BRAIN-be
Belgian Research Action through Interdisciplinary Networks

RespirIT

Assessing spatio-temporal relationships between respiratory health and biodiversity using individual wearable technology

DURATION
15/12/2015 - 15/03/2020

BUDGET
1.411.006 €

PROJECT DESCRIPTION

There is growing evidence that changes in land use and vegetation composition - driven by climate change and human intervention - may increase the emission, dispersion and allergenicity of airborne allergenic pollen grains, prompting a further decline in the quality of life of allergy - sufferers as well as increasing socio-economic costs. Green spaces are generally assumed to have a negative effect on allergy-sufferers due to the higher pollen levels they emit. Yet, the role that plants and plant assemblages (plant diversity) play in the complex interaction between pollen, environmental conditions and allergy symptoms in patients, is still partly unknown and ambiguous. Although recent studies indicate that plant diversity might also have a mitigating effect on the prevalence of allergies and asthma as well as on the severity of its symptoms, quantitative evidence is still lacking.

In this light, our proposed project aims at exploring and understanding the spatial and temporal effects of plant diversity on respiratory health in general and allergic asthma and allergenic rhinitis specifically. We aim at examining three aspects of this relationship:

(i) the chronic health effect *(Does long term exposure to plant diversity has an impact on the risk of allergy or asthma prevalence?)*;
(ii) the acute health effect *(Does recent exposure to plant diversity has an impact on the acute expression of allergenic symptom severity?)*; and
(iii) possible future health effects *(How will future changes in plant diversity, coupled to climate and land use changes, have an impact on (i) and (ii)?).*

First, we will explore (based on an existing and ongoing birth cohort) possible consequences of *in utero* and early life exposures to plant diversity, pollen and air pollution levels in the residential neighbourhood on the one hand, and incident wheezing on the other hand. Also the association between *in utero* exposure and placental methylation changes in a selected set of genes will be investigated. These analysis will give insight in the consequences that early life exposures to plant diversity, air pollution and pollen levels have on population vulnerabilities to allergy and allergic asthma prevalence (the chronic health effect).

Second, we will evaluate if, how, and to what extent plant diversity has a direct impact (positive and/or negative) on allergenic symptom severity in patients (the acute health effect). To fully assess these spatio-temporal relationships we do not only need dynamic and spatially explicit information on the environment, including plant diversity, pollen concentration and air quality levels, but we also need data on when and where which patients suffer from what type of allergic symptoms. Data on patients' symptoms is very hard to obtain since they are generally not reported to medical doctors or recorded in scientific databases. To address this data gap we will apply an innovative data assimilation approach in which the whereabouts and symptom severity of individual patients is continuously tracked using individual wearable technology (via smartphones, smartwatches) and linked to spatially explicit and regularly updated information on plant diversity, air quality, microclimate and pollen concentrations. These wearable sensor systems will allow providing a unique coupled dataset on the whereabouts and symptom severity of a sample of individual allergy sufferers. By linking this information to spatially explicit information regarding plant diversity, air quality and pollen concentrations we will be able to quantitatively, dynamically and spatially study plant diversity effects on allergic symptom severity in a near real-time geographic information system (GIS).

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These two analyses will provide us insight **into the relative risks** of chronic allergy/asthma expression (first analysis) and acute symptom expression (second analysis) **per unit increase in exposure to plant diversity, air pollution and pollen**. These relative risks will then form the basis for:

(i) Creating risk maps for chronic allergy covering Belgium and a relative risk GIS for exacerbations and symptom severity of allergy, both covering Belgium, providing as such near real-time insight in the spatio-temporal risk dynamics throughout Belgium;

(ii) A third and final set of analysis in which we will evaluate how changes in plant diversity – coupled with simulated management strategies and climate and land use change scenarios – affect respiratory health risks.

In order to provide projections on future effects of plant diversity on respiratory health, we will therefore account and develop scenarios of changes in plant diversity, based on coupled climate and land use and management change scenarios specifically conceived for Belgium, and assess how these changes in plant diversity may affect respiratory health conditions.

The results of this project will not only provide new scientific insights into the complex spatio-temporal relationships between respiratory health and plant diversity, thereby pinpointing avenues for further investigation, but the results will also be exploited to provide recommendations for land use management practices that take account of respiratory health at a local and regional scale while anticipating on the health implications of current and projected changes in plant diversity.

Keywords: allergy, health, biodiversity, citizen-science, ecosystem services, mHealth

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