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The impact of social capital, land use, air pollution and noise on individual morbidity in Dutch neighbourhoods

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ABSTRACT

Background: Both social and physical neighbourhood factors may affect residents' health, but few studies have considered the combination of several exposures in relation to individual health status.
Aim: To assess a range of different potentially relevant physical and social environmental characteristics in a sample of small neighbourhoods in the Netherlands, to study their mutual correlations and to explore associations with morbidity of residents using routinely collected general practitioners' (GPs') data.
Methods: For 135 neighbourhoods in 43 Dutch municipalities, we could assess area-level social cohesion and collective efficacy using external questionnaire data, urbanisation, amount of greenspace and water areas, land use diversity, air pollution (particulate matter (PM) with a diameter < 10 μm (PM_{10}), PM < 2.5 μm ($PM_{2.5}$) and nitrogen dioxide (NO_2), and noise (from road traffic and from railways). Health data of the year 2013 from GPs were available for 4450 residents living in these 135 neighbourhoods, that were representative for the entire country. Morbidity of 10 relevant physical or mental health groupings was considered. Individual-level socio-economic information was obtained from Statistics Netherlands. Associations between neighbourhood exposures and individual morbidity were quantified using multilevel mixed effects logistic regression analyses, adjusted for sex, age (continuous), household income and socio-economic status (individual level) and municipality and neighbourhood (group level).
Results: Most physical exposures were strongly correlated with degree of urbanisation. Social cohesion and collective efficacy tended to be higher in less urbanised municipalities. Degree of urbanisation was associated with higher morbidity of all disease groupings. A higher social cohesion at the municipal level coincided with a lower prevalence of depression, migraine/severe headache and Medically Unexplained Physical Symptoms (MUPS). An increase in both natural and agricultural greenspace in the neighbourhood was weakly associated with less morbidity for all conditions. A high land use diversity was consistently associated with lower morbidities, in particular among non-occupationally active individuals.
Conclusion: A high diversity in land use of neighbourhoods may be beneficial for physical and mental health of the inhabitants. If confirmed, this may be incorporated into urban planning, in particular regarding the diversity of greenspace.

Abbreviations: BAG, base registrations addresses and buildings; EHR, electronic health record; ESCAPE, European study of cohorts for air pollution effects; GP, general practitioner; LGN, national land use Netherlands; PM, particulate matter; IQR, inter quartile range; LDEN, level day-evening-night; MUPS, medically unexplained physical symptoms; NIVEL, Netherlands Institute for Health Services Research; OR, odds ratio; PC5, five-digit postal code; PCD, primary care database; r_s, Spearman's correlation coefficient; SSND, study on the social networks of the Dutch

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1. Introduction

It is well established that the neighbourhood people live in affects their mental and physical health (Pemberton and Humphris, 2016). The neighbourhood – both in urban and rural areas – comprises a complex mixture of social and physical environmental factors. To date, the influence of these factors on health has typically been studied with a focus on physical or social neighbourhood exposure. For example, research projects have addressed adverse health effects of air pollution (Dimakopoulou et al., 2014), noise (Ising and Kruppa, 2004) or the combination of both (Foraster et al., 2014); others addressed beneficial health effects of greenspace (Hartig et al., 2014), blue spaces (White et al., 2013) or both (Gascon et al., 2015). Other studies have focused on social environments such as social capital (Mohnen et al., 2011; Murayama et al., 2012), social safety (Lovasi et al., 2014) or their interaction (Ruijsbroek et al., 2015). Very few epidemiological studies considered the combination of several physical and social factors (Dzhambov et al., 2018; Groenewegen et al., 2018). This is important since these factors are likely correlated, partly through individual and/or neighbourhood socio-economic status and urbanisation.

A more integrated approach of different social and physical environmental factors in relation to health also helps a proper investigation of the mechanisms of beneficial or adverse health effects of certain factors. For example, several mechanisms have been put forward to explain the observed beneficial effects of greenspace. One of the mechanisms is that more (accessible) greenspace in the neighbourhood enhances social contacts (Hartig et al., 2014), which in turn is positively associated with health (Murayama et al., 2012). However, to date few studies have been able to address this in detail.

The aim of this study was to assess a range of different potentially relevant physical and social environmental characteristics in a representative sample of small neighbourhoods in the Netherlands, to study their mutual correlations and to explore associations with morbidity using routinely collected general practitioners' (GPs') data. Greenspace comprises a complex environmental factor that is currently given much attention in both research and policy making. In our study we considered amount and general type of greenspace in neighbourhoods, as well as the overall land use diversity. We controlled for individual socio-economic status, a potential confounder in the relationship between several social and physical neighbourhood factors and individual health status. Consequently, our research question is to what extent are physical and social aspects of the residential environment associated with GP assessed morbidity in neighbourhoods in the Netherlands? In this exploratory analysis we considered various factors that are relevant from both a scientific and an urban planning point of view, and for which data were available in our setting. This included air pollution, noise, greenspace, land use diversity, social cohesion and collective efficacy.

2. Methods

2.1. Selection of neighbourhoods and study population

The definition of neighbourhood in this study is an area containing residential addresses with the same five-digit postal code (PC5) in the Netherlands. The country consists of in total 32,500 PC5 neighbourhoods within approximately 400 municipalities. A PC5 area typically consists of a few streets, most of them of a surface area of $< 1\ km^2$ with on average 500 inhabitants. However, both area surface and population show a large variation across PC5 neighbourhoods, depending e.g. on urbanisation.

This study is based on individual data from registered patients of Dutch GPs who were living in 2013 in one of the 181 PC5 areas in the Netherlands that were sampling units of the Study on the Social Networks of the Dutch (SSND) (Mollenhorst et al., 2014). The GPs in this study participated in the NIVEL Primary Care Database (Verheij, 2014). The data sources and flows are summarised in Fig. 1 and are elaborated below. The eventual study population with all data available included 4450 participants (Fig. 1) that were representative for the entire country.

2.1.1. Study on the social networks of the Dutch

The overall aims and methods of the longitudinal SSND have been described elsewhere (Mollenhorst et al., 2014). Briefly, a stratified random sample was drawn from 40 Dutch municipalities, representing the various provinces and regions, taking into account the degree of urbanisation and number of residents in these municipalities. In each of these 40 municipalities, four neighbourhoods were randomly selected using the postal code system. Next, per neighbourhood, 25 addresses were randomly selected. At eight of these addresses, the resident between 18 and 65 years of age who had his or her birthday first (counting from the date of the interview) was interviewed in 1999/2000. Follow-up studies in 2006/2007 and 2013/2014 included interviews in the same and new individuals (related to loss to follow-up), while in the last follow-up 20 additional socially disadvantaged neighbourhoods (from 8 municipalities) were added. For the purpose of the present analysis, 181

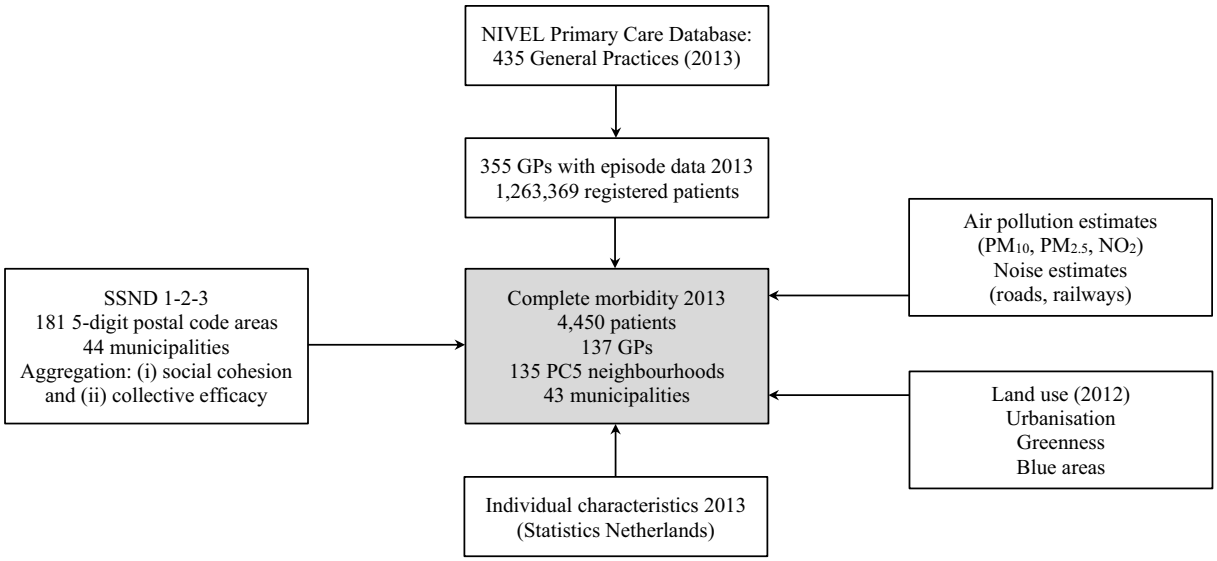

Fig. 1. Overview of data sources and flow of study subjects.