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# Effect of Air Pollutants on Increased Risk of Pulmonary Tuberculosis; a Review

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**Abstract**

As per World Health Organization (WHO), air pollution is the cause for more than two million deaths every year. Mostly, outdoor air pollution results in reduced lungs function and increased respiratory disease. Therefore, breathing polluted air is as dangerous as eating/drinking polluted food/water. TB (Tuberculosis) is a major public health threat globally and India is the country with the highest burden of both TB and MDR TB (multi drug resistant tuberculosis). TB is a highly contagious air born disease caused by *Mycobacterium tuberculosis*. People with compromised immune systems, malnutrition, diabetes, etc. are more prone to TB infection. According to WHO most of the TB deaths (95%) are reported from low and middle income countries where people are exposed to smoggy air for a long period of time. However no studies confirm that outdoor air pollution has impact on TB in these countries. Some studies have suggested that ambient air pollution might increase the risk of pulmonary TB. Few studies have indicated link between air pollution and incidence of TB. A study conducted in Chengdu, China reported positive association of air pollutants such as particulate matter <10 µm ($PM_{10}$), $NO_2$ and $SO_2$ with the occurrence of TB. Another study in China reported that air pollution such as $PM_{2.5}$, $PM_{10}$, $O_3$, and CO is associated with increased risk of DR-TB (drug resistant tuberculosis). A study conducted in Tehran, Iran reported that long term exposure to $PM_{2.5}$ and CO has positive association with TB development. Various studies suggested that socially deprived, crowded and poor ventilated areas have higher TB prevalence.

These studies suggested that mitigating air pollutants might help in reduction of TB incidence.

**Keywords:** Air pollution; Particulate matter; Tuberculosis; Drug resistant tuberculosis; *Mycobacterium tuberculosis*

## Introduction

Tuberculosis (TB) is the most deadliest disease ranked next to HIV as a leading cause of death globally accounting for 54 million deaths since 2000. According to WHO [1] report, TB burden is highest in Africa and Asia with India leading with highest number of TB as well as MDR TB [2] (Multidrug Resistant Tuberculosis) cases. About 24% of world's MDR TB cases are reported from India. The "End TB" strategy aims to reduce TB incidence by 80% and death due it by 90% by 2030 (https://www.downtoearth.org.in/news/health/india-leads-the-world-in-tb-burden-61677). As per World Health Organization [3] report environmental pollution is associated with 80% of disease. Reports suggested that people living in air polluted areas suffer from chronic respiratory diseases mostly tuberculosis. The relationship between indoor air pollution with development of pulmonary TB is well established. Recently some studies have reported about the association between outdoor air pollution and incidence of active TB. Thus the reduction of air pollution level in the atmosphere may decrease TB incidence rate.

## Tuberculosis (TB)

Tuberculosis is a highly contagious air born disease with a high mortality rate globally. It causes by the bacterium *Mycobacterium tuberculosis* and mostly affect the lungs (pulmonary TB) but it can affect other organs too (extra pulmonary). According to World Health Organization about one third of the world's population has latent TB (WHO, 2012). The risk of progression of latent TB to active TB is higher in person with compromised immunity, HIV patients, diabetic patients, smokers and bibulous persons. As it is a contagious disease, it transmits from one person to other through air. Tuberculosis is transmitted when a person with active TB speaks, splits, coughs or sneezes. People with latent TB do not spread the disease. The active TB symptoms are fever, chronic cough with bloody sputum, loss of weight, appetite loss, fatigue and night sweat. People those in close, frequent and prolonged contact with TB patients are at high risk of being infected. However it is curable with early detection and proper treatment. If active TB patient is left untreated, it will cost patient's life as well as transmit to more and more people.

### *Mycobacterium tuberculosis*

The causal organism of tuberculosis is *Mycobacterium tuberculosis* [4]. It is chemo-organotropic, non-spore forming, non-motile, aerobic, slow growing and acid fast bacteria [5].

## Air Pollution a Risk Factor for Tuberculosis

India is a developing country where industrialization and urbanization is in progress. These two development process are the major contributor of air pollution. Recent studies have considered




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air pollution as one of the factor affecting the incidence of TB [6-10]. According to [11] occurrence of TB is reported majorly from localities with severe air pollution. Air pollution has detrimental impact on immune system which increases the susceptibility towards active TB. The rising air pollution affects lungs function by various means such as decreasing macrophage functioning, inflammation of airways, bronchial irritation, reduce mucociliary clearance, increased reactivity and enhanced vulnerability towards pathogens [12-14]. The expression of proinflamatory mediators during infection is suppressed by the particulate matters released due to diesel combustion leading to alteration of antimicrobial immunity [14,15]. Air pollution relating to TB may be classified into two type's i.e. indoor air pollution and outdoor air pollution. Burning of biomass fuel (wood, agriculture residue, straw, cow dung cake) and coal for cooking purpose causes indoor air pollution where as outdoor air pollution is source from the fuel combustion of automobiles [16-18]. Few studies have identified the association between outdoor air pollution and respiratory diseases [9,19-20]. Many reports have suggested the link between indoor air pollution and TB however, a very little information is available about the effect of outdoor air pollution on TB [21].

A retrospective study conducted at metropolitan hospital, Los Angles reported that exposure to a higher level of particulate matter with an aerodynamic diameter of < 2.5μm ($PM_{2.5}$) and $O_3$ is significantly associated with positive TB. This is the first paper reporting about the correlation between ambient air pollution and smear positive tuberculosis [22]. The incidence of TB is reported to be more in socially deprived [23,24], overcrowded [25-27] and poor ventilated areas [28,29]. Lai Pc [30] Explained that the high rise and high density dwelling in urban areas of Hong Kong results in poor ventilation, bad air quality and lowering of sunlight penetration. These conditions are related with the development and transmission of active TB.

Investigated the association of $PM_{10}$, CO, $O_3$, $SO_2$ and $NO_2$, with the incidence of TB in Seoul metropolitan area [8]. This study reported that the concentration of $PM_{10}$, CO, $O_3$ and $NO_2$ were not associated with the development of TB in neither male nor female but the increased concentration of $SO_2$ was linked with increased risk of TB development in male by 7%.

Evaluated the association of seasonal variation and short term exposure to environmental risk factor (air pollution and climate) with pulmonary TB development in HIV positive patients in Spain [14]. The data of this retrospective study suggested that seasonal variation is linked to pulmonary TB development in HIV positive patient and a significant association between short term exposure to higher concentration of $SO_2$ and $NO_2$ as well as temperature.

Investigated the relationship between diagnosis of new TB cases and regular exposure to $PM_{10}$, $SO_2$ and $NO_2$ in Chengdu [31]. The result of this study concluded that exposure to increased concentration of $PM_{10}$, $SO_2$ and $NO_2$ was linked with increase in development of new TB cases.

An epidemiological study conducted in Jinan city of China reported that exposure to air pollution i.e. $PM_{10}$, $PM_{2.5}$, CO, $O_3$ are significantly associated with increased risk to develop first line drug resistant TB [32]. Conducted a study in a metropolitan city of Teheran to find the relation between outdoor air pollution and incidence of TB is associated with exposure of CO and $PM_{2.5}$ for a long period of time [10]. A study conducted in China also reported about the positive association of air pollutants i.e. $PM_{2.5}$, CO, $O_3$ and $SO_2$ with diagnosis of new TB cases [33].

## Conclusion

In recent studies air pollution is identified as a risk factor for many respiratory disease mostly, Tuberculosis. Despite several government programmes to control TB is active in country, India is leading the world with highest TB burden. Therefore, to eradicate TB the identification of risk factor and its control is foremost necessary. Cessation of smoking and utilization of clean energy will help in reducing the indoor as well as outdoor air pollution. This might help to control TB in country to some extent.

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