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A SPATIAL ANALYSIS OF THE DETERMINANTS OF PNEUMONIA DISEASE IN NORTH BASTAR KANKER DISTRICT, CHHATTISGARH, INDIA

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Abstract

Pneumonia is a leading cause of morbidity and mortality among the major diseases in the tribal areas of Chhattisgarh, including the North Bastar Kanker district. Pneumonia contributes about 20 per cent of infant deaths and it is the 2nd highest cause of infant mortality (after prematurity and low birth weight)in the district. This disease has been chosen to investigate at the ground level because the factors behind its origin are both physical and socio-cultural.This paper attempts to investigate the causal relationship between the natural environment and the socio-cultural environment in instances of outbreak of pneumonia disease. It also tries to find out the spatial distribution of pneumonia cases in the North Bastar Kanker district. The study is based on both primary and secondary sources of data. Primary data on pneumonia cases and their socio-cultural determinants have been collected from sample households. The elevation map prepared using a 30-metre SRTM DEM (Satellite data), and drainage and vegetation maps prepared from Landsat-8 images were used as environmental indicators. Pearson's product-moment correlation coefficient has been used to find out the relationship between socio-cultural determinants and pneumonia disease.The Odds Ratio (OR) has been measured to understand the prevalence of risk and strengths of the relationship between exposure and non-exposure groups. The prevalence of pneumonia has a notable association with physical conditions and the socio-cultural determinants such as scheduled tribes population, illiterate people, unclean household environment, low family income, not maintaining personal hygiene and nature of housing condition.

Keywords: Spatial analysis, Determinants of Pneumonia, Natural environment, Public health

Introduction

Pnuemonia is defined as a change in living tissues that endangers the survival in an environment. It is intimately related to the natural and socio-economic environment. Spatial epidemiology deals with the geographical distribution of diseases and it is a holistic approach that involves the interactions and associations between the elements of physical and socio-cultural environments. Pneumonia is one of the leading public health issues worldwide and

the World Health Organization (2021) defines pneumonia as a 'form of acute respiratory infection that affects the lungs'. Pneumonia is an acute illness that usually occurs from an infection that causes the lungs to expand and inflam, decreasing oxygen exchange and producing a cough and shortness of breath. It can be caused by a large variety of microorganisms, including bacteria, respiratory viruses, and fungi. The prevalence of these microorganisms varies widely across different geographic regions.Most severe cases of pneumonia are caused by bacteria, of which the most important are Streptococcus pneumoniae (pneumococcus) and Haemophilusinfluenza. In addition, about half of all pneumoniais caused by either *H. influenzae* or *S. pneumoniae* (Scott et al., 2008). Severe pneumonia is more common in children between two and 12 months of age compared with children between 13 and 60 months of age. The global prevalence of pneumonia is highest in the age group of 1–4 years(Kasundriya et al., 2020).Banstola and Banstola (2013) claimed that children residing in rural areas were more affected by severe pneumonia compared with children living in urban areas.Children under the age of five and older adults with a history of chronic diseases are particularly sensitive groups who are affected by pneumonia more frequently than other people. It is transmitted through direct contact with respiratory droplets of carriers. Moreover, the bacteria often spread within households and in crowded conditions. Naturally, the pneumonia mortality rate of children in rural areas is 1.6 times higher than their urban counterparts due to limited healthcare services at the community and facility levels. In terms of gender, more girls die due to Pneumonia than boys (Wahl et al., 2020).Meade and Emch, (2010) said how human behaviour interacts with environmental conditions for preventing disease in the cultural and socio-economic contexts.Infections of pneumonia are more prevalent in the winter and early spring seasons.

Socio-cultural factors significantly impact health and well-being, making health inequalities a severe public health concern worldwide. The socio-cultural circumstance of the study area has a significant degree of inequities, influencing the well-being of people.Poor parental educational status is significantly associated with acute respiratory infection. (Ujunwa, &Ezeonu, 2014).Undernutrition, crowding, lack of exclusive breastfeeding, low degree of maternal education, limited access to secondary care and passive care–seeking behaviour are the characteristics, of poor households found by many studies, which are the common risk factors for the occurrence of acute respiratory infection (Rudanet al. 2013).Socio-cultural determinants include social group, literacy, nature of the house, food habits, personal hygiene, sanitation addiction, family size per room, family annual income, and occupation are also studied in association with acute respiratory infections.

North Bastar Kanker district, where the tribal population is highly concentrated, is one such area in the state of Chhattisgarh state. The tribes dwell in hilly forested areas where their widely dispersed rural hamlets are in such inhospitable terrain and environs wherein access to health and medical care services is challenging because of inadequate availability of transport facilities, hilly terrain, and inadequate health infrastructure.Basedon

the available data on diseases from various government sources in North Bastar Kanker district, it is found that the district has poor health conditions. However, diseases that are very prevalent in the district, like malaria, pneumonia, typhoid, tuberculosis, cough, fever, diabetes mellitus, gastric ulcer, hypertension, and sickle cell anemia, Pneumonia is a life-threatening disease to children and old age groups in the district. It is also observed that there is a wide variation in the epidemiology of Pneumonia in the district in terms of prevalence rate, dominance power, and intensity of diseases. The specific environmental conditions and socio-economic factors closely associated with this disease's occurrence, in the district, are not explored much. Further, many people are affected by this disease due to lack of health awareness. Therefore, this study focuses on spatial distribution of pneumonia cases in North Bastar Kanker District and investigates the relationship between the physical and the socio-cultural environments where pneumonia is prevalent. The findings of the study have important implications for public health and also provide guidelines for health management plans for pneumonia in the tribal region.

Study Area

North Bastar Kanker district is located in the southern part of Chhattisgarh state, which shares a 5.3 per cent area of the state. It is the part of Bastar Plateau covered by the Kanker and Kotri basins. Kotri is a tributary of the Indrawati River, while the Mahanadi River and its tributaries drain the Kanker basin. The total geographical area of the district is 6432.68 km^2 in which rural areas is 73 per cent area (4698.35 km2). The location of the study area extends from 19°42′ N to 20 °31 ′ N latitude and 80 °23′ Eto 81° 49 ′ E longitude. As per the forest report 2019, the district has covered 3396.01 sq. km of forest area. It is surrounded by Rajnandgaon district in the northwest, Narayanpur district in the south, Durg district in the north, Bastar district in the southeast and Dhamtari district in the northeast. It shares a boundary with Maharashtra in the west. Administratively, the district includes seven tehsils and equal numbers of CD blocks namely, Koyalibeda, Antagarh, Durgkondal, Bhanupratappur, Kanker, Charama, and Naraharpur (Fig.1). It consists of 1083 villages which includes 1058 inhabitant and 25 un-inhabitant villages. As per the Census of India (2011) the total population of North Bastar Kanker district is 748941, and the decadal growth rate was 15.1 per cent during 2001-2011. The density of the population is 105 persons / km^2. The sex ratio is 1006, which is more than the state's sex ratio of 991 females per thousand males. The literacy rate of the North Bastar Kanker district is 70.3 per cent. Most of the people in the study area are Schedule Tribe (55.3 %) and the least number of people live in urban areas (10.3%).

Sources of Data and Methodology

The present research work is based on both primary and secondary data. Primary data, on pneumonia cases and its socio-cultural determinants, have been collected from sample households surveys.Here, pneumonia risk factors have been chosen based on the previous studies.In general, the outbreak of pneumonia disease is influenced by various sociocultural factors like social groups, household environment, personal hygiene,

education, income, housing condition, family size, and smoking addiction. Hence, this information have been collected from the surveys. From the literature such as Braveman and Gottlieb (2014), Alves and Oliveira (2018), Chelogo et al. (2020), Coyne et al. (2006), Mankar and Shaikh, (2021), and Nayak et al. (2012) the study assumed that the occurrence of pneumonia disease in the North Bastar Kanker district is directly or indirectly influenced by various physical determinants like elevation, natural drainage, vegetation cover, temperature and rainfall. Therefore, the elevation, drainage, and vegetation maps have been prepared using 30-metre SRTM DEM and Landsat-8 images. The data generated was used tostudy the relationship between physical and sociocultural determinants of pneumonia disease and their spatial distribution patterns in the North Bastar Kanker District.

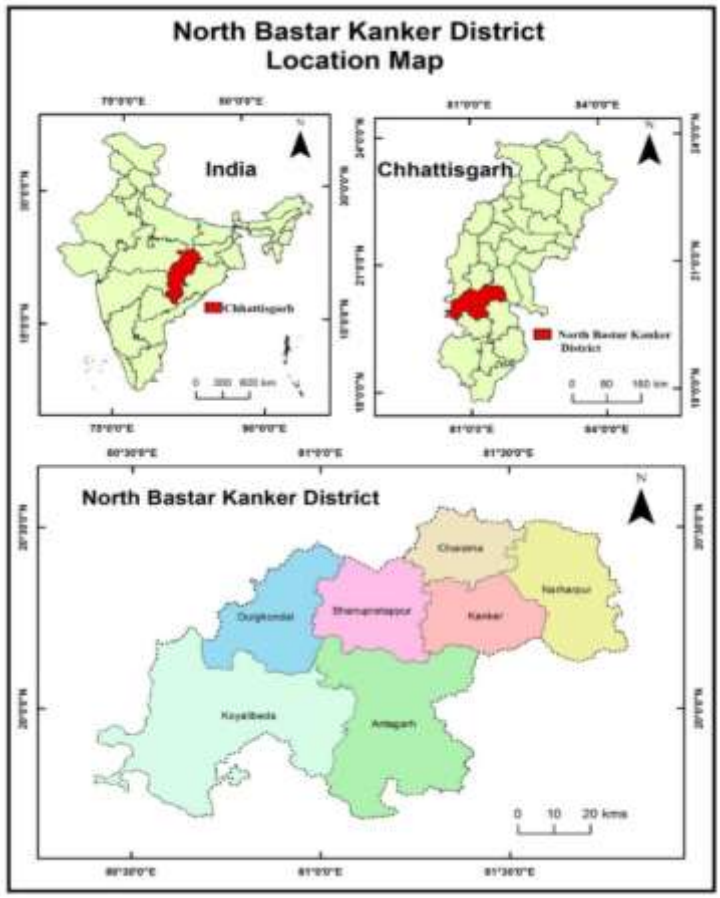


Fig. 1 Study area

The North Bastar Kanker district has seven CD blocks and 1083 villages where pneumonia is the most common disease.To investigate the factors that caused pneumonia, 21 villages, or 2 per cent of the total, were chosen randomly from each of the seven CD blocks in the North Bastar Kanker district. A random sampling method was used to select 50 per cent of the households from each sample village. A total of 4,706 samples were

chosen from 983 sample households (Figs. 2 and 3). A questionnaire was prepared to collect information on pneumonia cases and their contributing factors. The responses of respondents provided data of pneumonia cases and their determinants from each sampled household.In this case, reporting of pneumonia cases by the respondents related to their households during the survey is based on diagnosis and treatment by the doctors at the health centres or clinics.The patients' medical prescriptions were referred forconfirmation ofthe pneumonia.Proper consent was obtained before data collection by highlighting the district's geo-medical importance, high morbidity, and mortality.

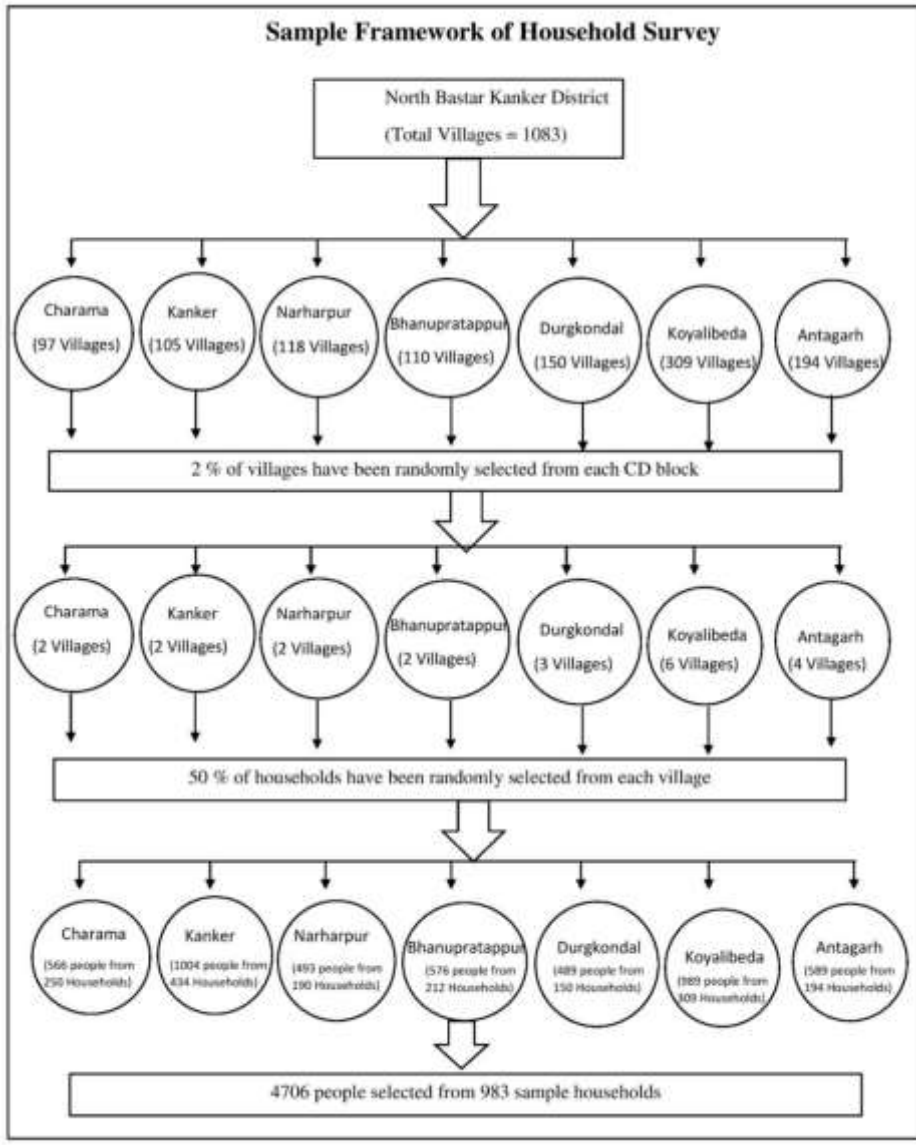
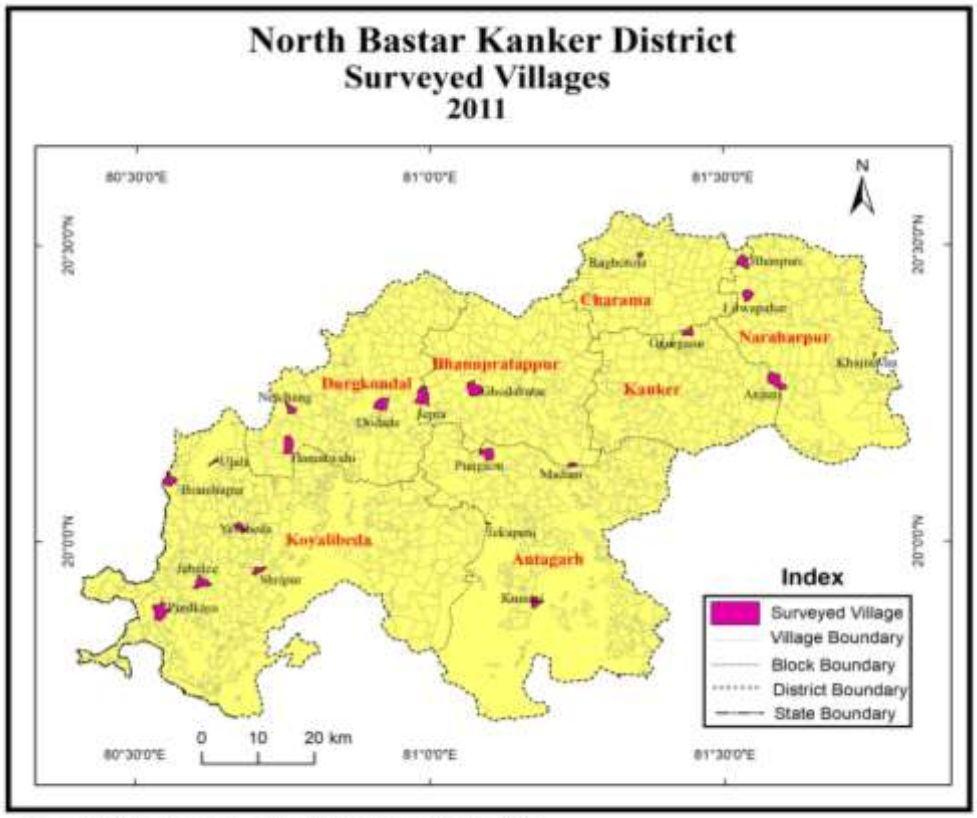


Fig. 2 Sample design



Source: District Census Handbook: Uttar Bastar Kanker,2011

Fig. 3 Surveyed locations

Pearson's product-moment correlation coefficient has been used to determine the correlation between socio-economic variables and diseases. In the present study, the absolute and casual relationship between sociocultural determinates and pneumonia disease has been worked out using linear regression model. The formula of the linear regression model is given below:

$$Y = bX + a$$

Where,

Y = Dependent Variable

a = Intercept (Constant)

b = Slope of the line

X = Independent Variable

Student's t-distribution has been calculated to find the significant difference between variables. In the case-control studies, the Odds Ratio (OR) has been measured to understand the prevalence of risk and strengths of association between exposure and non-

exposure groups. It is also called the '*gross product ratio'*.The Odds Ratio (OR), its standard error and 95% confidence interval, Z statistics, and significance level are calculated. It is computed using MedCalc-20.110 software. Theodds range from 0 to infinity while the Odds Ratio of 1 (OR = 1) is associated with the prevalence in the exposed group which is same as the prevalence of the unexposed group. It means there is a high degree of association between exposed and unexposed groups. However, an odds ratio is more than 1 (OR>1) indicates the prevalence of the exposed group is greater than the prevalence of the unexposed group. This shows a positive strength of association between exposed and unexposed groups and increased risk levels. On the other hand, odds ratio of less than 1 (OR<1) refers to the prevalence of disease in the exposed group which is lower than the prevalence of disease in the unexposed group. It reflects the negative strength of the association and decreases the risk. The Odds Ratio (OR) has been calculated from the following formula:

$$\text{Oddsatio (OR)} = \frac{\text{Odds that a case was exposed } (\text{A} * \text{D})}{\text{Odds that a control was exposed } (\text{B} * \text{C})}$$

Where,

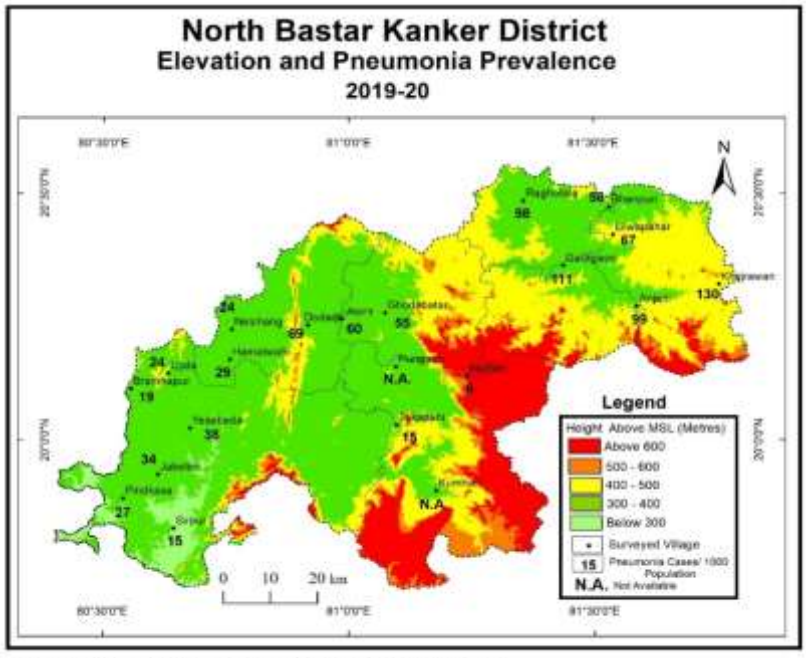
Groups	Disease (Case)	No Disease (Control)	Total
Exposed	A	B	A + B
Unexposed	C	D	A + B
Total	A + C	B + D	A + B + C + D

Results and Discussion

Pneumonia is a serious inflammation of the lung tissue (alveoli) caused by a wide variety of microorganisms such as viruses, fungi, bacteria, chemical exposure, or physical damage to the lungs, as well as the indirect effects of other diseases (Solehati et al., 2017). Pneumonia is a major cause of death in children all over the world, and it is one of the most common infectious diseases in the district. The cases were prevalent in all age groups, but 31.6 per cent of pneumonia cases were only found in the below 10 years of age group. It also affects the old age population. Most of the children and old age groups are infected by the disease and it is also a major cause of death in this age group.Pneumonia sickness is most common in the under-5 age group (147 per thousand children) and 75–79 age group

(210 per thousand persons). Due to low immunity power, these age groups are more vulnerable to pneumonia disease. The disease is associated with different physical factors like elevation, temperature, rainfall, soil, water bodies, and vegetation cover. In this study, the topographical features of the district influence pneumonia cases. The temperature and rainfall are closely associated with pneumonia cases. The study reveals that average monthly temperature and pneumonia cases are inversely related (r= -0.523) while the monthly amount of rainfall is positively correlated (r=0.258) with pneumonia cases. Vegetation cover is negatively correlated (r= -0.653) with the prevalence rate of pneumonia disease in the district.The northern parts of the district have a high prevalence rate of pneumonia as compared to the southern parts of the district. The existence of water bodies and water logging areas of Kanker, Narharpur and Charama blocks have a high concentration of pneumonia cases.

The maximum prevalence of pneumonia cases has been reported in the surveyed households of Anjani village (64 /1000 population), which is located 395 m above mean sea level. However, the western parts of the district arefound with low prevalence of pneumonia, and low elevation (below 340 m) whereas the eastern parts of the district are found with higher prevalence of pneumonia and high elevation. Moreover, pneumonia patients are absent in Kumari and Pungaon villages where the elevation are 396 and 360 respectively **(Fig. 4)**. Pneumonia cases between Anjani village of Kanker block and Kumari and Pungaon sample villages of Antagarh block located at 395 metres, 396 metres and 360 metres respectively from sea level are due to their distinct location.

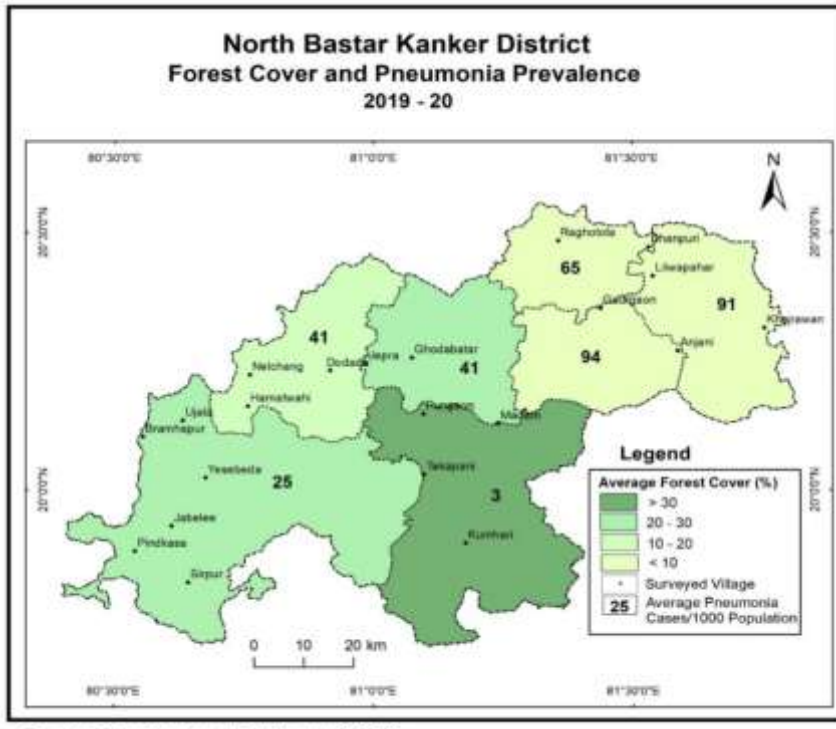


Sources:SRTM Digital Elevation Model (Satellite Data), Field Survey, 2019-20

Fig. 4 Elevation of the study area with pneumonia cases

Anjani village is close to the urban area, where people are more aware of their diseases and treatment. They used to contact the primary health centre, sub-health centre, and private doctors, whenever they get sick. Their disease is diagnosed and made known to the patient and then treated. On the other hand, Kumari and Pungaon villages are located in the interior, where people are least aware of their health; whenever they get sick, they go to the Baiga /Traditional healers for treatment. So they do not come to know about the reality of the disease. For this reason, they might have not reported pneumonia cases during the household survey.

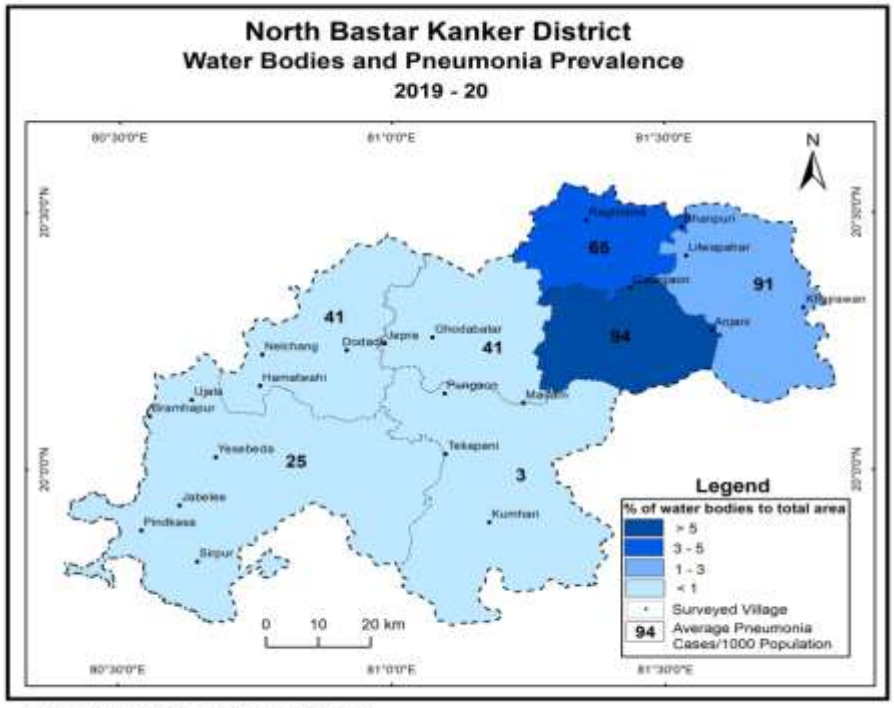
Vegetation cover is inversely related to the prevalence rate of pneumonia disease in the district. Vegetation cover can have both direct and indirect effects on pneumonia cases. It plays a crucial role in improving air quality by absorbing pollutants, thus reducing the risk of respiratory infections like pneumonia. Moreover, it can regulate the microclimate by providing shade, reducing temperature extremes, and maintaining humidity levels. This modulation of temperature and humidity can impact the survival and transmission of respiratory pathogens, potentially decreasing the likelihood of pneumonia cases.The data reveal that the lowest prevalence of pneumonia cases have been recorded in the surveyed households of Antagarh block, which has the highest percentage of vegetation cover (58.5 %). On the other hand, the northern parts of the district have a high prevalence rate of pneumonia with low vegetation cover (Fig. 5).



Sources: Village Panchayat, Field Survey, 2019-20

Fig. 5 Forest cover and pneumonia prevalaence

The existence of water bodies and water logging areas is one of the major influencing variables for the development of pneumonia. The existence of water bodies in tribal areas can have both positive and negative effects on the incidence of pneumonia cases. Water bodies such as rivers, and ponds can contribute to humidity and moisture in the surrounding air. High humidity levels can potentially increase the risk of respiratory infections which includes pneumonia as humidity creates an environment conducive to the growth of bacteria and viruses. Moreover, tribal areas could lack in basic sanitation practices would lead to an increased risk of vector-borne diseases like malaria, and dengue. While these diseases are not directly related to pneumonia, their presence can weaken the immune system and make individuals more susceptible to secondary respiratory infections, including pneumonia. If the water bodies are not adequately maintained, it may generate an environment that is favourable to the occurrence of various infectious diseases, such as pneumonia. It is noticeable thatthe higher concentrations of pneumonia cases are only found in the areas with a large concentration of water bodies. Moreover, tribes mainly use small water bodies, which are, in most cases, contaminated due to regular bathing, washing of dirty clothes with detergents, cleaning of animals, etc. This contaminated water causes waterborne pathogens, notably Legionella, Shigella spp., Pseudomonas aeruginosa, and Nontuberculous mycrobacteria which are responsible for pneumonia. The study finds that Kanker, Narharpur and Charama blocks have a higher concentration of pneumonia cases found, and the proportion of water bodies is high (Fig. 6).



Sources: Landsat - 8, Field Survey 2019-20

Fig. 6 Water bodies and pneumonia prevalaence

Temperature and rainfall in the study area are closely associated with pneumonia cases. The winter months (Dec-Feb) comprise 46.5 per cent of pneumonia cases followed by the rainy months (June to August) with 36.7 per cent. On the other hand, a low number of pneumonia cases have been reported in the summer months when the temperature is maximum and rainfall is scanty. The monthly amount of rainfall is positively correlated (r=0.258) with pneumonia cases. People are more exposed to cold environments in winter and rainy months than in summer. Due to these reasons, people were more infected with pneumonia disease (Fig. 7).

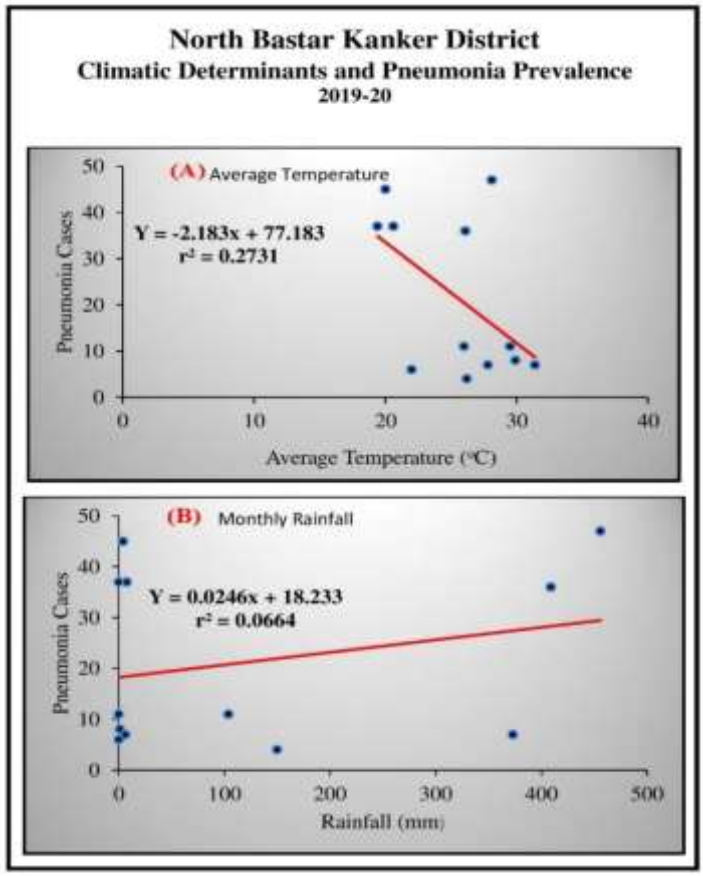


Fig. 7 Scatter plot of average temperature and ranifall versus pneumonia cases

Air pollution is a significant environmental variable of pneumonia outbreaks. It increases the risk of pulmonary infections. However, exposure to ambient air pollutants is associated with an increased rate of respiratory diseases such as pneumonia, especially in younger children (Brunekreef and Holgate, 2002). Poor ambient air quality can adversely affect the respiratory system and damage the human body's natural defences against bacteria and viruses. As a result, pneumonia disease is more prevalent where the air quality is poor. However, in the current study, North Bastar Kanker is a tribal district of Chhattisgarh

that covers 47.42 per cent of forested area. High forest coverage areas have shown good air quality. Due to high forest coverage, the North Bastar Kanker district is the most convenient place for health. The ambient air quality (AAQ) values are below 50 and consistent throughout the year. It displays good air quality that is suitable for respiratory health. The study reveals that the ambient air quality of the district is not at risk of an outbreak of pneumonia disease.

The outbreak of pneumonia disease is also influenced by socio-cultural factors like social groups, household environment, personal hygiene, education, income, housing condition, family size, and smoking addiction. In the study area, the scheduled tribe population is largely affected by pneumonia disease compared to other social groups.Due to a lack of knowledge, high levels of illiteracy, low family income, and an unhealthy lifestyle, the scheduled tribe population is more vulnerable than other social groups in the district. The regression Coefficient (b) value shows that one unit increase in the scheduled tribe population has resulted in 0.664 unit increase in pneumonia cases (Table 1). However, the coefficient (r^2) value indicates that 41 per cent of the change in disease occurrence can be explained by the scheduled tribe population (Fig. 8.A). The Odds Ratio (OR = 0.688 point) shows that the prevalence rate of pneumonia cases in the scheduled tribe population is lower than that of other social groups in the district (Table 2).

Table 1 North Bastar Kanker District: Relationship between Socio-cultural Determinants and Pneumonia Cases, 2019-20

Product Moment Correlation Coefficient			Student's t-Distribution					Regression Analysis		
X	Y	r	Calculated t value	Tabulated 't' Value		Sig / Insig	H_o / H_1	a	b	r^2
				0.05	0.01					
Scheduled Tribes Population (%)	Pneumonia Cases (%)	0.640	3.727	2.093	2.861	Sig	H_1	10.178	0.664	0.41
Unclean Household Envt. (%)		0.239	1.100			Insig	H_o	3.519	0.911	0.057
People maintain Personal hygiene (%)		0.326	1.542			Insig	H_o	30.808	0.704	0.107
Illiterate People (%)		0.307	1.443			Insig	H_o	9.877	1.102	0.095
Low HouseholdIncome (%)		0.572	3.119			Sig	H_1	4.31	0.894	0.328
Kutcha Houses (%)		0.554	2.976			Sig	H_1	-32.24	1.289	0.307
Households living More than 4 Persons per Room (%)		0.297	1.391			Insig	H_o	25.425	0.911	0.088
People Consumed Tobacco (%)		0.458	2.306			Sig	H_1	0.842	1.282	0.210

Source: Based on Field Survey, 2019-20

An unclean household environment can have a significant impact on the occurrence and severity of pneumonia cases. Unclean environments can harbour a higher number of bacteria, viruses, and other microorganisms. Exposure to these pathogens, especially in crowded or poorly ventilated spaces, increases the chances of respiratory infections such as pneumonia. Here, the unclean household environment is positively related to pneumonia

cases. The surveyed North Bastar Kanker district households have found 9.4 per cent of pneumonia cases in 31.6 percent of unclean households. The coefficient determination (r^2) shows that a weak relationship was found between these two variables (Fig. 8.B). The odds ratio (OR= 1.462 point) also explains that an unclean household environment is not a risk for pneumonia cases in the district. On the other hand, an unhealthy lifestyle, and not maintaining personal hygiene are the risk factors for outbreaks of pneumonia disease in this tribal district. The regression coefficient (b) value also shows that per unit change in the population which does not maintain personal hygiene has caused rise in pneumonia cases (30.8 point). However, coefficient determination (r^2) shows a weak relationship between these variables (Fig. 8.C). The Odds Ratio (OR= 2.835 point) reveals that people who do not maintain personal hygiene have a 2.88 times greater chance of risk of pneumonia than those who maintain personal hygiene.

Table 2 North Bastar Kanker District: Socio-cultural Determinants of Pneumonia and Odds Ratio, 2019-20

Socio-cultural variables	Disease (Case)	No Disease (Control)	Odds Ratio (OR)	95 % confidence interval		Z Value	Level of Significance (P value)
				Lower Limit	Upper Limit		
Social Group							
Scheduled Tribes	142	2867	0.688	0.534	0.887	2.888	0.0039
Other Social Groups	114	1583					
Total	256	4450					
Household Environment							
Unclean	24	287	1.462	0.946	2.26	1.708	0.0876
Clean	232	4163					
Total	256	4450					
Personal Hygiene							
Not Maintain	158	1548	2.835	2.188	3.673	7.888	<0.0001
Maintain	98	2902					
Total	256	4450					
Education							
Illiterate	78	1095	1.736	1.296	2.324	3.701	0.0002
Literate	123	2997					
Total	201	4092					
Household Income (Rs.)							
< 20000 / Year	41	652	1.111	0.787	1.577	0.599	0.549
> 20000 / year	215	3798					
Total	256	4450					
Nature of House							
Kutcha	212	3520	1.273	0.913	1.775	1.422	0.155
Pucca	44	930					
Total	256	4450					
Family size / Room							
Above 4 Members / Room	19	401	0.81	0.543	1.415	0.866	0.387
Less 4 Members / Room	237	4049					
Total	256	4450					
Consumed Tobacco							
Yes	51	469	2.112	1.532	2.912	4.56	<0.0001
No	205	3981					
Total	256	4450					

Source: Based on Field Survey, 2019-20

Lack of maternal education is significantly associated with the occurrence of pneumonia. Educated mothers recognize the signs and symptoms of pneumonia early and access health care earlier so their children have a better outcome than others (Tiewsohet al, 2009). Illiteracy is often associated with lower socio-economic status. Individuals from lower socio-economic backgrounds may live in overcrowded, poorly ventilated, and unclean households. Such environments promote the growth of bacteria and viruses, increasing the risk of pneumonia transmission. In the present discussion, Illiterate people comprise 30.5 per cent of pneumonia cases due to a lack of awareness about different responsible factors for the outbreak of pneumonia disease. Illiterate people are positively related to pneumonia cases, but coefficient determination (r2) highlights a very weak relationship between illiterate people and pneumonia cases (Fig. 8.D). Moreover, the odds ratio (OR= 1.736 point) highlights that the prevalence of pneumonia is 1.74 times greater chance of risk in illiterate people than in literate people. On the other hand, unclean households are vulnerable to pneumonia outbreaks.Based on the study, people with weaker socio-economic status, illiteracy, living in dirty houses, and neglecting to maintain personal hygiene are all at a greater risk for an outbreak of pneumonia(Table 2).It has been observed that residents of Kutcha houses account for 82.8 per cent of the total pneumonia cases. Moreover, People with poor socio-economic backgrounds reside in kutcha houses. In addition, 74.8 per cent of people live in kutcha houses with insufficient ventilation that restricts fresh air flow.This leads to an increase in the chances of respiratory infections like pneumonia.

Family income is directly related to pneumonia cases. Socio-economic conditions of the family depend on the income of the family. It helps access better healthcare services and a good lifestyle.Low family income and pneumonia cases are positively related. The regression coefficient (b) value highlights that per unit change in the population belonging to the low-income group has resulted in an increase of 0.894 unit in pneumonia cases. Furthermore, coefficient determination (r^2) shows that 32.8 per cent change in pneumonia patients is explained by people of the low-income group (Fig. 8.E). On the other hand odds ratio (OR= 1.111 point) displays that the low-income group is at 1.11 times greater risk of pneumonia than the family income of above Rs. 20000/year.

The housing condition of the family is directly related to pneumonia cases. Environmental risk factors, and children living in kutcha houses has an increased risk of severe pneumonia. This corroborates the finding of Banstola &Banstola (2013), “Kutcha houses are typically built by the poor and are a recognized risk factor for pneumonia”. In tribal communities, kutcha houses might be small and overcrowded, with several family members living in a confined space. Crowding facilitates the spread of respiratory infections which can easily spread to the near ones.. People having kutcha houses comprise 78.9 per cent of pneumonia cases whereas poor ventilation system causes high humidity, allowing for the development of bacteria and increasing the prevalence of pneumonia. Based on observations, three-quarters of the population lives in kutcha houses, which are at high risk of being affected by a pneumonia outbreak. Moreover, 8.5 per cent of households are overcrowded (more than 4 persons/room) which occupies 23.8 per cent of pneumonia cases.

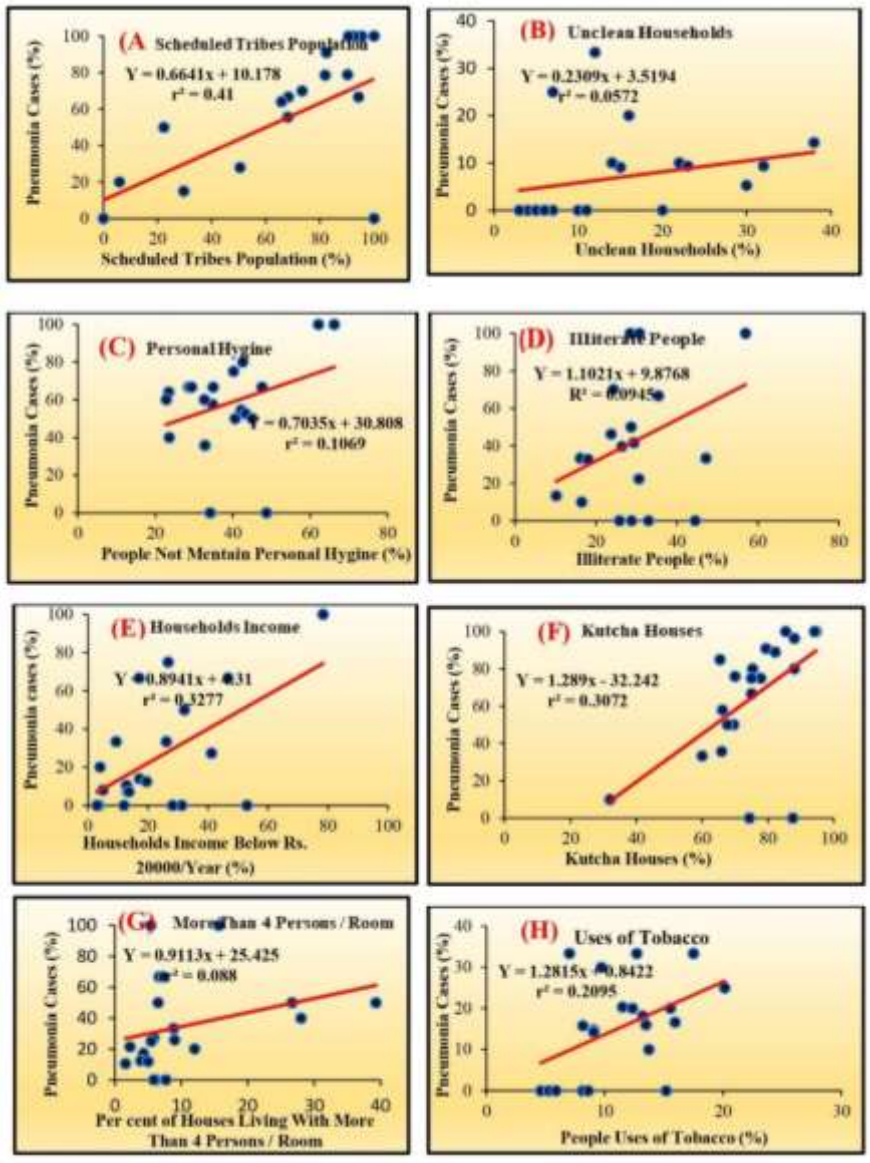


Fig. 8 Relationship between socio-cultural determinants and pneumonia cases in North Bastar Kanker district during 2019-20

Here, per cent of kutcha houses and the prevalance of pneumonia cases are positively related. The coefficient determination (r^2) value also indicates that 30.7 per cent total change in pneumonia patients is explained by residential kutcha houses in the surveyed households in the district (Fig. 8.F). The Odds Ratio (OR= 1.273 point) highlights that people having kutcha houses have a 1.27 times greater chance of risk than people residing in pucca houses. It is an infectious disease so more number of family members living together in

small number of rooms are at risk of transmitting bacteria and viruses of pneumonia disease. The house has insufficient ventilation and lighting due to unhealthy environmental conditions, resulting in high humidity, which allows for the breeding and transmission of diseases caused by bacteria, viruses, and fungi (Kurniasih et al., 2015). Here, family members living together with more than 4 persons per room share 23.8 per cent of pneumonia cases in the 8.5 per cent households. It is also positively correlated (r= 0.297) with pneumonia cases (Fig. 8.G). Although, the odds ratio (OR) is 0.81 point, it shows that size of family has (large or small in reference to living room / bed room) has nothing to do with pneumonia cases.

Data show that pneumonia disease is dangerous for people who consume tobacco. Excessively consumed tobacco can damage the human body's natural defence mechanism against bacteria and viruses. As a result, people have a greater chance of being infected by pneumonia disease. Here, per cent of people use tobacco, and pneumonia cases are positively correlated (r= 0.458) and statistically significant at 0.05 level. The coefficient of determination (r^2) highlights that a weak relation between the use of tobacco and pneumonia cases, and 21 per cent of the change in pneumonia cases can be explained by people who have consumed tobacco (Fig. 8.H). But in case of tobacco consumtions, a much higher odds ratio (2.112 point) reveals that the prevalence of pneumonia cases is 2.1 times greater amongst the tobacco consumers than that of the non tobacco consumers.

It is further observed that 55.5 per cent of pneumonia cases have been reported from the scheduled tribe population. This is also reflected in a positive correlation (r=0.64) between the share of tribal population and the prevalence of pneumonia cases; the relationship is significant at p 0.01. The unclean household environment is also positively correlated (r= 0.239) with pneumonia cases. Similarly, people not maintaining personal hygiene and pneumonia cases are positively correlated (r= 0.326). Illiterate people are more prone to pneumonia cases; the prevalence of pneumonia cases is 1.74 times higher among the illiterate people than that of literate people. It is observed that 14.8 per cent of pneumonia cases are found in 20.9 per cent of households in which families have monthly income below Rs. 20000 per year. Share of kutcha houses and occurrence of pneumonia cases are also positively correlated (r=0.554) where residing people residing in Kutcha houses have a 1.27 times greater chance of getting affected by pneumonia than those in pucca houses.

Conclusion

The study reveals that physical and socio-cultural factors are directly related to the prevalance of pneumonia in the study area. The northern parts of the district have a high prevalence rate of pneumonia compared to the southern parts. The study reveals that average monthly temperature and pneumonia cases are inversely related (r= -0.523), while the monthly amount of rainfall is positively correlated (r=0.258) with pneumonia cases. Vegetation cover is negatively correlated (r= -0.653) with the district's prevalence rate of pneumonia disease.The existence of water bodies and water logging areas of Kanker,

Narharpur and Charama blocks have a high concentration of pneumonia cases. Socio-cultural determinants like scheduled tribes population, illiterate people, unclean household environment, low family income, not maintaining personal hygiene, and nature of housing condition (Kutcha house)are positively associated with pneumonia disease. The Odds Ratio reveals that an unclean household environment, illiteracy rate, and not maintaining personal hygiene are the main risk factors for the occurrence of pneumonia disease. The study suggests that increasing awareness about personal health and hygiene, equal access to health care services, increased literacy rate, and different health programs would reduce the magnitude of pneumonia cases in the district.

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