Green & Quiet Brussels?

Analysis of social inequalities in the health-related outcomes of environmental characteristics in the Brussels Capital Region: a mixed method intersectionality approach

Research by Interface Demography (Department of Sociology of the VUB) – Commissioned by Innoviris
State of the art of the project

Research objectives

Data and methodology

1. Quantitative analysis (WP2-WP5)
   Population design
   Databases
   Variables
   Statistical analysis

2. Qualitative analysis (WP6-WP7)
   Population and design
   Methodology

Valorisation

References
State of the art of the project

Socio-epidemiologic research has illustrated a sound association between different aspects of the living environment and health, morbidity and mortality. A healthy living environment entails different dimensions: an indoor dimension, consisting of the buildings and places where people live and work in; and an outdoor dimension, consisting of contextual environmental characteristics. Characteristics of housing and work environments such as indoor air pollution (e.g. presence of mould or dampness, gas cooking, indoor smoking, etc.) directly impact upon health. Outdoors, living in green areas, levels of outdoor air and noise pollution influence various aspects of health – as witnessed by their increasing inclusion in epidemiologic research as “men-made health determinants”. Moreover, the elements of the in- and outdoor environment tend to interact with each other and with individuals’ social background characteristics. The aim of this project is to disentangle the interrelations between (in- and outdoor) environmental factors and social background factors (socioeconomic position, gender, age and migration background), to investigate the impact of these so-called social stratifiers on the association between living environment and health and mortality. Focus will be on the Brussels Capital Region. We will use a mixed method and intersectionality approach, which are rarely applied in the field of environmental epidemiology.

Outdoors, especially green spaces such as parks and playing fields have recently received sustained attention from different disciplines, including psychology, epidemiology, demography and sociology. In the context of a demographic shift towards urbanisation, interest in the health consequences of urban living contexts has grown considerably during the past decades. Studies evaluating the relationship between green space and health are heterogeneous in design, study population, green space assessment and covariate data. There is nevertheless accumulating evidence for a salutogenic effect of green spaces on self-assessed health (Maas et al. 2006, Bowler et al. 2010, Mitchell et al. 2011, De Jong et al. 2012). Reviews generally suggest a stronger evidence for mental health benefits than for other aspects of health, such as physical health indicators (Lee et al. 2010, Gascon et al. 2015). With respect to morbidity, studies have shown an association between low quantities of green spaces and elevated risk of cardiovascular diseases (Mitchell et al. 2008, Pereira et al. 2012) and type 2 diabetes (Astell-Burt et al. 2014). Evidence that exposure to urban green space is linked to reduced mortality rates is also accumulating (Gascon et al. 2016), especially for all-cause mortality, cardiovascular mortality and lung cancer mortality. To explain the association between health and green spaces, several pathways have been put forward. First, green spaces provide opportunities for physical activity, which is associated with reduced physical and mental disorders (Pretty et al. 2005). Second, social contacts are facilitated by the availability of green spaces (Maas et al. 2009). Third, exposure to green promotes psychological restoration (Hartig et al. 1991, Carter et al. 2014). Last, green areas are associated with an improvement of outdoor air quality through a reduced exposure to air and noise pollution and through moderating ambient temperature.

People’s social background acts as an important interacting factor with the living environment. It is generally accepted that wealthier people are more likely to report better general health, to have lower mortality rates (Gadeyne 2006, Deboosere et al. 2009, Renard et al. 2016) and to live in both better quality houses and neighborhoods with more green spaces. People are thus differentially exposed to beneficial/harmful health factors depending of the social strata they belong to (Diderichsen et al. 2001). Moreover, a growing body of evidence has reported that individual socioeconomic position modifies the health benefits of green spaces (De Vries et al. 2003, Maas et al. 2006), underlining a larger beneficial effect among deprived people (Mitchell et al. 2007, Mitchell et al. 2008, Davdand et al. 2012, Markevych et al. 2014). This is in line with research on other (social) determinants of health: the more people belong to less-advantaged groups in society, the stronger they benefit/suffer from beneficial/disadvantageous health factors (Nordahl et al. 2014, Adler et al. 2016). Other dimensions of social stratification such as gender and migration background may interfere as well. The available studies on the potential modifying effect of ethnicity on the health benefits of green spaces are scarce
but suggestive of such effects (Agyemang et al. 2007, Lee et al. 2011). To address similar interactive, non-additive effects of social stratifiers, social scientists have developed the intersectionality approach. So far, this approach has not often been implemented in environmental health research.

An important pathway through which green spaces impact upon health is their buffering or reducing effect of air and noise pollution, both important aspects of outdoor pollution (Dzhambov et al. 2014). Noise pollution is one of the four major pollutions in the world and approximately 80 million people in the European Union suffer from unacceptable noise levels (65 dB) and over 170 million are exposed to noise levels between 55 and 65 dB (Dzhambov et al. 2014). In the last decade, a number of large scale studies on environmental noise and health have been carried out. Traffic noise — the most prominent and common type of urban noise pollution — has shown to be associated with lower levels of physical activity (Foraster et al. 2016) and medical conditions such as cardiovascular diseases, type 2 diabetes, sleep disorders or mental health disorders (Basner et al. 2014, Foraster et al. 2014, Eze et al. 2017, Fuks et al. 2017, Pitchika et al. 2017).

Since the 1930 Meuse Valley episode in Belgium (Nemery et al. 2001) and the London fog of December 1952, the number of studies showing adverse health effects of short and long term exposure to outdoor air pollution has grown and especially during the past 20 years (Anderson et al. 2012, West et al. 2016). Evidence from a large number of studies underline the existence of a small and consistent association between short-term elevations in number of air pollutants and increased mortality and hospitalization rates (Wang et al. 2014, Samoli et al. 2016). In Brussels, recent increases in the concentrations of several air pollutants are associated with increases in respiratory medication sales (Casas et al. 2016). Studies reporting long-term exposure to air pollution show an inverse association with life expectancy and a large global burden of respiratory and allergic diseases, including asthma, chronic obstructive pulmonary disease, pneumonia, and possibly tuberculosis, and with cardiovascular diseases such as stroke (Khafaie et al. 2016). It is now widely recognized that exposure to outdoor air pollution contributes to a broad array of acute and chronic health effects, ranging from minor physiological impacts to death from respiratory and cardiovascular disease. It is also recognized that the effects on human health are large and widespread. In 2015, air pollution was responsible for 19% of all cardiovascular deaths worldwide, 24% of ischemic heart disease deaths, 21% of stroke deaths, and 23% of lung cancer deaths (GBD Mortality and Causes of Death Collaborators 2016).

Health effects of indoor air pollution received limited scientific attention compared to outdoor pollution (Jones 1999). A great deal of studies suggested that the health effects of outdoor pollution are considerably higher. However, interest has been increasing since the second half of the 1980s. Literature underlined the role of indoor pollution in affecting health, as people generally spend most of their time indoors (Viegi et al. 2004). Indoor pollution emanates from different sources: human activities (e.g. indoor smoking), crowdedness, pet ownership and plants, construction materials, heating and cooking systems (e.g. gas for cooking and heating, fire places...), ventilation, etc. Exposure to indoor pollutants can potentially lead to a variety of adverse health outcomes (Bascom et al. 1995, Mendell et al. 2011, Cox et al. 2013, Lin et al. 2013, Casas et al. 2016): increased risk of chronic obstructive pulmonary diseases, acute respiratory symptoms, atopic sensitization, bronchial hyper-responsiveness, respiratory cancer, infectious diseases, and irritation phenomena. Changes in building design devised to improve energy efficiency have meant that modern homes and offices are frequently more airtight than older structures. Furthermore, advances in construction technology have caused a much greater use of synthetic building materials. Whilst these improvements have led to more comfortable buildings with lower running costs, they also provide indoor environments in which contaminants are readily produced and may build up to much higher concentrations than are found outside.

Studies dealing with the association between these characteristics of the in- and outdoor living environment and health are scarce in Belgium, let alone in the Brussels Capital Region. There is to our
knowledge one recently published study, finding no significant association between self-assessed health and the built environment in the elderly population living in the Brussels Capital Region (Dujardin et al. 2014). However, the latter study was limited in terms of exposure assessment (information on duration of residence was not available) and health outcomes (no objective health measure available). The GRESP-HEALTH project intends to put an end to this situation with its focus on the impact of green and blue spaces on health indicators at the national level in Belgium (https://www.belspo.be/belspo/brain-be/projects/GRESP-HEALTH_en.pdf). Social background variables as mediating/moderating factors are only superficially touched upon in that project. They have the status of confounders, but their effects are not studied as such. Building on the on-going GRESP-HEALTH research project, Green&Quiet will refine its research results through a number of distinctive features: i) focus on intersectionality; ii) use of a mixed method approach (quantitative and qualitative analysis); iii) integration of indicators of indoor pollution; iv) application of objective as well as subjective indicators of the in- and outdoor living environment; v) exploitation of new census data (census 2011); and vi) profound focus on the Brussels Capital Region. The Green&Quiet project intends to move from “description” to “explanation” by digging deeper into pathways and mechanisms behind the threefold association between environmental factors, social stratifiers (socioeconomic position, age, gender and migration background) and health/mortality.

Research objectives

More specifically, the Green&Quiet project aims to investigate the health impact of the living environment in the Brussels Capital Region using both quantitative and qualitative research strategies and an intersectionality perspective. The general aim of Green&Quiet crystallises into four specific research objectives:

1. to inquire the health impact of the in- and outdoor living environment and the effect that crucial dimensions of social stratification – socioeconomic position, migration background, age and gender – exert on this impact (RQ1)
2. to inquire the relationship between objective and subjective (perceptive) indicators of the living environment taking into account the same dimensions of social stratification – socioeconomic position, migration background, age and gender (RQ2)
3. to inquire the pathways and mechanisms behind the association between living environment and health through a qualitative study including once more the crucial dimensions of social stratification – socioeconomic position, migration background, age and gender (RQ3)
4. to combine the research results of the quantitative and qualitative analyses (RQ4)

RQ1 will probe into the interrelations between social stratifiers, in- and outdoor living environment – in terms of indoor pollution, availability of green spaces, and outdoor air and noise pollution – and health in the capital region. Living environment will be operationalised by objective and subjective indicators relating to the perception of the environment. The inclusion of data on indoor pollution and on the perception of the living environment is innovative and has not often been addressed elsewhere.

Similarly, the intersectionality approach is a distinguishing feature of the Green&Quiet project and has seldom been implemented in research on environmental health effects (Lee 2010; Dadvand 2014). First termed “intersectionality” by Crenshaw (1989), intersectionality theory initially sought to enhance understandings of race- and sex/gender-based studies by arguing that multiple marginalizations, such as those experienced by African-American women, were mutually constituted and could not be understood or ameliorated by approaches that treated race and sex/gender distinctively. According to Bauer (2014), intersectionality has the potential to improve research not only on sex/gender and race/ethnicity, but on all other domains of social background factors, such as socioeconomic status,
educational background, or age cohort. Intersectionality approaches differ from unitary and multiple approaches to research (Hancock, 2007). In a unitary approach, only one main category of social stratification is of primary research interest. For example, analyses can focus on sex/gender or on race/ethnicity or on socioeconomic position. A multiple approach includes more than one social stratification dimension and functions under an additive assumption that treats multiple marginalizations as individual categories that can be layered (Hancock, 2007). In the GRESP-HEALTH project, social background variables are considered as mediating/moderating factors and consequently only superficially touched upon. They have the status of confounders, but their non-additive and interactive effects are not studied as such. In contrast, the intersectionality approach of the Green&Quiet project assumes that an individual’s experience, and his/her health, are not simply the sum of their parts, and that, for example, what it means to live in a polluted environment and what the health implications are, may be different for men versus women, for lower versus higher educated, for Moroccans and Turkish versus native-born communities. This makes sense in that living environment can be constituted through cultural meanings and processes (Bauer, 2014).

The capital region represents a perfect laboratory to implement the intersectionality approach. Brussels is characterized by a clear differentiation between the poorer districts, mixed neighborhoods and the affluent areas of the city. Its demographic development has always been dominated by migration over the past one and a half centuries and this is not different today (Deboosere et al. 2009). The capital city experienced a rise in population over the past years and, just like all large European cities, the population composition is highly influenced by internationalization. According to the census 2001, Brussels had 45 different nationalities (nationality of origin) with at least 1,000 inhabitants. The composition has diversified further since then and there has been an increase in inhabitants from European Union countries. The focus on intersectionality in Green&Quiet will allow for this diversity and for a differentiation of the health effects of exposure to living environments. As mentioned, studies illustrated that lower social strata may benefit more strongly from green spaces given the poorer environment quality they live and work in. Research relating to environmental effects on health among migrants are scarce and in addition inconsistent. A few studies indicated the absence of a health impact among ethnic minorities (Dadvand et al. 2014), while other studies found a more detrimental impact of neighborhood environmental stressors among migrant minorities (Agyemang et al. 2007). The reasons for the stronger/weaker associations in the migrant minority groups are unclear in literature but could relate to the same mechanisms and pathways as with the more deprived population groups, ethnic minorities often belonging to these groups. Hence the importance of integrating both dimensions of social stratification in a study on the health effects of the living environment.

An important pathway to understand the interrelations between social stratifiers, living environment and health undoubtedly relates to the differential way in which in- and outdoor environment is used, experienced and perceived by men and women, by different age groups, socioeconomic groups and migrant communities. As mentioned by Bauer (2014) living environments are constituted through cultural meanings and processes. To get a deeper insight into these experiences and perceptions, the second research question (RQ2) will examine in a quantitative manner the association between objective indicators of the living environment (green spaces, air and noise pollution) and the perception of the living environment (perception of green in the neighborhood, air quality, noisiness, etc.) maintaining the intersectionality perspective. RQ2 will thus compare the discrepancy between the objective reality and the perceptions of this reality across men and women, different age groups, socioeconomic groups and migrant communities. This analysis should be considered as an intermediate step towards the qualitative analysis.

The third research question (RQ3) will profoundly address the mechanisms and pathways behind the associations between social stratifiers, living environment and health in the capital region. Quantitative analyses are often not very suitable to shed a clear light on the specific mechanisms making a certain environment more beneficial to health then another. Qualitative research into people’s appreciation of
public green spaces and/or their own living environment are better suited to reveal more precise mechanisms and factors (Carter et al. 2014). Certainly, from an intersectionality perspective differences in perception and use of green spaces and the living environment can reveal crucial insights. For example: do people from all social backgrounds use the same definitions of “accessibility”, “equipment”, “usability” of green places – or do such quality-definitions depend upon social background characteristics? The few existing studies suggest that at least gender and migrant background seem to influence expressions of usability and aesthetics (Carter et al. 2014).

The fourth research question (RQ4) will address the implications of our research results for existing insights and knowledge about environmental health effects and the role of intersectionality in these effects. In doing so, we will round up, bring together and synthesize the results of the previous work packages. Given the variety of individual and contextual social and environmental characteristics that will be integrated and the holistic focus on health (self-assessed health, all-cause and cause-specific mortality), what does Green&Quiet offer as new insights and knowledge? The research results will be compared with other studies, positioning our research output within a broader national and international context. As mentioned, Brussels is a perfect laboratory for Green&Quiet, as variations are far larger than in many other parts of the country and Europe.

Data and methodology

The project will be organized in nine work packages, each including specific tasks. WP1 will focus on data administration and data management. WP2, WP3 and WP4 will deal with the first research question and disentangle the interrelations between social stratifiers, living environment and self-assessed health (WP2), all-cause mortality (WP3) and cause-specific mortality (WP4) in an intersectionality approach. WP5 will concentrate on the association between objective indicators of the living environment and the perception of this environment using an intersectionality approach. WP6 and WP7 will carry out a qualitative analysis and provide deeper insights into the mechanisms and pathways explaining the interrelations between social stratifiers, living environment and health in the Brussels Capital region. WP8 will bring together the results of the quantitative and qualitative analysis and synthesize the research results. It will mainly address the implications of our results for existing insights and knowledge, confirming, refuting, adapting them or offering new ones. WP9 will disseminate Green&Quiet’s results in different ways. In this part of the project proposal, we will first describe the study population and the study design, the databases and the methods of analysis in the quantitative approach relating to the first and second research question (WP2-WP5). Next, we will depict the basic principles of the qualitative analysis relating to the third research question (WP6-WP7).

1. Quantitative analysis (WP2-WP5)

Population design

To answer the first two research questions different databases will be used. The base population will consist of all individuals included in the censuses of the Belgian population performed in 1991 and 2001 and in the administrative census of 2011. Given the strong age-dependency of health and of the experience and perception of the living environment, analyses should in the first place be stratified by age. Green&Quiet will focus on three main age groups using the year 2001 for age calculation: 1) adolescents and young adults born between 1985 and 1976 (aged between 16 years and 25 in 2001); 2) adults in their working age born between 1975 and 1937 (aged between 26 and 64 in 2001); and 3) elderly born before 1937 (aged 65 and older in 2001). Given the intersectionality approach of
Individual mortality is available for the period 2001-2013. Currently, data of the administrative census 2011 are being integrated in the mortality and migration database. This database originally consisted of a linkage between the Belgian census of 1991 and register data of all deaths and migrations in the period from 1 October 2001 to 31 December 2013. The database was further extended with information on the causes of death (underlying and immediate cause of death) for the period 1991-2013. Currently, data of the administrative census 2011 are being integrated in the National Mortality Database and a mortality and migration follow-up until 2015.

In addition, two ecologic datasets are used in this project, providing information on the living environment for each statistical ward. The second dataset consist of data on the presence and proximity of green spaces (percentage of green space, distance to the closest green space, accessibility of green areas, fragmentation of green patches and type of green) and the percentage of built-up areas in each statistical sector in the Brussels Capital Region. The third dataset concerns the distribution of air pollution (PM$_{2.5}$, PM$_{10}$, NO$_2$, traffic density and distance to major roads) and noise pollution (sound pressure levels in dB of road, rail and traffic noise for different time windows; day, evening and night). Indicators are available for specific years in the 2000s and 2010s. In this project, we will assume that although the amount of green spaces or concentrations of air and noise pollution may vary across time, their spatial distribution remains relatively constant.

Depending on the health outcome of interest (self-assessed health or mortality), the research project will follow either a cross-sectional or a longitudinal study design. Information on individual all-cause mortality is available for the period 1991-2015; on cause-specific mortality for the period 1991-2013. Individual self-assessed health was assessed by the census questionnaire in 2001. Information on
sociodemographic and socioeconomic characteristics is available in 1991, 2001 and 2011 at the individual (or household) level. Data on green spaces at the level of statistical wards are available at different time points between the years 2000 and 2015 to take account of potential changes over time in the landscape.

Variables

To measure outdoor environmental quality, several indicators will be included. The expertise relating to the construction of these indicators gathered during the GRES-P-HEALTH project by the Centre Environment and Health (KULeuven) will be of uttermost importance in this respect. It is essential to mention that dr. Lidia Casas, senior research associate at the Centre Environment and Health and in the GRES-P-HEALTH project, will act as an expert subcontractor in the Green&Quiet project. The extent, shape and relative spatial organization of green spaces is calculated for each statistical ward using data from the Coordination of Information on the Environment (CORINE) land-cover (Janssen et al. 2008). The CORINE land-cover provides a detailed inventory of the biophysical land cover in Europe using forty-four classes. The European Environment Agency made it available at a resolution of 250 m grid cells. Information on green spaces is calculated at CORE/IMAQ (UCL) for the GRES-P-HEALTH project and is available for the years 2000, 2006 and 2012. Green spaces are split up according to the type of green: agricultural land, forests, semi natural and urban green. For each statistical ward, the percentage of green space, the distance to the closest green space, the accessibility of green areas and a total exposure index of the green spaces is calculated.

For air pollution, we will use interpolated regional background levels of PM10, PM2.5 and NO2 for each statistical ward. The data are modelled using a spatial temporal interpolation method (Kriging) with pollution data collected in the official fixed site monitoring network and land cover data obtained from satellite images (CORINE land-cover dataset) in combination with a dispersion model. This will be combined with measurements of traffic density and distance to major roads from the residential area. The information on air pollution data is available through IRCEL (Belgian Interregional Environmental Agency) for the years 2001, 2005, 2010 and 2015. The data for year 2015 are modelled at the highest spatial resolution (25x25 m grid) available to date. Since the spatial distribution of the concentrations of air pollutants does not change over time, in our analyses we will use the high-resolution data (2015) in and perform sensitivity analyses with the low-resolution data (4x4km) from years 2001, 2005 and 2010. Equally for this measure, a total exposure index to air pollution can be compiled.

Noise pollution information is based on measurements from the NOISE (Noise Observation and Information Service for Europe) for the years 2002 and 2007. The noise pollution indicators relate to sound pressure levels in dB of road, rail and traffic noise sources for different time windows: day (Lday), evening (Levening), night (Lnight) and a subjective 24h-average of the three time windows weighted (Lden).

To determine indoor environmental quality in Green&Quiet, the project will use the census 2001 data to construct proxies for potential indoor polluters. Usable information relates to the year of construction of the dwelling, renovations since 1991, main source of energy to heat the dwelling, isolation of the dwelling, overcrowding, availability of a garden, condition of the electric installation, of the inner and outer walls, the windows and the roof.

Green&Quiet’s use of subjective indicators of the living environment is innovative as well. The variables relate to individual’s perception of the buildings in the neighborhood, the cleanliness of the neighborhood, the air quality and the noise pollution. In addition, information is available on how respondents evaluate footpaths, bicycle tracks, streets, green spaces and public transport services in their neighborhoods.
**Indicators of socioeconomic position** are available in the 1991, 2001 and 2011 census at the individual (or household) level. The dataset provides the opportunity to measure different dimensions of socioeconomic position. Indicators for the following domains will be created: i) material wealth/deprivation (e.g. measured by means of house ownership); ii) educational attainment (e.g. highest level at the individual and/or household level); and iii) professional status (e.g. labour market status, including unemployed, disabled, housekeeper, (self-)employed; classification of occupations). Green&Quiet will also include **socioeconomic neighborhood characteristics**, computed by aggregating individual socioeconomic indicators available in the censuses at the statistical ward level. In addition, having information on socioeconomic factors at three points in time (1991, 2001 and 2011) will allow for studying the influence of patterns of change in socioeconomic composition of the population. At the level of statistical ward, it will allow for investigating processes of gentrification or degradation of the socioeconomic living environment.

**Socio-demographic indicators** in the censuses relate to age, gender, living arrangement, nationality of origin, migration history (during 1991 and 2014) and duration of residence over a period of 20 years (from 1991 to 2011).

**Health indicators** will be extracted from the census 2001 and the National Mortality Database. The 2001 census includes individual information on self-assessed health. Self-assessed health is measured using two variables widely available in population surveys: perceived health and functional limitations. **All-cause mortality** is available for all Belgians registered in the 1991, 2001 and 2011 census until 2015. **Cause-specific mortality** is defined through the WHO International Classification of Diseases, Tenth Revision codes (ICD-10) and is currently available until 2013. Based on literature, specific groups of causes will be selected. Previous studies observed associations between green spaces, air and noise pollution and specific groups of disorders that are very much linked to the potential explanatory pathways. Several studies reported positive associations with stress-related causes of death such as cardiorespiratory causes of death, mental diseases, suicide, drug abuse and also respiratory diseases and diabetes. The Green&Quiet project will focus on all-cause mortality and on relevant causes or cause groups of death (cardiovascular mortality, mortality related to neuropsychological disorders (including Alzheimer and dementia), suicide, diabetes, ...).

**Statistical analysis**

Central to WP2-WP4 are the interrelations between social stratifiers, living environment and health within an intersectionality perspective. The analysis will proceed step by step. First, we will investigate the association between outdoor environmental indicators and self-assessed health. To grasp the association between self-assessed health and each dimension of the outdoor living environment (green spaces, air and noise pollution), each of these dimensions will be introduced socioeconomic position arately in a bivariate multilevel logistic model for the three distinguished age groups. Second, the association of each of these dimensions with health will be controlled for one another in a multivariate model. Third, to introduce the intersectionality perspective, socioeconomic and socio-demographic indicators (gender, SOCIOECONOMIC POSITION and migrant background) will be added. Given the centrality of intersectionality in this project, interaction terms will be included between the environmental indicators and gender, socioeconomic position and migrant background. Moreover, analyses will be stratified by these social stratifiers in order to allow for a full interaction model. Finally, results will be controlled for macro socioeconomic and socio-demographic indicators.

In a second series of models, the project will focus on the impact of indoor pollution. These analyses will be built up following the same principles as the abovementioned analyses, first including socioeconomic position arately indicators of indoor pollution and subsequently integrating the intersectionality perspective.
These models will be repeated for all-cause mortality and for specific causes (or cause groups) of death using multilevel Poisson regression models. It is important to underline the advantages of the National Mortality Database in this respect, allowing for very detailed analysis by cause of death, socioeconomic and socio-demographic indicators as it includes the total population officially residing in the Brussels Capital Region. Moreover, causes of death information includes data on direct and underlying causes of death, allowing for the analysis of causes of diseases that are not often recorded as the direct cause of death, such as respiratory diseases, diabetes, neurodegenerative diseases such as Alzheimer or Parkinson diseases, etc.

A major limitation of most previous studies evaluating the relationship between living environment and health or mortality is the lack of information on the amount of time of exposure to the same living environment. In the Green&Quiet project, we will have information on the statistical ward where individuals have lived in 1991, 2001 and 2011. Therefore, we will be able to perform sensitivity analyses in a sub-population that has been exposed to the same living environment during 10 or 20 years, i.e. individuals who report living in the same statistical ward in 1991 and in 2001 and/or 2011. In addition, information of duration of residence can be controlled for as continuous information is available on migration behavior. Green&Quiet will thus provide a unique opportunity to evaluate the effects of the living environment in a population with (at least) 10 or even 20 years of exposure.

In order to dig deeper into and to better understand interaction effects between living environment and social stratification dimensions and their impact on health, WP5 will concentrate on the association between objective indicators of the outdoor living environment and the perception of this environment stratified by gender, socioeconomic position and migrant background through regression modelling. This will enable us to detect whether perceptions of environments depend upon the social stratifiers and in what sense. It will provide some clues about the underlying pathways of the health impact of environmental factors. To probe more profoundly into these mechanisms, WP6 and WP7 will carry out a qualitative study.

2. Qualitative analysis (WP6-WP7)

Population and design

The qualitative research will focus on the three age groups central to Green&Quiet: i) adolescents and young adults (aged 16 to 25); ii) adults in their working age (aged 26 to 64); and iii) the elderly (aged 65 and older). Within these broad age groups, specific sub-populations will be delimited according to the three axes of intersectionality: socioeconomic position, gender and migration background. Further refinements will be based on the results of the quantitative analyses and on information obtained from key stakeholders.

The design of the qualitative research will consist of four sub-tasks:

1. A realist literature review of international qualitative studies on the usage and perception of the living environment (including green spaces) and health
2. An inquiry of key stakeholders about the specificities in the Brussels context in terms of living environment and public (green) spaces
3. In-depth interviews with Brussels’ citizens on their perception, (non-)usage and preferences regarding their immediate living environment and near green spaces/recreational zones
4. Four concept mapping exercises around specific neighborhoods or recreational spaces, focusing on usage and future perspectives.
Methodology

Literature review
Green&Quiet will use a realist literature review to gain solid knowledge about the functioning of complex social processes implied in the interrelationships between social stratifiers, living environment and health. The use of the realist literature review method was first proposed in the context of health services research by Pawson et al. (2005) and has proven particularly well suited to inquire complex economic and social policy modalities. The realist review method consists of an explanatory analysis discerning what works for whom, in which circumstances, in what respects and how. Given the intersectionality approach of the Green&Quiet project, this is a very important and appropriate research method. Moreover, the realist literature review acknowledges the value of diverse kinds of evidence (e.g., scholarly articles, grey literature, interviews with key informants). Until recently, qualitative research in environmental epidemiology was very scarce. Given the fact that ecological associations between exposure to beneficial and harmful factors in the living environment are difficult to interpret and at constant risk of ruling out human agency, qualitative and mixed research designs saw light. Some of these studies found their way to peer-reviewed journals (e.g. Carter et al. 2014, Sheppard et al. 2012, Kessel et al. 2009, O’Campo et al. 2009), but many are probably reported in the grey literature. In line with the guidelines of a realist literature review, we will use different channels to obtain relevant publications: academic search engines (web of science, pubmed, etc.), non-academic internet search engines (e.g. google scholar), snowballing methods and inquiries among academic peers and actors in the field. Based on the information derived from the literature survey, we will map-out an overview of factors and mechanisms relating the living environment to health and mortality. Additionally, we will also map-out diversity among groups of actors based on their social characteristics: qualitative research has already served as a powerful tool for revealing such differences (de la Barrera et al. 2016, Woodgate et al. 2015). Insights from this review will further fine tune the methodology that will be used in subsequent phases.

Interviews with key stakeholders
Based on existing contacts with policy-makers (e.g. politicians and other representatives), academics, governmental organizations (e.g. Brussels Instituut voor Leefmillieu (BIM); the Brussels Capital Health and Social Observatory, ...) and actors/organizations in civil society (e.g. interest groups and think thanks, like BRAL), Green&Quiet will further delimit the specificities of the Brussels context in terms of living environment and public (green) spaces. More specifically, we will interrogate key stakeholders on specific obstacles and assets of the region regarding the availability of and access to green/recreational zones, environmental factors affecting the living environment of Brussels’ inhabitants and pressing policy issues. Furthermore, we will also inquire the stakeholders about specific neighborhoods and populations they perceive as particularly suitable to include in the subsequent research phase. Based on the provided information, we will select both problematic and good-practice situations and (sub-)populations to include in our in-depth interviews with citizens. The interview material will be recorded and verbatim transcribed; and subsequently thematically analyzed.

In-depth interviews with Brussels’ citizens
The in-depth semi-structured interviews will consist of open-ended questions, loosely related to a prepared topic list. In this stage of the qualitative research, Green&Quiet will concentrate on the narrative concerning the usage and perceptions of the living environment and perceived relations with health among a diversified group of purposefully selected respondents. The interviews and analyses will be done from a phenomenological perspective since we focus on the experiences and the opinions of the interviewees. The foundational question in phenomenology is “what is the meaning, structure and essence of the lived experience of this phenomenon for this person or group of people?” (Patton 2002). As a consequence, in phenomenology the focus lies on exploring how human beings make sense of experiences and transform experiences into consciousness, both individually and as a shared
meaning (Patton 2002). A phenomenological perspective thus pays attention to the perceptions and feelings of people associated with what they experience, not only to mere observations of the experience itself (Creswell 2007).

The in-depth interviews with a diverse, purposefully selected sample of respondents will serve three aims. i) First, we want to reveal users’ lived experience of their day-to-day living environments, green spaces and/or recreational zones in their proximity: for which ends do they use their living environment?; What do they particularly value in their living environment and what do they disapprove of?; ii) Second, we want them to reflect about pitfalls, obstacles and problems regarding the use of the immediate living environment and nearby green/recreational zones; and iii) Third, we want them to reflect about how characteristics of their immediate living environment and close by green/recreational zones affect their health and well-being.

To address these topics, the interview will be done starting from the perspective of a typical day during school/work times and/or during holidays/weekends (in case this distinction is relevant, based on the activity profile of the respondent). This will give the appearance of a natural conversation to the interview. The collected qualitative data will consist of verbatim transcripts of in-depth semi-structured interviews, which will be analysed using qualitative data analyses software. The coding tree will initially be inspired by the guiding interview topics, but emerging themes will of course be incorporated as well. This mixed deductive-inductive approach has proven to be useful in earlier studies conducted by our research team (Bosmans et al. 2016; Hardonk et al. 2010). As a means of validation, several researchers will code some randomly selected interviews. The coding trees and coded text fragments will be compared looking for a consensus in the interpretations and codes between the researchers (investigator triangulation) (Creswell 2007).

In order to ensure maximum variety in our sample and to attain sufficient respondents, we will use different recruitment channels. We will recruit in specific neighborhoods that will be selected on the basis of the interviews with key stakeholders in the previous phase. However, in each of the recruiting zones we will be attentive for the intersectionality perspective. This implies that we will strive for a maximum stratification alongside the lines of age (adolescents/young adults, working-aged adults/families and the elderly), gender, socioeconomic position and migration background in each of the selected neighborhoods. By doing so, we want to reveal potential differences in the narratives of these groups. Actual recruitment will occur through spontaneous encounters in the street/parks and neighborhood-based civil society organizations (for example cultural or recreational associations); and via snowballing sampling initiated by previously selected respondents. Saturation will be reached when for each of the selected neighborhoods our stratification roster will be filled. In total, we will select between six and eight neighborhoods.

**Concept mapping**

Concept mapping is a participatory qualitative research method that yields a conceptual framework for how a group views a particular topic (Burke et al. 2005). It uses inductive and structured group data collection processes, allowing for the collection of a wide range of participant-generated ideas and for the application of quantitative analytical tools (i.e. multidimensional scaling and hierarchical cluster analysis). Results from the quantitative analysis are used to produce illustrative cluster maps that depict relationships of ideas in the form of clusters. This method provides structure and objectivity to qualitative data. It has been underused by public health researchers interested in capturing the lived experiences of target populations and exploring risk factors and potential for policy interventions. Concept mapping is a process that traditionally involves six steps: preparation, generation, structuring, representation, interpretation and utilisation.

The main strengths of concept mapping are: i) it integrates several qualitative and quantitative methods into a single process. The use of different data collection and methods of analysis within a structured process permits the exploration of complex ideas during a relatively short time; ii) it starts
by generating specific, individually brainstormed items and ultimately aims for supported consensus within the group regarding these items, neutralizing as much as possible undesirable group dynamics; iii) the inclusion of participants in the interpretation and analyses of propositions and solutions constitutes action-based and community-supported research conclusions/policy recommendations.

The concept mapping in the Green&Quiet project will embark on policy options and solutions regarding specific, well-described locations. Assisted by our civil society partner (BRAL), and the knowledge gathered through the quantitative and qualitative analyses in this project, we will delimit up to four different locations for which we will initiate a collective reflection in the form of a concept mapping exercise. This approach has proven to be particularly fruitful regarding the field of living environmental and health/well-being in previous research in Toronto, Canada (O’Campo et al. 2009, Sheppard et al. 2012). Our concept mapping exercise will focus on two central questions: i) which factors have a positive or negative impact on the relation between the selected location and the health of its users/inhabitants?; ii) which changes should occur/measures should be taken to improve this situation? In each concept mapping exercise, we will engage a diverse group (alongside the above-specified criteria), living in/using the same location. In a first round, they will be asked to formulate their opinion on both focal questions; in a second round, they will be challenged to select and order the different opinions/factors formulated by their peers. This second round will strive for consensus-building among a socially diversified group about i) influential factors (beneficial or not) and ii) possible changes/policy measures. It is our intention to reach a widely-supported diagnosis of the situation and a set of policy recommendations with an immediate relevance towards local policy makers.

Valorisation

The valorisation of the Green&Quiet project will be based on three priorities. The first one focuses largely on an academic audience through the publication of papers in peer-reviewed national and international journals, and through the participation in national as well as international scientific conferences. As for publications, we will target highly ranked epidemiological and public-health-related journals. Furthermore, we plan to actively participate in national and international conferences for environmental and public health specialists, demographers, geographers and prevention advisors, such as the European Public Health Conference, the International Society of Environmental Epidemiology, the International Population Conference, the European Colloquium in Theoretical and Quantitative Geography, the Annual Conference of ERSA, etc. Additionally, it is our aim to integrate our research results within other European research projects on environmental health, establishing new working relationships. Finally, two PhD’s will result from the Green&Quiet project.

The second priority is to present our research results to policy makers. Since research on environmental-social health differences is relevant in ways that transcend a fundamental-research perspective, its wider implications are of great importance to health professionals and policymakers. There is solid evidence that health can be influenced by policies, not only policies of the health sector, but also by measures in other policy sectors. The conclusions of our research project will provide a sound basis for policy measures in the domains of urban planning and in the domains of health promotion. Green&Quiet will translate its quantitative and qualitative research output into accessible policy briefs and salutogenic interventions and policy recommendations that can be very useful at the local and neighborhood level. Research results will be presented to policy makers at different constitutional levels, to advisory bodies, to health promotion organizations, health observatories, etc. A clear added value can be expected from the ‘intersectionality perspective’ in Green&Quiet. It will permit to propose policy measures and preventive actions for targeted groups, taking different social classes, migrant communities, age groups and men and women, and their mutual interrelations into
account. It will advance a ‘intersectionality reflex’ among policy makers, making them reflect on the differential (and sometimes contradictory) health impact of environmental and living quality policies upon different social groups in society. This could make policies in this field more inclusive.

The third priority focuses on the wider public and society in general. As society has become more critical, diverse and multicultural, more attention is paid to themes regarding social inequalities, poverty and environmental health threats, also among print media. For this reason, we will regularly prepare short reports about our findings and communicate these to journalists or press agencies. At the beginning of the project the staff involved in the project will get science communication training. Depending on the needs, one or more of the following topics will be addressed: writing for a broad audience, using social media to communicate about research, writing press releases, etc. In this way researchers obtain skills in science communication and can get started themselves in blogging, social media and presentations. Key results will be further communicated to the general public through informative materials on the project website and by approaching sociocultural organizations in neighborhoods.

At the societal level, the distance to green areas, their accessibility, the characteristics of these areas, and the social environment have an impact in the use that society makes of green areas. Different choices in use of space influence the directions and magnitudes of the effects in health and mortality. Therefore, understanding the link between the living environment, socioeconomic factors and health/mortality is highly relevant. The translation of the research results to general population through the media or informative materials on websites, and by approaching civil society and sociocultural organizations will promote actions to improve health and life quality in relation to the use of green spaces and the living environment in general.

We will also establish an advisory board to support the Green&Quiet team by exchanging expertise, providing active feedback and suggesting new possibilities to valorize the research. The advisory board will be composed of experts from institutions at the local, regional as well as the national and international level. In order to facilitate the different kinds of wider valorization, we will not only include academics in our advisory board, but also public health professionals, policymakers, governmental departments and representatives from citizen’s societies. It is worthwhile mentioning in this respect that the ‘godfathers’ of the Green&Quiet project – the Brussels Instituut voor Leefmilieu (BIM), the Brussels Capital Health and Social Observatory and Citizens Action Brussels (BRAL) – will all be a member of the advisory board. The differentiated composition of the advisory board clearly reflects the diversity of the audience we intend to reach with our project. We aim to use their well-developed communication channels (their own websites, newsletters and activities) to disseminate the project’s research results.

At the start of the project, a project website will be constructed and regularly updated to disseminate the research results and project activities. The website will inform about our activities, our scientific papers and policy-relevant presentations at meetings. Finally, we will summarize our findings in an intermediary and final project report and arrange a final seminar for scientists, policy makers and health professionals at the end of the project.

References


- M. Q. Patton (2002), *Place Relations as a Possible Mechanism Behind the Relation Between Green Space and Health.* *Place Relations as a Possible Mechanism Behind the Relation Between Green Space and Health.*


- P. O’Campo, C. Salmon, J. Burke (2009), Neighbourhoods and mental well-being: What are the pathways?, *Health & Place*, vol. 15:56-68.


- R.L. Woodgate, O. Skarlato (2015), It is about being outside: Canadian youth’s perspectives of good health and the environment, *Health & Place*, vol. 31:100−110.