Area Environment and Health in the Netherlands

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Chapter 1

General introduction

Geographical differences in health are becoming an increasingly important theme in the field of public health. Studies focusing on health differences between countries, or regions within countries, or even at a smaller geographical scale, provide evidence for geographical variations in health. The unequal distribution of health across geographical areas implies that where one lives does matter to health. The studies in this thesis aim to contribute to this discussion by focusing on the area environment and its relation to health at the small geographical scale.

This introduction starts with a brief historical description of the role of place of residence in public health, followed by an explanation for observed geographical health patterns. We then elaborate on the mechanisms that might explain how the area environment can influence health. Next, five area features - which are the focus of this thesis - and their possible relation to health are discussed. Finally, we present an outline of this thesis with a brief summary of the individual chapters.

1.1 Place and health: a brief history

The idea that place matters to health existed in ancient times when Hippocrates stated that the study of medicine should consider the effects of season, winds, water, ground, as well as the life and lifestyle of individuals[1]. These ideas formed the epidemiological reference for more than two thousand years.

In the 19th century the industrial revolution and rapid urbanisation boosted the development of quantitative epidemiology[2,3]. The rise of urban slums with poorly constructed houses lacking adequate ventilation, light or sewerage accelerated the spread of epidemic diseases. These health problems resulted in an interest for spatial health patterns and the first disease maps were produced. Medical geography concerned with the spatial features of health and health-related topics flourished. Two types of geographical studies were generally used, namely comparative studies and comprehensive studies. Comparative studies described differences in mortality and morbidity across a large number of geographical areas. Comprehensive studies used a standard protocol measuring several features of a single city or region that could be relevant for the state of health[1]. The health statistics resulting from these

studies showed the toll of sickness and deaths in the city slums[3]. Sanitary reformers argued that society should be concerned about the conditions in the city slums because the increased risk of diseases led to economic losses[2]. A sick worker resulted in a loss of productive labour and a dead male worker added a widow and her children to the relief rolls. Closed drainage and sewage systems, supplemented by garbage collection, public baths and improved housing were realised to enhance public health[2,3].

Advances in microbiology brought an end to the environmental view of diseases, and theories on specific disease models in which single agents relating to single diseases dominated the scene[2,3]. One of the founding works preceding this era was a map created by John Snow illustrating the cholera outbreak in 1854 in the Soho area of London (UK)[1]. Although an environmental view of diseases prevailed in the creation of the map, John Snow referred to a microbiological origin of the cause of the disease. The increased knowledge on bacteriology gave a simple and scientific explanation for communicable diseases and this narrow laboratory perspective diminished the interest in epidemiology of populations and environmental exposure[3].

After the Second World War, epidemics became controlled in developed countries and as a consequence the interest in communicable diseases diminished. The rise in mortality rates caused by chronic diseases challenged epidemiologists to examine possible risk factor for these diseases[3]. Initially, the place of residence was not considered to be an important risk factor for chronic diseases. The possible reasons for this include fear of falling prey to the ecological fallacy, the availability of large datasets with individual information, a dominant methodological, conceptual and political individualism, and the fact that much of the public health research was performed outside the field of geography[4]. As a reaction to the dominant methodological and theoretical individualism, researchers emphasized the possible role of place effects in public health research. This resulted in increasing interest in the area environment and its possible impact on health[4,5].

1.2 Explaining geographical health patterns

Attempts to understand spatial health patterns at a small geographical scale resulted in a discussion about the influence of composition and context[6]. The observed health differences between areas can be the result of differences between the populations living in these areas (compositional explanation) or the area characteristics (contextual explanation). A compositional explanation indicates that geographical health patterns are the result of similar people (in terms of personal characteristics related to health) clustering together. This clustering might stem either from personal choice, for instance a common culture, or lack of choice because of low financial resources. An implication of this compositional explanation is that poorer unhealthy people will be in poorer health wherever they live[6].
A contextual explanation centers on the health effects of the characteristics of places themselves[6]. Characteristics of places might be beneficial or detrimental to health and can thus contribute to the spatial health patterns observed in most countries. In contrast to compositional effects, contextual effects imply that similar types of people can be expected to achieve very different levels of health depending upon where they live[6].

Although most reports on area influences on health make a clear distinction between compositional and contextual effects, the separation of these effects is in fact complicated because both composition and context can change over time and can interact with each other. Several processes influence the settlement of people across places. As stated by Macintyre and Ellaway (2003): “people create places, and places create people”[7]. The choice for place of residence is shaped through many personal restrictions or desires such as financial resources, proximity to work, cultural background, reputation of an area, services provided in the area, etc. In addition, places are not static and both their contextual and their compositional characteristics change over time. Historical, political, economical, and societal processes at a national level influence the formation of places. For instance, Limburg (a province in the south of the Netherlands) was formerly a mining area attracting lower-educated manual workers. Although mining activities now belong to the past, the presence of this labour group in the Limburg population is still apparent in public health statistics

through, for example, the relatively high number of respiratory health problems related to the former working conditions of this group of workers.

1.3 Processes behind area effects on health

Although it is generally accepted that place of residence matters to health, theories on how these health effects are produced are scarce[8]. Three ecological effects are proposed to explain how features in the area environment might be related to health[9]. First of all, area features can have a direct effect on health. For instance, loud noise directly causes hearing damage[10] and particular substances in the air immediately affect a person's respiratory system[10-15]. Secondly, area features may modify the relationship between individual characteristics and health. For instance, black people residing in areas with high percentages of black people fare better in terms of health than black people residing in areas with high percentages of white people[16-18] In other words, in this case the concentration of black people in an area modifies the relation between race and health. Finally, area features might indirectly affect health by changing individual characteristics by means of, for example, an area promoting healthy or preventing unhealthy behaviour. For instance, safe and attractive playgrounds may stimulate children to be physically active thereby also preventing overweight and its related health risks.

1.4 Evidence for relation between area environment and health

Five features of the area environment are the focus of this thesis, namely area deprivation, urbanisation, area demographic composition, community social capital and the presence of social nuisance within areas. Area deprivation and urbanisation are two more general environmental features, often investigated in the international literature, and may provide a first indication of whether living in a certain area could be related to the health of people living in the Netherlands. After analyses of these general features, and also based on the results of these analyses, we decided to focus further analyses on three more specific social features of the area environment: demographic composition, community social capital, and presence of social

nuisance. Research on these social environmental factors was warranted because evidence of previous, mostly foreign studies on their health impact was either scarce or contradictory. Earlier international and national studies on these five area features, and their relation to health, are discussed below.

Area deprivation

Area deprivation was one of the first features of the area environment considered to be a determinant of health. Researchers suggested that living in a deprived area could lead to poorer health. Although many earlier studies provided evidence for a negative association between area deprivation and health, few considered the possible confounding effect of individual socio-economic status. Therefore, the observed detrimental health effect of area deprivation was probably overestimated as lower socio-economic groups, who have poorer health outcomes, more often reside in deprived areas. More recent studies that took this individual confounder into account, supported the previously assumed detrimental effect for a series of health outcomes such as all-cause and cause-specific mortality[8,19-29], morbidity[26,30-34], poor psychological health[35-37], poor self-reported health[38,39] and unhealthy behaviours[26,40-42].

Deprived areas are generally characterised by an inferior physical, social and service environment, which may mediate the health effects of area deprivation[26,27,43-49]. This inferior environment might, either directly or indirectly affect the health of the residents living in such environments. For instance, proximity to polluting factories and toxic waste sites may increase a person's risk for several diseases such as respiratory diseases and some specific cancer types.

Indirectly, the fewer and less well accessible services and facilities restrict residents from benefitting from such opportunities[6,48]. For instance, lack of gyms or open spaces can cause people to be less active, and fewer grocery stores can result in eating less vegetables and fruits. In the public opinion, the Netherlands is considered to be a relatively egalitarian country where public goods are equally distributed across the country. However, physical environmental conditions related to air, noise, and external safety were observed to be worse in lower compared to higher income areas[50,51]. In addition, positive environmental features (environmental 'goods') such

as the availability of public green spaces, were more often present in higher than lower income areas[50]. This unequal distribution of negative and positive area features across areas in the Netherlands might be the underlying reason for the observed independent health effect of area deprivation.

In the Netherlands, also poorer health outcomes were found among residents living in more deprived areas when differences between the area populations were accounted for. Mortality rates and the prevalence of unhealthy behaviours were found to be higher in deprived compared to less deprived areas in the Netherlands[52-57]. For self-rated health, there were contradictory results showing that residents of deprived areas more often reported poor to fair health[56] whereas others found no indications for a relation between area deprivation and health[58].

Urbanisation

Living in an urban environment is also thought to be detrimental for health. Determining a possible health effect is important since many people live in cities. International studies focusing on urban-rural health patterns indeed found that residents of urban areas had worse health outcomes than rural residents. These findings were observed for a number of health outcomes such as all-cause and cause-specific mortality[59-73], morbidity[64-66,69,74,75], as well as for more subjective health outcomes[76-78]. The majority of these studies did not take into account the possible differences in personal characteristics between urban and rural populations. Since urban areas more often contain groups with higher risks for poorer health such as singles and individuals with lower socio-economic status[79] the observed urban-rural health differences might still be explained by these population differences.

There may also be a contextual effect, because the urban environment is often reported to be inferior to the rural environment in terms of physical environment, e.g. higher levels of air and noise pollution. In addition, loneliness is thought to be greater among urban than rural residents[80] and this loss of social support may lead to more health problems (especially psychological) among the urban population[81-84]. On the other hand, cities provide more services such as an extensive public transportation system, choice of medical centres, etc. The more (negative) specific features in the

urban environment can either directly or indirectly be responsible for the observed detrimental health effect.

The few Dutch studies focusing on urban-rural health differences indicate that mortality rates and prevalence of chronic conditions are higher in the more urban areas[55,70,85] and that an increasing degree of urbanisation leads to an increasing number of people reporting poor to fair self-rated health[85]. Although a negative association was observed, insufficient adjustments for individual socio-economic differences between urban and rural residents could be a reason for this association.

Area demographic composition

In theory, one's health might be influenced by the demographic make-up of the area. However, contextual effects of area population composition are seldom investigated in geographical health studies. Only in the US attention is paid to the health impact of what is called 'racial segregation'. These studies investigated the health differences of blacks and whites living in predominately black or white neighbourhoods, respectively. The results indicated that the dominant ethnic group in an area experienced better health outcomes compared to members of the same ethnic group residing in areas where they were a minority[16-18,86]. In this thesis, not only the ethnic composition but also the composition according to sex, age and marital status is investigated. Very few studies have addressed the possible health impact of living in areas with either high or low proportions of men or women, certain age groups, or singles or married persons. In the US higher mortality rates were observed in neighbourhoods with higher proportions of elderly[87]. In contrast, no relation between the proportion of elderly in the area and mortality was found in Helsinki[25].

The assumption that living in neighbourhoods with a certain demographic composition might be related to health stems from the idea that social interactions known to be related to health[81] are strengthened or weakened in the presence of others that are different in terms of life stage or social position. Different social theories elaborate on the effect of diversity on social interaction[88,89]. The conflict theory proposes that diversity fosters out-group distrust and in-group solidarity[90-92]. This implies that people with different backgrounds brought together (e.g. in a neighbourhood) will stick to 'their own' while the 'other' will be distrusted. In contrast,

the contact theory proposes that if people are more often brought into contact with people who are unlike, the initial hesitation and ignorance will be overcome and replaced by some degree of trust and out-group solidarity[93]. Finally, the constrict theory posits that diversity might lead to a reduction in both in-group and out-group solidarity[88,89]. This means that besides the diminished trust in 'others', trust in people like themselves is diminished as well.

Until now these theories have only been tested with regards to ethnic diversity, with most studies reporting that ethnic diversity in neighbourhoods led to a decrease of social cohesion in neighbourhoods in the US[89]. In the Netherlands, ethnically diverse neighbourhoods showed some reduction in social cohesion but not for all measures[88,94-96]. The potential influence of proportions of other population groups in the neighbourhood (such as singles or elderly) on social cohesion is unclear. A high proportion of elderly in the neighbourhood might foster social contacts between neighbourhood residents as this group spends more daily life time in the neighbourhood. On the other hand, the poorer health status of elderly makes them less mobile, probably reducing contacts between neighbourhood residents[97].

The effects on health are even more speculative. Only a few small-area studies in the Netherlands, but nowhere else in Europe, have examined contextual effects of population composition on population health. An earlier Dutch study found a 16% increased mortality risk in areas with high percentages of migrants[70]. The incidence of psychotic disorders was found to be elevated among migrants living in neighbourhoods where their own ethnic group comprised a small proportion of the area population[98].

Community social capital

The concept of community social capital had a variety of definitions. The definition most often used in public health is that of Putnam, who defines social capital as those features of social structures (such as levels of interpersonal trust and norms of reciprocity and mutual aid), which act as resources for individuals and facilitate collective action[99].

There is extensive literature focusing on the relation between community social capital and health, with an equally large amount of studies finding a beneficial

effect[25,100-116] or finding no effect[100,101,106,108,109,117-124]. These contradictory findings on the relationship between community social capital and health might be related to the diversity in indicators used to embody the concept of social capital[125-127].

Community social capital is thought to be indirectly related to health through various factors[126]. First of all, the existing social norm and control in the area prevent people from engaging in unhealthy behaviour[46,126]. Collective efficacy induced by social interactions is thought to maintain services and amenities in the area, also affecting area reputation and probably health outcomes[126,128]. Finally, social support from neighbours may also produce beneficial health effects since it can act as a source of self-esteem preventing especially psychological health problems[129].

In the Netherlands, the health effects produced by community social capital are unclear. General and psychological well-being were observed to be better among children living in neighbourhoods with high levels of informal social control, social cohesion and trust[130], but when examined longitudinally these effects disappeared[119]. In addition, no relation was found between community social capital and use of mental health services[131,132]. For adults, living in communities with high levels of community social capital resulted in better scores for quality of life[133].

Social nuisance

Social nuisance relates to the more negative social features in an area environment. One can think of items such as violence, crime, litter, graffiti, but also nuisance from neighbours, drug abuse, or youngsters loitering. The presence of social nuisance within areas is most often investigated in relation to mental health. Residents who reported a lot of nuisance within their area environment more often suffered from mental health problems[45,134-140]. A similar relation was also observed for self-reported health[45,141-146], but the evidence was less abundant.

The relation between social nuisance and health is suggested to be mediated by stress[142] but direct health effects are also possible, such as physical injuries caused by violence. Stress is known to be related to a number of health outcomes such as high blood pressure, psychological health problems and a number of other

diseases[142]. In addition, nuisance from violence and crime may also discourage area residents from engaging in healthy lifestyles such as physical activity.

Again, little evidence is available on the possible health effects produced by the presence of social nuisance within areas in Dutch society. Elevated blood pressure levels were observed among residents reporting different forms of social nuisance within their area[147]. Smoking and physical inactivity rates were also higher in neighbourhoods characterised by physical decay, police attention, and noise pollution [53,54].

1.5 This thesis

Objectives of this thesis

General research on the relation between place and health is increasing and the evidence for health effects produced by features of the area environment is increasing. In the Netherlands, however, this evidence is still scarce; therefore, the main objective of this thesis is to identify features of the area environment that are related to health. Five area features are discussed, area deprivation, urbanisation, area demographic composition, community social capital, and the presence of social nuisance within areas. Because the work in this thesis focuses more on the social environment, these five features are further referred to as 'social' ones. Although area deprivation and urbanisation are more general concepts representing not only the social but also the physical and service environment in the area, social processes might underlie the produced health effects. Since these social features are thought to operate on a local scale, small areas are used as the geographical unit.

The following research questions are examined:

1. Which social features of the area environment are related to health at the smaller geographical scale in the Netherlands?

2. Do these associations between social features of the area environment and health persist when differences in population composition across small areas in the Netherlands are taken into account?

3. Do these associations between social features of the area environment and health vary between different demographic subpopulations living in small areas?

The first research question aims to provide an answer to the question whether or not where one lives matters with regards to health. It is a preliminary exploration in which only sex and age differences between the areas are taken into account. In many epidemiologic papers, sex and age-adjusted outcomes are used as a starting point.

The second research question aims to determine whether the social features of the area environment are independently related to health, as the observed relation between social environment and health might be explained by existing differences in personal characteristics of the area populations. For instance, poorer health outcomes in deprived areas could solely be caused by the poorer health status of lower socio-economic groups that more often reside in such areas. Besides sex and age, differences in marital status, ethnicity and socio-economic status between the area populations are also taken into account.

The last research question suggests that people react differently towards their area environment. Reasons for these different reactions might be the time spent in, or need for, or appreciation of (certain features in) the area environment. Answers to this last question might provide suggestions related to possible mechanisms between area environment and health. This possible diversity in associations is examined for urbanisation and community social capital.

Data used for this thesis

Two national datasets and three local datasets are used in this thesis. The first national dataset describes spatial health patterns related to area deprivation. This dataset includes information on area deprivation, urbanisation level, area demographic composition, mortality and hospitalisation records. This dataset only provides sex and age-standardised health outcomes and therefore corrections for differences in area population composition are minimal. Data on hospitalisation are provided by Prismant and all other data are provided by Statistics Netherlands (CBS). Information is available at the postal code level. In the Netherlands there are about 4,050 postal code areas which, on average, contain about 4,000 residents per postal code.

In the second national dataset individual information on mortality by sex, age, marital status and ethnicity is linked with neighbourhood data on deprivation, urbanisation, area demographic composition and community social capital, provided by CBS and originally gathered by the Ministry of Housing, Spatial Planning and the Environment. The detailed information at the individual level allows us to make proper adjustments for the mortality differences related to differences in area population composition. In comparison to postal code areas, neighbourhoods are smaller and more homogeneous in terms of socio-economic status of the residents. In the Netherland, neighbourhoods contain on average 1,500 residents and there are about 10,400 neighbourhoods.

The local datasets are provided by the municipal health services and a research department (located in Amsterdam) and include information from three surveys carried out in the capital city, Amsterdam. The Amsterdam Health Survey includes individual information on demographics, socio-economic status, evaluations of the neighbourhood environment, self-rated health, and psychological health. The Amsterdam Living and Security Survey provides information on the perceived safety and security situation of the Amsterdam general population. The Social State of Amsterdam City Survey provides information on living conditions, prosperity, and social, cultural and political participation. In the analyses, neighbourhoods are chosen as the geographical unit.

Outline of this thesis

After this introductory chapter, the five social features of the area environment and their relation to health are examined in chapters 2 to 8. All these chapters provide information to address research questions 1 and 2, focusing on the association between social features of the area environment and health with and without controlling for population composition. Findings from chapters 3, 5 and 6 are used to address research question 3, on the association between social features of the area environment and health when different demographic subpopulations are examined. A brief summary of each chapter is presented below.

Chapter 2 describes the existing spatial health patterns in the Netherlands at the detailed geographical scale and examines if these patterns are related to area deprivation, urbanisation level, or area demographic composition when controlling only for sex and age differences between the areas. Chapter 3 examines the association between living in an urban environment and mortality both with and without controlling for population compositional differences between the areas. The association between urbanisation and mortality is also examined among different population groups. Chapter 4 discusses the mortality impact of living in a neighbourhood with low or high proportions of specific population groups in terms of age, sex, marital status and ethnicity, after adjustments for health effects of these same demographic characteristics at the individual level. Chapter 5 investigates the association between community social capital and mortality for the total area population and for different subpopulations. Chapter 6 examines the relation between community social capital and suicide in both total and different subpopulations. Chapter 7 examines individual as well as aggregated evaluations of community social capital indicators (such as trust) and their relation with mental health and depression. Finally, chapter 8 explores the relation between different forms of social nuisance within neighbourhoods (crime, nuisance from neighbours, drug abuse, youngsters loitering, garbage on the streets, feeling unsafe and dissatisfaction about quality of green space) and self-rated health. Besides the above-mentioned social features, chapters 7 and 8 also examine a limited number of features of the physical environment. Finally, chapter 9 summarises and discusses the results of chapters 2 through 8 and presents implications for future policy and research. Chapter 9 also presents some additional results on the relation between area deprivation and

mortality (with adjustment for population composition) and on the contribution of compositional and contextual variables in explaining the existing geographical mortality patterns in the Netherlands.

Chapter 2

Exceptions to the rule: healthy deprived areas and unhealthy wealthy areas

Based on:

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Exceptions to the rule: healthy deprived areas and unhealthy wealthy areas

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Abstract

Background

In general, inhabitants of low socio-economic areas are unhealthier than inhabitants of high socio-economic areas, but some areas are an exception to this rule. These exceptions imply that other factors besides the socio-economic level of an area contribute to the health of the inhabitants of an area, e.g. environmental factors.

Methods

In our study we concentrate on areas within the Netherlands that are healthier or unhealthier than could be expected based on their socio-economic level. This study first identifies these areas and secondly determines which area characteristics distinguish these areas from those areas where the level of health is in agreement with their socio-economic level. We used nation-wide data on neighbourhood differences in population composition (gender, age, marital status and ethnicity), urbanisation and two health indicators: mortality and hospitalisation rates.

Results

In the Netherlands, many areas are healthier or unhealthier than could be expected based on their income level alone. Areas with higher mortality rates than expected are mainly urban areas with high percentages of elderly people and persons living alone. Similar but opposite associations are observed for areas with lower mortality rates than expected, which are further characterised by a low percentage of non-western immigrants. Areas with lower hospitalisation rates than expected are mainly rural areas with few non-western immigrants.

Conclusion

We conclude that urbanisation and residential segregation based on age, ethnicity and marital status might be important contributors to geographical health inequalities.

2.1 Introduction

Individuals with a lower socio-economic status (SES) have higher risks for both morbidity as well as mortality in comparison with individuals with a higher SES[148-150]. Not only at the individual level but also at the area level, socio-economic differences in health are found. These differences in health may be due to differences in population composition or differences in living environment[6]. Lower socio-economic areas have worse health outcomes than higher socio-economic areas, even when differences in population composition are taken into account[25,26,30,31,52]. In contrast, some other studies concluded that area socio-economic level had no independent effect on mortality over and above the effect of individual SES[32,151].

Explanatory studies of this relationship between area deprivation and health have been carried out in the past years. The influence of urbanisation on health is one of the emerging themes. Urban residents and remote rural residents experience generally higher morbidity and mortality rates than rural residents, thus suggesting an U-shape associations between urbanisation and health[59,64,70,71,152]. The physical environment of urban areas could be more harmful than that of rural areas because of higher levels of air and noise pollution, which may have an adverse effect on the health of urban residents[10,153,154]. Also availability of green space is lower in urban compared to rural areas, which could indirectly affect health through health-related behaviours, such as less physical activity[153,155]. The health of residents of remote rural areas might be negatively influenced by the low availability of certain services like health care. Area characteristics such as high air and noise pollution and little green space may also be found in areas with a high concentration of industries and enterprises. Therefore in these areas similar negative health outcomes might be anticipated. Mitchell et al. (2000) indeed reported that inhabitants of highly industrialised areas were more likely to report ill health than inhabitants of less industrialised areas[156].

Another emerging theme is the influence of residential segregation on health. Segregation refers to the spatial separation of two or more population groups. Population groups can become segregated along racial/ethnic, social class, marital status, sex or age lines[16]. Residential segregation based on race has been the focus

of many studies in the US. Findings indicate that the dominant ethnic group in segregated areas experience superior health outcomes compared to members of the minority group in their community and also compared to members of the same ethnic group residing elsewhere[17,18,86]. A theory on racial residential segregation proposed that social processes associated with ethnicity sort individuals of comparable SES into vastly different neighbourhood environments[16]. In the US, African Americans live in communities that are inferior to those of whites in terms of economic resources, institutions that support community life, and opportunity structures[157-161]. These features are all directly or indirectly related to health. Other aspects of population composition are also important for health. Elevated levels of age-standardised mortality were found in areas with higher proportions of people over 60-year-olds[25,87] and people without a partner[25]. Areas with a concentration of single person households, unmarried people and high population turnover had also higher levels of suicide mortality[162-166].

In contrast to most other studies, which use a regression approach to determine systematic associations between health outcomes and socio-economic or other variables, our study focuses on exceptions to the rule that low socio-economic areas show worse health outcomes than high socio-economic areas. The existence of low socio-economic areas with low morbidity and mortality rates (healthy deprived areas) and high socio-economic areas with high morbidity and mortality rates (unhealthy wealthy areas) would suggest that other area characteristics than socio-economic factors might influence health. In this study, we first identify these exceptional areas and then we determine the area characteristics that distinguish these exceptions from areas where levels of health agree with their socio-economic levels. In this study, we investigate the relationship of population composition (gender, age, marital status and ethnicity) and measures of the general physical setting (urbanisation, and concentration of enterprises), with both mortality and hospitalisation rates. Hospitalisation is included as a health indicator because in the Netherlands the availability and the accessibility of health care is high everywhere[167], and therefore area differences in hospitalisation may reflect differences in need rather than in access. Our analyses are based on nation-wide data, which showed higher variation in demographic, socio-economic and geographic characteristics across all included areas.

2.2 Methods

Data

All death records of the Dutch population between 1997 and 2001 were provided by Statistics Netherlands (CBS). Hospital admission data from 1998 until 2000 originated from the National Medical registration (LMR) kept by Prismant. The LMR covers all hospitals in the Netherlands, except for one cancer hospital. There was no information on the duration of stay in the hospital; each hospital admission of the same person was counted separately.

Areas were identified using 4-digit postal codes, which are based on the geographical division made by the postal service. Every year CBS collects information on socio-economic level, population composition, urbanisation and concentration of industrial and commercial enterprises of all postal code areas in the Netherlands. We used information for the year 1999 because this was the median year for both the mortality (1997–2001) and hospital admission records (1998–2000). In 1999, the Netherlands consisted out of 4050 postal code areas with 15,847,010 inhabitants. A postal code area contained on average 4000 inhabitants.

Six socio-economic indicators were available: (1) mean income per inhabitant, calculated as the sum of the total yearly income after tax of every inhabitant divided by the total number of inhabitants, (2) mean income per income recipient, including only inhabitants with an income for 52 weeks per year in the denominator, (3) percentage inhabitants with a high income, i.e. in the upper quintile of the national income distribution (>€20,828), (4) percentage inhabitants with a low income, i.e. in the lower two quartiles of the national income distribution (<€12,025), (5) percentage inhabitants entitled to a benefit, i.e. persons aged 15–64 years with a social benefit as most important source of income and (6) mean real-estate value of the houses in the postal code area. No information was available on mean educational or occupational level of inhabitants of an area. Some studies suggested that education or occupation may be less appropriate measures of the socio-economic level of an area than income[168-170].

Measures of population composition included (1) percentage inhabitants in the age groups 0–14, 15–24, 25–44, 45–64 or 65 years and older, (2) percentage non-western immigrants (inhabitants of whom at least one parent or the person in question was born in a non-western country or continent including Turkey, Africa, Latin America and Asia[171]) and (3) percentage persons living alone. Degree of urbanisation was measured by the population density measured as the number of private addresses per square kilometre. Concentration of enterprises included (1) number of all types of businesses (except for agricultural and fishing companies, and health services), (2) percentage of manufacturing industries, calculated in relation to the total number of businesses, (3) percentage of commercial businesses, calculated in relation to the total number of businesses and (4) percentage of non-commercial businesses.

Postal code areas with 1000 inhabitants or less (N=1348) were excluded from the analyses to reduce mortality and hospitalisation rate instability. This implies that the analyses excluded deeply rural areas, which are however rare in the Netherlands since this country is small and densely populated. We did not aggregate these small areas because this would require arbitrary decisions as to which areas should be combined. The heterogeneity within these combined rural postal code areas would also attenuate relations between area characteristics and health outcomes. Especially in the north of the Netherlands, the more rural part of the country, postal code areas were excluded from the analyses. In addition, 728 postal code areas were excluded because of missing data on hospitalisation. This resulted in a dataset of 1974 postal code areas (49%) that covered 75% of the Dutch population.

A comparison of area characteristics, mortality and hospitalisation data of the postal code areas included in the analyses and of all postal code areas in the Netherlands is presented in Table 1. Postal code areas included in the analyses showed a higher percentage of persons living alone, a higher population density and a higher number of inhabitants. The exclusion of smaller rural areas did not introduce a selection bias with regard to socio-economic characteristics.

Table 2.1: Descriptive statistics of area and health characteristics of the postal code areas included in the analyses and the total number of postal code areas in the Netherlands

	Postal code areas included in the analyses (N = 1974)		**All postal code areas in the Netherlands (N = 4050)**	
	Mean	(std)[a]	Mean	(std)[a]
Population composition				
Number of inhabitants	5992	(3767)	3971	(3951)
% inhabitants aged 0-14 year	18.38	(4.14)	19.14	(4.36)
% inhabitants aged 65 and older	14.12	(5.77)	13.18	(5.64)
% non-Western immigrants	6.56	(9.17)	6.55	(9.58)
% persons living alone	22.13	(11.52)	19.94	(10.93)
Urbanisation				
Population density	1291	(1395)	903	(1282)
Concentration enterprises				
Number of all types of businesses	5.18	(1.18)	4.14	(1.82)
Area socio-economic level				
Mean income per inhabitant (€)	10032	(1397)	9853	(1443)
Mean income per income recipient (€)	15178	(1923)	15105	(1949)
% low-income inhabitants	40.06	(6.33)	39.88	(6.94)
% high-income inhabitants	20.61	(7.38)	20.95	(7.44)
% inhabitants entitled to a benefit	17.10	(7.25)	16.89	(7.61)
Mean real-estate value (€)	85531	(28834)	86386	(29205)
Health				
Absolute number of deaths	280	(236)	173	(215)
Standardised mortality[b]	8.01	(1.79)	7.12	(2.71)
Absolute number of hospital admissions	1594	(1047)	1267	(1109)
Standardised hospitalisation rate[b]	8.77	(1.16)	8.63	(1.80)

[a] Std = standard deviation

[b] Rate per 100 persons

Data analysis

Mortality and hospitalisation rates were directly standardised for gender and age using 5-year age groups, except for the age groups 'less than 1 year' and '95 years and older'.

We first calculated the expected health outcome for each area based on percentage high-income inhabitants using linear regression analyses, since both mortality and hospitalisation rates were normally distributed (Table 1). The linear regression models were weighed for the number of inhabitants per postal code area, thus giving larger areas more weight than smaller areas. The weight was calculated by dividing the square of the total number of inhabitants in an area by the absolute number of events in that same postal code area (N^2/n).

In the second step, we identified unhealthier and healthier areas than expected based on socio-economic level of the area. We calculated the ratio between the observed mortality and hospitalisation rates (adjusted for gender and age) and the expected mortality and hospitalisation rates (adjusted for gender, age and area socio-economic level). Postal code areas with a ratio above 1.15 were categorised as areas with a higher mortality or hospitalisation rate than expected. Postal code areas with a ratio below 0.87 (=1/1.15) were classified as areas with a lower mortality or hospitalisation rate than expected. Sensitivity analyses were performed to evaluate our choice for these cut-off points.

Percentage high-income inhabitants was selected to indicate socio-economic level of the area, because it explained most of the geographical variation in hospital admissions (33%) while it explained 15% of the variation in mortality (Table 2). Slightly more of the variation in mortality across areas was related to percentage low-income inhabitants (18%) and percentage inhabitants entitled to a benefit (16%) (Table 2). We selected only one variable to indicate socio-economic level of the area instead of any combination of the six income variables, since such a combination did not improve the explanation of the geographical variation in health outcomes substantially. The six socio-economic characteristics together explained 36% of the variation in hospitalisation and 20% of the variation in mortality across postal code areas (Table 2).

Table 2.2: The explained variance in mortality and hospitalisation rate by socio-economic characteristics of the postal code areas using lineair regression analyses

Socio-economic characteristics	**Mortality rate** Adjusted R^2	**Hospitalisation rate** Adjusted R^2
Mean income per inhabitant (€)	3.43	18.53
Mean income per income recipient (€)	12.62	28.35
% low-income inhabitants	17.45	24.46
% high-income inhabitants	15.11	33.15
% inhabitants entitled to a benefit	16.26	20.82
Mean real-estate value (€)	11.03	21.96
All socio-economic variables	20.32	35.57

The correspondence between the results of the two health indicators was checked by calculating Pearson correlation coefficient between the two health indicators. Additionally, we compared which areas each of the health indicators identified as exceptions.

In the final step of our study, areas with exceptional health levels were described with regards to measures of population composition, urbanisation and concentration of enterprises. The average of area characteristics was calculated for the postal code areas with higher, expected or lower rates than expected based on percentage high-income inhabitants of the area. Chi-square tests were performed to test whether characteristics statistically significantly ($p<0.05$) differed between the exceptions and the areas with an expected rate.

2.3 Results

As is shown in Figs. 1 and 2, the percentage high-income inhabitants in an area is correlated negatively with the sex-and age-standardised mortality rates (($r=-0.336$ ($p<0.0001$)) and hospitalisation rates ($r=-0.518$ ($p<0.0001$)), respectively. In general, areas with a higher percentage of high-income inhabitants have lower mortality and hospitalisation rates, but there are exceptions to this rule. Some postal code areas

with a low percentage of high-income inhabitants have mortality or hospitalisation rates as low as postal code areas with a high percentage of high-income inhabitants.

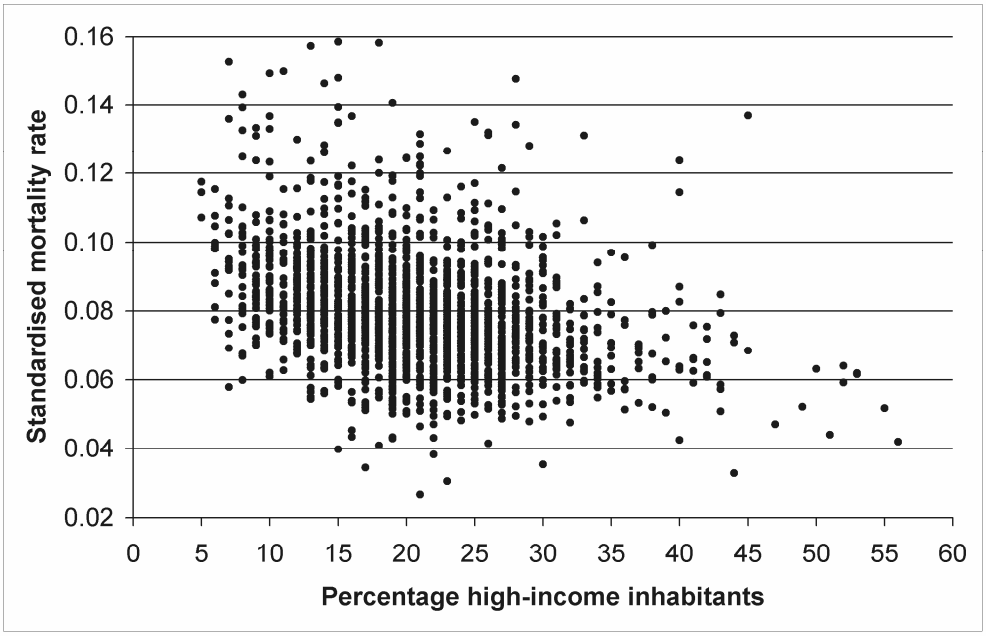

Figure 2.1: Correlation between standardised mortality rate and high-income inhabitants of the postal code area.

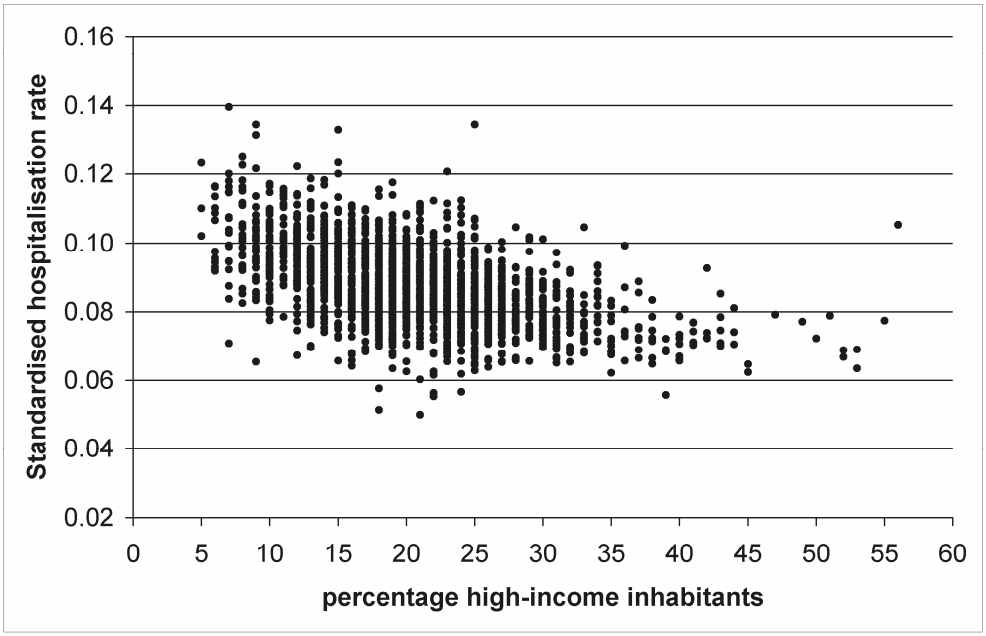

Figure 2.2: Correlation between standardised hospitalisation rate and high-income inhabitants of the postal code area.

Table 3 shows that 386 (20%) areas had a higher and 366 (19%) had a lower mortality rate than expected based on percentage high-income inhabitants. For hospitalisation, 205 (10%) postal code areas had fewer hospital admissions while 182 (9%) areas experienced more hospital admissions than expected based on percentage high-income inhabitants. Table 3 further shows that exceptions to the rule are not distributed evenly over the socio-economic quintiles.

Table 2.3: Distribution of the exceptions to the rule over five socio-economic groups with SES I the lowest and SES V the highest socio-economic group

	Total		Ses I		Ses II		Ses III		Ses IV		Ses V	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
Mortality rate												
Higher than expected	386	(19.6)	77	(19.1)	64	(16.1)	67	(15.3)	69	(18.4)	89	(24.8)
Expected	1222	(61.9)	267	(66.1)	248	(62.3)	265	(60.4)	233	(62.3)	209	(58.2)
Lower than expected	366	(18.5)	60	(14.9)	86	(21.6)	107	(24.4)	72	(19.3)	61	(17.0)
Hospitalisation rate												
Higher than expected	205	(10.4)	49	(12.1)	31	(7.8)	37	(8.4)	29	(7.8)	36	(10.0)
Expected	1587	(80.4)	317	(78.5)	314	(78.9)	351	(80.0)	297	(79.4)	308	(85.8)
Lower than expected	182	(9.2)	38	(9.4)	53	(13.3)	51	(11.6)	48	(12.8)	15	(4.2)

Table 2.4: Observed and expected mortality and hospitalisation rates and mean mortality and hospitalisation ratios (observed rate/expected rate) for areas with a higher, expected and lower mortality or hospitalisation rate

	Observed rate[a]			Expected rate[b]			Ratio		
	Mean	std[c]	p-value	Mean	std[c]	p-value	Mean	std[c]	p-value
Mortality rate									
higher than expected	0.105	0.020	<0.0001	0.078	0.007	0.004	1.35	0.22	<0.0001
expected	0.079	0.009	<0.0001	0.079	0.006		1.00	0.07	
lower than expected	0.061	0.008	<0.0001	0.079	0.006	0.346	0.78	0.09	<0.0001
Hospitalisation rate									
higher than expected	0.106	0.012	<0.0001	0.087	0.009	0.525	1.22	0.08	<0.0001
expected	0.088	0.009	<0.0001	0.087	0.006		1.00	0.07	
lower than expected	0.072	0.006	<0.0001	0.088	0.005	0.013	0.81	0.05	<0.0001

[a] Adjusted for gender and age

[b] Adjusted for gender, age and area socio-economic levels

[c] Std = standard deviation

Areas categorised as having a higher than expected rate have significantly elevated sex-and age-standardised mortality and hospitalisation rates compared to 'normal' areas (Table 4). Areas categorised as having a lower than expected rate also have significantly lower sex-and age-standardised mortality and hospitalisation rates compared to 'normal' areas. The calculated ratio between observed and expected rates also indicates that exceptions to the rule significantly differ from 'normal' areas (Table 4).

In Table 5 the results for mortality and hospitalisation are compared. In 60% of the cases (1185 areas), the two health indicators identify the same postal code areas as deviating or not deviating from the rule. In contrast, only 39 areas (2%) were categorised in opposite groups. The correlation between the two health indicators is fairly weak but significant, with a Pearson coefficient of 0.358 ($p<0.0001$).

Table 2.5: Association between classifications of higher or lower mortality rate than expected and higher or lower hospitalisation rate than expected, based on socio-economic level

	Mortality rate					
	Higher than expected		Expected		Lower than expected	
Hospitalisation rate	N	(%)	N	(%)	N	(%)
Higher than expected	57	(31.32)	103	(56.59)	22	(12.09)
Expected	292	(18.40)	1016	(64.02)	279	(17.58)
Lower than expected	17	(8.29)	103	(50.25)	85	(41.46)

Tables 6 and 7 show which area characteristics differ between areas identified as exceptions and areas with average mortality and hospitalisation rates, respectively. Areas with a higher mortality rate than expected are characterised by a low percentage of young inhabitants, a high percentage of elderly people and persons living alone, a high population density, and concentration of enterprises. For the areas with a lower mortality rate than expected the opposite is found. These areas are further distinguished by a low percentage of non-western immigrants (Table 6). Areas with a lower hospitalisation rate than expected have a low percentage of non-western immigrants, a lower population density and fewer enterprises (Table 7).

Table 2.6: Differences in area characteristics between the areas with a lower or higher mortality rate and the areas with an expected mortality rate. Among all areas and among the lowest (SES I) and highest (SES V) socio-economic areas

Mortality rate		**Total**	**Ses I**	**Ses V**
Population composition				
% inhabitants aged 0-14 year	higher than expected	17.43**	16.25	18.00*
	expected	18.26	16.65	19.18
	lower than expected	19.67***	17.72	20.30
% inhabitants aged 65 and older	higher than expected	15.22**	15.45	15.25
	expected	14.26	15.11	14.18
	lower than expected	12.62***	14.20	11.92*
% non-Western immigrants	higher than expected	7.53	17.92	4.91***
	expected	6.87	15.36	3.61
	lower than expected	4.50***	8.92**	2.81
% persons living alone	higher than expected	26.17***	34.34**	24.33***
	expected	22.11	29.93	18.90
	lower than expected	18.36***	24.30**	16.36
Urbanisation				
Population density	higher than expected	1594**	2424	1722**
	expected	1348	2179	1188
	lower than expected	824***	1295**	754*
Concentration of enterprises				
Number of all types of businesses	higher than expected	5.48*	5.27	5.70
	expected	5.33	5.30	5.45
	lower than expected	4.42***	4.35***	4.69***

* p<0.05;** p<0.01;*** p<0.001

Healthy deprived areas, i.e. areas in the lowest socio-economic quintile (SES 1) with a lower mortality or hospitalisation rate than expected, are characterised by a low percentage of non-western immigrants and concentration of enterprises. For mortality, also percentage of persons living alone and population density are significantly lower in healthy deprived areas. Unhealthy wealthy areas, i.e. areas in the highest socio-economic quintile (SES V) with a higher mortality rate than expected, show a significantly lower percentage of 0–14-year-olds, higher percentage non-western immigrants and persons living alone, as well as a higher population density. For hospitalisation, the unhealthy wealthy areas are characterised by a low concentration of enterprises.

The postal code areas with exceptional mortality or hospitalisation rates seem to be spatially clustered (Figs. 3 and 4, respectively). Postal code areas with higher mortality rates than expected are more concentrated in the southeast of the Netherlands (Limburg) and the urban agglomeration of western Holland, and especially the four main cities of Amsterdam, den Haag, Rotterdam and Utrecht. Areas with a lower mortality rate are clustered in the southwest (Zeeland) and north of the country, and in the northern part of the southern province Limburg (Fig. 3). Postal code areas with higher hospitalisation rates are concentrated in the centre of the south (Brabant) and in the centre of the province Limburg (southeast). In Zeeland and in the south of the province Limburg, areas with lower hospitalisation rates are spatially clustered (Fig. 4). Thus, the two health indicators show partially the same spatial concentration of areas that were healthier than expected, i.e. Zeeland and the north of the province Limburg. However, we did not observe the same correspondence between mortality and hospitalisation for areas that were unhealthier than expected. In the south of Limburg the two health indicators give contradicting results, with high mortality but low hospitalisation rates.

Table 2.7: Differences in area characteristics between the areas with a lower or higher hospitalisation rate and the areas with an expected hospitalisation rate. Among all areas and among the lowest (SES I) and highest (SES V) socio-economic areas

Hospitalisation rate		Total	Ses I	Ses V
Population composition				
% inhabitants aged 0-14 year	higher than expected	18.17	16.63	18.36
	expected	18.35	16.87	19.12
	lower than expected	18.80	15.68	19.93
% inhabitants aged 65 and older	higher than expected	14.34	15.92	15.22
	expected	14.19	15.06	13.95
	lower than expected	13.39	13.74	13.53
% non-Western immigrants	higher than expected	7.33	14.06	3.78
	expected	6.82	15.67	3.90
	lower than expected	3.56*	8.20*	1.93*
% persons living alone	higher than expected	22.06	29.24	20.06
	expected	22.28	29.70	20.04
	lower than expected	21.04	32.74	14.60
Urbanisation				
Population density	higher than expected	1196	1989	1001
	expected	1356	2156	1311
	lower than expected	875***	1713	515*
Concentration of enterprises		5.01**	5.08	5.06*
Number of all types of businesses	higher than expected	5.28	5.22	5.45
	expected	4.52***	4.71*	4.80*
	lower than expected	18.17	16.63	18.36

* p<0.05; ** p<0.01; *** p<0.001

Figure 2.3: Geographical location of the postal code areas with a higher or lower mortality rate than expected base don high-income inhabitants in the Netherlands.

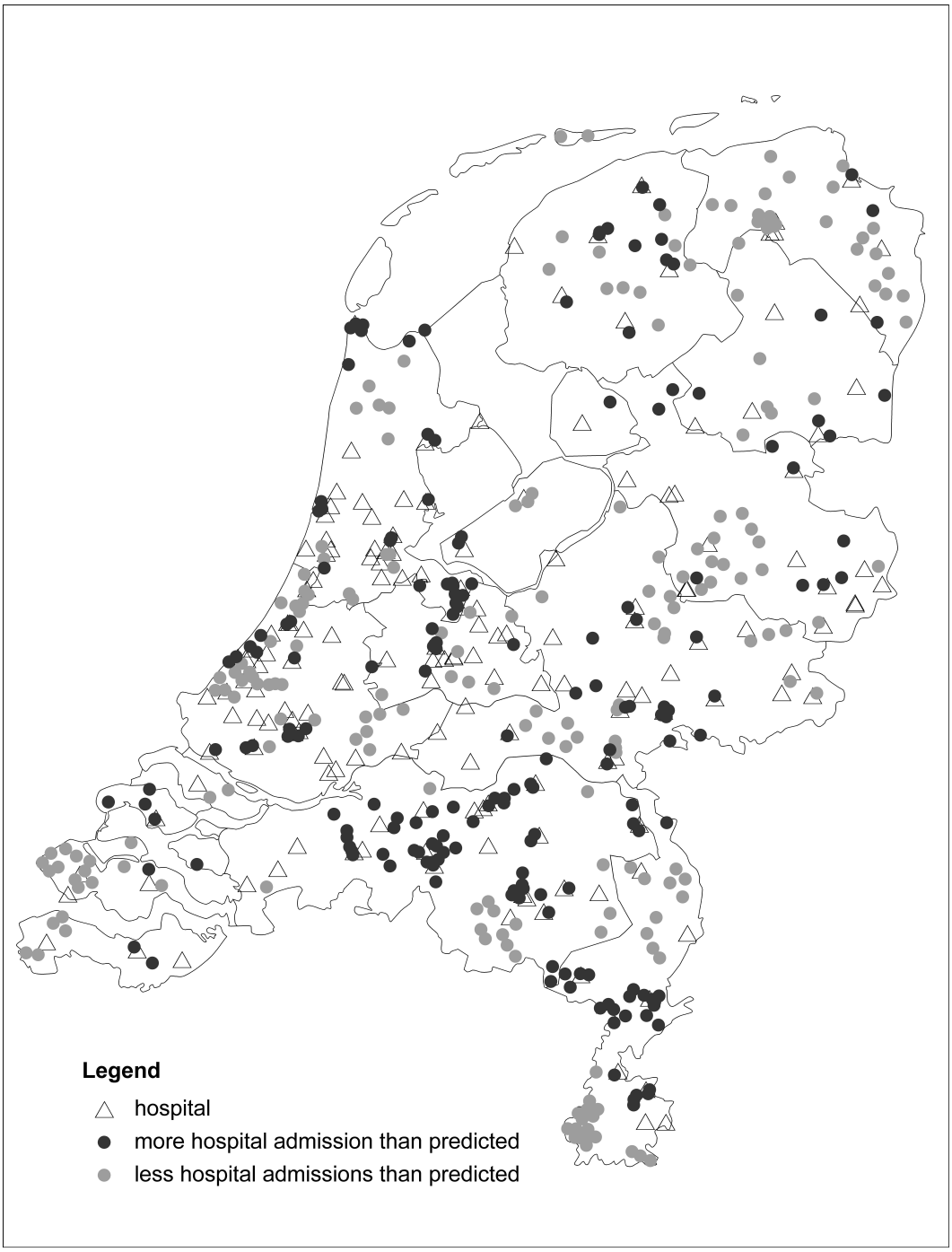

Figure 2.4: Geographical location of the postal code areas with a higher or lower hospitalisation rate than expected based on high-income inhabitants and hospital locations in the Netherlands.

Further evaluations

A potential weakness of our analysis is the use of the arbitrary cut-off values of 0.87 and 1.15 to identify exceptions to the rule. We judge that a relative difference of 15% between observed and expected values is substantial enough to identify areas as being exceptional. However, a higher cut-off point might have been chosen to identify the most dramatic cases, but the smaller number of 'deviating' areas would make it more difficult to identify area characteristics related to exceptional mortality or hospitalisation rates. Given the arbitrary nature of our cut-off point, we performed sensitivity analyses to determine the effect of choosing different cut-off points at 10% and 20%, respectively. For both mortality and hospitalisation rates, the significant relationships that were found using a cut-off point of 15% were also found, although not always with statistical significance, for a cut-off point of 10% or 20%.

We should also clarify that associations between area characteristics and health outcomes were studied by assessing these characteristics for areas with exceptional mortality and hospitalisation rates. This method contrasts to the usual regression approach, in which associations are studied across all areas. In order to compare these two approaches, we present some results from a regression-based approach (Table 8). Multivariate linear regression was applied for three area characteristics. For mortality rates, the regression coefficients show the same relationships with these three characteristics as we have found using our new method (table 6). For hospitalisation rates, however, some relationships are different, especially those with the percentage of persons living alone and population density (Table 7). This discrepancy shows that associations across the whole set of areas might be different from those that are observed when focusing on areas with the highest or lowest hospitalisation or mortality rates. Thus, the new method may offer insights that are complementary to the common regression-based approaches.

Table 2.8: Explanation of age- and sex-standardised mortality and hospitalisation rates with area level variables through lineair regression analyses (regression coefficient and se given as percentage of standardised rate)

	Beta[a]	(se)[b]	Beta[c]	(se)[b]
Mortality rate				
% non-Western immigrants	0.193***	(0.039)	0.053	(0.047)
% persons living alone	0.262***	(0.034)	0.156**	(0.049)
Population density[d]	0.194***	(0.025)	0.091*	(0.041)
Hospitalisation rate				
% non-Western immigrants	0.081***	(0.024)	0.197***	(0.029)
% persons living alone	-0.112***	(0.019)	-0.077**	(0.027)
Population density[d]	-0.064***	(0.014)	-0.086***	(0.023)

* p<0.05; ** p<0.01; *** p<0.001

[a] Adjusted for socio-economic level of the postal code area

[b] Se = standard error

[c] Adjusted for socio-economic level, % non-western immigrants, % persons living alone and population density of the postal code area

[d] Unit population density is 100 addresses per square metre

2.4 Discussion

Summary

This study aimed to characterise determinants of area differences in mortality and hospital admissions, by focussing on areas that are exceptions to the well-known rule that low socio-economic areas have generally higher levels of mortality and morbidity. Many areas have mortality and hospitalisation rates that are considerably higher or lower than could be expected based on their socio-economic level alone. Areas with higher mortality rates than expected were urban areas with a high percentage of elderly and persons living alone, and a high concentration of enterprises. Similar but opposite associations were observed for areas with lower than expected mortality rates. These areas were further distinguished by a lower percentage of non-western immigrants. Areas with lower hospital admission rates than expected were rural areas characterised by low percentages of non-western immigrants and a low concentration of enterprises.

Methodological considerations

The results should be evaluated against a series of limitations with the data that were available to this study.

First of all, we should stress that this study only uses data at the ecological level. An ecological analysis is appropriate for this study because our principle research objective, the identification of areas whose mortality or hospitalisation rates deviate from what could be expected from their socio-economic characteristics, relates to this aggregate level of analysis. None the less, the role of socio-economic factors should ideally be addressed by means of a multi-level approach that includes individual-level information on socio-economic factors and their effects on mortality and hospital admissions. Unfortunately, data required for such a multi-level analysis were not available for the Netherlands as a whole.

In the international literature, the relation between socio-economic level of the area and morbidity and mortality is often found to be strong[172-176]. Even though this strong association was the starting point of our work, we observed, unexpectedly, a fairly weak association between socio-economic level and our two health outcomes. About 20% of the geographical variation in mortality, and about 35% of the variation in hospital admissions could be explained by a series of socio-economic indicators. This weak association might be due to imperfect control for socio-economic associations in purely ecological instead of multi-level analyses. Perhaps more importantly, our study does not refer to a single city but covers the entire national territory, where regional factors such as different cultures and traditions may exert additional influence on area differences in mortality and hospitalisation[177].

The postal code areas that are distinguished in our analyses are relatively large units of analysis. It may be expected that the use of geographical areas that are smaller and more homogeneous in terms of socio-economic level would have shown larger area socio-economic differences in health outcomes, and perhaps a larger contribution of socio-economic factors. Two Dutch studies in which a lower level of aggregation (called ‘buurten’ or neighbourhoods) was compared to the aggregation level applied in our study (postal codes) observed larger health differences in

relationship to socio-economic factors[178,179]. In Britain, several studies also showed that geographical variations in mortality were more pronounced when considering smaller area units[180,181]. Thus, if data were available at a finer geographical scale, we would probably have observed larger health differences in relationship to socio-economic factors, even though the direction of the associations would be similar. It is uncertain to what extent we would have observed different associations with the non-socio-economic factors that were identified in our study.

Furthermore we would like to note that sparsely populated postal code areas were excluded from our analyses. Although the Netherlands is a densely populated country and sparsely populated areas are rare, it would been of interest to determine mortality rates of these areas. Inhabitants of remote rural areas have in general worse health outcomes[59,64,70,71,152]. It is uncertain, however, whether these areas would belong to exceptions to the rule that we identified in our study.

An important characteristic of our study is the parallel analysis of mortality and hospitalisation. The latter measure was included in order to determine whether the patterns observed for mortality could be reproduced by using another measure of population health. We observed moderate associations between the two measures: areas with higher than expected levels of mortality tended to have higher levels of hospital admission rates as well. However, the association was not strong. This raises the question to what extent the area differences in hospital admissions in the Netherlands were determined by other factors than health, such as the chance of being hospitalised in case of disease, health-care-seeking behaviour and accessibility. In the Netherlands, geographical differences in access to hospital care are small and, therefore, may not strongly determine utilisation patterns[167]. A parallel may be drawn with individual-level studies in the Netherlands that found no substantial differences in access to hospital care services between socio-economic groups[182,183]. None the less, hospitalisation rates in specific areas may have been influenced by the availability of health-care services, as in the case of low hospitalisation rates around the southern city of Maastricht. These low rates may perhaps be due to hospital admissions in Belgium, which were not included in our study. A closer inspection of Fig. 4 indicated that areas with the highest hospitalisation rates were not closer to hospital locations. This suggests that, even

though availability may play a role, it cannot explain most area differences in hospital admissions in the Netherlands.

Finally, we should emphasise that the health outcomes studied were standardised mortality and hospitalisation rates for all ages and both genders together. More specific patterns and effects may have been observed with the use of age-and sex-specific rates. In general, compared to older people, middle-aged persons may be more susceptible to contextual influences. A Finnish study observed that measures of social cohesion were related to mortality rates at ages 25–64 years, while these variables had no influence on mortality over 65 years[25]. In other studies, deprivation measures were found to be more strongly related to mortality in younger age groups[24,176]. In the Netherlands, 0 to 64 year-olds have higher mortality rates in the more urban areas, whereas no urban excess was observed for the elderly[55]. Neighbourhood influences may also be related in different ways to different causes of death. Urbanicity might be of greater influence on traffic injury than on cancer mortality. A study on injury mortality found that young adults living in more deprived neighbourhoods had higher mortality rates while this effect was much less for older individuals[19]. The use of mortality rates stratified by age group, gender, and cause of death may thus lead to different geographical patterns of deviating postal code areas.

Explanations

We showed that mortality and hospitalisation rates were not solely determined by the socio-economic level of the areas, but that they are also related to age structure of the population, the presence of non-western immigrants and persons living alone, population density and presence of enterprises. These associations are of interest as they point to geographical determinants of health that may operate in addition to, or in interaction with, the socio-economic composition of the population. Three types of determinants may play a role: compositional determinants, contextual determinants and selective migration.

Compositional determinants

Area differences in health outcomes may be due to differences in the composition of the neighbourhood population, with regard to characteristics that influence health at the individual level. For example, the area-level association that we observed

between mortality and percentage of the population living alone, might be due to the individual-level association between living alone and mortality. Higher mortality rates of persons living without a spouse have been observed in many studies at the individual level[184-188]. On the other hand, the positive association between area mortality and the presence of non-western migrants is difficult to attribute to compositional effects, because studies at the individual level in the Netherlands did not observe a consistent and large mortality excess of non-western migrants as compared to the native Dutch population[189].

Contextual determinants

Geographic differences in health outcomes may not only be determined by differences in the composition of the population, but also by differences in the environment in which the residents live and therefore are exposed to for a large part of their daily life. For example, the socio-economic level of an area may influence the health of each resident of this area, independently from (or in interaction with) their individual socio-economic characteristics. In our study, however, we compared areas with similar socio-economic levels but different health outcomes. Health variations between these areas may be due to non socio-economic characteristics of the areas that are compared.

Even though our paper is among the first to focus on geographical areas, which deviate from the usual health-wealth relationship, the general principle of 'doing well, despite adversity' has an established literature and is often referred to as the issue of 'resilience' [190-192]. Three factors are often mentioned to influence an individual's resilience: characteristics of (1) the individual, (2) their families and (3) their environment[193]. For example, social support and family cohesion are found to have a positive effect on adolescent's healthy behaviour[194-198]. Resilience as demonstrated at the individual and household level may equally operate at the level of communities, and thus be a key determinant of area variations in health.

A key feature may be the social environment of a community[81,107,126]. We observed higher mortality in areas with relatively old population structures and dominated by single person households. Other studies also observed elevated mortality risks in areas with a high proportion of people over 60 years[25,87] and people without a

partner[25]. In areas with high percentages of young and married individuals, social networks and community cohesion might be stronger, thanks to, among other factors, a greater outhouse orientation of families and increased social contacts among parents of children with similar ages. In addition, the presence of children may further stimulate residents to maintain public areas that provide safe and clean playing grounds for their children. Similarly, the greater presence of stable households might reduce residential turnover and thus foster social cohesion[199].

Areas distinguished by lower proportions of non-western immigrants showed both lower mortality as well as lower hospitalisation rates. This finding corroborates another Dutch study, which found elevated mortality risks in areas with higher percentages of non-western immigrants[70]. US studies indicated higher mortality risks for areas with high proportions of blacks[87,200]. Other US studies have noted that African Americans live in the more deprived areas[157-161] as the results of a long-standing process of ethnic segregation. In the Netherlands, non-western immigrants are also reported to live in the more deprived areas[167]. These deprived areas are generally known to have lesser economic resources, less stable community life and poorer opportunity structures.

For both mortality and hospital admissions, we observed higher rates in areas with a higher population density and a higher concentration of enterprises. These results agree with those of many previous studies that documented elevated morbidity and mortality risk among urban compared to rural residents[59,64,70,71,152], and among inhabitants of industrialised compared to non-industrialised areas[156]. Even though this British study focused on areas with economic decline, its results suggest a higher prevalence of morbidity in high-compared to low-industrialised areas, which is in line with our results. In general, urban and highly industrialised areas are characterised by a worse physical environment, which could directly and indirectly affect health. For instance higher air and noise pollution may have a direct effect on respiratory diseases and hearing deficiencies[10,153], while low availability of green areas might inhibit individuals to be physically active and therefore might be indirectly responsible for the higher observed mortality and hospitalisation rates in these areas[153,155,201].

Selective migration

The area in which people live may not only have an influence on their health, but the health of individual people may also influence the area where they will live. Several studies have observed that residential mobility is associated with individual health. Especially among younger adults, positive health is correlated with greater residential mobility[202,203]. If residential migration of young adults is towards areas with higher social reputation, the ‘‘healthy migrant effect’’ may have contributed to our observation that mortality rates are generally lower in areas with relatively young population structures. However, it is uncertain whether this contribution is substantial. A Dutch study on selective migration found only a weak association between health and migration[204].

2.5 Conclusion

The results of our study indicate that only part of geographical variation in health can be explained by socio-economic level of the areas. We found that there are areas where mortality or hospitalisation rates are substantially higher or lower than the rates to be expected on the basis of their socio-economic level. A closer inspection of these ‘‘exceptions to the rule’’ shows that they share a number of area characteristics.

Future research should focus on the identification of specific environmental factors that affect the health of inhabitants. Important insights will be derived from in-depth comparisons between areas that have similar socio-economic levels but widely different levels of mortality rates or other health outcomes. Such knowledge can ultimately help to enrich preventive measures and strategies by giving greater attention to the local circumstances that determine people’s exposure to the determinants of health.

Chapter 3

Higher mortality in urban neighbourhoods in the Netherlands: who is at risk?

Based on:

van Hooijdonk C, Droomers M, Deerenberg IM, Mackenbach JP, Kunst AE

Higher mortality in urban neighbourhoods: who is at risk?

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Abstract

Background

Urban residents have higher mortality risks than rural residents. These urban-rural differences might be more pronounced within certain demographic subpopulations.

Aim

To determine urban-rural differences in all-cause and cause-specific mortality within specific demographic subpopulations of the Dutch population.

Methods

Mortality records with information on gender, age, marital status, ethnic origin, and place of residence were available for 1995 through 2000. Neighbourhood data on address density and socio-economic level were linked through postcode information. Variations in all-cause and cause-specific mortality between urban and rural neighbourhoods were estimated through Poisson regression. Additionally, analyses were stratified according to demographic subpopulation.

Results

After adjustments for population composition, urban neighbourhoods have higher all-cause mortality risks than rural neighbourhoods (RR=1.05; CI:1.04-1.05), but this pattern reverses after adjustment for neighbourhood socio-economic level (RR=0.98; CI:0.97-0.99). The beneficial effect of living in an urban environment applies particularly to individuals aged 10 to 40 years and 80 years and above, people who never married, and residents from non-western ethnic origin. The beneficial effect of urban residence for non-married people is related to their lower cancer and heart disease mortality. The beneficial effect of urban residence for people of non-western ethnic origin is related to their lower cancer and suicide mortality.

Conclusion

In the Netherlands, living in an urban environment is not consistently related to higher mortality risks. Young adults, elderly, single and non-western residents, especially, benefit from living in an urban environment. The urban environment seems to offer these subgroups better opportunities for a healthy life.

3.1 Introduction

Urban residents generally experience higher mortality risks than rural residents[59-62,64,65,67,152], but lower risks[69,72,205] or a lack of urban-rural differences have also been reported[206]. Elevated mortality risks among urban residents have been found in the Netherlands too[55,70]. These higher urban mortality risks might be explained by the more unhealthy physical urban environment with, for instance, higher levels of traffic and air pollution. Yet, urban-rural differences in mortality might also be due to differences in population composition between urban and rural areas[6]. In the Netherlands, for instance, singles more frequently live in urban areas[79] and in general have higher mortality rates than people with a partner; therefore this compositional effect might explain to some extent the higher mortality rates in urban areas[184-188].

Few studies have addressed mortality in urban settings for specific demographic subpopulations, with contradictory results. Higher mortality risks for both men and women have been found in urban compared to rural areas[62,65,152], but lack of urban-rural mortality differences have also been reported[152,206]. And, while younger age groups experience slightly lower mortality risks in urban compared to rural areas, no urban-rural differences in mortality seem to exist among the elderly[206]. Two US studies on the relation between urbanicity and mortality for different ethnic groups reported higher risks in urban white residents compared to rural white residents[62,152], with one study indicating higher risks in urban African Americans compared to those living in rural areas[62] and the other found the same pattern for African American males but not for African American females[152]. No studies focused on the relation between urbanicity and mortality for married versus non-married people. Thus, while it is theoretically possible that the effect of living in an urban environment differs between subpopulations, there is yet little evidence to support this.

Our objective is to determine urban-rural differences in all-cause as well as cause-specific mortality within specific demographic subpopulations of the Dutch population. A national dataset with information on four individual characteristics of residents (sex, age, marital status and ethnicity) and one neighbourhood characteristic (socio-

economic level) is used to examine the possible negative influence of urbanicity on mortality.

3.2 Methods

Data

Individual data

Mortality records and demographic data for the years 1995 through 2000 were provided by Statistics Netherlands (CBS) and linked by personal identification number. All people who died during the study period were registered, irrespective of whether the death occurred in the Netherlands or abroad.

Primary cause of death was based on the International Classification of Diseases, ninth revision, ICD-9 (ninth revision, 1995) and ICD-10 (tenth revision 1996 through 2000). The following causes of death were distinguished: (1) all-cause mortality, (2) cardiovascular disease mortality, in particular ischaemic and cerebrovascular diseases, (3) cancer mortality, in particular lung and breast cancer, and (4) death by external causes, in particular suicide and traffic accidents.

Demographic information on sex, age, marital status (never married, married, divorced, widowed), ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other), and address of each individual was available. Five-year age categories were used except for the 0 to 1 year olds and 95 years and older. The standard definition of CBS was used to define non-western individuals[171]. A person was considered to be of non-western origin if at least one parent or the person in question was born in a non-western country or continent, that is Turkey, Africa, Latin America or Asia. In families from mixed origin the country of birth of the mother prevailed.

Neighbourhood data

In the Netherlands, neighbourhoods are small geographical units. The boundaries of a neighbourhood are based on topography or socio-economic similarities of residents. Neighbourhood data of the year 1995 was used for analyses because

mortality records were available from this year onwards. In 1995, the Netherlands consisted of 10381 neighbourhoods with on average 1486 residents.

Urbanicity was based on the number of addresses per square kilometre in a neighbourhood. The five standard urbanicity categories of CBS were applied, that is rural (0-499 addresses/km^2), semi-rural (500-999 addresses/km^2), intermediate urban-rural (1000-1499 addresses/km^2), semi-urban (1500-2499 addresses/km^2) and urban (>2499 addresses/km^2) with about 20 percent of the Dutch population in each category[207].

Socio-economic status (SES) is an important confounder in the relation between urbanicity and health. In the Netherlands individual SES is not routinely collected but neighbourhood socio-economic level can be used as a proxy for individual SES instead[208]. Neighbourhood socio-economic level was indicated by the percentage of residents with a low income, that is below the 40 percent level of the national income distribution (<€12,025), because it explained most of the geographical variation in mortality across neighbourhoods in the Netherlands.

Neighbourhoods with 100 or fewer residents (N=1553) were omitted to reduce mortality rate instability. This implies that the analyses excluded remote rural areas. We did not aggregate these small neighbourhoods because this would require arbitrary decisions as to which neighbourhoods should be combined. In addition, 476 neighbourhoods were excluded because of missing data on socio-economic level. The resulting dataset consists of 8352 neighbourhoods, which covered 77% of all neighbourhoods in the Netherlands and 99% of the total Dutch population. In total 807 348 people died during the 5-year study period, this is on average 97 deaths per neighbourhood.

Statistical analysis

Poisson regression models were applied to estimate urban-rural differences in mortality. For every urbanicity category, a relative risk was calculated with the group of rural neighbourhoods serving as reference category. In the Poisson regression model, the absolute number of deaths in each neighbourhood is the dependent variable and the logarithm of the expected number of deaths in that neighbourhood is

Table 3.1: The distribution of demographic and socio-economic characteristics and absolute number of deaths of the Dutch population over the five urbanicity categories

	Rural	Semi-rural	Intermediate urban-rural	Semi-urban	Urban
Number of neighbourhoods	4,156	1,244	998	1,225	729
Number of residents (as % of total study population)	21.0	20.3	19.4	21.1	18.2
Demographic characteristics					
% male	50.8	49.6	49.3	48.6	48.9
% 20 to 40 year old	27.5	28.0	29.1	30.3	37.5
% married residents	49.5	48.6	46.3	42.6	32.5
% residents of Western origin	92.9	88.8	84.1	79.0	66.2
Socio-economic characteristics					
% residents with a low income	39.1	37.9	38.1	40.8	43.7
Deaths (absolute number in 1995-2000)					
All-cause mortality	154,329	157,705	140,606	183,319	171,389
Cause-specific mortality					
Cancer	44,811	43,676	40,114	51,111	44,683
lung	10,287	9,593	8,953	11,491	10,259
breast	3,987	4,131	3,917	4,693	4,117
Cardiovascular diseases	57,027	57,530	51,282	67,658	61,338
ischaemic	22,795	21,757	19,643	25,709	23,007
cerebrovascular	13,301	14,455	12,680	16,337	14,908
External causes	6,229	5,591	5,004	6,536	6,686
suicide	1,657	1,606	1,547	2,028	2,128
traffic accidents	4,471	3,874	3,320	4,205	4,062

	Rural	Semi-rural	Intermediate urban-rural	Semi-urban	Urban
Demographic subpopulations (all-cause mortality)					
Sex					
male	84,011	77,733	69,422	88,957	79,663
female	70,318	79,972	71,184	94,362	91,726
Age (years)					
0–9	1,708	1,554	1,410	1,579	1,512
10–19	851	612	464	519	358
20–29	1,345	1,165	1,133	1,419	1,521
30–39	2,296	2,071	2,097	2,510	3,157
40–49	5,362	5,396	5,377	6,249	5,966
50–59	11,881	11,063	10,253	11,900	10,570
60–69	23,714	22,282	20,567	25,529	21,365
70–79	41,901	41,697	39,054	52,439	44,792
80–89	47,494	51,273	44,106	59,426	58,656
90 and above	17,777	20,592	16,145	21,749	23,492
Marital status					
never married	20,698	17,209	14,498	18,886	23,095
married	74,172	70,500	64,442	79,050	61,857
widowed	53,992	62,350	52,606	71,136	68,265
divorced	5,467	7,646	9,060	14,247	18,172
Ethnic origin					
Western	144,906	144,171	125,862	161,189	145,055
non-Western	9,423	13,534	14,744	22,130	26,334

the offset variable. The expected number of deaths in a neighbourhood is the sum of the expected number of deaths of each of the 336 population groups in one neighbourhood stratified by sex, age, marital status and region of origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other). The expected number of deaths per population group was calculated by multiplying the mortality risk of each population group, based on Poisson regression of the total Dutch population with the number of people in each population group. Additionally, Poisson regression analyses were corrected for neighbourhood socio-economic level.

These Poisson regression analyses were repeated to estimate urban-rural variations for specific causes of death and different demographic subpopulations that is men and women; 10 year age categories; never married, married, divorced and widowed; western and non-western.

Finally, we examined urban-rural variations in cause-specific mortalities within non-married (never married, divorced and widowed combined), married, non-western and western groups. These subpopulations were selected because we expected large differences between urban and rural neighbourhoods for these subpopulations. The two highest and lowest urbanicity categories were combined to assure a sufficient number of events in the urbanicity categories (table 1).

3.3 Results

Urban and rural neighbourhoods differ with regard to population composition and socio-economic level (Table 1). In urban areas the percentages of married and western residents tend to be lower, while the percentage of individuals aged 20 to 40 years tend to be higher. The differences in population composition between rural, semi-rural and intermediate urban-rural neighbourhoods are minimal. These urbanicity categories also have fewer residents with a low income, as compared to semi-urban and urban neighbourhoods.

All-cause mortality

Slightly elevated mortality risks are found in urban compared to rural neighbourhoods (RR= 1.09; CI: 1.08-1.10) (Table 2). After adjustment for sex, age and marital status, urban-rural differences in all-cause mortality become even smaller, but urban residents still experience higher mortality risks (RR=1.05; CI:1.04-1.05). Further adjustment for ethnicity does not alter the urban-rural mortality pattern. The urban-rural pattern in mortality however reverses when neighbourhood socio-economic level is added to the model, resulting in somewhat lower mortality risks in urban compared to rural neighbourhoods (RR=0.98; CI:0.97-0.99). In the semi-urban and intermediate urban neighbourhoods mortality risks are higher compared to both the rural and urban neighbourhoods. These risks are not affected by either neighbourhood composition or socio-economic level (Table 2).

Cause-specific mortality

Compared to rural neighbourhoods, mortality risks are higher in all four urbanicity categories for cancer, in particular lung cancer (Table 3). No significant differences between urban and rural neighbourhoods are found for breast cancer mortality. For mortality caused by cardiovascular diseases (including ischaemic and cerebrovascular diseases) a similar urban-rural pattern is found as for all-cause mortality: an initial increase is followed by a decrease in mortality risks. Compared to rural neighbourhoods all four urbanicity categories show lower mortality risks for death due to external causes, in particular for traffic accidents. No significant differences between urban and rural neighbourhoods are found for suicide.

Table 3.2: Urban-rural differences in all-cause mortality

	Rural[a]	Semi-rural		Intermediate urban-rural		Semi-urban		Urban	
Control variables	RR[b]	RR[b]	(CI)[c]	RR[b]	(CI)[c]	RR[b]	(CI)[c]	RR[b]	(CI)[c]
Age and sex	1.00	1.05	(1.04-1.06)	1.04	(1.03-1.05)	1.05	(1.04-1.06)	1.09	(1.08-1.10)
+ marital status	1.00	1.05	(1.04-1.05)	1.03	(1.03-1.04)	1.03	(1.02-1.04)	1.05	(1.04-1.05)
+ region of origin	1.00	1.05	(1.04-1.05)	1.03	(1.02-1.04)	1.03	(1.02-1.04)	1.04	(1.04-1.05)
+ neighbourhood ses[d]	1.00	1.05	(1.05-1.06)	1.04	(1.03-1.05)	1.00	(0.99-1.00)	0.98	(0.97-0.99)

Table 3.3: Urban-rural differences in all-cause and cause-specific mortality

	Rural[a]	Semi-rural		Intermediate urban-rural		Semi-urban		Urban	
Cause of death	RR[b]	RR[b,e]	(CI)[c,e]	RR[b,e]	(CI)[c,e]	RR[b,e]	(CI)[c,e]	RR[b,e]	(CI)[c,e]
All-cause	1.00	1.05	(1.05-1.06)	1.04	(1.03-1.05)	1.00	(0.99-1.00)	0.98	(0.97-0.99)
Cancer	1.00	1.03	(1.02-1.04)	1.04	(1.02-1.05)	1.04	(1.02-1.05)	1.05	(1.03-1.06)
lung	1.00	1.02	(0.99-1.05)	1.04	(1.01-1.07)	1.05	(1.02-1.07)	1.10	(1.07-1.13)
breast	1.00	1.03	(0.98-1.07)	1.06	(1.01-1.10)	1.02	(0.97-1.06)	1.03	(0.99-1.08)
Cardiovascular	1.00	1.03	(1.02-1.05)	1.02	(1.01-1.04)	0.98	(0.97-0.99)	0.94	(0.93-0.95)
ischaemic	1.00	1.00	(0.98-1.02)	0.99	(0.98-1.01)	0.96	(0.95-0.98)	0.94	(0.92-0.96)
cerebrovascular	1.00	1.09	(1.06-1.11)	1.06	(1.04-1.09)	0.98	(0.95-1.00)	0.92	(0.89-0.94)
External causes	1.00	0.93	(0.89-0.96)	0.88	(0.85-0.91)	0.88	(0.85-0.91)	0.85	(0.83-0.89)
suicide	1.00	1.02	(0.96-1.10)	1.00	(0.93-1.07)	1.03	(0.97-1.10)	0.99	(0.93-1.06)
traffic accidents	1.00	0.89	(0.85-0.93)	0.83	(0.79-0.87)	0.80	(0.77-0.83)	0.76	(0.73-0.79)

[a] Reference
[b] RR = Relative Risk
[c] CI = 95% confidence interval
[d] Ses = socio-economic level
[e] Adjusted for sex, age, marital status, ethnicity, and neighbourhood socio-economic level

Table 3.4: Urban-rural differences in all-cause mortality within demographic subpopulations of the Dutch population

	Rural[a]	Semi-rural		Intermediate urban-rural		Semi-urban		Urban	
Subpopulation	RR[b]	RR[b,d]	(CI)[c,d]	RR[b,d]	(CI)[c,d]	RR[b,d]	(CI)[c,d]	RR[b,d]	(CI)[c,d]
Total	1.00	1.05	(1.05-1.06)	1.04	(1.03-1.05)	1.00	(0.99-1.00)	0.98	(0.97-0.99)
Sex									
male	1.00	1.04	(1.03-1.05)	1.03	(1.02-1.05)	1.02	(1.01-1.03)	1.00	(0.99-1.01)
female	1.00	1.06	(1.05-1.07)	1.04	(1.03-1.05)	0.98	(0.97-0.99)	0.96	(0.96-0.97)
Age (years)									
0–9	1.00	0.97	(0.91-1.04)	0.92	(0.86-0.99)	0.96	(0.90-1.03)	0.97	(0.90-1.04)
10–19	1.00	0.77	(0.69-0.85)	0.62	(0.55-0.69)	0.64	(0.58-0.72)	0.52	(0.46-0.60)
20–29	1.00	0.90	(0.83-0.98)	0.86	(0.80-0.93)	0.78	(0.73-0.85)	0.64	(0.59-0.69)
30–39	1.00	0.96	(0.90-1.02)	0.95	(0.90-1.01)	0.90	(0.85-0.96)	0.88	(0.83-0.93)
40–49	1.00	1.07	(1.03-1.11)	1.09	(1.05-1.13)	1.10	(1.06-1.14)	1.04	(1.00-1.08)
50–59	1.00	1.03	(1.00-1.06)	1.03	(1.01-1.06)	1.05	(1.03-1.08)	1.04	(1.02-1.07)
60–69	1.00	1.04	(1.02-1.06)	1.04	(1.02-1.06)	1.04	(1.03-1.06)	1.05	(1.03-1.07)
70–79	1.00	1.05	(1.04-1.07)	1.04	(1.03-1.06)	1.00	(0.99-1.02)	1.00	(0.99-1.01)
80–89	1.00	1.08	(1.07-1.10)	1.05	(1.04-1.06)	0.98	(0.96-0.99)	0.95	(0.94-0.96)
90 and above	1.00	1.06	(1.03-1.08)	1.04	(1.02-1.06)	0.98	(0.96-1.00)	0.96	(0.94-0.98)
Marital status									
never married	1.00	1.03	(1.01-1.05)	1.01	(0.99-1.03)	0.94	(0.92-0.96)	0.89	(0.87-0.91)
married	1.00	1.03	(1.02-1.04)	1.04	(1.03-1.05)	1.03	(1.01-1.04)	1.03	(1.02-1.04)
widowed	1.00	1.09	(1.08-1.10)	1.06	(1.04-1.17)	0.99	(0.98-1.00)	0.98	(0.97-0.99)
divorced	1.00	1.07	(1.03-1.11)	1.02	(0.99-1.06)	1.01	(0.98-1.04)	0.97	(0.94-1.00)
Region of origin									
Western	1.00	1.06	(1.05-1.06)	1.04	(1.03-1.05)	1.00	(0.99-1.01)	0.99	(0.98-1.00)
non-Western	1.00	1.02	(0.99-1.05)	1.02	(1.00-1.05)	0.97	(0.95-1.00)	0.92	(0.89-0.94)

[a] Reference
[b] RR = Relative Risk
[c] CI = 95% confidence interval
[d] Adjusted for sex, age, marital status, ethnicity, and neighbourhood socio-economic level

Demographic subpopulation

Comparing the most urban category with the most rural category, no differences in mortality are found among males, but females show lower risks (Table 4). Lower mortality risks are also found among 10 to 40 year olds and the oldest old. In contrast, the middle-aged and elderly (50 to 70 years) living in the most urban neighbourhoods experience higher mortality risks than their rural peers. No urban-rural differences are found for other age groups.

In the most urban category, mortality rates are also higher for married individuals, while lower risks are found for never married and widowed individuals. For divorced individuals no significant urban-rural differences are found. Also, no urban-rural differences are found among western residents, but non-western urban residents have lower mortality risks than their rural peers.

Comparing urban-rural mortality patterns, a similar urban-rural pattern as for the total population, an initial increase followed by a decrease in mortality risks, is found among males, females, people aged 70 years and older, never married, widowed and divorced people (Table 4). A gradual decrease in mortality risks with increasing urbanicity is found among the younger age groups (10 to 40 years). For the other age groups (40 to 70 years) and married people an increase is found with some irregularities.

Figure 1 illustrates the urban-rural variation in cause-specific mortality according to marital status. The higher rural all-cause mortality risk among non-married people is mostly explained by the higher mortality for heart disease and external causes, in particular traffic accidents in rural areas. The higher urban all-cause mortality risk among married people is related to cancer mortality. The contrasting urban-rural pattern between non-married and married people for all-cause mortality is mostly related to cancer and heart disease mortality. In urban compared to rural neighbourhoods, cancer mortality risks are higher among married people while these are lower for non-married people.

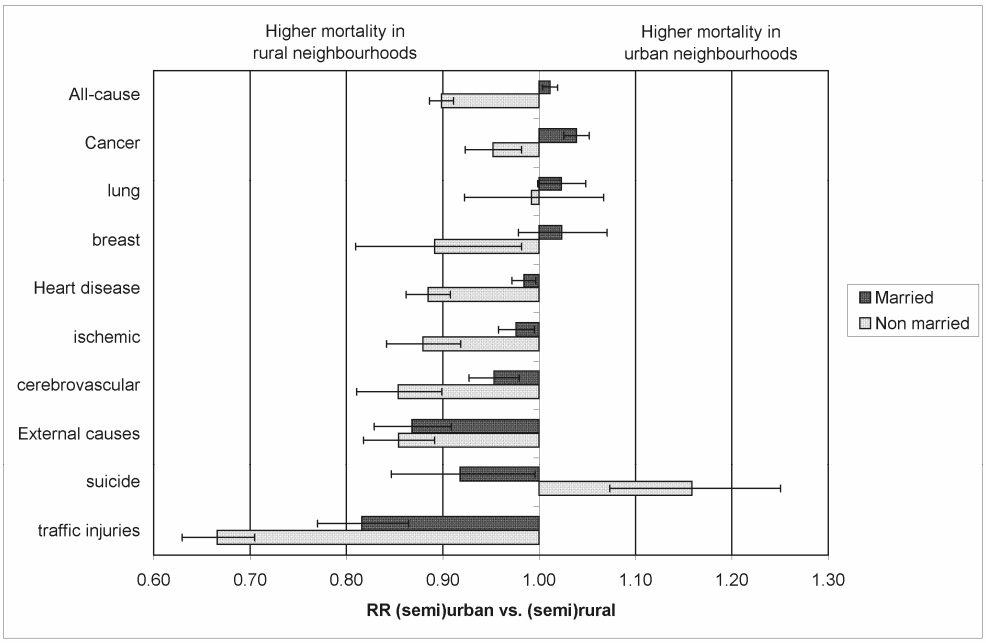

Figure 3.1: Urban versus rural differences in all-cause and cause-specific mortality risks according to marital status.

The larger beneficial effect of urban residence for people from a non-western ethnic origin compared to people from a western ethnic origin is mainly related to cancer mortality and suicide (figure 2). In urban compared to rural neighbourhoods, cancer mortality risks are higher among individuals from a western ethnic origin, while these are lower for individuals from a non-western ethnic origin. A similar pattern is seen for suicide.

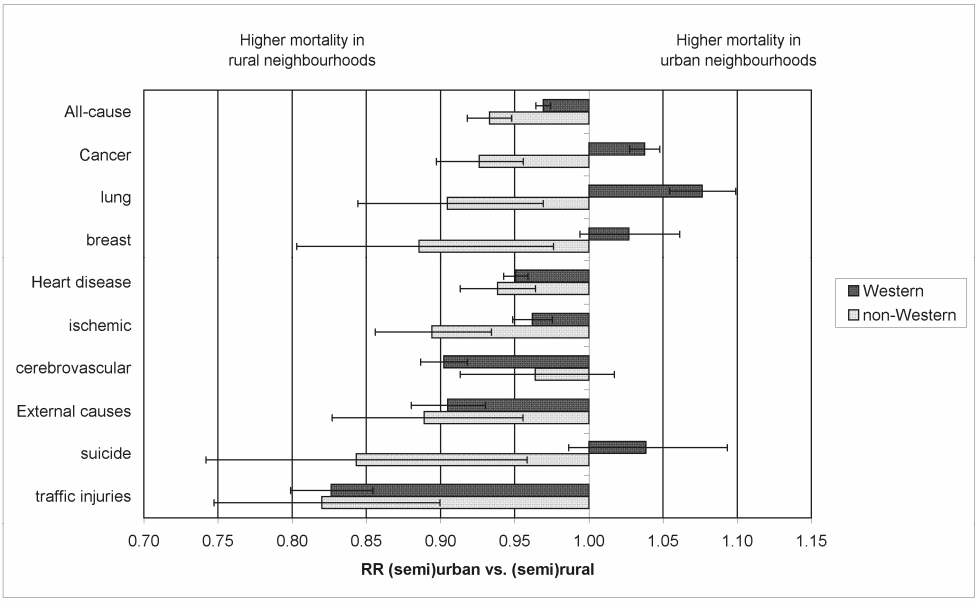

Figure 3.2: Urban versus rural differences in all-cause and cause-specific mortality risks according to ethnic origin.

3.4 Discussion

In the Netherlands, urban neighbourhoods show higher mortality risks than rural neighbourhoods when differences in population composition are considered. However when neighbourhood socio-economic level is taken into account the urban-rural pattern reverses, resulting in slightly lower mortality risks in urban neighbourhoods. The small beneficial effect of living in urban neighbourhoods applies particularly to younger (10 to 40 years) and older (80 years and above) age groups, never married people, and people from non-western ethnic origin. In contrast, middle-aged and elderly (50 to 70 years) and married people living in urban neighbourhoods experience somewhat higher mortality risks compared to those living in rural neighbourhoods. The beneficial effect of urban residence for non-married compared to married people is related to their lower cancer and heart disease mortality. The beneficial effect of urban residence for people of non-western background compared with people of western ethnic origin is related to their lower cancer and suicide mortality.

Evaluation of data and methods

Some limitations of the study need to be considered in the interpretation of the results.

Firstly, a multilevel analysis is generally the recommended approach to study environmental influences of health. However, a national dataset of 16 million people nested in 10.000 neighbourhoods proved to be too large for the multilevel analyses programmes within the CBS infrastructure. Disregarding the clustering of individuals within neighbourhoods underestimates standard errors of regression coefficients resulting in an overestimation of statistical significance. The absence of individual level data on SES was another reason for using ecological level analyses. In addition, we used only one neighbourhood socio-economic level indicator, that is proportions of households with low income, because of lack of information on neighbourhood educational level and other potentially relevant indicators. Lower socio-economic groups with, in general higher mortality risks more frequently live in urban areas. Incomplete control for neighbourhood and individual SES might therefore have led to an underestimation of the effect of urbanicity on mortality.

Finally, it is important to note that sparsely populated neighbourhoods were excluded from the analyses. In many countries, remote rural areas have higher mortality risks than rural areas resulting in an U-shape relationship between population density and mortality[68,69,74] .In comparison to other countries, however, the Netherlands is a densely populated country where remote rural areas as found in other countries do not exist[209,210]. The absence of such areas with, in general, higher mortality risks might explain the lack of the U-shape pattern for the Netherlands. This exclusion might however have led to either a small underestimation or overestimation of the effect of urbanicity on mortality.

Comparison to previous studies

Other studies report similar small urban-rural differences in mortality with some indicating lower mortality[69,205] and others indicating higher mortality risks in urban compared to rural residents[59,61,67]. In addition large urban-rural differences in mortality with lower[72] and higher risks in the more urban areas are also found[60,62,64,65,152]. A previous Dutch study found slightly elevated risks for residents of large municipalities which were defined as having more than 100.000 residents[55]. This result suggest that the choice for another measure of urbanisation may have led to the different results. Another Dutch ecological study found an increased mortality risk of 24% among urban residents aged 65 years[70]. The discrepancy in findings might be related to the imperfect control for relevant individual characteristics in the latter study.

Few studies addressed urban-rural mortality differences within certain demographic subpopulations. Sex differences were most studied. For men both lower[206] as well as higher mortality risks[62,152] were found for urban compared to rural areas. For women higher mortality risks[62] in urban areas and a lack of urban-rural differences[206] were reported. In densely populated municipalities in the Netherlands increased risks were found among elderly residents (65 years and above) but not among the age group below 65 years[55]. An English study reported lower mortality risks in middle aged men living in urban compared to rural areas and no urban rural differences for middle-aged women or individuals aged 65 years and above[206]. The narrow age groups compared in our study show a more diverse age-pattern of urban-rural mortality

differences than observed in these previous studies. If the cut-off point of 65 years were used, lower urban mortality risks would be found in the age-group below 65 years and no urban-rural differences would be found for the age-group above 65 years of age.

Possible explanations

The different urban-rural mortality patterns found within demographic subpopulations might be related to the different needs people have[211] and the opportunities that either an urban or rural environment offers them. For instance, the urban environment provides more job opportunities, retail businesses, and social events[212], which might be more beneficial to certain groups of people. Single living urban residents may feel less isolated because of the wide range of social events and many nearby places where they can meet other people. Elderly may profit from the better organised public transport[213] and the better availability and accessibility of medical and other services[214,215] in urban environments. Thus, lower mortality risks might be linked to different needs which are fulfilled by services provided within the urban environment.

The larger beneficial effect of urban residence for people with a non-western background compared to people with a western background is related to their lower cancer and suicide mortality. Whereas the cancer risk could involve a wide array of factors, the protective effect on suicide mortality suggest an important role of the social environment. The diversity of cultures together with the existence of diverse social networks within urban environments might create a more supportive and less stressful environment for migrants. In addition, urban governments may be more aware of problems regarding migrant groups and provide supportive and special services such as (medical) information in foreign languages or specialised accommodations.

Middle-aged and married people are better off when living in a rural environment. The larger beneficial effect of non-urban residence for married people is related to the lower cancer and heart disease mortality. The latter cause of death may suggest an important role of behavioural factors such as smoking, diet and physical activity. Middle-aged and married people living in rural and sub-urban settings might maintain

more healthy life styles, perhaps because of greater opportunities that the environment offers (e.g. recreation spaces, gardening, etc). In addition, middle aged and married people mostly have children, and rural and sub-urban environments may be perceived as more child friendly[216-218] because of lower levels of traffic, air and noise pollution, lower crime rates and greater availability of green spaces. The greater daily difficulties to raise children in an urban environment may contribute to higher levels of psychological stress and unhealthier life styles.

The urban-rural mortality patterns found in our study may in part be due to selective migration processes, in this case the move of healthier individuals to urban or rural neighbourhoods. A Dutch study found no health differences between individuals that moved from an urban into a rural area or individuals that moved from a rural into an urban area[219]. However, it is possible that different results might be produced for certain demographic subpopulations, since selective migration is related to age[202,219-221] or marital status[219]. Young people that move tend to be healthier than young people that do not move[202,220,221]. For the elderly the opposite is found, i.e. movers are unhealthier than stayers[202,220,221]. The lower mortality risks in urban areas found in the younger age groups could be a reflection of young healthy individuals moving into urban areas because of job opportunities. The same explanation could be suggested for the lower mortality risks found in rural areas among middle-aged individuals, with the healthier adults having moved to rural areas because of their children. The lower mortality risks among elderly urban residents could be related to the migration of healthy elderly towards urban environments because of easy access to medical and other services.

3.5 Conclusion

The urban environment is generally thought to have a negative impact on health. Our results show, however, that the urban environment affects the health of different demographic subpopulations in different ways. These results illustrate that health effects of environmental characteristics may vary according to the residents characteristics. As the needs of people vary according to their social position and change during their life course, so will the kind of environment that can best fulfill

these needs. Selective migration processes aimed to maintain an optimal match, and the health consequences of emerging mismatches, may both explain the great variability in the links between health and residential environment.

Chapter 4

Composition as context. The contextual effect of neighbourhood demographic composition on mortality

Based on:

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Composition as context. The contextual effect of age, sex, marital status, and ethnicity on neighbourhood mortality

Final draft

Abstract

Background

Contextual health effects of area demographic composition are rarely considered. In this paper, we discuss the possible health effect of living in neighbourhoods with differing demographic make-up in terms of sex, age, marital status and ethnicity.

Methods

Mortality records and individual data on sex, age, marital status and ethnicity, and place of residence were available for six years (1995-2000). For each neighbourhood the proportion of population groups related to sex, age, marital status or ethnicity was calculated. Poisson regression models were used to estimate the association between neighbourhood demographic composition and all-cause mortality. Analyses were performed on 8,828 neighbourhoods, i.e. 85% of all neighbourhoods in the Netherlands with 15,347,190 residents, i.e. 99.5% of all Dutch citizens.

Results

Over and above the compositional effect of age, sex, marital status and ethnicity, the proportion of singles, pensioners, and women in a neighbourhood is associated with the mortality rate of the neighbourhood. The higher the proportion of women, singles or pensioners in the neighbourhood, the higher the excess mortality rate in that neighbourhood. These associations are somewhat stronger for neighbourhoods where the proportion of women is high and the proportion of singles or pensioners is low.

Conclusion

Area demographic composition does not only affect health through population composition, but has to be taken into account as a contextual construct as well. The association between area demographic composition and health is smaller among areas that reflect the average population composition of the Netherlands.

4.1 Introduction

The place in which people are born, grow, live, work, and age affects their health[222]. Geographical health disparities are well documented and draw attention to the living environment as a possible health determinant. Neighbourhood disparities in health are explained by composition or context. The compositional explanation focuses on the effect of people and ascribes differences in health between places to the different kinds of people living in these places, such as for example differences in age or socioeconomic status. The contextual explanation focuses on the effect of the place where people live, i.e. on neighbourhood differences in the physical and social context. Although Macyntire and Ellaway (2003) already noted that the strict distinction between people and place might be somewhat artificial, the majority of studies that attempt to explain geographical health inequalities adhere to this distinction[7].

The sociological concept of segregation combines both the compositional and contextual view. Residential segregation is defined as the extent to which individuals of a certain population group are (un)evenly distributed across neighbourhoods in a region[223]. In epidemiology, residential segregation has been studied almost exclusively in the domain of racial segregation[16]. Most of these studies focus on the dissimilarity dimension of residential segregation, and study the relation between health and the degree to which each neighbourhood incorporates the same proportion of a race as the area overall[86]. A dissimilar distribution of African Americans is positively associated with infant and adult mortality and crime among African Americans[86].

Contrary to residential segregation at the regional level, segregation can also be used at the more detailed geographical scale. In this case, it describes a characteristic of a local neighbourhood, its demographic composition[223]. Studies on area demographics in relation to neighbourhood health differences are scarce. In the US, a number of studies examined the effect of neighbourhood racial composition on black and white mortality. While mortality rates among blacks were lower when this population group formed the majority, white morality rates did not substantially vary when they belonged to either the minority or majority in the neighbourhood[16-18,86].

The contextual health effect of other demographic variables than race, such as age or marital status, is rarely considered in studies on health determinants[97]. The few results on the effect of the area age structure, range from higher mortality in areas with an old age structure in the USA[87] to no effect of the percentage of elderly in the area on mortality in Helsinki[25].

In this paper we describe and discuss the contextual effect of the demographic composition of the neighbourhood according to different factors, such as age, sex, marital status and ethnicity on mortality in the Netherlands. The area demographic make-up might reflect particular physical or social neighbourhood environments that could affect the health of all neighbourhood inhabitants.

4.2 Methods

Mortality and demographic data

Mortality records and corresponding population data for the years 1995 through 2000 were provided by Statistics Netherlands (CBS) and linked by personal identification number. Persons could enter (through birth or immigration) or leave the study (by death or emigration) during the study period. All persons who died during the study period were registered, irrespective of whether the death occurred in the Netherlands or abroad.

For each person, information was available on sex, age, marital status (never married, married, divorced, widowed) and ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other). Five-year age categories were used except for the age groups 0 to 1 year old and 95 years and older. Following the standard definition of CBS[171], a person was considered to be of non-Western ethnic origin if at least one of the parents or the person in question was born abroad. In families from mixed origin, the country of birth of the mother prevailed.

Neighbourhood composition measures

Neighbourhoods were chosen as the geographical unit of analyses. The boundaries of these areas were defined in terms of topography or socio-economic similarities of

residents. Neighbourhoods were relatively small. In 1995, the Netherlands consisted of 10,381 neighbourhoods with on average 1486 residents and an area surface of 3.4 km^2. For each neighbourhood, the proportion of a certain population group was calculated by aggregating the individual information on sex, age, marital status and ethnicity to the neighbourhood level. Demographic data of the year 1995 was used, because mortality records were available from this year onwards.

Analyses

Analyses were performed on 8,828 neighbourhoods, i.e. 85% of all neighbourhoods in the Netherlands with 15,347,190 residents, i.e. 99.5% of all Dutch citizens. We excluded 1,418 neighbourhoods with less than 100 residents to avoid inaccurate mortality estimates, and 135 neighbourhoods because of missing data on mortality. This resulted in the exclusion of mostly rural neighbourhoods with few residents.

Poisson regression models were used to estimate the association between neighbourhood demographic composition and all-cause mortality. Neighbourhoods were the unit of analyses in the SAS genmod procedure calculating restricted maximum likelihood estimates. Standardised relative mortality risks were calculated to compare the different neighbourhood composition measures. The log likelihood ratio test of the SAS nlmixed procedure was used to estimate the contribution of each of the neighbourhood variables in explaining the geographical variation in mortality across neighbourhoods.

The Poisson regression analyses were adjusted for sex, age, marital status and ethnicity at the individual level by including the logarithm of the expected number of deaths in a neighbourhood as offset variable. The logarithm of the expected number of deaths is the usual offset, because the outcome, number of observed deaths (dependent variable) is logged in a Poisson model. The expected number of deaths in a neighbourhood was calculated by summing the expected number of deaths of each of the 1008 possible combinations of sex, age (5 year age groups), marital status (never married, married, divorced and widowed) and ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other) in one neighbourhood. The expected number of deaths of the 1008 population groups was calculated by multiplying the mortality risk of each population group, based on Poisson regression

of the complete population of the Netherlands, by the number of people in each group.

In further analysis, the linearity of the association between neighbourhood demographic composition and all-cause mortality was examined. Neighbourhoods were ranked according to their composition and categorised into quartiles with about 25% of the study population in each category. Poisson regression models were used to estimate the association between neighbourhood demographic composition and all-cause mortality within each category.

4.3 Results

Table 1 presents the average demographic make-up of neighbourhoods in the Netherlands. The exclusion of the most rural neighbourhoods in our analysis results in an excess mortality ratio which slightly exceeds 1 indicating that these excluded neighbourhoods have generally lower mortality rates than could be expected on their demographic composition.

Neighbourhood demographic composition is significantly associated with neighbourhood mortality after adjusted for individual demographic variables (table 2). Neighbourhood mortality increases with the percentage of women, elderly, singles and migrants living in the area. For example, if the percentage of singles increases with 1%, the neighbourhood excess mortality ratio increases with 0.0084 points. In other words, the increase in percentage of singles in the neighbourhood enlarges the difference between the number of observed deaths and the number of deaths that was expected based on the neighbourhood demographic population composition. In the case of 1% the difference between observed and expected mortality increase by 0.84%. Neighbourhoods with more residents younger than 65 years experience lower mortality rates (table 2).

Table 4.1: Distribution of mortality and compositional neighbourhood characteristics across neighbourhoods in the Netherlands

Neighbourhood characteristics	Mean	Std[a]	25th percentile	75th percentile
Excess mortality ratio[b]	1.18	0.49	0.94	1.29
% women	49.55	3.44	47.96	51.01
% 0 to 20 year olds	24.91	6.56	21.08	28.78
% 20 to 45 year olds	37.67	7.75	33.63	40.73
% 45 to 65 year olds	24.10	5.92	20.62	27.64
% 65 years and older (pensioners)	13.37	8.13	8.60	16.31
% singles[c]	52.83	7.80	48.30	55.37
% non-married[d]	43.95	7.48	39.72	46.98
% divorced	3.71	2.48	1.91	4.95
% widowed	5.28	4.14	3.05	6.34
% migrants	11.11	9.73	4.47	15.04

[a] Std = standard deviation

[b] Excess mortality ratio = observed mortality / expected mortality adjusted for sex, age, marital status and ethnicity

[c] Singles = non-married, divorced and widowed

[d] Non-married = non-married living together and non-married not living together

The standardised mortality risks indicate that the percentage of singles within the neighbourhood has the largest influence on neighbourhood all-cause mortality (table 2). The percentage of 20 to 45 year olds and the percentage of migrants within the neighbourhood have only a small impact on neighbourhood all-cause mortality in comparison to the other neighbourhood composition measures.

Variation in the share of singles in an area accounts for 12.5% of the geographical variation in mortality. Neighbourhood differences in the portion of pensioners explains 7% and the percentage of women 5.5% of the neighbourhood variation in mortality (table 2). Although the effect estimate of the percentage of women on neighbourhood mortality resembles the effect estimate of the percentage of singles, the latter explains a much larger part of the geographical mortality differences, due to the greater variation in the percentage of singles compared with the variation in the percentage of women over the neighbourhoods studied (table 1).The other

neighbourhood demographic composition measures accounted for less than 5% of the neighbourhood differences in mortality.

Table 4.2: Association between neighbourhood composition measures and all-cause mortality

Neighbourhood features	Beta[a,b]	(CI)[a,c]	RR[d]	(CI)[c]	Variance explained[e]
% women	1.57	(1.51;1.64)	1.055	(1.053-1.058)	5,47
% 0 to 20 year olds	-0.58	(-0.06;-0.54)	0.963	(0.961-0.965)	4,34
% 20 to 45 year olds	-0.14	(-0.17; -0.11)	0.989	(0.987-0.992)	0,07
% 45 to 65 year olds	-0.86	(-0.91; -0.82)	0.950	(0.948-0.953)	2,97
% 65 years and older	0.52	(0.50; 0.54)	1.043	(1.041-1.045)	6,99
% singles	0.84	(0.81;0.87)	1.068	(1.065-1.070)	12,54
% migrants	0.22	(0.20; 0.24)	1.022	(1.020-1.024)	1,78

[a] Multiplied by 100

[b] Regression coefficient adjusted for sex, age, marital status and ethnicity at the individual level

[c] CI = 95% confidence interval adjusted for sex, age, marital status and ethnicity at the individual level

[d] Standardized RR = relative risk adjusted for sex, age, marital status and ethnicity at the individual level raised to the power of the standard deviation of the mean (Table 1)

[e] Percentage neighbourhood variance explained = (1- (neighbourhood variance full model / neighbourhood variance constant model))*100

Table 4.3: Association between neighbourhood demographic composition and all-cause mortality within neighbourhoods ranging from the lowest to highest proportion of the corresponding demographic characteristic

	Proportion neighbourhood population group							
	Lowest		Low		High		Highest	
Neighbourhood feature	Beta[a,b]	(CI)[a,c]	Beta[a,b]	(CI)[a,c]	Beta[a,b]	(CI)[a,c]	Beta[a,b]	(CI)[a,c]
% women	-1.02	(-1.23;-0.81)	-0.14	(-0.34;0.60)	0.90	(0.73;1.08)	2.38	(2.30;2.46)
% 65 years and older	1.04	(1.01;1.08)	0.48	(0.44-0.52)	0.42	(0.37;0.46)	-0.25	(-0.30;-0.19)
% singles[d]	1.81	(1.77;1.86)	0.58	(0.51-0.64)	0.50	(0.43-0.57)	0.33	(0.28-0.38)

[a] Multiplied by 100

[b] Regression coefficient adjusted for sex, age, marital status and ethnicity at the individual level

[c] CI = 95% confidence interval adjusted for sex, age, marital status and ethnicity at the individual level

[d] singles = never married (never married living together and never married not living together), divorced and widowed

Stratified analyses suggest that the contextual effect of the percentage of women, singles and elderly on mortality is not linear. The impact on mortality of neighbourhood demography differs between areas with a varying composition of the corresponding demographic characteristic (table 3). The mortality risk related to the share of singles and pensioners is somewhat larger in areas with relatively few singles or pensioners respectively. For example, the neighbourhood excess mortality rate increases much sharper with the percentage of singles among areas where singles are relatively few. The positive association between percentage of women and mortality, on the other hand, is more pronounced among neighbourhoods where more women reside. In fact, among neighbourhoods with relatively few women, the association between the percentage of women and neighbourhood mortality inverts. In those neighbourhoods, an increasing number of women seems to protect the neighbourhood population against excess mortality.

4.4 Discussion

Over and above the compositional effect of age, sex, marital status and ethnicity, the share of singles, pensioners, and women in a neighbourhood is associated with neighbourhood all-cause mortality. The higher the proportion of women, singles or pensioners in a neighbourhood, the higher the excess mortality rate in that neighbourhood. These associations are somewhat stronger within neighbourhoods where the proportion of women is high and the proportion of singles or pensioners is low.

We find no evidence for a negative health effect of the neighbourhood composition in terms of ethnicity in the Netherlands. In the USA, the dominant ethnic group in an area experiences superior health outcomes compared to members of the minority group in that area and to members of the same ethnic group residing in areas where they are the minority[16-18,86]. This discrepancy is well explained by the completely different manifestation of ethnic diversity in the Netherlands, compared with the USA. In the Netherlands, there are only a handful of mono-ethnic neighbourhoods where more than half of the residents are migrants. Furthermore, Dutch neighbourhoods with migrants almost always accommodate several different ethnic groups[88].

The effect of composition as context, based on other demographic variables than race, such as age or marital status, is rarely considered in contextual studies of health[97]. The rare results on the effect of the neighbourhood age structure range from higher mortality in areas with an old age structure in the USA[87] to no effect of the percentage of elderly in the area and mortality in Helsinki[25]. Although, statistically significant, the effect size reported in our study seems small. In the Netherlands, as well as in other European welfare states, the degree of diversity is moderate, and therefore the contextual effects of composition might be expected to be less substantial.

Limitations of the data or analyses

Some limitations of the study need to be considered in the interpretation of the results. First of all, the exclusion of smaller neighbourhoods and those which lacked information on mortality has resulted in an exclusion of neighbourhoods with lower than expected mortality. The data used, however, still showed adequate variation in excess mortality as well as neighbourhood demographic composition to study associations (table 1). Secondly, results are based on ecological analysis with neighbourhoods as the unit of analyses. Although composition was taken into account using indirectly standardised mortality rates, multilevel analyses would be a more appropriate statistical technique to estimate contextual health effects. However, the 15,347,190 residents nested in 8828 neighbourhoods were too many to allow multilevel analyses within the CBS structure. Finally, results are not adjusted for the effect of individual socioeconomic status as this information is not available on a nationwide scale in the Netherlands. Due to the lack of adjustment for individual socioeconomic status, we might have overestimated the health impact of the neighbourhood composition measures studied. Interpreting the results presented above, one also has to bear in mind that these are based on cross-sectional data. Selective migration processes where individuals with poorer or better health outcomes move into neighbourhoods with a certain demographic structure might affect our results.

Area demographic composition and the neighbourhood physical and social context

The mortality risk for all neighbourhood inhabitants increases slightly when more women, singles and pensioners reside in the neighbourhood. Such demographic make-up of the area probably reflects particular physical or social neighbourhood environments detrimental for health.

Singles and pensioners are on average less wealthy and their budget constraints might force them to live in neighbourhoods with poorer physical environment and poorer (access to) services that harm all residents' health[7,223].

The association between area demographic composition and mortality might also be mediated by social interactions between the neighbourhood residents[89]. Residents of diverse neighbourhoods have less people around with whom they feel familiar with and can socially identify. They might feel less comfortable with others and will socially connect less to other people, even people of their 'own kind'. Until now this theory is only tested with regards to ethnic diversity, with most studies reporting that ethnic diversity led to a decrease of social cohesion in US neighbourhoods[89]. In the Netherlands, ethnic diversity was also related to less social contacts in the neighbourhood, but did not have detrimental effects on perceived trust[88,96,224,225]. Such a social cohesion mechanism fits the fact that neighbourhoods that reflect the average population composition of the Netherlands experience the lowest mortality risk and that the risk increases with diversions from the average either way.

Besides connections within the neighbourhood, social connections outside the neighbourhood might also explain our findings of higher mortality rates in neighbourhoods with higher percentages of singles, elderly and women. According to Bourdieu, social capital constitutes the resources that people possess via their connection to others. The downside of social capital is the exclusion of individuals from obtaining resources tied to a network[226]. Singles, pensioners and women, the latter being less (often) employed in the Netherlands, might well be such people without or with smaller networks and limited access to resources. Having more of these people in the neighbourhood results in lower neighbourhood social capital including all the adverse health consequences attached[227].

4.5 Conclusion

Area demography does not only affect health through population composition, but has to be taken into account as a contextual construct as well. Geographical disparities in mortality in the Netherlands are weakly associated with segregation in terms of sex, age and marital status. Racial segregation does not seem to play a role. Our results need to be corroborated in future research using more appropriate longitudinal data on the individual level as well as multilevel analyses.

Chapter 5

The diversity in associations between community social capital and health per health outcome, population group and location studied

Based on:
van Hooijdonk C, Droomers M, Deerenberg IM, Mackenbach JP, Kunst AE
The diversity in associations between community social capital and health per health outcome, population group and location studied.
Int J Epidemiol, 2008, 37(6):1384-92.

Abstract

Background

Literature on the effect of community social capital on health is inconsistent and could be related to differences in social capital measures, health outcomes, population groups and locations studied. Therefore this study examines the diversity in associations between community social capital and health by investigating different diseases, populations groups, and locations.

Methods

Mortality records and individual data on sex, age, marital status, ethnic origin, and place of residence were available for six years (1995–2000). Neighbourhood data, i.e. community social capital, socio-economic level and urbanicity, were linked through postcode information. Community social capital was indicated by measures of community interaction, belongingness, satisfaction and involvement. Variations in all-cause and cause-specific mortality across low and high social capital neighbourhoods were estimated through Poisson regression. In addition, analyses were stratified according to population group and to urbanisation level.

Results

In the total population, community social capital was not related to all-cause mortality (RR=1.00; CI:0.99-1.01). However residents of high social capital neighbourhoods had lower mortality risks for cancer [especially lung cancer (RR=0.92; CI:0.89-0.96)] and for suicide (RR=0.90; CI:0.83-0.98). Slightly lower mortality risks were also found for men (RR=0.98; CI:0.97-0.99), married individuals (RR=0.96; CI:0.94-0.97), and for residents living in socially strong neighbourhoods located in large cities (RR=0.95; CI:0.91-0.99).

Conclusion

The association between community social capital and health differs per health outcome, study population and location studied. This underlines the need to take such diversity into account when aiming to conceptualise the relation between community social capital and health.

5.1 Introduction

A positive association has been reported between community social capital and health[25,100,102,103,105,106,110,112,114-116], whereas others have found no such association[25,100,106,117,118,121-124]. This contradiction might be related to the different definitions used to embody the concept of social capital[125-127]. The definition most often used in public health is that of Putnam, in which social capital is defined as those features of social structures (such as levels of interpersonal trust and norms of reciprocity and mutual aid), which act as resources for individuals and facilitate collective action[99]. The way in which community social capital might be related to health is still debated. However, at least three plausible pathways are suggested: 1) through health-related behaviours, 2) through access to services and amenities, and 3) through psychosocial processes[126].

Another explanation for the contrasting results regarding social capital might be related to differences in health outcome, study population, or the setting of the performed studies. Firstly, living in a strong social community might affect only certain health outcomes or diseases[126]. One of the pathways between community social capital and health specifies health-related behaviour as a mediator. Since unhealthy behaviour is related to certain diseases, one would expect stronger associations with these diseases. Secondly, living in a high social capital neighbourhood may be more beneficial for certain groups of people[7,228]. Differences in the amount of time spent in the neighbourhood, or in the appreciation of living in a strong social community, might elicit a series of health effects[229,230]. Finally, the location of the study might also affect the association between community social capital and health[126]. For example, higher levels of social capital are observed in rural than in urban areas[231,232]. Since the average level of social capital is higher in rural areas, the relation between social capital and health might be less strong. Whereas the concept of social capital and its pathways to health are strongly debated, less attention is paid to the possible diversity in associations between community social capital and health.

Therefore, the present study focuses on the diversity in associations between community social capital and health with regard to different diseases, population groups, and locations. First, we determined the relationship between community

social capital and all-cause and cause-specific mortality using (nation-wide) data on individuals and data on socio-economic level, urbanicity and community social capital of neighbourhoods. To embody the concept of community social capital, several dimensions were combined e.g. measures of community interaction, belongingness, satisfaction and involvement. Then we examined the association between community social capital and mortality among different population groups and at different levels of urbanisation.

5.2 Methods

Data

Data were available at the individual level (including information on demographics and mortality) and on the neighbourhood level (including information on community social capital, socio-economic level and level of urbanisation). Individual and neighbourhood data were linked by postcode information.

Individual data

Mortality records and demographic data for the years 1995 through 2000 were provided by Statistics Netherlands (CBS) and linked by personal identification number. During this six-year period, persons could enter (through birth or immigration) or leave the study (by death or emigration). All persons who died during the study period were registered, irrespective of whether the death occurred in the Netherlands or abroad.

The primary cause of death was classified according to the ICD-9 (1995) and ICD-10 (1996-2000). The following causes of death were distinguished: 1) all-cause mortality, 2) cancer mortality, in particular lung cancer and breast cancer, 3) cardiovascular disease mortality, in particular ischaemic and cerebrovascular diseases, and 4) external causes, in particular suicide and road traffic accidents.

Demographic information on sex, age, marital status (never married, married, divorced and widowed) and ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other) of each individual was available. Five-year age categories

were used, except for the age groups 0 to 1 year old and 95 years and older. The standard definition of CBS was used to define ethnic origin[171], i.e. a person was considered to be of non-Western origin if at least one parent or the person in question was born in a non-Western country or continent, i.e. Turkey, Africa, Latin America or Asia. In families from mixed origin the country of birth of the mother prevailed.

Neighbourhood data

Neighbourhoods were chosen as the geographical unit of analyses because neighbourhoods are small and the boundaries are based on topography or socio-economic similarities of residents. In 1995, the Netherlands consisted of 10 381 neighbourhoods with on average 1486 residents and an area surface of 3.4 km^2. All neighbourhood data were provided by CBS.

Community social capital data originated from the Housing Demand Survey (WBO) of 1998. This national survey was carried out by The Netherlands Ministry of Housing, Spatial Planning and Environment in a two-step procedure. First, one or more municipalities were selected out of each COROP area (a large geographical division in the Netherlands). Then, persons aged 18 years and older living in the selected municipalities were drawn at random. The total response rate across all municipalities was 51%. The data were collected by means of telephone interviews, face-to-face interviews, or internet questionnaires. Information was available for 117 569 individuals, i.e. 0.76% of the Dutch population. We identified 13 items which represented dimensions that could be linked to the definition of social capital as stated by Putnam[99] (Table 1). These items represented themes such as community interaction, belongingness, satisfaction and involvement. The 13 items were used to create a single component to indicate community social capital through an unrotated principal component analysis with correlation matrix. This single component had an eigenvalue of 6.95 and explained 54% of the variation between the items. All 13 items were moderate to highly correlated with the calculated component (Table 1). In addition, a reliability test was performed to examine whether the 13 items reflected one single dimension, i.e. community social capital. A Cronbach's alpha of 0.60 was found, indicating an acceptable reliability of the calculated social capital measure. Subsequently, neighbourhood social capital was calculated as the mean score of all

interviewed neighbourhood residents. The neighbourhood social capital score had a mean of zero and a standard deviation of 0.43.

Socio-economic status (SES) is an important confounder in the relationship between community social capital and mortality; therefore, appropriate adjustments should be made during analyses. In the Netherlands, there is no national registry for the individual SES. Therefore the neighbourhood socio-economic level, which can be used as a proxy for individual SES[208] was used. Neighbourhood socio-economic level was indicated by the percentage of neighbourhood inhabitants with a low income; this is an income below the 40% level of the national income distribution (<€12 025). More detailed measures on neighbourhood income were available, but the percentage of low-income inhabitants was selected because this explained most of the geographical variation in mortality across neighbourhoods in the Netherlands (14%). We selected only one variable to indicate the socio-economic level of the neighbourhood, rather than any combination of the six available income variables, since such a combination did not substantially improve the explanation of the geographical variation in health outcomes (20%). No information was available on the mean educational or occupational level of the area residents. It has been suggested that education or occupation may be less appropriate measures than income to indicate area socio-economic level[168-170].

The neighbourhoods were divided into three levels of urbanisation. The highest level included neighbourhoods located in the four largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague and Utrecht); this category included 148 neighbourhoods with 1235 960 residents. Neighbourhoods included in the medium category were located in one of the smaller cities (including Almelo, Arnhem, Breda, Deventer, Eindhoven, Enschede, Groningen, Helmond, Hengelo, 's-Hertogenbosch, Leeuwarden, Maastricht, Nijmegen, Tilburg and Zwolle); this level included 421 neighbourhoods with 1359 500 residents. The remaining neighbourhoods were categorised in the lowest urbanisation level and included 2938 neighbourhoods with 8442 180 residents.

Table 5.1: Mean and standard deviation (std) on items representing community social capital and their relation with the calculated social capital score at the individual level

Statement	Response options	Mean (std)	Correlation[a]
I talk a lot to my next-door neighbours	(1) totally agree; (2) agree; (3) equal; (4) don't agree; (5) don't agree at all	2.64 (0.39)	0.646
I talk a lot to neighbours other than my next-door neighbours	idem	2.93 (0.39)	0.635
In this neighbourhood people treat each other with respect	idem	2.08 (0.29)	0.790
People hardly know each other in this neighbourhood	idem	3.67 (0.45)	-0.720
I feel attached to my neighbourhood	idem	2.52 (0.45)	0.742
I feel at home in my neighbourhood	idem	1.93 (0.31)	0.807
I feel at ease with the people in my neighbourhood	idem	2.18 (0.33)	0.844
I live in a neighbourhood with a low level of solidarity	idem	3.55 (0.39)	-0.723
I'm satisfied with the population composition of this neighbourhood	idem	2.08 (0.31)	0.727
I'm satisfied with my living environment	idem	1.82 (0.35)	0.792
The buildings in this neighbourhood are attractive	idem	2.15 (0.40)	0.734
It is unpleasant to live in this neighbourhood	idem	4.30 (0.29)	-0.695
To what extent are you involved with the liveability of your neighbourhood?	(1) high involvement; (2) limited involvement; (3) not involved	2.15 (0.28)	0.612

[a] Pearson correlation coefficient

Information on neighbourhood socio-economic level and level of urbanisation for the year 1995 was used because mortality records were available from this year onwards.

Neighbourhoods with less than five observations for the 1998 WBO survey (6863 neighbourhoods) were excluded from analyses because social capital scores based on such a small sample are less reliable. An additional 11 neighbourhoods were excluded because of missing data on neighbourhood socio-economic level. Analyses were performed on the remaining 3507 neighbourhoods (33.78% of all neighbourhoods in the Netherlands) with 11037 640 residents (71.56% of all Dutch citizens) of which 91 656 were interviewed (77.96% of all interviewed individuals in the WBO survey). Mostly rural neighbourhoods with few residents were excluded from our analyses. Rural areas generally have a lower mortality rate[59,64,65,67,152] and a higher level of social capital[231,232], thus excluding these areas might have led to underestimation of the association between community social capital and mortality. The 3507 neighbourhoods were ranked according to their community social capital score and divided into five categories with 20% of the study population in each category.

Analyses

All-cause mortality

Poisson regression models were used to calculate relative all-cause mortality risks for each social capital category, with the lowest social capital category as reference. These analyses were adjusted for population composition by including the logarithm of the expected number of deaths in a neighbourhood as offset variable. The logarithm of the expected number of deaths is the usual offset, because the outcome, i.e. the number of observed deaths (dependent variable), is logged in a Poisson model. The expected number of deaths in a neighbourhood was the sum of the expected number of deaths of each of the 336 population groups based on sex, age, marital status and ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other) in one neighbourhood. The expected number of deaths per population group was calculated by multiplying the mortality risk of each population group, based on Poisson regression of the total Dutch population, by the number of people in each population group. Additionally, the regression models to estimate relative mortality

risks per social capital category were adjusted for neighbourhood socio-economic and urbanisation level.

Cause-specific mortality, population group and urbanisation level

Similar to all-cause mortality, Poisson regression analyses were performed to estimate the association between community social capital and specific causes of death, and community social capital and all-cause mortality among the population groups and the urbanisation levels. The regression analyses were stratified according to the population groups (male or female; non-married or married; Western or non-Western ethnic origin) and urbanisation levels (high, medium and low).

5.3 Results

Neighbourhoods with a high level of community social capital had a higher percentage of residents who were married, aged 45 years and older, and of Western origin (Table 2), and fewer residents with a low income and of lower age. There were also fewer deaths in this type of neighbourhood.

Table 5.2: Neighbourhood mortality, demographics and socio-economic characteristics per community social capital category

	Low social capital	**II**	**III**	**IV**	**High social capital**
Neighbourhoods	N = 583	N = 584	N = 608	N = 697	N = 1035
Mean number of deaths per neighbourhood	180.42	188.78	186.33	159.83	112.41
Demographic characteristics					
25-45 year olds (%)	34.65	32.40	31.03	30.57	29.57
45-65 year olds (%)	21.12	23.40	24.38	24.41	25.62
65 years and older (%)	11.76	13.35	13.97	13.75	14.06
married individuals (%)	37.72	43.77	46.13	47.42	48.94
Western individuals (%)	70.25	82.08	85.31	87.66	89.35
Socio-economic characteristics					
Inhabitants with a low income (%)	42.84	39.23	37.75	37.58	37.70

After adjusting for population composition, lower mortality risks were found in high social capital neighbourhoods (Table 3). When socio-economic level and urbanicity of the neighbourhood were taken into account, mortality risks in neighbourhoods in the highest social capital category were similar to those found in the lowest social capital category. After adjustment for population composition, neighbourhood socio-economic level and urbanicity, the slightly lower mortality risks remained for the intermediate social capital category.

Although no association was found between community social capital and all-cause mortality, social capital was associated with both lower and higher mortality risks for specific causes of death (Table 4). The lowest mortality risks for cancer and lung cancer were observed among residents living in neighbourhoods with the highest social capital levels. A pattern similar to that for all-cause mortality was found for death due to external causes and suicide. Residents living in strong social neighbourhoods had a higher risk for mortality from cerebrovascular heart disease. No associations were found between community social capital and mortality caused by breast cancer, cardiovascular diseases, ischaemic heart disease, and road traffic accidents.

Table 5 presents data on all-cause mortality risks per social capital category for different population groups and urbanisation levels. Slightly lower mortality risks were found across the social capital categories for residents who are male, married, and of Western origin; only in the highest social capital category, residents of Western origin showed no increased risk. Somewhat higher mortality risks were observed in the highest social capital neighbourhoods (but not in the three intermediate categories) for women, non-married residents, and residents of non-Western origin.
In urban areas, residents living in socially strong neighbourhoods had a lower mortality risk than those in socially weak neighbourhoods. The opposite was found for residents of neighbourhoods in the medium urbanisation level, with slightly elevated mortality risks among residents of high social capital neighbourhoods. In the lowest urbanisation level, no higher or lower mortality risks were found for residents living in strong or weak social neighbourhoods.

Table 5.3: All-cause mortality risks per community social capital category

	Low social capital	II		III		IV		High social capital	
Control variables	RR[a]	RR[a]	(CI[b])	RR[a]	(CI[b])	RR[a]	(CI[b])	RR[a]	(CI[b])
Age and gender	1.00	0.93	(0.92-0.94)	0.90	(0.89-0.90)	0.89	(0.88-0.90)	0.91	(0.90-0.92)
+ marital status and ethnicity	1.00	0.94	(0.94-0.95)	0.92	(0.91-0.93)	0.92	(0.91-0.92)	0.94	(0.93-0.95)
+ SES[c]	1.00	0.98	(0.97-0.99)	0.98	(0.97-0.99)	0.99	(0.98-0.99)	1.01	(1.00-1.02)
+ urbanicity	1.00	0.98	(0.97-0.99)	0.98	(0.97-0.99)	0.98	(0.97-0.99)	1.00	(0.99-1.01)

[a] RR = Relative Risk

[b] CI = Confidence Interval

[c] SES = neighbourhood socio-economic level

Table 5.4: All-cause and cause-specific mortality risks per community social capital category

	Low social capital	II		III		IV		High social capital	
Mortality	RR[a]	RR[a]	(CI[b])	RR[a]	(CI[b])	RR[a]	(CI[b])	RR[a]	(CI[b])
All-cause	1.00	0.98	(0.97-0.99)	0.98	(0.97-0.99)	0.98	(0.97-0.99)	1.00	(0.99-1.01)
Cancer	1.00	0.98	(0.96-0.99)	0.98	(0.97-1.00)	0.97	(0.95-0.99)	0.97	(0.95-0.98)
lung	1.00	0.96	(0.93-0.99)	0.92	(0.89-0.96)	0.92	(0.89-0.95)	0.92	(0.89-0.96)
breast	1.00	0.99	(0.94-1.04)	1.03	(0.98-1.09)	0.98	(0.93-1.04)	0.99	(0.94-1.05)
Cardiovascular	1.00	1.01	(1.00-1.02)	1.00	(0.98-1.01)	1.00	(0.99-1.02)	1.02	(1.00-1.03)
ischaemic	1.00	1.01	(0.98-1.03)	0.99	(0.97-1.01)	1.00	(0.98-1.02)	1.00	(0.98-1.03)
cerebrovascular	1.00	1.05	(1.02-1.08)	1.03	(1.00-1.06)	1.03	(1.00-1.06)	1.09	(1.06-1.12)
External causes	1.00	0.93	(0.89-0.98)	0.91	(0.87-0.95)	0.92	(0.88-0.97)	0.97	(0.93-1.02)
suicide	1.00	0.91	(0.84-0.99)	0.88	(0.81-0.96)	0.90	(0.83-0.97)	0.90	(0.83-0.98)
traffic accidents	1.00	0.97	(0.92-1.02)	0.95	(0.90-1.01)	0.97	(0.91-1.03)	1.04	(0.98-1.10)

[a] RR = Relative Risk adjusted for sex, age, marital status, and ethnic origin at the individual level, and socio-economic level and urbanicity at the neighbourhood level

[b] CI = Confidence Interval adjusted for sex, age, marital status, and ethnic origin at the individual level, and socio-economic level and urbanicity at the neighbourhood level

Table 5.5: All-cause mortality risks per community social capital category for different population groups and urbanisation levels

All-cause mortality	Low social capital RR[a]	II RR[a]	II (CI[b])	III RR[a]	III (CI[b])	IV RR[a]	IV (CI[b])	High social capital RR[a]	High social capital (CI[b])
Population group									
Men	1.00	0.98	(0.97-0.99)	0.97	(0.96-0.98)	0.97	(0.96-0.98)	0.98	(0.97-0.99)
Women	1.00	0.98	(0.97-0.99)	0.99	(0.98-1.00)	0.99	(0.98-1.00)	1.03	(1.01-1.04)
Non-married[c]	1.00	1.01	(0.98-1.03)	1.00	(0.98-1.03)	1.02	(0.99-1.04)	1.05	(1.02-1.08)
Married	1.00	0.96	(0.95-0.97)	0.95	(0.94-0.96)	0.95	(0.93-0.96)	0.96	(0.94-0.97)
Western	1.00	0.97	(0.97-0.98)	0.97	(0.96-0.98)	0.97	(0.97-0.98)	1.00	(0.99-1.01)
Non-Western	1.00	1.01	(0.99-1.04)	1.03	(1.00-1.05)	1.02	(0.99-1.05)	1.05	(1.02-1.08)
Urbanisation level[d]									
High	1.00	0.93	(0.91-0.95)	0.96	(0.94-0.98)	0.91	(0.88-0.93)	0.95	(0.91-0.99)
Medium	1.00	0.95	(0.93-0.97)	1.01	(0.99-1.04)	1.04	(1.01-1.06)	1.04	(1.01-1.07)
Low	1.00	1.00	(0.99-1.01)	0.98	(0.97-0.99)	0.99	(0.98-1.01)	1.01	(1.00-1.02)

[a] RR = Relative Risk adjusted for sex, age, marital status, and ethnic origin at the individual level, and socio-economic level and urbanicity at the neighbourhood level

[b] CI = Confidence Interval adjusted for sex, age, marital status, and ethnic origin at the individual level, and socio-economic level and urbanicity at the neighbourhood level

[c] Non married = never married not living together, never married living together, divorced and widowed

[d] Relative Risk per urbanisation level not adjusted for urbanicity at neighbourhood level

5.4 Discussion

Key findings

This study found a great diversity in associations between social capital and health when different diseases, population groups and locations were taken into consideration. However, most of the observed associations between community social capital and mortality were weak, with relative risks ranging from 0.92-1.09 for the different causes of death, from 0.96- 1.05 for the different demographic groups, and from 0.95-1.04 for the different urbanisation levels. No association was found between community social capital and all-cause mortality when taking the total Dutch population into consideration. However, living in a strong social neighbourhood was related to a lower mortality risk for cancer (especially lung cancer), and for external causes (especially suicide). Men, married individuals, and residents of urban areas living in a socially strong neighbourhood had a slightly lower mortality risk than those living in a socially weak neighbourhood.

Evaluation of data and methods

Some methodological limitations of the present study need to be addressed.

First, the clustering of individuals within neighbourhoods and the spatial clustering of neighbourhoods was disregarded. Residents living in the same neighbourhood tend to be more comparable in terms of demographic and socio-economic characteristics as opposed to residents of other neighbourhoods. More appropriate statistical methods (such as multilevel analysis) would take this clustering of individuals into account, leading to better estimates of contextual influences[6,233]. In addition, geographically adjoining neighbourhoods are comparable in terms of contextual variables, which might also influence associations found in the present study[234-236]. Unfortunately we were unable to adjust for clustering between individuals and neighbourhoods because the data set was too large to perform such analyses within the CBS infrastructure. Indirect standardised mortality rates were used to account for clustering between individuals within neighbourhoods. The spatial correlation between adjoining neighbourhoods in community social capital seemed minimal when neighbourhoods were mapped across the Netherlands (map not shown). However, disregarding the clustering of individuals within neighbourhoods and the

spatial clustering between neighbourhoods could have led to overestimation of the significance levels of the observed associations; however, we believe that such an overestimation will be minimal.

Second, the concept of social capital remains debatable and various definitions are used to embody this concept[125-127]. We used the definition of Putnam[99] and created an index containing several social capital items; however, some aspects of community social capital were not included because data were not available. Nevertheless, we believe that including more items would not have substantially changed the geographical variation in community social capital.

Third, community social capital was based on the perceptions of a sample of neighbourhood residents; this sample was sometimes as small as five persons (neighbourhoods with fewer respondents were excluded from our analysis). This minimum number might be too low and too unreliable to indicate neighbourhood social capital. Therefore we evaluated to what extent our results would differ if a higher cut-off limit, i.e. 20 respondents per neighbourhood, had been used to include the neighbourhoods. Had we used the later cut-off point, the final study sample would have included 1002 neighbourhoods with 4481 960 residents. Most of the studied associations did not reach statistical significance, but did give an indication that supported our main findings. For example, slightly lower all-cause mortality risks (RR=0.98; CI: 0.96-0.99) and lower risks for ischaemic heart disease mortality (RR=0.95; CI: 0.92-0.99) were found among residents living in the highest social capital category. Comparable associations were observed for the different population groups, except that women, non-married residents, and residents of non-Western origin showed no elevated mortality risks in the highest social capital category. No associations were found between community social capital and mortality in any of the three urbanisation levels.

Finally, the variation in our community social capital measure was small (Table 1) and might be responsible for the weak association found between community social capital and mortality. Other studies reported a greater variation in their social capital measure[100,106,121] but comparison is difficult because different constructs are used to embody community social capital[125-127].

Comparison to previous studies

In the present study, no association was found between community social capital and all-cause mortality. Although some earlier studies also reported no association[117,123,124], others found a lower mortality risk in strong social communities [25,102]. Although the association between community social capital and mortality proved to be weak, it might be stronger for less extreme health outcomes, such as self-perceived health. Most studies[103,106,110,114,115], but not all[106,118,121], found that living in a strong social community was related to better self-perceived health.

Very few studies have examined the relation between community social capital and health for certain population groups. One study found that living in religiously affiliated communities in Israel decreased mortality risks and that these risks were lower for men than for women[102]. A study examining the influence of community social capital on survival after hospitalisation among the elderly found no evidence for any interactions between social capital and sex, or between social capital and ethnicity[116]. A study performed in the Helsinki metropolitan area found that community social capital was related to lower mortality rates among the younger age groups but not among the elderly[25].

In the present study, the association between community social capital and mortality varied slightly depending on the urbanisation level. To our knowledge, only one other study stratified their study sample into various urbanisation levels but found no association between community social capital and self-perceived health in rural or in urban areas[231].

Explanations for the results

No association was found between community social capital and all-cause mortality for the total Dutch population. An explanation for this might be that, in the Netherlands, community social capital is a less important determinant of health compared with the social environments created in other places (e.g. work, school or sports club). Compared with contacts with friends or relatives, contacts with neighbours are often seen as ‘weaker’ social ties[230], and have less impact on health than the ‘stronger’ social ties[237].

Living in a high social capital neighbourhood was most clearly related to a lower mortality risk among men and married persons. Different levels of appreciation of living in a strong social community[112,231] might explain the observed differences in associations between the married and non-married groups. The higher risk for mortality in strong social neighbourhoods for women, and for residents of non-Western origin might be related to processes of social pressure and social control, which might prohibit these groups from making the optimal choice for their own well-being[122].

Ethnic heterogeneity within the neighbourhood might also influence the relation between social capital and mortality. Studies on racial residential segregation in the USA reported worse health outcomes among residents of racially segregated areas[17,18,86]. However compared with the USA, ethnic heterogeneity within Dutch neighbourhoods is less dramatic with only 15% of the neighbourhoods containing more than 20% migrants. In additional analyses, in which neighbourhoods were stratified according to the percentage of migrants, no substantial differences emerged for the relation between social capital and mortality between neighbourhoods with a low or high percentage of migrants.

Lung cancer mortality risk was decreased among residents living in high social capital neighbourhoods. Informal social control and social pressure from neighbours might prevent smoking and thereby reduce lung cancer rates. In additional analyses, the role of smoking was assessed by examining smoking percentages across the social capital categories, using data from the WBO survey. From the highest to the lowest social capital category the percentages of smokers were 29%, 30%, 31%, 33%, and 38% (p-value for trend <0.001), which supported the role of smoking.
Finally, selective migration processes might contribute to the observed associations between community social capital and mortality as observed in the different population groups and locations. Healthier individuals are more likely to move towards the 'more attractive' areas such as high social capital neighbourhoods while unhealthier individuals stay behind in the 'less attractive' areas such as low social capital neighbourhoods. In the Netherlands only weak associations were found between self-perceived health and migration to deprived or less deprived areas[204]. Selective migration processes are also related to personal characteristics such as

age and marital status[202,220,221] and the resulting health differences across neighbourhoods might therefore be larger for certain population groups However the effect of selective migration processes on the relationship between community social capital and health has not yet been fully investigated.

5.5 Conclusion

This study found that the association between community social capital and health differs according to the cause of death, population group and location studied; however, most of the associations found were weak. The range of health effects found in previous research on social capital might be explained, in part, by the differences in health outcomes, populations or locations studied. Comparisons of different health outcomes, population groups and locations might help to further elucidate the relation between community social capital and health.

Chapter 6

Community social capital and suicide mortality in the Netherlands

Based on:

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Community social capital and suicide mortality in the Netherlands

Final draft

Abstract

Background

Evidence on the effect of community social capital on suicide mortality rates is fragmentary and inconsistent. The present study aims to assess whether small area variations in suicide mortality across the Netherlands are associated with measures of community social capital.

Methods

A data base was created with all deaths in 1995-2000 classified according to neighbourhood of residence in 1995. We included 3507 areas and 6207 suicide deaths. Data from a large-scale national survey and population registries were used to measure, for each area, the level of social capital according to a perceptive/behavioural and a structural/demographic measure. Associations with mortality were assessed by means of Poisson regression analysis, with control for individual-level variables (age, sex, marital status, ethnic origin) and background contextual variables (socioeconomic level, population density, cultural-religious orientation).

Results

Suicide mortality rates were 30 percent higher in areas with low social capital as compared to areas with high social capital, according to the perceptive/behavioural measure. This association could largely be explained by the compositional effect of marital status, with an additional effect of control for background contextual variables. An 8 percent difference (CI: 1.02-1.16) remained after full control. Stratified analyses showed a 12 percent difference among men, an 18 percent difference in the age group 0-50 years, and a 30 percent difference among the non-married after full control. In contrast, differences were 2 percent or even smaller among women, 50+ years olds, and the married. Associations with the structural/demographic measure of social capital were similar, but weaker, and not statistically significant after full control.

Conclusion

The association between suicide mortality and community social capital is largely explained by compositional effects. Contextual effects, if any, would be restricted to specific population groups, such as younger men living without a partner.

6.1 Introduction

Enhancing social cohesion of communities has gained increasingly more popularity as a strategy to improve the health of populations at local, regional or national levels [122,126,238]. A growing literature therefore aims to describe variations in health between communities, and to identify community characteristics associated with these health variations [8]. Particular attention has been given to social capital, which is defined in various ways, including the well-known definition of Putnam as "those features of social structures (such as levels of interpersonal trust and norms of reciprocity and mutual aid), which act as resources for individuals and facilitate collective action" [99].

Despite the expectation of positive effects of community social capital on the health of populations, the evidence for such effects is yet inconsistent [37,82,239]. Most often, observed effects were small as compared to effect of personal characteristics of individual people. Evidence is particularly scarce with regard to effects on the occurrence of mental (instead of physical) health problems. A recent review suggested that ecological or multi-level studies do not provide consistent evidence to suggest that social capital as measured at community levels is related to mental health problems [82].

This also applies to suicide. Ever since the classic studies of Durkheim, large geographical variations in suicide mortality have been observed in many countries [240]. Many studies documented that such variations were related to socioeconomic conditions and social-cultural traditions [241]. Yet, it is uncertain whether these geographical patterns are related to the social organisation of communities, and more particularly to different levels of community social capital [242]. A recent review identified only two studies that assessed associations between regional suicide mortality rates and measures of social capital - with opposing results [82].

In a recent paper on the Netherlands, we observed that community social capital had very small effects on all-cause mortality and most causes of death, but larger effects in the expected direction on suicide mortality [243]. Neighbourhoods with higher level of social capital had about 10 percent lower suicide mortality rates as compared to other neighbourhoods. The purpose of the present paper is to further analyse this

preliminary evidence for a protective effect of community social capital. We will extend that work in three ways.

First, we will use complementary measures of social capital. The previous paper only applied a measure based on self reports of respondents to survey questions on social relationships [243]. This measurement, which is most common in studies on health effects of community social capital, stresses the perceptive, cognitive and behavioural aspects of social capital. As recommended by others, we will use a complementary measure emphasising structural measures of social capital [82]. More specifically, we will use Congdon's measure of social fragmentation [244-246].

Second, we will assess the specific role of community social capital against the background of more fundamental characteristics of neighbourhoods. Geographical variations in social capital do not originate at random, but emerge in response to historical, social-cultural, and socioeconomic conditions. These conditions could act as confounders if they are independently related to suicide mortality rates. In the Netherlands, particular attention may need to be given to the large social-cultural variations within the country, which traditionally were associated with differences in religious denomination [247].

Third, we will assess cross-level effects. Geographic studies of suicide mortality observed interactions between area-level variables and characteristics of individuals [242]. For example, a study on suicide rates within London observed that a higher proportion of non-white residents in an area was associated with lower suicide mortality rates among non-whites, but with higher suicide rates among whites [248]. However, cross-level interactions are not observed in each study [108]. To our knowledge, cross-level effects involving community social capital and suicide have not been investigated in any previous study.

The current paper utilises a national data set representing all suicide deaths in the Netherlands in the period 1996-2000. We will study variations in suicide mortality between 3507 Dutch neighbourhoods in relationship to two indicators of social capital (perceptive/behavioural and structural/demographic) and with control for four background characteristics of these areas (socioeconomic level, population density

and two cultural-religious variables). We will take into account four characteristics of individual residents (age, sex, marital status and ethnic origin) both to control for compositional confounding and to assess cross-level effects.

6.2 Methods

Mortality records and corresponding population data for the years 1995 through 2000 were provided by Statistics Netherlands (CBS). Mortality records were linked to population registry data using personal identification numbers. Persons could enter (through birth or immigration) or leave the study (by death or emigration) during this period. All persons who died during the study period were registered, irrespective of whether the death occurred in the Netherlands or abroad.

Suicide deaths were classified according to the ICD-9 (in 1995, with codes E950-E959) and the ICD-10 (1996-2000, with codes X60-X84). During the 6-year study period, the average number of suicide deaths per neighbourhood was 1.77, with standard deviation of 2.28, and a maximum of 33 deaths in one large neighbourhood.

For each person, information was available on sex, five-year age group, marital status (never married, married, divorced, widowed), ethnic origin (Dutch, Turkish, Moroccan, Antillean, Surinamese and other non-Western) and place of residence (using postcode data). Following the standard definition of CBS, a person was considered to be of non-Western origin if at least one of the parents was born in Turkey, Africa, Latin America or Asia (excluding Japan and the former Dutch colony of Indonesia) [171].

Using the postcode information, each individual was classified according to neighbourhood of residence. Neighbourhoods ("buurten" in the official CBS terminology) were chosen as the geographical unit of analyses. The boundaries of these areas were defined in terms of topography or socio-economic similarities of residents. Neighbourhoods were relatively small. In 1995, the Netherlands consisted of 10,381 neighbourhoods with on average an area surface of 3.4 km^2 and 1486 residents.

Community social capital within each neighbourhood was derived from the Housing Demand Survey of 1998 (WBO). This national survey is based on a randomly drawn sample of the Dutch population aged 18 years and over. The data were collected by means of telephone interviews, face to face interviews, or internet questionnaires. Information was available for 117,569 individuals i.e. 0.76% of the Dutch population. Response rate across all municipalities was 51 percent. The WBO included 13 questions on aspects of neighbourhood social capital as defined according to Putnam [99]. These items represented topics such as the attachment to the neighbourhood, degree of interaction with neighbours, and responsibility for the neighbourhood environment. An unrotated principal component analysis with correlation matrix was used to identify a mutual component. All thirteen items had a correlation of 0.60 or higher with the first component. The first component explained 54% of the variation between the thirteen items, with a Cronbach's alpha of 0.60. The level of neighbourhood social capital was calculated as the average score on this component of all neighbourhood residents that participated in the survey [243].

A complementary measure of social capital focussed on the structural dimension, as measured by demographic variables. For this, we applied an index developed by Congdon [244,245]. This index equals the sum of the percentage of adult resident living alone, the percentage of households headed by single parents, the percentage of residents living less than 1 year in the neighbourhood, and the percentage of households renting a house. Data on these four indicators were derived from the continuous population registry or the WBO survey of 1998.

The socio-economic level of neighbourhoods was measured by the percentage of residents with an income below the 40 percent level of the national income distribution (i.e. less than 12,025 euro in 1995). The income data were derived from tax registries for the year 1995. From a wider range of possible income measure, this measure was selected because it was most strongly related to neighbourhood variation in mortality across the Netherlands. In addition, the inclusion of other income measures did not substantially contribute to the explanation of these mortality variations [243]. Unfortunately, no information was available on the educational level or occupational class of residents of neighbourhoods.

The population density of neighbourhoods was measured by means of the number of addresses per square kilometre. Data were obtained from the population registry for 1995. We selected this measure because it is commonly applied by CBS to measure population density or degree of urbanisation. Application of an alternative measure, based on the population size of municipalities, did not show relationships much different from those reported in this paper.

Two indicators were used to measure the cultural-religious orientation of different areas in the Netherlands: (a) the proportion of the residents who reported to belong to the Roman Catholic Church, and (b) the percentage of resident that go to church at least once a week. The first measure potentially relevant to the Netherlands because of the traditional distinction between the Roman Catholic south and the protestant West and North of the country, which is associated with long-standing social-cultural differences between different regions. The latter measure is especially relevant to distinguish between areas of a traditional, orthodox signature, and more modern and liberal areas [247]. Data on both variables were derived from the WBO survey.

Neighbourhoods with less than 5 observations for the WBO survey (6,863 neighbourhoods) were excluded from analyses because social capital measures based on such a small sample were less precise. We have evaluated to what extent our results would differ if a higher limit, 20 respondents per neighbourhood, were used to include neighbourhoods. Even though results varied in details, they support the main findings as summarized below. Another 11 neighbourhoods were excluded because of missing data on neighbourhood socio-economic level. Analyses were performed on the remaining 3,507 neighbourhoods (33.78% of all neighbourhoods in the Netherlands) with 11,037,640 residents (71.56% of all Dutch citizens). Excluded areas mostly consisted of small rural neighbourhoods.

The selected neighbourhoods were ranked according to their scores on the contextual variables, and grouped into five quintiles (for the background variables) or three tertiles (for the social capital measures) with each category containing an equally sized proportion of the total number of Dutch citizens.

Poisson regression models were used to measure the association between area levels of suicide mortality and contextual determinants. Contextual variables were included in the models as independent variables. Control was made for population size and population composition by means of the offset variable. In our Poisson regression model, this offset variable was equal to the logarithm of the expected number of deaths in each neighbourhood. For this, we first calculated the expected number of deaths for each of the 1008 possible combinations of sex, age, marital status and ethnic origin. This number of deaths was calculated by multiplying the mortality rate corresponding to each combination with the number of residents in that combination. By summing the product over all 1008 combinations, we obtained the number of deaths that could be expected given the size and composition of the population of each neighbourhood [243].

Regression analyses were carried out for both the total population, and for subgroups of the population stratified according to sex (male or female), age (0-49 or 50+ years), marital status (non-married or married) and ethnic origin (Western or non-Western).

6.3 Results

An overview of the independent variables together with their average values, distributional measures, and their correlation with the first measure of community social capital is presented in table 1. Level of social capital is strongly correlated with low population density (correlation of -0.508). Weaker associations (correlations of about 0.20) are observed with the presence of low income groups and cultural-religious characteristics of areas. The two social capital measures are only weakly correlated (0.218).

Table 6.1: Distribution of number of suicide deaths, and of contextual variables across neighbourhoods in the Netherlands

Contextual variable	Mean	Std[a]	Minimum	Maximum	Correlation with social capital
Social capital (perceptive/behavioural)	0.00	1.00	-3.60	4.64	1.000
Social capital (structural/demographic)	0.02	2.32	-4.27	14.28	0.218
Percentage residents with a low income	38.79	7.53	16.00	76.00	-0.241
Population density (no. addresses/km^2)	1211	1141	16	11330	-0.508
Percentage Roman Catholics	32.92	29.54	0	100	0.150
Percentage residents that go to church	14.41	10.64	0	85.71	0.209

[a] Std = standard deviation

Suicide mortality levels of neighbourhoods very strongly in relationship to most of the background characteristics of these areas (table 2). About one half of the variations can be explained by control for marital status as the compositional variable. In multivariate analysis, large variations are observed only in relationship to the socioeconomic variable, while variations according to population density and cultural-religious variables are small, non-linear, and non-significant after full control.

Suicide mortality rates are 30% higher in areas with low community social capital according to the perceptive/behavioural measure (table 3). Half of this difference is explained by the compositional effect of marital status, and an additional part of this difference is explained by control for background area characteristics. An 8 percent difference remains in the full model, with 95 percent confidence ranging from 2 to 16 percent. Associations with the complementary measure of social capital are weaker, and in the final model not statistically significant.

Table 6.2: Association between background contextual variables and suicide mortality (results of multivariate regression analyses)

Contextual variable		Number of suicides	Rate Ratio (95% confidence interval) estimated with control for					
			age, sex, ethnic origin		plus marital status		plus all background contextual variables	
Neighbourhood socio-economic level	low	1651	1.60	(1.48-1.73)	1.33	(1.23-1.44)	1.31	(1.21-1.42)
		1370	1.28	(1.18-1.39)	1.18	(1.09-1.28)	1.17	(1.08-1.27)
		1021	1.12	(1.03-1.22)	1.08	(0.99-1.18)	1.07	(0.98-1.17)
		1135	1.03	(0.94-1.12)	1.01	(0.93-1.10)	1.01	(0.93-1.10)
	high	1030	1.00		1.00		1.00	
Population density (no. addresses/km^2)	urban	1609	1.45	(1.34-1.56)	1.12	(1.04-1.21)	1.05	(0.96-1.14)
		1273	1.18	(1.09-1.28)	1.05	(0.97-1.14)	1.03	(0.95-1.12)
		1126	1.07	(0.98-1.16)	1.01	(0.93-1.09)	1.01	(0.93-1.10)
		1125	1.06	(0.98-1.16)	1.04	(0.96-1.14)	1.05	(0.97-1.15)
	rural	1074	1.00		1.00		1.00	
Percentage Roman Catholics	low	1169	0.96	(0.88-1.05)	0.92	(0.85-1.00)	0.92	(0.84-1.01)
		1235	0.98	(0.91-1.07)	0.92	(0.84-1.00)	0.92	(0.84-1.01)
		1288	1.06	(0.98-1.15)	0.97	(0.89-1.05)	0.99	(0.90-1.07)
		1495	1.04	(0.96-1.12)	0.99	(0.92-1.08)	1.02	(0.94-1.10)
	high	1020	1.00		1.00		1.00	
Percentage residents that go to church	low	1390	1.28	(1.18-1.38)	1.12	(1.03-1.21)	1.02	(0.93-1.11)
		1282	1.17	(1.08-1.27)	1.11	(1.03-1.21)	1.06	(0.97-1.16)
		1276	1.15	(1.06-1.25)	1.07	(0.99-1.16)	1.03	(0.95-1.12)
		1192	1.11	(1.02-1.21)	1.04	(0.96-1.13)	1.02	(0.94-1.11)
	high	1067	1.00		1.00		1.00	

Table 6.3: Association of suicide rates with the two measures of community social capital. Results of multivariate regression analyses

Contextual variable		Number of suicides	Rate Ratio (95% confidence interval) estimated with control for					
			age, sex, ethnic origin		plus marital status		plus all background contextual variables	
Social capital (perceptive/behavioural)	low	2434	1.31	(1.24-1.40)	1.15	(1.08-1.22)	1.08	(1.02-1.16)
	medium	1902	1.02	(0.96-1.09)	0.98	(0.92-1.04)	0.98	(0.92-1.05)
	high	1871	1.00		1.00		1.00	
Social capital (structural/demographic)	high	2254	1.22	(1.15-1.30)	1.08	(1.02-1.15)	1.02	(0.96-1.09)
	medium	2014	1.10	(1.04-1.18)	1.05	(0.99-1.12)	1.03	(0.97-1.10)
	low	1939	1.00		1.00		1.00	

Table 6.4: Association between social features of the neighbourhood and suicide according to social-demographic characteristics of residents

A. Stratification by sex

Contextual variable		Rate Ratio (95% confidence interval)							
		Men				Women			
		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables	
Social capital (perceptive/behav)	low	1.17	(1.09-1.26)	1.12	(1.04-1.22)	1.11	(1.00-1.23)	1.01	(0.91-1.13)
	medium	1.00	(0.93-1.08)	1.01	(0.94-1.10)	0.93	(0.84-1.04)	0.92	(0.83-1.03)
	high	1.00	--	1.00	--	1.00	--	1.00	--
Social capital (structural/demog)	high	1.09	(1.01-1.17)	1.04	(0.96-1.12)	1.07	(0.97-1.19)	0.98	(0.88-1.10)
	medium	1.05	(0.97-1.13)	1.03	(0.95-1.11)	1.07	(0.96-1.19)	1.04	(0.93-1.16)
	low	1.00	--	1.00	--	1.00	--	1.00	--

B. Stratification by age

Contextual variable		Rate Ratio (95% confidence interval)							
		0-50 years olds				50 years and older			
		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables	
Social capital (perceptive/behav)	low	1.26	(1.16-1.37)	1.18	(1.08-1.29)	1.01	(0.92-1.11)	0.98	(0.88-1.08)
	medium	1.04	(0.96-1.14)	1.05	(0.96-1.15)	0.91	(0.82-1.00)	0.91	(0.82-1.00)
	high	1.00	--	1.00	--	1.00	--	1.00	--
Social capital (structural/demog)	high	1.15	(1.06-1.24)	1.05	(0.96-1.14)	1.00	(0.91-1.10)	0.98	(0.89-1.08)
	medium	1.08	(1.00-1.18)	1.05	(0.97-1.15)	1.02	(0.93-1.12)	1.02	(0.92-1.12)
	low	1.00	--	1.00	--	1.00	--	1.00	--

C. Stratification by marital status

Contextual variable		Rate Ratio (95% confidence interval)							
		Unmarried				Married			
		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables	
Social capital (perceptive/behav)	low	1.39	(1.26-1.54)	1.30	(1.16-1.45)	1.00	(0.91-1.11)	0.98	(0.88-1.09)
	medium	1.10	(0.99-1.23)	1.10	(0.98-1.23)	0.89	(0.80-0.98)	0.90	(0.81-1.00)
	high	1.00	--	1.00	--	1.00	--	1.00	--
Social capital (structural/demog)	high	1.19	(1.08-1.32)	1.07	(0.96-1.19)	1.04	(0.94-1.15)	1.01	(0.91-1.13)
	medium	1.11	(1.00-1.24)	1.08	(0.97-1.20)	1.07	(0.97-1.18)	1.07	(0.97-1.18)
	low	1.00	--	1.00	--	1.00	--	1.00	--

D. Stratification by ethnic origin

Contextual variable		Rate Ratio (95% confidence interval)							
		Western				Non-Western			
		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables		Control for age, sex, ethnicity, marital status		Plus control for background contextual variables	
Social capital (perceptive/behav)	low	1.16	(1.08-1.23)	1.09	(1.01-1.17)	1.19	(1.01-1.40)	1.10	(0.92-1.31)
	medium	0.97	(0.90-1.03)	0.97	(0.90-1.04)	1.08	(0.90-1.29)	1.07	(0.89-1.29)
	high	1.00	--	1.00	--	1.00	--	1.00	--
Social capital (structural/demog)	high	1.09	(1.02-1.16)	1.02	(0.95-1.09)	1.10	(0.94-1.29)	1.04	(0.88-1.23)
	medium	1.04	(0.97-1.11)	1.02	(0.95-1.09)	1.15	(0.98-1.36)	1.12	(0.94-1.32)
	low	1.00	--	1.00	--	1.00	--	1.00	--

Results of stratified analyses are presented in table 4. Important cross-level effects are suggested in the full model. The perceptive/behavioural measure of social capital is associated with a 12 percent difference in suicide mortality among men, but not among women. Similarly, an 18 percent mortality difference in observed for the age group 0-50 years, but not for the younger age groups. A 30 percent difference is observed among the non-married, but not among the married. Statistical tests showed that the interactions with sex, age and marital status were statistically significant. The interaction with ethnic origin was statistically significant, but small in substantial terms. Interactions with the structural/demographic measure of social capital were similar, but weaker, and no association was statistically significant after full control.

6.4 Discussion

In principle, community social capital could directly influence suicide risk of residents in various ways [81]. At the community level, high levels of social capitals could be important for undertaking collective action and mobilising of resources, including social and mental health services. Among neighbours, high levels of social capital may increase mutual aid and social support, including to residents with mental health problems. For individual residents, living in a high-capital community may foster positive psychosocial mechanisms related to feelings of security, identity, and shared emotional connection.

Although community social capital may therefore be expected to influence suicide mortality rates, empirical evidence on the existence and magnitude of such an effect is yet fragmentary [37,82,239]. This current study utilised a large national data set with detailed measurement of social capital for 3507 neighbourhoods. We observed large differences in suicide mortality in relationship to two measures of community social capital. However, about one half of these differences could be explained by the compositional effect of marital status. Control for background contextual variables, especially socioeconomic conditions, explained an additional part of these differences. The residual differences were small for the total population (8 percent)

and mostly restricted to men, residents younger than 50 years, and non-married people.

Evaluation of data limitations

As most other studies on social capital and health, this paper is based on secondary analysis of available data. A main advantage of our data is that it covered small areas across the entire national territory. This coverage ensured representativeness of the results for the total national population, but it also implied a methodological difference to those previous studies that were restricted to cities or metropolitan areas. Further analysis showed that we would have observed slightly larger effects of community social capital on suicide mortality rates if we were to restrict the analysis to the four largest cities of the Netherlands (*results not shown*).

In this study, we deliberately selected the smallest possible geographical units, local neighbourhoods, because such areas were expected to be most meaningful for the postulated causal mechanisms linking social capital to suicide. These neighbourhoods were only 3.4 km^2 large and had only 1486 residents on average. Moreover, most of these areas were demarcated in socioeconomically or geographically meaningful terms, and therefore they were likely to correspond, at least in part, to people's perceptions of what constitute their community. Nonetheless, because of our choice to compare local neighbourhoods, we may have missed associations that could have be formed at lower geographical scales such as blocks or streets or at higher scales such as cities or states [249,250].

In this study, suicide deaths were identified by the population registry using death certificates for "non-natural causes". The coverage of this source of information could be evaluated by comparison to policy registries. A small degree of underreporting of suicide deaths was observed, although exact estimates are lacking [251]. However, we do not expect that the degree of underreporting would systematically vary between different types of areas, such as areas with different levels of social capital.

A multilevel analysis would have been the most appropriate method given the nested structure of the data. However, by the time of our study, a national dataset of 11 million people nested into 3500 neighbourhoods was too large for running multilevel

analyses programs within the CBS infrastructure. We therefore applied another methodology to control for compositional effects (see Methods section). Application of this alternative methodology does not bias estimates of the magnitude of effect. However, the length of the 95 percent confidence intervals surrounding these estimates can be underestimated because this method disregards the clustering of individuals within neighbourhoods. Therefore, estimates of confidence intervals should be interpreted with some caution.

The measurement of neighbourhood variations in social capital was based on secondary analysis of available data. Our key measure of social capital was constructed on the basis of 13 items that were selected from a larger range of potentially relevant questions in the WBO survey. The selection and processing of these items was guided by Putnam's definition of community social capital [243]. Despite this careful construction, we cannot exclude the possibility that areas have been misclassified in terms of community social capital. For example, some areas may have been misclassified due to a small number of residents included to the WBO survey. Assuming this misclassification to be non-differential, we expect this to have caused an underestimation of the associations studied in this paper.

To conclude, most of the data limitations discussed above are likely to have caused no substantial bias or otherwise resulted in a underestimation of the association between community social capital and suicide mortality. A stronger association might perhaps have been observed especially if we were to have validated data on community social capital.

Explanations of observed patterns

The observed association between social capital and suicide could for about 50 percent be attributed to the compositional effect of marital status. This underlines the potential importance of population composition in explaining associations between community social capital and mental health in general, and suicide in particular. Strong compositional effects have also been observed in other studies on mental health [108,242]. In our study, the true contribution of compositional effects is therefore likely to exceed by far the 50 percent contribution observed for marital status only. Several other compositional factors may be important.

The first type of factors are unmeasured factors related to marital status. Factors such as partnership (e.g. cohabitation of unmarried people) and parenthood (e.g. number of small children) have been found to be related to suicide mortality at the individual level [252-254]. These factors are likely to vary between areas in similar ways as marital status. One study observed that the association between community social capital and the prevalence of depression could in part be explained by the composition of the population in terms of partnership and parenthood [82].

The second type of factors relates to the socioeconomic position of residents. In our analysis, we could only control for socioeconomic factors as measured at the area level, and we observed that this explained about one half of the association observed after control for marital status (table 3). A considerably larger effect might have been observed if we would have been able to control for individual-level measures of socioeconomic position. Analyses from Finland and Denmark found that area-level associations between suicide mortality and socioeconomic indicators could almost entirely explained by individual-level associations [108,242]. This suggests that the area-level associations mostly represent stronger associations at the individual-level. Residual confounding by individual-level socioeconomic factors might explain why associations were observed especially for men and for unmarried people. In most European countries, socioeconomic position as measured by educational level has a greater influence on suicide mortality among men compared to women [255] and among non-married compared to married people [256].

The third type of factors relate to social-cultural features. In our analysis, we aimed to control for socio-cultural differences between neighbourhoods as measured by religious variables that reflected large variations between Dutch regions [247]. However, religious variables may also operate at the individual level. Suicide risk has found to be related to individual factors such as religious denomination (including nowadays Islam), church or mosque attendance, and degree of religiosity [257,258]. In as far as the composition of population in such social-cultural terms is related to social capital, this may have confounded the associations of community social capital with suicide risk.

Compositional effects could play this potentially important role only if community social capital is strongly correlated with the population composition of the neighbourhoods. Two types of geographical processes may be involved [242]. First, composition may influence context. The population composition of an area may affect the amount of social capital within an area. For example, the presence of many families with young children may increase interaction among neighbours, and feelings of responsibility for the neighbourhood.

The second explanation, context influences composition, is part of the selective migration hypothesis. As with other health problems [202,259], people at the greatest risk for suicide are likely to move into, or stay in, areas with low community social capital. As a result, high in-migration rates may be associated with local suicide rates, like one British study observed [260]. The association between community social capital and suicide mortality might therefore in part be due to selective migration. Consistent with this explanation is that we observed an association only among residents younger than 50 years, not among older residents. In the Netherlands, rates of inter-neighbourhood migration are much higher at ages below 50 years than at higher ages. For example, in 2005-2006, about 80 percent of all adults who moved during the last 10 years were younger than 45 years, compared to only about 40 percent of the non-migrants.

Thus, the associations observed in this study might be attributed to effects of population composition and selective migration. This raises the question whether there is any evidence for the expectation that there is a direct, contextual effect of community social capital on suicide mortality rates. More specifically, we should ask whether this expectation fits with our finding that community social capital was associated with suicide risk mainly among men, among those 0-50 years, and among the non-married. In principle, different population groups may benefit from community social capital to a different extent. The largest benefits may be expected among people for whom the neighbourhood is an important source of social support as compared to other environments (e.g. family, friends, work, church or leisure time associations). One Dutch study assessed the amount of social support and practical help that people asked to, and received from, their neighbours instead of other people. Residents with small children were most likely to receive support from their

neighbours, whereas no large differences were observed by sex or by age [261]. Similarly, another Dutch study observed no large differences by sex or by generation in the number of contact with neighbours as compared to others [262]. Based on this partial evidence, it is difficult to believe that community social capital would be much more important to men than to women, or to young as compared to older people.

6.5 Conclusion

We observed that areas with a high level of community social capital had lower suicide mortality rates. This association is consistent with the expectation that high community social capital protects residents against suicide death. However, the empirical support is weak, for two reasons. First, we find it difficult to believe why this contextual effect would be limited to men, the unmarried and the young. Second, the observed patterns might also be explained with reference to compositional effects and selective migration processes.

The lack of strong supporting evidence does not imply that the social environment does not play a role in determining suicide risk. The potential importance of social integration has been emphasised ever since Durkheim [240]. Old studies from the Netherlands observed that high suicide mortality rates during the early 20th century were particularly high in small municipalities characterised by social disintegration, as measured for example by a high percentage of voters on fascist parties [263]. Suicide rates were also high in small, isolated villages where social life and the moral climate was dominated by a gloomy form of orthodox Protestantism [263].

These older studies contain important suggestions for studies on the relationship between social environment and suicide in the 21st century [81,254]. Instead of an exclusive focus on social capital, future studies may benefit from a broader perspective of the social environment by taking into account for example social disorder and molest, and the general social-cultural climate. In addition, associations with suicide risk might be observed only in a highly focussed approach, as specific social factors may influence suicide risk in both positive and negative ways, and in different ways for different residents.

Chapter 7

Individual and aggregated evaluations of the neighbourhood environment and psychological health in Amsterdam, the Netherlands

Based on:

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Individual and aggregated evaluations of the neighbourhood environment and psychological health in Amsterdam, the Netherlands

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Abstract

Background

A positive evaluation of the neighbourhood environment is related to better psychological health at the individual level. This study tests the reverse causation hypothesis that people with mental health problems evaluate their environment more negatively than people without these problems. Both individual and aggregated evaluations of the neighbourhood environment are examined and, if aggregated evaluations are not related to psychological health, this would support reverse causation.

Methods

Demographics, education, chronic diseases, physical limitations, psychological health and evaluations of the environment were reported by 1348 participants aged ≥18 years living in 13 neighbourhoods in Amsterdam. Psychological health was measured with the Mental Health Index (MHI-5) and the Kessler Psychological Distress scale (K10). The data for aggregated evaluations and the individual data originated from different surveys. Multilevel regression models were used to estimate the association between evaluation of the environment and psychological health.

Results

A positive evaluation of the neighbourhood environment is consistently associated with better mental health and less depression at the individual level. Aggregated evaluations of the same neighbourhood environment are not related to either mental health or depression. These findings are observed for both social and physical features of the neighbourhood environment.

Conclusion

These findings support the reverse causation theory that states that people with mental health problems evaluate their environment more negatively than people without these problems.

7.1 Introduction

There is increasing evidence that the environment in which one lives is related to one's psychological well-being, with a more positive evaluation of the environment being associated with better psychological well-being. Individuals who indicate that their community does better on social environmental features, such as social capital[82], trust[100,264], cohesion[100,265], neighbourhood connections[264,266-268] and social participation[264,269], less often report psychological health problems. More physical features, such as quality of housing and living environment, are also consistently related to psychological health[100,146,239,267,269-271]. Furthermore, neighbourhood disorder or problems generally represented by a combination of negative social or physical features in the environment (e.g. crime, drug use, graffiti or vandalism) are also negatively related to psychological health[139,146,265,272-274].

Although the cross-sectional association between individual evaluation of the environment and psychological health is often assumed to be causal[35,82,100,146,239,266,267,269-271,275-279], few longitudinal studies are available to test for causality. Two longitudinal studies examined the association between neighbourhood deprivation, disorder and ethnic composition at baseline, and the incidence of mental health problems during follow-up; in these studies no associations were found with psychological health[280,281]. This result contrasts with the often positive results of longitudinal research on other determinants of mental health. For instance, low social support from friends and family was found to precede psychological health problems[282-285]. Causal relations were also reported between work-related factors (e.g. job satisfaction, work stress, job demands and responsibility) and psychological health[285-288].

As evidence for a causal relationship is scarce, other explanations should be explored. One possible explanation relates to the reverse causation hypothesis, which states that persons with psychological health problems would evaluate their environment more negatively than persons without these health problems. This study aims to test this alternative hypothesis. An effective test is to compare the associations between mental health and neighbourhood characteristics measured in two ways: on the individual level by the respondents themselves, and on the

aggregate level by (a sample of) all residents of the neighbourhood. If individual evaluations of the neighbourhood are associated with psychological health but aggregate evaluations are not, this would support the alternative hypothesis of an effect of individual health on the evaluation of the environment.

Only a few studies have examined individual as well as aggregated evaluations of the environment in relation to psychological well-being. Fone et al. (2007) reported that individual and aggregated evaluations of social cohesion were both positively associated with psychological health[35]. In contrast, De Silva (2007) observed that individual evaluations of a strong social community were associated with better psychological health, but when community social capital was judged by many in the area no such association was found[277]. Similar results were also obtained in the US, with social cohesion being associated with depression at the individual level but not at the aggregated level[275]. In contrast, this latter study also found that neighbourhood problems based on more physical environmental features were related to depression when evaluated both by the individual and by many residents in the neighbourhood[275].

The present study aims to contribute to this line of research with analysis of data from Amsterdam. These data allow to examine two mental health outcomes (general mental health and depression) in relationship to both social and physical features of the neighbourhood environment. We first examine the association between individual evaluation of the environment and psychological health, and then explore whether a similar association emerges when aggregated evaluations of the neighbourhood environment are used.

7.2 Methods

Data

Individual data

Data at the Individual level were obtained from the 2004 Health Survey carried out by the Amsterdam Municipal Health Service. This survey involved a stratified sample by age and ethnicity of the Amsterdam general population aged ≥ 18 years, which was

drawn from the municipal registers in 15 neighbourhoods in Amsterdam (Figure 1). The survey provided information on socio-demographics, having a chronic disease or physical limitation, psychological well-being and evaluation of the neighbourhood environment. The overall response rate was 44%.

Psychological well-being was indicated by general mental health measured with the Mental Health Index (MHI-5) and by depression measured with the Kessler Psychological Distress scale (K10). The MHI-5 contains five questions on how many times people felt nervous, down, calm and peaceful, downhearted and miserable, and happy in the past month. The answering categories range from (1) always; (2) mostly; (3) often; (4) sometimes; to (5) seldom. The answering categories of question 3 and 5 were reversed, and a mental health score was calculated that ranged from 0 (indicating poor mental health) to 100 (indicating good mental health)[289]. The K10 consists of 10 questions concerning symptoms of psychological distress experienced in the past 30 days (tired out for no good reason, nervous, so nervous that nothing could calm you down, hopeless, restless or fidgety, so restless you could not sit still, depressed, everything was an effort, so sad that nothing could cheer you up, worthless). The answering categories range from (1) none of the time; (2) a little of the time; (3) some of the time; (4) most of the time; to (5) all of the time. The answering categories to all the questions were reversed and summed to calculate a depression score that ranged from 10 (indicating severe distress) to 50 (indicating no distress).

Evaluations of the neighbourhood environment included statements on social and physical features of the neighbourhood environment (Table 1). The answering categories to the statements ‘People in the neighbourhood hardly know each other’ and ‘In my neighbourhood nuisance from neighbours is common‘ were reversed so that for all neighbourhood features low scores indicated a bad evaluation and high scores indicated a good evaluation of the neighbourhood environment.

Figure 7.1: The 15 neighbourhoods in Amsterdam (in grey) in which data were collected at the individual level.

The following variables were considered as possible confounders in the relation between individual evaluation of the neighbourhood environment and psychological well-being: sex, age, marital status, ethnicity, education, having a chronic disease and physical limitations. Ethnicity was defined according to the definition used by Statistics Netherlands (self-reported country of birth and/or the country of birth of the respondent's mother or father)[171]. Four educational levels were considered (1) primary school and below, (2) lower secondary school or vocational school, (3) higher secondary, pre-university or intermediate vocational education and (4) higher vocational education or university. Chronic diseases included heart problems, stroke, cancer, diabetes, high blood pressure, high cholesterol, migraine, arteriosclerosis, respiratory diseases, bowel problems, psoriasis, eczema, incontinence, rheumatoid arthritis or other long-term illnesses. Physical limitations were calculated from the Activity of Daily Living questionnaire.

Table 7.1: Description of social and physical features of the neighbourhood environment as evaluated by the individual (n=1348) and by other residents in the neighbourhood (n=13)

Neighbourhood environment	Level	Exact formulation	Answering categories
Social features			
Enjoyable neighbourhood	I	- My neighbourhood is enjoyable and has a high level of solidarity	agreement [a]
	N	- I live in an enjoyable neighbourhood with a high level of solidarity	agreement [a]
Feeling at ease among neighbours	I	- I feel at ease with the people in my neighbourhood	agreement [a]
	N	- I feel at ease with the people in my neighbourhood	agreement [a]
People know each other	I	- People in the neighbourhood hardly know each other (recoded)	agreement [a]
	N	- People in the neighbourhood hardly know each other (recoded)	agreement [a]
No nuisance from neighbours	I	- In my neighbourhood nuisance from neighbours is common (recoded)	agreement [a]
	N	- Do your neighbours ever cause a nuisance to you?	experience nuisance[c]
Physical features			
Satisfaction with home	I	- How satisfied are you with your home?	satisfaction [b]
	N	- How would you rate your home?	rate from 1 to 10
Satisfaction with neighbourhood environment	I	- How satisfied are you with your living environment?	satisfaction [b]
	N	- How would you rate your living environment?	rate from 1 to 10
Availability of green	I	- I live in a neighbourhood with a lot of green areas	agreement [a]
	N	- Are you satisfied with the amount of green areas in your neighbourhood?	satisfaction [b]
Availability of shops	I	- In my neighbourhood the local shops are nearby	agreement [a]
	N	- Are you satisfied with the local shops meeting your daily shopping needs?	satisfaction [b]
Availability of play areas	I	- In my neighbourhood there are many play areas for children and young people	agreement [a]
	N	- Are you satisfied with the play areas for children in your neighbourhood?	satisfaction [b]

I = individual level; individual evaluation of the neighbourhood environment

N = neighbourhood level; aggregated evaluation of the neighbourhood environment

[a] (1) don't agree at all; (2) don't agree; (3) neither agree nor disagree; (4) agree; (5) totally agree

[b] (1) not satisfied at all; (2) not satisfied; (3) neither satisfied nor dissatisfied; (4) satisfied (5) very satis

[c] (1) a lot; (2) sometimes; (3) never

Aggregated data

In order to prevent same-source bias, the aggregated evaluation of the neighbourhood environment originated from a different survey than for the individual neighbourhood evaluations and psychological well-being [35,290]. The two surveys used were the Amsterdam Living and Security Survey, and the Social State of Amsterdam City Survey. Both surveys were conducted by the Department of Research and Statistics of Amsterdam Municipality. The Amsterdam Living and Security Survey was a large cross-sectional study (n=9955) conducted in 2003 to assess the safety and security situation of the Amsterdam general population aged 18 years and older. The Social State of Amsterdam City Survey was conducted in 2004 to measure living conditions, participation in prosperity, as well as social, cultural and political participation among 3400 residents aged ≥ 18 years. These surveys included questions on social and physical features of the neighbourhood environment, comparable to the questions used for obtaining individual evaluations of the neighbourhood environment (Table1). The variable "nuisance from neighbours" originated from the Social State of Amsterdam City Survey and all other questions on environmental features originated from the Amsterdam Living and Security Survey. The answering categories to the statement 'People in the neighbourhood hardly know each other' were reversed so that for all neighbourhood features low scores indicated a bad evaluation and high scores indicated a good evaluation of the neighbourhood environment. These evaluations by other neighbourhood residents were aggregated to a weighted average for each of the 15 neighbourhoods and linked with the individual data by neighbourhood code.

For the Amsterdam Health Survey, data were available for 1736 participants. Because of missing data on education or psychological health, 351 participants were excluded. Two neighbourhoods with less than 20 respondents were excluded (total of 37 participants excluded) as a minimum number of 20 observations within a group is suggested for performing multilevel analyses[233,291] . Data analysis was performed on data from the remaining 1348 participants.

Statistical Analyses

Multilevel linear regression analyses were performed to estimate the association between individual (dependent variable) and aggregated (independent variable)

evaluations of the neighbourhood environment. A SAS MIXED procedure was used with individuals at the first level and neighbourhoods at the second level (SAS Institute, Inc., Cary, NC). The method of estimation was a restricted maximum likelihood procedure using random intercept models, and an unstructured covariance structure. Models were adjusted for sex, age, marital status, ethnicity, education, having a chronic disease and having a physical limitation at the individual level. In addition, the mean individual evaluation was fitted against the mean aggregated evaluation of the neighbourhood environment for all 13 selected neighbourhoods.

Similar multilevel linear regression analyses were performed to estimate the association
between individual or aggregated evaluation of the neighbourhood environment and mental health or depression (SAS MIXED procedure with restricted maximum likelihood, random intercept and unstructured covariance). Sex, age, marital status, ethnicity, education, having a chronic disease and having a physical limitation were included as possible individual confounders. For comparisons between mental health effect estimates related to individual and aggregated evaluations of the neighbourhood environment, evaluations were standardised with a mean of zero and a standard deviation (SD) of one. A p-value of 0.05 was taken as the level of significance.

7.3 Results

Table 2 presents the response rate, number of interviewed residents, mean mental health and depression score, and mean aggregated evaluation of the neighbourhood environment for each of the 13 selected neighbourhoods in Amsterdam. Neighbourhoods with lower or higher scores for the two psychological health outcomes do not consistently have lower or higher scores for the aggregated evaluations of the neighbourhood environment.

Table 7.2: Distribution of response rates, number of interviewed residents, psychological health, and aggregated evaluation of the neighbourhood environment for the 13 investigated neighbourhoods in Amsterdam

	Amsterdam neighbourhood												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**11**	**13**
Response rate (%)	38.3	40.6	39.9	42.9	46.1	56.3	48.9	44.7	47.3	43.0	47.7	43.1	40.2
Number of interviewed residents (N)	78	91	56	87	81	82	36	173	129	151	112	182	90
Psychological health (mean)													
Mental health score [a]	78.2	65.2	67.8	75.9	76.5	69.1	76.0	74.5	75.8	73.8	70.8	71.7	72.6
Depression score [b]	33.8	29.7	30.3	33.9	33.9	31.0	34.1	34.0	33.8	33.7	34.0	32.2	32.7
Aggregated evaluation of the neighbourhood environment[c]													
Social features (mean)													
Enjoyable neighbourhood	3.4	3.2	3.0	3.4	3.1	3.0	3.1	3.1	2.7	2.7	2.5	3.1	2.9
Feeling at ease among neighbours	3.9	3.5	3.5	3.8	3.8	3.5	3.6	3.5	3.3	3.2	2.9	3.6	3.4
People know each other	3.3	3.2	2.9	3.0	2.8	2.9	3.1	3.0	2.7	3.0	2.6	3.1	3.0
No nuisance from neighbours	2.3	2.4	2.5	2.3	2.2	2.4	2.0	2.4	2.2	2.4	2.6	2.3	2.6
Physical features (mean)													
Satisfaction with home	7.8	7.3	6.8	7.5	7.2	7.7	7.4	7.5	6.7	7.5	7.2	7.6	7.8
Satisfaction with environment	7.9	7.3	7.2	7.6	7.2	7.4	7.4	6.9	6.4	7.0	6.2	7.2	7.0
Availability of green	3.3	3.8	3.5	3.6	3.2	3.3	3.7	4.0	3.8	4.0	3.8	4.0	4.1
Availability of shops	4.2	3.8	4.2	4.5	4.3	4.2	4.2	3.9	3.4	3.9	3.7	4.0	3.8
Availability of play areas	3.1	3.5	3.2	3.4	3.1	3.3	3.4	3.2	3.1	3.5	3.2	3.4	3.4

[a] Mental health score ranges from 0 (indicating poor mental health) to 100 (indicating good mental health)

[b] Depression score ranges from 10 (indicating severe distress) to 50 (indicating no distress)

[c] Higher scores indicate a more positive evaluation towards the neighbourhood environment (see Table 1 for answering categories)

Table 7.3: Association between individual (dependent) and aggregated (independent) evaluation of the neighbourhood environment and neighbourhood variance in individual evaluation of the neighbourhood environment

Neighbourhood environment	Coeff.[a,b]	p-value	Neighbourhood variance without aggregated evaluation[b]	Neighbourhood variance with aggregated evaluation[b]	Reduction in neighbourhood variance (%)
Social features					
Enjoyable neighbourhood	0.70	<0.001	0.034	0.002	94%
Feeling at ease among neighbours	0.45	0.010	0.019	0.008	59%
People know each other	0.29	0.112	0.014	0.001	90%
No nuisance from neighbours	0.58	0.083	0.020	0.014	30%
Physical features					
Satisfaction with home	0.32	0.019	0.021	0.086	na[c]
Satisfaction with environment	0.49	<0.0001	0.052	0.000	100%
Availability of green	1.17	<0.0001	0.151	0.019	87%
Availability of shops	0.61	0.004	0.048	0.020	58%
Availability of play areas	0.55	0.040	0.042	0.005	87%

[a] Coeff = regression coefficient

[b] Adjusted for sex, age, marital status, ethnicity socio-economic status, having a chronic disease and physical limitations at the individual level

[c] na= not applicable because of an increase instead of a decrease in neighbourhood variance

The majority of associations between individual and aggregated evaluation of corresponding environmental features are significant (Table 3). A more positive individual evaluation of the environment is linked with a more positive evaluation by others. Only individual and aggregated evaluations of the environmental features 'people know each other' and 'no nuisance from neighbours' are not significantly associated.

Neighbourhood variance in individual evaluations of the neighbourhood environment ranges from 0.014 to 0.052 when adjusted for all potential correlates at the individual level. Only the neighbourhood variance for the evaluation of availability of green areas is higher, namely 0.151. In most instances, aggregated evaluations of the neighbourhood environment largely reduce the neighbourhood variance in individual evaluations. Smaller reductions are found for the environmental features 'feeling at ease among neighbours', 'no nuisance from neighbours' and 'availability of shops'. Thus, in general, neighbourhood variations in individual evaluations can be explained by neighbourhood variations in aggregated evaluations.

In Figures 2, 3 and 4 the mean individual and aggregated evaluation are fitted against each other for the environmental features 'feeling at ease among neighbours', 'no nuisance from neighbours', and 'satisfaction with neighbourhood environment'. These three environmental features were chosen because of their difference in explained neighbourhood variance calculated in Table 3. The vertical lines display the standard deviation of the mean individual evaluation and indicate that these individual evaluations vary greatly around the mean. On sight, the association between individual and aggregated evaluation of 'no nuisance from neighbours' is weak and non-linear, indicating limited correspondence between the two evaluations (Figure 3). Although some non-linear variations are observed, a mostly linear trend is found between individual and aggregated evaluation of 'feeling at ease among neighbours' (Figure 2) and 'satisfaction with neighbourhood environment' (Figure 4). Again, the correspondence between individual and aggregated evaluations of the neighbourhood environment is high.

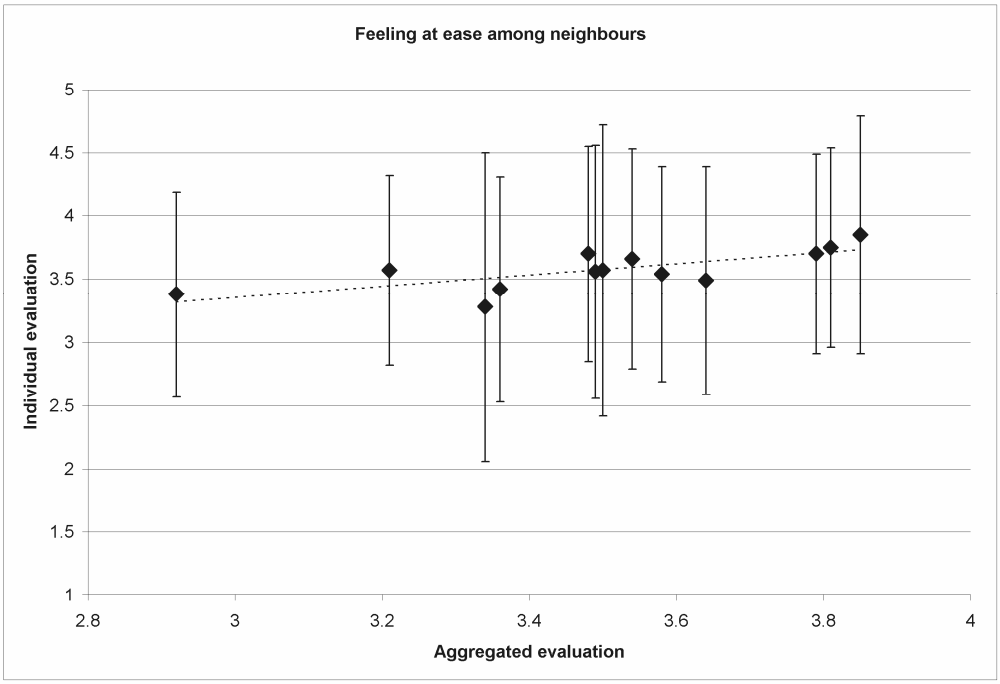

Figure 7.2: Mean and standard deviation of individual evaluation fitted against mean aggregated evaluation of feeling at ease among neighbours

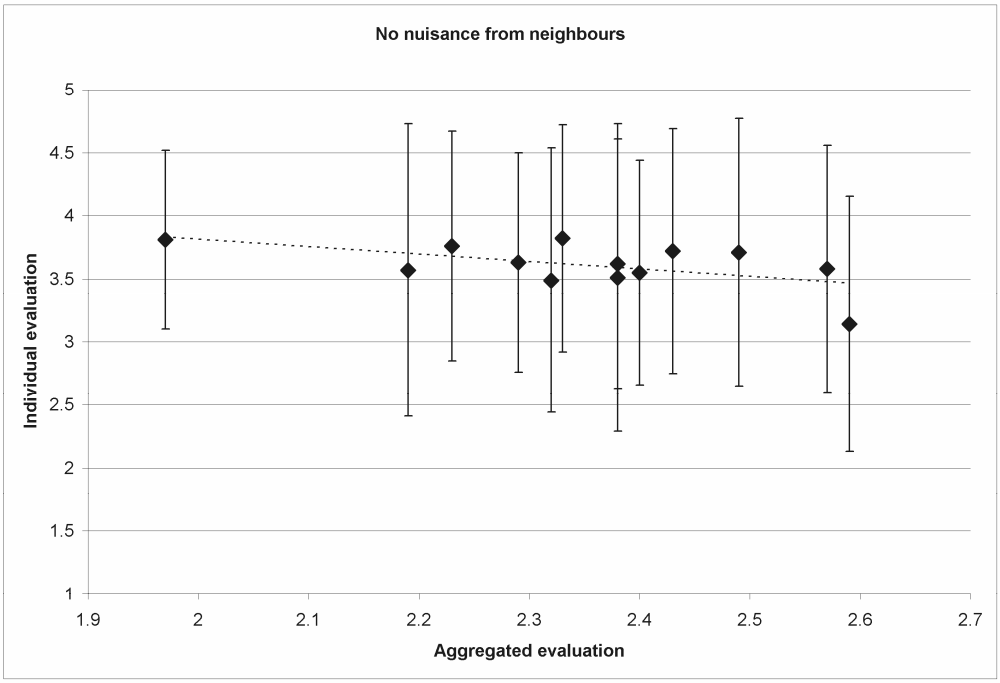

Figure 7.3: Mean and standard deviation of individual evaluation fitted against mean aggregated evaluation of nuisance from neighbours

Table 4 shows the associations between individual and aggregated evaluation of social and physical environmental features with mental health and depression. All observed associations between individual evaluation of the environment and psychological health are in the expected direction, i.e. a more positive evaluation is associated with better psychological well-being. For mental health the strongest associations are observed for 'feeling at ease among neighbours', 'no nuisance from neighbours', and 'satisfaction with home'. For depression, the strongest associations are observed for 'feeling at ease among neighbours', 'satisfaction with home', and 'satisfaction with neighbourhood environment'. The individual evaluation of 'availability of green' is not significantly associated with either mental health or depression. In addition, individual evaluations of 'availability of shops' and 'availability of play areas' are also not associated with depression.

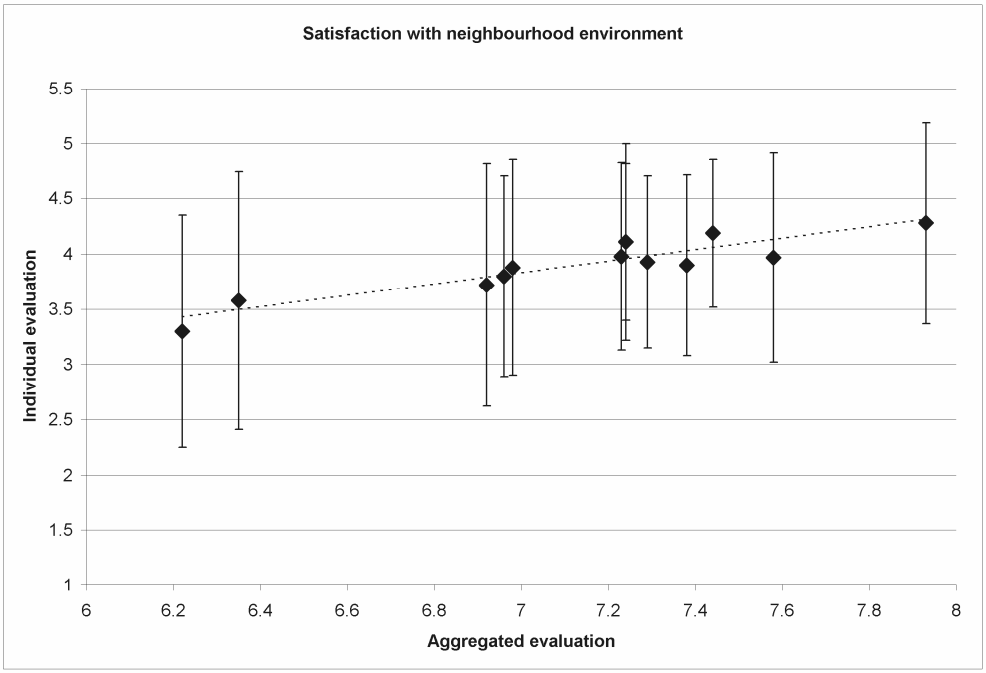

Figure 7.4: Mean and standard deviation of individual evaluation fitted against mean aggregated evaluation of satisfaction with neighbourhood environment

Aggregated measures of social and physical environmental features are most often not significantly associated with psychological health. Only 'availability of play areas' is significantly related to mental health, however in the unexpected direction. If more neighbourhood residents are satisfied with the play areas in the neighbourhood, on average, poorer mental health scores are reported.

Table 7.4: Descriptive statistics and standardised effect estimates of individual and aggregated evaluations of the neighbourhood environment in relation to psychological health

				Poor mental health[a]		Depression[b]	
Neighbourhood environment[c]	Level	Mean	(std)[d]	Beta[e,f]	(CI)[e,g]	Beta[e,f]	(CI)[e,g]
Social features							
Enjoyable neighbourhood	I	3.72	(1.03)	**-1.61**	(-2.61;-0.61)	**-0.53**	(-0.89;-0.17)
	N	3.00	(0.25)	-0.19	(-1.90;1.52)	0.37	(-0.35;1.09)
Feeling at ease among neighbours	I	3.55	(0.94)	**-2.64**	(-3.62;-1.65)	**-0.95**	(-1.31;-0.60)
	N	3.48	(0.25)	-0.38	(-2.07;1.31)	0.31	(-0.42;1.03)
People know each other	I	3.09	(1.07)	**-1.11**	(-2.11;-0.11)	**-0.68**	(-1.04;-0.32)
	N	2.97	(0.19)	0.59	(-1.04;2.21)	0.54	(-0.11;1.20)
No nuisance from neighbours	I	3.58	(1.01)	**-2.39**	(-3.36;-1.42)	**-0.83**	(-1.17;-0.48)
	N	2.36	(0.13)	1.01	(-0.56;2.57)	-0.18	(-0.54;0.91)
Physical features							
Satisfaction with home	I	3.90	(1.07)	**-2.64**	(-3.67;-1.61)	**-0.88**	(-1.25;-0.51)
	N	7.39	(0.32)	1.09	(-0.37;2.55)	0.34	(-0.36;1.04)
Satisfaction with neighbourhood environment	I	3.85	(0.98)	**-1.63**	(-2.62;-0.64)	**-0.98**	(-1.33;-0.63)
	N	7.06	(0.44)	0.34	(-1.26;1.95)	0.52	(-0.11;1.16)
Availability of green	I	3.61	(0.95)	-0.81	(-1.84;0.22)	-0.30	(-0.68;0.07)
	N	3.78	(0.44)	0.76	(-0.82;2.34)	-0.005	(-0.74;0.73)
Availability of shops	I	3.88	(0.91)	**-1.10**	(-2.10;-0.10)	-0.10	(-0.46;0.26)
	N	3.95	(0.27)	0.39	(-1.23;2.01)	0.30	(-0.41;1.01)
Availability of play areas	I	3.48	(0.99)	-0.47	(-1.52;0.58)	-0.35	(-0.74;0.03)
	N	3.29	(0.15)	**1.62**	(0.30;2.93)	0.63	(-0.01;1.26)

I = individual level; individual evaluation of the neighbourhood environment; N = neighbourhood level; aggregated evaluation of the neighbourhood environment; Estimates printed **bold** are significant at the p<0.05 level; [a] Mental health score ranges from 0 (indicating poor mental health) to 100 (indicating good mental health); [b] Depression score ranges from 10 (indicating severe distress) to 50 (indicating no distress); [c] Higher scores indicate a more positive evaluation towards the neighbourhood environment; [d] std = standard deviation; [e] Standardised regression coefficient (effect size estimated at individual and aggregated level can be compared); [f] Adjusted for sex, age, marital status, ethnicity socio-economic status, having a chronic disease and physical limitations at the individual level; [g] CI = 95% confidence interval

7.4 Discussion

As in other studies, the present study found an association between individual evaluation of the neighbourhood environment and psychological health, with a more positive evaluation associated with better psychological health. When aggregated evaluations of the neighbourhood environment were linked to psychological health most often no association was observed. These findings support the alternative reversed causation theory that people suffering from psychological health problems evaluate their environment more negatively than people without these problems.

In the present study, some limitations in the available data should be addressed. An immediate concern is the small number of neighbourhoods. Limited power and limited variation in either environment or health outcome could be responsible for finding no associations between aggregated evaluations of the neighbourhood environment and psychological health. However, other groups using this same study sample did find significant associations between aggregated evaluations of the environment and blood pressure and physical activity despite limited power and variation[147,292]. Nevertheless, we cannot rule out that significant associations might have been found between aggregated evaluations of the neighbourhood environment and psychological health had data from more neighbourhoods been available, or if more diversity had existed between the selected neighbourhoods.

Furthermore, internal migration of residents between neighbourhoods in Amsterdam might have contributed to the weak associations that we observed between neighbourhood environment and psychological health. For people who recently moved into a neighbourhood, their former neighbourhood environment may be a more influential contributor to health than their current neighbourhood environment. For these inter-area migrants, relevant exposures to environmental factors may therefore be difficult to measure, and some misclassification is unavoidable when these people are classified on the basis of the current place of residence. The mean number of years lived in the neighbourhood did not statistically differ between the 13 neighbourhoods and we therefore expect that the effect of internal migration on the observed associations will be minimal.

Finally, although response rates were low they were comparable to other national surveys in the Netherlands[293,294]. Response rates did not vary greatly between areas, and no clear association was found between response rate and psychological health (results not shown; see Table 1). Therefore, we believe that the observed variation in psychological health across the studied neighbourhoods is not primarily due to selective responses. However, we cannot rule out that the high percentage of non-response could have affected our results.

Studies examining both individual as well as aggregated evaluations of the neighbourhood environment and psychological health are scarce and contradictory. For example, whereas no association between aggregated evaluations of the social environment and psychological health has been reported[82,275,277], higher mental health risks were found in low social cohesion areas[35]. In addition, one study on area variation in depression observed no association with the percentage of houses in a dilapidated condition, but a positive association with the percentage of houses in a deteriorating condition[295]. Furthermore, neighbourhood problems evaluated by others were also associated with depression[275]. In contrast, aggregated evaluations of green areas or provided services in the area were not found to be associated with psychological health[36,296-298]. Thus, the few cross-sectional studies mostly agree with our findings that mental health is related to individual evaluations of the environment, but not consistently with aggregated evaluations.

Our findings, and those of others, provide evidence that the consistent association between individual evaluation of the neighbourhood environment and psychological health might be due to reverse causation, i.e. an effect of psychological health on the evaluation of the environment, instead of the other way around. People suffering from psychological health problems might make more negative reports about their neighbourhood environment than people without these problems. Although it seems likely that one's psychological health influences one's evaluation, evidence to support such a relation is scarce. De Lange et al. (2005) found that unhealthy employees were more likely to make negative reports about the support from supervisors than healthy employees[299]. The proposed mechanism, defined as the 'gloomy perception', suggests that unhealthier workers have a gloomier perception of reality. This

mechanism could explain our results if people suffering from psychological health problems indeed have a gloomier perception of their neighbourhood environment.

However, a causal relation between individual evaluation of the neighbourhood environment and psychological health might exist despite finding no associations between aggregated evaluations and psychological health. Aggregated measures might be inappropriate to test causal effects occurring at the individual level. A smaller variation in aggregated measures across neighbourhoods, as was observed for our Amsterdam sample (Table 4), might be expected as minimum and maximum scores will partly elevate each other. This smaller variation in neighbourhood evaluations decreases the possibility of finding significant health effects. Thus, causal effects might still be possible but longitudinal studies are needed to confirm this. Although longitudinal research on other determinants of mental health did support causality, reversed causation was also supported thus indicating transactional interactions[285-288]; this might also be applicable for the association between individual evaluation of the neighbourhood environment and psychological health.

7.5 Conclusion

In the present study a more positive evaluation of the neighbourhood environment was associated with better psychological health at the individual level but not at the aggregated level. These findings support the reverse causation theory that persons with mental health problems evaluate their environment more negatively than those without such problems.

Chapter 8

The association of neighbourhood psychosocial stressors and self-rated health in Amsterdam, the Netherlands

Based on:

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The association of neighbourhood psychosocial stressors and self-rated health in Amsterdam, the Netherlands

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Abstract

Aim

To investigate associations between neighbourhood-level psychosocial stressors (i.e., crime, nuisance from neighbours, drug abuse, noise, garbage on the street, graffiti, youngsters loitering, feeling unsafe, dissatisfaction about the quality of green space, and unemployment/social benefit) and self-rated health in Amsterdam, the Netherlands.

Methods

A random sample of 2914 subjects aged ≥18 years was drawn from 75 neighbourhoods in the city of Amsterdam, the Netherlands. Individual data from the Social State of Amsterdam survey 2004 were linked to data on neighbourhood-level attributes from the Amsterdam Living and Security Survey 2003. Multilevel logistic regression was used to estimate odds ratios and neighbourhood-level variance.

Results

Fair to poor self-rated health was significantly associated with neighbourhood-level psychosocial stressors: nuisance from neighbours, drug abuse, youngsters loitering, garbage on the streets, feeling unsafe and dissatisfaction about the quality of green space. In addition, when all the neighbourhood-level psychosocial stressors were combined, individuals from neighbourhoods with a high score of psychosocial stressors were more likely than those from neighbourhoods with a low score to report fair to poor health. These associations remained after adjustments for individual-level factors (i.e., age, sex, educational level, income and ethnicity). The neighbourhood-level variance showed significant differences in self-rated health between neighbourhoods independent of individual-level demographic and socio-economic factors.

Conclusion

Our findings show that neighbourhood-level psychosocial stressors are associated with self-rated health. Strategies that target these factors might prove a promising way to improve public health.

8.1 Introduction

In the past few years, interest in neighbourhood effects on health has increased tremendously. Evidence strongly indicates that the neighbourhood in which people live influences their health, either in addition to or in interaction with individual level characteristics[26,300]. A recent systematic review of multilevel studies[26], for example, showed fairly consistent and modest neighbourhood effects on health despite the differences in study designs, neighbourhood measures and possible measurement errors.

The explanation for the relative bad health of people living in disadvantaged neighbourhoods is the subject of intense debate. There are two main interpretations: a psychosocial perspective and a neo-material perspective. According to the proponents of the psychosocial theory, stressors in the neighbourhood make residents to feel unpleasant, and this affect their behaviour (inappropriate coping strategies) and biology (psycho-neuroendocrine mechanisms), which in turn, increase their susceptibility to diseases in addition to the direct effects of absolute material living standards[129,301-305]. A negative neighbourhood climate characterised by heightened fear and exposure to crime has been shown to be associated with poor health outcomes[8,126,301,305-308]. This psychosocial approach suggests that health can be promoted by improving neighbourhood psychosocial environment, for example, by reducing crime or drug abuse.

According to the neo-material theory, the impaired health of residents of certain neighbourhoods results from the accumulation of exposure and experiences that have their roots in the material world[309-313]. The health effects of being deprived of an array of material goods are the consequence of a combination of exposure to material deprivation and a lack of individual economic resources associated with a systematic low investment in a range of human, physical, health and social infrastructures[311]. The unequal distribution of neighbourhood income is the result of historical, cultural, political and economic processes. These processes influence the availability of private resources to individuals and also determine public infrastructure in areas such as education and health care services, availability of food, transport, control of the environment, quality of housing and rules and regulations in the

workplace[311]. According to the neo-material perspective, health can be promoted through reflection on the structural determinants that condition inequality of income such as residential segregation and unemployment.

Several studies have examined the influence of neighbourhood-level factors on self-rated health[39,45,46,56,103,121,143,145,178,274,314-320]. Most of these studies were focused on material conditions underlying the health disadvantage. They indicate that neighbourhood-level deprivation[39,56,121,178,274,316,320], lower socio-economic status[56,143,274], poor quality of the physical residential environment and lower transport wealth[143] are associated with fair to poor self-rated health. Although it is suggested that the features of neighbourhoods may also affect health through psychosocial pathways, only a small number of studies have examined the associations of neighbourhood-level psychosocial stressors and self-rated health[45,143,321]. The results of these studies have not been consistent. For example, Cummins and colleagues found no association between neighbourhood crime and self-rated health[143]. Steptoe and Feldman, however, found perceived neighbourhood problems to be associated with poor self-rated health[45].

Also, in the Netherlands, recent studies show clear associations between self-rated health and neighbourhood-level deprivation indicating the importance of material influences on health[56,178,270]. As in other countries, however, it is unclear whether the psychosocial perspective is relevant at this level as well. It is possible that residential neighbourhood problems may constitute sources of chronic stress, which may increase the risk of poor perceived health[45,46]. The main objective of this paper was to assess the associations between neighbourhood-level psychosocial stressors and self-rated health in Amsterdam, the Netherlands. We tested the importance of each neighbourhood-level psychosocial stressor (i.e. crime, nuisance from neighbours, drug abuse, noise, garbage on the street, graffiti, youngsters loitering, feeling unsafe, dissatisfaction about the quality of green space, and unemployment/social benefit) on self-rated health controlling for material factors at the individual level. In addition, we also determined whether self-rated health varies across neighbourhoods and the extent to which each psychosocial factor contributed to that variation. The estimation of measures of neighbourhood variance is of great importance and complements the information obtained by classical measures of associations[322,323].

8.2 Methods

The data for this study came from two different sources. The individual (first) level data included information on demographics, socio-economic status (household income and education level) and self-rated health. The contextual (second) level data included information on aggregated neighbourhood-level psychosocial stressors. These two levels were linked by neighbourhood, creating a multilevel design for data analysis.

Data collection at the individual level

The individual-level data were provided by the Department of Research and Statistics of Amsterdam Municipality (Dienst Onderzoek en Statistiek (O+S) based on The State of the City of Amsterdam survey. This cross-sectional study was carried out in 2004 by O+S to monitor the participation and living conditions in the Amsterdam general population aged ≥18 years. A proportional random sample was drawn from the Amsterdam municipal registers in 14 city districts in Amsterdam (figure 1). The data were collected by means of three different survey methods: postal questionnaires, telephone interviews, and face-to-face interviews. The data obtained from face-to-face interviews (275 individuals) were excluded from the analyses because of possible response bias. A further 268 were excluded because of small neighbourhood sample size (<10 subjects in a neighbourhood (n=14 neighbourhoods)), and missing data on gender, age, educational level, ethnicity or self-rated health. Data analyses were performed on the remaining 2914 participants from 75 neighbourhoods. Of the 2914 participants included in our analyses, 65% were interviewed by postal survey and 35% by telephone. The average number of participants per neighbourhood was 50, ranging from 11 to 120. Women were slightly better represented than men.

Figure 8.1: The 15 neighbourhoods in Amsterdam (in grey) in which data were collected at the individual level.

Individual level variables

Self-rated health: Self-rated health was asked in a single question: "How is your health in general?" and included five answer categories: "excellent, very good, good, fair, and poor". Responses were dichotomised by assigning 0 to those who answered excellent to good and 1 to those responding fair or poor. Self-rated health is considered a valid and robust measure of general health status. It is a strong and independent predictor of morbidity and mortality[324].

Ethnic groups: were classified according to the self-reported country of birth and/or the country of birth of the respondent's mother or father in accordance with the Netherlands Central Bureau of Statistics[171].

Education level was divided into three categories (primary school and below (low), lower secondary school or vocational school to intermediate vocational school or intermediate / higher secondary school (middle), and higher vocational school and university (high)).

Income was determined by a self-reported monthly income and was divided into two categories <1000 euros (low) and ≥1000 euros (high).

Neighbourhood-level data

The contextual level variables were also provided by O+S Amsterdam, based on the Amsterdam Living and Security Survey 2003. This was a large cross-sectional study (n=9955), which was carried out in 2003 by O+S to assess the safety and security situation of the Amsterdam general population aged ≥18 years[325]. Information on psychosocial stressors were calculated for each neighbourhood. In the Netherlands, neighbourhoods are areas with a similar type of building, often delineated by natural boundaries. As a result, they are socio-culturally quite homogenous. The population size varies greatly by neighbourhood[178].

Neighbourhood-level variables

Crime: Experience of crime was based on the proportion of people in each neighbourhood who reported to have experienced crime (such as break-ins, theft, aggravated assault, vandalism, or a stolen purse) in their own neighbourhood in the past 12 months.

Nuisance from drug abuse: The proportion of people in each neighbourhood who reported being bothered by frequent drug abuse.

Nuisance from youngsters loitering: The proportion of people in each neighbourhood who reported being regularly bothered by youngsters loitering.

Garbage on the street: The proportion of people in each neighbourhood who reported garbage on the streets.

Graffiti: The proportion of people in each neighbourhood who reported graffiti on the walls.

Feel unsafe: The proportion of people in each neighbourhood who reported feeling unsafe regularly.

Nuisance from noise: The proportion of people in each neighbourhood who reported being bothered by noise.

Nuisance from neighbours: Proportion of people in each neighbourhood who reported being frequently bothered by the neighbours in their neighbourhood.

Dissatisfaction about quality of green space: Proportion of people in each neighbourhood who reported being dissatisfied about the quality of green space in their own neighbourhood.
Unemployment/social benefit: The proportion of people in each neighbourhood who reported being unemployed or who were receiving social benefit.

Neighbourhoods were divided into three equal-sized groups (tertiles) for each neighbourhood-level factor. Tertile 1 represented neighbourhoods with the lowest proportion of the neighbourhood factor and tertile 3 represented neighbourhoods with the highest proportion of the neighbourhood factor.

Data Analysis

We performed a multilevel logistic regression to determine the associations between neighbourhood-level factors and self-rated health with individuals at the first level and neighbourhoods at the second level using the SAS GLIMMIX macro procedure (SAS Institute, Inc., Cary, North Carolina). Each neighbourhood-level stressor was modelled separately because of high correlations between neighbourhood-level stressors (table 1).

Table 8.1: Correlation matrix for neighbourhood level psychosocial stressor variables

Psychosocial stressor	1	2	3	4	5	6	7	8	9	10
1. Experience of crime	1.000									
2. Nuisance from neighbours	.042*	1.000								
3. Nuisance from drug abuse	.263***	.461***	1.000							
4. Nuisance from noise	.376***	.413***	.688***	1.000						
5. Garbage on the street	.377***	.594***	.484***	.559***	1.000					
6. Graffiti	.533***	.243***	.548***	.592***	.507***	1.000				
7. Youngsters loitering	.073***	.513***	.381***	.280***	.449***	.070***	1.000			
8. Feeling unsafe	.400***	.419***	.358***	.448***	.658***	.443***	.594***	1.000		
9. Unemployment/ social benefit	.086**	.521***	.266***	.136***	.285***	.110***	.019	-.026	1.000	
10. Dissatisfaction green space	.391***	.234***	.429***	.571***	.419***	.541***	.006	.204***	.241***	1.000

*p<0.05, **p< 0.01 ***p<0.001

In addition, we created summary scores for all the neighbourhood psychosocial stressors for each neighbourhood. The results are shown as odds ratios and 95% confidence intervals (CI's). The method of estimation was a restricted maximum likelihood procedure. We performed three models to determine the associations between neighbourhood-level psychosocial stressors and self-rated health adjusting for potential confounding factors. Model 1 included each neighbourhood variable and the individual-level variables age and sex. In model 2 the same variables were included but in addition the individual level variables education level and income were added to determine whether the differences were independent of individual level socio-economic status. In Model 3 the same variables were included but in addition the individual level variable ethnic background was added. Ethnicity was included in the final model because recent evidence in the Netherlands suggests that different ethnic groups might interpret the perception of self perceived health differently[293]. We calculated the intraclass correlation (ICC) to estimate the proportion of total variation in self-rated health that occurred at the neighbourhood level, using the latent variable method[326]. In addition, we calculated the median odds ratio (MOR), which has a consistent and intuitive interpretation[327,328]. MOR quantifies cluster variance in terms of odds ratios. It is therefore comparable to the fixed effects odds ratio, which is the most widely used measure of effect for dichotomous outcomes.

8.3 Results

Table 2 shows the characteristics of the study population. About 17% of the respondents reported fair to poor health.

Table 3 shows the association between each neighbourhood-level psychosocial stressor and fair to poor self-rated health in three different models. A significantly increased risk of reporting fair to poor self-rated health was observed for people living in neighbourhoods with medium to high proportions of nuisance from neighbours, drug abuse, garbage on the streets, youngsters loitering, unemployment/social benefit and those feeling unsafe in their own neighbourhoods. These associations were attenuated but remained after further adjustments for individual-level

socioeconomic status, and ethnicity although neighbourhoods with medium levels of nuisance from neighbours, and garbage on the streets were of borderline significance in the full model. Neighbourhood dissatisfaction about the quality of green space was associated with fair to poor self-rated health although the difference was significant only for the low versus medium levels. There were no significant associations between neighbourhood experience of crime, graffiti, nuisance from noise, and self-rated health. In addition, when all the neighbourhood-level psychosocial stressors were combined, participants from neighbourhoods with a high score of psychosocial stressors were more likely than those with a low score to report fair to poor health, the differences still remaining after adjustments for individual level variables. The trends in the effects of the neighbourhood psychosocial stressors on fair to poor health were of similar magnitude.

Table 8.2: Characteristics of the study population

Number of participants	2914
Number of neighbourhoods	75
Mean [min-max] number of participants per neighbourhood	50 (11-120)
Individual level data	
Mean age (SD)	44.0 (15.6)
Women (%)	57.2
Ethnic groups (%)	
Dutch	69.0
Surinamese	7.8
Antilleans	1.1
Turkish	2.7
Moroccan	2.0
Other	17.4
Education (%)	
Low	29.7
Middle	24.0
Higher	46.2
Income (%)	
<1000 euros	16.7
>1000 euros	83.3
Fair to poor health (%)	16.9

Table 4 shows the variation in fair to poor self-rated health across neighbourhoods in Amsterdam (i.e., the random intercept). The variation in self-rated health between neighbourhoods was statistically significant. These differences persisted even after adjustment for individual-level differences in age, sex, socio-economic status, and ethnicity. Six per cent of the total variation in self-rated health was between neighbourhoods. Adjustments for individual-level socio-economic status and ethnicity reduced between neighbourhood variations to 4.6%. Adjustment for each neighbourhood-level stressor further reduced the variation between neighbourhoods except for crime. Adjustments for nuisance from neighbours had the biggest impact, reducing the between-neighbourhood variations to 2.8%. The neighbourhood variance corresponds well to the MOR values.

Table 8.3: Odds ratios (and 95% CI) of reporting fair to poor health by neighbourhood level stressor

Neighbourhood stressors		Model 1 Age and sex adjusted	Model 2 Adjusted for age, sex and education level and income	Model 3 Adjusted for age, sex and education level, income and ethnicity
Crime	Low	1.00	1.00	1.00
	Med	0.70 [0.48, 1.07]	0.72 [0.49, 1.04]	0.75 [0.53, 1.08]
	High	0.84 [0.58, 1.23]	0.86 [0.59, 1.25]	0.92 [0.64, 1.31]
Nuisance from neighbours	Low	1.00	1.00	1.00
	Med	1.38 [1.06, 1.96]*	1.39 [0.99, 1.95]	1.36 [0.97, 1.89]
	High	2.55 [1.86, 3.49]***	2.16 [1.54, 3.03]***	1.99 [1.43, 2.78]***
Nuisance from drug abuse	Low	1.00	1.00	1.00
	Med	1.59 [1.10, 2.30]**	1.59 [1.10, 2.28]**	1.49 [1.05, 2.12]*
	High	1.68 [1.17, 2.40]**	1.66 [1.17, 2.35]**	1.59 [1.13, 2.23]**
Nuisance from noise	Low	1.00	1.00	1.00
	Med	1.30 [0.89, 1.90]	1.30 [0.90, 1.88]	1.24 [0.87, 1.76]
	High	1.35 [0.92, 1.99]	1.36 [0.94, 1.99]	1.30 [0.91, 1.88]
Garbage on the street	Low	1.00	1.00	1.00
	Med	1.42 [1.00, 2.03]*	1.41 [1.00, 2.00]*	1.41 [0.99, 2.00]
	High	1.68 [1.17, 2.42]***	1.68 [1.17, 2.40]**	1.68 [1.17, 2.40]**
Graffiti	Low	1.00	1.00	1.00
	Med	1.37 [0.95, 1.97]	1.37 [0.96, 1.95]	1.31 [0.93, 1.84]
	High	1.18 [0.80, 1.97]	1.19 [0.84, 1.73]	1.15 [0.81, 1.64]
Youngsters loitering	Low	1.00	1.00	1.00
	Med	1.41 [0.97, 2.03]	1.40 [0.97, 2.01]	1.35 [0.95, 1.91]
	High	1.76 [1.23, 2.52]**	1.73 [1.21, 2.46]**	1.62 [1.15, 2.28]**
Feeling unsafe	Low	1.00	1.00	1.00
	Med	1.23 [0.85, 1.77]	1.22 [0.85, 1.76]	1.17 [0.83, 1.65]
	High	1.53 [1.06, 2.20]*	1.50 [1.05, 2.16]*	1.47 [1.05, 2.07]*
Dissatisfaction green space	Low	1.00	1.00	1.00
	Med	1.65 [1.07, 2.53]*	1.66 [1.10, 2.55]**	1.64 [1.11, 2.44]**
	High	1.20 [0.83, 1.73]	1.22 [0.85, 1.74]	1.22 [0.87, 1.72]
Unemployment/social benefit	Low	1.00	1.00	1.00
	Med	1.46 [1.00, 2.12]*	1.45 [1.01, 2.08]*	1.35 [0.96, 1.90]
	High	1.57 [1.09, 2.26]*	1.56 [1.10, 2.22]**	1.51 [1.09, 2.10]**
All stressors combined[a]	Low	1.00	1.00	1.00
	Med	1.34 [0.93, 1.94]	1.33 [0.93, 1.91]	1.29 [0.91, 1.83]
	High	1.66 [1.88, 2.34]**	1.65 [1.18, 2.32]**	1.54 [1.11, 2.14]**

*p<0.05, **p<0.01, ***p<0.001; all models are adjusted for survey type

[a] Summation of all the neighbourhood stressors

Table 8.4: Variation in fair to poor self rated health across neighbourhoods in Amsterdam

	Neighbourhood variance [SE][a]	ICC[b]	MOR[c]
Base model: Age and sex adjusted	0.208 [0.072]**	0.060	1.55
Adjusted for age, sex, SES[d]	0.203 [0.071]**	0.058	1.54
Adjusted for age, sex, SES and ethnicity	0.160 [0.065]*	0.046	1.47
Adjusted for age, sex, SES, ethnicity + crime	0.158 [0.065]*	0.046	1.46
Adjusted for age, sex, SES, ethnicity + nuisance from neighbours	0.094 [0.051]	0.028	1.34
Adjusted for age, sex, SES, ethnicity + nuisance from drug abuse	0.123 [0.059]*	0.036	1.40
Adjusted for age, sex, SES, ethnicity + nuisance from noise	0.149 [0.064]*	0.043	1.45
Adjusted for age, sex, SES, ethnicity + more garbage on the street	0.148 [0.063]*	0.043	1.44
Adjusted for age, sex, SES, ethnicity + graffiti	0.145 [0.064]*	0.042	1.43
Adjusted for age, sex, SES, ethnicity + youngster loitering	0.124 [0.058]*	0.036	1.40
Adjusted for age, sex, SES, ethnicity + feeling unsafe	0.129 [0.061]*	0.038	1.41
Adjusted for age, sex, SES, ethnicity + dissatisfaction green space	0.124 [0.060]*	0.036	1.40
Adjusted for age, sex, SES, ethnicity + unemployment/social benefit	0.124 [0.056]*	0.036	1.40
Adjusted for age, sex, SES, ethnicity + all stressors combined[e]	0.114 [0.059]	0.035	1.38

*p<0.05, **p<0.01

all models are adjusted for survey type

[a] SE = standard error

[b] ICC = Intraclass correlation coefficient, i.e. the proportion of the total variance in self rated health that is between neighbourhoods and is estimated as $\sigma u0^2 / (\sigma u0^2 + \pi^2/3)$ and ranges from 0 (no differences in self rated health between neighbourhoods) and 1 (all variation is at the neighbourhood level)

[c] MOR = Median Odd ratios and is estimated as $\exp [\sqrt{(2 \times \sigma^2)} \times \Phi^{-1}(0.75)]$

[d] SES were determined by education & income

[e] Summation of all the neighbourhood stressors

8.4 Discussion

The findings of this study indicate that neighbourhoods with high levels of nuisance from neighbours, drug abuse, youngsters loitering and garbage on the streets were associated with fair to poor perceived health among their inhabitants. These associations remained after adjustments for individual-level socio-economic status. The study findings also show clear neighbourhood differences in self-rated health. These differences persisted after adjustment for differences in individual-level demographic and socio-economic factors. Specific psychosocial stressors at the neighbourhood level contributed to the variation between neighbourhoods in self-rated health.

Some limitations must be acknowledged. Interviews were carried out by postal survey and telephone. It is possible that people might respond differently to questions on paper than to questions asked by an interviewer on the phone. In this study, individuals interviewed by postal surveys were more likely than those interviewed by telephone surveys to report fair to poor health (p=0.01). Nevertheless, applying both postal and telephone interviews was necessary to increase participation and it is an adequate procedure to obtain information of good quality[329]. We controlled for the survey methods in all the analyses. It is therefore unlikely that these differences in survey methods could bias the study conclusions. We were unable to equalise household income because of lack of information on the number of people in each household who had an income. A monthly income of 1500 euros for a household of three people, for example, is not the same as a household of six people, and this may possibly affect our study conclusions. In addition, our neighbourhood-level psychosocial stressors were not adjusted for neighbourhood-level socio-economic factors such as percentage of people with a low education level and income, which may also affect our study conclusions. However, after further adjustment for neighbourhood-level unemployment/social benefit (also an indicator of neighbourhood socio-economic status), people living in neighbourhoods with high proportions of nuisance from neighbours (OR=2.14; 95% CI:1.46-1.93), drug abuse (OR=1.52; 95% CI:1.10-2.13), garbage on the streets (OR=1.57; 95% CI:1.09-2.26) and youngsters loitering (OR=1.60; 95% CI:1.14-2.25) were still associated with fair to poor self-rated health. More studies are needed to confirm these findings. The

study sample was limited to the Amsterdam population, which makes it somewhat difficult to generalise the results to the whole of the Netherlands. Also, fourteen neighbourhoods were excluded from the analyses because of the low number of respondents in these neighbourhoods. It is possible that these excluded neighbourhoods might differ from the included 75 neighbourhoods, which might affect our study conclusions. A further limitation was the cross-sectional nature of the study design, which is limited in its ability to pin down the direction of causality. More recently, Oakes has raised a series of important questions on the validity of observational approaches in research on neighbourhood and health and suggested randomised community trials as an alternative[330]. Nevertheless, as emphasised by others[331-333], and also acknowledged by Oakes[330], randomised community trials have their own sets of limitations. For many neighbourhood factors of interest, it is impossible to design a randomised community trial and to obtain evidence on the effect of a single factor[331].

A strength of this study is that it is one of the few studies, and the first in the Netherlands, to assess associations between neighbourhood-level psychosocial stressors and self-perceived health. The neighbourhoods considered in our study are socio-culturally rather homogenous communities. It has been emphasised that contextual or area bound factors may have a greater impact on health if a neighbourhood relates to a socio-culturally homogeneous community[178]. The neighbourhood-level variance showed significant differences in self-rated health between neighbourhoods in Amsterdam even after adjusting for individual-level demographic and socio-economic variables. This study finding is consistent with several studies[145,178,318,319,334], including earlier studies on neighbourhood deprivation and self-rated health in the Netherlands[56,178]. The findings of associations between neighbourhood psychosocial stressors and self-rated health in our study add to the existing literature documenting an association between neighbourhood attributes and health[39,45,46,56,103,121,143,145,178,274,314-320]. A small number of studies have focussed on neighbourhood-level psychosocial stressors[45,143,145,315]. Our study provides further evidence on the associations between these stressors and self-rated health independent of individual-level demographic and socio-economic factors. Our findings provide support for the psychosocial perspective and are consistent with

other studies that have demonstrated associations between neighbourhood-level psychosocial factors and other health outcomes[45,143,145,301,302].

There are several mechanisms through which neighbourhood psychosocial stressor may be linked to poor health. For example, neighbourhoods that score high on perceived fear of victimisation (such as frequently feeling unsafe as a result of youngsters loitering) may discourage residents from engaging in healthy lifestyle measures such as physical activity, which in turn, may lead to poor health. In addition, a poor quality of the neighbourhood built environment, such as unsatisfactory green space may also discourage residents from engaging in outdoor recreation, which in turn may lead to unhealthy lifestyles. In our study, dissatisfaction about neighbourhood green space was associated with a higher risk of fair to poor self-rated health. Takano et al. also found that living in a neighbourhood with greenery-filled public areas positively influenced the longevity of urban senior citizens[335]. It has been shown that a significant portion of physical health differentials across neighbourhoods is due to stress level differences across neighbourhoods[321]. It is possible that the biological pathway between neighbourhood environment and poor health may be mediated by an abnormal neuro-endocrine secretory pattern[334] due to stress. Chronic activation of the stress system is believed to lead to allostasis or allostatic load (i.e., wear and tear on organ systems), which may have harmful effects on health[336].

Our finding of lack of association between experience of crime and self-rated health is surprising, but consistent with Cummins and colleagues' study from England[143]. It is in contrast with the strong associations reported between neighbourhood crime and other health outcomes. For example, a recent study from Sweden showed a positive association between neighbourhood crime and coronary heart disease even after controlling for the individual-level factors[337]. Agyemang and colleagues' recent study found a positive association between neighbourhood crime and blood pressure in Amsterdam[147]. In addition, Morenoff found that the neighbourhood violent crime rate was one of the most robust environmental predictors of infant birth weight, after controlling for both individual- and neighbourhood-level characteristics[338]. The reasons for these inconsistent results are unclear. However, it might well be that perception of general health is influenced more by the fear of crime or victimisation

rather than experience of crime. A perception of crime and disorder within an individual's community has been associated with numerous outcomes, including anxiety, depression and posttraumatic stress disorder[137,339,340]. It is also possible that the discrepancies between our results and those reported elsewhere may be due to a difference in neighbourhood definition and the spatial scale at which exposure was measured. The stronger association between neighbourhood nuisance and self-rated health than other neighbourhood attributes might reflect the importance of social cohesion and trust on health[126]. Stafford and colleagues also found neighbourhoods with low levels of trust or tolerance of neighbours to be strongly associated with fair to poor self-rated health[145]. It is possible that nuisance from neighbours might increase the negative effects of neighbourhood problems more than other neighbourhood factors we considered with greater consequence on health[339].

8.5 Conclusion

In conclusion, the findings of this study suggest that neighbourhood-level psychosocial stressors are related to fair to poor perceived health independent of individual-level demographics. These findings provide indications to suggest that strategies that target these neighbourhood-level psychosocial stressors might prove a promising way to improve public health. For example, promotion of neighbourhood social relations, clean streets, and discouragement of drug abuse might provide additional benefit in improving the general health of disadvantaged neighbourhoods.

Chapter 9

General discussion

The main objective of this thesis was to identify social features of the area environment that influence health at a small geographical scale in the Netherlands. In this thesis, five social features of the area environment were examined, i.e. area deprivation, urbanisation, area demographic composition, community social capital, and the presence of social nuisance within areas. The associations between these social features of the area environment and health were investigated with adjustments for sex and age only, and with additional adjustments for other compositional effects (martial status, ethnicity, socio-economic status). The interaction between context and composition was examined for urbanisation and community social capital. The research questions of this thesis were:

1. Which social features of the area environment are related to health at the smaller geographical scale in the Netherlands?

2. Do these associations between social features of the area environment and health persist when differences in population composition across small areas in the Netherlands are taken into account?

3. Do these associations between social features of the area environment and health vary between different demographic subpopulations living in small areas?

This chapter starts with a summary of the results of the previous chapters. In this summary, the associations between the five social area features and health are presented with and without controlling for compositional confounders at the individual level. For urbanisation and community social capital, this association with health is studied in the total area population and in different demographic subpopulations. Subsequently, the methodological limitations relevant for the interpretation of the results are addressed. Furthermore we compare our results to those of others and present some possible explanations for our findings. Finally, implications for both policy and research are presented and discussed.

9.1 Environment and health in the Netherlands

Area deprivation

In this thesis, area deprivation was examined in relation to hospital admissions, mortality, suicide and self-rated health. When only sex and age were included as possible confounders for this relation, deprived areas showed a higher amount of hospital admissions, total number of deaths, total number of suicides, and number of people reporting poor to fair health in comparison to less deprived areas.

For mortality and suicide, additional adjustments were made for individual level marital status and ethnicity but not for individual socio-economic status. Mortality and suicide rates remained higher in the more deprived areas. In the most deprived areas, the observed relative risk for overall mortality decreased by about 13% from 1.40 (CI: 1.39-1.41) to 1.35 (CI: 1.34-1.36) when these additional adjustments were made. For suicide a decrease of about 47% was observed in the most deprived areas with the relative risk decreasing from 1.62 (CI: 1.50-1.75) to 1.33 (CI: 1.23-1.44).

Only for the association between area deprivation and self-rated health were additional adjustments made for individual level socio-economic status. Again, residents of more deprived areas more often reported poor to fair health compared with residents of less deprived areas. The odds ratio for reporting poor to fair health for areas in the highest deprivation category decreased by about 11% when compositional differences between the areas were incorporated, i.e. from 1.57 (1.09-2.26) to 1.51 (CI: 1.09-2.10).

In conclusion, it can be stated that living in a deprived area in the Netherlands is associated with poorer health outcomes.

Urbanisation

Urbanisation in the Netherlands was examined in relation to hospital admissions, all-cause mortality and specific causes of death. We performed additional analyses on a national dataset comparing sex and age-standardised mortality and hospitalisation

rates across urban and rural postal code areas. The more urban areas showed higher hospitalisation and mortality rates in comparison to the more rural areas.

Only for overall mortality were additional adjustments made for individual level marital status and ethnicity. The previous positive association between urbanisation and mortality remained. This additional control resulted in a 56% decrease in mortality risk in the most urban areas, namely from 1.09 (CI: 1.08-1.10) to 1.04 (CI: 1.02-1.04). Since no data were available to adjust for individual socio-economic status, area deprivation was used as a proxy. After removing area socio-economic differences between urban and rural areas, the detrimental health effect of living in an urban environment disappeared (RR: 0.98; CI: 0.97-0.99).

The urban-rural patterns for the different causes of death were examined only after adjustments were made for population composition and area deprivation. Different patterns were found for different causes of death. In the more urban areas, total cancer and lung cancer mortality risks were higher while cardiovascular mortality risks (with both ischemic and cerebrovascular heart disease mortality as subdivisions) were lower. Urban areas also showed a lower number of deaths caused by traffic injuries in comparison to rural areas. The number of suicide deaths was not different between urban and rural areas.

Besides examining the association between urbanisation and health in the total area population, this association was also investigated among different demographic subpopulations in the Netherlands. Females, 10 to 40 year olds, people aged 80 years and over, people who never got married and non-western immigrants all experienced lower all-cause mortality risks in the more urban areas compared to the more rural areas. In contrast, 50 to 70 year olds and married individuals living in the most urban areas experienced somewhat higher mortality risks compared to those living in the most rural areas.

In conclusion, urbanisation in the Netherlands was not associated with higher all-cause mortality rates when the total population of the area was examined. Different urban-rural patterns were found when different causes of death and different groups of the area population were studied.

Area demographic composition

Area demographic composition was examined in relation to hospital admissions and overall mortality. When only sex and age differences between the areas were taken into account, areas with higher percentages of migrants or singles also showed higher hospitalisation and mortality rates. The proportion of elderly in the area was not associated with the number of hospital admissions in the area but a higher proportion of elderly was associated with higher overall mortality rates. (These results were not presented in one of the chapters, but were revealed with additional analyses on the national dataset, presented in chapter 2, using sex and age-standardised mortality and hospitalisation rates according to postal code area).

In the analysis reported in chapter 4, the association between neighbourhood demographic composition and overall mortality was additional adjusted for marital status and ethnicity at the individual level. Similar results were obtained as mentioned above, with a positive association between percentage of singles, elderly or migrants in the neighbourhood and overall mortality. In addition, increased mortality rates were observed in neighbourhoods with a high percentage of women. Although all of these associations were significant, the magnitude of the effects was generally small.

In conclusion, area demographic composition was generally associated with mortality but most of these associations were weak.

Community social capital

Community social capital was examined in relation to all-cause and cause-specific mortality, and psychological well-being. For all-cause mortality and psychological well-being the association with community social capital was examined when only sex and age differences between the areas were considered. Dutch neighbourhoods with high levels of community social capital showed lower all-cause mortality rates. No associations between the community social capital indicators and psychological well-being were observed.

The association between community social capital and overall mortality still existed when additional adjustments were made for individual marital status and ethnicity. In

the areas with the highest levels of community social capital the relative risk for mortality increased from 0.91 (CI: 0.90-0.92) to 0.94 (CI: 0.93-0.95). Since no data were available to adjust for individual socio-economic status, area deprivation was used as a proxy. The association between community social capital and mortality disappeared when these additional adjustments for area deprivation were made.

The association between community social capital and different causes of death was only examined after adjustments for population composition, area deprivation and urbanisation. Different patterns were observed for different causes of death. In areas with high, as compared to low levels of social capital, deaths due to cancer (especially lung cancer) and suicide were lower. No relation was found between community social capital and total cardiovascular mortality, but when levels of community social capital increased the number of deaths due to cerebrovascular heart diseases increased.

Only for the association between indicators of community social capital and psychological well-being were adjustments made for individual level socio-economic status. For this association, having a chronic disease or physical limitation was also included as a relevant confounder. Again, no associations were found between the studied indicators of community social capital and psychological well-being.

Besides examining the association between community social capital and mortality in the total area population, this association was also investigated among different demographic subpopulations. Men and married individuals experienced lower overall mortality risks in areas with higher levels of community social capital. For women, non-married individuals and non-western migrants, the association between community social capital and mortality was less clear. In the areas with the highest social capital levels these population groups showed slightly higher mortality risks whereas in the areas with average levels of community social capital, often no increase or decrease in mortality risk was found.

In summary, no association was observed between community social capital and overall mortality or psychological well-being when the total area population was

examined. Depending on the cause of death and population group under study, mixed results were found with both positive and negative associations.

Social nuisance

The presence of social nuisance (such as crime and litter) within areas was examined in relation to self-rated health. Nuisance from neighbours was also examined in relation to psychological well-being. When sex and age differences between the areas were taken into account, the presence of social nuisance was negatively related to self-rated health (OR: 1.66; CI: 1.88-2.34). When area residents reported being bothered by nuisance from neighbours, nuisance from drug abuse, garbage on the street, youngsters loitering or feeling unsafe, they rated their health more often as being poor to fair. In the Amsterdam population, nuisance related to crime, noise or graffiti was not related to self-rated health. Nuisance from neighbours was not related to psychological well-being.

For self-rated health, additional adjustments were made for individual socio-economic level and ethnicity (marital status was not found to be a confounder). The previously found associations between nuisance and self-rated health remained. After these additional adjustments, the observed odds ratio of 1.66 decreased by 18% to 1.54. The relation between psychological well-being and nuisance remained non-significant after being adjusted for individual socio-economic status, marital status, ethnicity, having a chronic disease and physical limitations.

Explaining spatial health patterns in the Netherlands

The association between social features of the area environment and health was the focus of this thesis. The idea that the area environment might be related to health arises from the fact that health is unequally distributed across geographical areas. The following paragraph addresses this variation in health, and explores the role of compositional and contextual variables in explaining the observed geographical variation in health across small areas in the Netherlands. The contribution of four compositional and three contextual variables is estimated through additional

analyses[1] on the national dataset with individual level information on sex, age, marital status, ethnicity and mortality, as well as neighbourhood information on area deprivation, urbanisation and community social capital (table 1).

Table 9.1: Contribution of compositional and contextual factors in explaining the geographical variation in mortality across small areas in the Netherlands

Model adjusted for	Contribution after adjusted for sex and age[a]	Contribution after adjusted for sex, age, marital status and ethnicity[b]
Marital status and ethnicity	1.05%	
Area deprivation	2.57%	1.05%
Urbanisation	0.26%	0.03%
Social capital	0.29%	0.07%

[a] Contribution calculated as (1-(scaled deviance present model/scaled deviance model adjusted for sex and age))*(1-(scaled deviance model adjusted for sex and age/scaled deviance constant model))

[b] Contribution calculated as (1-(scaled deviance present model/scaled deviance model adjusted for all four compositional variables))*(1-(scaled deviance model adjusted for all four compositional variables/scaled deviance constant model))

The geographical variation in mortality across small areas in the Netherlands can largely be explained by sex and age differences between the areas (value scaled deviance decreases by 87%). In addition to sex and age, marital status and ethnicity together explain 1% of the remaining geographical variation in mortality. Area deprivation contributes slightly more, explaining 3% of the remaining geographical variation in mortality across areas. The contextual variables urbanisation and community social capital explain less than 0.5% of the geographical variation in mortality after adjustments for sex and age.

[1] Poisson regression analyses were performed on 3,505 neighbourhoods including 11,037,400 residents. The scaled deviances of different models are compared to estimate the contribution of the studied compositional and contextual variables.

When area mortality differences are adjusted for the four compositional variables (sex, age, marital status and ethnicity), area deprivation explains a little over 1% of the remaining geographical variation in mortality. In these additional analyses, no information on individual socio-economic status was available and adjusting for this compositional variable could substantially reduce the observed contribution of area deprivation in explaining the geographical variation in morality across areas in the Netherlands. The contribution of urbanisation and community social capital in explaining the geographical variation in mortality after taking into account population compositional differences between the areas is almost zero.

In conclusion, sex and age differences between the areas are the most important contributors to the geographical variation in mortality in the Netherlands. Other compositional variables (such as marital status and ethnicity) and contextual variables (such as deprivation and urbanisation) explain only a small part of the remaining variation in mortality across small areas in the Netherlands after sex and age differences between the areas are removed.

Overall conclusion

The aim of this thesis was to identify social features of the area environment related to health. Three additional research questions were posed. First, are social features of the area environment related to health at the small geographical scale in the Netherlands? Second, does this association remain after controlling for compositional differences between the areas? Finally, does this association change when different population groups are examined?

The five area features studied in this thesis (area deprivation, urbanisation, area demographic composition, community social capital, presence of social nuisance) were all associated with health when only sex and age differences between the areas were taken into account. Over and above compositional effects, area deprivation and the presence of social nuisance remained independently associated with health. Living in neighbourhoods with low or high proportions of a certain population group remained weakly associated with overall mortality, but area population compositional differences were not fully removed. The contextual variables - urbanisation and community social capital - were weakly or no longer associated with overall mortality,

but some stronger associations remained for some causes of death and among some demographic subpopulations. The contextual variables studied explained only a limited part of the geographical variation in health across small areas in the Netherlands compared with more compositional variables such as sex and age.

9.2 Methodological considerations

The previous chapters have presented specific methodological limitations of the different studies. The following paragraphs address more general methodological issues related to examining the associations between area features and health in a geographical framework. The following concerns are addressed: the inclusion of confounding individual level variables, the choice of geographical area unit, the use of cross-sectional data, and the measurement of contextual variables.

Inclusion of confounding individual level variables

The observed associations between the studied area features and health outcomes as found in this thesis might still be the result of residual confounding at the individual level. The majority of studied associations were not adjusted for individual socio-economic status and the associations might disappear when this confounding variable is introduced. For instance, the increased mortality risk in deprived areas in the Netherlands might be substantially reduced when individual socio-economic status is controlled for, since lower socio-economic groups with poorer health more often reside in deprived areas. A precise estimate of this reduction is difficult. In the Netherlands, reductions of 30 to 60% were observed when additional adjustments for individual socio-economic status were made for the association between deprivation and mortality[20,52]. In other countries reductions between 10 and 85% were reported[21,24,25,28,29,32,124,341]. For self-rated health, a 40 to 60% reduction was observed in the Netherlands [56,342] and one study reported that the association between area deprivation and self-rated health was completely explained when individual socio-economic status was incorporated in the analyses[58]. In this thesis, individual socio-economic status reduced the strength of the association between area deprivation and self-rated heath by only 2%. A reason for this might be that

especially lower socio-economic areas were selected for our study sample, thus limiting the variation in individual socio-economic status.

In this thesis, urbanisation and community social capital were examined in relation to mortality without controlling for individual level socio-economic status - since no data were available. Although area deprivation was incorporated as a proxy for individual level socio-economic status[208], some residual confounding at the individual level may be responsible for the associations found for urbanisation and community social capital. The observed association between area demographic composition and mortality were not corrected for any socio-economic differences between the areas and could therefore be a representation of these differences. Area deprivation and the presence of social nuisance within areas remained associated with self-rated health after controlling for individual socio-economic differences between area populations implying that these two area features have an independent effect on health.

Choice of geographical area unit

The choice of the geographical area unit depends on the contextual variable of interest. In this thesis, because the focus lies on contextual variables that operate at a local scale, smaller geographical area units were chosen as the unit of analysis. Most of the studies in this thesis used the neighbourhood as geographical unit of analysis; the exception is chapter 2, in which the analyses were performed on somewhat larger area units i.e. 4-digit postal code areas. Neighbourhoods in the Netherlands have an area surface of about 3.4 km^2 and contain on average 1,500 residents. An even smaller area unit would be the 6-digit postal code area, which often represents one side of a street (± 40 residents). The smaller the geographical unit, the larger the variation in both contextual variables and health outcomes might be, and therefore stronger associations between environment and health might be observed. In the Netherlands, stronger associations between area deprivation and mortality were observed at the most detailed geographical level (6-digit postal codes)[179] but for self-rated health the strongest relation with deprivation was observed when larger geographical area units were compared (boroughs with ± 6,600 residents)[178]. In other countries, slightly stronger associations between

deprivation and health were also found when using the smallest available geographical units[343-345].

In this thesis, the use of smaller geographical area units such as the 6-digit postal code areas might have resulted in stronger associations between area deprivation and health. Urbanisation, on the other hand, was based on address density and using 6-digit postal codes, which generally represents one side of the street, is not appropriate. However, smaller geographical units might be suggested when other measures of urbanisation such as housing density are used. The presence of social nuisance is also a contextual variable that probably shows less fluctuation across streets. If residents on one side of the street report a certain form of nuisance, residents across the street will probably also suffer from this. The same can be said for community social capital. Again, this is not true for all indicators of social nuisance and social capital, for instance, nuisance from or contact with direct neighbours. The use of smaller geographical area units in this case might be more appropriate. Thus, the use of neighbourhoods as geographical units (as done in this thesis) might have resulted in weaker associations between the studied social features of the area environment and health outcomes.

Another concern in geographical studies is the use of administrative area units. The contextual variables measured in a specific administrative unit do not have to represent the complete picture for every resident in this area, as especially residents near the borders of these units can benefit from or be harmed by the contextual variables present in neighbouring areas. In addition, the community as perceived by the area residents themselves does not necessarily have to correspond with the size of the administrative units used in the analyses, which might be either too large or too small. Although these limitations of using administrative geographical units are well known, alternatives are seldom investigated. Spatial scan techniques where contextual factors are measured continuously across space and linked to clusters of increased prevalence of morbidity or mortality, might be an alternative approach to examine the association between area features and health. A comparison between spatial scan techniques and multilevel analyses showed stronger associations when spatial scan techniques were used[346,347]. However, the latter authors noted that, although this technique provides information on the most appropriate scale at which

the process occurs, it still is not a representation of the living environment as proposed by the individual. Qualitative research might help to better capture the community as perceived by the individual, but as all individuals perceive their environment differently it will be hard to translate this into a geographical unit. The use of administrative geographical units (as used in this thesis) might have resulted in weaker associations between the studied social area features and health outcomes.

Use of cross-sectional data

In this thesis, because only cross-sectional data were available it is not possible to establish the direction of causality. Features of the area environment could cause health problems, but health problems might also influence the choice of residence and surrounding area environment[348]. If people are selected into certain areas based on the health outcome being investigated, the association between area environment and health will be stronger. In order to better investigate these selection effects, longitudinal studies are needed. Until now very few longitudinal studies are available. In the UK, selective migration into deprived or non-deprived areas was found to be an important contributor to the small area variation in health across the country[221,349,350]. In the Netherlands, selective migration towards urban or rural, and to deprived or non-deprived areas, hardly contributed to explaining the geographical variation in health across small areas[204,219]. However, it must be noted that because these latter analyses were performed in one Dutch city only (i.e. Eindhoven), the results can not be generalised to the rest of the Netherlands. Selective migration processes might therefore still explain some of the associations between area environment and health as observed in this thesis.

Another concern when using cross-sectional data (as in this thesis), is the inability to take into account the contextual health effects related to the area environments that residents lived in previously. People move from one residence to the other, making it difficult to establish whether features of the present or the past environment are related to health. Moreover, the area environment itself changes overtime, influenced by larger societal processes such as economic cycles, changes in the industrial and manufacturing sectors, demographic shifts and migrations. Since contextual health effects are often indirect and a long period of time might pass between exposure and

effect, associations between area environment and health might be diluted by this change in environment. This implies that the associations presented in this thesis are probably weaker than in reality.

Measurement of contextual variables

Contextual variables can be measured either objectively or subjectively. It is known, however, that the association between features of the area environment and health might differ depending on whether area features are measured objectively or by self-report[351]. Objective data do not have to correspond with the self-reported evaluations of the area residents[351]. If crime rates are high but people do not feel unsafe, the association between objective crime and health might not be apparent. Subjective measures on the other hand frequently display less variation than objective assessments, making it more difficult to detect associations[8]. In addition, personality or health might influence the rating for the area environment. This dependency between outcome and exposure strengthens the association between health outcome and contextual variable when measured cross-sectionally[8,352].

In this thesis, area deprivation, urbanisation and area demographic composition were based on registry data, while community social capital and the presence of social nuisance were measured using questionnaires administrated to area residents. For area deprivation, urbanisation and area demographic composition the associations with health might be stronger had self-reported data been used, since registered data do not have to correspond with the situation as observed by the residents themselves. For community social capital and social nuisance, weaker associations might have been detected because self-reports often show less variation. In this thesis, the dependency between outcome and exposure might have less impact on the observed associations because ratings of the environment originated from data sources other than the studied health outcome.

9.3 Interpretation of findings

Area deprivation

In this thesis, it is established that deprived areas had increased levels of poorer health even when compositional differences between areas were taken into account. These results are in line with the international literature on area deprivation and health. A review of studies up to 1998 focusing on area deprivation and different health outcomes showed that 23 out of 25 studies found a negative association with health[26]. All these studies performed multilevel analyses to incorporate the hierarchical structure of the data and, besides demographic compositional confounders, individual level socio-economic status was adjusted for. More recent studies also provide support for this negative association between area deprivation and several health outcomes when individual demographic and socio-economic differences between areas were accounted for[8,19,21-25,28-32,34-37,39,52,56,315,341]. Dutch studies have also confirmed the negative association between area deprivation and health i.e. higher mortality rates[20,52], more residents reporting poor self-rated health[56,342], and more residents engaging in unhealthy behaviour[53,54,56,57,342] in the more deprived areas even when individual demographic and socio-economic dissimilarities between areas were taken into account.

The results of this thesis, together with data from earlier Dutch studies, allow to conclude that living in a deprived area in the Netherlands is detrimental for health. In this thesis, an excess mortality risk of 35% was observed, but this excess risk was not adjusted for individual socio-economic status. For self-rated health, residents of deprived areas were 1.5 times more likely to report poor health than residents of non-deprived areas, even when individual socio-economic differences between the areas were corrected for. Comparable effect sizes were observed in previous Dutch studies, with excess risks between 20 and 60% for a series of health outcomes when adjusting for individual socio-economic status[20,52-54,56,57,342]. This effect size was also observed in other countries[26].

The independent health effect of area deprivation (as found in the present work and in other studies) is probably related to the more inferior physical, social and service environment of deprived areas[26,27,44-49]. The less favourable spots to live (such as

near busy freeways, large industries, or garbage dumps) are often deprived places[50]. The increased exposure to noise and air pollution can be directly linked to health, but the presence of busy freeways or large industries can also indirectly affect health through more psychosocial processes such as stress. In addition, the social engagement between residents of deprived areas is less explicit, inhibiting social support, social monitoring, and the formation of collective efficacy[35,44,270,316,353]. The fewer and less well accessible services and facilities also restrict residents from benefitting from such opportunities[6,48]. For instance, less gyms or open spaces may cause people to be less active, and fewer grocery stores can result in eating less vegetables and fruits. In the public opinion, the Netherlands is thought of as being a more egalitarian type of land where public goods are equally distributed across the country. However, physical environmental conditions related to air, noise, and external safety were observed to be worse in low as compared to high income areas[50,51]. In addition, positive environmental features (e.g. the availability of public green spaces) were more often present in higher than in lower income areas[50]. This unequal distribution of negative and positive area features across areas in the Netherlands might be the underlying reason for the observed independent health effect of area deprivation.

Urbanisation

In this thesis, higher mortality rates were observed in urban compared to rural areas, but when population compositional differences between urban and rural areas were adjusted for these mortality differences disappeared. Higher mortality rates among urban residents were also found in other studies for the Netherlands[55,70] as well as for other countries[64-67,152] but the majority of these rates were insufficiently adjusted for possible differences between urban and rural populations. Dutch cities, for example, are more often inhabited by population groups with higher risk profiles for poorer health[79] probably explaining the existing urban-rural health patterns in the Netherlands. This unequal distribution of demographic and socio-economic groups may be the result of selective migration processes related to larger societal processes such as economic developments, housing and job opportunities[51].

In this thesis, although urbanisation was no longer associated with overall mortality after accounting for population compositional differences between areas, urban-rural

differences for some causes of death remained. Cancer mortality was found to be higher and cardiovascular mortality was found to be lower among urban residents. The few studies comparing urban-rural patterns for cancer mortality found a similar association[61,354-356] but among male urban residents a decreased risk was also observed[356]. After additional adjustment for individual socio-economic status, as done in two of these studies, cancer mortality rates remained higher in the more urban areas[354,355]. The few studies comparing cardiovascular mortality rates between urban and rural areas resulted in contradictory results, with some finding lower[69,73] but most finding higher rates in urban areas[59,71,205,354,355]. After adjustment for individual socio-economic status, higher cardiovascular mortality rates were still reported in urban areas[354,355]. Unfortunately no other studies have examined the possible association between urbanisation and different causes of death in the Netherlands.

The processes behind the urban-rural patterns observed for specific causes of death in the Netherlands could involve a variety of factors. A contextual explanation might be that area features in the urban environment itself are responsible, such as elevated levels of air pollution leading to higher lung cancer rates in urban areas. More opportunities to be physically active or increased availability of healthy foods might be linked to the lower numbers of deaths due to cardiovascular diseases in urban areas. Secondly, a compositional explanation might also be possible because of incomplete control for individual differences between urban and rural populations. The higher lung cancer rates in urban areas might be a representation of the higher proportion of smokers in urban areas, as was observed in this thesis. Finally, selective migration processes might be responsible for the observed urban-rural patterns of different causes of death in the Netherlands. The selective migration of heart disease patients to the quieter and less stressful countryside might be a reason for the observed lower cardiovascular mortality rates in the more urban areas.

Besides examining the relation between urbanisation and mortality in the total area population, this association was also investigated among different demographic population groups. The urban-rural mortality patterns among different demographic subpopulations led to a diverse picture with both higher and lower mortality risks. This interaction between context and composition is often suggested but seldom

investigated[7,145,228]. For urbanisation the interaction with sex was mainly examined with, however, contradictory results[62,152,206]. An interaction between context and composition as observed in this thesis implies that people react differently to their environment. The different needs people have makes them search for a specific environment which can best fulfill these needs[211]. For instance, younger age groups seem to profit from living in an urban environment, which might provide them with more job opportunities and cheaper housing. Urban elderly were also found to do better than their rural peers in terms of health. This might be explained by more accessible services and better public transport in an urban environment. The needs of people may also vary according to their social position. These needs change during their life course as will the kind of environment that can best fulfill these needs. Different patterns for different people might therefore arise, as was observed in this thesis.

It should be noted that the estimated mortality risks for living in an urban environment in the Netherlands (as found in this thesis) only approximate the true health effect, since these risks are still susceptible for individual confounders such as socio-economic status. Our results could not be confirmed because no other Dutch studies with sufficient control have been performed. More research is needed before valid conclusions can be drawn.

Area demographic composition

In the Netherlands, area demographic composition was associated with overall mortality. When differences in area population composition were accounted for, neighbourhoods with a higher proportion of women, elderly, singles or migrants showed higher mortality rates.

Earlier studies on the contextual effect of population composition are scarce and contradictory. In Helsinki, for instance, no mortality differences were observed between areas characterised by low or high percentages of elderly[25] while a large study in the US did observe an increase in (age-standardised) area mortality rates when the proportion of elderly in the area increased[87]. An earlier Dutch study found a 16% increased mortality risk in areas with a high percentage of migrants, however,

this study adjusted for sex and age only, and a smaller excess risk might be expected when other individual confounders had been considered[70].

The demographic make-up of an area might reflect particular physical or social environments that could affect the health of all neighbourhood residents. Areas with high percentages of singles and elderly might be more deprived areas as the average wealth of singles and pensioners is lower. The association between demographic composition and health might also be mediated by social interactions between neighbourhood residents. People are thought to mingle better with persons who are more alike in terms of life phase and social or cultural background[357,358]. This implies that neighbourhood diversity would lead to fewer interactions. Until now this theory is only tested with regards to ethnic diversity. In the US, ethnic diversity in neighbourhoods led to a decrease in trust - even among those of one's own race[89]. In addition, altruism and community cooperation were rarer and fewer friends were reported in ethnic diverse neighbourhoods. In the Netherlands, social interactions between neighbours were found to be decreased in ethnically diverse neighbourhoods, but for other dimensions of social cohesion such as trust or social participation this was not consistently found[88,94-96]. This diversity theory might also apply to the higher mortality rates in neighbourhoods with higher percentages of elderly. The overall Dutch percentage of elderly is low and an increase will therefore lead to more diversity and following the theory fewer social interactions between neighbourhood residents.

Given the state of affairs regarding research on this topic, no definite conclusions on the potential health impact of living in areas with low or high proportions of specific populations groups can be drawn. The associations (as observed in this thesis) could still be susceptible for individual confounders such as socio-economic status and no earlier Dutch studies could confirm our findings. If such contextual variables are indeed independently related to health, the magnitude of this effect is likely to be small, at least in the Netherlands.

Community social capital

In this thesis, community social capital was examined in relation to overall mortality, different causes of death and psychological well-being. Areas with high levels of

community social capital showed lower overall mortality rates compared to areas with low levels of community social capital, but this association was explained by differences in individual demographic and socio-economic characteristics of the area populations. Lower numbers of death caused by cancer or suicide were still observed in areas with high levels of community social capital after taking into account area population compositional differences. No association was seen between community social capital and psychological well-being. This inconsistency in results for the association between community social capital and health was also reported earlier, with an equally large amount of studies finding a positive assocation[25,100-116] or no assocation[100,101,106,108,109,117-124] for different health outcomes. One of the possible reasons for the contradictory findings might be related to the diversity in indicators used to measure the concept community social capital[125-127]. The range of health effects might also be explained by the differences in health outcomes, population groups or locations studied (as found in this thesis).

In Dutch neighbourhoods with high levels of social capital the number of deaths caused by lung cancer was lower in comparison to neighbourhoods with low levels of social capital. Evidence for such an association is limited to a few studies on this topic indicating either no association[25,101,117] or slightly decreased lung cancer mortality risks in communities with high levels of social capital[101]. In this thesis, it was observed that fewer smokers resided in the areas with higher levels of community social capital. These results imply that the association between community social capital and health could be explained by specific determinants such as smoking. Common values and social control in areas with high community social capital might prevent the uptake of smoking and might increase the support for stopping with smoking, eventually leading to fewer smokers in the area[46,126,359].

In the Netherlands, suicide risks were lower in areas with higher levels of community social capital. Earlier studies support these findings[82,101,108] although one study found no evidence for such a relation[117]. Psychosocial processes are likely to be involved as the underlying mechanisms for the lower suicide risks in areas with higher levels of community social capital. A strong precursor for suicide attempts is psychological well-being, which in turn is related to levels of social support[81,82,84]. Stress-related situations and negative life events seem to have a smaller impact on psychological

well-being when people receive sufficient social support from family and friends[81-84]. In this thesis, a comparable process might be suggested with social support coming from community members instead of family and friends, preventing psychological distress and resulting in lower suicide rates in areas with high levels of social capital. Even though this mechanism is consistent with the findings of our national study on suicide mortality, it is not supported by our Amsterdam study on psychological health in which residents of Amsterdam areas with higher levels of social capital were not better in terms of psychological well-being. The lack of association could, however, be due to the fact that a smaller Amsterdam sample was used, with little variation in both community social capital indicators and psychological well-being.

The association between community social capital and health was not only investigated in the total area population, but also among different demographic subpopulations. Males and married residents living in areas with high as compared to low levels of community social capital had lower overall mortality rates. For suicide, living in areas with high levels of community social capital was especially beneficial for men, younger age groups, singles and individuals of Western ethnic origin. Few studies have explored the possible diversity in associations between community social capital and health when examining different populations groups. Some have provided evidence that community social capital interacted with sex[102] and age[25] whereas others observed no interactions with sex or ethnicity[116]. The interaction between community social capital and compositional variables (as observed in this thesis), supports previous suggestions that the environment does not affect all of us equally[7,145,228]. Some population groups might benefit from the additional social support arising from community social capital. For instance, young single men, a group known to have high suicide rates, especially benefited from living in areas with high levels of community social capital. Their need for social support is probably partly fulfilled by community members preventing them from committing suicide.

Although we found evidence for the effect of community social capital on some specific health outcomes (lung cancer, suicide mortality), the effects on overall mortality and general health seem to be small or non-existent. In addition, we would like to note that the observed health effects of community social capital could still be susceptible for individual confounders such as socio-economic status. In the

Netherlands, social contacts created at other places (such as work or school) may be of more importance when it comes to health than the social network existing in the community. It is suggested that social ties between community members are weak and therefore less influential compared with stronger social ties such as those that exist between relatives and friends[230,237,360]. Social norms and attitudes towards, for instance, healthy behaviour might be shaped by friends and relatives rather than by other community members. Since no other Dutch studies on the relation between community social capital and health are available a valid conclusion is hard to draw and more research is needed.

Social nuisance

In this thesis, presence of nuisance in the area was represented by crime, nuisance from neighbours, drug abuse, youngsters loitering, garbage on the streets, feeling unsafe and dissatisfaction about the quality of green space. The presence of nuisance was negatively related to self-rated health and this association remained even when population differences between the areas was accounted for. The increased risk of about 50% for reporting poor to fair health when living in areas with high levels of nuisance is comparable to effect sizes reported in earlier studies on this topic[45,141-146].

Unfortunately, Dutch studies examining the relation between nuisance and health are lacking but some evidence is provided for the relation between the amount of green in the area and health. Although this is not a measure of nuisance, it may be of interest given the overlap with dissatisfaction about green space as measured in our study. It was found that the amount of green was related to health even when individual demographic and socio-economic differences between areas were accounted for[201,296]. Our study found a more U-shaped curve, with no association with self-rated health in the lowest and highest dissatisfaction category but more people reporting poor to fair health in the medium dissatisfaction category. Although results are not completely comparable, green in the area seems to be positively related to health.

In comparison to community social capital, the relation between presence of nuisance and health was found to be stronger. One reason for this stronger

association could be the different health outcomes examined, i.e. mortality versus self-rated health. However, in one analysis we also studied community social capital in relationship to a self-reported health outcome (psychological health) and found no association. An alternative explanation is that there really is a stronger association with nuisance prevalence than with community social capital. The concept of community social capital stresses positive features of the environment (what the neighbourhood can give to its residents) while nuisance stresses negative features (how the environment can be disturbing and stressful). In psychology, health effects related to negative events are suggested to be stronger than positive events[361,362]. Reasons for this are thought to lie in the evolutionary history of the human species, for whom higher chances of survival and reproduction were related mostly to the ability to accurately respond to stress and danger. Lessons learned from threats and bad experiences should be remembered so that history will not repeat itself, whilst more positive experiences should have a fading effect in order for individuals to continue the search for more and better outcomes[361]. Our results suggest that the theory that "bad is stronger than good"[361] might also apply to the health effect of neighbourhood conditions.

The health effect caused by nuisance is suggested to be mediated by stress, which is known to be related to a number of health outcomes[142]. Direct health effects, however, such as physical injuries caused by violence, are also possible. The presence of nuisance might impose a great level of daily strain and coping with this strain not only induces stress but might also cause mental problems[82], as was observed for social disorder, a concept including different forms of nuisance[45,134-140]. In addition, communities with high levels of nuisance are likely to have a disintegrated social network[45] leading to fewer resources for social support, which is needed not only to deal with the nuisance itself but also the related stress[81-84]. This breakdown of social control results in more maladaptive and antisocial behaviour, and might discourage residents from engaging in healthy lifestyle measures such as physical activity. Nuisance also induces nuisance, thus making it more difficult to break the vicious circle[359].

Small contribution of contextual factors in explaining spatial health patterns

In comparison to compositional variables, contextual variables were less important in explaining the geographical variation in health across small areas in the Netherlands. Although it is reported that composition is far more important than context in explaining geographical health differences, very few estimates are given[8,19,24-26,31,33,56,341,363]. In the Netherlands, area deprivation still explained about half of the geographical variation in self-rated health when only adjusting for sex and age (decrease from 5 to 2.6%)[58]. A similar reduction was observed for morbidity, where area deprivation in addition to sex and age explained about 50 to 75% of the remaining geographical variation (decrease from 3% to between 1.5 and 0.8%)[58]. In this thesis, area deprivation only explained 3% of the remaining variation in mortality after adjusting for sex and age. This large difference in contribution might be explained by the studied health outcome (mortality in this thesis versus self-reported health), the different methodology used (scaled deviance in this thesis versus intra-class correlation coefficient) or the study population (national sample in this thesis versus a smaller Amsterdam sample).

The small contribution of the area environment in explaining geographical health patterns could be related to the fact that most people do not spend a large part of their time in their area environment. Other environments, such as the working or school environment in which a larger part of the day is spent, are probably more or equally important[25,291]. If people are minimally exposed to their area environment, the contribution of this environment to health will also be minimal.

Comparison with other countries

In this thesis, five social features of the area environment were examined in relationship to health. In this section, our results are compared with the results obtained in other countries. Our main question is whether the association between environment and health that we observed for the Netherlands, is smaller than in other countries such as the UK and the US. We hypothesized that smaller effects would be found for countries such as the Netherlands, where a welfare state is fully developed.

Our results showed that people living in a deprived area had a 35% increased mortality risk and were 50% more likely to report poor to fair self-rated health. We

applied different indicators for area deprivation, namely percentage of low income groups in relation to mortality, and unemployment rates and social benefits receipt rates in relation to self-rated health. For comparison with other countries, we selected only those studies that used the same indicators of area deprivation in relationship to the same outcome measure.

Three American studies were identified which used income as area deprivation indicator in relation to mortality. Since our results were not adjusted for individual socio-economic status, the unadjusted (only for sex and age) mortality risks in deprived areas were compared. The 35% increased mortality risk for living in the most deprived areas in the Netherlands was comparable to the increased mortality risk as observed in the US. In the most deprived areas in the US, white people had an increased mortality risk ranging from 29 to 61% [21,364,365]. Differences in methodology could explain the differences in the precise magnitude of effect. In line with these findings, a comparative study of five European cities (including the Dutch city Eindhoven) and the US found no substantial differences in the size of the association between area deprivation (unemployment rate) and mortality across the six cities[20].

We found that residents of areas distinguished by a high number of unemployed or people receiving social benefits were 50% more likely to report their health as poor. Previous Dutch studies reported no excess risk[58] and a twofold excess risk[56], respectively. For other European countries, risk estimates were comparable to our estimates, with residents of deprived areas reporting 30 to 50% more often to be in poor health[143,319]. According to one American study, area unemployment rates did not seem to be related to self-rated health[366]. As with mortality, these comparisons are tentative because of methodological differences between the studies. Nonetheless, together with the evidence found for mortality, the available evidence suggests that the strength of the association between area deprivation and health in the Netherlands is comparable to that of most other industrialized countries.

For the comparison of urban-rural mortality patterns, unadjusted estimates (sex and age) were compared as such estimates were used in most previous studies. In this thesis, a 9% increased mortality risk among urban compared to rural residents was

observed in the Netherlands. Similar results were found among citizens of the four largest cities of the Netherlands, with an increased mortality risk of 6% as compared to residents of less urbanised municipalities (population less than 100,000)[55]. Most results from other studies could not be compared with ours because either premature mortality rates[63,205] or specific causes of death[59,61,68,69,72,73,205] or narrower age groups[62,64,65,69,73,205] were examined. In the UK, excess mortality risks of about 20 to 30%[66] were found but less striking excess mortality risks ranging from 5 to 8%[71] were also observed among urban as compared to rural residents. In comparison to our results, American studies reported both higher as well as lower mortality risks among urban compared to rural residents with somewhat larger risk estimates ranging from 10 to 25%[67,152,367]. A weaker association between urbanisation and mortality might exist in the Netherlands, but limited evidence from other countries is available for comparison.

Earlier studies on possible health effects of living in an area with a certain demographic composition are scarce. Therefore comparisons of effect estimates are limited and no conclusions can be drawn.

We examined community social capital in relation to mortality and psychological well-being and found no associations with either health outcomes. For the comparison of effect estimates studies with non-comparable measures of community social capital were used as no previous studies examined exactly the same indicator.

Since our results were not adjusted for individual socio-economic status, the unadjusted (sex and age) mortality risks for community social capital were compared. In the Netherlands, residents of neighbourhoods with high levels of social capital have a 9% decrease in mortality risk. In other European studies, the association between community social capital and mortality appears to be stronger[25,101,112,113,123]. In Oceania somewhat higher mortality risks were observed in communities with low community social capital[117] as compared to our results, but no such association was also reported[124].

In this thesis, no association was found between community social capital and psychological well-being. Other cross-sectional Dutch studies found that community

social capital was positively associated with psychological well-being among children[130], but this relation disappeared when examined longitudinally[119]. Among an adult population, as examined in our study, no other effect estimates from the Netherlands or another country are available. From the comparisons obtained for mortality, it seems that the association between community social capital and health is weaker in the Netherlands as compared to other countries.

The results obtained for our measure combining different forms of social nuisance was used for comparison with other studies, as most of these combine different forms of nuisance. In the Netherlands, people living in neighbourhoods with high levels of nuisance were 50% more likely to report poor to fair health as compared to people living in neighbourhoods with low levels of nuisance. In the UK, several studies explored the association between neighbourhood problems and self-rated health. The estimates of these studies varied substantially with some studies indicating no association[143,211], weaker associations with excess risks of 10 to 20%[143,144,211] and stronger associations with even a two-fold increase for reporting poor to fair health when living in a neighbourhood with many problems[45,141,211]. In the US, physical disorder and social disorder appear to be less strongly associated with self-rated health as compared to the Netherlands, with reported excess risks not exceeding 20%[316,320]. In Canada, physical (noise and pollution) and social dislikes (lack of safety) were not related to self-rated health, but the Canadian study adjusted reported associations for health-related behaviours which was not done in our study[146]. Presence of nuisance within the area might be more weakly associated with self-rated health in the Netherlands as compared to other countries, but the large variation in effect estimates from earlier studies make judgements less reliable.

In conclusion, the size of the health effect of area deprivation as observed in the Netherlands is comparable to that observed in other countries. For urbanisation and community social capital health effects seem to be smaller in the Netherlands compared with other countries, however, due to the lack of comparable studies, caution is required in the interpretation of these results.

We anticipated that area deprivation would have a smaller impact on health in the Netherlands as compared to other countries. Firstly, the Netherlands is a small and

densely- populated land with probably less striking differences in area environments as compared to, for instance, the US or large European countries. If the variation in area environment is smaller, the health impact of contextual variables might also be smaller. Secondly, government action and policies in the Netherlands might have weakened the association. The Netherlands has a welfare state with characteristics of both social-democratic and conservative-corporatistic regimes[368-370]. The redistributive social security system provides income, security and services to marginalised groups such as the poor, elderly, and disabled people. This social equality principle may affect geographical inequalities in different ways. For instance, social housing programs might reduce inequality in living conditions by enabling low-income groups to live in decent houses and in well-maintained and well-serviced neighbourhoods. Despite differences in welfare systems, area deprivation had similar health effects across countries. These findings might be related to a concept called relative deprivation[371]. In the health inequality literature, relative deprivation was also speculated to play a role in the unexpectedly larger health inequalities found in welfare states providing the most extensive welfare provision[370].

The weaker association between urbanisation and mortality observed in the Netherlands as compared to other countries might be related to a smaller variation in population density across the Netherlands, together with high proximity of main cities to most areas in this small country. Even the most rural areas still contain a considerable amount of inhabitants per square kilometre. Small variations in population density might result in smaller health variations between rural and urban places. In addition, smaller distances between communities may have contributed to a weaker association between community social capital and health. Relevant social networks with family and friends may more easily be maintained beyond neighbourhoods when travel times are short.

9.4 Implications for policy and research

In this thesis, five social features of the area environment and their relation to health were examined. For area deprivation and presence of social nuisance within areas, an independent health effect was observed. The associations between health and these two features were sufficiently adjusted for compositional differences between areas and/or also observed in earlier Dutch studies. For urbanisation, area demographic composition and community social capital the associations with health were insufficiently controlled for individual socio-economic differences between the areas. No strong evidence from earlier Dutch studies was available to draw definite conclusions about the possible health effects of these area features. These results suggest that, with the current evidence at hand, the focus should lie on deprived areas or areas characterised by high levels of social nuisance, in policies and programs aimed at reducing health inequalities between areas. Dutch research on the association between area environment and health is limited and more studies are needed to determine which features of the area environment are most important for the health of residents in the Netherlands. In the following sections, implications for policy and research are discussed in more detail.

Implications for public health policy

The health effects of the social area features studied in this thesis are generally modest. However, environmental interventions might still be considered as useful policy measures to improve population health. There are a number of advantages when implementing interventions aimed at the environment, rather than at the individual. First, all residents in the area could be exposed to the intervention and the more vulnerable groups which are often the hardest to reach in other types of interventions might also benefit from the environmental improvements taken. Second, changing the environment avoids the risk of blaming the victim. Intervention aimed solely at the individual can suggest that individuals are entirely responsible for their health problems, perhaps making them more reluctant to participate in the intervention[128]. Health effects could of course be larger when environmental interventions are adjusted to the specific problems existing in the area. For instance, the provision of safe and clean playgrounds in highly urbanised areas can be used to

increase physical activity among children, whereas their effect may be more limited in rural areas.

In the Netherlands, living in the more deprived areas is clearly associated with poorer health. Therefore, interventions and programs to reduce area differences in health should initially focus on these areas. There are indications that deprived areas are characterised by an inferior social, physical and service environment, which may indirectly affect the health of area residents[26,27,44-49]. In this thesis, no evidence was found for a large effect of community social capital and health. Targeting the physical or service environment, rather than a cohesive social environment, might therefore be a better entry point for policymakers. Deprived areas in the Netherlands more often contain negative environmental features (the environment is disturbing and stressful) and less often positive environmental features (what the environment can give to its residents)[50,51]. Negative environmental features refer to noise levels, air pollution concentrations, the proximity to industries (with potential risks such as firework factories), and the lack of public green in the area. A more equal distribution of negative and positive environmental features is likely to reduce the existing geographical health inequalities in the Netherlands.

In deprived areas, making services more easily available or more accessible could be another priority for public health policy, although clear indications that the service environment is related to health are missing. Encouraging business owners to set up new businesses in deprived areas could stimulate the economic conditions in the area[372]. New businesses not only provide new job opportunities, but also contribute to the liveability of the area as owners generally want to keep the area clean, safe and attractive for their customers. Further, the establishment of more businesses may positively affect the area reputation[372]. Other services may also be important. Examples include extra police attention to reduce vandalism and criminality, sports and recreations facilities, and services for the care of pre-school children allowing their mothers to work.

The presence of social nuisance (e.g. litter, vandalism or graffiti) was found to be related to more health problems. Reducing different forms of nuisance might therefore be a component of a strategy to reduce geographical health inequalities in

the Netherlands. A number of interventions were found to be effective in reducing nuisance in Dutch communities[373]. For instance, the presence of surveillance cameras or police surveillance decreased the number of incivilities, with the effect that people felt safer. Social monitoring by parents or coaches led to a better compliance with general rules, such as offering garbage at garbage pick-up time. Preventing disorderly behaviour might start with reducing social problems in the area, as such behaviour seems to be stimulated in a socially disorganised community[374].

Implications for public health research

Research on environmental determinants on health is a relatively new area, with many issues still to be explored. Examining more specific area features, different health outcomes and focusing on different population groups are among the general recommendations that we can make. When deciding on a topic, researchers should elaborate on how and why specific area features are thought to have an impact on health, and assess the importance of the proposed mechanisms. Finally, longitudinal studies are needed to elucidate the direction of causality. These recommendations are discussed in the following paragraphs.

In this thesis, five more social features of the area environment were investigated. Area deprivation and urbanisation might be considered as more general contextual variables while area demographic composition, community social capital and the presence of social nuisance might be seen as more specific area features related to deprivation and urbanisation. Until now, many studies have focused on general rather than on specific area features, with area deprivation being most often investigated[348]. Data on area deprivation are easily available and these suffice for a first indication about the extent to which the area environment influences people's health. Since the evidence from multi-level studies for an independent health effect of area deprivation is accumulating, it is time to pay more attention to the health effects of features representing specific items of the area environment[348].

Different health outcomes should be considered in research on contextual health effects. In this thesis, the association between community social capital and health differed depending on the outcome studied. Although overall mortality was unaffected by community social capital, the rates of some causes of death were found to be

lower in areas with high levels of community social capital. Such results indicate the role of disease-specific pathways of causation, such as the possible effect of community social capital on mental health or on health-related behaviour[126]. Since specific determinants are related to specific diseases, further evidence on the role of such determinants might be expected from the distinction between specific diseases.

Another route towards improved understanding of the associations between contextual variables and health outcomes is to focus on the possible interaction between context and composition, i.e. on cross-level effects. In this thesis, some evidence was found for this interaction between context and composition for both urbanisation and community social capital. For instance, community social capital was negatively associated with overall mortality among men and married persons, while no association was found among females and unmarried persons. These results remind us that different people may react differently to their area environment. Reasons for these different reactions might be the time spent within and around their home, and the need of or appreciation for certain features in the area environment[7,145,228-230]. Until now, few studies have examined this possible interaction between context and composition.

In this field of research, some have commented on the absence of a theoretical framework that would clarify the relation between area environment and health. Construction of such a framework is difficult because the relation between area environment and health is highly complex. Despite frameworks constructed by some researchers, a complete and comprehensive framework is still lacking[6]. However, rather than trying to construct a comprehensive theoretical framework, individual researchers might better focus on their specific topic and create a specific framework to address that topic. For instance, studies on the consequences of geographical variations in crime rates could focus on selected health outcomes such as psychosocial stress, blood pressure or psychological well-being. In addition, including more intermediate factors (such as social control) could set the agenda for research on specific pathways linking crime to community health.

Associations between area environment and health outcomes are often suggested to be causal, but this has seldom been tested using an adequate study design.

Longitudinal studies are needed to assess and remove the possible confounding effect of selective migration in studies on the relation between area features and health. In addition, longitudinal studies are usually needed to assess the duration of exposure to an area feature in relationship to health, and to take into account appropriate time lags. Although badly needed, geographical data with longitudinal design are scarce. Alternative approaches, for application to cross-sectional data, include restricting study samples to residents who have lived in the area for a longer time, in combination with retrospective environmental data. In the Netherlands, this alternative is feasible since data on area features, health outcomes and information on length of residence are routinely gathered in the population registry.

To conclude, we recommend that future studies focus more on the contextual effects of specific environmental features and this for multiple health outcomes among different population groups and within different settings. Preferably, a longitudinal design (or similar approach) should be used to test hypotheses derived from conceptual frameworks. The results should ultimately inform the development of effective interventions aimed to reduce geographical health inequalities.

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Summary

The possible role of the area environment in the field of public health has recently received increasing attention. As health inequalities are persistently found between countries and regions, and even at a detailed geographical scale, questions are raised about how one's place of residence might contribute to these inequalities. This thesis aims to contribute to this discussion. In the Netherlands, few studies have addressed the possible health impact of the area environment. Therefore, the main objective of this thesis is to identify features of the area environment related to health. This thesis mainly focuses on social features of the area environment operating at a local scale. Five such area features are studied in detail; namely, area deprivation, urbanisation, area demographic composition, community social capital and the presence of social nuisance within neighbourhoods. The following specific research questions are examined:

1. Which social features of the area environment are related to health at the smaller geographical scale in the Netherlands?

2. Do these associations between social features of the area environment and health persist when differences in population composition across small areas in the Netherlands are taken into account?

3. Do these associations between social features of the area environment and health vary between different demographic subpopulations living in small areas?

At the detailed geographical scale (the focus of this thesis), population compositional differences between areas might explain existing health differences between areas because of the unequal distribution of individuals with higher health risks across areas. For instance, poorer health outcomes in deprived areas could solely be caused by the poorer health status of the lower socio-economic groups that reside in such areas. Therefore, not only is the association between area environment and health examined in this thesis (research question 1), but also whether this association remains after controlling for population compositional differences between areas (research question 2). Lastly, besides examining the association between environment and health in a total population, we explore the possibility that social features of the area environment might be more strongly associated with

health among certain population groups. Previous studies on environmental health effects proposed that people might react differently towards features in their area environment. This diversity in associations is further investigated for two environmental features, namely urbanisation and community social capital.

In this thesis, both national data as well as data collected in a single city (Amsterdam, the Dutch capital) are used to address the research questions. Chapters 2 to 6 examine the various associations between area environment and health in a national sample. In these chapters, area deprivation, urbanisation, area demographic composition, and community social capital are studied in relation to overall mortality and/or more specific causes of death. Chapters 7 and 8 examine community social capital and presence of social nuisance in relation to more self-reported health outcomes in the Amsterdam sample.

Chapter 2 focuses on areas that are healthier or unhealthier than would be expected based on their socio-economic level. This chapter presents a first exploration of health differences between areas in the Netherlands. In the Netherlands, 39% of all areas had a 15% higher or lower mortality rate and 19% had a 15% higher or lower hospitalisation rate than would be expected based on their socio-economic level. These findings imply that not only socio-economic disadvantage, but also other area characteristics might contribute to health. Areas that were healthier than expected based on their socio-economic level were often rural or contained low percentages of elderly, singles or non-Western migrants. Similar but opposite associations were observed for areas that were unhealthier than expected based on their socio-economic level. These results imply that contextual variables, such as urbanisation and area demographic composition, might contribute to health inequalities across neighbourhoods in the Netherlands.

Chapter 3 describes the urban-rural mortality patterns in the Netherlands. Only slightly higher mortality risks were found among urban residents as compared to rural residents. These urban-rural mortality differences were mostly explained by population composition and differences in area socio-economic level between urban and rural areas. After controlling for these factors, a reversed pattern was observed with slightly lower mortality risks among residents of urban neighbourhoods. Different

patterns were found for different causes of death. In the more urban areas, overall cancer and lung cancer mortality risks were higher, while traffic injury mortality and cardiovascular mortality risks were lower. No urban-rural differences were found for suicide. Living in an urban environment had a different impact on health when specific population groups were considered. In the Netherlands, particularly individuals aged 10 to 40 years and 80 years and above as well as singles and migrants, fared better in an urban than rural environment. In contrast, 50-70 year olds and married individuals living in urban neighbourhoods experienced somewhat higher mortality risks compared to their rural peers. As different urban-rural patterns were observed for different causes of death and population groups, it seems likely that the urban environment poses hazards but also offers opportunities, with the balance of effects being different for different groups of people.

In **Chapter 4**, the possible health impact of living in a neighbourhood with a certain demographic composition is examined. Over and above the compositional effects of sex, age, marital status and ethnicity, neighbourhoods characterised by a higher percentage of women, elderly, singles or migrants showed higher mortality rates. These associations were somewhat stronger when examined among neighbourhoods with particularly high or low percentages of the corresponding population group, except for migrants. Although neighbourhood demographic composition affected neighbourhood mortality rates, the associations found were weak, questioning the importance of such contextual variables as health determinants in the Netherlands.

Chapter 5 examines associations between community social capital and mortality in the Netherlands by investigating different causes of death, population groups and locations. Areas with high levels of community social capital showed lower overall mortality rates as compared to areas with low levels of community social capital. However, this association was explained by differences across the neighbourhoods in area population composition and neighbourhood socio-economic level. However, lower rates of mortality by cancer (especially lung cancer) and suicide were observed in areas with high levels of community social capital, also after taking into account the demographic and socio-economic structure of the neighbourhood. In contrast, slightly higher risks of mortality from cerebrovascular heart disease were observed in

neighbourhoods with high compared to low levels of social capital. Further analysis suggested that the beneficial health effect of living in a neighbourhood with high levels of social capital (if any), applies particularly to men, married individuals and urban residents. It can be concluded that the protective health effect of living in a neighbourhood with high levels of social capital applies to certain diseases, population groups and geographical locations.

Chapter 6 further examines the association between community social capital and suicide mortality. In addition another related (more structural) feature of the environment is investigated, namely social fragmentation. As in chapter 5, the associations are not only examined in the total neighbourhood population but also among different population groups. Again, suicide mortality rates were found to be higher in neighbourhoods with low compared to high levels of social capital. Although variation in suicide mortality was largely explained by neighbourhood differences in population composition (especially marital status), neighbourhood socio-economic level and cultural-religious orientation, a small (about 8%) difference between high and low social capital neighbourhoods remained. Particularly men, individuals aged up to 50 years, and singles showed higher suicide mortality rates when living in neighbourhoods with low levels of social capital. Similar but weaker associations were observed between social fragmentation and suicide. The results suggest that the protective health effect of community social capital is likely to be small and restricted to specific population groups.

Chapter 7 focuses on the association between individual evaluation of the neighbourhood environment and psychological well-being. The positive association often found between individual evaluation of the neighbourhood environment and psychological well-being is commonly assumed to be causal; however, little evidence is available to support this assumption. In chapter 7, using data from surveys in Amsterdam, we assessed the association of psychological health with both individual evaluation and aggregated evaluations of the same neighbourhood environment. Individual evaluations of social and physical features of the neighbourhood environment were persistently associated with psychological health, with a more positive evaluation being associated with better psychological health. In contrast, aggregated evaluations of the neighbourhood environment most often showed no

association with psychological health. The latter results raised questions about the assumed causality of the association between individual evaluation of the neighbourhood environment and psychological health. Alternative interpretations include the possibility of reversed causal effects with people suffering from mental health problems making more negative reports about their neighbourhood environment.

In **Chapter 8**, the presence of different forms of social nuisance within the neighbourhood (such as crime and litter) is studied in relation to self-rated health. In the Amsterdam surveys, people living in neighbourhoods with high levels of social nuisance were more likely to report fair to poor (instead of good) health after individual demographic and socio-economic confounders were taken into account. Nuisance from neighbours, drug abuse, youngsters loitering, garbage on the streets, feelings of unsafety and dissatisfaction about the quality of green space, were individually associated with fair to poor self-rated health. About 25% of the neighbourhood variation in self-rated health was explained by the presence of social nuisance within the neighbourhood. This suggests that this latter factor is an important contributor to geographical variations in health.

Chapter 9, the General Discussion, starts with a summary of the main results of this thesis and is followed by a discussion of the potentially most important methodological limitations. Particular attention is paid to methodological issues affecting the study of contextual variables in a geographical analysis. These issues include: 1) control for confounding by variables at the individual level, 2) choice of the geographical area unit, including the discrepancy between the area unit as studied and the perception of this unit by the resident, 3) limitations of a cross-sectional study design and related difficulties of causal inferences, and 4) choice between objective versus subjective measures of contextual variables.

Taking into account the evidence generated our own studies, as well as findings from other studies, we discussed the potential role of the five area features central to this thesis (area deprivation, urbanisation, area demographic composition, community social capital, presence of social nuisance). We concluded that all features were associated with health when only sex and age differences between the areas were

taken into account. In addition, for area deprivation and presence of social nuisance within neighbourhoods, there was evidence for an independent health effect after control for compositional differences. For urbanisation, area demographic composition and community social capital, the associations with health could be due to compositional effects that were not sufficiently controlled for in the analyses. No evidence was available from other Dutch studies to support (or refute) our conclusions on the health effects of these area features.

These results suggest that policies and programs aimed at reducing health inequalities between areas need to pay particular attention to the role of area deprivation and social nuisance. More studies are needed to determine which features of the living environment are most important for the health of residents in the Netherlands. Future studies on neighbourhood environment and health should identify possible effects by focusing on multiple health outcomes among specific populations groups within different settings.

Samenvatting

Er is recentelijk meer aandacht voor de omgeving als mogelijke determinant van gezondheid door de veelvuldig aangetoonde gezondheidsverschillen tussen landen, regio's en zelfs buurten. In Nederland is er tot nu toe weinig onderzoek verricht naar de mogelijke gezondheidsgevolgen van het wonen in een bepaalde omgeving. Dit proefschrift bestudeert daarom de relatie tussen omgeving en gezondheid in de Nederlandse samenleving. We richten ons op de omgeving waarin mensen wonen en de opgenomen studies in dit proefschrift onderzoeken om die reden de relatie tussen omgeving en gezondheid op lokaal niveau. De term 'omgeving' is breed en ter beperking is gekozen om 5 meer specifieke omgevingsvariabelen van een sociaal karakter te onderzoeken, namelijk: sociaal-economische status van een gebied (beter bekend als deprivatie), stedelijkheid, de demografische bevolkingsopbouw van een gebied, sociaal kapitaal en overlast. Deze omgevingskenmerken zijn in de regel onderzocht aan de hand van de volgende drie onderzoeksvragen:

1. Welke sociale kenmerken van een omgeving zijn geassocieerd met de gezondheid in Nederland op lokaal geografisch niveau?

2. Blijven deze relaties tussen sociale kenmerken van een omgeving en gezondheid bestaan als er rekening wordt gehouden met de bevolkingsopbouw van kleine geografische gebieden?

3. Zijn deze relaties tussen sociale kenmerken van een omgeving en gezondheid anders voor verschillende bevolkingsgroepen wonend in kleine geografische gebieden?

De gezondheidsverschillen tussen kleine geografische gebieden, zoals onderzocht wordt in dit proefschrift, zullen voor een deel een reflectie zijn van de gezondheidstoestand van de bewoners wonend in die gebieden. In Nederland, maar ook andere landen, blijken mensen met bepaalde gezondheidsrisico's zich te verzamelen in bepaalde gebieden. Mensen met een lage sociaal-economische status blijken bijvoorbeeld vaker in achterstandsgebieden te wonen. Als we de invloed van de leefomgeving op gezondheid willen schatten dienen we dus rekening te houden met de verschillen in bevolkingsopbouw tussen de gebieden. In de eerste onderzoeksvraag willen we weten of er überhaupt een relatie is tussen omgeving en

gezondheid. Als een dergelijk relatie inderdaad bestaat is de volgende vraag of deze relatie tussen sociale omgeving en gezondheid blijft bestaan als we rekening houden met bestaande gezondheidsverschillen veroorzaakt door verschillen in bevolkingsopbouw tussen gebieden (onderzoeksvraag 2).

In eerdere studies naar de relatie tussen leefomgeving en gezondheid wordt tevens vaak geopperd dat niet iedereen hetzelfde reageert op de invloeden vanuit zijn omgeving. De derde onderzoeksvraag richt zich om die reden op de relatie tussen sociale omgeving en gezondheid als bepaalde bevolkingsgroepen wonend in het gebied worden uitgelicht. De mogelijkheid dat omgevingsinvloeden van minder of meer belang zijn voor de gezondheid van bepaalde groepen wordt in het bijzonder onderzocht voor twee van de vijf omgevingskenmerken, namelijk stedelijkheid en sociaal kapitaal.

Om deze drie onderzoeksvragen te beantwoorden zijn zowel nationale gegevens als gegevens voor een enkele Nederlandse stad gebruikt (Amsterdam). In hoofdstuk 2 tot en met 6 worden de nationale gegevens gebruikt om de omgevingskenmerken sociaal-economische status van een gebied, stedelijkheid, demografische bevolkingsopbouw van een gebied en sociaal kapitaal te onderzoeken in relatie tot totale en doodsoorzaakspecifieke sterfte. Hoofdstuk 7 en 8 maken gebruik van de Amsterdamse gegevens om de relatie te onderzoeken tussen de omgevingskenmerken sociaal kapitaal en sociale overlast en zelf gerapporteerde gezondheid.

Hoofdstuk 2 van dit proefschrift omvat een eerste verkenning naar eventuele gezondheidsverschillen tussen kleine geografische gebieden in Nederland. De focus ligt hierbij op gebieden die ongezonder of gezonder zijn dan verwacht op basis van de sociaal-economische status van het gebied. In Nederland had 39 procent van de gebieden een 15 procent hogere of lagere sterfte en 19 procent van de gebieden een 15 procent hoger of lager aantal ziekenhuisopnames dan verwacht op basis van de sociaal-economische status van het gebied. Deze ‘uitzonderingen op de regel’ demonstreren dat naast sociaal-economische status, een belangrijke determinant van gezondheid, andere omgevingskenmerken van invloed zijn op de gezondheid van de bewoners van gebieden. De gezondere gebieden waren eerder rurale

gebieden of gebieden waar weinig ouderen, alleenstaanden of niet-Westerse migranten woonden. Voor de ongezondere gebieden vonden we dezelfde associaties terug, maar dan omgekeerd. Deze resultaten wijzen er op dat de bestaande geografische gezondheidsverschillen in Nederland gerelateerd zijn aan stedelijkheid en de verdeling van bepaalde demografische groepen over Nederland.

In **hoofdstuk 3** van dit proefschrift wordt het verband tussen stedelijkheid en gezondheid verder uitgediept. Er wordt onderzocht of er sterfteverschillen zijn tussen de minder en meer verstedelijkte buurten in Nederland en of dit verband anders is wanneer bepaalde bevolkingsgroepen worden onderzocht. De sterfteverschillen tussen de minst en meest stedelijke buurten in Nederland waren klein met een minimaal verhoogd sterfterisico in de meest stedelijke buurten. De verschillen in bevolkingsopbouw tussen de buurten verklaarden voor een groot deel deze sterfteverschillen. Er werd na controle voor bevolkingsopbouw en sociaal-economische status van de buurt zelfs een verlaagd sterfterisico gevonden in de meest stedelijke buurten als deze werden vergeleken met de minst stedelijke buurten.
De invloed van stedelijkheid op sterfte bleek te variëren als sterfte werd opgesplitst naar doodsoorzaak. De meer stedelijke buurten werden gekenmerkt door een hogere sterfte aan kanker en longkanker, maar een lagere sterfte door verkeersongelukken en hart- en vaatziekten. Stedelijkheid was niet gerelateerd aan zelfmoord. De invloed van stedelijkheid op sterfte bleek ook anders te zijn voor verschillende bevolkingsgroepen. Zo hadden 10 tot 40 jarigen, oudere mensen (80 plus), alleenstaanden en niet-Westerse migranten een lagere sterftekans als zij in een stedelijke omgeving woonden terwijl 50 tot 70 jarigen en gehuwden daar een hogere sterftekans hadden. Hieruit blijkt dat de stedelijke omgeving niet voor iedereen een ongezonde omgeving hoeft te vormen. Waarschijnlijk zijn er naast de vele nadelen van het leven in een stedelijke omgeving ook vele voordelen waardoor bepaalde doodsoorzaken minder voorkomen en bepaalde bevolkingsgroepen verlaagde sterfterisico's hebben in stedelijke gebieden.

Hoofdstuk 4 richt zich op de mogelijke gezondheidseffecten van het leven in een buurt met een bepaalde demografische bevolkingsopbouw. Onderzocht werd of de risico's op sterfte anders zijn als men in een buurt woont met weinig of veel vrouwen,

ouderen, alleenstaanden of niet-Westerse migranten. Buurten met veel vrouwen, ouderen, alleenstaanden en niet-westerse migranten hadden hogere sterfterisico's dan buurten met weinig mensen van deze bevolkingsgroepen. Dit verband werd gevonden zelfs na controle voor verschillen in bevolkingsopbouw (geslacht, leeftijd, burgerlijke staat en etniciteit). Voor een bepaalde bevolkingsgroep zoals vrouwen bleek de associatie tussen aanwezigheid van die bevolkingsgroep, in dit geval vrouwen, en sterfte zelfs iets sterker te zijn. Alleen voor niet-Westerse migranten was dit niet het geval. Hoewel we vaak een significante associatie vonden tussen demografische bevolkingsopbouw van de buurt en sterfte, waren de meeste associaties zwak. In Nederland lijkt de aanwezigheid van bepaalde bevolkingsgroepen in een gebied een beperkte invloed te hebben op de gezondheid van de buurtbewoners in dit gebied.

In **hoofdstuk 5** wordt de relatie tussen sociaal kapitaal en sterfte in buurten in Nederland onderzocht. Het bleek dat buurten waarin een hoge mate van sociaal kapitaal werd vastgesteld een lager sterfterisico hadden dan buurten waarin een lage mate van sociaal kapitaal werd vastgelegd. Deze sterfteverschillen werden echter verklaard door verschillen in bevolkingsopbouw en sociaal-economische status tussen buurten met een hoog en laag sociaal kapitaal. De invloed van sociaal kapitaal op sterfte bleek te variëren wanneer verschillende doodsoorzaken werden onderzocht. Buurten met hoge mate van sociaal kapitaal kenmerkten zich door lage sterftecijfers voor kanker (met name longkanker) en zelfmoord, maar met hoge sterftecijfers voor cerebrovasculaire aandoeningen. Tevens hadden mannen, gehuwden en mensen wonend in een stedelijke omgeving een enigszins verlaagd sterfterisico in buurten met meer sociaal kapitaal. Het lijkt er op dat in Nederland het wonen in een buurt met een hoge mate van sociaal kapitaal een gezondheidsbevorderend effect heeft, maar dan alleen voor bepaalde ziekten, onder specifieke bevolkingsgroepen of binnen een stedelijke setting.

Ook in **hoofdstuk 6** staat het omgevingskenmerk sociaal kapitaal centraal. Er wordt in dit hoofdstuk meer specifiek gekeken naar zelfmoord, aangezien verwacht wordt dat vooral deze gezondheidsmaat sterk gerelateerd zal zijn aan de sociale omgeving. Tevens zal in dit hoofdstuk een andere, meer structurele maat voor de sociale omgeving worden onderzocht, namelijk sociale fragmentatie. Wederom vonden we

een lager sterfterisico als gevolg van zelfmoord in de buurten met meer sociaal kapitaal. De buurtverschillen in sterfte aan zelfmoord werden grotendeels verklaard door bestaande verschillen in bevolkingsopbouw (voornamelijk burgerlijke staat), sociaal-economische status van de buurt en cultureel-religieuze oriëntatie van de regio. Toch bleef er een klein verschil van 8 procent in sterfterisico bestaan tussen buurten met een hoge en lage mate van sociaal kapitaal. De relatie tussen sociaal kapitaal en zelfmoord was sterker onder mannen, de groep 0 tot 50 jarigen en alleenstaanden. Voor sociale fragmentatie en zelfmoord werden dezelfde resultaten gevonden, maar veelal zwakker. Op basis van deze resultaten werd geconcludeerd dat het gezondheidsbevorderende effect van het wonen in een buurt met veel sociaal kapitaal vermoedelijk klein is en vooral wordt gevonden bij bepaalde bevolkingsgroepen.

Hoofdstuk 7 richt zich op de relatie tussen de buurtomgeving en psychische gezondheid in Amsterdam. In eerder onderzoek werd al vaak aangetoond dat op individueel niveau een positieve beoordeling van de omgeving samenhing met een betere psychische gezondheid. Het is echter onduidelijk of deze relatie causaal is. In dit hoofdstuk wordt de alternatieve hypothese getest, die stelt dat mensen met psychische gezondheidsproblemen geneigd zijn minder positief te oordelen over hun omgeving dan mensen zonder psychische problemen (omgekeerde causaliteit). Om dit te testen werden naast individuele beoordelingen ook beoordelingen over de omgeving van andere mensen uit dezelfde buurt onderzocht. Een eigen positieve beoordeling van de omgeving hing in de regel samen met een betere psychische gezondheid op het individuele niveau. Als deze omgeving werd beoordeeld door anderen in de buurt werd er echter over het algemeen geen relatie met psychische gezondheid gevonden. Deze resultaten ondersteunen de hypothese volgens welke mensen met psychische gezondheidsproblemen eerder geneigd zijn negatief te oordelen over hun omgeving dan mensen zonder deze problemen. Onze conclusie was dat een omgekeerd causaal verband een waarschijnlijkere verklaring is voor de relatie tussen individuele beoordeling van de omgeving en psychische gezondheid dan een causaal verband.

In **hoofdstuk 8** wordt de relatie tussen verschillende vormen van overlast en zelf-gerapporteerde gezondheid in Amsterdam nader bestudeerd. We onderzochten

overlast door criminaliteit, buren, drugsgebruikers, geluid, hanggroepjongeren, vuilnis op straat, graffiti, gevoelens van onveiligheid en ontevredenheid met het groen in de buurt. Wij vonden dat mensen wonend in buurten met veel overlast op deze verschillende aspecten hun gezondheid vaker als slecht beoordeelden dan mensen wonend in buurten met weinig overlast. Dit verband werd ook gevonden wanneer gecorrigeerd werd voor verschillen in demografische en sociaal-economische kenmerken tussen mensen. De sterkste associaties werden gevonden met overlast van buren, drugsgebruikers en hanggroepjongeren, met overlast door vuilnis op straat, gevoelens van onveiligheid en ontevredenheid met het groen in de buurt. Ongeveer een kwart van de buurtverschillen in zelf-gerapporteerde gezondheid tussen de buurten werd verklaard door de aanwezigheid van overlast, hetgeen aangeeft dat overlast een belangrijke bijdrage zou kunnen leveren aan de geobserveerde geografische gezondheidsverschillen in Amsterdam.

De algemene discussie van het proefschrift, beschreven in **hoofdstuk 9**, begint met een samenvatting van de belangrijkste resultaten van dit proefschrift. Vervolgens worden vier methodologische beperkingen in geografisch onderzoek besproken: 1) het corrigeren voor individuele 'confounders', 2) de afbakening van geografische eenheden en daarmee verbonden de perceptie van deze eenheden door bewoners, 3) de beperkingen van cross-sectionele studies en 4) de verschillen tussen subjectieve versus objectieve meting van omgevingsvariabelen.

Na deze uiteenzetting wordt onderzocht, met behulp van onze en andere resultaten, welke omgevingskenmerken (deprivatie, stedelijkheid, demografische bevolkingsopbouw van een gebied, sociaal kapitaal en sociale overlast) onafhankelijk gerelateerd zijn aan de gezondheid van de Nederlander. Alle vijf de omgevingskenmerken waren gerelateerd aan gezondheid na controle voor geslacht en leeftijd. Echter, als gecontroleerd werd voor andere demografische en sociaal-economische verschillen tussen buurten, bleken enkel deprivatie en sociale overlast nog geassocieerd te zijn met gezondheid. Bij de analyse van stedelijkheid, demografische bevolkingsopbouw van een gebied en sociaal kapitaal kon onvoldoende gecorrigeerd worden voor demografische en sociaal-economische verschillen tussen buurten. Tevens was er geen ondersteunend bewijs vanuit ander Nederlands onderzoek. Daardoor kon geen uitsluitsel worden gegeven over de vraag

of in Nederland deze omgevingskenmerken onafhankelijk geassocieerd waren met gezondheid.

Onze aanbevelingen luiden dat, teneinde buurtverschillen in gezondheid te verminderen, volksgezondheidsbeleid zich zou moeten richten op gebieden met een lage sociaal-economische status of gebieden die worden gekenmerkt door veel sociale overlast. Aangezien onderzoek naar omgevingsdeterminanten van gezondheid schaars is in Nederland, is het belangrijk dat er meer onderzoek verricht wordt naar de omgeving als mogelijke determinant van gezondheid met aandacht voor specifieke omgevingsvariabelen in relatie tot verschillende gezondheidsmaten en onder verschillende bevolkingsgroepen.

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About the author

Curriculum Vitae

Carolien van Hooijdonk was born on December 5th 1978, in Oudenbosch, the Netherlands. In 1997, she completed her secondary school education at Sint Eduardus in Merksem, Belgium. Thereafter, she continued her studies at the Wageningen Univeristy, where she obtained a Master's degree in Nutrition and Health in 2002. In 2003, she started her PhD project of which the results are described in this thesis. This project was conducted at the Centre for Prevention and Health Services Research of the National Institute of Public Health and the Environment (RIVM) in Bilthoven in collaboration with the Department of Public Health of the Erasmus Medical Centre in Rotterdam. During this period, she obtained a Master of Public Health at the Netherlands Institute for Health Sciences (Nihes). In September 2007, Carolien van Hooijdonk started working as a researcher at the Department of Public Health of the Erasmus Medical Centre in Rotterdam.

Carolien van Hooijdonk werd geboren op 5 december 1978 in Oudenbosch. In 1997 behaalde zij haar diploma voor de Moderne Humaniora Wiskunde Wetenschappen (vergelijkbaar met VWO) aan het Sint Eduardus te Merksem, België. Daarna startte zij met haar studie Voeding en Gezondheid aan de Wageningen Universiteit waar ze in 2002 haar doctoraal behaalde. In 2003 begon zij als promovendus aan het project waarvan de resultaten zijn beschreven in dit proefschrift. Dit project was een samenwerking tussen het Centrum voor Preventie en Zorgonderzoek van het Rijksinstituut voor Volksgezondheid en Milieu (RIVM) te Bilthoven en de afdeling Maatschappelijke Gezondheidszorg van het Erasmus Medisch Centrum te Rotterdam. In deze periode behaalde zij tevens haar Master of Public Health aan het Netherlands Institute for Health Sciences (Nihes). Sinds september 2007 is Carolien van Hooijdonk werkzaam als onderzoeker bij de afdeling Maatschappelijke Gezondheidszorg van het Erasmus Medisch Centrum te Rotterdam.

List of publications

Wouters-Wesseling W, van Hooijdonk C, Wagenaar L, Bindels J, de Groot L, van Staveren W. The effect of a liquid nutrition supplement on body composition and physical functioning in elderly people. Clin Nutr 2003;22(4):371-7.

van Hooijdonk C, Droomers M, van Loon JAM, van der Lucht F, Kunst AE. Exceptions to the rule: healthy deprived areas and unhealthy wealthy areas. Soc Sci Med 2007;64(6):1326-42.

Agyemang CO, van Hooijdonk C, Wendel-Vos GCW, Ujcic-Voortman JK, Lindeman EM, Stronks K, Droomers M. Ethnic differences in the effect of environmental stressors on blood pressure and hypertension in the Netherlands. BMC Public Health 2007;23(7):118.

Agyemang CO, van Hooijdonk C, Wendel-Vos GCW, Ujcic-Voortman JK, Lindeman EM, Stronks K, Droomers M. The association of neighbourhood psychosocial stressors and self-rated health in Amsterdam, the Netherlands. J Epidemiol Community Health 2007;61(12):1042-9.

van Hooijdonk C, Droomers M, Deerenberg IM, Mackenbach JP, Kunst AE. Higher mortality in urban neighbourhoods in the Netherlands: who is at risk? J Epidemiol Community Health 2008;62(6):499-505.

van Hooijdonk C, Droomers M, Deerenberg IM, Mackenbach JP, Kunst AE. The diversity in associations between community social capital and health per health outcome, population group and location studied. Int J Epidemiol 2008;37(6):1384-92.

Wendel-Vos GCW, van Hooijdonk C, Uitenbroek D, Agyemang CO, Lindeman EM, Droomers M. Environmental attributes related to walking and bicycling at the individual and contextual level.
J Epidemiol Community Health 2008;62(8):689-94.

van Hooijdonk C, Droomers M, Wendel-Vos GCW, Uitenbroek D, Lindeman EM, Kunst AE. Individual and aggregated evaluations of the neighbourhood environment and psychological health in Amsterdam, the Netherlands. Submitted to Soc Psychiatry Psychiatr Epidemiol.

Wendel-Vos GCW, van Hooijdonk C, Uitenbroek D, Lindeman EM, Droomers M. Physical activity in Amsterdam, the Netherlands: The association between environmental attributes and walking and bicycling. Submitted to Journal of Environmental and Public Health.

Droomers M, van Hooijdonk C, Deerenberg IM, Mackenbach JP, Kunst AE. Composition as context. The contextual effect of age, sex, marital status and ethnicity on neighbourhood mortality. Final draft.

Kunst AE, van Hooijdonk C, Droomers M, Deerenberg IM, Mackenbach JP. Social capital and suicide mortality in the Netherlands. Final draft.

PhD Portfolio Summary
Summary of PhD training and teaching activities

Name PhD student: Carolien van Hooijdonk
Erasmus MC Department: Public Health

PhD period: 2003-2009
Promotor: Prof. dr. J.P. Mackenbach
Supervisors: Dr. M. Droomers
Dr. A.E. Kunst

1. PhD training	**Year**	**Workload Hours/ECTS**
General academic skills		
- Scientific writing in English Taalcentrum-VU, Amsterdam	2005	24 / 0.9
Research skills		
- Master of Public Health Netherlands Institute for Health Sciences (Nihes), Rotterdam	2003-2005	1745 / 62.3
In-depth courses **(e.g. Research school, Medical Training)**		
- Ruimtelijke Statistiek Rijksinstituut voor Volksgezondheid en Milieu, Bilthoven	2003	16 / 0.6
- Multilevel analyse EMGO Instituut, Amsterdam	2006	24 / 0.9
- Research on neighbourhood effects Nethur, Delft	2007	16 / 0.6
Presentations		
- Health inequalities between neighbourhoods: what is the influence of our daily environment? Research meeting, Department of Public Health, Rotterdam	2003	10 / 0.4
- Oorzaken van gezondheidsverschillen tussen wijken. Projectbespreking, Preventie en Zorgonderzoek, Bilthoven	2003	5 / 0.2
- Socio-economic and demographic indicators are important predictors of geographical variation in hospital admissions. EUPHA conference, Oslo	2004	10 / 0.4
- Oorzaken van gezondheidsverschillen tussen (bewoners van) wijken. Milieu en Natuur Planbureau, Bilthoven	2004	5 / 0.2

1. PhD training (continued)	Year	Workload Hours/ECTS
Presentations		
- Stad of platteland: wie kan waar het beste wonen? Nederlands Congres Volksgezondheid, Rotterdam	2006	10 / 0.4
- The association between community social capital and mortality International Conference on Urban Health, Amsterdam	2006	10 / 0.4
- Where should I live? International Congress of Behavioral Medicine, Bangkok	2006	5 / 0.2
- The association between community social capital and mortality Nederlands Congres Volksgezondheid, Rotterdam	2007	5 / 0.2
- The association between environmental attributes and mental health in Amsterdam Nederlands Congres Volksgezondheid, Rotterdam	2007	10 / 0.4
- Environmental influences on health: reducing geographical health inequalities Nethur, Delft	2007	10 / 0.4
- Explaining geographical health inequalities; the role of urbanisation and community social capital ENHR Conference, Rotterdam	2007	5 / 0.2
International conferences		
- EUPHA conference, Oslo	2004	20 / 0.7
- 17th World Congress of Epidemiology	2005	28 / 1
- 5th International Conference on Urban Health, Amsterdam	2006	20 / 0.7
	2006	28 / 1
- 9th International Congress of Behavioral Medicine, Bangkok	2007	28 / 1
- ENHR Conference, Rotterdam		
National conferences		
- Nederlands Volksgezondheid Congres	2006	16 / 0.6
- WEON	2006	8 / 0.29
- Nederlands Volksgezondheid Congres	2007	16 / 0.6
Seminars and workshops		
- Attending seminars of the Centre for Prevention and Health services Research	2003-2007	75 / 2.7
- Attending seminars of the Department of Public Health	2003-2009	35 / 1.25
- Symposium Natuur en Gezondheid, Nivel, Utrecht	2005	8 / 0.29
- Gezondheid en zorg in cijfers, CBS, Den Haag	2005	4 / 0.1
- Preconference ISBNPA	2005	8 / 0.29
2. Teaching activities		
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