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SPATIO-TEMPORAL ANALYSIS OF TUBERCULOSIS MORTALITY IN MARATHWADA REGION (M.S., INDIA)



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Abstract: Health is considered as a major determinant of happiness. The link between health and development is very close. Creativity of human being is depended on his health condition. In this context, Medical Geography as a branch of human geography deals with such aspects. Tuberculosis remains a global public health problem even though its causative organism was discovered and highly effective medicines and vaccines are available for cure them, have been known for a long time. India is the highest TB burden country in the world and accounts 20 percent of global burden of tuberculosis.

The data regarding TB has been collected from vital statistics published by government of Maharashtra. The present study attempts to evaluate the Spatio-temporal analysis of Tuberculosis mortality in Marathwada region of Maharashtra state. The objective of this research paper is to study the distributional pattern and correlation between various geographical and socio-cultural factors and mortality of tuberculosis in the study region. The researcher proposes to analyze the available data at various stages is being calculated using various statistical methods. The collected data has correlated with different physical and socio cultural variables. The distributional pattern of Tuberculosis is to be investigated at district level. The data collected for 35 years period has been analyzed by Choropleth methods, Standard Mortality Rate (S. M. R.), simple ranking technique and Karl Pearson's correlation method is used for understanding comparison, distributional pattern and correlation between various factors and Tuberculosis. Class intervals for distribution is decided by percentile method.

The study reveals that various climatic phenomena such as temperature, humidity, rainfall, sunshine and altitude partially contribute in the occurrence of the TB in the study region. Moreover, various cultural factors such as economic status, housing conditions, occupational structure, level of industrialization and environmental sanitation contribute significantly in the occurrence and transmission of the TB. Poverty, low vitality, overcrowding urban areas, faulty dietary pattern, malnutrition, social customs like 'Purdah', repeated pregnancies, child marriages, lack of timely and adequate treatment facilities and poor sanitation are some of the causes responsible for tuberculosis mortality in the study region.

Key words: Health, Tuberculosis mortality, Geographical and Socio-cultural factors, Medical Facilities.

INTRODUCTION :

Today Health is an important aspect of human being. It is closely related to the various geographical factors. These factors are more influencing and they determine the health of individual and the community. Health is considered as a major determinant of happiness and as a factor of development.

Medical scientists are wrestling with the problems of human health caused by malnutrition and environmental pollution brought about by the changes in ecology (Ishtiaq A. Mayer-2007).

The idea that place and location can influence health is a very old and familiar concepts in the western medicine. Since Hippocrates, it has been known that certain diseases seen to occur in some places and not in others or the intensity of some diseases is usually 'region specific'.

The relationship between environmental factors and distribution of diseases has been well recognized. The ecological (environmental) factors, which are favourable for the growth, transmission and spread of an infective agent, often produce an aerial distribution pattern. Some diseases (impose) have greater morbidity in particular regions due to dominance of certain conditions that given rise to an intra-regional ecological synthesis which is the most favorable breeding ground for a disease. Such a synthesis needs a specific combination of multiple conditions related to the cultural, economic and physical aspects of a region.

Armstrong (1965) defines medical geography as a subject concerned with the distribution and comparison of various indices of diseases in human (or animal) population, and the inter-relation with other elements of physical, biological and cultural environment in space.

Thus, medical geography is a spatial analysis of health and diseases, diseases diffusion processes, social and political ecology, and health service delivery systems as well as it focuses on contagious infectious diseases, vectored diseases, and newly emerging diseases.

EPIDEMIOLOGY OF TUBERCULOSIS:

Tuberculosis remains a global public health problem even though its causative organism was discovered and highly effective medicines and vaccine are available for cure them, have been known for a long time. India is the highest TB burden country in the world and accounts 20 percent of global burden of tuberculosis.

Tuberculosis is a specific infectious disease caused by mycobacterium tuberculosis, that mainly affects lungs and cause pulmonary tuberculosis. It can also affects intestine, meninges, bones and joints, lymph glands, skin and other tissues of the body. The disease is usually chronic with varying clinical manifestations (Park and Park 2011).

The agents that cause the disease are of three types-human, bovine and avian. The human and bovine types can infect human and animal hosts reciprocally. The bovine type can be transferred to man through milk, meat or contact with infected animals (Misra R.P. 2007).

About three million tuberculosis patients die each year and four to five million new cases occur each year in the world. Tuberculosis strikes all ages of people but it is more common among the younger and a many of the people whose immune systems have been poor (suppressed). It is more prevalent in males than in females.

Infection is likely to result from tubercle bacilli that penetrate, beyond airways lined with mucus into the alveolar sacs deep in the lungs, primary infection is a stage in the development of tuberculosis, but it does not always lead to the disease. Tubercle bacilli that enter an alveolar sac are usually engulfed by large ameba like cells called alveolar macrophages. Normally these cells are able to digest bacteria. However, tubercle bacilli resists digestion and most of them actively thrive and multiply inside the macrophages. Some of the macrophages carrying these bacteria may migrate to the mucus layer and be carried out the body. Other may carry the bacteria to another part of the lungs or into the lymph or to a nearby lymph node or even into the blood (World book 1994).

The disease T.B. is associated with number of organic as well as inorganic factors. "Various climatic phenomena such as temperature, humidity, rainfall, sunshine and altitude partially contribute in the occurrence of the disease. There is a positive correlation between tuberculosis and rainfall and negative correlation with temperature variation" (Agnihotri R.C, 1995).

"Various cultural factors such as economic status, housing conditions, occupational structure, level of industrialization and environmental sanitation contribute significantly in the occurrence and transmission of the diseases. Poverty, low vitality, overcrowding, faulty dietary, pattern, social customs like 'Purdah', repeated pregnancies, child marriages, lack of timely and adequate treatment facilities and poor sanitation are some of the causes responsible for tuberculosis morbidity".

"The spirituous liquor and smoking are major causes of tuberculosis among persons of lower income group, due to lack of medical facilities, poor diet, low standard of living and chronic diseases, most of the patients of chronic fever and diabetes mellitus become more susceptible to tuberculosis" (Agnihotri R.C, 1995).

"Tuberculosis is not hereditary and hence its occurrence at birth is rare phenomenon. Tuberculosis is an acquired disease: Ingestion and inhalation are the two main modes of infection. Labors engaged in occupations leading to the inhaling of dust, coal, silicon, asbestos, cotton fibers etc., are likely to get tuberculosis more easily than those who are not" (Misra R.P.1970).

Diet seems to have a considerable influence on the incidence of tuberculosis. Those who do not get enough of proteins and vitamin D are more susceptible to these diseases than others. A close contact with patients in dwellings with poor or no ventilation helps the spread of the disease. Children's are the first victims in families where patients discharge the tubercle bacillus in their sputum (Misra R.P. 1970)

"Tuberculosis of the lung is perhaps the most serious fast spreading disease of the chest in India. It is especially in large cities. Malnutrition, overcrowding and poverty syndrome is the main cause of disease".

STUDY REGION:

The researcher has specific purpose to select the Marathwada region. As medical geography is concerned with an analysis of the study of areal distribution of diseases and its relationship to the existing environmental, the physico-socio-cultural factors are the main (major) aspects which serve to explain diseases and other conditions of health.

The area under study comprises of eight (8) districts of Marathwada region namely Aurangabad, Beed, Jalna, Nanded, Osmanabad, Latur, Parbhani and Hingoli (Hingoli district separated from Parbhani at May 1999). The midyear rural population (2005) of these eight districts is 11651300, which is 19.89% of the total rural population of Maharashtra and urban population is 431290, which is only 9.51% of the total urban population of Maharashtra. The total population of these eight districts is 15964000, which is 16.68% of the total population of Maharashtra. The study region includes 2 corporations and 51 municipalities.

This study region is heterogeneous in nature, in case of Physiography climate, soils, vegetation, drainage patterns, rainfall, occupation, social factors, sex ratio, urbanization, industrialization etc. The latitudinal and longitudinal extent of the area is 170 351 North to 200 401 North and 740 401 East to 780 15' East respectively.

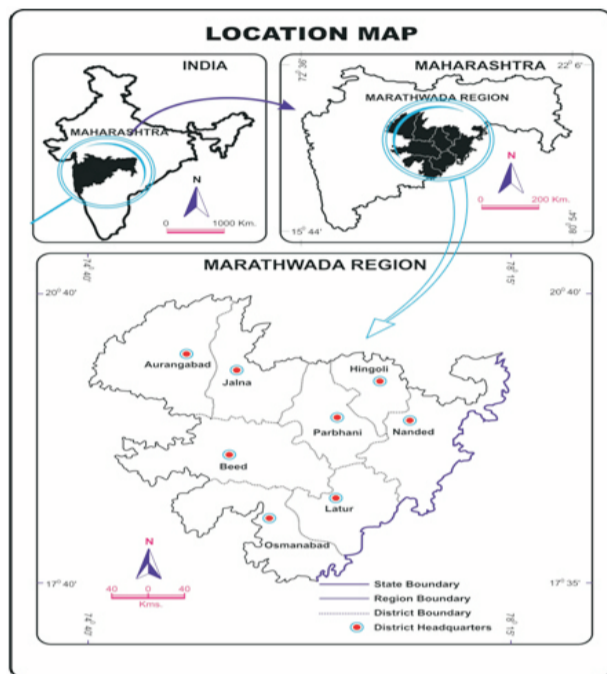


Fig.1

Marathwada region is located in the (south) central part of Maharashtra state and it covers 64813 km² area (21.04 percent). The environmental factors of this region may cause the larger morbidity and mortality of certain infectious and parasitic diseases.

OBJECTIVES:

- I.To study the distributional pattern of Tuberculosis in the study region
- II.To study the correlation between various factors and Tuberculosis in the study region

METHODOLOGY:

The researcher proposes to analyze the available data at various stages is being calculated by using various statistical methods. The collected data has correlated with different physical and socio cultural variables. The distributional pattern of Tuberculosis is to be investigated at district level. The data collected for 35 years period, has been analyzed by choropleth methods, Standard Mortality Rate (S. M. R.) technique, Ranking technique and Karl Pearson's correlation method is used for understanding comparison, distributional pattern and correlation between various factors of Tuberculosis. The data regarding deaths by Tuberculosis has been collected from vital statistical report published by government of Maharashtra.

Class intervals for distribution is decided by percentile method. The various graphical and distributional methods are used for showing distribution.

SPATIO- TEMPORAL DISTRIBUTION:

The disease Tuberculosis is communicable disease spread by air and physical contacts. This disease is very important disease causes for deaths in the study region. The disease TB is urban dominated disease. The pollution level of

urban areas is higher than the rural area.

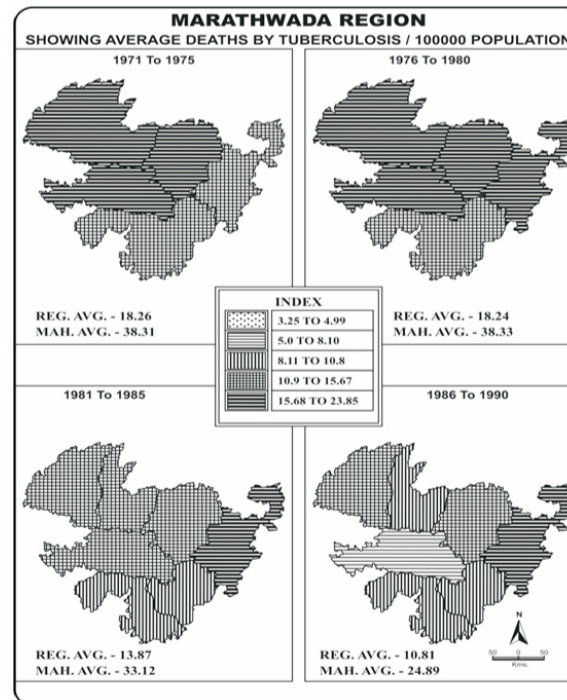
The table 1 shows the death rate of TB in the study region and figure 2 displays the spatial distribution of the death rate. The regional average death rate of TB is 11.09 per lakh population and the state average is 27.03 per lakh population. The regional average is very low as compare to state average. This means that other districts in the state have high mortality rate by T. B.

Table 1
MARATHWADA REGION
SHOWING S.M.R. AND RANKING OF AVERAGE
DEATH RATES BY TUBERCULOSIS

Sr. No.	District Name		1971	1976	1981	1986	1991	1996	2001	1971
			To	To	To	To	To	To	To	To
1	Aurangabad	Death rate	23.85	18.26	15.67	13.24	9.58	3.25	4.58	12.63
		S.M.R.	131	100	113	122	137	77	75	122
		Rank	I	IV	II	II	I	VII	VI	II
2	Jalna	Death rate	23.85	18.26	13.35	10.50	6.18	4.82	5.01	11.71
		S.M.R.	131	100	96	97	88	114	82	77
		Rank	I	IV	IV	IV	V	III	V	IV
3	Beed	Death rate	16.73	19.39	12.70	8.03	7.01	3.75	3.78	10.20
		S.M.R.	92	106	92	74	100	89	62	98
		Rank	III	III	V	VII	III	V	VII	VI
4	Nanded	Death rate	15.51	22.48	22.53	15.69	9.33	5.36	9.70	14.37
		S.M.R.	85	123	162	145	133	127	160	139
		Rank	IV	I	I	I	II	I	I	I
5	Osmanabad	Death rate	13.27	11.66	10.64	8.13	5.45	3.63	5.89	8.38
		S.M.R.	73	64	77	75	78	86	97	81
		Rank	V	V	VI	VI	VI	VI	III	V
6	Latur	Death rate	13.27	11.66	8.34	9.03	4.90	3.83	5.50	8.08
		S.M.R.	73	64	60	84	70	91	90	64
		Rank	V	V	VII	V	VII	IV	IV	VII
7	Parbhani	Death rate	21.95	19.43	13.88	11.04	6.45	4.92	8.09	12.25
		S.M.R.	120	107	100	102	92	117	133	118
		Rank	II	II	III	III	IV	II	II	III
Study Region	Death rate	18.26	18.24	13.87	10.81	6.99	4.22	6.08	11.09	
	S.M.R.	100	100	100	100	100	100	100	100	
Maharashtra State	Death rate	38.31	38.33	33.12	24.89	23.00	21.08	10.47	27.03	
	S.M.R.									

Source: Computed by Authors based on Annual Vital statistics Report published by Govt. of Maharashtra from 1971 to 2005.

* Jalna and Latur were separated from Aurangabad and Osmanabad in 1981 and 1982 respectively.



The districts Nanded, Aurangabad, Parbhani and Jalna have observed high mortality rate. The mortality rate of these districts is above 11.09 per lakh population. The temperature variation, high rainfall, partially industrialization and overcrowding urban centers cause for pollution. This pollution causes for spread of TB in the Nanded, Aurangabad and Parbhani districts.

The districts of southern part and southwest part of the study region have observed moderate mortality rate. The death rate of Beed and Osmanabad is moderate. In these districts, the mortality rate is observed between 8.11 to 10.8 per lakh population. Due to the various medical facilities, the mortality rate of TB in Latur district is low.

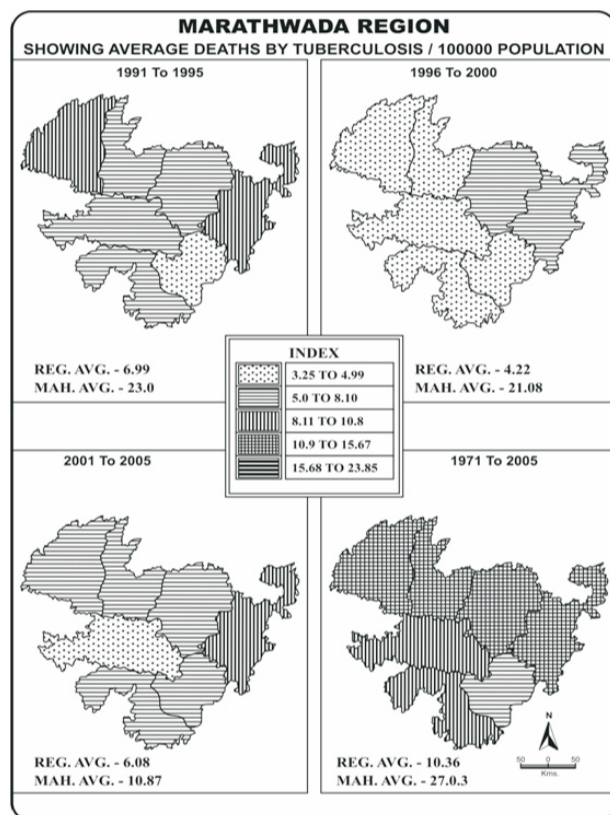


Fig.2

The trend of TB is observed decreasing in the study region and also in the state. The mortality rate of the study region is decreased from 18.26 per lakh population during the years 1971 to 1975 to 6.08 per lakh population during the years 2001 to 2005. In this period, the state average is decreased from 38.31 to 10.47 per lakh population. All districts in study region have decreasing trend from 1971 - 1975 to 1996 -2000. After that the mortality rate of TB is increased.

PROMINENT AREA:

The figure 1 shows the Spatio- temporal distribution of the TB. The figure shows that some districts have continuous higher mortality and some have lower. The districts, which have continuous higher mortality, have various favorable factors for TB. Therefore, these districts

can be marked as prominent areas of TB. In future, there will be highly possible spread of TB in the study region. So there is need of TB controlling programme.

The northern region can be marked as prominent area of TB. Nanded district is important area of the disease TB. The Aurangabad, Parbhani and Jalna have higher mortality rate. Therefore, the Aurangabad, Parbhani and Jalna have also prominent areas of TB in the study region.

CORRELATION FACTOR:

The different environmental and social factors responsible for spread of TB. The table 2 shows the correlation between various factors and TB in the study region.

The correlation between maximum temperature and death rate by TB is observed negative in the study region and positive in the state. But in the northern region have observed positive correlation. In the prominent areas also observed positive correlation in the study region.

The correlation between minimum temperature and deaths by TB is observed significantly negative in the study region and the state also. Four districts have positive correlation. This shows that the minimum temperature is adversely affected the TB. The germs of TB not develop well in the cold temperature. In the prominent area, the correlation is not uniform.

The correlation between average temperature and deaths by TB is observed negative in the study region and in the state also. There are four districts has observed negative correlation while three districts observed positive correlation in the study region. This depict that the average temperature adversely affected the TB death rate. In the prominent area, the correlation is not uniform one.

The correlation between rainfall and death rate by TB is observed negative in the study region and in the state. Minor all districts in the study region excluding Nanded have observed negative correlation. In Nanded district, the correlation between rainfall and death by TB is positive. This district is a prominent area in the study region. In this district, TB observes highest mortality rate.

Table 2
MARATHWADA REGION
SHOWING CORRELATION BETWEEN VARIOUS
FACTORS AND TUBERCULOSIS

Sr. No.	District	Max. Temp.	Min. Temp.	Avg. Temp.	Avg. Rainfall	Total Death Rate	Infant Mortality Rate	Density Of Population	Literacy	House Occupancy Ratio
1	Aurangabad	0.18	-0.82	-0.74	-0.11	0.91	0.98	-0.95	-0.97	0.87
2	Jalna	-0.47	-0.90	-0.84	-0.43	0.93	0.93	-0.88	-0.94	0.81
3	Beed	0.83	-0.69	0.20	-0.03	0.82	0.97	-0.96	-0.91	0.96
4	Nanded	0.42	-0.82	-0.75	0.34	0.74	0.78	-0.81	-0.81	0.71
5	Osmanabad	-0.83	0.32	-0.15	-0.28	0.85	0.95	-0.83	-0.94	0.83
6	Latur	0.37	0.62	0.79	-0.07	0.02	0.91	-0.80	-0.79	0.66
7	Parbhani	0.54	0.61	0.67	-0.25	0.92	0.98	-0.85	-0.89	0.61
	Study Region	-0.32	-0.88	-0.66	-0.22	0.92	0.97	-0.93	-0.96	0.81
	State Average	0.30	-0.88	-0.59	-0.41	0.83	0.93	-0.97	-0.97	0.92

Source: Computed By Authors

The correlation between total death rate and death rate by TB is observed significantly positive in the study region and in the state also. All districts in the study region

have observed high degree positive correlation but in the Latur district it is minor positive. This depicts that the total death rate affected by the TB deaths. Increasing in TB death rate causes for increase in total death rate and decreasing death rate causes for decreasing total death rate. By controlling TB, the total death rate can be decreased in the study region.

The correlation between infant mortality rate and deaths by TB is observed very high degree positive in the study region and in the state also. Deodhar and Andrawala in 1971 say, "Infants and children age below 3 years are highly susceptible." All districts in the study region have significantly observed positive correlation. This shows that the TB in the infants affects the I. M. R. The child TB is common disease in the study region. Therefore, most infant's deaths are observed TB so; the correlation between I. M. R. and TB is very high degree positive in the study region. When the TB death increases, we observed the I. M. R. also increases.

The correlation between population density and death rate by TB is observed significantly negative in the study region and in the state also. All districts in the study region have observed significantly negative correlation. This shows that, the density of population is not affected the TB. Although TB is communicable disease, the mere contacts could not spread the TB.

The correlation between Literacy rate and deaths by TB is observed significantly negative in the study region and in the state also. All districts in the study region have observed significantly negative correlation. The literate people take care of their health. Therefore, the death rate is low in these people. But illiterate people does not know about health care. So the mortality rate are high.

The correlation between house occupancy ratio and deaths by TB is observed significantly positive in the study region and also in the state. All districts in the study region have observed significantly positive correlation. This depicts that the higher house occupancy ratio responsible for higher death rate by TB. In the dense family, there are maximum chances of close contact. This close contact spread the disease. So the optimum place for a person should be providing to the people.

STANDARD MORTALITY RATE:

The standard mortality rate is calculated for the disease TB. The table 1 shows the S. M. R. in the study region. There are three districts have S. M. R. above the regional average. The high S. M. R. observed in Nanded district (139), While Aurangabad and Parbhani districts have S. M. R. above the regional average. These are prominent districts of TB in the study region. The death rates of these districts are always higher than the regional average. The S. M. R. of Nanded is always highest from the year between 1976-1970 to 2001-2005. So, there is prominence need of TB control program.

Other districts have S. M. R. below the regional average. The lowest S. M. R. observed in Latur districts (64).

Ranking of Disease:

The ranking of the disease TB is shown in the table

1. The ranking shows the prominent areas of the disease. The table shows that the first rank is of Nanded district. There are different favorable conditions for TB like pollution, close contacts, high temperature and high rainfall. The district Aurangabad and Parbhani have second and third ranks respectively. The district Jalna has fourth ranks. The lowest rank observed in the Latur district. The districts Beed and Osmanabad have lower ranks.

CONCLUSION AND SUGGESTIONS:

This research paper shows the important findings of district wise Spatio-temporal distribution of Tuberculosis in Marathwada region. The whole analysis is based on death rates, correlation factors, standard mortality rate and simple ranking techniques. TB is the major cause of death in the study region. The regional average death rate of TB is 11.09 per lakh population but the state average is 27.03. It means that other districts in the state have high mortality rate of TB.

It is found that the mortality rate of Nanded, Aurangabad, Parbhani and Jalna districts is high which is above 11.09 per lakh population. In the study region, disease TB is associated with number of organic as well as inorganic factors such as temperature, humidity, rainfall, sunshine and altitude. These factors partially contribute in the occurrence of the disease TB.

Various cultural factors such as economic status, housing conditions, occupational structure, level of industrialization and environmental sanitation also contribute significantly in the occurrence and transmission of the TB. Poverty, low vitality, overcrowding urban areas, faulty dietary pattern, malnutrition, social customs like 'Purdah', repeated pregnancies, child marriages, lack of timely and adequate treatment facilities and poor sanitation are some of the causes responsible for tuberculosis mortality in the study region.

The positive correlation has been observed with tuberculosis and total death rate, infant mortality rate and house occupancy ratio in the study region.

The mortality rate of the study region is decreased from 18.26 per lakh population during the years 1971 – 1975 to 6.08 per lakh population during the years 2001 - 2005. In this period, the state average is decreased from 38.31 to 10.47 per lakh population. The trend of mortality rate of TB is decreased due to the launching of the National Tuberculosis Control program (NTCP) in 1962, New Program of short course of nine-months duration (DOTS) in chemotherapy in 1983 and Revised National Tuberculosis Control Program (RNTCP) in 1993 by the Government of India. The mortality rate of all the districts in study region is decreased in 1971 to 2000. But after 2000, it is again increased. So there is need and necessity of the awareness and implementation of TB controlling programmes.

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