The Effects of Climate Change on Tuberculosis

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Abstract

Climate change which results to seasonal variations has been widely reported for many respiratory infections in different parts of the world, but less documented for Tuberculosis. There has been much change in the distribution of tuberculosis recently as a result of changes in climate which has resulted to various mutations which has taken place in the mycobacterium strains. This mutation which occurs as a result of changes in the climate has brought about Mycobacterium strain showing resistance to pharmacological interventions. Therefore Scientist are presenting identifying these resistant strains and as well compounding new drugs that can be used to cure the disease (Tuberculosis).

Systematic review of peer reviewed studies identified through literature searches using online databases belonging to PubMed and the Cochrane library with key words “Tuberculosis, climate change” and “Tuberculosis, Seasonal variation”. The search was restricted to articles published in English.

Tuberculosis notifications in India as a case study shows a seasonal pattern, with a peak during the months of March, April, May, October and December. New tuberculosis strains are discovered during these periods which fall during the spring season in India. Since seasons involve variations in various phenomena like temperature, humidity, precipitation, length of daylight, and so forth and also vary by geography and latitude, the presence of climate change, seasonal variation and the timing and magnitude of such seasonal variation may depend on some of these factors in ways not yet fully understood. A change in climate brings about a seasonal pattern of Tuberculosis for newly diagnosed smear positive cases with variable degrees of changes. These observations suggest the presence of a seasonal disease-modifying factor. The regulation of peak seasonality in Tuberculosis case detection may prove to be a useful to initiate measures for a better implementation of control.
Key Words: Tuberculosis, Climate change, Seasonal variations,

Introduction

Climate change can be defined as a change in the global climate pattern such that the difference in climate of the mid to 20th century is quite different from what we have today (Thesaurus dictionary.com, 2014). Climate change has brought about a decrease in air quality, severe weather events, and many other environmental problems (Cait, Hartwyk, 2015). The Centre for Disease Control recently gave some warning concerning the consequence of global warming which has caused alterations in the world’s climate may leading to the outbreak of infectious diseases spreading to areas where they are not commonly seen (Lindahl et al., 2015). The rising world temperatures are changing local weather events, and warmer weather giving rise to mosquito and insect populations, which spread diseases such as malaria, dengue fever and encourage the bred of micro-organisms (Patz et al., 2003). The impact of climate change is widespread, and there is an indication that preparing for prospective health risks is necessary (Frumkum et al. 2008). The shifting climate affects human well-being on many levels (Cait Hartwyk, 2015). Changes in diverse environments lead to deviations in the incidence and distribution of infectious disease. Increasing high temperatures causes severe weather and extreme heat, resulting in injuries and heat-related illnesses (Institute of Medicine, 2008). Rising sea levels influence water quality, leading to more occurrences of infectious diseases like tuberculosis (WHO, 2003). It is known that the incidence of many respiratory infections show according to the different changes in climate conditions, and there are very little well documented cases for tuberculosis (TB) (Thorpe et al. 2004). Before the coming of antibiotics, TB mortality rate was higher in late winter and early spring than any other time of the year (Nagayama and Ohmori, 2006). Although the mechanism beneath the increase of tuberculosis in a particular time of the year is still not clear; several researchers have suggested that the environmental and social factors such as temperature, humidity, sunlight, as well as crowding and person-to-person contacts, are a source of TB outbreak, particularly, in winter time (Nagayama and Ohmori, 2006), (Naumovi, 2006). This explanation applies to primary or re-infection TB, but not to reactivation TB. To explain the seasonal trend of both reactivation and primary TB, it is common to consider that the main cause of TB outbreak at a particular period of time is intrinsic (Maes et al. 1994). A possible link between vitamin D deficiency and
impaired host defence to *Mycobacterium tuberculosis* infection leading to primary TB has been assumed (Davies, 1985). Moreover, significant seasonal vitamin D variations were observed in several communities, and reveal that variation of values for (25-OH D) decreases in spring and winter (Elizondo et al, 2017). The immune system ability to fight against diseases vary throughout the year with significant periodicity in cell function, proliferation, and percentage or number of peripheral blood leukocytes subsets (Davies, 1985). For example, the level of B lymphocytes in the peripheral blood has been shown to vary throughout the year, being lower in winter than in summer.[15] The absolute number of CD4+ T lymphocytes is the lowest in summer when the level of CD8+ T lymphocytes is the highest (Nagayama and Ohmori, 2006). The climate changes of TB notification may reflect the changes in vitamin D and human immunity which may be caused by the influence of seasons on human activity; however, these questions related to climate changes in relation to tuberculosis remain controversial (Fares, 2011). A research study conducted from 2003-2012 discovered that TB is higher in winter among the male patients; those at the age of 15 years and above 64 years of age were affected with TB during the fall season, youths and Adults reported high cases of TB in winter (Schaafs et al. 1996). Also in Tanguatinga area of Brazil, it was noticed then when the pollution dropped to 15.2% between 2003-2012, there was a coinciding reduction in TB incidence during that period (Fernanda, CF et al. 2017).

In South Africa, a cohort study was conducted between 2004-2014; a high increase in the occurrence of pulmonary tuberculosis was observed on a monthly bases irrespective of the change in climate (Ballif and Zurcher, 2018).

Xinjiang one of the highest TB burdened province in China conducted a research study between the period of 2005-2014 and a peak period of TB outbreak was recorded from the month of march which narrowed down to Oct, also additional new TB cases was also recorded in march than in Oct (Atikaimu Wubuli et al. 2017). Also in China, TB climatic change variation research studies was conducted from 2005-2012 nationwide, it was observed that during the spring peak which often falls in April, There is a seasonal amplitude of 46.3% compared to the winter in February and it was concluded that TB is a seasonal disease
in China (Xin-Xu Li, 2017). A significant climatic variation in tuberculosis (TB) was observed in north India during 2006–2011, particularly in states like Himachal Pradesh, Haryana and Rajasthan. To quantify the climatic variation, the average amplitude was measured (peak to trough distance) across seasons in smear positive cases of TB and observe that it is maximum for Himachal Pradesh (40.01%) and minimum for Maharashtra (3.87%). In north India, smear positive cases peak in second quarter (April–June) and reach a trough in fourth quarter (October–December), however low climatic variation in TB was observed in southern region of the country than the northern part of the country. (Pankaj et al, 2015)

Method

Literature search terms

This review was restricted to published research articles and abstracts that compared the aggregated TB notification data during the course of the year to determine seasonal patterns of tuberculosis as a result of changes in climate. These studies were identified in the following three ways:

1. Medline was searched through Pubmed by using search terms: “Tuberculosis, Climate Change”, and “Tuberculosis and climate variations”, infectious diseases.
2. Cochrane Library database was used to search for various literature reviews and studies using the same search terms mentioned above.
3. The bibliographies of all identified paper were checked for further relevant publications.

Inclusion criteria

The following inclusion criteria were applied to select the studies:

1. Papers in English language and published in peer-reviewed journal were considered. Review articles, clinical trial, cross-section study, meta-analyses, letter, editorial, textbook chapters, case reports, practice guidelines, and biomechanical studies were gathered to augment overall knowledge and to identify research articles or data not obtained using the search engines.
2. Studies dealing with *M. tuberculosis*, and examining the climatic changes on tuberculosis
incidence in human subjects were considered.

3. Studies had to be used data on patients notified with tuberculosis in primary or secondary care setting stratified by months or weeks, sex, site of disease, symptom onset, and mode of detection.

**Patients’ diagnosis procedures**

Studies used for this paper included patients who were diagnosed and confirmed positive with TB which was based on positive *Mycobacterium* culture, positive AFB, positive radiological or histological findings in inpatients and outpatients, new case or re-treatment and patients with PTB were included. All age and sex were also considered, only one study subjected children only (Schaafs et al, 1996).

**Statistical analysis**

Due to lack of insufficient and inconsistency in the statistical methods used in most of the studies, There were limitations found in the data provided with particularly relates to age, sex, and site of disease. Therefore, it was not possible to do statistical analysis to integrate the results for all countries.

**Result and Discussion**

Various researches have been conducted from different parts of world which I included in my write-up showed that there are more records of TB outbreaks during the peak of the winter and new cases are been recorded during those peak periods; except for south Africa which showed a monthly occurrence of Tuberculosis disease irrespective of the change in climate. India also showed a seasonal pattern, with a peak during the months of March, April, May, October and December and new tuberculosis strains were discovered during these periods which falls during the spring season in India.

The effects of climate change is seen as well as effect in all aspects of life and living, therefore health and safety measures should be provided and made available to the population so as to prevent the adverse effects that comes with the change in climate especially health wise. Public health actions, especially preparedness, can protect people from the effects of climate change on health. As some of these consequences of climate change become more evident.

**References**


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