A Systematic Literature Review: The Impact of Climate on the Case of Tuberculosis (TB): A Review

Al Edy Dawu¹, Resti Nur Pratiwi¹, Samsiah Winda¹, Agus Supriyanto Suparno¹, Ramadhan Tosepu¹,²

¹Public Health Studies, Program Postgraduate Program at Halu Oleo, University, Kendari, Indonesia.
²Informatics Department of Health, Faculty Administration, of Public Health, University Halu Oleo, Kendari, Indonesia.

*Correspondence Email: ramadhan.tosepu@uho.ac.id

Abstract. One of the factors that has an impact on life and threatens human health is climate. So has been significant climate change in recent decades. Infectious disease variety can be affected by climate change and will increase when risk of transmission. One of them is (TB) Tuberculosis has become equally interesting monitoring along with data from various studies in various construction and arrangement. (TB) Tuberculosis is a serious infectious disease caused by the bacteria complex tuberculosis mycobacterium that can spread through tiny airborne droplets, which affect the lungs and spread by coughing or sneezing from one person to another. Tuberculosis can spread to other human organs classified the skin, intestines, sexual organs, urinary tract, and bones. With recent advances in case detection, diagnosis, treatment and follow-up care, tuberculosis is still commitments for an estimated 8.6 million new infections and 1.3 million deaths annually worldwide. The WHO assumptions that around 10 million people will have Tuberculosis worldwide in 2019. WHO sets a goal of reducing Tuberculosis morbidity and mortality by 90% and 95%, respectively, between 2015-2035. Accurately predicts this epidemic trend can help estimate peak likelihood and provide a reference for Tuberculosis prevention and control. The purpose of writing this review article is to determine the impact of climate change with the incidence of tuberculosis. The method in this study is a systematic review. The 10 articles obtained the combination, terms and keywords "climate, weather and disease" the result is that climate change creates new transmission opportunities for airborne infections in warm temperature. So that there is a relationship between air temperature and tuberculosis. Solutions to efforts to improve living standards and cut intra and inter air pollution may be as important as TB-specific observation. This broad public health and ecological emphasis provides broad and synergistic benefits to individuals and communities driven by tuberculosis. The new focus on the importance of Tuberculosis prevention will serve to receive both the profound social nature of the disease and the nature of our response which must be holistic.

1. Introduction

One of the global problems is TB (Tuberculosis). TB is a severe plague disease that every intimidating health and is in the top ten impact carrier of death internationally. Studies carried out in diverse countries in the northern main have identified the climax months for tuberculosis notification March to May in 4-10, late spring and the beginning summer April to June 7,11,12, or
annual period June to August 13-16. In this study, the seasonal adjustment motivating aspect of TB in the second quarter of the current year April to June in Lahore, Pakistan. The (WHO) estimated that around 10 million people will develop TB worldwide in 2019. In addition, there are an estimate 1.2 Million Tuberculosis death distance negative-HIV soul and 208,000 Tuberculosis deaths among HIV-positive soul. To curb the Tuberculosis epidemic, World Health Organization has set a goal of lower Tuberculosis morbidity and mortality by 90% and 95% respectively, between 2015 - 2035. Accurately take into account these epidemic trends can help estimate the likelihood of peaks and prepare a articles for Tuberculosis handling and supervision. 

The impact caused by tuberculosis (TB) is urgency social and economic. The individual deficit that right include causing minded in the family, death of family members and a reduced life expectancy. Meanwhile, the direct economy impact on tuberculosis sufferers is the cost of treatment, while the indirect is the loss of work time school time and other cost incurred other than for treatment such as transportation and accommodation during patient care.

The term tropical disease implies the relationship between climate and disease, climate being an important component of the spatial and temporal distribution of vector-borne diseases, acting both to limit their spread and to influence the dynamics of transmissions. The climate, however, cannot account for all of the natural history of transmitted disease.

Environmental temperature is an important factor that directly affects the growth of tuberculosis bacteria. Climate change creates new transmission opportunities for airborne infections in warm climates. This systematic review is to explain current knowledge about Tuberculosis as it relates to weather and climatic factors such as air temperature and environment. This information can be useful for developing and implementing efficient health information systems with public interventions to control the incidence and spread of tuberculosis (TB) around the world.

2. **Metode**

2.1 **Searching strategy**

Google dan google scholar are used as the majour source from database used in october 2020 to extract the research proven by English used as the content on tuberculosis (TB) worldwide. The searching strategy developd in this study was through the combination, condition, and keywords “climate, weather, and tuberculosis” in searching the articles. I am observing the articles of the research published in 2020, title, abstract, and the keywords shared as the first step in searching the related articles that fulfill the criterion.

2.2 **The inclusion criterion**

1. Articles that evaluated the climate condition to the spreading of tuberculosis
2. Articles that discussed the impact of the climate towards the spread of tuberculosis published in 2019-2020.

3. **Result and Discussion**

3.1 **Literature review**

Initial search identified 10 articles collected from google and google scholar, among which 10 articles were entered and met the inclusion criteria. Research studies took place in Vietnam, United States, Australia, Pakistan, China, Pacific. All articles included studying the relationship between the impact of weather climate on dengue fever. Several methods are used to determine the impact of weather climate variables on dengue fever, one article uses moment correlation, four articles use statistical analysis, one article uses a field study, one article uses an anti-body test, one article uses the google database. One study uses analysis bivariate.
Table 1. Characteristics Study Discusses the Relationship Between Climate Impacts on Disease Tubercolosis (TB)

| Study on language | Region and research | Data collection | Disease/vector | Method of statistic | Main finding |
|-------------------|---------------------|----------------|----------------|--------------------|--------------|
| Bonellet et al. (2020) | Vietnam | Climate, air temperature | Tuberculosis | Series of time descriptive analysis employing LOSSES regression | There was a correlation among climate, temperature, and tubercolusis |
| J. Denholm (2020) | Australia | Seasonal, climate change | Tuberculosis | Analysis statistic | Season and the change of the climate related to tubercolusis |
| Edward Nardel et al. (2019) | The USA | Minimum temperature, seasonal climate | Tuberculosis | Experiment | Minimum temperature related to tubercolusis |
| Mohsin F. Butt (2018) | Pakistan | Climate, latitude season with increasing cases of tubercolusis | Tuberculosis | Analysis statistic | Season and climate change related to tubercolusis |
| Li et al. (2020) | China | Seasonal, climate | Tuberculosis | Mean integritasdecompositis mistake (MAPE), and moon mean cubis mistake (RMSE). | Seasonal, temperature had an efffect on tubercolusis |
| Lachlan McIver, 2015 | | Climate and transmission | Tuberculosis | Descriptive analysis | exist in a antique confluxo f tuberculosis dangerfactors combined as well the finish potent of temperature change in this highly sensitive community. its very low altitude and extreme vulnerability. The transmission rate of tuberculosis has been associated with climatic activities, such as seasonal changes, |
| Jiandong Yang (2020) | China | Tuberculosis air pollution | Tuberculosis | Using GAM. | there is a relationship between air pollution and the incidence of tuberculosis |
| Farzan YAHYA, (2020) | Pakistan | Air pollution against tuberculosis | Tuberculosis | GMM Two-step system | The system's GMM estimates also show that |
Tuberculosis has occupied the top 10 death-causing diseases in the world. This chronic disease which is very intimidating to health, causes several cardiovascular lung diseases and the size of the seasonal effect anyway arise to be stronger in ares season, with the climax month notice being more

| Authors            | Country | Study Title                                                                 | Methodology                                | Findings                                                                 |
|--------------------|---------|-----------------------------------------------------------------------------|--------------------------------------------|------------------------------------------------------------------------|
| N. Naranbat (2019) | East Asia | Extreme continental climate and tuberculosis disease | Tuberculosis gravitational regression analysis | Urbanization is further strengthening the positive relationship between CO2 emission and tuberculosis. Over when 9 year focus a absolut of 14,905 collect positive tuberculosis events the reported, with an annual average of 1,656 cases. More than twice as many cases of tuberculosis the reported to the lastin the climax month April compared to the last months October-Desember, parallel to were lunht curve. Fluctuations recur stability throughout the whole monitoring fase, analog in the capital make an analogy to other countries, and independent of age and gender. |
| Ahmad et al. (2019) | Nigeria | Climate and prevalence of tuberculosis | Tuberculosis statistic analysis | The results showed that the risk of tuberculosis has a close relationship with climatic conditions, especially with the age range (50-69) years |
than 40% higher than the take level in the last period. It is obey to opinion why such an incite naturally modification more duration. The increased use of stem treatment for veiled tuberculosis contamination Tuber culosis laten (LTB) by the community perhaps partly describe these changes, with a decrease in background (Non-Seasonal) reactivation allowing the recent transmission season to become more arise. But, as the temporal dissimilarity have occurred in pain parallel with important trends in extreme air events in the area, they could also serve as next fact of the effects of temperature change on health. In relation to tuberculosis, this disease can be caused by indoor and outdoor air pollution. We conclude that the tuberculosis infection rate in areas with warmer and cooler temperatures will be much more sensitive to climate change. Compared to all nations, specific conditions based on maximum and minimum air temperatures are the determining factors for outbreaks. Seasonal climatic factors, such as maximum and minimum air temperature, show a positive impact on tuberculosis transmission. This study gives a message to health policy makers in exploring potential strategies to reduce the burden of increasing TB (Tuberculosis), transmission in eleven countries, namely India, China, Indonesia, Nigeria, Pakistan, Bangladesh, Brazil, Philippines, United States, Vietnam, Thailand. Several studies have research the connections between provisions from the equator and the seasonal variation of tuberculosis, and it is plausible that the tuberculosis season is more prominent in areas where UV exposure is trim and skin nutrition synthesis is low. To research published in India, which suggest northern regions have seasonal variation in areas further from the equator. Based on the findings, all articles show that seasonal climate and air temperature affect the incidence of tuberculosis. The results show that climate that contributes to vector density such as air temperature and seasonal climate is one of the factors for tuberculosis disease.

4. Conclusion

There is a significant correlation between the impact of climate, weather, rainfall, and temperature. Occurrence of Tuberculosis. Many climatic factors contribute to vector density such as air temperature and seasonal climate. But basically there are many factors that can cause Tuberculosis other than those that are mentioned or observed, it could be from a socio-cultural aspect or other factors.

Reference

[1] Bonell, Ana, et al. "Does sunlight drive seasonality of TB in Vietnam? A retrospective environmental ecological study of tuberculosis seasonality in Vietnam from 2010 to 2015." BMC Infections Diseases 20.1 (2020): 1-11.
[2] Denholm, J. "Seasonality, climate change and tuberculosis: new data and old lessons." The International Journal of Tuberculosis and Lung Disease 24.5 (2020): 469-469.
[3] Nardell, Edward A. "Preventing Transmission of Mycobacterium Tuberculosis—A Refocused Approach." Clinics in chest medicine 40.4 (2019): 857-869.
[4] WHO, GLOBAL TUBERCULOSIS Report 2018, Geneva: World Health Organization; 2018.
[5] Global, regional, and national burden of tuberculosis, 1990-2016; result from the global burden of Diseases, injury, and risk factors 2016 study. Lancet infect dis. Heal 2018; 18(12);1329-49
[6] World Health Organization. Global tuberculosis report 2013. World Health Organization, 2013.
[7] Yahya, Farzan, and Muhammad Rafiq. "The Influence of Air Pollution and Clean Energy on Tuberculosis: The Moderating Role of Urbanization." Iranian Journal of Public Health 49.6 (2020): 1106-1111.
[8] Li, Z. Q., Pan, H. Q., Liu, Q., Song, H., & Wang, J. M. (2020). Comparing the performance of time series models with or without meteorological factors in predicting incident pulmonary tuberculosis in eastern China. Infectious diseases of poverty, 9(1), 1-11.
[9] Jiandong, Y., Mengxi, Z., Yanggui, C., Li, M., Rayibai, Y., Yaoqin, L., ... & Baolin, R. (2020). A study on the relationship between air pollution and pulmonary tuberculosis based on the general additive model in Wulumuqi, China. International Journal of Infectious Diseases.
[10] Naranbat, N., et al. "Seasonality of tuberculosis in an Eastern-Asian country with an extreme continental climate." *European Respiratory Journal* 34.4 (2009): 921-925.

[11] Yahya, Farzan, and Muhammad Rafiq. "The Influence of Air Pollution and Clean Energy on Tuberculosis: The Moderating Role of Urbanization." *Iranian Journal of Public Health* 49.6 (2020): 1106-1111.

[12] McIver, Lachlan, et al. "Climate change, overcrowding and non-communicable diseases: The 'triplewhammy' of tuberculosis transmission risk in Pacific atoll countries." *Annals of the ACTM: An International Journal of Tropical and Travel Medicine* 16.3 (2015): 57.

[13] Butt, Mohsin F., et al. "The Relationship Between Seasonality, Latitude and Tuberculosis Notifications in Pakistan." (2020).

[14] Ike, Onwuka Gerald, and Odeyale Abideen Babatunde. "Correlation Assessment and Social determinants of Tuberculosis disease and Attributable Death rate Surveillance in Nigeria, 2010-2016."