NITROPOL-BE

Impacts of nitrogen deposition in the natural environment on pollen allergy and respiratory infection outcomes in Belgium

DURATION
15/01/2021 - 15/04/2025

BUDGET
1 406 185 €

PROJECT DESCRIPTION

Allergic disorders are associated with a relative high burden of disease for the modern societies because of their high prevalence, often life-long morbidity impact and impact on mental health and well-being. In 2018, the proportion of women that suffered from allergy in Belgium was 20.3 % compared to 17.0% in men. This prevalence is expected to increase in the following decades, as a result of various interactions between changes in environment and lifestyle. Global change continues to have impacts on aeroallergens and the prevalence of respiratory allergic diseases through impacts on plant species distributions, pollen amounts, pollen allergen potency, pollen season and pollen distributions. Pollen allergy patients are exposed to more and potentially increasingly potent pollen over longer time periods, escalating the burden of allergic diseases and the economic costs for society.

A potentially important yet unexplored driver of increasing aeroallergen and allergy prevalence is environmental nitrogen pollution. Emissions from combustion of fossil fuels and from intensive agricultural (artificial) fertilizer application generate atmospheric deposition of nutrients –in particular nitrogen– which have enriched the biosphere. In Belgium exposure of ecosystems to excessive nitrogen loads dramatically increases from southeast to northwest. The ecological effects of excessive nitrogen enrichment include biodiversity losses, changes in plant distributions, ecosystem simplification and loss of ecosystem service provisioning capacity Specifically, nitrogen enrichment generally leads to more productive ecosystems, which tend to be species-poor and dominated by a few, highly competitive plant species. It can be hypothesized that these changes in environmental nitrogen concentration, plant community composition, and plant productivity may affect airborne pollen distributions, abundances and allergen potency. Environmental nitrogen deposition may therefore have important direct and indirect impacts on aeroallergens and, consequently, on the prevalence and severity of allergic diseases. However, such possible impacts of nitrogen deposition on human health are at present unappreciated and the mechanisms are poorly understood, despite ever increasing nitrogen pollution.

Therefore, in this project, we **aim** to quantify the **burden of respiratory allergic diseases** that may be attributed to **nitrogen pollution** of the natural environment.

Our **general objective** is to understand how environmental nitrogen enrichment affects pollen allergy burden in Belgium. Specifically, we aim to test the **novel hypothesis** that nitrogen enrichment may induce increased allergen potency of airborne pollen (allergen amount per pollen grain) by quantifying pollen allergens (ELISA tests) and clinically testing the allergen-specific IgE reactivity against pollen in a cross-sectional sample of allergic patients (IgE-based immunoblotting). We will used pollen collected from the environment and pollen of key allergenic grass and tree species subjected to experimental nitrogen enrichment. We then aim to establish the burden of respiratory allergic and infectious diseases that can be attributed to nitrogen enrichment of the environment and to evaluate the health care costs and benefits of multiple future nitrogen deposition scenarios in the context of different policy interventions, through a disability-adjusted life year (DALY) approach.

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The results of this project will provide **novel scientific insights** in the effects of environmental nitrogen deposition and changes in plant community composition and productivity on airborne pollen emissions and pollen potency of natural environments. The experimental components of the research will allow us to **infer causality of increasing allergenicity of natural environments**, which is an important goal in environmental epidemiology and which is beyond the state of the art in terms of research topic (*scientific impact*). The results of NITROPOL-BE will also allow us to contribute to policy recommendations regarding the management of public and private green spaces with respect to respiratory health, in support of measures to sustain habitability. Specifically, we will be able to propose safe baseline nitrogen enrichment values and measures in terms of biodiversity and land use management to halt or decrease nitrogen pollution-mediated allergic disease pressure (*policy impact and environment, health and quality of life impact*). The proposal aims to contribute to a better understanding of the interactions between people and the environment in order to assess, prevent and control environmental risks to public health. Results of the project may be used to assess allergy risks of green spaces, allowing health care professionals to inform patients and allowing patients to take preventive measures or actions, potentially reducing the economic costs of allergic disease for society (*society and economy impact, environment, health and quality of life impact*). The final research results will be published in international, peer-reviewed journals and in publications for the wider audience. An open science symposium will be organized at the end of the project.

CONTACT INFORMATION

Coordinator

Raf Aerts
Sciensano
Risk and Health Impact Assessment
raf.aerts@sciensano.be

Partners

Nicolas Bruffaerts
Sciensano
Mycology and Aerobiology
nicolas.bruffaerts@sciensano.be

Brecht Devleesschauwer
Sciensano
Epidemiology and Public Health
brecht.devleesschauwer@sciensano.be

Olivier Honnay
Katholieke Universiteit Leuven (KU Leuven)
Division Ecology, Evolution and Biodiversity Conservation
olivier.honnay@kuleuven.be

Catherine Linard
Nicolas Dendoncker
Université de Namur (UNamur)
Department of Geography
catherine.linard@unamur.be
nicolas.dendoncker@unamur.be

Rik Schrijvers
Katholieke Universiteit Leuven (KU Leuven) / UZ KU Leuven
Allergy and Clinical Immunology Research Group
rik.schrijvers@kuleuven.be

Niko Speybroeck
Université Catholique de Louvain (UCLouvain)
Research Institute Health and Society
niko.speybroeck@uclouvain.be

LINKS

https://www.sciensano.be/en/projects/impacts-nitrogen-deposition-natural-environment-pollen-allergy-and-respiratory-infection-outcomes