

Study links increasing air pollution to the rise of a type of lung cancer

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An international team of scientists, led by Nanyang Technological University, Singapore (NTU Singapore), has linked increased air pollution to an uptick in cases of lung adenocarcinoma (LADC)

worldwide. The same study also concluded an overall lower consumption of tobacco worldwide is statistically linked to less people contracting lung squamous cell carcinoma (LSCC).

Lung adenocarcinoma is a type of cancer for which research strongly suggests that genetic, environmental, and lifestyle factors play a part, while [lung](#) squamous cell carcinoma is often linked to a history of smoking.

This study, done in collaboration between NTU and the Chinese University of Hong Kong, showed that a 0.1 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) increment of black carbon, also known as soot, in the Earth's atmosphere, is associated with a 12 percent increase in LADC incidence globally.

Black carbon is a pollutant that is classified as under PM2.5, and the research team found that it has increased globally by $3.6 \mu\text{g}/\text{m}^3$ yearly from 1990 to 2012.

Meanwhile, a one percent decline of smoking prevalence was associated with a nine percent drop in LSCC incidence globally. The number of smokers worldwide decreased by 0.26 percent a year, cumulatively falling by nearly six percent from 1990 to 2012.

Lung cancer remains the leading cause of cancer with an estimated 1.8 million deaths in 2020, according to *CA: A Cancer Journal for Clinicians*. Global statistics have highlighted the trends of lung cancers, but understanding what may be causing them has been unclear, until the NTU-led study, which has associated the incidence of the cancers with tobacco consumption and [air pollution](#).

Professor Joseph Sung, NTU's Senior Vice President (Health and Life Sciences) and Dean, Lee Kong Chian School of Medicine

(LKCmedicine), who led the study, said, "In our study, we were able to determine that the global increase of lung adenocarcinoma is likely associated with air pollution. It had always been unclear, in the past decades, why we are seeing more females and more non-smokers developing [lung cancer](#) worldwide. Our study points to the importance of environmental factors in the causation of specific types of lung cancer."

Associate Professor Steve Yim, from NTU's Asian School of the Environment, who holds an appointment at LKCmedicine, the first author of the study, said, "Our study provided us with an indication as to the reason behind the rising trend of lung adenocarcinoma, despite the decreasing trend of smoking prevalence. Our findings pinpoint the necessity and urgency to reduce air pollutant emissions, especially black carbon."

The study analyzed data from the World Health Organization from 1990 to 2012 for data on lung cancers, while the dataset for age-standardized smoking prevalence rates from 1980 to 2012 was derived from the Institute for Health Metrics and Evaluation, an independent global health research center at the University of Washington. The statistics on pollution were obtained from National Aeronautics and Space Administration (NASA). Pollutants that were analyzed were black carbon, sulfate, and PM_{2.5}.

The results of the study were published in the peer-reviewed academic journal *Atmospheric Environment* in November.

Gender and geography have a role to play

The links between lung cancers and black carbon also vary between different genders across different continents. For instance, the link between the pollutant and the incidence of both LADC and LSCC was stronger in females than in males.

Globally, a $0.1 \mu\text{g}/\text{m}^3$ annual increment of black carbon was linked to a 14 percent rise in LADC in women, compared to nine percent in men. As for LSCC, the same increase in the pollutant was linked to a 14 percent increase in females, compared to eight percent in the opposite sex.

The study found that the link between air pollutants and LADC varied across continents. In North America, a $0.1 \mu\text{g}/\text{m}^3$ increment of black carbon was linked to a ten percent increase in LADC cases, compared to seven percent in Europe.

In the study, global data demonstrates that the drop in LSCC is more significant among males, said the researchers, and that the declining trend coincides with the declining trend of tobacco consumption.

However, despite the overall decreasing trend of tobacco usage, a positive association between smoking and LSCC was demonstrated for females in Asia, North America and Oceania, where a one percent increment in the number of female smokers was associated with a 12 percent increase of the cancer in those geographies.

Impact of population growth and rising air pollution

The scientists explained that despite lower overall percentage of smokers worldwide, there were more smokers worldwide due to massive population growth from 1980 to 2012, resulting in the number of female smokers increasing seven percent.

The rising incidence of LADC is particularly prominent in Asia, where emissions of black carbon and sulfate have been on the rise, according to the scientists.

LADC among males in Asia saw the largest increasing trend, increasing

by 24 percent yearly, mainly contributed by the prominent rises in Japan (38 percent yearly) and South Korea (37 percent yearly). For females in Asia, LADC increased by 25 percent year, similarly, with both Japan (43 percent yearly) and South Korea (36 percent yearly) showing a clear increasing trend.

The researchers highlight the prominent trend of air pollution in Asia, in which black carbon ($11.9 \mu\text{g}/\text{m}^3/\text{year}$) and sulfate ($35.4 \mu\text{g}/\text{m}^3/\text{year}$) showed the highest increase worldwide, with South Korea presenting the largest increase for both pollutants.

The combustion of fossil fuel for power generation or transportation has long been known as the source of particulate air pollution in most urban settings. It also worsens climate change by increasing the carbon dioxide emissions, which cause global warming.

Prof Sung added, "Results of this study should give us fair warning that air pollution should be better controlled to protect health and avoid premature deaths from lung cancer or related illnesses, particularly in populations that live near urban areas, which are known to experience high levels of pollutant emissions. Air pollution, together with climate change, is one of the greatest environmental threats to human health. Our findings underscore the urgent need for further research into how pollutants such as black carbon and sulfate lead to the development of lung adenocarcinoma, and for international leaders and experts to look into mitigation strategies for air pollution."

Assoc Prof Yim added, "While national environmental regulatory bodies commonly measure and report on the levels of fine particulate matter, our results pinpoint the importance to measure individual types of particulates, especially, black [carbon](#). The information would be useful for formulating effective emission control policies, supporting policies for sustainable development."

The team plans to carry out further research to investigate the functions of [black carbon](#) and sulfate in the development of LADC, which could lead to new studies to combat the surge of the [cancer](#). The team also hopes to explore other pollutants that might be linked to lung cancers.

More information: Steve H.L. Yim et al, Rise and fall of lung cancers in relation to tobacco smoking and air pollution: A global trend analysis from 1990 to 2012, *Atmospheric Environment* (2021). [DOI: 10.1016/j.atmosenv.2021.118835](#)

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