



Air pollution may affect human health via bacteria changes in respiratory tract

Written by Catharine Paddock on March 3, 2017

New research suggests that air pollution may have an effect on human health by altering bacteria. It shows that black carbon, a major component of air pollution, dramatically changes how bacteria grow and form biofilms, which can affect their survival in the lining of airways and their resistance to antibiotics.



The researchers found that exposure to black carbon changes the composition and structure of biofilms of bacteria that infect the respiratory tract.

The study was conducted by researchers from the University of Leicester in the United Kingdom.

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The team suggests that the work may have important implications for the treatment of infectious diseases, which are known to occur more frequently in places with high levels of air pollution.

First author Julie Morrissey, associate professor in microbial genetics, says that the findings show “that the bacteria which cause respiratory infections are affected by air pollution, possibly increasing the risk of infection and the effectiveness of [antibiotic](#) treatment of these illnesses.”

According to the World Health Organization (WHO), air pollution is the [largest environmental risk](#) factor for human disease. They estimate that in 2012, around 1 in 8 deaths worldwide were due to exposure to air pollution.

A recent analysis also confirms that 92 percent of the world’s population live in places where air quality levels exceed WHO limits.

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Black carbon's effect on bacteria 'poorly understood'

The link between particulate matter and human health is well established. The new study concerns black carbon – a main component of particulate matter that results from the burning of fossil fuels such as diesel, biomass, and biofuels.

For example, studies have shown that exposure to black carbon is linked with cardiopulmonary disease and deaths, and that black carbon [may also cause disease](#) by carrying a wide range of chemicals, varying in toxicity, into the human body.

However, as Prof. Morrissey and colleagues note, the effects of black carbon on bacteria, “organisms central to ecosystems in humans and in the natural environment, are poorly understood.”

For their study, they investigated how black carbon affects bacteria living in the respiratory tract – that is, the nose, the throat, and the lungs.

They focused on two bacteria that are major causes of respiratory disease in humans and show high levels of resistance to antibiotics:

Staphylococcus aureus and *Streptococcus pneumoniae*. Both of these bacteria are in the WHO's global list of [12 priority pathogens](#).

Exposure to black carbon changes biofilms

The researchers [found that](#) black carbon alters the antibiotic tolerance of *S. aureus* biofilms and increased the ability of *S. pneumoniae* biofilms to resist [penicillin](#), the front-line drug for treating bacterial [pneumonia](#).

Biofilms form when bacteria cells stick to surfaces and form communities held together by a slimy, glue-like substance that they excrete and

surround themselves with. These surfaces can include living tissue, such

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Once established, biofilms cause stubborn infections that are [hard to treat](#) and extremely resistant to antibiotics once they become chronic.

The researchers note that their findings show that “exposure to black carbon induces structural, compositional, and functional changes in the biofilms of both *S. pneumoniae* and *S. aureus*.”

Finally, in tests on mice, they also found that black carbon causes *S. pneumoniae* to spread from the nose to the lower respiratory tract – a key step in the development of disease.

They conclude that their study “highlights that air pollution has a significant effect on bacteria that has been largely overlooked.”

“Our research could initiate an entirely new understanding of how air pollution affects human health. It will lead to enhancement of research to understand how air pollution leads to severe respiratory problems and perturbs the environmental cycles essential for life.”

– *Prof. Julie Morrissey*

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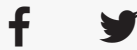


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