Deutsche Umwelthilfe

Relationship Between Covid-19 and Air Quality

Studies/Research:

Up to date there are no large-scale studies on the current outbreak of the new coronavirus, but there are some indications from smaller publications. The harmful effect of air pollutants on the respiratory system makes it difficult for the immune system to fight the additional infection of the lungs caused by SARS-CoV-2. As a result, there is a higher chance of a more severe course of the disease and an increased mortality risk. Pre-existing diseases increase the probability of a serious and potentially lethal course of the illness.

One frequently referenced study on SARS-CoV from 2003 (https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X-2-15) examines five regions with at least 100 SARS cases during the SARS-CoV epidemic in 2002/2003. The result: During the study's timeframe, SARS cases from regions with higher levels of air pollution had an 84% increased risk of dying from SARS.

DUH has collected some studies and summarised the central results. Studies for analogy conclusions are also listed, which investigate connections with other viruses and epidemics (e.g. SARS-CoV1, MERS-CoV and other RNA viruses, such as influenza, Ebola, and measles) as well as bacteria (especially pneumococci), since epidemiological studies, cohort and panel studies are very time-consuming and require a time lag from the phenomenon under investigation.

This list is not exhaustive.

Key findings from the studies listed below:

- Increased exposure to PM2.5 generally leads to an increase in acute lower respiratory tract infections and pneumonia, with older people being particularly at risk. Smokers and ex-smokers are more susceptible to SARS-CoV-2/ COVID-19.
- An increase of 1µg/m³ PM2.5 increases the death rate from Covid-19 by 8%.
- Increased NO2 exposure leads to an increase in viral-induced asthma in children.
- In general, people in cities with higher levels of air pollution are more at risk. Common ailments are air pollution-induced diabetes, respiratory diseases and high blood pressure → People with pre-existing heart or lung diseases are less able to fend off lung diseases.
- Cities in the USA with high coal burning (and thus higher pollution levels) had significantly higher mortality rates during the Spanish flu.
- Diesel exhaust particles allow pneumococcal pathogens to settle in the blood and lungs.
- There is evidence (Jasper et al. 2005) that oxidative stress caused by diesel exhaust particles increases susceptibility to viral infections.

Content

Short-Term Air Pollution and Incident Pneumonia: A Case-Crossover Study.

Authors: Pirozzi CS, Jones BE, VanDerslice JA, Zhang Y, Paine R, Dean NC.

Published: Annals of the American Thoracic Society December 2017. doi: 10.1513/AnnalsATS.201706-495OC; https://www.ncbi.nlm.nih.gov/pubmed/29283681.

Key statement:

"Among older adults, short-term ambient PM2.5 exposure is associated with more ED visits and hospitalizations for pneumonia, severe pneumonia, increased mortality, and increased health care costs. NO2 and O3 modestly increase pneumonia risk and illness severity"

Summary:

This paper examines relationships between short-term air pollution exposure and the number and severity of pneumonia cases (research period: 2 years; case number: 4.336).

Among adults aged 65 years and above the study found consistently positive associations between PM2.5 and instances of pneumonia, severe pneumonia, and inpatient mortality.

In older adults, short-term ambient exposure to PM2.5 is associated with increased ED sedation and hospitalization due to pneumonia, severe pneumonia, increased mortality and increased health care costs.

Nitrogen dioxide and ozone modestly increase pneumonia risk and illness severity.

Ambient particulate matter pollution and adult hospital admissions for pneumonia in urban China: A national time series analysis for 2014 through 2017

Authors: Yaohua Tian Hui Liu, Yiqun Wu Yaqin Si Man Li, Yao Wu, Xiaowen Wang, Mengying Wang, Libo Chen, Chen Wei, Tao Wu, Pei Gao, Yonghua Hu

Published: PLOS Medicine, https://doi.org/10.1371/journal.pmed.1003010, December 2019.

Key statement:

"At the national level, a 10-µg/m3 increase in 3-day moving average (lag 0–2) concentrations of PM2.5 and PM10 was associated with 0.31% (95% confidence interval [CI] 0.15%–0.46%, P < 0.001) and 0.19% (0.11%–0.30%, P < 0.001) increases in hospital admissions for pneumonia, respectively."

Summary:

The paper investigated the association between PM levels and hospital admissions for pneumonia in Chinese adults (study period: 2014 – 2017). During this period more than 4.2 million hospital admissions for pneumonia in 184 Chinese cities were recorded. Short-term elevations in PM concentrations were associated with increased pneumonia admissions.

At the national level, a 10-µg/m3 increase in 3-day moving average (lag 0–2) concentrations of PM2.5 and PM10 was associated with 0.31% and 0.19% increases in hospital admissions for pneumonia, respectively.

Air pollution and case fatality of SARS in the People's Republic of China: an ecologic study

Authors: Yan Cui, Zuo-Feng Zhang, John Froines, Jinkou Zhao, Hua Wang, Shun-Zhang Yu, Roger Detels

Published: Environmental Health volume 2, Article number: 15 (2003), https://ehjournal.biomedcentral.com/articles/10.1186/1476-069X-2-15, November 2003.

Key statement:

"SARS patients from regions with moderate APIs [air pollution index] had an 84% increased risk of dying from SARS compared to those from regions with low APIs (RR = 1.84, 95% CI: 1.41–2.40). Similarly, SARS patients from regions with high APIs were twice as likely to die from SARS compared to those from regions with low APIs. (RR = 2.18, 95% CI: 1.31–3.65)."

Summary:
The study demonstrates a positive association between air pollution and SARS case fatalities in the Chinese population by utilizing publicly accessible data on SARS statistics and air pollution indices. Publicly accessible data on SARS morbidity and mortality were utilized in the data analysis. Air pollution was evaluated by air pollution index (API) derived from the concentrations of particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide and ground-level ozone.

Ecologic analysis conducted in five regions with 100 or more SARS cases showed that case fatality rate increased parallel to an increase in air pollution. Partially ecologic study based on short-term exposure demonstrated that SARS patients from regions with moderate APIs had an 84% increased risk of dying from SARS compared to those from regions with low APIs. Similarly, SARS patients from regions with high APIs were twice as likely to die from SARS compared to those from regions with low APIs. Partially ecologic analysis based on long-term exposure to ambient air pollution showed the similar association.

The Association between Respiratory Infection and Air Pollution in the Setting of Air Quality Policy and Economic Change

Authors: Daniel P. Croft, Wangjian Zhang Shao Lin, Sally W. Thurston, Philip K. Hopke, Mauro Masiol, Stefania Squizzato, Edwin van Wijngaarden, Mark J. Utell, and David Q. Rich

Published: Annals of the American Thoracic Society, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6394122/#, March 2019.

Key statements:

"(…) increased rates of culture-negative pneumonia healthcare encounters, emergency department visits for influenza and hospitalizations for bacterial pneumonia were associated with increased concentrations of PM2.5 over the previous few days."

Summary:
This study examined 498,118 adult New York State residents with a primary diagnosis of influenza, bacterial pneumonia, or culture-negative pneumonia upon hospitalization or emergency department (ED) visit (2005–2016).

Increased rates of culture-negative pneumonia and influenza were associated with increased PM2.5 concentrations during the previous week (1-7 days before).

Personal exposure to nitrogen dioxide (NO2) and the severity of virus-induced asthma in children

Authors: A J Chauhan, Hazel M Inskip, Catherine H Linaker, Sandra Smith, Jacqueline Schreiber, Sebastian L Johnston, Stephen T Holgate

Published: THE LANCET, June 2003,
https://www.thelancet.com/journals/lancet/article/PIIS0140673603135829/fulltext

Key statement:

"Although reductions in peak expiratory flow and increases in lower respiratory-tract symptoms were small, because of the ubiquitous nature of NO2 exposure the proportion of children exposed would lead to a large number with attributable morbidity if applied to the general population of asthmatic children."

Summary:
This study aims to assess whether there is a relationship between NO2 exposure, and the severity of asthma exacerbations caused by proven viral respiratory infections in children. Its approach was to examine a cohort of 114 children for which there was evidence of a worsening of their asthma due to a viral respiratory infection.

The study shows a link between increased exposure to the air pollutant NO2 and the severity of virus-induced asthma exacerbations in children. High NO2 exposure in the week before an upper respiratory infection was associated with either increased severity of lower respiratory-tract symptoms or reductions of PEF (Peak Expiratory Flow). Thus, we can conclude that NO2 increases asthma in a viral infection. The symptoms were mild for the individual subject. But due to the widespread exposure to NO2, a high burden for all asthmatic children can be assumed.

Air Pollution and Respiratory Infections during Early Childhood: An Analysis of 10 European Birth Cohorts within ESCAPE Project

Authors: Elaina A. MacIntyre, Ulrike Gehring, Anna Mölter, Elaine Fuertes, Claudia Klümper,5 Ursula Krämer, Ulrich Quass, Barbara Hoffmann, Mireia Gascon, Bert Brunekreef, Gerard H. Koppelman, Rob Beelen, Gerard Hoek, Matthias Birk, Johan C. de Jongste, H.A. Smit, Josef Cyrys, Olena Gruzieva, Michal Korek, Anna Bergström, Raymond M. Agius, Frank de Vocht, Angela Simpson, Daniela Porta, Francesco Forastiere, Chiara Badaloni, Giulia Cesaroni, Ana Esplugues, Ana Fernández-Somoano, Aitana Lerxundi, Jordi Sunyer, Marta Cirach, Mark J. Nieuwenhuijsen, Göran Pershagen and Joachim Heinrich

Published: Environmental Health Perspectives, October 2013
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3888562/

Key statement:

"Urban air pollution has been associated with respiratory tract infections (Jedrychowski et al. 2013; Lin et al. 2005), pneumonia (Gouveia and Fletcher 2000), croup (Schwartz et al. 1991), persistent cough (Esplugues et al. 2011), and otitis media (MacIntyre et al. 2011) during childhood. […] Our findings are consistent with previous studies that used similar methods to examine air pollution and otitis media in three of our cohorts—PIAMA (Brauer et al. 2006), LISAplus Munich (Brauer et al. 2006), and INMA (Aguilera et al. 2013)—and a recent meta-analysis on long-term PM2.5 and acute lower respiratory infection in children, which also included the PIAMA study (Mehta et al. 2013)."

Summary:

This study investigated the association between air pollution and pneumonia, croup and otitis media in ten European birth cohorts.

It found consistent evidence for an association between air pollution caused by traffic and pneumonia during a subject's first two years following birth.

Urban air pollution may impair a person's defence mechanisms, and oxidising pollutants may exacerbate virus-induced inflammation of the respiratory system.

Short-Term Elevation of Fine Particulate Matter, Air Pollution and Acute Lower Respiratory Infection

Author: Benjamin D. Horne

Published: American Journal of Respiratory and Critical Care Medicine Vol. 198, No. 6 September 2018.

Key statement:

"The air pollution itself may make the human body more susceptible to infection or may impair the body's ability to fight off the infectious agents. It may be that PM2.5 causes damage to the airway so that a virus can successfully cause an infection or that PM2.5 impairs the immune response so that the body mounts a less effective response in fighting off the infection."

Summary:
This study evaluates the link between ambient $PM_{2.5}$ levels and acute lower respiratory infection (ALRI). To this end 146,397 subjects with an ALRI diagnosis between 1999 and 2016 were examined. Air pollution makes the human body more susceptible to infections by reducing its ability to fight off said infections. PM2.5 can cause damage in the lower respiratory tract, thus enabling a virus to cause infection. Furthermore, the immune system can be damaged by PM2.5 exposure.

Long-term exposure to PM2.5 pollution promotes infections of the lower respiratory tract. Bronchiolitis is the most common ALRI which is caused by RSV and is the most common cause of hospitalization in the first 2 years of life in the United States. Overall 64.0% of subjects received a bronchiolitis diagnosis.

The synergetic effect of ambient $PM_{2.5}$ exposure and rhinovirus infection in airway dysfunction in asthma: A pilot observational study from the central valley of California

Authors: Joseph Vempilly, Belayneh Abejie, Vivian Diep, Melissa Gushiken, Mamta Rawat & Tim R. Tyner

Published: Experimental Lung Research. November 2013

Key statement:

„Increasing ambient $PM_{2.5}$ and low temperature independently worsened airway function in asthma. The interaction between rhinovirus and $PM_{2.5}$ significantly impairs airway function in asthma. “

Summary:
This study investigates the effect of PM2.5 and concomitant rhinovirus infection on airway function in asthma in an area with high PM2.5 concentration. Elevated levels of particulate matter $PM_{2.5}$ and rhinovirus infection have been known to exacerbate asthma individually.

Wheezing and dyspnoea in asthmatics were worsened with increasing ambient PM2.5. Furthermore, it could be concluded that an increasing PM2.5 concentration in turn decreased the predicted FEV1% (FEV= Forced expiratory volume) and FEF25-75% in subjects with asthma. Rhino viral infection reduced FEF25-75% predicted in subjects with asthma. The reductions in FEV25-75 and FEV1 per 10 µg/m3 increase in ambient PM2.5 were 6% and 5% respectively.
Rhino viral infections reduced the predicted FE25-75% for asthmatics. Rhino viral infections in conjunction with increased ambient PM2.5 caused a 4-fold reduction of the FEF25-74 and a 2-fold increase in the predicted FEV1% values in asthmatics.

Influenza virus infection in mice after exposure to coal dust and diesel engine emissions

Authors: Nicholas Hahon, James A.Booth, FrancisGreen, Trent R.Lewis

Published: Environmental Research. June 1985.

Key statement:

"The findings of this study indicated that the severity of influenza virus infection is more pronounced in mice exposed to diesel engine emissions than in control animals and it is not appreciably accentuated by coal dust."

Summary:
This study examines the impact of Influenza virus infections initiated in mice previously exposed to respirable particulates at 2 mg/m^3 of either coal dust (CD), diesel engine emissions (DEE), a combination of both (CD/DEE), or to filtered air (control) for the duration of one, three, or six months.

The course of infection in mice exposed to all particle classes for one month did not differ appreciably among the four animal groups. After a six-month exposure, however, the CD, DEE & CD/DEE groups were twice as likely to develop a pulmonary consolidation as the control group which had been exposed only to filtered air.

Ergo, the influenza infections took a more severe course in mice which had been exposed to pollutants.

Pollution, Infectious Disease, and Mortality: Evidence from the 1918 Spanish Influenza Pandemic

Authors: Karen Clay, Joshua Lewis, and Edson Severnini

Published: Journal of Economic History.
https://www.researchgate.net/publication/328030297_Pollution_Infectious_Disease_and_Mortality_Evidence_from_the_1918_Spanish_Influenza_Pandemic. December, 2018.

Key statement:

"In randomized control trials, mice exposed to higher levels of particulate matter (PM) experienced increased mortality when infected with a common strain of the influenza virus (Hahon et al. 1985; Harrod et al. 2003; Lee et al. 2014).[…] Air pollution has also been shown to increase the severity of bacterial infections in the lungs (Jakab 1993). (…) The effects of air pollution on pandemic mortality were sizeable. Cities with high levels of coal capacity collectively experienced tens of thousands of excess deaths in 1918."

Summary:

This paper studies the impact of air pollution on mortality during the 1918 flue pandemic. The analysis uses data on mortality rates combined with new methods of measurement for air pollution, based on the amount of coal burnt in various US cities at the time.

Due to the use of different methods of energy production, the levels of pollution varied widely throughout the US. Pollution was particularly high in cities which used coal burning as a source of energy. Cities that used more coal experienced tens of thousands of excess deaths in 1918 relative to cities that used less coal. It should be said that pre-pandemic socioeconomic conditions and baseline health also had an influence on mortality rates in addition to pollution.

Thus far air pollution has received almost no attention in the historical literature on the pandemic, despite emerging evidence that air pollution exacerbates pandemics. In randomized control trials, mice exposed to higher levels of particulate matter (PM) experienced increased mortality when infected with a common strain of the influenza virus. Additionally, microbiological studies of respiratory cells also identify a link between pollution exposure and respiratory infection.

Exposure to diesel exhaust particles increases susceptibility to invasive pneumococcal disease

Authors: Rebecca K. Shears, PhD, Laura C. Jacques, PhD, Georgia Naylor, MBiol, Lisa Miyashita, PhD, Shadia Khandaker, PhD, Filipa Lebre, PhD, Ed C. Lavelle, PhD, Jonathan Grigg, MD FRCPCH, Neil French, PhD FRCP, Daniel R. Neill, PhD, Aras Kadioglu, PhD

Published: Journal of Allergy and Clinical Immunology. https://www.sciencedirect.com/science/article/pii/S0091674919316355. January 2020.

Key statement:

"Although only a proportion of PM may reach the lungs because of various clearance mechanisms (eg, mucus and cilia), meaning that the experimental exposure presented in this article may be closer to much higher levels of PM, these findings suggest that under the right circumstances (dependent on age, genetics, and coinfection status), exposure to environmental particulates such as DEPs could significantly alter the outcome of pneumococcal carriage, increasing susceptibility to invasive disease in humans."

Summary:
This study sought to determine whether exposure to DEPs (diesel emission particles) could promote the progression of asymptomatic nasopharyngeal carriage of Streptococcus pneumonia to invasive pneumococcal disease. Pneumococci are known as pathogens of pneumonia.

The study used mice and in vitro tests to provide a mechanistic understanding of the link between DEP exposure and pneumococcal disease risk.
It shows that daily exposure to DEPs disrupts asymptomatic nasopharyngeal carriage in mice and promotes pneumococcal dissemination to the lungs and blood. It was demonstrated that inhaled DEPs lead to influx of neutrophils in the lungs, even in the absence of infection.

It also found that DEP exposure reduces the phagocytic ability of human airway macrophages, suggesting that impaired bacterial clearance by airway macrophages following inhaled particulate exposure may also potentially affect pneumococcal infection outcome in humans. Given that 91% of the world's population inhabit areas where the air pollution exceeds World Health Organization guideline limits, reducing the amount of airborne pollution has the potential to reduce the global burden of pneumococcal disease significantly.

Assessing nitrogen dioxide (NO2) levels as a contributing factor to the coronavirus (COVID-19) fatality rate

Author: Yaron Orgen

Published: Science of the Total Environment. April 7, 2020, https://www.sciencedirect.com/science/article/pii/S0048969720321215.

Key statement:

"The Sentinel-5P data (satellite data) shows two main NO2 hotspots over Europe: Northern Italy and Madrid metropolitan area. According to these results, high NO2 concentration accompanied by downwards airflows cause of NO2 buildup close to the surface. This topographic structure combined with atmospheric conditions of inversion (positive omega) prevent the dispersion of air pollutants, which can cause a high incidence of respiratory problems and inflammation in the local population. This chronic exposure could be an important contributor to the high COVID-19 fatality rates observed in these regions."

Summary:
This study investigates the influence of NO2 on mortality rates in 66 regions in Italy, Spain, France and Germany.
3,487 of 4,443 examined deaths (78%) are in five regions in northern Italy and central Spain, which simultaneously have the highest NO2 concentrations on satellite records. In addition, the study takes into account meteorological conditions such as downward air currents and inversion (upper air layers being warmer than lower ones), which prevent a distribution of NO2.
In regions where the maximum nitrogen dioxide concentration was higher, the percentage of deaths due to covid-19 was also significantly higher than in regions with lower NO2 concentrations.

Spatial Correlation of Particulate Matter Pollution and Death Rate of COVID-19

Authors: Ye Yao, Jinhua Pan, Weidong Wang, Zhixi Liu, Haidong Kan, Xia Meng, Weibing Wang, Dr. Yao, Ms. Pan, Mr. Wang, Ms. Liu

Published: School of Public Health, Fudan University, Shanghai. April 7, 2020, https://www.researchgate.net/publication/340563732_Spatial_Correlation_of_Particulate_Matter_Pollution_and_Death_Rate_of_COVID-19.

Key statements:

"Our results demonstrate that the death rate of coronavirus disease (COVID-19) has a strong association with PM2.5 and PM10, whether in Hubei province or other cities in China."

"We speculate that the effects of PM2.5 and PM10 on death mainly affect the progress of patients from mild to severe and [sic!] prognosis."

Summary:
This observational study identifies a correlation between an increased mortality rate in Hubei, China, due to COVID-19 and increased air pollution by PM2.5 and PM10. Of the 49 cities investigated, 33 were outside Hubei, 15 inside Hubei and finally Wuhan itself. Air pollution was highest in Wuhan, as was the mortality rate.

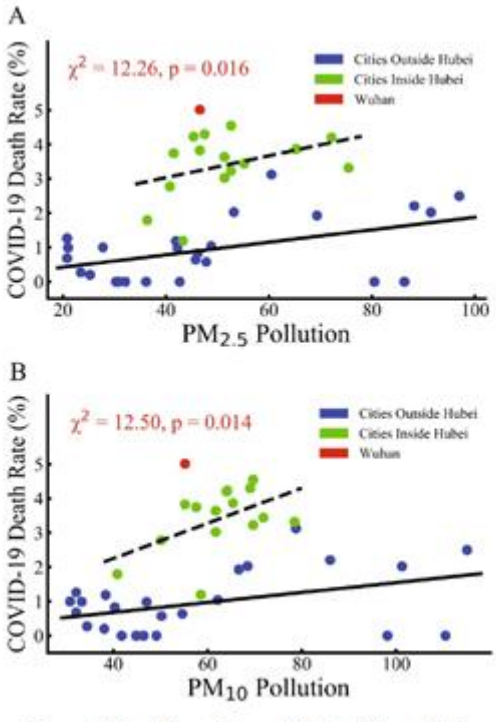

Figure 1 Death Rate Versus $PM_{2.5}$ & PM_{10} pollution.

Exposure to air pollution and COVID-19 mortality in the United States

Authors: Xiao Wu MS, Rachel C. Nethery PhD, M. Benjamin Sabath MA, Danielle Braun PhD, Francesca Dominici PhD

Published: Harvard T.H. Chan School of Public Heath, Boston. April 5, 2020, https://www.medrxiv.org/content/10.1101/2020.04.05.20054502v2.

Key statement:

"The results indicate that long-term exposure to air pollution increases vulnerability to the most severe COVID-19 outcomes."

"We found statistically significant evidence that an increase of 1 μg/m3 in long-term PM2.5 exposure is associated with an 8% increase in the COVID-19 mortality rate."

Summary:

The study investigates whether long-term PM2.5 exposure is associated with an increased risk of covid-19 mortality.

For this purpose, data from the Johns Hopkins University on Covid-19 deaths up to 22 April was evaluated from more than 3,087 counties in the USA (98% of the total population). Of these, 1,799 (58.3%) counties had no corona deaths.

Negative binomial mixed models were adjusted for Covid-19 deaths in the counties as a result and long-term averages of PM2.5 in the counties as exposure.

An increase of 1µg/m³ PM2.5 increases the death rate from Covid-19 by 8%. (95% confidence interval: 2%, 15%). These results were statistically significant and stable compared to secondary and sensitivity analyses.

The study was supplemented by data up to 22 April. Prior to that, it contained data until 4 April. Therefore, the increase in the death rate was reduced from 15% to 8%.

Pre-admission air pollution exposure prolongs the duration of ventilation in intensive care patients

Authors: De Weerdt A, Janssen BG, Cox B, Bijnens EM, Vanpoucke C, Lefebvre W, El Salawi O, Jans M, Verbrugghe W, Nawrot TS, Jorens PG

Published: Intensive Care Medicine. March 17, 2020, https://www.ncbi.nlm.nih.gov/pubmed/32185459.

Key statement:
"Controlling for pre-specified confounders, an IQR increment in BC (1.2 µg/m3) up to 10 days before admission was associated with an estimated cumulative increase of 12.4% in ventilation duration (95% CI 4.7–20.7). Significant associations were also observed for PM2.5, PM10 and NO2, with cumulative estimates ranging from 7.8 to 8.0%."

Summary:
The study investigates the influence of pre-intensive care ambient air pollutant exposure of a patient on the duration of artificial ventilation.

The medical records of patients admitted to the intensive care unit (ICU) of Antwerp University Hospital (Flanders, Belgium) in 2003, who were artificially ventilated directly upon ICU admission or within 48 hours thereafter were used for the analysis. Daily air pollutant exposure [particulate matter with an aerodynamic diameter ≤ 2.5 µm ($PM_{2.5}$) and ≤ 10 µm (PM_{10}), nitrogen dioxide (NO_2) and black carbon (BC)] was modelled for each patient's home address for the period of ten days prior to hospital admission, using a high-resolution spatial–temporal model.

Controlling for pre-specified confounders, an IQR increment in BC (1.2 µg/m^3) up to ten days before admission was associated with an estimated cumulative increase of 12.4% in ventilation duration (95% CI 4.7–20.7). Significant associations were also observed for $PM_{2.5}$, PM_{10} and NO_2, with cumulative estimates ranging from 7.8 to 8.0% (PM2.5 = 7.9% (95% CI 0.5–15.9), PM10 = 7.8% (95% CI 0.4–15.8), NO2 = 8.0% (95% CI 0.02–16.4).

The results add to the growing body of evidence that links air pollution exposure to respiratory health. Short-term ambient air pollution exposure prior to ICU admission represents an unrecognized environmental risk factor for the duration of artificial ventilation in the ICU. The higher the exposure to pollutants preadmission, the longer the patients needed to be ventilated.

Longitudinal survey of microbiome associated with particulate matter in a mega city

Authors: Nan Qin, Peng Liang, Chunyan Wu, Guanqun Wang, Qian Xu, Xiao Xiong, Tingting Wang, Moreno Zolfo, Nicola Segata, Huanlong Qin, Rob Knight, Jack A. Gilbert, Ting F. Zhu

Published: Genome Biology. March 2, 2020, https://genomebiology.biomedcentral.com/articles/10.1186/s13059-020-01964-x.

Key statement:

"The data suggest that potential pathogen and antibiotic resistance burden increases with increasing pollution levels and that severe smog events promote the exposure."

Summary:

In order to examine the microbiome of airborne particulate matter, this study undertook a longitudinal metagenomic (metagenomic = genetic material is extracted directly from environmental samples, sequenced and analysed) analysis of 106 samples of PM2.5 and PM10 from Peking, collected over six months across 2012 and 2013.

Overall, the study identified that airborne particulate matter harbours rich and dynamic microbial communities. Among them, microbial elements were identified that can have health consequences.

As air pollution increases, so does exposure to pathogens and resistance to antibiotics. Smog events promote the exposure.