

5.5. Bed Healthcare Institution Ratio (BHCIR)

The number of beds available in a HCI is represented by Bed Healthcare Institution Ratio (BHCIR). There are seventy four beds available in Santuria-I block per HCI followed by Purulia (66). In contrast Kashipur and Raghunathpur-I blocks are in moderate condition in terms of availability of beds per HCI and their respective values are 42 and 28. The block Manbazar-II and Purulia-II are in bad condition where only 10 beds are available per HCI followed by rest of the blocks.

Descriptive Statistics	HCIPR	DPR	BPR	DHCIR	BHCIR	HCFI
Mean	3.185	7.582	7.825	2.288	21.093	0.2107
Median	2.975	5.850	4.033	1.775	14.033	0.1454
S.D.	1.110	6.380	10.367	1.253	18.486	0.2095
CV	34.865	84.157	132.483	54.773	87.640	99.4358
Min	1.759	2.360	2.360	1.000	10.000	0.0299
Max	5.510	30.486	37.700	5.533	74.000	0.9479

Table 2: Description of the Healthcare Facility indicators of Purulia district
Source: Authors' computation

We can find from table-2that in an average there are three healthcare institutions (HCI) per lakh people in the district Purulia and maximum HCI is 5. It is unquestionable that availability of doctors acts significant role in healthcare delivery system. In this case, averagely seven doctors are available per lakh people and range of doctors is also very high i.e. 28. It is undoubtable that some blocks don't have the average number of doctors of the district. The average number of bed available per ten thousand people in the district is 7, where the maximum and minimum values are 37 and 2 respectively. The gap is also huge and patients may be deprived from basic facility. The district's average number of doctor per HCI is 2 though there is variation in case of DHCIR because maximum value and range are 5 & 4 respectively. The average number of bed per HCI is 21 whereas; the range is 64. Finally we can understand from HCFI the overall status of all healthcare related parameters. The average value of HCFI is found to be 0.21. The maximum and minimum values are 0.9479 and 0.0299. The range is 0.918.The variation is found to be very high and indicates deprivation of HCF across the blocks.

C.D. Block	HCFI	Rank	Remarks
Arsha	0.0790	17	Very Poor
Baghmundi	0.1572	10	Very Poor
Balarampur	0.1591	9	Very Poor
Barabazar	0.0558	19	Very Poor
Joypur	0.0878	16	Very Poor
Jhalda-I	0.0643	18	Very Poor
Jhalda-II	0.1335	11	Very Poor
Bandowan	0.1897	7	Very Poor
Hura	0.1127	13	Very Poor
Manbazar-I	0.1109	15	Very Poor
Manbazar-II	0.2119	5	Poor
Puncha	0.1283	12	Very Poor
Purulia-I	0.9479	1	Very Good
Purulia-II	0.0299	20	Very Poor
Kashipur	0.4116	4	Moderate
Neturia	0.1955	6	Very Poor
Para	0.1812	8	Very Poor
Raghunathpur-I	0.4188	3	Moderate
Raghunathpur-II	0.1111	14	Very Poor
Santuria	0.4272	2	Moderate

Table 3: Healthcare Facility Index (HCFI) of Purulia district, 2012
Source: Authors' computation

6. Overall Condition

In this juncture, we are able to realize the overall status of blocks. Based on HCFI we find that Purulia-I enjoys the best position having the value of 0.9479. In contrast, Purulia-II block is in worst condition having the HCFI value of 0.0299. Only one block is in poor condition i.e. Manbazar-II. Three blocks enjoy the moderate condition. The rest of the fifteen blocks experience the very poor condition and this the actual situation of the district (Table: 3). There is no block found to be enjoying the good position.

6.1. Cluster Analysis

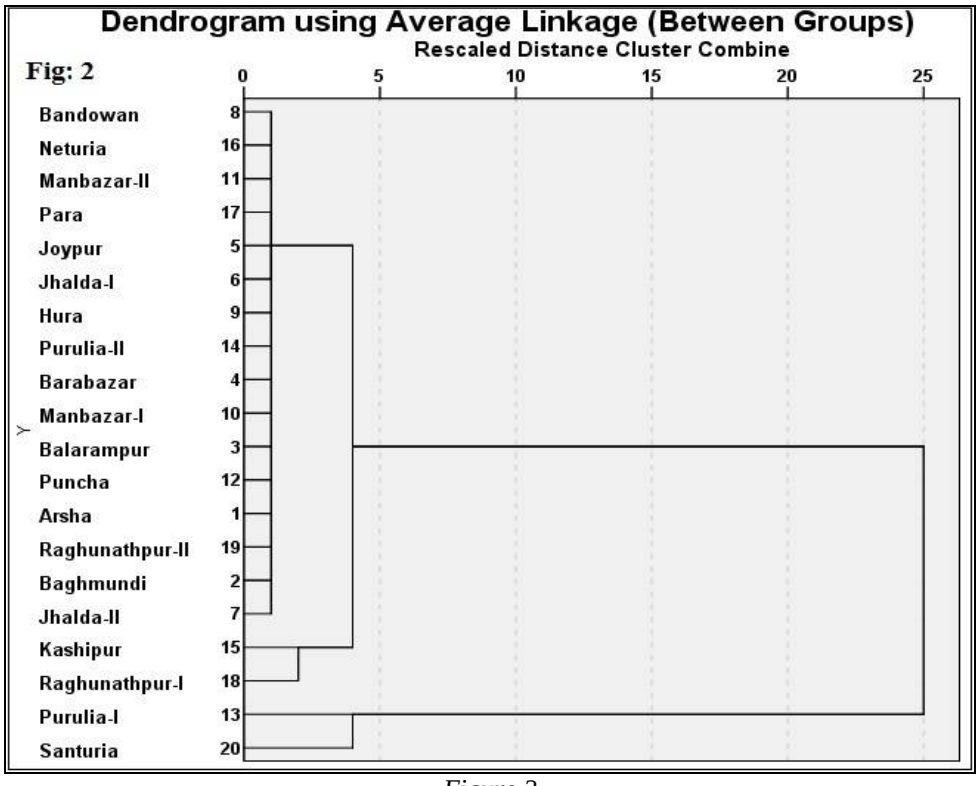

Figure 2

Based on the value of HCFI of multiple indicators of HCF, it is tough to determine the similarity among the blocks. We have done the cluster analysis with the help of indicators of HCF following the mentioned methodology to understand the pattern of methodology. The Dendrogram (Fig: 2) represents the result of cluster analysis. Here in this analysis we consider five possible clusters. Purulia-I and Santuria blocks make distinct cluster for each of them. In contrast, Raghunathpur-I and Kashipur also make cluster number 3 and 4 respectively. The rest of 16 blocks fall in the fifth cluster. If we consider 5 point scale of dissimilarity, we find all the blocks fall in a single cluster.

6.2. Conclusion

The study confirms that only the Purulia-I block enjoys the very good condition of healthcare facility. If we overlook three blocks enjoying moderate condition of HCF, it is clear rest of the sixteen blocks are in bad condition. The HCF is not distributed equally across the blocks. The block Purulia-I acts like a nodal point of HCF. All the blocks are not well connected through bus and rail with the district headquarter and people have to suffer a lot to enjoy the HCF. Till date there are so many areas of the districts rely on traditional medicines due to their remote locations lack of facility. The basic healthcare amenities need to be available to all irrespective of their location and community.

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