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# SPATIO-TEMPORAL ANALYSIS OF TUBERCULOSIS MORTALITY IN MAJOR URBAN CENTERS IN MARATHWADA REGION

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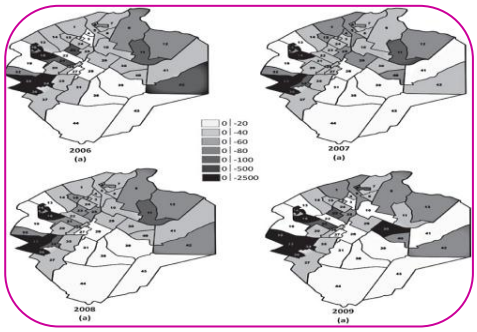
## ABSTRACT




*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 it's 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 of major urban centers in Marathwada region. 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 urban centers of 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 urban centre. The data collected for 35 years period has been analyzed by 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.*

*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 urban centers of 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 favourble 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 it's 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).

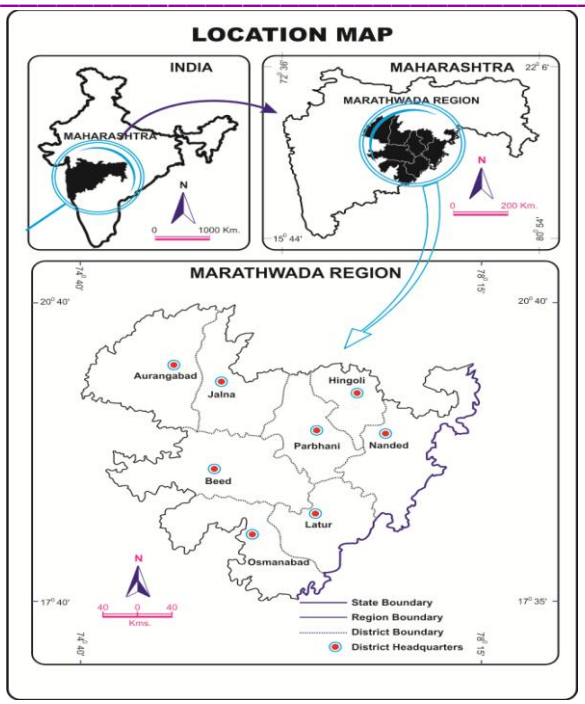
Diet seems to have a considerable influence on the incidence of tuberculosis. Those who do not get enough of proteins and vitamin D are more susceptible to these diseases than others. A close contact with patients in dwellings with poor or no ventilation helps the spread of the disease. Children's are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

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 $17^0\ 35^1$ North to $20^0\ 40^1$ North and $74^0\ 40^1$ East to$78^0\ 15'$ East respectively.

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 both spatially and temporally in the Urban Centers of the study region

II. To Study the Correlation between various factors and Tuberculosis in urban centers 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 urban center wise. The data collected for 35 years period, has been analyzed by, 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. The various graphical and distributional methods are used for showing distribution.

The collected data has shown in the form of located bar graphs. Eleven urban centers are selected for the study of Tuberculosis diseases. The mortality data of these urban centers is available in the Vital Statistics of Maharashtra. The year wise cause specific mortally rates are calculated.

The major urban centers selected for the study are eleven in number and they are as follows-

| | | | | |
|---|---|---|---|---|
| 1] Ambejogai | 2] Aurangabad | 3] Beed | 4] Hingoli | 5] Jalna |
| 6] Latur | 7] Nanded | 8] Osmanabad | 9] Parbhani | 10] Parli-Vaijinath |
| 11] Udgir | | | | |

## SPATIO – TEMPORAL DISTRIBUTION:

Tuberculosis is one of the important diseases, which causes deaths in the study region. Tuberculosis is an urban dominated disease. Therefore, the death rate by this disease is high in all urban centers. The table 1 shows the death rate per lakh population in the study region and figure 2 shows the graphical distribution of the disease.

**Table 1**
**MARATHWADA REGION**
**RANKING OF AVERAGE DEATH RATE BY TUBERCULOSIS**

| Sr. No | Urban Centers | | 1971 To 1975 | 1976 To 1980 | 1981 To 1985 | 1986 To 1990 | 1991 To 1995 | 1996 To 2000 | 2001 To 2005 | 1971 To 2005 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ambejogai | Death R. | - | - | 57.50 | 49.10 | 108.4 | 47.31 | 24.00 | 57.25 |
| | | Rank | - | - | II | I | I | I | IV | I |
| 2 | Aurangabad | Death R. | 53.90 | 25.27 | 14.71 | 20.86 | 21.82 | 10.42 | 12.59 | 22.80 |
| | | Rank | I | V | VII | VIII | IV | VI | VIII | VI |
| 3 | Beed | Death R. | 20.58 | 62.22 | 43.31 | 21.52 | 12.05 | 7.49 | 20.58 | 26.82 |
| | | Rank | VI | II | IV | VII | VIII | VIII | V | V |
| 4 | Hingoli | Death R. | 26.33 | 26.43 | 11.52 | 12.24 | 6.01 | 5.18 | 10.00 | 13.96 |
| | | Rank | III | IV | IX | IX | IX | IX | IX | IX |
| 5 | Jalna | Death R. | 24.38 | 24.89 | 30.05 | 22.57 | 20.49 | 16.69 | 18.82 | 22.56 |
| | | Rank | IV | VI | VI | VI | V | II | VI | VII |
| 6 | Latur | Death R. | 21.39 | 10.64 | 14.13 | 29.45 | 18.33 | 13.78 | 15.33 | 17.58 |
| | | Rank | V | VIII | VIII | V | VI | IV | VII | VIII |
| 7 | Nanded | Death R. | 6.00 | 58.65 | 58.20 | 39.78 | 32.48 | 14.67 | 31.86 | 34.52 |
| | | Rank | IX | III | I | II | II | III | I | II |
| 8 | Osmanabad | Death R. | - | - | 48.64 | 39.64 | 23.51 | 12.86 | 26.00 | 30.13 |
| | | Rank | - | - | III | III | III | V | III | IV |
| 9 | Parbhani | Death R. | 47.03 | 80.41 | 30.59 | 30.96 | 13.43 | 8.47 | 27.12 | 34.00 |
| | | Rank | II | I | V | IV | VII | VII | II | III |
| 10 | Parli-Vaijinath | Death R. | 7.41 | 14.52 | 6.43 | 1.01 | 2.26 | 3.00 | 6.33 | 5.85 |
| | | Rank | VIII | VII | X | XI | XI | X | XI | X |
| 11 | Udgir | Death R. | 10.69 | 9.69 | 4.48 | 1.81 | 4.02 | 1.46 | 6.76 | 5.56 |
| | | Rank | VII | IX | XI | X | X | XI | X | XI |
| **Average** | | **Death R.** | **24.18** | **34.75** | **29.05** | **24.45** | **23.89** | **12.85** | **18.13** | **24.64** |

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

The death rate by T.B. is a declining trend from 1971 to 2000. Then the death rate is observed in increasing trend. The regional average death rate is 24.64 per lakh population. Five urban centers' death rate by T.B. is above the regional average. The highest mortality rate is found in Ambejogai urban centre (57.25). The lowest mortality rate is observed in Udgir urban centre (5.56).

## PROMINENT URBAN CENTRE:

Tuberculosis is found in all districts of the study region. The distribution of death rate is not even in all urban centers. Some urban centers have consistently high mortality rate. These urban centers are prominent urban centers of T.B. Ambejogai, Nanded, Parbhani, Osmanabad, Jalna, and Beed urban centers are prominent urban centers. Various factors are favorable in these urban centers.

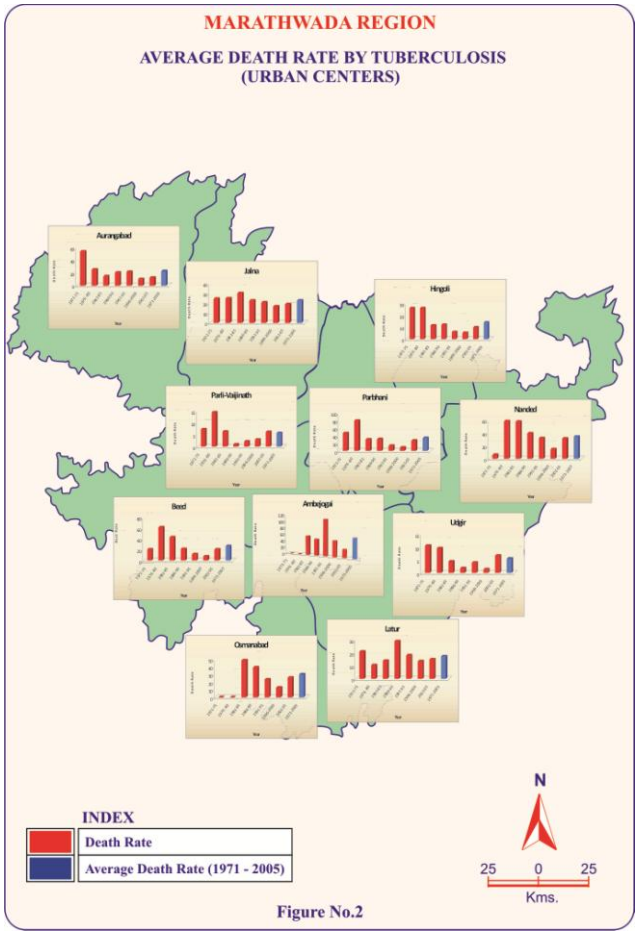



Figure No.2

## CORRELATION FACTOR:

"The spread of Tuberculosis is by direct contact or by air borne droplets indirect transmission is also occurs through droplets nude and dust" (Deodhar N. S. and Adranwala J.K. 1974, p.310).

## Table 4.20
## MARATHWADA REGION

**CORRELATION BETWEEN VARIOUS FACTORS AND TUBERCULOSIS**

| Sr. No. | Urban Centers | Max. Temp. | Min. Temp. | Aveg. Temp. | Aveg Rain. | Total Death Rate | Infant Mortality Rate | Population Density | Literacy | House Occupancy Ratio |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Ambajogai | 0.34 | 0.15 | 0.15 | -0.65 | 0.46 | 0.63 | -0.31 | -0.31 | 0.66 |
| 2 | Aurangabad | -0.68 | -0.61 | -0.67 | -0.95 | 0.81 | 0.83 | -0.75 | -0.73 | 0.74 |
| 3 | Beed | -0.16 | -0.68 | -0.55 | -0.18 | 0.85 | 0.79 | -0.58 | -0.61 | 0.45 |
| 4 | Hingoli | 0.25 | 0.60 | 0.52 | 0.03 | -0.46 | 0.24 | -0.83 | -0.85 | 0.04 |
| 5 | Jalna | 0.28 | -0.23 | -0.20 | 0.02 | -0.87 | 0.67 | -0.80 | -0.74 | 0.72 |
| 6 | Latur | 0.74 | 0.11 | 0.58 | 0.27 | 0.44 | 0.65 | -0.19 | -0.12 | 0.19 |
| 7 | Nanded | -0.27 | -0.16 | -0.20 | 0.70 | 0.63 | 0.75 | -0.16 | -0.22 | 0.20 |
| 8 | Osmanabad | -0.67 | 0.36 | 0.12 | -0.12 | 0.93 | 0.91 | -0.88 | -0.83 | 0.70 |
| 9 | Parbhani | 0.58 | 0.42 | 0.55 | -0.01 | 0.24 | 0.38 | -0.76 | -0.74 | 0.27 |
| 10 | Parli-Vaijinath | -0.05 | -0.72 | -0.63 | -0.45 | 0.40 | 0.70 | -0.51 | -0.63 | 0.40 |
| 11 | Udgir | -0.25 | 0.70 | 0.64 | 0.50 | 0.11 | 0.85 | -0.66 | -0.63 | 0.47 |
| **Total** | | **0.46** | **-0.35** | **-0.17** | **-0.12** | **-0.36** | **0.65** | **-0.77** | **-0.77** | **0.72** |

***Source:*** *Computed By Authors.*

T.B is caused by various environmental and social factors. The table 2 shows the correlation between various factors and T.B. in the urban centers and figure 4.29 shows the graphical presentation of the correlation values.

The correlation between maximum temperature and deaths by T.B. is positive. Most of the urban centers have positive correlation. Ambejogai, Jalna and Parbhani urban centers are prominent urban centers. Six urban centers have negative correlation. In Latur urban centre, the significant positive correlation is observed

The correlation between minimum temperature and death rate by T.B. is observed negative in the study region. Six urban centers have observed positive correlation and five urban centers have negative correlation.

The correlation between average temperature and death rate by T.B. is negative. Six urban centers have negative correlation and five urban centers have positive correlation.

The correlation between rainfall and death rate by T.B. is slightly negative in the study region. Six urban centers have negative correlation and five urban centers have positive correlation. In Aurangabad, urban centre the significant negative correlation is observed between rainfall and T. B.

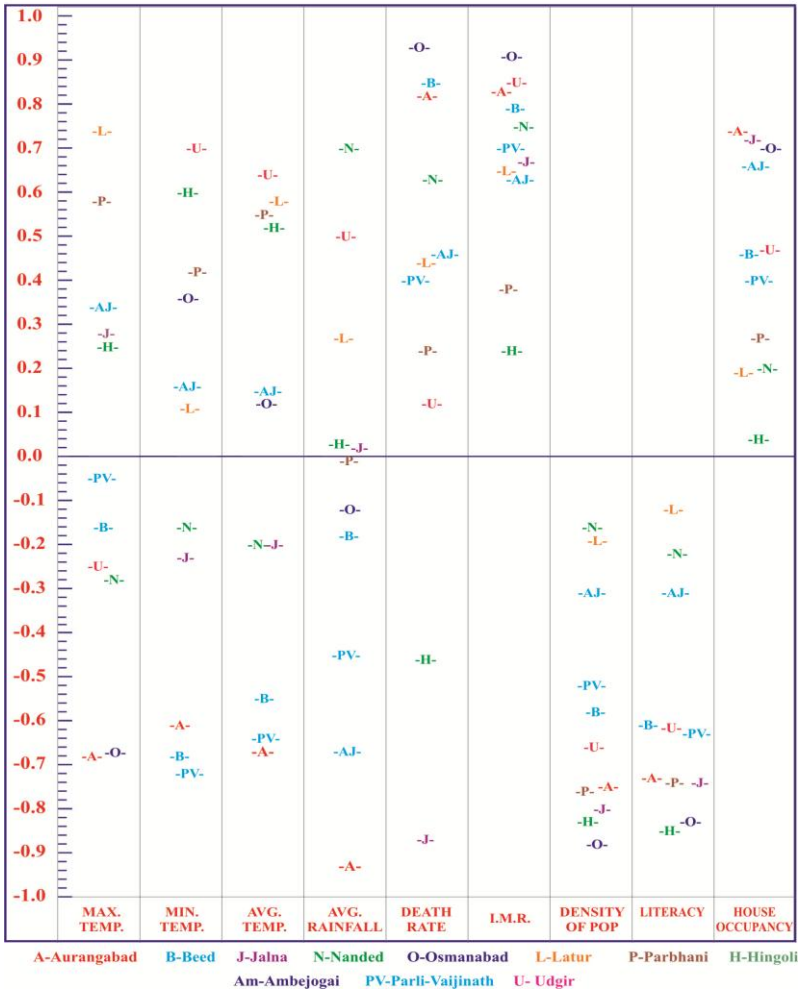
The correlation between total death rate and deaths by T.B. is negative in the study region. However, all urban centers have positive correlation except Hingoli and Jalna urban centers. Most of the prominent urban centers have significant positive correlation between total death rate and T.B. This shows that total death rate is affected by T.B.

The correlation between Infant mortally rate and deaths by T.B. is moderately positive (0.65) in the study region. All urban centers have observed positive correlation between I.M.R. and T.B. Most of the prominent urban centers have observed significantly positive correlation between I.M.R. and T.B. This shows that T.B. has affected the I.M.R. in the study region and in the prominent urban centers.

The correlation between population density and death rate by T. B. is moderately negative. All urban centers have negative correlation. Most of the urban centers of prominent urban centers have significantly negative correlation between

**MARATHWADA REGION**

**CORRELATION BETWEEN VARIOUS FACTORS AND TUBERCULOSIS**



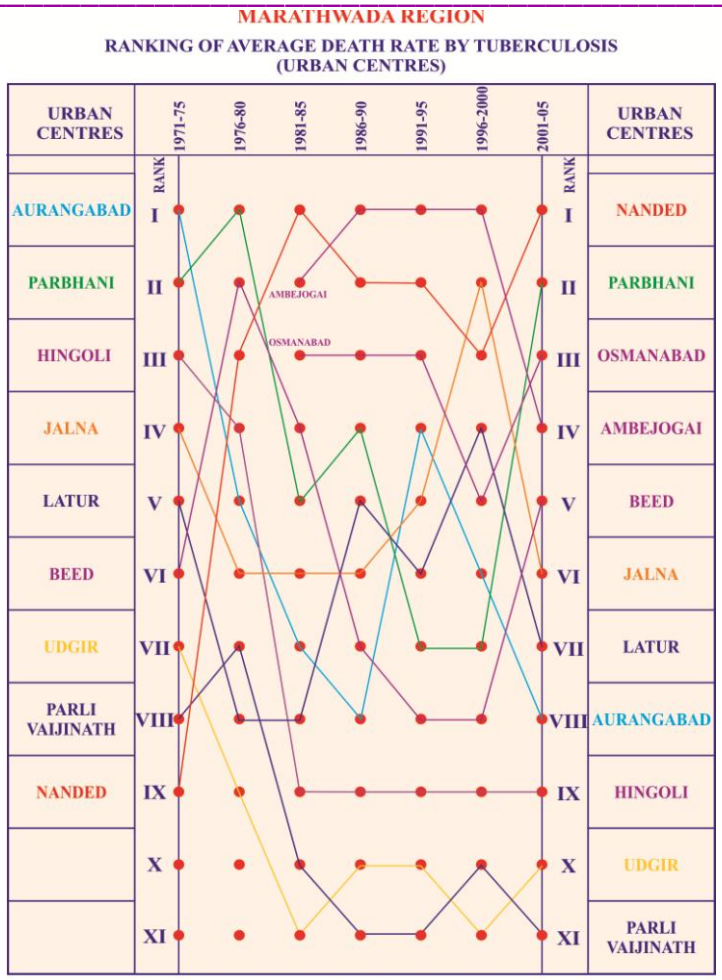



Figure No. 4

density and T.B. This shows that the impact of population density is adverse. Mere contact cannot spread T. B.

The correlation between literacy rate and deaths by T. B. is significantly negative. All urban centers have negative correlation. Most of the prominent urban centers have significantly negative correlation between literacy rate and T.B. This shows that literacy and deaths by T. B. are inversely proportional to each other. Increase in literacy causes the decrease of death rate.

The correlation between House occupancy ratio and deaths rate by T.B. is positive in the study region. All urban centers have positive correlation between house occupancy ratio and T.B. The high house occupancy ratio causes high mortally because there are more chances of close contact.

## RANKING OF THE DISEASE:

The table 1 shows the ranking of T. B. and the figure 4 shows the graphical presentation of the ranks. Ambejogai urban centre has consistently first rank from 1986 to 2000. Nanded and Parbhani urban centers have second and third ranks respectively. Osmanabad and Beed have fourth and fifth ranks respectively. All these urban centers are prominent urban centers.

The lowest rank is in the Udgir urban centre. Other urban centers Parli – Vaijinath, Hingoli and Latur have lowest ranks.

## CONCLUSION:

This research paper shows the important findings of urban centre 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.

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.

Rapid and uncontrolled urbanization generates a series of complex problems, of which, besides basic sanitation and environmental pollution, housing is an important one. Poor housing in urban areas is usually associated with lack of adequate water supply and basic sanitation facilities.

Tuberculosis, a disease of first rank, another major respiratory disease has found to be concentrated in Ambejogai, Nanded and Parbhani urban centers and infant mortality and house occupancy ratio shows positive correlation.

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

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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