Using Biomarkers to Decode the Effects of Air Pollution

THE OBJECTIVES OF THE ALERT STUDY

For individuals with chronic respiratory conditions such as asthma and COPD, air quality is a key factor in their overall health and quality of life. The ALERT study (Airborne Link to Respiratory Effects and Toxins), led by the University of Antwerp in collaboration with the Antwerp University Hospital (UZA) and supported by the province of Antwerp, investigates how the effects of air pollution can be assessed in these conditions.

PhD researcher Laila Truyen explains that the study aims to explore the potential of volatile organic compounds (VOCs) in exhaled breath as non-invasive biomarkers of pollution-related health effects.

A GLOBAL HEALTH CONCERN
Air pollution is a major global health issue, contributing to 7 million deaths and 213 million disability-adjusted life years (DALYs) annually. However, its effects are not uniform; individuals with obstructive lung diseases like asthma and COPD are particularly vulnerable, facing higher risks of hospitalisation and mortality. The ALERT study seeks to determine whether VOCs, released due to (a change in) lung metabolism, can serve as reliable biomarkers for these exposure-related health impacts. Since VOCs reflect underlying biological processes, they could provide critical insights into the connection between respiratory symptoms and air pollution exposure. Notably, VOCs can be sampled non-invasively, which makes them promising biomarkers for use in clinical settings or personal health monitoring.

EXPLORING THE DEEPER LINKS BETWEEN AIR POLLUTION AND RESPIRATORY HEALTH
While the harmful effects of air pollution on respiratory health are well established, the ALERT study goes deeper by exploring the biological mechanisms involved. The goal is to identify biomarkers that could signal early pollution-related health impacts, potentially paving the way for new preventive measures and treatments.

The study focuses on two major pollutants: fine particulate matter (PM) and nitrogen oxides (NOx), both of which are known contributors to respiratory problems. Patient inclusion began in 2022, and the first measurement period and data collection started in May 2023. This phase spans four campaigns over two years, allowing researchers to assess both short-term and long-term effects of pollution exposure. This approach increases the study's statistical power, offering a clearer picture of how varying pollution levels affect individuals over time.

TRACKING POLLUTION EXPOSURE: PASSIVE AND ACTIVE SAMPLING
To measure long-term pollutant exposure, two passive detectors are installed during the first visit. PCC collectors accumulate fine particulate matter (PM) exposure inside and outside the home, while Palmes tubes monitor nitrogen dioxide (NO_2) levels outdoors. Despite their simple setup, these devices collect valuable data on participants' environmental exposure, which is later analysed in the lab to determine pollution levels over a 30-day period.

At the second visit, 30 days later, the PCC and Palmes tubes are retrieved. Participants also undergo spirometry tests during this visit to assess

The GC-TOF-MS setup at the Laboratory of experimental medicine and paediatrics (LEMP).
This state-of-the-art facility allows the identification and quantification of volatile organic compounds (VOCs).
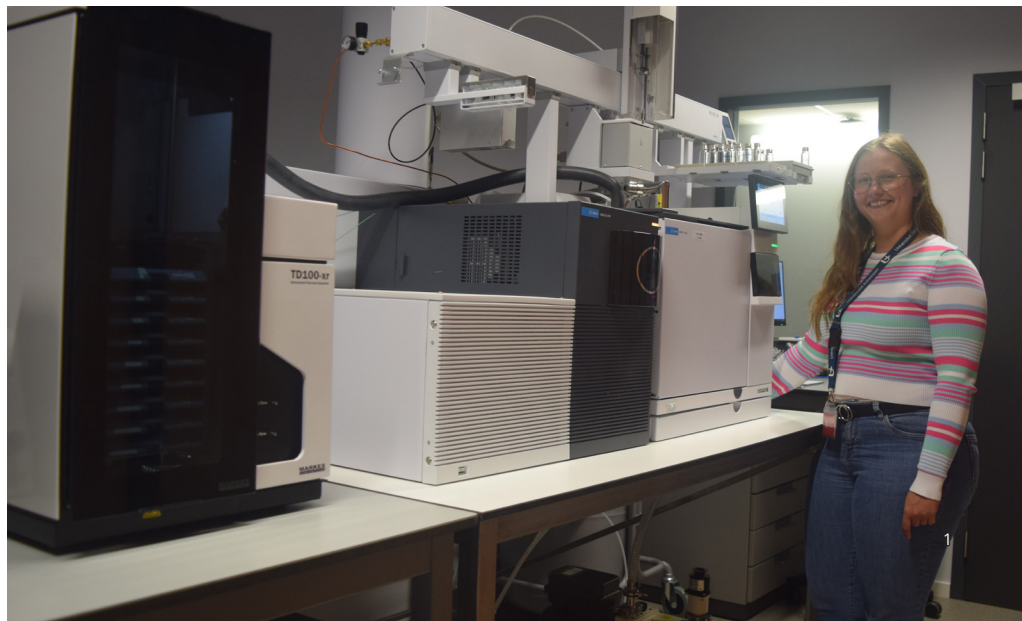
lung function by measuring airway obstruction, which is an indicator of respiratory health. Additionally, they complete questionnaires to report symptoms such as shortness of breath, coughing, and sleep disturbances.

In parallel with these measurements, non-invasive breath samples are collected to analyse VOCs, which may indicate inflammation or other pathophysiological changes triggered by pollution exposure. During breath sample collection, acute exposure to particulate matter (PM) is also measured, offering a 'snapshot' of exposure at that moment. These VOC samples are analysed using gas chromatography-mass spectrometry (GC-TOF-MS), a technique that identifies and semi-quantifies individual compounds. This analysis provides valuable insights into metabolic processes in the lungs and how they may be influenced by both acute and long-term air pollution exposure.

The study will also investigate differences in VOC profiles between patient groups, such as those with asthma or COPD, to better understand how air pollution sensitivity may vary and what role VOCs play in explaining these differences.

FROM RESEARCH TO POLICY: PRELIMINARY FINDINGS

Although the study is still ongoing, preliminary findings have already provided valuable insights. Initial data suggests that asthma patients experience increased airway obstruction when exposed to higher levels of fine particulate matter, reinforcing existing research. The increase in airway obstruction following exposure is well documented in the literature, and VOCs are expected to further clarify the individual impacts of this exposure.

The researchers are optimistic that identifying reliable VOC biomarkers could reshape how respiratory health is monitored and managed. The findings of the ALERT study could influence public health policies by

deepening our understanding of how air pollution affects lung health, potentially encouraging legislators to establish stricter air quality guidelines. At a later stage, these insights could inspire further research into new treatments and preventive measures, such as breath tests to detect early signs of lung inflammation, enabling early interventions for vulnerable populations.

SUSTAINING SCIENTIFIC PROGRESS

Research initiatives like the ALERT study are made possible through essential funding from various organisations and institutions. While the practical work of the ALERT study has been completed, financial support is still necessary to focus on the critical phase of analysing and publishing the extensive data collected. This financial backing ensures that groundbreaking projects like ALERT can continue to enhance our scientific understanding, ultimately leading to impactful public health interventions and informed policy changes.

CONCLUSION: A PATH FORWARD FOR RESPIRATORY HEALTH

As the ALERT study continues to shed light on the relationship between air pollution and respiratory health, its findings hold the potential to reshape how we monitor, manage, and prevent the impact of pollution on vulnerable populations. By identifying reliable biomarkers like VOCs, the study paves the way for stricter air quality standards and innovative health interventions.
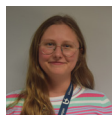
About Laila Truyen
Laila Truyen is a PhD student at the University of Antwerp, working within the Laboratory of Experimental Medicine and Pediatrics (LEMP). Since starting her PhD in 2022, Laila has focused on studying the health effects of air pollution exposure, particularly in patients with asthma and chronic obstructive pulmonary disease (COPD). Laila is passionate about discovering novel biomarkers as to advancing our understanding of air pollution's effects. Her goal is to empower both clinicians and patients to improve patient welfare. Additionally, she advocates for the importance of clean air and strives to make scientific knowledge accessible to the public.

ABOUT EU.RECA

The European Respiratory Cluster Antwerp provides a knowledge platform that focuses on the lung as a crucial part of the body, the healthy functioning of this vital organ and combating lung disease. There are many developments in the respiratory sector; the prevalence of lung disorders is increasing, but there is also a tremendous drive to get new treatments on the market.

As a catalyst for innovation, we bring promising start-ups into contact with leading companies, pharma with product designers, academics with entrepreneurs, and investors with patients. That is why our approach is based on interaction. Our extensive network will ensure a top-quality pool of participants; our workshops and symposia will encourage in-depth dialogue.

eu.reca facilitates innovation in the respiratory sector by providing innovation and business support for late-stage researchers, start- and scale-ups.

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eu.reca fuels discussions by sharing point of views, research insights and innovations focused on respiratory health. Got something to share or interested to support? Reach out via info@eureca.world.