



# Effects of Tobacco smoking on immune response: A Review

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**ABSTRACT:** Tobacco smoking causes a variety of illnesses, the most common of which is "Chronic Obstructive Pulmonary Disease" (COPD), and has a severe influence on one's health. Tobacco consists of nearly 7000 toxic chemicals, including free radicals and oxidizing agents. The impact of smoking on research is being done on both the innate and adaptive immune responses. Adaptive and innate immune systems affected by smoking include T helper cells, regulatory cells, memory T/B lymphocytes and DCs, macrophages, NK cells, respectively. Smokers are showing highly different values of parameters like several NK cells, cytokines, leukocytes, granulocytes, monocytes etc., from controls. As a result, immunological responses are impeded and cellular and molecular processes are permanently impaired.

**KEYWORDS:** Chronic Obstructive Pulmonary Disease (COPD), free radicals and oxidizing agents, adaptive immune systems, innate immune systems

## 1. INTRODUCTION

India has a serious public health problem due to a poor diet, excessive alcohol usage, and cigarette smoking. Students' problems with focus and physical health are becoming worse as a result of these troubling behaviours (Maiti and Samanta, 2018; Das et al., 2017; Das and Das, 2021). Smoking and lack of exercise are two of the most major modifiable risk factors for chronic illness and early mortality, and both may be reduced (Dey and Guha, 2020; Sarkar, 2016). There are 1.3 billion smokers in our world, with the number steadily increasing. Tobacco smoke contains carbon monoxide, nicotine, cadmium, nitrogen oxides, polyaromatic hydrocarbons, hydrogen cyanide (HCN), and hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) linked to the "pulmonary", "cardiovascular", "brain", and "cancer" development. Nicotine lowers hunger, raises blood sugar, and causes blood sugar disturbance. Nearly 7000 harmful substances enter a smoker's body, most of which are cancerous. These are quickly absorbed by cells and harm the immune system.

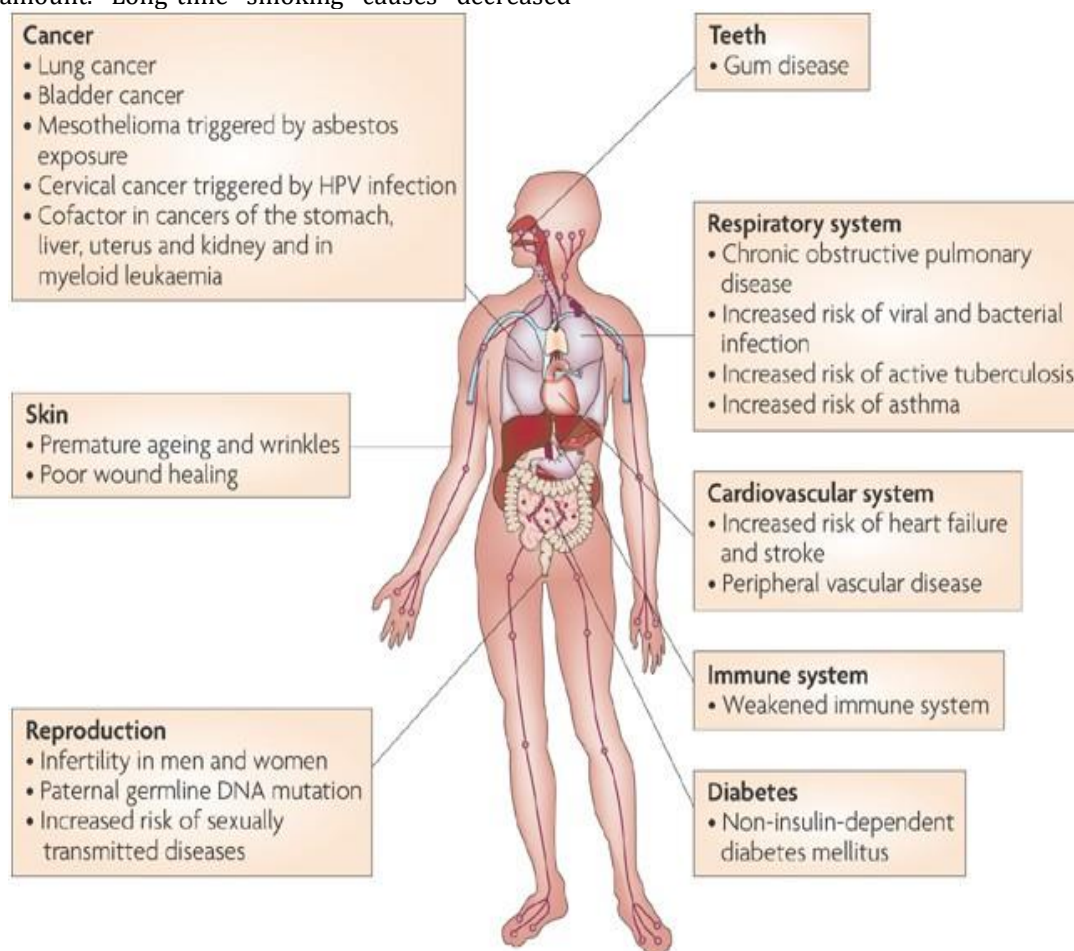
Several studies have shown that tobacco smoking has far-reaching impacts on chronic inflammation and autoimmune, including chronic obstructive pulmonary disease, rheumatoid arthritis, systemic lupus erythematosus, and psoriasis. By disturbing the cellular and molecular mechanisms, smoking affects the primary components of immune cells.

### 1.1 Effect of Cigarette Smoke on body Immune system

Tobacco containing toxic chemicals are exposed through the lungs route. It has its own specific and non-specific mechanism to eliminate the substances from lungs. Adaptive immune components-T helper cells, CD4+, CD8+, CD25+, T & B cells and memory T/B lymphocytes affected due to smoke and in the case of the "innate immune system", NKs, DCs, and Macrophages got affected (Qie et al., 2017). Alveolar macrophage (AM) is a part of innate immunity that increases the number of smokers. AM secretes a high level of lysosomal enzymes, Elastase, which usually damages parenchymal

and epithelial cells of lungs that contribute to pathogenesis in COPD. AM also secretes some pro-inflammatory cytokines, a major part of the body's defence system. In smokers' bodies these cytokines have less amount. Long-time smoking causes decreased

serum immunoglobulin (Ferson et al., 1979) level but increased auto-antibodies (Mathews et al., 1973; Masdottir et al., 2000).



**Figure 1.** Cigarette smoke has negative health impacts. Everyone's health is negatively impacted by cigarette smoke. The majority of smoking-related fatalities are caused by non-cancerous disorders of the heart, lungs, and circulatory system, as well as cancer. Additionally, cigarette smoking may affect one's immune system, hinder the body's ability to heal wounds, lead to diabetes, lower one's fertility, and raise one's vulnerability to sexually transmitted illnesses. Human papillomavirus, abbreviated as HPV (Source: Nature Reviews Immunology, 2009).

## 1.2 Cigarette smoking's effects on immunological cells

### T lymphocytes

"T lymphocytes" (T cells) are a kind of immune cell that is found in large numbers in the body. Tobacco smoking impacts their activation and their release of pro-inflammatory mediators.

### T helper cells

"Crohn's disease" is caused by a combination of Th1 and Th17 cells. Inflammation in the lungs as a result of smoking has been linked to an increase in the Th1 and Th17 cell subsets, according to several studies (CSE). Tobacco smoking may lead to autoimmune disease by increasing Th1 polarization.

### CD8+ T cells

T lymphocytes that destroy diseased or damaged cells are referred to as "cytotoxic T lymphocytes" (CTLs) by CD8+ T cells. These cells are increased by number and their activation and function in smoker's body.

### Regulatory T cell (Treg)

The regulatory T cells (Tregs) play a key function in the maintenance of immunologic homeostasis. Significantly it has an immunosuppressive capacity that becomes imbalanced by inhaling tobacco smoking or COPD patients. COPD patients had a lower proportion of suppressive Tregs than the general population (rTregs and aTregs). As a result, the level of Treg cells has increased in COPD patients.

## B cells

It has been shown that smokers have higher levels of circulating IgE, which may lead to atopic illness and asthma. Alpha4 and alpha7 are a subunit of nicotinic receptors present in B cell lines. In response to nicotine treatment, which resulted in the growth of hybridoma B cells, the expression of alpha4 and alpha7 was enhanced. IgE production is increased, memory B cells and regulatory B cell counts are down, and the synthesis of other immunoglobulins is decreased by cigarette smoking.

## Memory lymphocytes

The human immune defence system relies heavily on memory T cells and B cells. Tobacco use, for example, increased the number of human peripheral blood memory T cells and class-switched memory B cells. COPD patients had higher class-switched memory B cells and IgG+ levels in their blood and lungs, respectively.

## Toll-like receptors and smoking (TLRs)

A group of proteins known as TLRs is critical to the innate immune system. mRNA expression of TLR-2 and

4 in gingival tissue generated inflammation as a result of smoking.

## Dendritic cells (DCs)

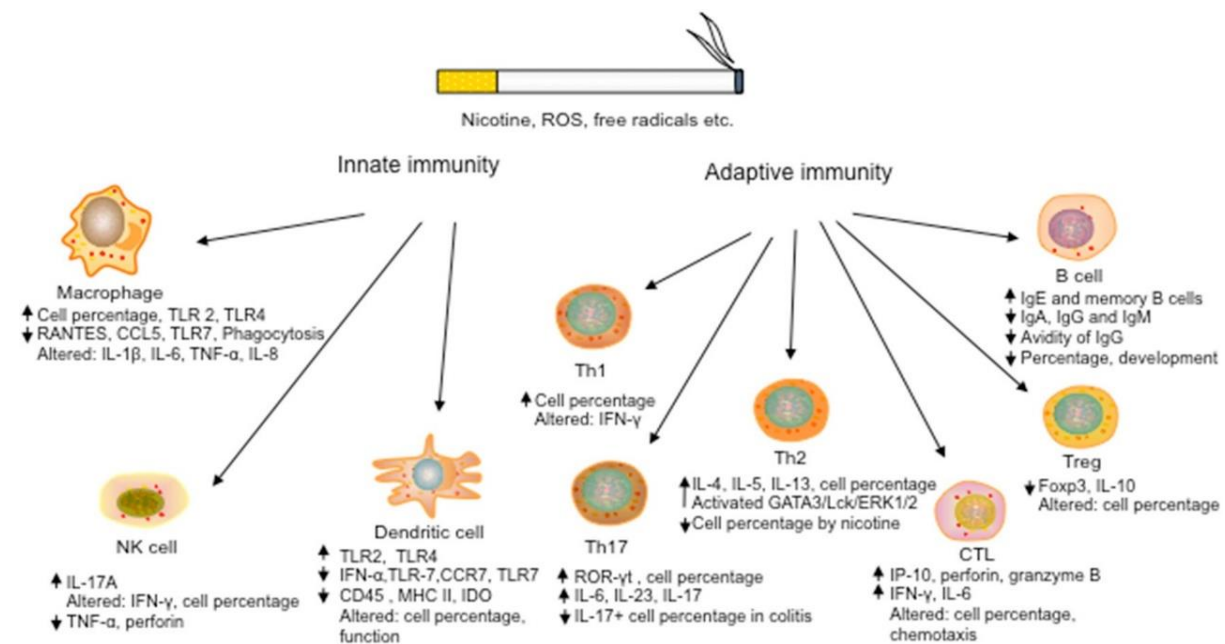
Immune responses to pathogens may be induced by DCs, which are produced from the hematopoietic lineage of bone marrow. The DCs and Langerhans cells of smokers are altered (LCs). In pDC from healthy individuals, tobacco smoke extract reduces the expression of IFN- and TLR-7. It has profoundly impacted create inflammation.

## NK cells

Cytotoxic lymphocytes with perforin, granzymes, TNF-/IFN- and IFN- are NK cells. Innate immune cells need it to function properly. IFN- and TNF- expression is reduced in human NK (CD56+, CD3-) cells that are exposed to cigarette smoke.

## Macrophages

When foreign pathogens enter the body, macrophages phagocytose and consume them before recruiting lymphocytes.



**Figure 2:** Smoking's impact on innate and adaptive immune cell formation and function. (Source: Oncotarget, 2017, Vol. 8, (No. 1), pp: 268-284).

Innate immune cells, such as dendritic cells (DCs), macrophages (M) and NK cells (NK cells), and adaptive immune cells (CD8+ T cells, CD4+ T cells, regulatory T cells, and B cells) are all altered by cigarette smoking, resulting in pro-inflammatory responses and/or immune cell malfunction. ("Altered" denotes contradictory results with both up-regulation and down regulation)

## 2. CONCLUSION

Smoking tobacco disrupts immune homeostasis, resulting in a variety of illnesses. Tobacco smoke affects

the levels of all of the body's immunological cells. As a result, the cellular and molecular mechanism are affected through some signalling. Nicotine affected human body has not capable of defensive function of the immune system including physical activity. Smoking, on the other hand, has a detrimental effect on health. COPD flare-ups are a common occurrence when this is present as a contributing factor. There are so many therapies for COPD, but the cellular damages are permanent. Thus, tobacco smoking affects air sacs, air lines, lungs, and normal immune responsiveness of the human body.

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