The Intricacies of Asthma

UNRAVELING THE IMPACT OF THE INTERACTION BETWEEN ALLERGENS AND POLLUTION ON ASTHMA

Asthma is a complex respiratory condition affecting millions of people worldwide. Tania Maes, Associate Professor at the Laboratory for Translational Research in Obstructive Airway Diseases (Ghent University Hospital), and her team, aim to shed light on how air pollution intertwines with genetic factors and allergen exposure in asthma.

With 262 million people affected by asthma globally, 10% of them experiencing severe asthma and resulting in 455,000 deaths each year (WHO, 2019), understanding the complex interplay of genetic predisposition and environmental factors is crucial.

ASTHMA IS INFLUENCED BY VARIOUS FACTORS

Genetics is important in asthma since research has highlighted that genetic variations in DNA make certain individuals more susceptible to developing asthma. However, the environment also plays an important role and factors influencing asthma include exposure to allergens, air pollution, and chemical agents.
The research, employing various methodologies such as mouse models and human respiratory cells revealed that exposure to allergens, like house dust mites and environmental pollutants, like cigarette smoke and diesel exhaust particles can expedite asthma progression.

THE IMMUNE RESPONSE IN ALLERGIC ASTHMA

Concretely, the exposure to allergens triggers the respiratory system's lining, known as the airway epithelium, to release cytokines, including interleukins. This causes dendritic cells, that function as sentinels, to present allergens to T-cells, which initiates an immune response, with production of type2 cytokines. This cascade results in the formation of allergen-specific immunoglobulins that bind receptors on mast cells, which become activated upon re-exposure to allergens. Type2 cytokines also induce recruitment of eosinophils, which play a critical role in asthma pathology. Similar to activated mast cells, eosinophils release toxic granules, prompting airway constriction and giving rise to typical asthma symptoms. These phenomena are exacerbated in the presence of air pollution.

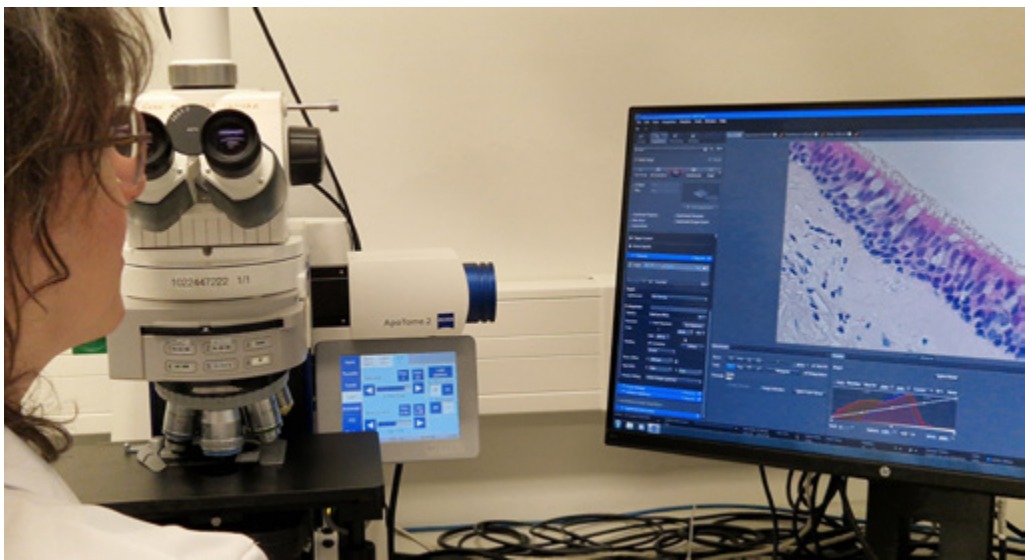
IMPACT OF AIR POLLUTION

Exposure to air pollution is associated with the increase of neutrophils in the airway compartment, implicating that the classical eosinophilic inflammation in patients with asthma may change when there is air pollution. The research by T. Maes and her team indeed demonstrated in mice studies that the body exhibits distinct responses to a combination of the common allergen HDM (house dust mites) and diesel exhaust particles (DEP) during both subacute and chronic exposures. Subacute exposure leads to the presence of eosinophils and neutrophils with a predominant eosinophilic inflammation. Importantly, this inflammation is more pronounced compared to the situation where only HDM allergens are present. Prolonged exposure to the combination of HDM and DEP shifts the balance towards dominance by neutrophils. Understanding these immune system shifts over time is pivotal for comprehending the long-term effects of environmental factors and shaping future preventive measures. Efforts to uncover key inflammatory responses aim to pave the way for tailored interventions addressing eosinophilic and neutrophilic inflammation nuances. Recognizing that long-term exposure to air pollution may have an impact on current therapies that target eosinophilic inflammation is also warranted.

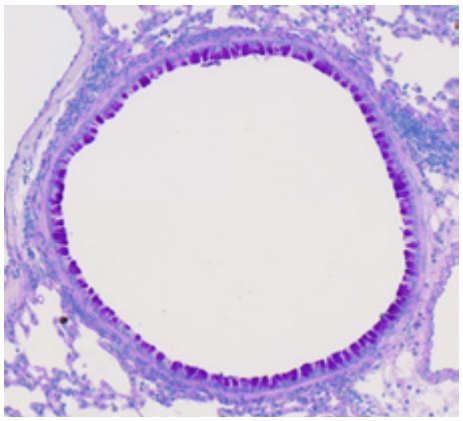
PREVENTIVE MEASURES

The study emphasizes the significant influence of environmental factors

Microscopic analysis and imaging of human airway epithelium.



on asthma, specifically highlighting ambient air pollution and proximity to highways. Various sources, including industry, household heating, and traffic, contribute to this ambient air pollution by releasing particulate matter and nitrogen oxides through the combustion of fossil fuels. In the EU, where 96% of the population resides in cities, the amount of fine particulate matter in the air consistently exceeds the World Health Organization (WHO) guideline of 3 to 5 micrograms per cubic meter. Experimental findings further indicate that pollution not only exacerbates asthma symptoms but also heightens sensitivity to allergens. This underscores the urgent need for ongoing refinement of environmental management strategies to mitigate the adverse impact of air pollution on respiratory health.



Microscopic view on an airway of a mouse exposed to the combination of allergen and diesel exhaust particles. Purple staining shows the mucus-producing goblet cells. Blue dots show nuclei from structural cells and inflammatory cells in the lung.

RAISING AWARENESS

Based on these findings, Professor Maes urges healthcare professionals and policymakers to emphasize the pervasive impact of air pollution on respiratory health. Continued efforts, particularly in terms of public transport and intensified awareness campaigns are vital in reducing the impact of air pollution on respiratory health. Future studies will delve deeper into the specific role of neutrophils and their mediators, unraveling their potential as a therapeutic target, promising new avenues for proactive health management.

CONCLUSION

Navigating the nuanced interplay of genetic factors, allergens, and pollution is pivotal for developing tailored strategies for asthma prevention and treatment. A sustained commitment to mitigating environmental stressors, particularly air pollution, remains crucial for advancing respiratory well-being at a societal level. Persistent research is indispensable for delving deeper into asthma complexities, refining preventive approaches, and charting a course towards new therapies. Collaborative endeavors involving scientists, healthcare professionals, policymakers, and the wider community are paramount for collectively addressing respiratory health challenges and paving the way toward a healthier future.

GHENT UNIVERSITY

About Prof. Dr. Tania Maes

Prof. Dr. Tania Maes is associate professor at the Department of Internal Medicine and Pediatrics at the Faculty of Medicine and Health Sciences (Ghent University), where she performs research at the Translational Laboratory for Research in Obstructive Lung Diseases. She obtained a Master's degree in Biotechnology (1994) and a PhD in Biotechnology (2001), both at Ghent University. Her current research focusses on the effects of environmental factors (indoor and outdoor air pollution) on the development of asthma. By combining analyses in human cell cultures with murine models, she is unraveling which immunological mechanisms drive the aggravation of asthma by air pollution. Her research also includes analyses on patient samples. She has more than 80 A1 publications, with around 4000 citations and a Hirch index of 39 (Web of Science). She is an active member of the European Respiratory Society (ERS) and is part of the steering committee of the "Basic Science group" from the Belgian Respiratory Society (BeRS).

References

Trajectory of neutrophilic responses in a mouse model of pollutant-aggravated allergic asthma. De Volder J, Bontinck A, De Grove K, Dirven I, Haelterman V, Joos G, Brusselle G, Maes T. Environ Pollut. 2023 Jul 15;329:121722.

The work at the Department of Respiratory Medicine (Ghent University) is funded by Research Foundation-Flanders (FWO Vlaanderen, FWO041819N, G025123N and FWO-EOS projects G0G2318N, G0H1222N) and a Ghent University Grant (BOF/GOA 01G00819). TM holds a Chiesi Chair on the Role of Environmental factors in Asthma development and a GSK chair on eosinophilic airway disease.

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.

Visit www.eureca.world for more respiratory-related research insights from within our network, business services and events.

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.