22.19 Prevalence, incidence, morbidity and mortality of respiratory diseases

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Prevalence, incidence, morbidity and mortality of respiratory diseases (RD)	Health and Wellbeing
Description and justification	Breathing unhealthy air is a cause or contributor to most respiratory conditions. The most common sources of unhealthy air are tobacco smoke, indoor air pollution from burning solid fuels, unhealthy air in the workplace, air pollution from traffic and industrial sources, air containing microbes, and air with toxic particles or fumes (Forum of International Respiratory Societies: Respiratory diseases in the world Realities of Today – Opportunities for Tomorrow, 2013). Increased concentrations of greenhouse gases, especially carbon dioxide, in the earth's atmosphere have already substantially warmed the planet, causing more severe and prolonged heat waves, temperature variability, increased length and severity of the pollen season, air pollution, forest fires, droughts, and heavy precipitation events and floods, all of which put respiratory health at risk. The main diseases of concern are asthma, rhino-sinusitis, chronic obstructive pulmonary disease (COPD) and respiratory tract infections, but the extent to which these are spread will vary according to the proportion of susceptible individuals in a given population. Individuals with pre-existing cardiopulmonary diseases are at higher risk of suffering from climate changes (D'Amato, Cecchi, D'Amato, & Annesi-Maesano, 2014). Furthermore, many respiratory illnesses are related to immunologic dysfunction and this has been associated to unbalanced respiratory and gut microbiomes, due to a lack of appropriate exposure to biodiverse environments both at a time when a healthy immune system is formed as well as in adulthood (Haahtela et al., 2013; Hanski et al., 2012; Kuo, 2015). A study on children and adults in Finish and Russian Karelia found that allergic symptoms and diseases were systematically more common in Finnish children and adults than in their Russian counterparts (Haahtela, Laatikainen, Alenius, Auvinen, Fyhrquist, Hanski, von Hertzen, Jousilahti, Kosunen, Markelova, Mäkelä, Pantelejev, Uhanov, Zilber, & Vartiainen, 2015). Sensitization to birch pollen was significantly larger in Finnish children, and while adults born in the 4o's in the

	two regions had similarly low rates of respiratory illnesses, those born in the 70's differed significantly, supporting the notion that the epidemic of allergy and asthma is a result of reduced exposure to natural environments with rich microbiota, a changed diet and a sedentary lifestyle (Haahtela et al., 2015). Villeneuve et al. (2012) advanced research findings that suggest that areas that have more green space have a slightly lower mortality rate (stronger association for respiratory disease mortality), yet authors emphasize the need for more research aimed at identifying whether there is a selection bias related to people who have been exercising in their youth move to areas with green space as well as the specific characteristics of green space that have the strongest influence on mortality, and at evaluating the potential confounding role of other lifestyle-related mortality risk factors. The ways in which green space affects respiratory symptoms are yet to be fully understood, and seem to depend on the characteristics of the bio-geographical region (Markevych et al., 2017; Tischer et al., 2017), which indicates that other factors (e.g., dryness, heat, etc.) need to be taken into account. Results of designs aimed at exploring the link between respiratory disease and greenspace are inconsistent across studies, which makes it difficult to draw useful conclusions with regards to the amount, type and structure of green space that would be conducive to respiratory health. A systematic review of the greenspaces' effect on allergies and atopic sensitization, using studies that covered 11 cohorts, showed that findings are not consistent across studies, with four cohorts registering protective effects from greenspace, two cohorts showing an increase in sensitization related to greenspace, and five cohorts displaying no significant effect of greenspace on atopic sensitization (Lambert, Bowatte, Tham, Lodge, Prendergast, Heinrich, Abramson, Dharmage, & Erbas, 2018). Lambert et al. (2018) suggest that this is due to variations in exposure measurements, study populations and location, the specific allergens tested, and inclusion of confounders. Authors also conclude that not only the contributions of greenspace to specific allergens need to be understood, but also how the amount, type of greenspace and specific allergens contribute to prevalence, incidence and risk of particular respiratory disease should be considered in future studies (Lambert et al., 2018).
Definition	**RD** is a type of disease that affects the lungs and other parts of the respiratory system. Respiratory diseases

include asthma, chronic obstructive pulmonary disease (COPD), pulmonary fibrosis, pneumonia, and lung cancer (National Cancer Institute - Dictionary of Cancer Terms, n.d.).

Prevalence is a measure of the burden of disease in a population in a given location and at a particular time, as represented in a count of the number of people affected (Ward, 2013). Prevalence is a function of both the incidence and duration of disease. In turn, duration is affected by the availability and effectiveness of curative treatments and by survival times of afflicted individuals (National Institutes of Health. Autoimmune diseases coordinating committee—Autoimmune diseases research plan, n.d.).

Incidence represents how quickly new cases occur relative to population size and the passage of time. Incidence is calculated as the ratio of the number of new cases of a disease occurring within a population during a given time to the total number of people in the population (National Institutes of Health. Autoimmune diseases coordinating committee—Autoimmune diseases research plan, n.d.). While the prevalence represents the existing cases of a disease, the incidence reflects the number of new cases of disease within a certain period and can be expressed as a risk or an incidence rate (Noordzij, Dekker, Zoccali, & Jager, 2010).

Morbidity refers to the state of being diseased and the severity and impact of disease. Like prevalence, measures of morbidity represent the burden that a disease places on a population. In contrast to prevalence, morbidity estimates use more complex approaches that are potentially more informative than a simple count of cases (National Institutes of Health. Autoimmune diseases coordinating committee—Autoimmune diseases research plan, n.d.).

Mortality measures deaths caused by a specific disease, deaths resulting from treatment for a specific disease, or deaths in which a specific disease is a contributing factor, but not the primary cause. Mortality is the number of deaths due to a disease during a specific time divided by the number of persons in that population at the beginning of the time period. Hence, mortality is a rate in the sense that it represents how quickly deaths occur relative to population size and the passage of time. It can be interpreted as reflecting the risk of death from a particular cause faced by persons within the population being studied (National Institutes of Health. Autoimmune diseases

	coordinating committee—Autoimmune diseases research plan, n.d.).
Strengths and weaknesses	+ some research that supports the notion of a solid association between greenspace and exposure to nature, and respiratory disease prevalence and mortality (e.g., Villeneuve et al., 2012) - inconsistencies across studies make it difficult to draw useful conclusions with regards to the amount, type and structure of green space that would be conducive to respiratory health; e.g., ecological cross-sectional study found no evidence at the scale of the American city for the general claim that access to green space yields health benefits; not only that there was no association between greenness and mortality from heart disease, diabetes, lung cancer, or automobile accidents, but mortality from all causes was significantly higher in greener cities (Richardson, Mitchell, Hartig, de Vries, Astell-Burt, & Frumkin, 2012)
Measurement procedure and tool	☒ *Quantitative*: epidemiological data (Health Data Administration/Cities) Incidence of RD relevant for measurement, along prevalence, as it indicates the number of new cases of disease within a certain period (for example, since the implementation of the NBS), and can be expressed as a risk or an incidence rate. Pre-existing cardio-pulmonary diseases relevant to investigate, as they were found to heighten the risk of suffering from climate changes (D'Amato et al., 2014). Recommended variables for RD: o prevalence/incidence/morbidity/mortality of RD (asthma; acute bronchitis/cough; emphysema; lung cancer; pulmonary hypertension; autoimmune diseases that damage the lungs, such as scleroderma and rheumatoid arthritis)
Scale of measurement	-
Data source	
Required data	✓ Essential: NBS characteristics for each city/site
Data input type	Quantitative
Data collection frequency	Before and after NBS implementation (longitudinal)
Level of expertise required	☒ Methodology and data analysis requires high expertise in psycho-social research ☒ Quantitative data collection requires no expertise
Synergies with other indicators	P3 Perceived Quality of Green Spaces Sc5.1 Perceived Safety Sc5.2 Actual Safety SC7 Geographical Access to NBS

	SC8 Perceived Access to NBS HW3 General Wellbeing and Happiness HW4 Life expectancy and healthy life years expectancy HW10 Prevalence, incidence, morbidity of chronic stress HW11 Mental Health Wellbeing: Depression and Anxiety HW12 Restoration-Recreation: Enhanced physical activity and meaningful leisure
Connection with SDGs	Goal 3. Ensure healthy lives and promote well-being for all at all ages Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
Opportunities for participatory data collection	-
Additional information	
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